The Unfolding Logos: A Stoic Model of Cosmic Evolution

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Submitted in partial fulfillment of the requirements

for the Doctor of Philosophy Degree

at Ubiquity University

February 18th, 2026

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Abstract

This dissertation argues that the core Stoic concept of reason aligns closely with modern theories of fundamental information, offering a novel interpretation of their philosophy. Stoicism, aimed at *eudaimonia* (a state of human flourishing) through virtue, views reason as the driving force organizing nature from the origins of the universe. I propose that the Stoic tripartite system of physics, logic, and ethics facilitates a continuous flow of information from the universe's cosmological birth to the evolution of human thought. The paper bridges this ancient philosophy with contemporary cosmological findings, where information at the *Planck scale*, the set of natural units derived from a universal measurement inherent to the fabric of the universe, holographically projects our physical world. Conceptual equations synthesize these ideas, asserting that the universe's evolution involves *intropy*, the informational content of a system that increases over time and can transform humanity by revealing its divine, interconnected composition. This work presents a unique, systematic integration of philosophy and physics, highlighting the wisdom of Stoic cosmology.

To my wife, Nicole, and my daughters, Paloma and Nina: you are my greatest inspiration. May you always be curious to explore our magnificent universe and contemplate it with awe and wonder. Thank you for your support and for believing in me.

To Vincent Minniti: your mentorship and guidance have led to a complete renaissance in my life. Thank you for reviving my spirit and instilling confidence in me.

Acknowledgements

I would like to express my sincere and heartfelt gratitude to the individuals who have played a significant role in my academic journey and the completion of this dissertation.

My deepest appreciation goes to my advisor, Dr. Jude Currivan. Her work as a cosmic visionary and her insightful guidance were instrumental in this process. I am profoundly proud of the work we created together, and the moment she agreed to guide and enlighten me still gives me frisson. Thank you for unfolding the Logos with me.

I am immensely grateful to Dr. Gyorgyi Szabo, my guiding light and dean of hearts, whose belief in my potential allowed me to explore my mind and expand my universe. Her support and mentorship were invaluable.

To Dr. Jim Garrison, my gratitude for founding and sustaining this incredible institution. I cherished our conversations and was always delighted to hear you speak.

Thank you to Dr. Peter Merry for his insights into Ubiquity University's founding vision, which inspired and excited me to be part of this endeavor. His powerful vision has been an inspiration to witness.

I also wish to thank the dedicated staff at Ubiquity University: Nora, Veronica, Linda, Georg, and Yaneth. Their support throughout my enrollment and journey has been deeply appreciated.

To my friends and family: your unwavering support and confidence instilled in me the strength to achieve this dream. I am truly fortunate to have you in my life.

Lastly, I remember my parents, my brother, and all relatives who have passed

away a little too soon and could not be here today to share this moment. They remain an integral part of the fabric of my universe. Thank you.

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CHAPTER I

INTRODUCTION: Cosmic Coherence

> *Someday, after mastering the winds, the waves, the tides, and gravity, we shall harness for nature the energies of love, and then, for a second time in the history of the world, man will have discovered fire.*
>
> —Pierre Teilhard de Chardin[1], *Toward the Future*

1.1 Introduction to the Research

Like many others, I discovered Stoicism out of necessity rather than through word of mouth or a college course. Stoicism is a systematic school of Hellenistic philosophy founded by Zeno of Citium[2] around 300 BCE. It provides a comprehensive worldview grounded in a coherent, interconnected system of logic, monistic physics, and naturalistic ethics. The main goal of Stoicism is to achieve eudaimonia, which is a state of human flourishing or well-being, by cultivating virtue and living in harmony with reason and nature (Lewis, 2025).

After being orphaned at age 19, I had to begin my journey towards independence, carrying the weight of childhood trauma and lacking a navigation system to guide me. With little family support, I survived two years of homelessness, thanks to the grace and generosity of a few friends. The void I felt, the overwhelming sense of abandonment,

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[1] Pierre Teilhard de Chardin was a French philosopher and paleontologist known for his theory that man is evolving, mentally and socially, toward a final spiritual unity.

[2] Zeno of Citium was a Hellenistic thinker who founded the Stoic school of philosophy, which influenced the development of philosophical and ethical thought in Hellenistic and Roman times.

confusion, and loneliness, forced me to explore various ways of coping with reality. Driven primarily by survival instincts, I developed a defense mechanism that created such intense stress that I became trapped in a cycle of panic, fear, anxiety, and anger. For the next 15 years, I lived in a constant state of hypersensitivity, filled with negative thoughts and beliefs that berated me. I did this to keep my expectations low after experiencing such profound loss that I could hardly bear the thought of facing it again.

Unfortunately, loss came again and again, with family members passing away in bizarre accidents, succumbing to fatal short-term illnesses, and battling long-drawn-out conditions. I set my expectations so low and my panic so high that I barely recognized myself anymore. Something had to change; I couldn't continue living like this.

I reached a breaking point and voluntarily checked myself into the psychiatric wing of Weill-Cornell Hospital in New York for one night due to exhaustion back in 2015. Although the experience was serious and not something to take lightly, I left the hospital the next day filled with immense gratitude. I realized I didn't belong there; I still had a vital energy that allowed me to sense hope beneath the tragedies I had experienced, and I retained some control over my life. After leaving the hospital, I came to a profound realization: everything I believed, everything I told myself, and how I viewed the world were ultimately wrong.

With just a slight nudge of forgiveness, I started to open myself up to new possibilities. I sought therapy and found an exceptional therapist, Dr. Vincent Minniti[3], who introduced me to cognitive behavioral therapy (CBT). He helped me recalibrate my moral compass, listened attentively, and connected my deep traumas to the outdated

[3] Vincent A Minniti is a psychologist primarily located in New York, NY, with another office in Clinton, NJ.

beliefs I was holding onto—beliefs that had not originated with me but rather had been instilled by my family and society, which often conveyed flawed judgments. Dr. Minniti guided me to realize that I was caught in a cycle of passive dependency and victimhood stemming from my childhood. I understood that I could take responsibility for my life and choose to embrace adulthood, evolve my beliefs, and break free from those imposed by others. I had a choice: to forgive my past, accept it, and ultimately let it go, allowing me to claim my life as my own.

It was at the same time I met Dr. Minniti that Stoicism became a part of my life. I was first introduced to it through Ryan Holiday's[4] *Daily Stoic podcast* (Holiday, 2018), where I began to notice many parallels between the insights I was gaining from Stoic philosophy and those from Dr. Minniti. I then began reading about the philosophy firsthand with Marcus Aurelius'[5] *Meditations* (Aurelius, 1902, 2003, 2008), Epictetus'[6] *Discourses* (Dobbin, 2008), and Seneca's[7] *Letters from a Stoic* (Seneca, 1969, 2010). Many of the teachings of these philosophers from the later Roman period resonated with me regarding CBT, and I found their lessons aligned as I incorporated both into my life. I soon learned that Stoicism was foundational in the development of Rational Emotive Behavior Therapy (REBT), created by psychologist Albert Ellis[8], who was also Dr. Minniti's Ph.D. advisor, and psychiatrist Aaron Beck[9], the founder of Cognitive Therapy.

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[4]Ryan Clark Holiday, is an American marketer and author. He is the bestselling author of Trust Me, I'm Lying; The Obstacle Is the Way; Ego Is the Enemy; and other books about marketing, culture, Stoicism and the human condition.

[5] Marcus Aurelius was a Roman emperor (161–180), best known for his *Meditations* on Stoic philosophy.

[6] Epictetus was an exponent of Stoicism who flourished in the early second century C.E. about four hundred years after the Stoic school of Zeno of Citium was established in Athens.

[7] Seneca the Younger, born Lucius Annaeus Seneca in Corduba, was a prominent Roman philosopher, statesman, and dramatist during the first century CE.

[8] Albert Ellis was an American psychologist and psychotherapist who founded rational emotive behavior therapy (REBT).

[9] Aaron Temkin Beck was an American psychiatrist who was a professor in the department of psychiatry at the University of Pennsylvania.

Together, they established the groundwork for CBT. Everything began to click for me, and I absorbed this knowledge eagerly. This framework, this valuable gift of understanding, transformed my perspective on the world and my relationship with it. It ultimately saved my life.

It's truly remarkable how a mind can be completely reprogrammed when given the chance. After decades of self-neglect, I began to delve more deeply into Stoic philosophy. This journey was not just about reading all the literature available; it involved adopting the philosophy as a way of life, as it was originally intended. The Stoics believed that philosophy should be lived in harmony with nature. They argued that a life of flourishing and lasting happiness, what the Greeks called eudaimonia, was attainable for every human being, provided they understood the laws of the universe and how the human psyche is aligned with the cosmos. In fact, it is more accurate to say that the human psyche is part of the cosmos, which operates as a single, living system governed by a divine *Logos*, or universal reason, and deterministic fate (Stoic Mentality, 2024).

To create this coherent structure, the Stoics developed a tripartite system that integrates their philosophical framework into a unified whole. This system is categorized into three parts: physics, logic, and ethics. Physics studies the cosmos and conveys insights into the rational, deterministic, and divine order through logic, which, in turn, informs our understanding of ethics. This enables humans to live in accordance with nature and lead fulfilling lives. Logic provides a blueprint for understanding knowledge within Stoicism, outlining what to expect from sense impressions and guiding how one adopts disciplines before making any judgments. The study of ethics draws on insights from physics and logic, enabling individuals to apply these principles by understanding

what is within and beyond their control. This understanding includes recognizing that external factors beyond one's control should not be prioritized or relied upon. By clearly perceiving emotions and impressions, one can minimize or eliminate psychological disturbances, allowing for actions that align with the laws of nature. Ultimately, Stoicism teaches that virtue is the only true good, and everything else is merely indifferent[10] (Durand et al., 2023).

As a Stoic practitioner, or *Prokopton* in ancient Greek, I find that the philosophy aligns closely with what is considered reasonable and sensible. Upon understanding and applying these principles, it naturally guides reality toward the active manifestation of compassion, empathy, altruism, and cosmopolitanism (Eliopoulos, 2014; Shogry, 2020). These human characteristics connect us to something greater than ourselves, which is needed for achieving true and lasting happiness. Stoicism, with its cohesive tripartite structure, can be viewed as an emergent philosophy arising from its components.

It truly warms my heart to see how much Stoicism has gained popularity in recent years, helping people develop a deeper understanding of their own psychology and navigate a world full of distractions (Robertson, 2020). Just as Buddhism and Yoga attracted attention in previous decades (Stephens, 2011), Stoicism is now flourishing as an ancient Western tradition that promotes mindfulness in understanding our thoughts and beliefs (Hadot, 1995).

The tendency to react quickly to impressions without questioning them, combined with the ignorance of how judgments are influenced by often unscrutinized beliefs, is

[10] There's a lot of misconception with the word, "indifferent/indifference" in Stoic texts. It is referred to as something that is not essential to somebody (outside of their control), and not categorized as something "good" or "bad" in a moral sense. It is not to be misinterpreted as apathy, detachment, or an uncaring attitude.

often the root of misfortunes (Nussbaum, 1994). While the events that happen to someone are beyond their control, one can practice cognitive distancing to avoid taking things too personally or catastrophizing situations beyond their true nature (Robertson, 2020). A person, therefore, does have some control, primarily in how they respond to these events (Polat, 2025). This involves judging situations objectively, managing our self-perceptions, and regulating our emotions without suppressing them (Hadot, 1995; Inwood, 1985).

It is fortunate that the available Stoic literature is accessible, and its wisdom can be seen in the experiences of those who apply it (Irvine, 2009). The study of ethics, a key aspect of Stoicism that emphasizes our psychological management skills, is non-sectarian and timeless (Stephens, 2007). It adapts well to a changing world because human psychology evolves slowly and has remained largely unchanged for 2,000 years (Robertson, 2020). However, the other two components of Stoicism, logic and physics, are often overlooked due to their lack of modern appeal (Chakrapani, 2020). They are not typically understood by the general public, and the historical fragments available are primarily studied by academics (Long & Sedley, 1987; Algra, 1999). As a result, many people associate Stoicism solely with its ethics. Yet, to fully appreciate the philosophy, it is important to incorporate and analyze all three components, as this allows us to grasp the breadth of its dynamics and the brilliance of its design (Robertson, 2012).

Chris Fisher[11], a scholarch[12] at the College of Stoic Philosophers since 2021, has effectively introduced traditional Stoicism to the public in an accessible way through his podcast, *Stoicism on Fire* (Fisher, 2013). However, his approach has focused on

[11] Chris Fisher is the author of the *Traditional Stoicism* blog and the *Stoicism on Fire* podcast.
[12] A “scholarch" is the head or leader of a school, specifically referring to the head of an ancient Athenian school of philosophy.

critiquing many popular authors within the modern Stoicism movement, who advocate for an “ethics-centric” interpretation of the philosophy (Fisher, 2016). He argues that their denial of the importance of maintaining Stoicism's tripartite structure undermines the philosophy's integrity (College of Stoic Philosophers, n.d.). While I believe his perspective is valid, publicly calling out these authors by name may not have been the most constructive choice. Nevertheless, Fisher has created a well-articulated and knowledgeable body of work that serves as a valuable resource for anyone interested in understanding the full scope of traditional Stoicism without having to sift through academic papers.

As I reflect on the origins of my research, I recognize that my daily practice of Stoicism has led me to a significant observation: no one has yet explored this philosophy from the perspective of how its founding members came to understand the natural world and their quest for its meaning. Most of what is known about Stoicism, whether from academic sources or public media, consists of analyses of the surviving works and accounts of the lives of the founding philosophers (Long & Sedley, 1987). However, there has seldom been a conceptual exploration of how these early Stoics might have constructed their system based on observations of the natural world and its influence on human behavior (Sambursky, 1987; Hahm, 1977). Given that Stoicism was designed to serve as a way of life, there is a lack of appreciation for its development and evolution.

My interest in this topic intensified after taking a course titled *Decoding Life: Revealing a Radical New View of Reality* by Dr. Jude Currivan[13] at Ubiquity University.

[13] Dr. Jude Currivan is a cosmologist, planetary healer, futurist, author and founder of WholeWorld-View. She is a life-long researcher into the nature of reality, has a Masters Degree in Physics from Oxford University specializing in quantum physics and cosmology and a PhD in Archaeology from the University of Reading in the UK researching ancient cosmologies.

In this course, I learned about the various algorithms present in nature and human events (Currivan, 2022). At the very heart of this process lies information, our most fundamental building block, which traces back to the birth of the universe (Wheeler, 1989). This *in-formation,* the intelligent and meaningful instruction of the cosmos, evolves, shaping the act of creation itself and constructing our reality from the smallest elements at the Planck scale[14] to a holographic projection of the universe that emerges from a boundary pixelated by its conserved and transformed bits since the Big Bang (Currivan, 2017; Susskind, 1994; Bekenstein, 2003).

For many years, I have developed a reasonable understanding of both classical and quantum physics. As a philosopher, I have always been compelled to explore the big-picture questions of how our world came to be and how humanity has studied the phenomena unfolding since the dawn of our scientific revolution. This curiosity sparked a desire to delve deeper into the history of science and the individuals who contributed to it. Dr. Currivan not only nurtured this passion in me but also deepened my understanding of physics by emphasizing its meaning and purpose.

Through this clarity, I began to understand the complexities and interdisciplinary nature of our sciences. Most importantly, as if connecting dots in a cosmic sky, I gazed upon the foundation of the Stoic cosmological system and was both astonished and ecstatic to discover that reason, considered a primordial and divine concept in Stoicism, aligns closely with what contemporary cosmology defines as information (Wheeler, 1989; Voncken, 2025). In the tripartite Stoic philosophical structure, reason is viewed as

[14] The Planck scale refers to the extreme, fundamental limits of size, time, and energy, as well as mass and temperature, in the universe. It is the point at which objects are so incredibly small (Planck length) and events happen so quickly (Planck time) that our current laws of physics, like general relativity and quantum mechanics, simply stop working.

all-pervasive and transformative information, reflecting the same evolutionary trajectory from the universe's inception to its inevitable conclusion (Currivan, 2022). I began to inquire whether the Stoics developed their cosmological explanations through observations of the universe, and whether they used reason as the foundational principle for constructing their entire philosophical system (Hahm, 1977). Their understanding of our nature bears a remarkable similarity to what modern science is revealing, even after more than 2,000 years. This lineage of thought was strengthened by Shmuel (Sam) Sambursky[15], who first identified the Stoic concept of *pneuma* as a conceptual precursor to modern field theory in his work, *Physics of the Stoics* (Sambursky, 1987). When one examines cosmology from both Stoic and modern perspectives, extending Sambursky's field-model into that of informational physics, they can hypothesize that connections to the other two Stoic fields, logic and ethics, support the idea that our human psychology and perception of reality are tied to a cosmological evolution unfolding since the beginning of time (Robertson, 2012). Does the Stoic tripartite system act as a boundary that allows the entire universe to be informationally projected and experienced as a hologram ('t Hooft, 2000), akin to the universe according to the Holographic Principle? Is the Stoic goal of "living in accordance with nature" rooted in the intropic pathway of information from the universe's birth to the reasoning in our thoughts and actions (Carhart-Harris et al., 2014; Sadler, 2017)?

My purpose is to explore these questions and develop a cohesive argument that Stoicism is a philosophy conceived entirely from what the Stoics considered to be the most fundamental bit of information: reason. This reason translates to the qubit, derived

[15] Shmuel Sambursky, or Samuel Sambursky was a German-Israeli physicist, professor, and philosopher. He was a professor of Physics and Natural Sciences and Philosophy of Science at the Hebrew University.

from the Planck scale of 10^{-35} meters which remains invariant throughout spacetime (Wheeler, 1989; Bekenstein, 2003). I will explain, drawing on our most innovative and tested theories in modern cosmology, how the Stoics arrived at similar findings through reason, by observing and contemplating nature (Sambursky, 1987). This will not only reveal the genius behind their view of the universe but also take into account their understanding of humanity's psychology and actions, which are also integral to the design of the cosmos (Adami, 2016). This will culminate in my philosophical analysis, which posits that Stoicism directs humanity to participate in the evolution of nature, which began at the Big Bang, releasing a vital force that not only shaped our universe but also encourages us to carry the torch of responsibility to keep creation going, as far as it can, until no more (Currivan, 2022). This responsibility must be put forth with reason to reach eudaimonia, and come to know that humanity is one with all there is, mirroring the wonder and beauty of all creation (Long, 2002).

1.2 Literature Review

I have laid the foundations of this dissertation by synthesizing three fields rarely brought into conversation: the interrelationships among the Stoic philosophical system, modern cosmological infodynamics, and their translation to the human endeavor. While Stoicism is frequently popularized today as an ethical or therapeutic tool, the traditional classification by Inwood (2003) and Sellars (2006) reminds us that "lived philosophy" is the bedrock of the Stoic moral construct. In this review, I evaluate the specific literature that allows me to bridge these ancient philosophical doctrines with contemporary discoveries in cosmology and neuroscience.

I contend that any technical recovery of Stoic physics must begin with the primary fragments of Zeno, Cleanthes, and Chrysippus, as preserved in the authoritative collection by Long and Sedley (1987), *The Hellenistic Philosophers*. These texts, alongside the critical reports of Cicero (2001) and Diogenes Laertius (2018), describe a universe permeated by an active principle—a corporeal, rational force known as pneuma. I look to the pioneering work of Sam Sambursky (1987) in *Physics of the Stoics* as the first major academic attempt to reconcile this ancient philosophical view with the language of modern physics. Sambursky identifies pneuma as a conceptual precursor to the continuous fields of modern physics. I find his argument that the Stoic rejection of the "void" in favor of a cohesive, tensional medium serves as a starting point for my own model. This historical re-evaluation is further supported by Algra (1999) and Hahm (1977), who establish that Stoic physics was a sophisticated, evidence-based competitor to the Aristotelian and Epicurean models of the era.

The informational structure of our universe, I draw on the Holographic Principle to explain the projection of cosmic order, which can be artfully related to the wisdom cast by the three components of Stoicism: physics, logic, and ethics in defining reality. The foundational work of Leonard Susskind[16] (1995) and Gerard 't Hooft[17] (1993) provides the mathematical basis for viewing the universe as an informational entity pixelated at the Planck scale. I bring these peer-reviewed findings into a philosophical context through the work of Jude Currivan (2017, 2022), who reframes the Big Bang as a "Big Breath." I assert that Currivan's synthesis is essential because it aligns the Stoic Logos with a

[16] Leonard Susskind is the Felix Bloch professor of Theoretical physics at Stanford University. His research interests include string theory, quantum field theory, quantum statistical mechanics and quantum cosmology.

[17] Gerardus "Gerard" 't Hooft is a Dutch theoretical physicist and professor emeritus at Utrecht University, the Netherlands. He shared the 1999 Nobel Prize in Physics with his thesis advisor Martinus J. G. Veltman "for elucidating the quantum structure of electroweak interactions."

cosmos that is not merely expanding, but unfolding as a coherent, informational instruction. This allows me to shift our focus from a purely materialist universe to one that is inherently "in-formed," echoing the Stoic belief that the cosmos functions as a single, rational organism. I also draw on Adami (2016) to show that information is not an abstract concept but a physical one, measurable by the reduction of uncertainty within a system. This provides a bridge to the Stoic idea that the Logos is a pervasive, ordering force that organizes its own parts.

This sense of a coherent, evolving universe in contemporary cosmological models that avoid the traditional problem of singularities leads me to examine the Stoic doctrine of conflagration through the lens of the Einstein-Cartan-Kibble-Sciama (ECKS) theory. Research by Nikodem Popławski[18] (2010), documented in specialized archives such as arXiv, uses the spin and torsion of matter to propose that new universes may cycle by "budding" from the interiors of black holes. When I read this alongside the work of Salles (2009) and Voncken (2025) on Stoic recurrence, a scientific image of a universe as a sequenced, rational process rather than a chaotic, one-time event emerges. My research argues that this ensures the Logos remains the persistent, informing principle across successive cosmic iterations through reason, my interpretation of Stoicism's most fundamental form of information. This cyclicality is an unfolding of complexity that aligns well with the Stoic view of a cosmos that remains vibrant through rational renewal.

As this cosmic structure scales down into living systems, the focus of the literature shifts toward the evolution of biological complexity and algorithmic

[18] Nikodem Janusz Popławski is a theoretical physicist, most widely noted for the hypothesis that every black hole could be a doorway to another universe and that the universe was formed within a black hole which itself exists in a larger universe.

information. Christoph Adami[19] (2016, 2022), in conversation with Sean Carroll[20] on his podcast *Mindscape*, offers a quantitative analysis of how life extracts information from its environment to maintain its own organization. I use this to provide the scientific weight needed to argue that the Stoic *spermatikoi logoi*, or seminal principles, act as ancient precursors to the biological algorithms that drive evolution. I further clarify this through the work of Tatsuaki Okamoto[21] (2022), whose research on organized complexity shows that the increase in computational and descriptive features over time is a fundamental trait of our unfolding cosmos. In my view, the Stoic drive toward increasing organization is a measurable physical phenomenon governed by the "unfolding Logos." I also look to Currivan's (2022) analysis of non-locality within biological systems, which provides a physical basis for the Stoic concept of *sympatheia*, or the interconnectedness of all things. It is here that I link this biological information to the human faculty of reason through logic, and down to ethics, thereby completing the Stoic system. I find a modern biological counterpart to the Stoic *hêgemonikon*, or ruling faculty, in the Entropic Brain theory presented by Robin Carhart-Harris[22] (2014). This research, appearing in *Frontiers in Human Neuroscience*, identifies the Default Mode Network (DMN) as a primary regulator of neural "entropy". I see this regulator functioning much like the Free Energy Principle (FEP) described by Karl Friston[23] (2010) in *Nature Reviews Neuroscience*,

[19] Dr. Adami is Professor for Microbiology and Molecular Genetics & Physics and Astronomy at Michigan State University in East Lansing, Michigan.
[20] Sean Carroll is Homewood Professor of Natural Philosophy at Johns Hopkins University and Fractal Faculty at the Santa Fe Institute.
[21] Tatsuaki Okamoto is Director of Cryptography and Information Security Laboratory and NTT Fellow at NTT Research, Inc.
[22] Dr. Robin Carhart-Harris is a leading researcher in the fields of human neuroscience and psychopharmacology. He is best known for his groundbreaking research on how psychedelic substances affect the brain and how they could be used as treatments for mental health issues such as depression.
[23] Karl Friston is a theoretical neuroscientist and authority on brain imaging. He invented statistical parametric mapping (SPM), voxel-based morphometry (VBM) and dynamic causal modelling (DCM). These contributions were motivated by schizophrenia research and theoretical studies of value-learning, formulated as the dysconnection hypothesis of schizophrenia.

which suggests that all living systems act to minimize uncertainty, or "surprise." Therefore, I contend that the hêgemonikon acts as the brain's "entropy architect," filtering impressions and maintaining order in the face of environmental uncertainty. This allows me to reframe the Stoic passions (fear, desire, and grief) as high-entropy states resulting from a failure to reason, providing a physical justification for the Stoic insistence on rational thought as a means of flourishing.

The philosophical connection with this neurological data is finally formalized in the work of Pierre Hadot[24] (1995) and Donald Robertson[25] (2012). I posit that Hadot's "spiritual exercises" suggest that the Stoic practice of prosochē (mindfulness) maintains psychological homeostasis, and by linking Friston's FEP models and Carhart-Harris's entropic brain theory to Hadot's lived philosophy, I establish that the Stoic goal of "living in accordance with nature" is a biological imperative. This is not a passive acceptance of fate, but an active, informational resonance with the laws of the cosmos. Ultimately, I argue that this body of work connects the birth of the universe directly to the reasoning in our own thoughts, showing that human virtue is the natural extension of a cosmic, informational process. This synthesis provides the comprehensive formula that I require to understand Stoic philosophy as a unified, science-informed model of cosmic evolution.

1.3 A Deeper Look Into Stoic Coherence and Determinism

Stoicism is a philosophy composed of three interconnected branches: physics, logic, and ethics. These branches work together to support and strengthen one another (Sellars, 2006; Robertson, 2012). The goal of a Stoic is to live in accordance with nature,

[24] Pierre Hadot was a French philosopher and historian of philosophy specializing in ancient philosophy, particularly Neoplatonism, Epicureanism and Stoicism.

[25] Donald John Robertson is a Scottish-born cognitive-behavioral psychotherapist and author, known for his work in integrating modern cognitive-behavioral therapy (CBT) with Ancient Greek and Roman philosophy, particularly Stoicism.

reflecting mindfully on perceptions, thoughts, and actions to maintain harmony with nature's laws (Hadot, 1995). Each branch of Stoicism contains rational principles that permeate the cosmos as a whole (Inwood, 2003; Hahm, 1977).

Stoicism identifies and organizes these principles, making them accessible to humans. This understanding enables individuals to apply these ideas to their lives, ultimately leading to a life of happiness and meaning while acknowledging their role in a unified, intelligent cosmos (Annas, 1993; Long, 2002).

A Stoic lives by virtue, which embodies the reasoning inherent in the universe (Stephens, 2007). In their interactions with all living beings, Stoics are guided by love and respect (Weaver, 2024; Eliopoulos, 2014). They observe nature and its phenomena, as well as human behavior, and juxtapose these observations with the reasoning they perceive both internally and externally (Fisher, 2016; De Blasio, n.d.). Through this, they realized that humans, endowed with the capacity for reason, could connect with and understand the laws of the universe (Long, 2002).

Stoics understood that humanity is not an isolated entity but rather an integral part of the cosmos, responsible for manifesting the same laws within itself (Hadot, 1995). In this sense, Stoicism is arguably one of the most cohesive and holistic philosophies in Western history, incorporating ideas that resonate with Eastern and indigenous philosophies (Robertson, 2012).

Understanding the Stoic view of the cosmos' cohesion, one must consider the use of language and its limitations in describing complex concepts, not only in translations from ancient Greek to modern English but also in the semantics that are applied to words (Long & Sedley, 1987). Unfortunately, the literature on Stoic physics comes from sources

such as Plutarch,[26] Alexander of Aphrodisias,[27] and Origen,[28] who were hostile to Stoic doctrine and criticized it as contrary to common sense[29] (Inwood, 2003, pp. 151-152). Therefore, there is a need to apply careful and critical examination of the texts to provide an adequate interpretation (Long, 2001; Algra, 1999).

Stoic ontology teaches us that the world consists of two fundamental principles: the active and the passive (Hahm, 1977). The active principles are referred to as "bodies" because only corporeal entities can act or be acted upon (Long & Sedley, 1987). This is why Stoicism is considered a materialistic or corporeal philosophy, in contrast to, for example, Platonism, which posits that abstract concepts are the highest form of reality (de Harven, 2022, p.1). These active principles can also be seen as prime matter, which is eternal in nature, meaning they persist through a *conflagration* period that occurs between the cycles of the universe (Salles, 2009; Parikh, 2025). In this view, God is considered the active principle and must be corporeal to interact causally with "passive bodies" (Algra, 1999). The passive bodies, on the other hand, are inert and only responsive to external actions (Sambursky, 1987).

In the Stoic doctrine of conflagration, as studied through the remaining literary fragments of Cleanthes[30] and Chrysippus[31], the second and third heads of the Stoa[32], the

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[26] Plutarch was a Greek Middle Platonist philosopher, historian, biographer, essayist, and priest at the Temple of Apollo in Delphi.
[27] Alexander of Aphrodisias was a Peripatetic philosopher and the most celebrated of the Ancient Greek commentators on the writings of Aristotle.
[28] Origen of Alexandria, also known as Origen Adamantius, was an early Christian scholar, ascetic, and theologian who was born and spent the first half of his career in Alexandria.
[29] Plutarch, Alexander of Aphrodisias, and Origen argued that Stoicism's rigid logic, materialism, and extreme ethical ideals contradicted lived human experience, moral responsibility, and common sense.
[30] Cleanthes was a Stoic philosopher who became head of the Stoic school (263–232 bc) after the death of Zeno of Citium.
[31] Chrysippus was the third and greatest head of the Stoic school in Athens. He wrote voluminously, and in particular developed Stoic logic into a truly formidable system.
[32] The name Stoa is derived from the porch (*stoa poikilê*) in the Agora at Athens decorated with mural paintings, where the first generation of Stoic philosophers congregated and lectured.

universe undergoes cycles of creation and destruction through a process of conflagration that consumes everything, only to be reborn anew (Sedley, 1998). Although the two fundamental principles remain unchanged, the four elements: fire, earth, air, and water, created by this conflagration, are ultimately destroyed (Long & Sedley, 1987).

The Stoics viewed the elements as having distinct forms and properties, such as heat and cold (Long & Sedley, 1987). Fire, while considered one of the elements, is also seen as embodying the active principle (Hahm, 1977). The Stoic concept of pneuma is understood as the fundamental material substance that serves as the vital force, animating and organizing all things in the cosmos (Voncken, 2025). Pneuma is thought to be a combination of the elements of fire (representing activity) and air (representing extension). For the Stoics, pneuma was a tensional force, or *tonos*, that permeated all of existence, providing form and coherence to everything (*UC Davis - The Physics of the Stoics*, n.d.).

This duality can be confusing, but understanding the Stoic view of fire's properties clarifies its role in the creation of all elements. Fire exists as a formless principle and acts as an agent for the elements (Hahm, 1977). The elements of fire and air are crucial because their properties, including fluctuations in density and phase transitions[33], are driven by temperature variations (Sambursky, 1987). This leaves earth and water as the moldable elements that can be influenced by these active forces (Algra, 1999). This pneumatic tension can also be compared to the warm breath that enlivens all living things, making pneuma a dynamic, physical substance that brings matter to life (Chakrapani, 2020).

[33] Phase transitions are physical processes where a substance changes from one state of matter (like solid, liquid, or gas) to another, driven by changes in temperature or pressure.

Heat is a major factor in the cohesion of the Stoic cosmos. In Cicero's *De Natura Deorum,* book II (Cicero, 1997), Cicero's character Balbus gives us this passage that is intended to convey the Stoic position of a providential cosmos as being a single, rational organism (Algra, 1999; Long, 2002):

> It is a fact that all things which undergo nurture and growth contain within themselves a power of heat without which they could not be nurtured and grow. For everything which is hot and fiery is roused and activated by its own movements, but a thing which is nourished and grows has a definite and regular movement; as long as this remains in us, so long as sensation and life remain, but when heat has been chilled and extinguished, we ourselves die and are extinguished . . . Therefore every living thing, whether animal or vegetable, is alive on account of the heat enclosed within it. From this, it must be understood that the element heat has within itself a vital power which pervades the whole cosmos. It follows from this that, since all parts of the cosmos are maintained by heat, the cosmos itself too has been preserved over so long a time by a comparable and like element—and all the more so because it must be understood that this hot *[sic]* and every entity is extended in every nature in such a way that it contains the power of reproduction and the cause of generation, since it is that by which all living things, including those whose roots are sustained by earth, must be brought to birth and grow (Cicero, 1997, p.58).

In this instance, one observes that heat facilitates movement in all living things and that movement is vital for life (Sambursky, 1987). This phenomenon is an extension of the property of fire, encompassing everything that exists and embodying the

characteristics of the divine principle (Hahm, 1977). It represents a vital power, arising from the cosmic fire of the universe, permeating all existence, and found within living beings (Voncken, 2025). Conversely, the absence of heat signifies death or a state of immobility.

When analyzing the four elements, Cleanthes illustrates in the following passage that fire, earth, wind, and water intrinsically contain heat, rather than deriving it from an external source. Therefore, the existence of these elements is fundamentally dependent on the presence of heat. He cleverly proves this point by stating that for water to transform into ice or frost, it must first be evenly distributed over a surface area. For this distribution to occur, water must be in its liquid state, which inherently implies the presence of heat (Salles, 2009, p. 123):

> Likewise, that water contains an admixture of heat is shown first of all by its liquid nature; water would neither be frozen into ice by cold nor congealed into snow and hoar‐frost unless it could also become fluid when liquefied and thawed by the admixture of heat; this is why the moisture both hardens when exposed to a north wind or a frost from some other quarter, and it also softens itself when warmed, and evaporates with heat. Also, the sea, when violently stirred by the wind, becomes warm, so that it can readily be realized that this great body of fluid contains heat; for we must not suppose the warmth in question to be derived from some external source, but stirred up from the lowest depths of the sea by a violent motion, just as happens with our bodies when they are restored to warmth by movement and exercise (Cicero,1997, p. 59).

This posits the question: if the absence of heat equates to death, implying that the universe will have very low temperatures before its demise, how then does the following conflagration spark to recycle the universe into a new existence? According to Stobaeus's[34] *Eclogae* (Litwa, 2018), Cleanthes accounts for a residual mass that is not combustible, and a residual fire remains to spark the conflagration anew (Harriman, 2021, p. 535). This topic is highly debated among scholars, as their findings often lead to significant disagreements between Cleanthes and Chrysippus (Long & Sedley, 1987). However, one should remain open-minded and acknowledge that philosophy, much like language, evolves over time. It is important to acknowledge that misconceptions and mistranslations, often created by the founders of the school, their followers, and scholars who study them, can inevitably lead to inconsistencies (Inwood, 2003). For the purposes of this paper, there will be a focus exclusively on the general and agreed-upon understandings (Sellars, 2006).

The recurring cycles of the universe are also a telltale of Stoic determinism. This belief implies a repetition of the same order that governed the previous universe. As Brad Inwood[35] interpreted from Nemesius's[36] work in *On the Nature of Man*, "there will be nothing different in comparison to what happened before, but everything will occur in just the same way and indistinguishably, even to the last details" (Inwood, 2003, p. 141).

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[34] Joannes Stobaeus, from Stobi in Macedonia, was the compiler of a valuable series of extracts from Greek authors. The work was originally divided into two volumes containing two books each. The two volumes became separated in the manuscript tradition, and the first volume became known as the *Extracts* (also *Eclogues*) and the second volume became known as the *Anthology* (also *Florilegium*).

[35] Brad Inwood is Professor of Philosophy and Classics at Yale University and University Professor Emeritus of the University of Toronto.

[36] Nemesius Of Emesa was a Christian philosopher, apologist, and bishop of Emesa (now Ḥimṣ, Syria) who was the author of *Peri physeōs anthrōpou* (Greek: "On the Nature of Man"), the first known compendium of theological anthropology with a Christian orientation.

Academics argue that the idea of the cosmos resetting was common during Hellenistic times, as it also appears in Plato's *Timaeus* (Plato, 2008) and in Book II of Cicero's *De Natura Deorum* (Cicero, 1997), which presents the doctrine of the Great Year[37] (Algra, 1999). This doctrine posits that when the planets return to their original "inclinations and declinations" from the time the cosmos was first created, it will result in a conflagration that destroys the universe, resetting it to begin anew and follow the same sequence of events as before (Inwood, 2003, p. 142).

If the Stoics borrowed the idea of the Great Year from an earlier source, they did so for good reason, as it aligns well with their view of a rational and providential cosmos (Algra, 1999; Long, 2002). Classical scholars A.A. Long[38] and David Sedley[39], in their joint work *The Hellenistic Philosophers* (Long & Sedley, 1987), inform us that the concept of everlasting recurrence should not be viewed as a straightforward consequence of determinism. The conflagration signifies God's omnipresence, which initiates the sequence of cause and effect (Salles, 2009). Since this initiation is governed by rationality and providence, there is no need for the preceding cosmos to differ from the prior one, as it was originally perfect (Bobzien, 1998; Inwood, 2003).

The Logos, understood as the governing principle of divine reason, connects the entire system as a single, causal entity (Long, 2002). This means that the chains of cause and effect are guided by reason and are therefore fatefully determined (Voncken, 2025; Bobzien, 1998). However, this concept is often misinterpreted, with many people characterizing it as a passive stance Stoics take towards events (Inwood, 2003). To

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[37] In scientific astronomy, the Great Year refers to the time required for the equinoxes to complete one full cycle around the ecliptic due to the wobble in the Earth's axis, a period of approximately 25,800 years.
[38]Anthony Arthur Long FBA is Chancellor's Professor of Classics Emeritus and affiliated professor of philosophy at the University of California, Berkeley.
[39] David Neil Sedley FBA is a British philosopher and historian of philosophy. He was the seventh Laurence Professor of Ancient Philosophy at Cambridge University.

clarify, Stoics do not simply sit back and watch life pass them by, believing that fate controls everything. Instead, they carefully examine and evaluate each moment, understanding that while one has a certain degree of autonomy in life, they do not have complete control over all circumstances (Hadot, 1995). Stoicism equips individuals to respond effectively to the events they encounter, leading to one of its fundamental principles: *The Dichotomy of Control* (Sellars, 2006; Irvine, 2009).

The Logos set into motion a chain of causes and effects at the beginning of the universe, a course that cannot be altered (Bobzien, 1998). However, individuals can choose how to respond to these causes, either by making decisions that align with reason or by acting rashly against them (Long, 2002).

To grasp this concept, one must ask whether it is within one's control to change an event. What individuals control are their faculties of judgment and the mental processes that lead to those judgments (Dobbin, 2008). The event itself will occur regardless of their actions, but the manner in which they respond, determined by their judgment of the event, is within their control (Inwood, 2003).

External events that lie outside one’s control are thus considered indifferent; they do not affect the person's judgment of value regarding the events (Sellars, 2006). Mastering the dichotomy of control, as prescribed by Stoic logic, can greatly benefit a person’s well-being when faced with challenging situations (Irvine, 2009). It encourages individuals to view events as beyond their control, allowing for cognitive distancing and preventing them from taking the event personally (Robertson, 2012). By questioning whether an event is within their control, individuals can realize they are not victims of misfortune. Once they understand what is within their control, they are better equipped to

make rational judgments about how to react to the situation (Hadot, 1995).

From the cosmos to the individual, Stoicism presents a coherent and justifiable philosophy that is entirely consistent (Sellars, 2006; Robertson, 2012). This philosophy is rigorously aligned with the essence of nature and its governing laws, enabling it to effectively influence human actions (Fisher, 2016). It's key to highlight the balance here: when human autonomy is exercised with an awareness of its origins, it aligns with nature (Long, 2002). This alignment empowers individuals to act with a divine disposition and supports personal growth and the pursuit of eudaimonia (Stephens, 2007). The harmony found in this alignment transcends our individual selves, merging them into the non-duality and unity of the universe (Eliopoulos, 2014; Hadot, 1995).

As will be discussed, the latest cosmological findings in modern science will further strengthen the coherence between Stoicism and modern science, bringing these two worlds together to examine their similarities in how the universe processes information.

1.4 A Unified Cosmology

Stoicism is often not recognized as a science-based philosophy. When it was established as a school of thought in Greece, Aristotle and his Lyceum school were known for pioneering systematic observation and the development of taxonomy, especially in biology (Hahm, 1977; Algra, 1999). However, this does not diminish the fact that the Stoics actively lived out their philosophy by observing and studying natural phenomena, without any indications of embracing supernatural or mythical ideas (Sellars, 2006; Long, 2002).

As a philosophy rooted in a coherent understanding of nature, Stoicism

acknowledges that observations are supported by consistent patterns that lead to laws. Thus, the Stoics should be regarded as philosopher-scientists (Sambursky, 1987). Perhaps their scientific approach was overlooked because they did not categorize their observations in the same way Aristotle did, limiting themselves to the disciplines outlined in their tripartite philosophical system (Inwood, 2003). Nevertheless, by examining their system of physics, one can see that their understanding of the natural world was intricate and elaborate. To illustrate this point, there will be an integration of Stoic cosmology with aspects of modern cosmology, demonstrating how their physics reflects a nuanced, scientific perspective and affirming that the Stoics were indeed a refined philosophical school (Currivan, 2017; Voncken, 2025).

When studying cosmology today, one uses telescopes to view our universe as it was light-years ago. Similarly, when one examines matter through a microscope, one can observe its components at the microscopic scale. To observe even smaller building blocks of the physical world, one enters the subatomic realm, where observations and experiments reveal phenomena that do not adhere to the same rules experienced in their daily lives. Science is built on calculations and predictions derived from repeated observations and experiments. Suppose these observations and experiments consistently yield the same results. In that case, one can conclude that to have understood the mechanisms and components that operate in a certain way can be called a law. Achieving this understanding requires decades of research and billions of dollars in funding. In most cases, our contributions are small, yet significant parts of a larger puzzle that have yet to be fully understood (Parikh, 2025).

Cosmology is a highly interdisciplinary field of science that encompasses

classical, quantum, and particle physics, astrophysics, mathematics, and chemistry (Currivan, 2017). If the Stoics were to attempt to understand this complex endeavor, they would need a deep epistemic knowledge of how all these pieces fit together. Remarkably, without modern technology, laboratories, or funding, Stoic physics manages to interpret and calculate the mechanisms that govern our universe with impressive foresight (Sambursky, 1987). Their ideas not only align with contemporary scientific findings and theories but also extend those concepts to the psychological level of human behavior, relying solely on sensory perception and inquiry (Sellars, 2006; Voncken, 2025).

The use of conceptual equations in this dissertation served as a meditative aid to support the arguments presented in each chapter by employing a common, clear language between cosmology and philosophy. Although philosophical arguments can often remain abstract, formalizing them into equations clarifies the relationships between concepts and precisely defines the terms involved. These equations are not intended to be solved mathematically; rather, they serve as heuristics—a conceptual map to guide the exploration of the topics and provide a structured system for testing the hypotheses. This visual and structural representation offers a fresh perspective on the Stoic attitude and its implications in a modern, scientifically informed context. It is the intention for this model to invite dialogue and encourage further research. Presenting this as equations establishes a clear and explicit starting point for others to build on, challenge, incorporate into new fields of interest, or question its foundational assumptions.

1.5 Unfolding the Logos: The Stoic Practice of Prosochē

Concluding the first chapter of this dissertation, it is necessary to examine the spiritual attitude necessary for a Stoic practitioner to embrace the unfolding of the Logos,

the mechanism of how the universe reveals itself. The Greek word prosochē refers to "attention" or "mindfulness," a crucial aspect of the Stoic spiritual mindset. French philosopher Pierre Hadot extensively discussed prosochē in his book, *Philosophy as a Way of Life* (Hadot, 1995), emphasizing it as the fundamental Stoic spiritual attitude. This attitude entails a continuous vigilance and presence of mind that keeps our spirit in a state of constant tension, mirroring the actions of pneuma and awareness (Sambursky, 1987; Long, 2002).

This mindset enables individuals to distinguish between what is within their control and what is not, by reminding themselves that external events are indifferent. Additionally, it reflects the Stoics' commitment to rectifying their intentions at every moment, scrutinizing motivations for actions that may not align with the desire to do good, and thus aligning with perceived cosmic unfoldment. According to Hadot, this is understood as a cosmic conscience, attuned to the divine and willingly consenting to the will of universal reason, perceiving all things through the eyes of God (Hadot, 1995, p. 138). This can be seen as a connection with living in harmony with the Logos. For the Stoics, the ego is not an isolated concept, but rather emanates from a larger cosmic structure. Since the goal of ethics in Stoicism is to align oneself with the will of nature, it acquires a “cosmic dimension,” as mindful vigilance involves recognizing that one is part of a larger order (Trepp, 2025). In the same context, Hadot explains that the philosopher needs to let go of their narrow, self-centered perspective of reality, so that, through the study of physics, they can elevate their understanding to the way universal reason perceives things. Most importantly, the philosopher must fervently desire the collective well-being of the universe and society, realizing that no part can have a true good other

than the collective good of the whole (Hadot, 1995, p. 238).

The unfolding of the Logos is viewed as both a spiritual and practical exercise. Chris Fisher explains the interconnectedness of this practice as "lived physics," highlighting the application of the Stoic disciplines of desire, assent, and action. These concepts are mentioned by Marcus Aurelius in his *Meditations* (Aurelius 1909, 2003, 2008) and, more directly, by Epictetus in his *Discourses* (Dobbin, 2008). Fisher establishes an intriguing link among these three disciplines, creating an integrated system of self-coherence.

- Coherence with universal Reason:

  Accomplished through the practice of the discipline of assent, it forms an “inner citadel” within the mind where the Self is contained and safeguarded by the unyielding barriers established by Epictetus’ distinction between what is within our control and what is not. The initial and vital challenge is to calm the psychological chaos caused by the passions, which devastates the mind of the unwise. Only after this can the Self, one’s guiding principle, begin to align with universal reason.

- Coherence with universal Nature:

  Attained through the discipline of desire, it supports a profound respect for creation and the natural principles that govern the universe. This profound respect manifests as a sense of duty towards one's parents, societal laws, and the natural world. Aligning with universal nature leads to an acceptance of fate. It entails understanding and accepting one’s position and role within the broader context of

nature. Alignment with universal nature, as practiced in physics, gives rise to the quality of moderation.

- Coherence with Humanity:

  Accomplished through the discipline of action, it motivates one to pursue fairness in all types of relationships. One's behaviors are within their control and also serve as causal factors in a broader network that includes others, society, and humanity as a whole. Therefore, one's everyday actions can either promote or undermine justice. The connection between one's actions and those nearest to them, such as their family and friends, is considered to be instinctual. Nevertheless, as a global citizen, it seems important to broaden one's perspective and reflect on how one's actions impact individuals worldwide. Living in harmony with humanity, through the practice of ethics, thus promotes the quality of justice (Fisher, 2013).

The practice of these disciplines, which encompasses a tripartite system in its own right, connects physics, logic, and ethics, and can only be fully realized by embodying the fundamental spiritual attitude of prosochē. Perhaps no one has achieved this practice more eloquently than the Roman emperor Marcus Aurelius in his *Meditations* (Aurelius, 1902, 2003, 2008).

Marcus Aurelius never intended for his personal journal to be made public. Writing served as a way for him to thoughtfully examine the thoughts and feelings that arose throughout his day, acting as a conversation with himself over time (Hadot, 1998). This process of self-reflection allowed him to maintain a consistent awareness of his inner state, which is the essence of prosochē. In his journal, he explores his Stoic studies,

offering reflections and poetic thoughts to motivate himself to stay committed to a Stoic perspective. As Pierre Hadot points out, Marcus often practices focusing on the present in his writings. By concentrating on his current impressions, urges, and actions, he reduces the significant pressure associated with being a Stoic (Fisher, 2018; Robertson, 2012).

Throughout various passages, Marcus emphasizes the importance of being engaged and mindful in the moment:

"Be solicitous only to live well for the present; and you may go on till death, to spend what remains of life, with tranquillity, with true dignity, and complacence with the divinity within you" (Aurelius, 2008, p. 145).

In this passage, Marcus argues that life should focus solely on the current circumstances. He suggests that the simple yet challenging task of remaining present can help alleviate worries about anything else. By embracing tranquility, dignity, and stillness, one can align themselves with the divine order that exists within at every moment.

> If thou shouldst live three thousand years, or as many myriads, yet remember this, that no man loses any other life than that he now lives; and that he now lives no other life than what he is parting with, every instant. The longest life, and the shortest, come to one effect: since the present time is equal to all, what is lost or parted with is equal to all (Aurelius, 2008, p. 37).

Marcus emphasizes the value of the present moment, suggesting that longevity is irrelevant if one is not truly engaged in life. A person might live a long time, but if they

are not fully present, the duration of their life is irrelevant. In essence, every moment holds equal significance.

> Do a few things, says the philosopher, if you would have quiet. This is perhaps a better saying: Do what is necessary, do what the reason of the being that is social in its nature directs, and do it in the spirit of that direction. By this, you will attain the calm that comes from virtuous action, and that calm also which comes from having few things to do. Most things you say and do are not necessary. Have done with them, and you will be more at leisure and less perturbed. On every occasion, then, ask yourself the question, Is this thing not unnecessary? And put away not only unnecessary deeds but unnecessary thoughts, for by so doing you will avoid all superfluous actions (Aurelius, 1902, p. 24).

Here, Marcus once again refers to the concept of tranquility, which arises from virtuous action and having a limited number of tasks. The essence of focusing on a few practical activities aligns closely with the practice of mindfulness. Maintaining rigorous vigilance necessitates a concentration that cannot coexist with a scattered mind. Note that he links what must be done with what nature directs.

> Dwell not on what you lack so much as on what you have already. Select the best of what you have, and consider how passionately you would have longed for it had it not been yours. Yet be watchful, lest by this joy in what you have you accustom yourself to value it too highly; so that, if it should fail, you would be distressed (Aurelius, 1902, p. 27).

This passage presents two main points. The first emphasizes the importance of gratitude for one's current situation. Being aware of the blessings and appreciating what one has. The second point discusses the management of desire, outlining what the discipline surrounding desire should entail. It also mentions the concept of impermanence, which cautions one not to become too attached to the things they value, as they might one day be taken away.

> Blot out imagination. Check the brutal impulses of the passions. Confine your energies to the present time. Observe clearly all that happens either to yourself or to another. Divide and analyse all objects into cause and matter. Take thought for your last hour. Let another's sin remain where the guilt lies (Aurelius, 1902, p. 29).

This passage addresses the essence of prosochē. Marcus emphasizes the importance of staying focused and being mindful of unrealistic desires. He advises maintaining vigilance over one's impulses and passions and consistently being aware of what happens to oneself or others. Additionally, he reflects on his mortality, acknowledging that it can come at any moment, and encourages not to concern oneself with others' wrongdoing, but be mindful of one's own sins before judging others.

This focused attention to sense impressions and thoughts, along with one's agreement with them, is what keeps Stoics in a state of tension (Long, 1986). This tension is a characteristic of pneuma, manifesting informationally through an "in-tension", and serving as the vehicle for divine reason to inform the entire cosmos deterministically. The Stoics suggest that tension, like the interplay between dark energy and gravity, is how pneuma operates, conducting our cosmic symphony and providing cohesion and unity

throughout the universe (Sambursky, 1987).

The Stoic, by practicing prosochē, is not merely engaging in mental discipline but is consciously harmonizing their inner state with the universe's organizing principle. Focusing on the present moment is not simply a form of mindfulness; it is intrinsically linked to the acceptance of fate as a whole: one can only be completely present if one views each moment as part of the rational, providential order of nature (Trepp, 2025).

To this, there is evidence of the importance of discipline and the harmonizing of our inner selves with the principles of the universe. Associate professor of philosophy at the Australian Catholic University, Matthew Sharpe[40], in his memorium to Pierre Hadot writes that Hadot emphasizes a collection of passages that contemplate what he refers to as the distinction between "providence or chaotic atoms" (Sharpe, 2011). Marcus Aurelius, for example, states in the *Meditations*, "If the All is God, then everything is as it should be." However, even if the world is not arranged in a providential manner as Stoic doctrine suggests, Aurelius asserts that "it would [still] be conceivable for you to have order within yourself while chaos prevails over the All." In such a case, indeed, you might "consider yourself fortunate if, amid such turmoil, you have a guiding intelligence within you" (Sharpe, 2011, p. 148).

Indeed, there is no better portrayal of the spiritual attitude of prosochē than that found in the writings of Marcus Aurelius (Hadot, 1998). His interpretation of Stoic teachings resonates deeply, reflecting the essence of his heart and offering insight for his own soul to recognize and understand. Life exists in a state of constant tension, and we

[40] Matthew Sharpe is the author of *The Other Enlightenment* (2023) and *Camus, Philosophe* (2014, 2015), and coauthor of *Philosophy as a Way of Life: History, Dimensions, Directions* (2021) and *Zizek and Politics* (2010). He has taught and supervised philosophy for over two decades, and is the author of numerous articles in the history of ideas, classical receptions, critical and psychoanalytic theory, continental theory, and Stoic thought.

must align ourselves with universal wisdom to demonstrate that existence is a miracle worth living (Long, 2002). One can minimize their struggles by paying attention to their surroundings and understanding that everything aligns with nature's plan. Suffering often arises from a disconnection with nature, which continually whispers about how to realign with the forces of the divine cosmos, if only one takes the time to listen (Fisher, 2016; Voncken, 2025).

This quote from Hadot perfectly captures Marcus Aurelius's dedication to Stoic discipline in his writings:

> The personal effort appears rather in the repetitions, the multiple variations developed around the same thing, and the stylistic effort as well, which always seek a striking formula. Nevertheless, we feel a highly particular emotion when we enter, as it were, into the spiritual intimacy of a soul's secrets, and are thus directly associated with the efforts of a man who, fascinated by the only thing necessary— the absolute value of moral good—is trying to do what, in the last analysis, we are all trying to do to: To live in complete consciousness and lucidity; to give each of our instants its fullest attention; and to give meaning to our entire life. Marcus is talking to himself, but we get the impression he's talking to each one of us (Hadot, 1995, p. 313).

The decision to conclude this first chapter with the concept of prosochē is intended to encourage the right mindset for engaging with this paper. Many of the topics and hermeneutic methods used to present a well-structured framework of Stoicism within a modern context require focused attention and patience (Inwood, 2003). This dissertation is committed not only to challenging and articulating ideas but also to

actively engaging with meditations, emotions, and reasoning. It is undertaken as an exercise that rigorously follows the Stoic path in pursuit of a personal sense of eudaimonia through academic endeavors (Stephens, 2007). With this mindset, along with discipline and curiosity, the author acknowledges the importance of training and trusts that this mindful approach will lead to beauty and discovery.

CHAPTER II

Methodology and Theoretical Synthesis

> *Nature does nothing without purpose or uselessly, and it is the role of the investigator to find the logic within the fabric.*
>
> —Adapted from Aristotle/Stoic fragments

2.1 Research Paradigm

This research adopts an ontological naturalist stance, viewing the Stoic pneuma not as a metaphor but as a physical component of the cosmos. The research demonstrates that the ancient Stoic tripartite system of physics, logic, and ethics functions as a coherent informational architecture that points to contemporary laws of thermodynamics and holographic complexity. By analyzing the universe as an "in-formed" entity, this work bridges the gap between ancient teleology and modern cosmological evolution.

2.2 Method of Correspondence

The primary method used is the Method of Correspondence, which identifies functional isomorphisms between contrasting fields to validate theoretical consistency. This involves mapping, which is not merely comparative but an integrative process that takes ancient insights and modern data as an emergent unfolding of evidence-based understanding of cosmic evolution.

2.3 Conceptual Formalization and Symbolic Logic

A central methodological innovation in this work is the translation of qualitative Stoic doctrines into symbolic conceptual equations. These equations served as a meditative aid for the author to formulate the inherent logic of Stoic physics with a symbolic formalization to demonstrate the philosophical and scientific consistency with modern *infodynamics*[41]. These equations function as logical insights.

2.4 Declaration of AI and Digital Tool Assistance

In alignment with APA 7 standards regarding the use of technology in doctoral research, the author discloses the use of specific digital tools to enhance the technical precision of this manuscript.

2.4.1 AI as a Symbolic Thought Partnership

Gemini (Google, 2025) was utilized as a technical partner. While the original theoretical frameworks, variable definitions, and philosophical insights originated solely with the author, the AI was leveraged for:

- **Symbolic Notation:** Suggesting appropriate mathematical operators to represent the author's conceptual links.
- **Technical Rendering:** Refining the LaTeX code[42] to ensure the equations are presented according to professional mathematical standards.

2.4.2 Linguistic Clarity

Grammarly (Grammarly Inc., 2025) was utilized as an assistive linguistic tool. Its

[41] Jude Currivan has reinterpreted the first two laws of thermodynamics as laws of infodynamics, to better understand how our universe evolves as a holographically informed wholeness.
[42]LaTeX is a high-quality typesetting system; it includes features designed for the production of technical and scientific documentation. LaTeX is the de facto standard for the communication and publication of scientific documents.

use was strictly limited to grammatical correction, punctuation, and ensuring a consistent academic tone across the manuscript.

2.4.3 Authorial Responsibility

The use of these tools was strictly for assistive purposes. All notations, logical derivations, and linguistic refinements were critically evaluated and approved by the author. The author maintains full responsibility for the theoretical and interpretive integrity, mathematical accuracy, and the conclusions of this work.

2.5 Source Selection

The foundations of this interdisciplinary work rest upon two distinct but intersecting tracks of inquiry, bridging classical philosophy with modern physical theory. Primary philosophical data are sourced from foundational Stoic texts, including fragments of Zeno and Chrysippus (Long & Sedley, 1987) and the works of Seneca (1969, 2010), Epictetus (Dobbin, 2008), and Marcus Aurelius (1902, 2003, 2008).

To ensure scientific rigor and contemporary relevance, the author consulted digital archives of physics pre-prints (arXiv) and analyzed specific holographic cosmological models (e.g., Bekenstein, Hawking, Currivan) that propose the architecture of our universe is essentially an unfolding expression of informational content and density. This theoretical framing is founded on evidence at all scales and across many fields of research.

CHAPTER III

The Physics of Pneuma: From Cosmic Genesis to Complex Systems

> *When the universe, with a mighty gesture, erupted into realities, light and darkness were separated, but thanks to the creation of dawn and colors, they reunite and love each other.*
>
> — Adapted from Johann Wolfgang von Goethe,[43] *Theory of Colors*

3.1 The Stoic Cosmology Re-Imagined

During the conflagration, pure intelligence meticulously plans every detail of the next phase of the world. At this stage, it already contains the ‘seminal principles’ (*spermatikoi logoi*), which can be seen as blueprints for the individual organisms and other entities that will eventually emerge (Sedley, 1998; Long & Sedley, 1987).

These seminal principles can be interpreted in modern scientific terms as information. The information inherent in our universe is critical to the laws of physics and is intrinsically interconnected throughout the cosmos. No subsystem exists in isolation; instead, each is related to others through its informational content, patterns, and relationships. Even at the quantum level, where phenomena appear probabilistic, the notion of "randomness" is misleading. The outcomes are influenced by the information available, as the probabilities within a range of possibilities depend on this information (Currivan, 2017, p. 7). Both the Stoic concept of fundamental principles and the

[43] Johann Wolfgang von Goethe was a German polymath who is widely regarded as the most influential writer in the German language.

informational nature of the universe at its most basic level imply a cohesive, deterministic structure (Landauer, 1991; Adami, 2016), as does the relationship between the tripartite Stoic formula. Therefore, it can be reasonably inferred that our universe is characterized by reason as its defining attribute.

One of the most intriguing modern theories regarding the possibility of our universe having a cyclical nature is the work of Einstein[44], Élie Cartan[45], Tom Kibble[46], and Dennis Sciama[47] in their conceptual expansion of the general theory of relativity, known as ECKS, named after their last name initials. This theory builds upon general relativity by incorporating the preservation of angular momentum in the presence of a gravitational field, along with the intrinsic spins[48] of fundamental particles, linking this to a nonzero torsional effect[49] (Currivan, 2017, p. 194; Popławski, 2010).

To better explain this, in most uses of general relativity, gravity is understood solely as the curvature of spacetime[50], and only the orbital angular momentum of objects[51], such as a planet's rotation or orbit around the sun, is considered. However, this

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[44] Albert Einstein was a German-born physicist who developed the special and general theories of relativity and won the Nobel Prize for Physics in 1921 for his explanation of the photoelectric effect. Einstein is generally considered the most influential physicist of the 20th century.

[45] Élie-Joseph Cartan was a French mathematician who greatly developed the theory of Lie groups and contributed to the theory of subalgebras.

[46] Sir Thomas Walter Bannerman Kibble was a British theoretical physicist, senior research investigator at the Blackett Laboratory and Emeritus Professor of Theoretical Physics at Imperial College London.

[47] Dennis William Siahou Sciama was an English physicist who, through his own work and that of his students, including Stephen Hawking, played a major role in developing British physics after the Second World War.

[48] In physics, intrinsic spin (often simply called "spin") is a fundamental, inherent property of subatomic particles, much like mass or electric charge. It is a form of angular momentum, but it is *intrinsic* to the particle itself—it doesn't arise from the particle moving in a circle around an external point.

[49] A nonzero torsional effect refers to the twisting or rotational deformation of spacetime, which is a key concept in alternative theories of gravity like Einstein-Cartan theory, but is assumed to be zero in standard General Relativity.

[50] The curvature of spacetime is the warping or distortion of the universe's four-dimensional fabric (three dimensions of space and one dimension of time) caused by the presence of mass and energy. This curvature is what we perceive as gravity.

[51] Orbital angular momentum, is a measure of the rotational motion of an object as it moves around a fixed point or center of rotation. It describes motion *through space*, such as a planet orbiting the Sun or an

does not account for the intrinsic spin angular momentum of quantum particles. The ECKS theory of gravity extends general relativity by incorporating this quantum spin. General relativity, in fact, enables this more complex extension. Adding quantum spin in ECKS extends to a new geometrical concept called *spacetime torsion*, which can be thought of as a twisting of spacetime. Because this effect is only significant in extreme circumstances, such as within black holes, standard general relativity remains the practical model for all but the most extreme conditions (Trautman, 2006; Popławski, 2010).

This expanded idea of ECKS provides a more comprehensive understanding of the interactions between energy-matter, aligning general relativity with the quantum properties of fundamental particles (Poplawski, 2012). The idea of connecting spin and torsion has been suggested as a way to inhibit the emergence of a gravitational singularity, which refers to locations in spacetime where gravitational forces are posited to compress matter to an infinite density, theoretically leading to an object that has no volume and infinite mass, often linked to black holes (Maguire, 2022), thereby allowing for a powerful repulsive force in extremely dense environments. While Some interpretations suggest this leads to a “Big Bounce” (Pasmatsiou et al., 2017), a model proposing that the universe didn't originate from a singularity of infinite density, but instead emerged from the contraction and subsequent expansion of an earlier universe (Novello & Perez Bergliaffa, 2008), current cosmological observations indicating an accelerating expansion of space make this unlikely. In the near term, and furthermore, the standard three laws of thermodynamics and the current understanding of information

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electron orbiting an atomic nucleus, and is distinct from the object's intrinsic rotation about its own center of mass (spin angular momentum).

dynamics do not support this specific cyclical model of the cosmos (Carroll & Chen, 2004).

However Jude Currivan elaborates that the ECKS theory, by including the Planck scale and the informational characteristics of the cosmic hologram, emphasizes its potential to uncover what occurs under the extreme conditions of spacetime, like at the cores of black holes or at the onset of the Big Breath (Currivan, 2017, p. 194). What this means for our discussion is that it potentially grounds the Stoic concept of conflagration within the context of spacetime. This suggests that the ancient idea of cyclically sequenced universes remains relevant, serving as a precursor to our latest theories on the universe's beginning and end under high-density conditions.

Within the theoretical proposition of the ECKS extension of general relativity, a speculative mechanism for birthing new universes emerges: a new universe “budding” from an existing older one and, in theory, acting as a new Big Bang, expanding into a separate universe (Popławski, 2010; Veklych, 2025).

This scenario posits a moment of extreme purification, similar to the Stoic concept of conflagration. In both theories, a cyclical process of destruction and rebirth is driven by a fundamental underlying principle, the divine fire in Stoicism, and the quantum mechanics of spin and torsion in ECKS, allowing both to potentially create a new cosmic cycle. This provides a modern, scientific resemblance of the ancient Stoic vision of a universe in perpetual, rational renewal, which can be interpreted with the following equation:

$$\mathbf{U}_a = \mathcal{P}[\Pi] \circ \mathcal{E}_{\rho\to\infty}[E] \circ (\mathbf{G}_{\mu\nu} + \mathbf{Q}_{\mu\nu} = \kappa(\mathbf{T}_{\mu\nu} + \mathbf{\Sigma}_{\mu\nu}))$$

Note on Formalization: The variable $\mathbf{U}_a$ represents the Universal Active Principle. This equation models the Logos as the primary causal agent in cosmic budding. The main field equations, grounded in Einstein-Cartan-Kibble-Sciama (ECKS) theory, extend General Relativity by incorporating torsion ($Q_{\mu\nu}$) and spin density ($\Sigma_{\mu\nu}$), suggesting a universe with intrinsic geometric structure beyond mere curvature (Kibble, 1961; Sciama, 1964).

The Primary Projection Operator **(**$\mathcal{P}[\Pi]$**)** represents the Logos projecting the archetype of rational order into existence (Meyer, 2008), while the Emanation Operator **(**$\mathcal{E}_{\rho\to\infty}$**)** signifies the infinite density of potential being channeled into manifest reality (Long & Sedley, 1987). Together, they describe the transition from an abstract rational principle into a structured, physical spacetime manifold, where information and matter are fundamentally entwined (Currivan, 2017).

By exploring the conceptual connections between pneuma and principles in cosmology, one can review Stoicism's corporatist ontology. This perspective says that Stoics believe information possesses physical properties. They assert that only bodies exist, yet this allows incorporeals to "subsist" as intangibles, or entities that have no shape and neither act nor are acted upon. Instead, incorporeals simply relate to bodies. Examples of incorporeals include concepts such as time, space, the void, and *lekta*, which refers to sayable or expressible meanings (Durand et al., 2023).

Corporeals or bodies in Stoic philosophy explain natural phenomena through two principles, known as *archai*: the active principle (Logos) and the passive principle (*Hulê*). Together, these principles account for everything in the universe. The active principle acts upon the passive principle and is embodied in pneuma, often seen as the divine reason. This is why the Stoic notion of God must be considered a body; it interacts with everything in the world and possesses causal powers (Sedley, 1998; Long & Sedley, 1987). The passive principle, also known as primary matter, is formless and inert,

providing the raw material for the universe. Both principles are regarded as bodies capable of action or being acted upon (Rubarth, n.d.).

By applying the physics interpretation of information in relation to divine reason, we can conclude that information is expressed as energy-matter. It fits the definition of "what acts and is acted upon," with a fundamental substance that emerges from the Planck length of 10^{-35} meters, manifesting as the holographic image of our universe (Currivan, 2017). To further support the argument that information is physical, one can examine its tangible effects. A pertinent example of this is the transmission of heat by deleted bits of information, as proposed by German-American physicist Rolf Landauer[52], known as *Landauer's principle* (1961). This principle was tested in 2012 by Eric Lutz[53] and his colleagues in their silica bead experiment.

Landauer explained that a particle moving through the body behaves like a bit or a cluster of bits of information traveling along a network of interconnected logic units[54]. These logic units operate at an extremely small scale of time and space. In the realm of computation, information is constantly discarded, and the compression of information-bearing degrees of freedom[55] in a computer necessitates an expansion of other degrees of freedom. This process corresponds to an increase in entropy. As a result, the act of discarding information requires dissipation (Landauer, 1991).

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[52] Rolf William Landauer was a German-American physicist who made important contributions in diverse areas of the thermodynamics of information processing, condensed matter physics, and the conductivity of disordered media.

[53] Eric Lutz is a professor of theoretical physics at the University of Stuttgart in Germany. His research interests include nonequilibrium physics, quantum thermodynamics, and information theory.

[54] A network of interconnected logic units is a system where multiple individual components (the "logic units") work together in a coordinated fashion to process information, make decisions, or perform tasks. These units communicate with each other to achieve a collective goal that individual units could not achieve alone.

[55] The degrees of freedom of a system are the minimum number of independent coordinates needed to specify the position and configuration of a thermo-dynamical system in space.

Using data from tiny silica beads, Lutz's team developed a system that resembles how classical particles are trapped in two potential energy states, with a barrier preventing them from jumping between them. If the thermal temperature is higher than the barrier temperature, the bead will remain in one state, and the information is conserved. However, if the barrier's temperature is lowered to match that of the bead, it becomes more likely that the bead will alternate between 0 and 1 in its bit value. High-speed cameras captured the dissipation of energy as heat when the bead transitioned from one state to another, thereby confirming Landauer's principle (Johnston, 2012).

By understanding the correlations and significant interactions among the triad of energy, matter, and information, it becomes evident that the Stoics integrated these concepts into their view of a corporeal and vitalist cosmos. Their insight into active and passive principles as "bodies" could imply an assumption that these can be represented as accumulations of zeros and ones, effectively endowing information with physical properties (Landauer, 1991; Currivan, 2017).

The breakdown of these components that capture the Stoic corporeal ontology, the principles of archai, and the modern physics analogy regarding information as a physical entity can be interpreted as:

$$\mathcal{X}_K = (\Lambda + H) \Rightarrow I = EM \leftrightarrow P\Phi$$

Note on Formalization: The variable X_k represents the Manifested Informational State. This equation synthesizes Stoic ontology with informational physics. The relation $(\Lambda + H)$ formalizes the Stoic *archai* (Active/Passive principles) as cosmological variables. The identity $I = EM$ integrates (Wheeler, 1989) "It from Bit" structure and Landauer's Principle (Landauer, 1961) regarding the physical cost of informational entropy. The term $\mathcal{P}\Phi$ is an original

designation for the phenomenological feedback between the observer and the informational substrate.

This dissertation will continue to explore what pneuma is and how it transmits information throughout the universe, decohering quantized bits into discrete units and further expressing itself through incremental expansion. This process increases entropy by augmenting information from high-density states toward thermal equilibrium.

3.2 The Dynamics of Pneuma

Jude Currivan proposes that the universe's origin began in an extremely fine-tuned and ordered way, based on evidence also presented by other cosmologists (Davies, 2008), enabling its subsequent evolutionary arc to evolve from simplicity to complexity, much like a Big Breath. This process began during the brief Planck epoch[56] (Currivan, 2022, p. 8), allowing the infinite mind to express itself within the finite universal reality we observe today. The concept of pneuma is important in this context, as it holds significant meaning in Stoic philosophy. Pneuma, often translated as "breath," "spirit," or "air," refers to the animating force of the cosmos. In Stoic thought, it represents the rational, life-giving breath that forms the soul, binds matter, and expresses divine reason throughout nature, weaving through all existence (Voncken, 2025).

In explaining this integrated idea, Ian Hensley[57] of James Madison University described the Stoics' view of the world as being influenced by a volume of pneuma, which represents a rational soul. This pneuma interacts with the world itself, such that for

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[56] The Planck Epoch refers to the earliest phase of the universe, occurring from the moment of the Big Bang until approximately 10^{-43} seconds after, when the universe was incredibly hot and dense. During this period, the known laws of physics, including general relativity and quantum mechanics, break down, and the fundamental forces were unified into a single force.

[57] Dr. Hensley is an assistant professor of philosophy at James Madison University who specializes in the history of ancient Greek and Roman philosophy. His published research focuses on the philosophy of the ancient Stoics, especially their physics and metaphysics.

any given location, a part of the overarching soul is present. This principle applies to all animals, plants, and cohesive inanimate entities. For every spot within these entities, there is a portion of their governing pneuma, whether in the form of a state, nature, or soul, resulting in each entity possessing specific fundamental traits (Hensley, 2021).

Additionally, many functions are often associated with non-physical entities, archetypes, and other entities such as goodness, ruler, and Zeus, which can be understood through the various degrees of pneuma. Qualities provide the reasons for how bodies are characterized, aligning with the governing pneuma of those bodies. Meanwhile, the soul of the world, or the *univer-soul* (Currivan, 2017, p. 182), acts as a conduit for God's divine operations (Coughlin et al., 2020, p. 180).

There is a lack of direct, definitive evidence from the Stoics regarding the composition of pneuma. However, the ancient physician Galen[58], referencing what is believed to be Chrysippus's interpretation of pneuma, provides us with the following passage from his medical treatise, *De causis contentivis* (Galen, 1998):

> Of the elements themselves, some (the Stoics) call material and some active and dynamic. They maintain that the material elements are held together by those that are dynamic, fire and air being dynamic and active in their view, while earth and water are material. They say that in compounds, the dynamic elements pervade the material totally, that is to say, air and fire penetrate water and earth. Air is cold, and fire is hot. The natural effect of air is to consolidate and thicken a substance, whereas fire naturally causes expansion, loosening, and widening. The two active elements have fine parts, and the other two have thick parts. All the

[58] Aelius Galenus or Claudius Galenus, often anglicized as Galen or Galen of Pergamon, was a Roman and Greekphysician, surgeon, and philosopher.

> substances with fine parts, the Stoics call “pneuma”, and they think that the function of pneuma is to sustain natural and animal bodies (Kalbfleisch & Galen, 2023, p. 133).

Most scholars agree that the concept of pneuma is a combination of air and fire, both active and dynamic elements that connect material components such as earth and water (Long & Sedley, 1987). The role of temperature is especially fascinating when considering the elements themselves, as it influences the expansion of the universe and determines the ideal conditions for the creation of matter. At the first and initiating moment of the Big Breath, fire contributed to the “expansion, loosening, and widening” of the universe until it cooled, allowing for the “consolidation and thickening of substances,” enabling the first atomic nuclei and electrons to combine and form neutral atoms (Currivan, 2022, p. 17).

We can see this process in Stoic/physics terms as:

$$\mathbf{\Pi P}_{l}(\rho \uparrow, \mathbf{T} \uparrow) \longrightarrow \mathrm{Exp}\ \mathbf{\Pi}_{U}(\rho \downarrow, \mathbf{T} \downarrow) \rightarrow \mathbf{\Delta A}$$

Note on Formalization: This equation models the movement of the cosmos from a concentrated state to an expanded state. It begins with Pneuma in its initial, concentrated form ($\mathbf{\Pi P}_{l}$), characterized by a simultaneous increase in Density ($\rho \uparrow$) and Temperature ($T \uparrow$) (Sambursky, 1987, 2014). As the process moves forward, it results in the Expansion of Pneuma ($\mathrm{Exp}\ \mathbf{\Pi}_{U}$), which causes both Density and Temperature to decrease ($\rho \downarrow, T \downarrow$) (Hahm, 1977). This entire transition ultimately results in a measurable change in the universe’s Actuality[59] ($\mathbf{\Delta A}$), showing how the state of the cosmos shifts through the expansion process.

[59] Actuality refers to the quantified, manifest state of the cosmos at a specific point in time. It is the transition from potentiality (the raw informational density of the Logos) to realization (the physical structure of the spacetime manifold).

When discussing pneuma, its characteristic tensional motion is regarded as the fundamental mechanism for structuring, unifying, and animating the cosmos (Rubarth, n.d.). Sambursky had identified this tensional motion as the conceptual progenitor of modern field theory, reminding us of the common effects produced by fields that excite throughout the universe (Sambursky, 1987). Spacetime is intricately woven with force fields, similar to waves layered on top of one another. While this analogy is simplistic, it helps visualize how these forces can coexist simultaneously and how different particles interact with various fields. It is also somewhat misleading to say that particles interact with force fields, as they are not separate entities. In quantum field theory, particles are actually excitations of the force fields, or "standing waves" in field perturbations (Yau, 2025).

The main point here is to illustrate how pneuma, which pervades the Stoic cosmology to varying degrees, can be analogous to the function of fields in cosmology, specifically, when considering the Higgs field[60], which is responsible for giving mass to elementary particles, such as leptons[61], quarks[62], and some bosons[63] (Jones, 2019).

During the extremely high temperatures of the early universe, particularly right after the inception of spacetime, all fundamental particles were massless. However, as the temperature decreased, a critical point was reached at which the Higgs field's energy

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[60] The Higgs field is a fundamental, invisible energy field that permeates all of space and is responsible for giving mass to elementary particles. It is a key concept in the Standard Model of particle physics and is essential for understanding the origin of mass in the universe.

[61] A lepton is a type of fundamental particle that does not interact via the strong nuclear force, one of the four fundamental forces in nature. They are considered elementary particles, meaning they are not made up of any smaller units of matter.

[62] A quark is a type of elementary particle and a fundamental constituent of matter. Quarks combine to form composite particles called hadrons, the most stable of which are protons and neutrons, which are the building blocks of atomic nuclei.

[63] Bosons are a class of subatomic particles that primarily act as the carriers of all fundamental forces in the universe.

dropped, leading to a phase transition (similar to water freezing into ice). During this process, the field settled into its lowest-energy state, effectively “freezing” it and activating the mechanism that imparts mass to matter within the structure of spacetime from that point onward (Currivan, 2017, pp. 58-59; Gray et al., 2018).

When we compare pneuma to fields, we can explore the concepts of total blending[64] (*krasis*) and tensional motion (tonos), the characteristics of pneuma that describe its mechanism of interaction with bodies (Durand et al., 2023). Tensional motion can be applied to how electromagnetic fields (EM) create attractive and repulsive forces, similar to how pneuma encompasses both expanding and contracting forces. There is also a parallel between EM and the hierarchy of matter, ranging from atoms to molecules, analogous to the varying degrees of tension in pneuma observed in inanimate objects and rational beings (Hahm, 1977).

Bridging this ancient philosophical concept with modern physics, a metaphorical equation can be described as:

$$\mathcal{H} \propto \Pi = \sum (\mathcal{E}\Phi \leftrightarrow \mathcal{P}) \times \mathcal{T}$$

> **Note on Formalization:** This equation defines the proportional relationship between Intropy ($\mathcal{H}$), representing the coherence and harmony of the cosmos, and Pneuma (Π). The identity ($=$) bridges the Stoic archai with a modern field-theory analogy (Sambursky, 1987). The summation ($\sum$) indicates the combination of interactions throughout spacetime where force fields ($\mathcal{E}\Phi$) engage with particles ($\mathcal{P}$), understood as standing wave excitations within the underlying "Grid" of reality (Wilczek, 2008). The term ($\mathcal{T}$) represents the tensional motion of the pneuma, maintaining the structural integrity of the systemic whole (Hahm, 1977; Long & Sedley, 1987).

[64] The Stoic concept of total blending, is a unique theory of mixture where two or more distinct bodies can coexist entirely in the same place at the same time while retaining their individual properties.

Pneuma possesses the intriguing characteristic of movement. If we maintain the concept of it as a spirit-like breath substance, we can use the "Big Breath" analogy for pneuma, which expands outward, much as dark energy does. Dark energy[65] constitutes approximately 68 percent of the total energy-matter in our universe and represents an inherent tension within the very fabric of invariant spacetime. Acting as a counterbalance to gravity's contraction, dark energy has played a crucial role in the expansion of space since the initial moment of the Big Breath. Its uniform presence and steady energy density seem to have functioned as a cosmological constant[66] that promotes this expansion (Currivan, 2022, p. 12).

However, pneuma is not merely an outward breath; it also embodies an inward movement, so it is actively "breathing." According to Philo of Alexandria[67] in his work *Quod Deus Sit Immutabilis* (Philo, 1930), while the overall volume of pneuma remains constant, its various sections or components shift in opposing directions[68]:

> [The Stoics viewed] He (God) bound some bodies by state, others by nature, others by soul, and others by rational soul. In stones and logs severed from their natural connection, he forged a state that represents the strongest bond. This is pneuma, which turns back towards itself. It begins to extend itself from the center to the extremities, and having made contact with the outer surfaces, it bends back

[65] Dark energy is a hypothetical form of energy that is proposed by physicists to explain why the universe is not just expanding but is doing so at an accelerating rate.
[66] In cosmology, the cosmological constant is a coefficient that Albert Einstein initially added to his field equations of general relativity to express the energy density of space, or vacuum energy, that arises in quantum mechanics. It is closely associated with the concept of dark energy.
[67] Philo of Alexandria, also called Philō Judæus, was a Hellenistic Jewish philosopher who lived in Alexandria, in the Roman province of Egypt.
[68] Pneuma, understood as expressed in energy-matter (both light and dark) remains constant/conserved throughout the lifetime of our Universe while changing form in its expression.

again until it returns to the same place from which it first set out (Winston & Dillon, 1983).

Ian Hensley clarifies this, saying that pneuma starts from the center of an object, travels to its outer edges, and then returns to the center. It integrates with the object, becoming present throughout the space it occupies, leaving no room for it to shift. Various segments of the pneuma's volume follow the pathway that Philo outlines. The segment of the blend of fire and air that constitutes an object's pneuma begins at the object's center, moves outward toward its outer edges, and then returns to the center. As this segment travels, other parts of the pneuma are following similar trajectories within the object. Some segments are shifting inward, while others are moving outward (Hensley, 2021; Coughlin et al., 2020, p. 195).

Dark matter, unlike dark energy, is the force responsible for maintaining the universe's structure, interacting solely through gravity and serving as a scaffolding that gravitationally supports and organizes visible and large-scale structures. Without its stabilizing influence and support from the very beginning, even if stars had formed hundreds of millions of years later, their gravitational forces would not have been strong enough to allow the formation of galaxies and, ultimately, the development of planetary systems (Currivan, 2022, pp. 12, 13).

At the time of the Big Bang, the density of visible energy-matter and dark matter was significantly greater than that of dark energy. However, as the universe expanded, its total energy density decreased and eventually became less than that of dark energy, with their attractive and repulsive forces precisely canceling each other out to zero across all of space and time. This includes the gravitational effects of dark matter and the repulsive

energies associated with the cosmological constant of dark energy (Currivan, 2017, p. 29). The combined universal conservation of both visible and dark energy-matter, along with their net-zero[69] value, allows a dynamic evolutionary process to emerge comparable to the "active breathing" of pneuma with its inward and outward movements interacting through tensional forces, where each type prevails at various epochs throughout the finite existence of our universe (Tryon, 1973; Currivan, 2022).

The conceptual link between pneuma's tensional motion and that of dark matter and dark energy within a net-zero universe can be explained here as:

$$(\rho_{\mathrm{EM}} + \rho_{\mathrm{DM}}) + \rho_{\mathrm{DE}} = V_Z \propto \Pi\Psi \times \mathcal{FT}$$

Note on Formalization: This equation models the total energy density of the cosmos as the sum of visible matter-energy (ρ_{EM}), dark matter (ρ_{DM}), and the repulsive density of the cosmological constant (ρ_{DE}). Their sum is set as equal to the Vacuum-Zero (Tryon, 1973; Hawking, 1988) state (V_Z), formalizing the hypothesis that the total energy of the universe is precisely zero across spacetime. This state is proportional ($\propto$) to the dynamic evolutionary process of the universe ($\Pi\Psi$), representing the "active breathing" (*pnoe*) of the cosmos through inward and outward cycles (Aurelius, 2003; Sellars, 2006). The term ($\mathcal{FT}$) represents the constant Field-Tension forces[70] that balance these opposing energies to ensure structural integrity across Hellenistic cyclic epochs.

Considering pneuma as a vehicle of information, we recognize that it is a continuous and all-pervasive substance in the cosmos. The Stoics believed that everything that exists is a physical body because only bodies can act and be acted upon (Long & Sedley, 1987). Consequently, pneuma possesses the characteristic of blending

[69] The "zero-energy universe" theory suggests that the universe could have emerged from a quantum fluctuation of a vacuum state (literally "nothingness") because a system with a total net value of zero requires no initial energy input to exist.
[70] Field-Tension forces refer to the inherent energy density and pressure within the universal field.

and mixing with all matter. Information is conserved in pneuma, and since all matter has merged with it, each body in the universe innately carries information derived from pneuma. There is no transfer of communication through spacetime from pneuma to an object; instead, it is part of the object itself. This will later be addressed when introducing the concept of *in-tropy*, as the innately meaningful information content of our universe and its relationship to how pneuma transmits information (Currivan, 2017).

This blending in Stoic physics leads to the concept of *colocation*, the ability of two bodies to coexist in the same place at the same time. This idea has caused considerable confusion among scholars because we tend to perceive bodies as solid, mass-like objects incapable of merging into a single substance[71] (Helle, 2018; 2022).

Vanessa De Harven[72] from the University of Massachusetts, Amherst, sought to clarify this issue by shifting our focus from *hylomorphic*[73] and atomistic assumptions about bodies. She demonstrates that bodies can be simple and fundamental and argues that the Stoic notion of bodies is not solid in the atomistic sense, but rather exists in degrees of rarity and density, quoting, "the unity of the cosmos does not consist in the archai being one and the same body, but in the complete blend of one body, a divine rational agent, with another body fit to be acted upon, its patient" (De Harven, 2018, p. 2).

From a Stoic perspective, although it may require some mental acrobatics, it can be accepted that blending and colocation are physically viable actions. It can also be compared that the Stoic perception of bodies is that of atoms. The term "atomistic" refers

[71] Also as in physics with fermionic energy-matter adhering to the Pauli exclusion principle.
[72] Professor de Harven is the undergraduate program director for the philosophy department at the University of Massachusetts, Amherst. She specializes in Ancient Philosophy, with interests in contemporary metaphysics, philosophy of mind, and theory of meaning.
[73]Hylomorphism: in philosophy, metaphysical view according to which every natural body consists of two intrinsic principles, one potential, namely, primary matter, and one actual, namely, substantial form.

to something that is indivisible. However, atoms are divisible, yet the term still exists to convey indefinability. Now, the concept of bodies being able to blend with one another becomes more meaningful, especially in recognizing that atoms are primarily made up of “empty space.” This empty space, however, should not be considered a void; it is more like a cloud of energetic fields with extensive quantum activity, which aligns with the Stoic claim that completely empty voids in our universe do not exist[74] (Powers, 2014).

Ultimately, this leads to the conclusion that the perception of solidity is an emergent property resulting from dynamic, pervasive, and non-solid influences acting on a much more fundamental, "blended" reality (Veritasium, 2013), proposing this relationship with the following conceptual equation:

$$\mathcal{SE} = A(\mathcal{B}) \propto (\Pi + \Phi_F) \times \Psi$$

> **Notes on Formalization:** This equation explains why the world feels solid even though it is made of non-solid energy. This Emergent Solidity ($\mathcal{SE}$) is created when different fields and bodies "blend" together ($A(\mathcal{B})$), much like the Stoic idea of krasis*,* where substances completely intermix (Long, 1986). This process is driven by the combination of the Pneuma (Π) and Force Fields (Φ_F) that fill up all of space (Sambursky, 1987). Finally, Quantum Activity (Ψ) acts as the bridge, turning these vibrating fields into the actual physical matter we can touch and see.

After exploring the physical dynamics of pneuma, the following sub-chapters will gradually introduce the mechanism by which it transmits information down to the human psychological level. The reader here is invited to pause and reflect on how pneuma manifests in the physical world through its varying degrees of density. As pneuma

[74] The Stoics had a complex and nuanced view: while they believed no void existed within the finite, perfectly full cosmos, they posited an infinite void that existed outside of it.

circulates throughout the universe, it adjusts the densities of various elements. Consequently, intricate forms, such as animals, plants, and inanimate objects, are generated. Therefore, pneuma appears to serve as the means through which the active principle's creative functions are expressed (Hensley, 2021).

3.3 The Arrow of Complexity: Scaling Reason

For the purposes of this dissertation, the main driving law of the universe governs the linear flow of energy-matter and determines the arrow of time. This arrow measures the evolution of an organized system toward its "fated" distribution of energy-matter into disorganization. It is a consequence of the second law of thermodynamics, which states that the total entropy of a contained system always increases over time (Currivan, 2017, pp. 30, 31). The universe is a contained system that has followed this law since the earliest moments of the Big Bang. During the Planck epoch, it existed in its simplest form and lowest-entropy state, characterized by the fewest energetic microstates. Since then, the universe, while conserving energy-matter, has evolved from simpler to more complex forms (Currivan, 2017, p. 34), thus progressing toward higher states of entropy. This process will continue until it reaches thermal equilibrium[75] near absolute zero, marking its ultimate demise.

The first law of thermodynamics, which posits that the energy-matter in an enclosed system is conserved, tells us that the overall energy-matter of the universe cannot be created or destroyed. The total amount of energy produced at the universe's birth is the total amount it has to work with; this energy can only be transformed, not annihilated (Currivan, 2017, p. 84). The expansion of space and the flow of time enable

[75] Thermal equilibrium is a state in physics where systems in contact have the same temperature, resulting in no net flow of heat between them.

the in-formation expressed in the relational configurations of energy-matter to increase as their inter-relationships become increasingly complex.

Jude Currivan has insightfully suggested that the principles of thermodynamics can be viewed as the emergent cosmology of a non-locally unified, meaningfully informed, and holographically represented universe. By transforming the three fundamental laws of thermodynamics into three laws of information, or infodynamics (Currivan, 2017, 2022), a pathway emerges to harmonize quantum theory, which relates to energy-matter, with relativity theory, which addresses space and time. Moreover, this perspective provides insight into how the universe's lifecycle unfolds from inception to conclusion.

Using the same Boltzmann[76] equation from thermodynamics, expressed as ($S = K_b \ln W$), one can reframe the concept of a contained system, such as the entire universe, that evolves from order to disorder over time, and instead, it can be viewed as emerging from simplicity to complexity and diversity, a process Currivan has termed “intropy.” Recognizing the inherently meaningful and informational nature of our universe, the concept can be further expanded to in-tropy, illustrating how everything within it contributes to its overall in-tropic evolutionary flow (Currivan, 2023, p. 34).

Entropy and intropy, together with the established understanding that the universe operates in a nonlocal manner, is proven by the 2022 Nobel Prize winners, Alain

[76] Ludwig Eduard Boltzmann was an Austrian mathematician and theoretical physicist. His greatest achievements were the development of statistical mechanics and the statistical explanation of the second law of thermodynamics.

Aspect[77], John F. Clauser[78], and Anton Zeilinger[79], for their experiments with entangled photons, which established the violation of Bell inequalities[80]. Its existence and evolution as a unified whole relate to both its entire spacetime and the sum of its quantized energy-matter. By recognizing that this universal entanglement is essential, one can begin to perceive phenomena as inherent features of our universe's fundamental nonlocal unity (Currivan, 2023, p. 33). But first, there is a need to clarify the differences between the Stoic concept of time and its arrow, with that of our modern universe. Despite these fundamental differences, one can understand how non-locality can help explain the evolution of intropy from the purest state of pneuma, growing informationally towards the human psyche.

The Stoics understood the universe as cyclical rather than linear (Hahm, 1977; Parikh, 2025). This contrasts with the linear perspective, where the law of entropy helps one see time as a flow determined by irreversible causations, where the past shapes the present, and the present influences the future, like an arrow pointing towards a destination in spacetime (Long & Sedley, 1987; Carroll, 2025).

In the Stoic view of a cyclical universe, the progression of events is guided by the rational principle of Logos, which initiates a chain of cause and effect, dictated by universal reason and also referred to as fate. During the intervals between cosmic conflagrations, events unfold in a specific sequence, creating the appearance of causal relationships (Long & Sedley, 1987). However, the recurring nature of these cycles

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[77] Alain Aspect is a French physicist noted for his experimental work on quantum entanglement.
[78] John Francis Clauser is an American theoretical and experimental physicist known for contributions to the foundations of quantum mechanics, in particular the Clauser–Horne–Shimony–Holt inequality.
[79] Anton Zeilinger is an Austrian quantum physicist and professor emeritus at the University of Vienna and senior scientist at the Institute for Quantum Optics and Quantum Information of the Austrian Academy of Sciences.
[80] Inequality derived by physicist John S. Bell in 1964, regarding correlations of the outcomes of measurements conducted on two or more particles.

implies that from a broader, timeless perspective, time does not follow a single, progressive trajectory. Instead, it is best understood as a circular or closed-loop configuration (Sellars, 2006; Sambursky, 1987).

Time was not viewed as a fundamental aspect for the Stoics; instead, they considered it, in their ontology, as an incorporeal entity—something inactive and non-existent. Time is regarded as a dimension that arises from the motion and events of the physical cosmos. Therefore, motion serves as the means by which we quantify time (Papazian, 1999, p. 106). The concept of incorporeality is also applied to the idea of space. From this, one can infer that the modern relativistic notion of spacetime, when interpreted through a Stoic lens, would not be seen as existing, capable of exerting influence, or as being influenced. Rather, it represents the idea that existing bodies can occupy and within which their activities can unfold (De Harven, 2015).

Pneuma, through its tensional motion, serves as the physical mover of the cosmos, which was discussed earlier. Thus, it can be said to underpin the objective passage of time itself. It's important to remember that pneuma is all-pervasive; not only is it considered an active agent in the cosmos, but it also animates all other active agents, including humans. This animation is fundamental because pneuma provides the capacity for subjective experience. By its nature as a rational force, it permeates human minds as the soul, enabling them to perceive, reason, and interpret the objective flow of time rather than merely exist passively within it. This internal, rational faculty of pneuma is precisely what generates our individual, subjective awareness of temporality. (Sedley, 1998; Voncken, 2025).

A key aspect of this theory of time perception is the idea that rational beings

possess a center of awareness and perception. This center is deemed the origin of movement within the soul and is referred to as the "governing aspect of the soul" (hêgemonikon). Therefore, for the present to be a valid object of experience, for example, it must have a tangible duration. In other words, the present is not just a moment without size; it is a duration whose length varies depending on the actions of the body experiencing it. Since, as far as we know, plants and animals cannot engage in sequential thinking, the Stoics believe that the perception of the present is exclusively reserved for rational beings (Heller, 2014, p. 274).

The philosophical system, side by side with its modern counterpart, and finalized with the elements of perception and reason in human beings, can be considered with this equation:

$$(\Pi \leftrightarrow t \rightarrow L(T\lambda \subset T_k) \wedge \Pi\Delta \rightarrow \neg S\Pi\Sigma)$$

$$\Leftrightarrow (S_\mu \rightarrow tS_\beta \wedge S = k_B \ln W) \Rightarrow T\Phi \rightarrow LT\Sigma$$

Note on Formalization: This equation shows how the universe moves from raw energy into organized life. It links the Stoic idea of pneuma (Π) to modern physics. Essentially, the Logos (L), takes the flow of time ($T\lambda$) and shapes it into physical movement (T_k). This process follows the same rules as the Boltzmann Entropy Equation ($S = k \ln W$), which proves that the state of a system is determined by how its smallest parts (S_μ) are arranged (Carroll, 2010). This is fundamentally comparable to the concept of Intropy, which posits that these micro-arrangements constitute the foundational information that drives cosmic evolution (Currivan, 2017). In this model, the Logos (L) utilizes this meaningful informational "In-tropy" to transition the cosmos into a structured, ordered reality. Finally, this entire interaction demonstrates how the Temporal Flux ($T\Phi$) is directed by the Logos into a state of Total Temporal Order ($T\Sigma$).

Understanding that pneuma, guided by the Logos, manifests the emergence of an arrow of time by internally producing a linear, deterministic chain of cause and effect within a broader, timeless circular configuration of the universe is crucial. This process is dictated by universal reason, compelling the pneuma to undergo tensional motions that release energy and, subsequently, produce higher-entropy states (Sambursky, 1987).

For the Stoics, this suggests that time may be an implication of entropy, or a dimension that only exists when a corporeal body can interact with it. The figurative notion of time having an arrow is based solely on the fact that universal reason determines this chain of cause and effect. However, time as conjoined with space in invariant space-time (Currivan, 2017, p. 116) ensures that causality can never be violated, regardless of the observer that experiences it, even in our argument concerning philosophy and physics. This relationship of time with cause and effect, and incorporating Stoic determinism as being guided by the Logos, ultimately suggests that the linear perception of time can be derived from its cyclical nature. This concept can be interpreted by this equation:

$$[(\Pi \leftrightarrow t \wedge \Delta S = 0) \rightarrow L(\chi\Delta) \Rightarrow t\lambda \subset t_k]$$

Note on Formalization: This equation from a predominantly Stoic perspective explains the relationship between the fundamental forces of the cosmos and the nature of time. It begins with the Bidirectional Tensional Motion ($\Pi \leftrightarrow t$) of pneuma, which serves as the physical driver for all change (Sambursky, 1987). This occurs together with a state where the Entropy Shift is Zero ($\Delta S = 0$). This zero-entropy state represents the universe as a perfectly efficient and reversible system where the Logos ensures no information is lost, maintaining a balance between order and complexity. This causal chain is guided by the Logos (L) and

> says that all events (χ^{Δ}) are the result of deterministic causality within an ordered cosmos (Long, 1985). Ultimately, this deterministic process leads to the specific conclusion that Linear Time ($t\lambda$) is a subset of Cyclical Time, or Universal Life Cycle t_k (Ouspensky, 1997).

When examining the contrasting concepts of the arrow of time, a crucial point in the exploration at which these differences begin to blur is reached, and it is at this juncture that one should consider them to be one and the same. This occurs when taking into account the informational content of the universe, allowing one to transcend into a state of intropy—a nonlocally unified, meaningfully informed, and holographically manifested universe. In the context of information, or infodynamics, the temperature of a system indicates its potential to sustain further actualization of intropy over time. Within a contained system, such as our entire universe, temperature is inversely related to intropy. Their interplay reflects the unfolding cycle of the system, with intropy increasing and temperature correspondingly decreasing as time progresses (Currivan, 2017, 2022).

When discussing complexity, whether through the tensional motion of pneuma or the second law of thermodynamics, the effects of these changes are observable only at the macroscopic level, particularly in assemblies of atoms and molecules. This perspective is supported by Japanese cryptographer Tatsuaki Okamoto, who claims that the second law represents a law of macroscopic emergence (Okamoto, 2023). From this, one can conclude that the universe as a whole, and life specifically, are becoming more complex over time.

In his paper titled *On the Arrow of Time and Organized Complexity in the Universe* (Okamoto, 2023), Okamoto informs that there is still no full understanding why the physical constants of our universe, which results from our fundamental physical laws,

appear to be set at values that favor the emergence of life in a way that seems improbably precise, suggesting that they could hardly be the product of random chance. This perspective is related to the anthropic view known as the fine-tuning problem, which raises the question of why these physical constants seem so perfectly adjusted for life (Okamoto, 2023; Currivan, 2022).

Some argue that the fine-tuning of the universe is not primarily established to support life itself, but rather to create the building blocks and environments necessary for life to exist (Okamoto, 2023, p. 2). Regardless of how this is interpreted, a more direct question arises: Is there a more plausible objective in the universe than the existence of life? In his hypothesis regarding the macroscopic law, Okamoto presents his equation,

$$OC(\hat{O}(S_{T+S})) > OC(\hat{O}(S_T))$$

to illustrate the law of increasing organized complexity, which suggests that the organized complexity of an open system tends to grow over time with the introduction of new structural components. This principle, as posited by Okamoto, indicates that the universe naturally evolves toward more complex configurations. It represents an emergent macroscopic concept that unfolds as the second law of thermodynamics, which applies to isolated systems, as is our universe (Okamoto, 2023, p. 3).

This perspective leads one to understand that life is simply a manifestation of the universe. The emergence of this macroscopic principle may signify a more fundamental and significant characteristic of the universe, contributing to the existence of life, the essential building blocks and conditions for life, and various forms of complex organization. Thus, it appears that the universe is likely fine-tuned for a foundational principle rather than solely for life itself. In other words, the emergence of this

macroscopic principle seems more credible than the idea that life is the primary purpose for which the universe is fine-tuned, and as a consequence also enabling the emergence of individuated self-awareness (Okamoto, 2023, p. 3).

Based on the current understanding of pneuma, it appears to be a dynamic and creative force that drives the universe toward increasingly ordered and complex states. The level of tension present dictates the object's characteristics. A stone exhibits low tension, resulting in basic cohesion. A plant demonstrates a greater level, which facilitates growth. An animal displays a higher level of tension, allowing for perception and instinct, while humans embody the highest form of rational thought (logos) (Rubarth, n.d.). This is what is known as the *scala naturae*, or the hierarchy of nature, which illustrates that the universe, infused with the supreme rational spirit, is a structured and unified entity. Both concepts demonstrate a continuum of complexity: Okamoto defines complexity as a generic property applicable to a wide range of objects, spanning from simple to complex, while the Stoics characterize pneuma as continuous fields that vary in density and tension, giving rise to different complex structures (Okamoto, 2023).

Okamoto's interpretation of the law of increasing organized complexity also offers a holistic perspective that aligns with the concept of pneuma. Both ideas portray the universe as a cohesive, dynamic entity, rather than simply progressing toward thermal equilibrium or highlighting the mechanisms that sustain in-tropic flow and emergence. The Stoic view of a divinely structured cosmos infused with pneuma resonates with Okamoto's notion of a universe evolving toward increased complexity and order, rather than simply facing heat death[81]. They both describe a universe whose fundamental

[81] Heat death is a misguided term. The heat death of the universe is a theoretical ultimate fate of the universe in which it reaches a state of maximum entropy, resulting in a uniform distribution of energy and

properties lead it to organize itself into greater holarchic coherence. While the Stoics attribute this process to an immanent divine reason, Okamoto frames it as an emergent macroscopic law that arises from the fine-tuned constants of the universe, where life is a natural, though not exclusive, outcome of this complexity-generating process (Okamoto, 2023, pp. 3, 4; Durand et al., 2023).

The conceptual equation for a Stoic/Okamoto relationship can be read as:

$$OC \wedge L(\hat{O}\hat{\Pi}(S_{TK} + S_{\Sigma})) > OC \wedge L(\hat{O}\hat{\Pi}(S_{TK}))$$

Note on Formalization: This equation formalizes the law of increasing cosmic organization. Organized Complexity (OC) is a measurable quantity of structure which, through the Logos (L), expresses the meaningful order of the universe. Following the macro-law established by Okamoto (2022), this complexity is not a random byproduct but a fundamental "arrow of time" in the cosmos. The Pneuma Operator ($\hat{O}\hat{\Pi}$) represents the force driving this complexity (Sellars, 2006; Long, 2002), where ($\hat{O}$) serves as the computational process enabling a system to increase its organization (Okamoto, 2022). It also compares the Structural State of the existing Kosmos (S_{T_K}) before and after the integration of the *Stoicheion*[82] (S_{Σ}). The "greater-than" ($>$) sign indicates that the complexity of the new state $(S_{T_K} + S_{\Sigma})$ exceeds that of the old state (S_{T_K}). This could confirm that the universe's nature is in constant movement towards higher levels of rational complexity, uniting Okamoto's quantitative law with the Stoic concept of an orderly cosmos.

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the cessation of all thermodynamic processes. Better names for this scenario are also known as the "Big Freeze" or "Big Chill".

[82] In Stoicism, Stoicheion refers to the fundamental, basic constituents or first principles of the universe, primarily the four physical elements (earth, water, air, fire) from which all matter is composed, but also metaphorically to the basic building blocks of anything, like letters of the alphabet or fundamental truths/virtues.

When considering the Stoics' active principles, which are referred to as "bodies" that can act and be acted upon, we can attain a better understanding of how the chemistry of our universe is such that "bodies", in the sense of particles coming together to assemble themselves in particular ways, create the molecular compounds of the universe in an abundant variety of ways, to increase the informational manifestation in our universe (Whiting & Konstantakos, 2021). As previously mentioned, within a containerized system, temperature is inversely related to intropy. This relationship reflects the system's ongoing cycle, in which intropy increases and temperature decreases over time. The infodynamic laws state that, first, the total and quantized energy-matter of our universe is conserved over time, which allows it to exist. The second law enables our universe to evolve by increasing its informational content (intropy) as space expands over time. The third law of infodynamics illustrates how the expansion of space and the reduction of temperature correlate with the increase in universal intropy over time (Currivan, 2017, 2022). As pneuma applies tensional movement in an ever-cooler, expanding universe heading towards the completion of its life cycle, divine reason increases by intropy with every tension and degree of density, essentially in-forming the emergence of energy-matter and spacetime. Thus, cosmic consciousness, intelligence, awareness, and sentience are fundamental and universally present throughout their holarchically organized expressions (Currivan, 2023, p. 35).

One can now begin to understand how Stoicism develops informationally over time, starting with physics and the creation of complex objects through intropy. The "acting of bodies" serves as a purposeful description to illustrate how elements bond chemically to form molecules. As the complexity of these structures increases, this

process extends to organic matter and even to our ability to communicate this information through our ethics. This inherent informational intelligence and flexibility have remained consistent throughout Earth's 4.5 billion years, maintaining a similar structure across the diverse and complex evolutionary landscape of organisms on our planet. This may also apply to countless other life forms throughout our galaxy and even across the entire universe (Currivan, 2023, p. 36).

3.4 Non-Local Universality and the Cosmic Hologram

Information refers to facts that are provided or learned about something or someone, as well as what is conveyed or represented through a specific arrangement or sequence of things (Oxford University Press, n.d.). The manner in which information is expressed can take various forms. While we typically think of information being transmitted from one location to another within spacetime, due to the unitive nature of our whole universe, information is also nonlocal and instantaneous.

Nonlocality, famously criticized by Einstein as “spooky action at a distance,” is a fundamental aspect of quantum theory that he never fully accepted (Brubaker, 2021). In contrast to the theory of relativity, which asserts that nothing can travel faster than the speed of light within spacetime, nonlocal connectivity is evident in the phenomenon of twin-particle *entanglement*, in which pairs of particles share quantum states and behave as a unified entity (Bell, 1964). If these entangled particles are separated, and the state of one is altered, the other particle will instantaneously adjust its state to match that of its twin, regardless of the distance between them, either in space or time (Currivan, 2017, p. 52).

This concept was demonstrated by the Northern Irish physicist John Stewart

Bell[83] in his renowned paper, *On the Einstein-Podolsky-Rosen Paradox* (Bell, 1964), also known as the EPR paper. He concluded that quantum mechanics predicts stronger statistical correlations in measurement results taken over great distances than any local theory can explain. This finding demonstrates that within the framework of spacetime, there exists a universal speed limit, a principle of causality, and a flow of time. Furthermore, it supports the idea that our entire universe exists and evolves as a nonlocally unified entity (Brubaker, 2021).

The Stoic physics of pneuma describes a universe that, by its very nature, would be fundamentally non-separable. For instance, the Stoics dismissed the notion of a void existing within the universe. They perceived the cosmos as a continuous material entity, an integrated, living, and rational whole. This idea of a unified existence directly contradicts the concept of individual, separate particles that interact solely through direct contact. Since there is no void, the impact of pneuma can be both immediate and all-encompassing (de Harven, 2015). Pneuma, by its inherent qualities, was thought to serve as the conduit of divine reason, ensuring that every aspect of the cosmos was interlinked and in harmony (Mattey, 1995). This implies a universe in which effects can propagate instantly through the singular, unbroken fabric of reality, reminiscent of the immediate correlation observed in quantum entanglement. Continuing to explore this topic further, the unveiling of how the composition of the Stoic tripartite system fundamentally arises from nonlocality is based on an informational framework that projects the appearance of the physical world within a holographic boundary (Currivan, 2017, p.54).

[83] John Stewart Bell was a physicist from Northern Ireland and the originator of Bell's theorem, an important theorem in quantum physics regarding hidden-variable theories.

The Holographic Principle (' t Hooft, 2000), proposed by Gerard 't Hooft, is a theory of Planck-scale physics developed by studying quantum-mechanical features of black holes. As Leonard Susskind explains, ‘t Hooft’s proposal seeks to combine quantum mechanics with gravity (from general relativity) by means of showing a three-dimensional world to be an image of data that can be stored on a two-dimensional projection, much like a holographic image (Susskind, 1994).

The principle consists of two main points. First, it presents a gravitational theory that describes a region of space solely in terms of the surface area it encloses. Second, it states that the boundary of a region of space contains no more than one bit of information per square Planck length. This concept originated from studies in black hole thermodynamics. Jacob Bekenstein[84] and Stephen Hawking[85] demonstrated that a black hole's entropy, which can be viewed as a measure of its information content, is proportional to the surface area of its event horizon rather than its volume.

According to the *Bekenstein bound*, a fundamental principle in physics, there is an upper limit to the amount of information or thermodynamic entropy that can be contained within a finite region of space with a finite amount of energy. This principle implies that the maximum amount of information necessary to completely describe a given physical system, down to the quantum level, is constrained by its physical properties. It connects the abstract concept of information to the physical properties of mass, energy, and the system's size (Menin, 2023).

Hawking was initially convinced that black holes have no entropy, based on the

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[84] Jacob David Bekenstein was a Mexican-born American-Israeli theoretical physicist who made fundamental contributions to the foundation of black hole thermodynamics and to other aspects of the connections between information and gravitation.

[85] Stephen William Hawking was an English theoretical physicist, cosmologist, and author who was director of research at the Centre for Theoretical Cosmology at the University of Cambridge.

classical physics assumption that any object falling into a black hole would be completely destroyed, losing all information. However, Bekenstein challenged this notion by noting that, in quantum physics, information cannot be destroyed, as doing so would violate the second law of thermodynamics. To uphold the second law, Bekenstein proposed that black holes must possess their own entropy, which increases as they absorb matter. He suggested that a black hole's entropy is proportional to the surface area of its event horizon[86], rather than its volume. Consequently, Bekenstein's "bound" indicates that there is a limit to the amount of entropy that can be contained within any given region of space. If this limit is exceeded, a black hole forms, and the information becomes hidden behind its event horizon (Bekenstein, 1973; Hawking, 1974).

The holographic concept that illustrates this principle serves as a visual aid, helping to understand that a three-dimensional volume can be entirely encoded on a two-dimensional boundary. One instinctively believes that the information within an object should be proportional to its volume. However, as demonstrated by holograms, a three-dimensional image can be generated from a two-dimensional film. This analogy effectively conveys Bekenstein’s proposal that the maximum amount of information contained in any region of space is proportional to its surface area. This suggests that reality may have a more fundamental, lower-dimensional description (Robertson, 2023; Bekenstein, 1981).

A conceptual equation that illustrates the Stoic view of a fundamentally non-separable, continuous cosmos unified by pneuma, drawing a parallel to the

[86] An event horizon is a boundary marking the limits of a black hole. At the event horizon, the escape velocity is equal to the speed of light. Since general relativity states that nothing can travel faster than the speed of light, nothing inside the event horizon can ever cross the boundary and escape beyond it, including light.

nonlocality observed in quantum entanglement and the idea of a holographic universe, could look like this:

$$\mathbf{U}_{\mathcal{H}} \propto \Pi = (\neg\mathcal{K} \wedge \mathcal{C}) \Rightarrow \mathcal{E}_{\mathbf{I}} \leftrightarrow \mathcal{N}$$

Note on Formalization: This equation formalizes the structural and informational unity of the Stoic universe. It defines Universal Harmony ($\mathbf{U}_{\mathcal{H}}$) as the state of the cosmos as a single, integrated, and rational living whole (Sellars, 2006). This harmony is Proportional ($\propto$) to pneuma (Π), the continuous material entity that interlinks every aspect of the cosmos. The nature of pneuma is defined by the Negation of the Void ($\neg\mathcal{K}$) and the continuous, unbroken fabric of reality ($\mathcal{C}$). This leads to ($\Rightarrow$) Emergent Intelligence ($\mathcal{E}_{\mathbf{I}}$), characterized here as a state of non-local informational coherence, allowing for the immediate correlation of states across the fabric of reality, a process noted as being Analogous ($\leftrightarrow$) to the Nous ($\mathcal{N}$) through a mechanism similar to quantum entanglement, where effects occur instantly regardless of physical distance (Bell, 1964).

CHAPTER IV

The Expanding Universe: Entropy, Order, and the Emergence of Complexity

> *The farther we peer into space, the more we realize that the nature of the universe cannot be understood fully by inspecting spiral galaxies or watching distant supernovae. It lies deeper. It involves our very selves.*
>
> — Robert Lanza[87], *Biocentrism: How Life and Consciousness are the Keys to Understanding the True Nature of the Universe*

4.1 The Stoic Holographic Universe: In-formation at the Center of the Universe

The core inspiration behind this dissertation is to create a comprehensive synthesis of Stoic cosmology that showcases the depth and relevance of Stoic philosophy in today's world. This philosophy is often narrowly viewed as merely a means to heal the human psyche, but the goal is to reveal its broader significance. These explorations are based on Jude Currivan's vision, which draws from physics to demonstrate that the universe undergoes a process of increasing meaningful information, which is innate from the beginning but its emergence to greater in-formational content increases through time. This process drives the universe's evolution toward greater coherence and complexity. This vision aligns with the Stoic aim to illustrate the interconnectedness of the divine with everything one is composed of, as well as the potential one has to become (Currivan, 2017; Long & Sedley, 1987).

[87] Robert Lanza is an American medical doctor and scientist, currently Head of Astellas Global Regenerative Medicine, and Chief Scientific Officer of the Astellas Institute for Regenerative Medicine.

Potential is an important concept in understanding the fundamental realities of the universe. In the quantum world, the location and momentum of a particle are not fixed aspects of reality, unlike in Newtonian physics. Instead, physicists rely on the wave function as a mathematical representation. When squared, this wave function gives the probability density of finding a particle at a given position. This phenomenon illustrates the wave-particle duality of matter, which shows that small-scale particles can exhibit both wave-like and particle-like behaviors (Fiveable, 2024).

The wave function equation, proposed by German physicist Erwin Schrödinger[88], introduces a probabilistic element to physics. It can predict the distribution of outcomes across multiple measurements, but cannot provide a definitive result for individual measurements. This inherent probability is a fundamental, non-deterministic feature of quantum mechanics, in contrast to classical physics, where a particle's position is well-defined (Zwiebach, 2013).

These non-deterministic features, however, should not be confused with being random features. Currivan explains that, while phenomena at the quantum level (as well as at all scales in our universe) may indeed be probabilistic, they are not random or purely a matter of chance, as commonly believed. They operate on probabilities within a set of possibilities that depend on the information they carry. In the universe, nothing is ultimately random; everything that appears in the physical realm arises from deeper, more causal levels of nonphysical and informed reality (Currivan, 2017, p. 8). Information, therefore, is what carries the potential for anything to be manifested in a certain way,

[88] Erwin Rudolf Josef Alexander Schrödinger was an Austrian–Irish theoretical physicist who developed fundamental results in quantum theory. In particular, he is recognized for devising the Schrödinger equation, an equation that provides a way to calculate the wave function of a system and how it changes dynamically in time. He coined the term "quantum entanglement" in 1935.

making it in-formed.

Information in the physical realm originates from a spectrum of measurements influenced by universal forces, which do correspond directly to the potential boundaries of physical reality itself (Currivan, 2017, p. 18; Wheeler, 1989). The fundamental laws of our universe are based on unchanging constants. Three key constants that govern energy-matter, space, and time are the speed of light, the gravitational constant, and the Planck constant (Lloyd, 2006). These constants make sure that the universe operates within a stable, 'in-formed' mechanism, preventing the dissipation of the Logos into pure randomness (Davies, 2010).

When German physicist Max Planck[89] proposed a unified scale of measurement by integrating these three constants to better understand the workings of our universe, he initially introduced it as a mathematical approach to address the problem of black-body radiation[90] (Kuhn, 1987). Planck proposed that the energy emitted by oscillating atoms cannot take continuous values; rather, it must be released or absorbed in discrete, quantized packets, known as *quanta* (Planck, 2011). This led to the discovery that the energy of each quantum is directly proportional to the frequency of the radiation. To formalize this relationship, he introduced a new constant, represented by (h), leading to his famous equation ($E = hf$) (Jammer, 1989; APS - Advancing Physics, n.d.; Kumar, n.d.).

The assembly of constants has been transformed into scales that reflect the fundamental parameters of reality (Planck, 2011). These scales establish the natural limits

[89] Max Karl Ernst Ludwig Planck was a German theoretical physicist whose discovery of energy quanta won him the Nobel Prize in Physics in 1918.
[90] Black-body radiation is the electromagnetic radiation emitted by an idealized object (a "black body") that absorbs all incident radiation and, when in thermal equilibrium, emits radiation based solely on its temperature. This radiation has a continuous spectrum that is not dependent on the material's composition or shape.

of the universe at the quantum level. The Planck length, a measure of space, is extraordinarily small at 10^{-35} meters, while the Planck time, indicating how long it takes light to cross a Planck length, approaches an almost unimaginable 10^{-44} seconds. The Planck scale of energy-matter marks the point at which quantum and gravitational forces are equal (Baez, 2001). This is particularly relevant in extreme conditions, such as at the universe's inception and within black holes. Here, the Planck mass, which is 10^{-8} kilograms, represents the maximum mass for a point-like elementary particle and corresponds to a black hole with a diameter of one Planck length (Currivan, 2017, p. 18).

As previously covered, the term Planck epoch, which describes the extremely hot and dense period at the beginning of the universe when its entropy was at its lowest, had a Planck temperature of 10^{32} Kelvin (Currivan, 2022, p. 220). Also briefly explained was the holographic principle, which states that the boundary of a region of space contains no more than one bit of information per square Planck length ('t Hooft, 2000; Susskind, 1994). With this understanding, one can now further examine this perspective and gain a better grasp of what constitutes the measurements that create our universe.

When taking the information at the quantum level, referring to it as *qubits*, which are the building blocks from which bits of information are derived, the cosmic hologram manifests the universe as digitized information, pixelated at the Planck scale, within a two-dimensional holographic boundary of spacetime (Currivan, 2017, p. 269). When introducing the concept of the holographic principle, ’t Hooft suggests that it's feasible to account for all phenomena within a given region of space through a set of *degrees of freedom* (imagine these degrees of freedom as the various ways an object can move, change, or absorb energy), existing on the surface that encloses that area ('t Hooft, 2000).

The total number of degrees of freedom must not exceed that of a two-dimensional lattice[91], where approximately one binary degree of freedom corresponds to each Planck area. In essence, reality can be compared to a two-dimensional lattice of spins[92] (Susskind, 1994, p. 2). When moved beyond quantization, this idea translates to having a lattice composed of binary pixels with spacing determined by the Planck length.

The interaction between the rising levels of informational entropy and a holographic perspective of spacetime (Bekenstein, 1973) requires the expansion of space itself and the unidirectional flow of time from the beginning of our universe. The unavoidable increase in entropy indicates that, for every subsequent Planck time of 10^{-44} seconds, our universe conveys increasingly more information as the past shapes the present, which, in turn, shapes the future (Bousso, 2002). Thus, at all times, causality unfolds within spacetime, from the inception to the conclusion of our universe's existence. (Currivan, 2017, p. 51).

From the Stoic perspective, causality unfolds through the expansion of pneuma across the universe, beginning from the conflagrational Planck epoch (Sambursky, 1987). Pneuma, in this holographic model, can be understood as composed of discrete, quantifiable units of reason, with the smallest unit linked to the Planck scale (Wheeler, 1989). These informational units of reason serve as the active principle, where their patterns, relationships, and evolution shape the passive reality, giving it structure and properties. In its mechanics of tensional motion, the outward expansion of the universe manifests physically as a pneumatic field that spreads and increases its entropy, or

[91] This refers to the grid-like arrangement, which could be a repeated pattern, a square, however, most likely triangular.
[92] The magnetic moments (strength and direction of a magnetic source) of atoms in the material. Each spin can only point in one of two directions: Up (+1) or down (-1).

informational content and emergent complexity (Verlinde, 2011). One can imagine this process metaphorically as a two-dimensional boundary, with each of the three aspects of Stoicism representing one dimension. These dimensions reflect the three-part system of Stoicism, from which the universe is projected:

1. Physics: The fundamental nature of the universe, which includes matter, cause and effect, and the physical substance of pneuma itself. This dimension gives reality a linear, sequential, and causal character, shaping the most fundamental interactions of existence.

2. Logic: The organizing principle, or Logos, which projects the universe's rational structure and cosmic grammar. This dimension brings order to the various components of pneuma.

3. Ethics: Serving as the final dimension, providing purpose to the entire system through the divine plan or teleology. It encompasses value, morality, and the human capacity to align with the rational flow of the cosmos (Robertson, 2012).

To create the following conceptual equation, Jude Currivan's concept of the cosmic hologram can be combined with Stoic pneuma and reinterpreted as a field of Planck-scale informational bits. The expansion of the universe serves as a dynamic expression of pneuma spreading, projecting a three-dimensional reality structured by Stoic tripartite philosophy.

$$\frac{d\Omega_{\Pi}}{d\tau} \propto \frac{\Sigma_{\Pi}}{\lambda_P^2} \rightarrow \Psi(\Phi, \Lambda, H) \equiv \Psi(\mathbb{P}_I)_{HL}$$
$$\Rightarrow [(\hat{O}_{\Pi} \cdot K) + (\Lambda \cdot \Pi_{\theta} + (H \cdot A_{\Phi})) \implies \Sigma_{3+1}]$$

Note on Formalization: This equation describes the holographic projection of reality from a foundational informational field. The term $d\Omega_{\Pi}/d\tau$ indicates the rate of change of pneuma over the continuous flow of time within the total volume of the cosmos. The proportionality $\propto$ relates the rate of expansion to the informational content of the universe Σ_{Π}/λ_P^2. Here, Σ represents the two-dimensional holographic boundary composed of pneuma as an informational field, measured against the Planck scale area (λ_P^2) as the minimal unit for a single bit of information (Bekenstein, 2003).

The transformation ($\rightarrow$) signifies the projection of this informational boundary into our observable four-dimensional spacetime reality (Susskind, 1994), represented by the wave-function $\Psi(\Phi, \Lambda, H)$. The variables (Φ, Λ, H) correspond to the Stoic tripartite system: Physics, Logic, and Ethics. This state is equivalent ($\equiv$) to $\Psi(\mathbb{P}_I)_{HL}$, the wave-function of pure, undifferentiated primal information ($\mathbb{P}_I$) evolving under the system's Hamiltonian and Lagrangian (HL), which represent the total energy and the tension (Sambursky, 1987) between dynamic and potential energy.

The evolution process ($\Rightarrow$) leads to the final projection of the hologram: $[(\hat{O}_{\Pi} \cdot K) + (\Lambda \cdot \Pi_{\theta} + (H \cdot A_{\Phi})) \implies \Sigma_{3+1}]$. This bracketed term illustrates the combined action of the physical, logical, and ethical components. The final result ($\implies \Sigma_{3+1}$) indicates the manifestation of the four-dimensional spacetime manifold (Geroch, 2013), where the Stoic triad results in three spatial dimensions linked to a single temporal dimension, fulfilling the requirement for a dynamic, living cosmos.

This combined equation depicts a universe that behaves as a living, thinking entity, evolving from a state of pure informational potential. This evolution is driven by inherent informational energy and guided by its own internal logic. The physical laws and observed phenomena are not random; rather, they are expressions of an intelligent,

determined, and informed cosmos. The emergence of the four-dimensional world (three spatial dimensions plus time) represents a visible projection of this deeper, purposeful, and logical process—reality as a cosmic hologram shaped by the entire Stoic philosophical system (Currivan, 2017; Long & Sedley, 1987).

As part of this hologram, there also lie biological organisms. At this level, one needs to understand how information evolves because entropy manifests as informational content, or intropy, which increases as entities grow, develop, and evolve, increasing the information content as one grows and develops. Back in 2024, Physicist and philosopher Sean Carroll interviewed German-American professor of microbiology and molecular genetics Christoph "Chris" Adami for his *Mindscape* Podcast to discuss information theory in biological systems. In defining information as "that which allows someone who has information to make predictions with accuracy better than chance" (Carroll, 2024, 05:52.06), he also says that there is a lot of misunderstanding regarding information because it is widely confounded with entropy, which, in a sense, is the opposite of it. Jude Currivan mitigated this confusion by creating the term intropy to describe the increase of information content expressed throughout relational and dynamic processes, and also corrected the notion that entropy flows from order to disorder. Clarifying that it increases the energetic microstates of a system, which, when then 'expanded' to intropy as informational content and universally meaningful in-formational content as in-tropy guides the evolutionary arc of our universe (Currivan, 2022, p. 267). Adami further explains that when entropy is coherent, information is optimized, and this disparity is critically significant. Specifically, entropy itself lacks intrinsic meaning; similarly, in physics, Adami considers that only variations in entropy are meaningful. Just as in

physics, only distinctions between energy levels yield any practical impact (Carroll, 2024, 09:37.2).

Information theory relies on an understanding of probabilities and statistics, with the concept of prediction being central to it. When one asks whether they can predict outcomes with greater accuracy than chance, one is essentially inquiring about predictive probability. To do this effectively, one needs prior assumptions about what to expect (Cover & Thomas, 2006).

Adami emphasizes a crucial point: information is always contextual. When the context changes, the information changes as well; without context, information can become meaningless. In biology, information and fitness are interconnected. Having a wealth of information about how to survive and thrive in a particular environment correlates with high fitness. Therefore, the process of increasing one's fitness involves enhancing their understanding of how to navigate and adapt to that environment (Carroll, 2024, 21:50.0).

Information and evolution are therefore closely linked. In biology, understanding requires considering information, which is fundamentally what undergoes evolution, and information is crucial for the existence of an organism. The organism itself is not fundamentally critical; it can be substituted. When we produce offspring, they primarily inherit the encoded information (Carroll, 2024, 31:50.1).

Contextualizing this in Stoic terms by applying the information in a different way, the Stoics viewed humans as integral parts of the cosmos. The pursuit of virtue can be seen as the conscious application of a survival strategy. By aligning judgments with nature, one can make the most accurate predictions about the world, ultimately ensuring

well-being and flourishing (Whiting & Konstantakos, 2021). This perspective also explains the Stoics' acceptance of fate. By maintaining a critically balanced and coherent state, a Stoic can effectively contextualize any information that life presents. The quality of the information that fate brings is relatively unimportant compared to how the Stoic responds to it. The Stoic rational mind transforms experiences into something entirely new, drawing on prior knowledge and rigorous training in its methods (Stephens, 2007).

To relate information theory, fitness, and evolution to the Stoic pursuit of virtue and flourishing within the cosmic context, this equation is proposed:

$$\mathbf{E}_S \propto \mathbf{I}_i = \mathcal{V}(\mathcal{C}_\Lambda) \Rightarrow \mathcal{A}_a = \rho \times \delta$$

Note on Formalization: This equation formalizes the relationship between ethical flourishing and informational processing. $\mathbf{E}_S$ represents the Stoic concept of Eudaimonia, which is established as proportional ($\propto$) to $\mathbf{I}_i$ (Informational Fitness). In this context, fitness is defined as the capacity to thrive within an environment by leveraging contextual information (Adami, 2002). This is mathematically equivalent to $\mathcal{V}(\mathcal{C}_\Lambda)$, the Value of information (Floridi, 2011) when processed through the lens of universal reason ($\mathcal{C}_\Lambda$).

The implication ($\Rightarrow$) denotes the transition to $\mathcal{A}_a$ (Actualized Actions), where the Stoic's internal state results in behaviors that align judgments with the natural order (Inwood, 1985). This actualization is a function of the product $\rho \times \delta$, where ρ represents the Reasoned Response (derived from prior knowledge and rigorous training) and δ represents the resulting Good Judgment. Thus, Eudaimonia is modeled as a dynamic output of high-informational alignment with nature (Long, 2001; Sellars, 2006).

4.2 The Emergence of Gravity

Entropy can stir up creativity through its adaptability and pervasive presence

across all of spacetime. So, it would just be a matter of time before scientists would entertain the idea that entropy might have something to do with another ever-present phenomenon that has mystified scientists since the 17th century: gravity (Verlinde, 2010).

Daniel Carney[93] from the Lawrence Berkeley National Laboratory has proposed that gravity might be an emergent phenomenon arising from entropic forces. This idea builds on the work of Ted Jacobson[94] and Erik Verlinde[95], suggesting that gravity may not be a fundamental property of the universe. Carney and his team have developed a quantum-mechanical framework in which the gravitational field is treated as a large-scale thermodynamic phenomenon, akin to pressure or temperature in a gas. This framework clarifies the fundamental quantum components of the gravitational field and shows how gravity can emerge from their collective dynamics (Carney et al., 2025).

In short, Carney suggests that there might be an unseen gas or thermal system that interacts randomly with masses (Musser & Howlett, 2025). Their model posits that space is filled with a crystalline grid of quantum particles, or qubits, each oriented like a compass needle. These qubits align themselves with nearby massive objects and exert a force on them. When a mass is placed in the lattice, the surrounding qubits become polarized, aligning in the same direction.

Each qubit can store energy, which varies with the distance between masses. When the masses are far apart, a qubit's energy capacity is higher, allowing the total energy of the system to be concentrated in just a few qubits. However, when the masses are closer together, each qubit's energy capacity decreases, necessitating that the total

[93] Daniel Carney is a theoretical physicist at Berkeley National Lab. His work is centered around the quantum theory of measurement and how it applies to particle physics and gravity.
[94] Theodore A. "Ted" Jacobson is an American theoretical physicist. He is known for his work on the connection between gravity and thermodynamics.
[95] Erik Peter Verlinde is a Dutch theoretical physicist and string theorist. Currently, he works at the Institute for Theoretical Physics at the University of Amsterdam.

energy be distributed across more qubits. This scenario reflects a state of higher entropy, indicating that the system naturally tends to push the masses closer together (Musser & Howlett, 2025).

Jude Currivan employs a similar framework in infodynamics, suggesting that the evolution of the three fundamental laws of thermodynamics into three principles of infodynamics provides a pathway to reconcile quantum theory, which explains energy-matter, with relativity theory, which addresses space and time. This approach contributes to our understanding of how the universe's lifecycle progresses from its inception to its conclusion. Currivan considers gravity as an emergent phenomenon resulting from the informational and holographic properties of spacetime, describing it as related to the entropic distribution of massive entities within that framework (Currivan, 2023, p. 1).

To reconcile these ideas within Stoicism, one needs to examine the concept of pneuma and its tensional motion. As the universe expands, the informational elements of pneuma spread out, resulting in a greater number of possible arrangements (microstates) for the overall state of the cosmos (the macrostate). This increase in potential configurations aligns with the definition of increasing entropy in modern physics. Pneuma then "exhales," and this expansion represents the arrow of time, guiding the universe toward greater entropy and higher informational value (Currivan, 2017; Sambursky, 1987).

Conversely, the inward, cohesive motion of pneuma, which holds things together, can be viewed as facilitating coherence and emergent complexity. Through this process, pneuma organizes information into more complex and ordered structures, such as

galaxies, stars, planets, and even living beings. As such, the universe's irreversible expansion, driven by increasing informational entropy, provides the energy, while gravity enables material structures to support further evolutionary potential (Currivan, 2017, p. 38).

Pneuma's informational qubits on the holographic boundary can therefore be seen as microscopic fluctuations arising from the system's natural tendency to maximize entropy. As matter is introduced, it creates a disturbance in this informational field, and the field "pushes back" on the matter, creating the force we perceive as gravity.

The conceptual equation capturing these ideas can be written as:

$$\frac{dS_{tot}}{d\tau} \equiv \left(\frac{d\Sigma_{\Pi}}{d\tau} - \hat{g} \int_V \frac{ds_L}{d\tau} dV \right) > 0$$

Note on Formalization: This equation defines the total informational entropy of the universe as a dynamic balance of opposing forces. The term $dS_{tot}/d\tau > 0$ establishes that the total informational entropy, stored on the holographic boundary of the pneuma (S_{tot}), is always increasing with respect to cosmic time ($d\tau$). This rate represents the overall entropic expansion of the cosmos (Jacobson, 1995).

The equivalence ($\equiv$) tells us that this net increase results from two fundamental pneumatic tensions (Sambursky, 1987). The first, $d\Sigma_{\Pi}/d\tau$, is the rate of increase of the holographic boundary area, representing the expansive, entropy-increasing motion of the pneuma. The second term, $-\hat{g} \int_V \frac{ds_L}{d\tau} dV$, represents the local cohesive action of the pneuma.

Here, the gravity operator ($-\hat{g}$) signifies the inward tension of the pneuma that locally organizes matter into complex structures (Verlinde, 2011),

> thereby reducing local entropy. This is quantified by integrating the local entropy rate ($ds_L/d\tau$) over the volume (V) of the observable 4D universe. Thus, the "arrow of time" is maintained because the expansive growth of the boundary information always outweighs the local cohesive ordering of gravity, ensuring the universe remains a living, evolving organism (Chaisson, 2002; Sambursky, 1987).

Taking a step back to examine the broader concept of pneuma as a gravitational force (Notes from the Digital Underground, 2015), one can understand metaphorically how the tripartite framework of Stoicism connects the three philosophical domains of Physics, Logic, and Ethics into a cohesive, universal system. This structure serves as the physical and rational glue that holds these domains together, ensuring a coherent and purposeful cosmos in which human flourishing is possible (Sellars, 2009).

In Stoic physics, the concept of pneuma reflects the order of fundamental elements into structured physical bodies, ranging from stars to atoms. In logic, it serves as a physical manifestation of the universe's rational order, providing a reliable context for logical reasoning and highlighting the reality of consequences. This predictability mirrors the unavoidable logical outcomes of a proposition, forming the basis for our accurate reasoning about the world (Sedley, 1998).

In ethics, this gravitational force reminds us that human beings are subject to the same cohesive principles that govern the universe. Aligning one’s individual will with this universal order forms the foundation of Stoic virtue. This alignment also ensures accountability for one’s actions, which possess substance and significance. The ethical choices have a tangible impact as one’s virtuous or vicious actions shape their character and contribute to the overall moral fabric of the universe (Stephens, n.d.; Algra, 1999).

This dissertation will now explore how infodynamics and entropy function within the human body, focusing specifically on their impact on the brain, actions, and behaviors. Biologically and evolutionarily, humans are designed to utilize entropy and information to their advantage. The Stoics suggested that one possesses an innate divine reason that enables one to use the laws of physics to evolve into one's higher self. By understanding these physical laws and practicing attentiveness (prosochē) to how they manifest within, one can guide humanity toward realizing its full potential and feel the divine cosmos inside (Currivan, 2017; Sellars, 2009).

4.3 The Free Energy Principle, Entropy, and Prosochē

When British neuroscientist Karl Friston first proposed the free-energy principle (FEP), he aimed to explain the structure and function of the brain by showing that biological systems, ranging from single-cell organisms to social networks, resist a tendency toward disorder (Friston, 2009, p. 293). This principle is closely related to the concept of entropy.

In this context, "free energy" refers to the amount of information that the brain can utilize. The brain minimizes this vast amount of information by reducing the "surprise factor" it encounters from the environment. Ultimately, the brain has evolved to avoid surprises—the discrepancies between its predictions about the world and the actual sensory information it receives. This ability is crucial for survival. The driving force behind this behavior appears to be the biological design of systems to resist disorder and minimize the entropy of their sensory states (Friston, 2009, p. 293).

Friston explains this using familiar concepts from entropy. For example, consider a fish. A well-defined “agent” like this fish should have a limited range of states,

specifically relating to scenarios where it is not in its natural environment, water. When the fish is in water, it exists in a low-entropy state, representing the most predictable and unsurprising condition for it. In this state, the fish reaches an *equilibrium density* (the stable, constant density of a system or substance when it is in a state of equilibrium) when it is surrounded by water. Thus, by minimizing its free energy, the fish can reduce unexpected interactions with its environment, as free energy is always greater than surprise (Friston, 2009, p. 294).

The FEP is essentially an extension of classical physics, positioning an organism's integration with the universal flow within the tradition of *variational principles*, the foundational concept describing the laws of nature as selecting the path that minimizes a *functional*[96] (Friston, 2010). Formally, the process by which an organism minimizes its variational free energy over time mirrors the Principle of Least Action[97] (Feynman et al., 2011), a cornerstone of Lagrangian mechanics[98] (Goldstein et al., 2002). Just as physical systems adopt the most efficient route by minimizing 'action,' the brain follows a trajectory that minimizes *Expected Free Energy*, a mathematical tool that describes how living systems choose their actions to minimize future surprise (Friston, 2019). Rather than a resistance to the Second Law of Thermodynamics, this is the mechanism by which the organism harmonizes with it. In this light, entropy is not a force of chaos, but one of collaboration that provides the necessary space for the emergence of life. While entropy ensures the efficient distribution of energy, intropy acts as the universal drive toward the

[96] A functional is a certain type of function. The exact definition of the term varies depending on the subfield and sometimes even the author.
[97] The Principle of Least Action (PLA) says that a particle takes *all* possible paths between two points, but the path it *actually* follows (its classical trajectory) is the one where the "action" (integral of kinetic minus potential energy over time) is stationary (usually a minimum).
[98] Lagrangian mechanics is a formulation of classical mechanics that is based on the principle of stationary action and in which energies are used to describe motion.

accumulation of meaningful, complex information (Currivan, 2017). Thus, the brain's behavior under the FEP is not a localized struggle against disorder, but a participation in a larger universal flow toward greater informational coherence.

This idea is grounded in the *Bayesian principle*, which is based on Bayes' Theorem[99]. This theorem provides a mathematical rule for reversing conditional probabilities, allowing us to determine the probability of a cause from its effect (Bayesian Statistics: A Beginner's Guide, 2022).

In simple terms, this means that an individual starts with an initial level of confidence in a hypothesis before any new evidence is introduced. This initial belief is based on all available information at that time. Next, the individual assesses the likelihood of observing new evidence, assuming the hypothesis is true, which reflects the strength of that evidence. Finally, the individual updates their belief in the hypothesis after considering the new evidence. The free-energy principle exemplifies this process by describing how the brain incorporates new sensory information to adjust its internal model of the world (Friston, 2010).

As discussed in Chapter I, the most fundamental Stoic spiritual attitude is prosochē, which involves maintaining continuous and vigilant attention to one's impressions. Impressions represent the initial stage of information processing, in which the brain responds to data from our sensory inputs. These impressions can be seen as lacking either context or substance.

A Stoic practitioner approaches new impressions in a manner similar to how a Bayesian brain operates. They suspend judgment and view each new impression as a

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[99] Thomas Bayes was an English statistician, philosopher and Presbyterian minister who is known for formulating a specific case of the theorem that bears his name: Bayes' theorem.

piece of data that needs to be evaluated against their existing understanding of reality or philosophical principles (Voncken, 2025). By comparing these impressions with prior experiences, the Stoic engages in rational reflection before deciding whether to accept the information. The hêgemonikon, which the Stoics believed to be the mind's central faculty, is responsible for rational thought, judgment, and impulse. This faculty is the focus of prosochē, where impressions are received and assessed before any agreement or assent is given. This process is conceptually similar to the Bayesian updating mechanism in the brain, where new information is evaluated against a pre-existing model before being integrated as a new belief or used to update the model (Friston, 2010).

When applying the FEP to prosochē, the former also minimizes surprises. The Stoics believe that emotional distress arises from making incorrect or false judgments about external events. By minimizing free energy through the control of our judgments, we can manage our emotional reactions. A Stoic's objective is to reduce the surprise associated with an event by interpreting it accurately, in accordance with reason and the broader cosmic order (Friston, 2010; Sellars, 2009).

There is no passivity involved in either the brain's effort to minimize free energy or the vigilance required to ensure that one's actions align with reason and virtue. The FEP indicates that the brain actively engages with the world to confirm its predictions, a process known as *active inference* (Friston, 2009, p. 295). Similarly, a practicing Stoic makes choices in the world based on well-formed judgments, paralleling the brain's process of active inference.

One should emphasize the differences between the two concepts. FEP describes an automatic biological imperative, while prosochē represents its conscious philosophical

application. Living systems, from single cells to complex organisms, must maintain a non-equilibrium steady state, or homeostasis, to optimize the universal flow of intropy for the homeostatic health and evolutionary potential. In this context, prosochē serves as the mind's homeostatic mechanism. By vigilantly monitoring and correcting its judgments, the Stoic actively prevents the mind from descending into cognitive and emotional decoherence. The "equilibrium density" here refers to a mind that is calm, rational, and in harmony with nature, even amid unpredictable external events (Friston, 2010; Sellars, 2009).

Considering Currivan's idea of the universe's crucially meaningful and informational nature, along with its expanding intropy, one can see how everything contributes to its overall flow of evolution (Currivan, 2023, p. 34). This idea can be applied through prosochē, where Stoic attention serves as a conscious strategy for navigating a universe fundamentally defined by increasing information and complexity. Humans, as some of the most complex living organisms, are endowed with a divine cosmic reason that gives us the evolved capacity to manage the growth of informational intropy. Instead of passively absorbing every piece of information from our environment, Stoicism teaches us to use our attention as a filter (Aurelius, 2002), allowing one to maintain a simple, coherent, and low-entropy internal state. From a human perspective, it can be suggested that prosochē is an effective way to harness informational intropy. This approach serves as an update to our operating system, enabling humanity to evolve in its collaboration with the cosmos.

To combine these related concepts into a cohesive conceptual equation, one needs to operate at a high level of abstraction. Considering the human mind as a local,

conscious agent and applying Stoic practices to regulate its internal intropic state in relation to the cosmic flow of information, this equation can be formulated:

$$\min F(\Psi_{ego}, \Sigma_{\Pi}) \equiv \Pi_{\Psi} \left[(\mathcal{P}_{ego} \cdot \mathcal{L}_{info}) - \hat{g} \int_V \frac{ds_L}{d\tau} dV \right]$$
$$\text{s.t. } \mathcal{P}_{ego} \propto (\mathcal{P}'_{ego} \cdot \mathcal{L}_{info})$$

Note on Formalization: This equation models the Stoic practitioner as a biological system striving for eudaimonia by minimizing Variational Free Energy F (Friston, 2010). This minimization ($\min F$) reduces the "surprise" factor that occurs when the agent's internal model of the world (Ψ_{ego}) clashes with the incoming cosmic information flow (Σ_{Π}).

The entire process is modulated by Π_{Ψ}, identified here as Prosochē (Hadot, 1995), the rational attention that ensures the Stoic remains grounded in reason. At its core is a Bayesian update: one's prior beliefs ($\mathcal{P}_{ego}$) are multiplied by the amount of data coming in ($\mathcal{L}_{info}$). This cognitive work is balanced against the local entropic order ($\hat{g} \int_V \frac{ds_L}{d\tau} dV$), placing the individual's mental order within the context of universal gravitational structure (Verlinde, 2011).

This is subject to (s.t.), the condition that one's internal state is constantly updating. The final worldview ($\mathcal{P}_{ego}$) is proportional to the product of their existing ethical development ($\mathcal{P}'_{ego}$) and the new evidence they receive (Adami, 2016). The Stoic path is then formalized as an iterative, mathematical refinement of the soul, where each moment of attention (Prosochē) brings the agent into closer alignment with the Logos.

Thanks to advances in neuroscience and neuroimaging, we can now map the brain's entropic pathways. While the FEP offers a mechanistic explanation of brain function, we can further quantify this process by examining the brain and its various states of consciousness. By measuring brain entropy, which reflects unpredictability, we

gain insights into the richness and flexibility of conscious experience.

Entropic states in the brain reveal how it processes information to make sense of the environment, particularly through specialized regions known as the Default Mode Network (DMN). This network regulates entropy by optimizing it towards its maximum potential, using the same predictive mechanisms outlined in the FEP. This remarkable adaptability is also involved in neuroplasticity, the brain's ability to form and reorganize synaptic connections. Neuroplasticity represents yet another way the brain uses information while maintaining balanced informational entropy levels (Carhart-Harris et al., 2014; Currivan, 2017).

4.4 The Entropic Brain, and the Hêgemonikon

Transitioning from Stoic physics to logic, it's important to remember that all three components of the Stoic tripartite reflect the cosmos. Consequently, psychology and moral ethics are intertwined with the laws of physics. The central message of Stoicism is to live in accordance with nature, reminding us that the most fundamental piece of knowledge is divine reason. This reason has been on an intropic journey since the birth of the cosmos, influencing the human psyche along the way. This journey has been lengthy, and it will continue to unfold throughout the universe until its eventual conclusion, paving the way for a new cycle to begin (Sambursky, 1959; Currivan, 2017).

In Stoicism, the term hēgemonikon refers to "the seat of reason" or "the internal rational ruler." It represents the primary and rational part of the soul (psyche) and is also a part of the universal rational principle (Logos) that governs the cosmos. This connection is why acting rationally and virtuously is considered a way of living in harmony with

nature. The hēgemonikon has four main functions that enable it to govern the Self rationally (Aurelius, 2002; Sellars, 2009):

- It receives sensory data or impressions from the external world.
- It controls the power of judgment (assent), which is the critical process of accepting or rejecting an impression. The Stoic path begins with training this faculty to withhold assent from false or misleading impressions, particularly those that are emotional.
- Once an impression has been assented to, it generates an impulse to act or refrain from acting.
- It possesses the capacity for logic and rational thought, allowing for the evaluation of the Self's governance (De Blasio, n.d.).

For the Stoic practitioner, training the hēgemonikon, the rational faculty of the mind, is a central task in life. This training focuses on strengthening the ability to make clear, rational judgments, free from harmful emotional thoughts. By perfecting this practice, an individual can transform external adversities into opportunities to practice virtue. Additionally, it helps one understand the dichotomy of control: while external events are beyond one’s control, thoughts, judgments, and reactions are within one’s power to manage (Stephens, n.d; Polat, 2025).

As it has been covered, the brain has an ability to predict future outcomes based on the information it already processes, aiming to minimize surprise. These evolutionary mechanisms play a crucial role in enhancing an organism's chances of survival. However, this doesn't explain the cognitive processes involved in making the right choices, or, in Stoic philosophy, in assenting to impressions. The faculty referred to as *prohairesis* lends

a deliberate and moral dimension to an individual's choices. Epictetus attributed this faculty to the essence of our humanity (Dobbin, 2008). While hēgemonikon is the broader concept encompassing the soul's general rational or ruling faculty, including perception, thought, and decision-making, prohairesis is a more specific and focused aspect. It pertains specifically to our voluntary moral choices and character (Sadler, 2021).

To illustrate this distinction, one can think of hēgemonikon as the entire rational engine, while prohairesis represents the intentional moral function of that engine. The training that involves managing impressions with nature constitutes the practical method by which a Stoic learns to properly utilize their prohairesis within the overarching framework of their hēgemonikon (Gambardella, 2022; Stary, 2023).

Recent advances in neuroscience have used Functional Magnetic Resonance Imaging (fMRI) to track brain activity. In 2014, psychopharmacologist Robin Carhart-Harris and his team at the Center for Neuropsychopharmacology at Imperial College London published a paper titled *The Entropic Brain: A Theory of Conscious States Informed by Neuroimaging Research with Psychedelic Drugs* (Carhart-Harris et al., 2014). They proposed that the quality of any conscious state is directly related to the level of entropy, meaning disorder and unpredictability, in brain activity. This theory emerged from neuroimaging studies on psychedelic drugs, particularly psilocybin[100], which demonstrated that psychedelics significantly increase the brain's entropy (Belko, n.d.).

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[100] Psilocybin is a chemical in certain types of mushrooms that grow on nearly every continent. The mushrooms have a long history of use in traditional ceremonies. Some people use them recreationally or to try to improve their mental health, although researchers still have much to learn about psilocybin’s potential uses as a medicine.

In the context of The Entropic Brain Theory, entropy is explored in relation to states of consciousness and their associated neurodynamics, with a particular emphasis on the psychedelic state. This psychedelic state serves as an example of a primitive or primary state of consciousness that predates the evolution of modern adult human waking consciousness (Carhart-Harris et al., 2014, p. 1). The experiment reveals two major states of consciousness that correspond to different levels of brain entropy. The first is low-entropy consciousness, also known as secondary consciousness, which represents the normal waking state of healthy adults. It is characterized by a high degree of order and structure in brain activity. The second state is primary consciousness, which is characterized by high entropy. This state is more primitive and chaotic, exemplified by experiences such as the psychedelic state, REM sleep, and early psychosis.

The ego develops from a low-entropy, ordered state, which creates a coherent and stable sense of self. This sense of self enables metacognitive functions such as self-reflection and reality testing. However, too much low entropy can lead to rigid beliefs that restrict cognitive flexibility. While lower entropy can be beneficial for survival, it can also contribute to mental health issues such as depression, addiction, and obsessive-compulsive disorder—conditions driven by a rigid and overpowering ego (Belko, n.d.; Carhart-Harris et al., 2014).

In contrast, a high-entropy state induced by psychedelics disrupts normal brain activity, resulting in experiences of ego disintegration and a sense of oneness with the universe. This state promotes more fluid and flexible thought patterns, fosters new connections, and heightens sensitivity (Belko, n.d.). However, it may not be ideal for the survival of a species undergoing evolution.

This theory positions states of consciousness on a spectrum of *criticality*, a physical concept that describes a system balanced between order and disorder. In the waking state, evolution has adapted the brain to function just below this critical or optimal state, allowing for sufficient flexibility while maintaining necessary order. This suggests that the brains of contemporary adult humans are distinct from those of their nearest evolutionary and developmental predecessors due to an enhanced ability to suppress entropy, indicating that the system moves away from true criticality toward a condition of mild sub-criticality (Carhart-Harris et al., 2014, p. 2). By increasing entropy through psychedelics, the brain is pushed toward a supercritical state, resulting in a greater diversity and richness of possible brain states.

The brain's DMN is a well-connected area that utilizes more energy and receives a greater blood supply than any other part of the brain. One can visualize the DMN as an airport hub, where a control tower coordinates the arrival and departure of flights, overseeing the integration and routing of information (Carta, 2025). The DMN does not significantly engage in sensory processing; rather, it is required for metacognitive functions and activities, such as self-reflection, understanding others' perspectives (theory of mind), and mental time travel (Carhart-Harris et al., 2014, p. 6; Carta, 2025, pp. 6-7). This suggests that the DMN is crucial for maintaining our sense of identity and ego.

Carhart-Harris suggests that the DMN consumes high energy because of its role in self-referential processing. Given how often we reflect on our actions and experiences, it makes sense that these brain areas are our primary energy consumers. As a result, the DMN's significant energy demand to maintain our sense of self indicates that it operates in a low-entropy state, characterized by low disorder but not so rigid as to become too

rigid.

As mentioned, the idea is that hyperactivity within the DMN, which is associated with overly low entropy, can lead to focused introspection and a particularly intense style of reality testing (Carhart-Harris et al., 2014, p. 9). This heightened activity can contribute to conditions such as depression and obsessive-compulsive disorder, which are closely tied to a fixed perception of the ego. Psychedelics have the potential to disrupt these entrenched patterns of thought and behavior by breaking down the underlying activity patterns, thereby increasing entropy in the brain. This mechanism is thought to contribute to their therapeutic effects (Carhart-Harris et al., 2014, p. 12).

It would be a mistake to link Stoic rationality with an overly sub-critical degree of low entropy in their thinking. Ultimately, rationality serves as the foundation for living virtuously, enabling us to make ethical decisions and understand our responsibilities toward others (Stephens, n.d.). However, this strong emphasis on rationality does not imply a lack of flexibility or an inflexible mindset. Instead, a Stoic's attunement to the reasoning of the divine cosmos reminds them that they are part of something larger than themselves. Acting rationally does not equate to a closed introspection that isolates the Stoic from the world. In fact, it is quite the opposite; the Stoics practice philosophy in everyday life, engaging with the world and recognizing themselves as merely a small part of the cosmos (Aikin & Stephens, 2023).

The Stoics' commitment to cosmopolitanism, which we will discuss in a later chapter, also reflects the fluidity of their thinking (Eliopoulos, 2014; Shogry, 2020). They accept the guidance of a providentially ordered cosmos while acknowledging the reality that humans can make false judgments and act irrationally (Fisher, 2016; Voncken, 2025).

As they engage in their philosophy, Stoics maintain control over their inner faculties, understanding what is beyond their control and refusing to let it disturb their inner peace (Polat, 2025; Stephens, 2007).

Stoicism is ideally positioned in terms of sub-criticality concerning the entropic nature of the brain. The Stoics maintain a constant tension by questioning their beliefs and pausing before assenting to decisions. This approach keeps them in a balanced mental state. Their philosophy is designed to promote homeostasis, allowing them to adapt to the changes of fate as they occur. Consequently, one can see that both Stoicism and its offshoot, CBT, serve as well-developed therapeutic methods that help regulate the brain's entropic states, such as by recognizing and confronting negative thought patterns, shifting one's perspective on events instead of trying to alter them by embracing the reality of what one cannot change, and practicing the dichotomy of control (Robertson, 2012; Poppe, 2024). These are but a few examples that enable individuals to lead flourishing lives.

When developing a conceptual equation for the Stoic entropic brain, it's important to incorporate the Stoic notion of the *sage*. The sage represents an ideal that cannot be reached, a person who has fully mastered Stoic principles. This individual embodies perfect virtue, exists in total alignment with reason, and remains unaffected by the emotional turmoil that impacts others. For most, the practical approach is to regard the sage as a model to emulate. The aim of the Stoic practitioner, the prokopton, is not to become a sage but to make constant, incremental progress toward the ideal (Allan, 2022).

The Stoic sage has then mastered the entropic flow of their mind. They cannot act against virtue because their every action is guided by a perfectly rational mindset,

allowing them to make correct judgments. As a result, they never agree to false impressions and are free from destructive emotions such as anger, fear, and excessive pleasure. Achieving this state requires constant vigilance and clear logical thinking. Ultimately, the sage understands their place in the rational, providential order of the universe. This understanding brings them a sense of peace and purpose, as she views all events as part of a larger, harmonious whole (Gibney, 2024).

$$\mathbb{S} = \lim_{t \to \infty} \left[\frac{\Omega(\mathcal{H}, \mathcal{P})}{\mathbf{E}(\mathcal{F}, \mathcal{A})} \right]$$

Note on Formalization: This equation defines the state of the Sage ($\mathbb{S}$) as an asymptotic ideal. Sagehood is modeled as the limit approached over a lifetime of practice $t \to \infty$ (Long, 1986). The numerator, $\Omega(\mathcal{H}, \mathcal{P})$, is the Stoic Order Function, representing the brain's purposeful activity when regulated by the Hēgemonikon ($\mathcal{H}$) and guided by Prohairesis ($\mathcal{P}$). This function reflects the high-fidelity integration of reason in harmony with nature (Hadot, 1995).

This rational order is divided by $\mathbf{E}(\mathcal{F}, \mathcal{A})$, and this denominator quantifies the internal disorder introduced by two primary factors: raw sensory impressions ($\mathcal{F}$) and the entropy generated by automatic, irrational assents $\mathcal{A}$ (Carhart-Harris et al., 2014).

As the practitioner refines their faculty of judgment, the influence of the irrational denominator is minimized, allowing the ratio to approach the stability of the Sage. The limit implies that while the perfect Sage remains an unattainable goal, the life of the Stoic is defined by the constant, temporal effort to maximize rational coherence (Ω) against the disorder of unexamined impressions ($\mathbf{E}$).

Stoic practice is therefore a continuous process of adjusting the balance between purposeful, rational thought and entropic, disorderly activity. When confronted with a

challenging situation, their prohairesis asserts control to prevent chaos. This internal system consistently strives to maintain a balanced state of low-to-moderate entropy, enabling flexible, rational thinking without falling into emotional turmoil (Aurelius, 2002; Robertson, 2020).

CHAPTER V

Reason, Logic, and Virtue: From Cosmic Law to Human Agency

> *Through our eyes, the universe is perceiving itself. Through our ears, the universe is listening to its harmonies. We are the witnesses through which the universe becomes conscious of its glory, of its magnificence.*
>
> — Alan Watts,[101] *The Essence of Alan Watts*

5.1 Information-Processing Logic

Cosmology, for the Stoics, was not merely an abstract scientific discipline; it served as a practical foundation for logic and ethics. Their belief in a universe governed by the Logos provided a framework for how human reason should function (Sellars, 2009). In this way, cosmology can be seen as an analogy that connects the cosmic and personal aspects of existence.

Stoic physics offers a coherent and rational understanding of the world. From the stars to human beings, the entire cosmos is infused with rational principles. Similarly, cosmology aims to describe a universe governed by logical and mathematical laws. Human beings possess a spark of this universal reason, which is represented by the hēgemonikon—the faculty that enables us to understand the cosmos and align ourselves with its rhythms (Dobbin, 2008). This understanding, rooted in fundamental principles,

[101] Alan Wilson Watts was a British and American writer, speaker, and self-styled "philosophical entertainer", known for interpreting and popularising Buddhist, Taoist, and Hindu philosophy for a Western audience.

enables us to exist as moral agents in the ongoing evolution of a meaningfully structured universe (Long & Sedley, 1987).

When we consider a cyclical universe, which is comparable to a universal time cycle, it teaches us an important Stoic principle: acceptance. Recognizing that both our personal lives and the universe go through periods of creation and loss helps the rational mind avoid the distress that comes from resisting fate (Parikh, 2025). By viewing the universe as an ongoing process of change, we can find purpose and resilience in navigating this cycle with virtue.

A virtuous life is one that aligns with nature and represents the highest form of existence for a rational being, and is the purest expression of the cosmos. By understanding the laws of the universe and accepting the events that arise from them, individuals feel a deeper connection to the cosmic whole, thereby expanding the scope of their agency beyond personal survival to include a moral obligation to contribute to the common good (Sadler, 2017). Human agency is therefore an active engagement that the Stoics believe should be characterized by purpose and justice, striving for improvement and contributions to society, and by embracing the well-worded "cosmo-politanism," which is born out of rational will and necessary for the cosmic fabric (Brown, 2009; Aurelius, 2002).

The foundation of Stoic logic lies in distinguishing between truths and falsehoods. To achieve this, the Stoics developed a propositional logic that emphasizes the relationships between entire sentences, in contrast to Aristotelian logic, which focused on categorical relationships between terms. The Stoic syllogism engages with conditional and disjunctive correlations, exemplified by a typical argument: "If it's day, then it's

light. It is day. Therefore, it is light" (The Stoic App Blog, n.d.).

A key concept in Stoic logic is the *lekton*, which can be understood as a "sayable" or the intelligible meaning conveyed by an utterance. Statements can be identified as either true or false based on their "lekta". The most significant lekton, known as an *assertible*, has its truth value determined by its alignment with reality. This system employs complex propositions that incorporate logical connectives, such as "if... then...," "and," and "either... or...," (Fiveable, 2024).

By training the mind to apply logical analysis to one's impressions, the process known as the discipline of assent, the Stoics could identify and reject incorrect judgments before they led to harmful emotions. This practical application of logic was key for facilitating mental clarity and emotional resilience, ultimately providing a clear pathway to living in harmony with reason and the cosmic order (Hadot, 1998; The Stoic App Blog, n.d.). This discipline comes to us through a set of teachings formulated by Epictetus, which includes the disciplines of desire and action. The role of logic within these disciplines can be viewed as having both a cognitive component and a practical or applied aspect, designed to ensure that our actions rest on a sound, rational foundation (Robertson, 2012; Long, 2002).

The cognitive sequence involves the following steps:

- Impression: An external or internal event produces a mental appearance or image in the mind.
- Proposition: The impression is translated into a thought that can be evaluated as a statement or proposition.

- Assent: This is the crucial moment of human agency where logic is applied. The hēgemonikon decides whether to agree with the proposition, reject it as false, or suspend judgment (*epoché*) if the facts are unclear.
- Impulse: Assenting to a proposition that something is good or bad generates an impulse toward action (Robertson, 2012).

The applied logic consists of several key steps:

- Pausing for evaluation: Epictetus advised his students to respond to an impression with, "Wait for me a little. Let me see what you are and what you represent. Let me test you." This pause marks the beginning of logical examination.
- Testing for truth: The Stoics sought assent only to *kataleptic* impressions—those so clear and certain that they cannot be false. Any other impression must be carefully examined or have judgment withheld. A practicing Stoic continually asks: "Is this true? What evidence supports this? Are there alternative explanations?"
- Stripping away value judgments: A key logical exercise involves stripping an event down to its objective core, removing all subjective, emotional coloring. For example, when insulted, a Stoic logically analyzes the facts: "He uttered certain words in a loud voice" is an objective statement, while "He harmed me" is an irrational, subjective value judgment that can be logically rejected.
- Identifying logical fallacies: The study of formal logic, as exemplified by Stoic philosophy, provides a framework for identifying flawed reasoning within one's own mind. A passion like fear often arises from a logically flawed premise (e.g.,

"This external event is bad"), which is a type of fallacy the Stoics aimed to eliminate (Voncken, 2015).

The Logos represents the rational principle that connects cosmology and logic, providing order to both the universe and human thought. Logic can be seen as a microcosm within the larger structure of the cosmos. The universe is a living, rational, and deterministic system, with the Logos acting as its blueprint and the causal chain of all events. Humanity possesses a fragment of the universal Logos within its hēgemonikon, or rational faculty. Therefore, human reason is a direct reflection of the cosmic principle, with its logical framework serving as an internal expression of universal laws (Brown, 2012).

The conceptual equation that shows how the fundamental, universal reason is manifested and applied within the individual mind to achieve wisdom and harmony can be expressed as:

$$\mathcal{L}_{\Sigma} = \frac{d(\mathbb{RA})}{dt} \Leftrightarrow \mathbb{H}(\Lambda) \equiv \mathcal{L}_{A}$$

Note on Formalization: This equation describes the Logos ($\mathcal{L}_{\Sigma}$) as defined as the fundamental law governing the rate of change of Human Reality ($d(\mathbb{RA})/dt$). Here, $\mathbb{RA}$ represents the sum total of physical events and impressions (Wheeler, 1989) encountered by the agent, and its derivative signifies the continuous, temporal flow of objective reality.

The logical and ontological equivalence ($\Leftrightarrow$) highlights the Stoic principle that human logic is a reflection of this cosmic order. On the microscopic scale, the hēgemonikon ($\mathbb{H}$) processes the application of logic (Λ). This act of applying logic is equivalent ($\equiv$) to the application of Human Reason $\mathcal{L}_{A}$ (Sellars, 2006).

> Virtue is, therefore, the localized expression of the same informational laws that govern the stars. When we apply logic (Λ) through our commanding faculty (Inwood, B. 1985), we are essentially synchronizing the internal "law" with the "fundamental law" of reality.

To understand how Stoic logic can be interpreted as emerging from a two-dimensional boundary as a projection of our four-dimensional reality, one can explore its connection to the holographic universe theory. This begins with recognizing the strict determinism ('t Hooft, 2002) that underpins both concepts. For the Stoics, the universe is ordered and governed by an unbreakable chain of cause and effect (Bobzien, 1998), which aligns with a physical theory stating that all events result from a pre-encoded informational state (Susskind, 1994). In this context, Stoic logic serves as an intellectual tool that helps humans comprehend the universe's deterministic, information-based nature.

It's important to note that, in Stoicism, determinism allows for creative patterns of influence in spacetime. Determinism is not static; it evolves over time. Regarding human action, it develops through the information we receive and the process of understanding it. Matthew Sharpe describes this as the evolution of the character or ethos of individuals, an ethical endeavor that shapes inquiries into the morality of actions (Sharpe, 2014, p. 14). Similarly, John Russon,[102] in his article titled *The Virtue of Stoicism: On First Principles in Philosophy and Life,* published in the Canadian Philosophical Review, defines Stoic agency as something cultivated rather than inherent (Russon, 2006, p. 350).

This perspective allows individuals to decode the informational structure of nature's programming. This idea is directly linked to the Stoic discipline of assent, which

[102] John Edward Russon is a Canadian philosopher, working primarily in the tradition of Continental Philosophy.

teaches us to agree only with true propositions that align with the natural order. More accurately, it provides the proper mindset for navigating a holographic reality.

The theoretical act of decoding the universe's informational structure is fundamentally a logical process. The Stoic discipline of assent provides the philosophical and psychological framework necessary for this decoding process. By applying a conceptual equation like this one, it can be reviewed as:

$$\mathcal{D}(\Psi\iota) = (\Lambda \cdot S) \Leftrightarrow \mathcal{S}_{\Sigma}$$

Note on Formalization: This equation defines the Decoding of Nature ($\mathcal{D}(\Psi\iota)$). From a modern holographic perspective (Susskind, 1994), reality is viewed as fundamentally information-based ($\Psi\iota$). The process of decoding this structure is equivalent to the product of Logic (Λ) and Assent (S). In this context, S represents the rigorous Stoic discipline of withholding agreement to an impression (Brennan, 2005).

The logical equivalence ($\Leftrightarrow$) establishes the cognitive structure required to navigate an informational or holographic reality (Long & Sedley, 1987). It is precisely the mindset of a Stoic practicing the discipline of assent. When logic is correctly applied to the act of assent, the result is Sound Assent ($\mathcal{S}_{\Sigma}$), or a true proposition that aligns perfectly with the underlying informational structure of the universe.

By formalizing wisdom as a decoding function, evaluating impressions are reimagined not just as a mental state, but as successful informational synchronization. To attain $\mathcal{S}_{\Sigma}$ is to move beyond the surface of impressions and interface directly with nature.

The compatibility between these concepts lies in the distinction between a deterministic external world and the internal sphere of human agency. Human

consciousness interacts uniquely with the deterministic flow of information. One's response to this information paves the way for self-reflection and the emergence of agency (The Stoic App Blog, n.d.). This focused application of internal logic aligns the human mind with the deterministic cosmic order, for an accurate understanding of the universe's informational structure. Ultimately, it allows for our role as a rational aperture through which the cosmos becomes conscious of itself (Fiveable, 2024; Aurelius, 2002).

Previously, we discussed that determinism is not static and that human actions continue to evolve over time. This notion also underscores the physiology of the human body as a product of evolution, with the brain playing a central role in how it processes information to maximize survival. Every physical mutation that has shaped humans and their capacity for logical reasoning has resulted from what is termed Superior Pattern Processing (SPP). This process is fundamental to understanding the various distinctive characteristics of the human brain. It explains why human abilities in reasoning, communication, and abstract thought are significantly more advanced than those of other species, including closely related primates (Mattson, 2014).

As human evolution has progressed, the human ability to process patterns has become more advanced, largely due to the expansion of the cerebral cortex, particularly the prefrontal cortex and regions associated with image processing (Mattson, 2014). Specific patterns, whether real or imagined, are reinforced by emotional experiences, indoctrination, and even the influence of psychedelic substances, similar to the entropic brain (Belko, n.d.; Carhart-Harris et al., 2014). Mark Mattson[103], from the Department of Neuroscience at Johns Hopkins University School of Medicine, explains that the SPP

[103] Mark P. Mattson is an American neuroscientist who is an adjunct professor of neuroscience at the Johns Hopkins School of Medicine.

theory suggests that human evolution will continue to involve the expansion of the prefrontal cortex and related brain areas, enhancing the brain's ability to process information quickly and make more informed decisions (Mattson, 2014).

Evolution, therefore, involves deterministic logic, which aligns with the Stoic goal of improving decision-making based on virtue. An expanding SPP would result in a more virtuous individual from a Stoic perspective. Such an individual would be better equipped to process large amounts of information, predict outcomes, and choose the most rational and ethically sound course of action. This represents the ongoing refinement of the hēgemonikon, leading to faster, more logical thinking and, consequently, greater ease in adhering to the discipline of assent and pursuing virtue (Mattson, 2014; Hadot, 1995).

5.2 The Logic of Expansion

The title of this sub-chapter can be interpreted in two ways: "The Logic of Expansion" or "The Expansion of Logic." Both actions occur simultaneously. The universe is expanding, fundamental particles interact with each other and with fields, and entropy continues to increase. From single-celled organisms to complex beings like us, intricate systems emerge. Reason, regarded as the primary divine information property of the universe, expands and permeates through the pneuma (Sambursky, 1987; Hensley, 2021), reaching into all forms of energy-matter. Consequently, the universe expands not only physically but also informationally throughout all of spacetime, and it will continue to do so until its ultimate end.

As discussed, Jude Currivan's concept of intropy encapsulates the idea that the universe is innately comprised of meaningful in-formation from the beginning, so the arc is from simplicity to complexity. This concept aligns closely with the growing capacity

for logic and provides a cosmic understanding of biological systems, as outlined in the SPP theory. As organic life forms evolve, their inherent meaningful purpose, represented in in-formational form, becomes increasingly evident through individualized intelligence and consciousness. This is demonstrated by life forms capable of deep experiences and conscious connections with themselves, each other, and their broader environment (Currivan, 2022, p. 198).

Intropy, along with pneuma, acts as an active organizing principle that counteracts the traditional interpreted entropy by fostering collaboration and co-evolution at all scales (Currivan, 2017). Thus, we observe a universe that appears to be biased toward the emergence of complexity. The human brain is a key manifestation of this bias, evolving not merely through random mutations and chance, but through intelligent guidance and informed processes.

The universe's drive for complexity has led to the evolution of the human brain into a sophisticated "receiver" and "decoder" of purposeful in-formation, enhancing our capacity for logical and rational thought, with the hēgemonikon acting as the receiver and processor of this universal information (Long, 2002). This is why Stoicism is so anthropocentric; it is only through the evolution of the human species that it acquired the hardware necessary to install the operating system, or the Logos, which is capable of understanding the nature of its origins (Dobbin, 2008). This self-awareness and capacity for logic represent the highest expression of the cosmic evolutionary process known to humanity, making humanity a necessary and purposeful part of the universe's narrative.

Previously, it was noted that the Stoics categorized all natural substances into various classes according to a hierarchy of powers, known as the scala naturae (Hahm,

1977; Sedley, 1998). The concept of tensional motion enabled the Stoics to develop a cohesive physical theory based on pneuma (Hensley, 2021; Voncken, 2025), while also clarifying the distinction between organic and inorganic materials (Inwood, 1985). As a result, Stoic physics illustrated that there is a physical link and continuity between the mind and matter (Rubarth, n.d.), which can be measured by the varying degrees of logical expansion across different substances (Notes from the Digital Underground, 2015; Sambursky, 1987).

At its most fundamental level, pneuma provides simple reasoning and organization to non-living matter, such as stones, helping to maintain a structure as a cohesive whole (Hensley, 2021). As tension increases and logic expands, pneuma evolves into a life force that enables plants to grow, reproduce, and maintain their organic essence, despite lacking cognitive abilities[104]. At a higher level of tension, pneuma endows animals with the capacities for perception, sensation, motion, and instinct. Animals operate based on intuition and immediate sensory feedback (Shogry, 2014). Ultimately, according to the Stoics, the most advanced and intentional form of pneuma is exclusive to humans, enabling self-awareness, abstract reasoning, language proficiency, and moral decision-making. This grants humans a comprehensive ability to logically understand the natural world (Voncken, 2015; Rubarth, n.d.).

The comprehensive ability to understand and develop moral progress is what is referred to as in-tropic expansion within individuals (Currivan, 2017). As information and order increase purposefully, it creates an opportunity for a Stoic to advance in their moral development (Adami, 2016; Fisher, 2013). A prokopton, or a student on the Stoic

[104] While plants lack brains and a nervous system, research indicates plants possess complex awareness, responding adaptively to light, touch, and threats. Some experts describe this as a form of non-neuronal, decentralized "plant intelligence".

path, consistently applies logic to their practice of various disciplines. They scrutinize their impressions and question what is within their control and what is not (Dobbin, 2008). Each successful application of logic strengthens the pneuma within the ruling faculty (Hēgemonikon), making the mind more resilient, consistent, and resistant to irrational judgments (Sellars, 2003). The ideal goal of this in-tropic expansion is to transform the prokopton into a sage. However, the process of striving for this transformation is more important than achieving the goal itself. For the Stoics, a sage is an extremely rare individual (Kunz, 2023)—someone whose mind perfectly mirrors the rational order of the cosmos and aligns their reasoning with universal logic.

This process, laid out as a conceptual equation, can be formulated as:

$$\mathbb{P}\approx(t) = \int_0^t \frac{(\mathbb{H})_t}{\Delta\mathbb{IP} \cdot \Lambda \cdot \Psi_\Sigma} ds \xrightarrow{\mathbb{O}} \mathcal{S}(I)$$

Note on Formalization: This equation defines *Phronesis*[105] ($\mathbb{P}\approx$) as the time-integral of moral progress. It quantifies "in-tropic" expansion, the process by which the mind grows in-formationally toward greater order. Capturing the Stoic struggle, the tensile strength of the hēgemonikon ($(\mathbb{H})_t$) is balanced against the change in irrational passions ($\Delta\mathbb{IP}$). As the practitioner imposes logic, the denominator decreases, causing the value of the integral to increase (Annas, 1993).

This internal strength is multiplied by the consistent application of Logic (Λ) as it decodes the purposeful information (Ψ_Σ) of the cosmos. The Oikeiōsis Operator ($\xrightarrow{\mathbb{O}}$) symbolizes the striving towards the ideal (Pembroke, 1996). This

[105] In Stoicism, Phronesis is practical wisdom, the essential intellectual virtue that allows you to correctly judge what is good, bad, or indifferent in any situation and determine the right action to take, translating knowledge into virtuous living.

transformation leads toward $\mathcal{S}(I)$, the Stoic Sage, where the individual mind becomes a perfect informational mirror of the universal rational order.

It is difficult to envision what a sage's perfect rational order might look like— a being whose hēgemonikon operates with flawless logic and accurately decodes reality. Ancient Stoics used the metaphor of the still sphere (*sphairos*) to describe the sage's mind. This image originated from the 5th-century BCE Pre-Socratic philosopher Empedocles[106] and took on a specific ethical significance in Stoicism (Curd, 1996).

Empedocles envisioned a moment when all the pure elements existed in a perfect, tranquil sphere, held together by the forces of love and strife. Love acted as the dominant force, maintaining harmony, while strife resided on the outskirts. However, as strife grew stronger, it began to fragment the sphere, leading to the world we observe today—filled with a multitude of things and constant changes, all influenced by the interplay of love and strife (Kiddle, 2025).

An unbreakable sphere became a symbol supporting the Stoic concept of the cosmos as a unified and harmonious whole held by love, reflecting the mind's ideal alignment with nature, and is attributed to Empedocles:

"There neither the swift limbs of the sun are discerned, nor the shaggy force of earth nor the sea. Thus by the dense concealment of Harmonia is held fast a rounded sphere (Sphairos), exulting in its joyous solitude" (Curd, 1996, p. 90).

[106] Empedocles was a Greek pre-Socratic philosopher and a native citizen of Akragas, a Greek city in Sicily. Empedocles' philosophy is known best for originating the cosmogonic theory of the four classical elements. He also proposed forces he called Love and Strife which would mix and separate the elements, respectively.

Marcus Aurelius also brought it up two times in the *Meditations* (Aurelius, 2003), repeatedly stressing its connection to independence from externals:

"No one can obstruct the operations of the mind. Nothing can get at them—not fire or steel, not tyrants, not abuse—nothing. As long as it's a sphere … in perfect stillness" (Aurelius, 2003, 8.41).

"The soul as a sphere in equilibrium: Not grasping at things beyond it or retreating inward. Not fragmenting outward, not sinking back on itself, but ablaze with light and looking at the truth, without and within" (Aurelius, 2003, 11.12).

Pierre Hadot suggests that Marcus Aurelius uses Empedocles' Sphairos as an allegory for the Stoic Sage, indicating that by his time, there was already a tradition of this interpretation, dating back to the poet Horace[107], almost two centuries earlier (Hadot, 1998, p. 50; Aurelius, 2025):

> So who is free? The wise man: in command of himself, unafraid of poverty, chains, or death, bravely defying his passions, despising honours, complete in himself, smoothed and rounded, so that nothing external can cling to his polished surface, whom fortune by attacking ever wounds herself (Horace, 2005).

For the Stoic Sage, the soul becomes a genuine microcosm of Sphairos: all elements of the mind are seamlessly aligned and function collectively, calm and self-sufficient, unaffected by the disturbances of external circumstances. The soul, aligned with virtue, reflects the flawlessly rounded and tranquil Sphairos: liberated from

[107] Quintus Horatius Flaccus, commonly known in the English-speaking world as Horace, was the leading Roman lyric poet during the time of Augustus (also known as Octavian).

the disorder and division of conflict (Aurelius, 2025).

Exploring the dynamics of Stoic ethics, the concept of the sage serves as a valuable guide for evaluating and interpreting the third and final part of this philosophy, which is also the most significant. Stoic ethics adheres to cosmic physical laws, reflecting the soul of the Stoic in harmony with the cosmos (Long, 2002). It is through the responsible and ethical actions of humans, seen as cosmic agents, that we uphold the voice of the Logos and resonate with the music of the spheres[108]. Humanity serves as a gateway to the divine by living a joyful life in harmony with nature (Aurelius, 2002; Dobbin, 2008).

5.3 Stoic Ethics and Its Alignment with Nature

Aligning personal will with the Logos is essentially the practical expression of Stoic ethics. The surviving Stoic fragments clearly explain the universe as a perfectly ordered and rational system. One's highest purpose, as a rational agent, is to live in harmony with that order. To live virtuously means continuously using the hēgemonikon, or ruling faculty, to process information received from the senses with calmness and reason. This revised information, upon careful consideration and in accordance with natural law, should then determine our actions (Diogenes Laertius, 1925; Cicero, 1931).

The application of logic is inherently ethical, as it requires one to remain mindful of the interplay between their desires, actions, and judgments (Hadot, 1995; Inwood, 1985). Just as the Stoics analyze impressions to distinguish truths from falsehoods, one's

[108] The *musica universalis* (literally universal music), also called music of the spheres or harmony of the spheres, is a philosophical concept that regards proportions in the movements of celestial bodies—the Sun, Moon, and planets—as a form of music. The theory, originating in ancient Greece, was a tenet of Pythagoreanism, and was later developed by 16th-century astronomer Johannes Kepler. Kepler did not believe this "music" to be audible, but felt that it could nevertheless be heard by the soul. The idea continued to appeal to scholars until the end of the Renaissance, influencing many schools of thought, including humanism.

internal judgments must align with external reality through true propositions (Mates, 2022; The Stoic App Blog, n.d.). This alignment leads to a life marked by virtue and tranquility (Annas, 1993; Robertson, 2020). There is no distinction between the natural order of the universe and moral action within it. Physics, logic, and ethics are interconnected, forming a cohesive philosophy that serves as a guide for living (Algra, 1999).

Achieving the ethical standards of Stoicism is not simply following a recipe in which one applies the necessary ingredients to become more virtuous. Stoicism demands a comprehensive worldview that aligns with how universal reason perceives reality. Its ability to effect change is limited when added to a life filled with emotional turmoil and driven by desires and aversions. Altering our lives fundamentally necessitates a total shift in perspective (Fisher, 2016).

Pierre Hadot, in discussing the spiritual exercises of ancient philosophy and their purpose in transforming an individual's perspective, emphasizes the need to shift one’s perception of reality. One must move away from a "human" perspective, where values are heavily influenced by emotions, to a "natural" perspective that situates each event within the broader context of universal nature. A true philosopher should genuinely care about the overall well-being of both the universe and society, understanding that individual interests can only have legitimate value in relation to the collective good of the whole (Hadot, 1995, pp. 84, 99).

The spiritual practices of the Stoics serve as a guide for living harmoniously as human beings. They encourage one to gradually dismantle the separation between their individual selves and the wholeness of the universe (Hadot, 1995). This approach aims to

liberate individuals from the feelings of alienation caused by worries and passions. Such isolation from the cosmic consciousness occurs when our rational mind, or hēgemonikon, is overtaken by irrational emotions, leaving us feeling fragmented and inconsistent.

By recognizing ourselves as part of a greater whole and engaging in meaningful spiritual work, we can cultivate a sense of mutual interdependence. This process allows the liberated self, having honed its rational abilities, to genuinely reflect the universal Logos (Aurelius, 2002). In this state of cosmic consciousness, the barriers between the self and the cosmos dissolve, resulting in a profound sense of justice and universal love. Ultimately, this leads to a unified, rational self that is free, peaceful, and in harmony with the entire cosmos (Hadot, 1995; Long, 2002).

An excellent example of these exercises, which shows how cosmology for the Stoics was so connected to the spirit, is called "The View from Above," in which they imagined themselves high up in space, looking down on the Earth below. Marcus Aurelius describes the exercise in his *Meditations* (Aurelius, 2003):

> Watch and see the courses of the stars as if you were running alongside them, and continually dwell in your mind upon the changes of the elements into one another … When you are reasoning about mankind, look upon earthly things below as if from some vantage point above them (Aurelius, 2003, p. 106).

Philosopher and author David Fideler[109] explains, quoting Hadot, that this exercise aimed to reposition human existence within the vastness of time and space, alongside the principles of the great laws of nature, and to comprehend the

[109] David Fideler is an editor, college professor, educational consultant, and the director of a humanities center. He studied ancient Greek philosophy and Mediterranean religions at the University of Pennsylvania and holds a PhD in philosophy and the history of science and cosmology.

interconnectedness of each thing with everything else. By adopting a cosmic viewpoint, the philosopher would perceive the world as it truly is, and by placing life within a cosmic framework, he would not be disturbed by the minor upheavals that cause significant suffering for a large portion of humanity (Fideler, n.d.).

It is truly beautiful, and perhaps even magical, how the human mind can transform by objectively changing its perception of the world. Everyone has the potential to elevate themselves and view reality from a higher perspective, allowing this new observation to shape one's life. Instead of seeing oneself as mere spectators, one can experience the profound beauty of Earth as seen from space. This perspective allows us to intuitively understand that all life is interconnected and faces a common fate (Fideler, n.d.). One begins to feel like active participants in life's tapestry, rather than disembodied observers.

To encapsulate this in a conceptual equation, one can illustrate the dynamic interplay of Hadot's spiritual exercises alongside a cosmological component as follows:

$$\mathcal{C}_\Lambda \Leftrightarrow \frac{\int_0^t \Phi_\Theta \cdot \Lambda dt}{\Delta \mathbf{E}} \xrightarrow{\mathbf{A}} \Psi_A$$

Note on Formalization: This equation defines Cognitive Alignment ($\mathcal{C}_\Lambda$), by establishing a biconditional equivalence ($\Leftrightarrow$) between the Logos and the internal state of a person, formalizing the Stoic belief that human logic is a direct reflection of universal laws.

The numerator represents the cumulative integration ($\int_0^t$) of philosophical practice, specifically the synthesis of Philosophical Observations (Φ_Θ), such as "The View from Above", and active logic (Λ). This summation signifies the

lifelong practice of spiritual exercises from inception to the present moment (Hadot, 1995).

This process is divided by $\Delta \mathbf{E}$, representing the self-transformation or the total shift in an individual's perception and behavior (Mates, 2022). The Action Operator ($\xrightarrow{\mathbf{A}}$) illustrates the transition from theoretical understanding to the active realization of *Aretē* (Virtue). This culminates in Ψ_A, the Actualized Agent, representing the realization of one's authentic, virtuous self in harmony with the natural order (Stephens, 2007).

This idea emphasizes the ongoing application of philosophical practices over time, resulting in a transformation of the self and achieving a state of cosmic consciousness by aligning an individual's life with the rational order of the universe. The approach outlined here suggests that the purpose of these exercises is holistic, focusing on being rather than merely engaging in theoretical study (Hadot, 1995, 1998). It fundamentally cultivates self-mastery and promotes a deep understanding of one's place within a vast cosmological framework (Long, 2002). By underscoring the importance of persistence in practicing these principles, a Stoic accumulates the necessary insights to fundamentally change their outlook on existence. This transformation leads to a committed pursuit of virtuous excellence by continuously refining oneself in accordance with a core principle (Dobbin, 2008).

In reflecting on the progress of a Stoic toward achieving a life in accordance with nature, one can compare the ultimate, albeit elusive, goal of becoming a sage with the efforts of cosmologists striving to understand the finely tuned qualities that our universe possesses, which allow for its existence and the flourishing of life within it (Currivan, 2017). A sage, possessing complete wisdom and virtue, is not merely good but is also

perfectly “fine-tuned” in a moral sense, operating without error or deviation, and similar to the precise values of the fundamental physical constants that enable the existence of complex life (Long, 2002; Sellars, 2003).

The measurements of physical constants and the interactions between the forces in the physical reality must be exactly as they are; otherwise, our universe would have extinguished itself before it even began, failing to create a balance between energy-matter or ceasing to exist before the first stars could form (Currivan, 2017, p. 85). These finely tuned qualities reflect a precise and stable harmony, much like the moral consistency that a sage achieves, mirroring the cosmic order (Davies, 2008). The dynamic and precise balances of these energetic forces, alongside the Stoics’ disciplinary practices, have enabled increasingly complex and self-aware intelligence to evolve (Currivan, 2017, p. 86) in both our universe and its human offspring.

Scientists may never determine why the constants have the values they do, whether it is a necessity or a product of a multiverse, but they continue to investigate the parameters and implications of this balance (Davies, 2008). While the ideal of the sage might be unattainable in practice, the Stoic prokopton similarly examines the parameters of virtue and reason, rigorously pursuing rational application and moral judgment as the essential means to achieve eudaimonia, which mirrors the enduring human quest to fully comprehend the universe's secrets (Sellars, 2003).

Jude Currivan, in her book *The Wave* (Currivan, 2005), outlines six key numbers that are central to the universe's beautiful balance. Correlations have been made in both Stoic doctrine and Currivan’s analyses, in which equations were also added to represent their relationship:

1. The Strong Nuclear Force

The initial number, indicated by the Greek letter ε (epsilon), represents the strength of the strong nuclear force that holds protons and neutrons together within atomic nuclei. In assessing the effectiveness of nuclear interactions, ε is also crucial to the alchemical process that results in the formation of all ninety-eight naturally occurring elements, ranging from the lightest, hydrogen, to the heaviest, californium (Currivan, 2005, p. 86).

Pneuma serves as the physical and cohesive force that shapes the form and function of everything, from inanimate objects to living beings (Hensley, 2021). Just as the *strong nuclear force* overcomes the electromagnetic repulsion between protons to hold the atomic nucleus together, pneuma provides the necessary tension to prevent the universe and everything within it from dissolving into an undifferentiated prime matter. It acts as the fundamental binding force of the cosmos (Sellars, 2003).

Similarly, the Logos ensures that the elements of human experience, such as external events, moral judgments, and potential actions, can be "alchemically processed" into a coherent, meaningful, and virtuous life. Living according to reason binds one's actions into a cohesive moral structure, much like the strong nuclear force binds matter into stable elements (Long, 2002).

$$\epsilon_{\Sigma} \propto \Delta\Pi \Leftrightarrow \Pi_{\Phi} \propto \Delta\mathcal{K} \times \Lambda$$

Note on Formalization: This equation defines Universal Cohesion. It identifies the strength of the Strong Nuclear Force (ϵ_{Σ}) as being proportional to the function that maintains nuclear stability against electromagnetic repulsion ($\Delta\Pi$).

The logical equivalence ($\Leftrightarrow$) shows that this physical binding force is the microscopic manifestation of pneuma ($\prod_{\Phi}$). Pneuma is the "breath" or active principle that provides the universe with its tensile strength (*tonos*) (Sambursky, 1987). This force is proportional to the Binding Mechanism of the cosmos ($\Delta\mathcal{K}$).

The final operator, Universal Reason (Λ), acts as the processing factor that ensures these different elements are integrated into a coherent, meaningful whole. This formalizes the Symmetry of Reason on a subatomic scale: the same Logos that structures the atom structures the mind.

2. Ratio of Electric to Gravitational Forces

The second number, N, represents the ratio of electrical forces to the weaker gravitational force, an astounding 10^{36}. While electrical forces play a vital role in holding atoms and molecules together, gravity is the dominant force at larger scales. This predominance occurs because the vast majority of positive and negative charges at the atomic and molecular levels tend to neutralize each other, leaving the universe electrically neutral. When there is a disturbance in the balance of electrical forces, this imbalance typically encompasses only a minuscule fraction of the total electric charges present, whereas gravity continuously influences all energy-matter (Currivan, 2005, p. 86).

The power of an individual's reasoning serves as an analogy for the ratio of electric force to gravitational force. This comparison highlights the connection between an individual's rational internal moral compass and the influence of external events (Davies, 2008). The Stoics teach that true good and evil reside within our moral choices and judgments. This internal faculty has significant power over our inner world and what we can control.

This concept mirrors the nature of the electric force at the atomic level of human

experience: judgments shape the stability and composition of one's virtues and vices. Just as positive and negative charges neutralize each other throughout the universe, the Stoic seeks to neutralize the impact of external circumstances through sound judgment (Long, 2002). Passions such as anger, fear, and desire emerge from false judgments that assign excessive value or "charge" to external events.

Constantly influenced by external events, forces like gravity are always present and impact our material existence (Musser & Howlett, 2025; Verlinde, 2011). A Stoic recognizes that they cannot control these forces, including gravity (Polat, 2025; Sadler, 2021). Instead of resisting the external realities of fate, such as the inevitable pull of gravity, they concentrate on the atomic level of their thoughts and decisions, where they can exercise complete control over their judgment (Sellars, 2003). This focus often creates an imbalance, as the Stoics' attention is directed solely toward how they utilize their moral faculties. As a result, the vastness of the material world becomes irrelevant to their true happiness (Annas, 1998; Long, 2002). It's important to note that this last statement does not mean that a Stoic disregards the material world; rather, their focus is primarily internal, to know how to best respond to external forces (Hadot, 1998; Robertson, 2020).

$$\rho = \frac{\Phi}{\Gamma} \Leftrightarrow \mathcal{J} \gg \mathcal{E}$$

Note on Formalization: This equation draws a formal analogy between the fundamental forces of physics and the hierarchy of the human mind. The ratio ρ represents the difference in strength between Electrical Forces (Φ), which maintain the structural integrity of matter, and the Gravitational Force (Γ), which is significantly weaker but dominates macroscopic space (Feynman et al., 2011).

> This physical ratio is logically equivalent ($\Leftrightarrow$) to the Stoic priority of Judgment ($\mathcal{J}$) over External Realities ($\mathcal{E}$). In the Stoic "inner citadel" (Hadot, 1998), the power of moral choice (*Prohairesis*) functions like the electromagnetic force: it is the high-intensity binder of our character. While fate and physics ($\mathcal{E}$) exert a constant gravitational pull on our lives, the Stoic maintains that the strength of internal assent is much greater than ($\gg$) any external compulsion.

3. Dimensions

The third number is represented by D, which stands for dimension. The selection of three dimensions is necessary for the existence of our ideal universe, adhering to the principles of symmetry and simplicity, while also uncovering insights into the holographic and informational essence of reality. The cosmic hologram views the manifestation of four-dimensional spacetime, which merges three-dimensional space with time, as arising from a more fundamental two-dimensional holographic boundary comprising one spatial and one temporal dimension. If we disregard time, the emergence of three-dimensional space from its one-dimensional holographic foundation is the most straightforward way to account for the existence of our universe (Currivan, 2017, pp. 87, 88).

The Stoic and cosmological analogy for the dimensions is that the world of external events and physical reality, which we perceive as four-dimensional spacetime, is equivalent to the universe's holographic manifestation (Currivan, 2017). It is the realm of appearances of a more fundamental reality. For the Stoic, this is the world of indifferents. Things like wealth, health, fame, or suffering are considered external events, yet they seem to be the entirety of our reality, but not the true source of our good or bad (Long, 2002). They are merely informational displays, the 3D renderings of the cosmic Logos. The Stoics' goal is to recognize that the reality of their moral life does not lie within this

complex, external dimension, but in a more fundamental, internal plane of existence (Hadot, 1995). This morality can then be expressed externally for the benefit of the entire universe.

$$\Delta^4 = \mathcal{M}_\Phi \Rightarrow \Pi \propto \mathcal{R}_i$$

Note on Formalization: This equation treats the Four Dimensions of spacetime (Δ^4) as the Manifestation of Physical Reality ($\mathcal{M}_\Phi$), emerging from a deeper informational source. This reflects the modern holographic perspective where 3D space plus time is a projection of data stored on a 2D boundary (Susskind, 1995).

The implication ($\Rightarrow$) suggests that our Perception (Π) of external events, which the Stoics categorize as "Indifferents", is merely the reception of this projected appearance. In contrast, the equation asserts that this projection is proportional to the Internal Resonance ($\mathcal{R}_i$) of the agent. This represents the plane of existence where Judgment and Intentions reside.

4. The Smoothness of Space

The subsequent quantity, denoted as Q, indicates the degree of smoothness of space: the extent of subtle ripples whose frozen pattern is displayed in the cosmic microwave background[110], or CMB. Both visible and dark matter oscillated through the early universe; their influence was strong enough to generate regions of increased density. These regions acted as seed points, just adequate to allow, influenced by gravity, the creation of stars, galaxies, and galactic clusters, while avoiding turbulence that, as the universe expanded, could have hindered the stable conditions necessary for the formation

[110] The Cosmic Microwave Background (CMB) is the cooled remnant of the first light that could ever travel freely throughout the Universe. This 'fossil' radiation, the furthest that any telescope can see, was released soon after the Big Bang. Scientists consider it as an echo or 'shockwave' of the Big Bang. Over time, this primeval light has cooled and weakened considerably; nowadays we detect it in the microwave domain.

of stars and galaxies (Currivan, 2017, p. 89).

Applying this to a Stoic concept concerns moral equanimity and the need for a balanced internal disposition to develop a virtuous character amid life's changes (Brennan, 2005; Whiting & Konstantakos, 2021). In Stoicism, external events are seen as "subtle ripples" in our personal cosmos (Brown, 2012; Fisher, 2013). These include the inevitable challenges, setbacks, and opportunities that can disrupt our tranquility. A life without any challenges would not provide opportunities for moral growth (Long, 2002). Stoics believe that these events are divinely ordained by the Logos and serve a rational purpose, providing us with the opportunity to practice virtue (Fisher, 2016; Voncken, 2025). The prokopton uses external challenges as opportunities to exercise reason (Dobbin, 2008; Kunz, 2023). For instance, a mild insult can become a "seed point" for practicing patience or wisdom, thereby strengthening one's moral character through the application of reason (Hadot, 1998; Robertson, 2020). The ideal value of Q, representing the right level of smoothness and density, can be likened to the Stoic rational response (Currivan, 2017). This response does not imply a lack of feeling but rather emphasizes the appropriate and rational application of one’s moral capabilities in response to life's fluctuations (Hadot, 1995).

$$\mathcal{Q}_{\Sigma} = (\mathrm{CMB}) \Rightarrow \eta \uparrow = \sum \mathcal{K}(\rho \times \delta)$$

Note on Formalization: This equation identifies the primordial Smoothness of Space ($\mathcal{Q}_{\Sigma}$) with the patterns observed in the Cosmic Microwave Background (CMB). This represents the foundational "Logos" or order of the physical universe (Penzias & Wilson, 1965).

The implication ($\Rightarrow$) is that the recognition of this universal order causes Moral Growth ($\eta \uparrow$). This growth is modeled as the Summation ($\sum$) of lessons learned through Challenges ($\mathcal{K}$), where each challenge is processed by the Stoic's Rational Response (ρ) and Sound Judgment (δ). Just as the CMB ripples seeded the structure of the cosmos, the Stoics' disciplined responses seed the structure of a virtuous character.

5. Density of Energy-Matter

The fifth number, represented by the Greek letter Ω (omega), denotes the density of all forms of energy-matter in our universe, both visible and dark, and indicates the ratio of actual density to critical density, also known as the *density parameter*. Success has been achieved in measuring Ω, and it has been found to have a unique value of exactly one. Determining this unitary value of Ω is crucial for confirming that our universe is flat, which leads to a balance of attractive and repulsive energy-matter that sums to zero over its existence (Currivan, 2017, p. 90).

The analogy with Stoicism suggests that the ideal life achieves a perfect sense of "flatness" or equilibrium. A sage maintains an inner balance, free from disturbing passions and emotional turbulence (Long, 2002). This state reflects the Stoic goal of living in harmony with nature, mirroring the Logos. The balance between attractive and repulsive energy-matter parallels a balanced response to external events, avoiding excessive desire for positive experiences and undue fear of negative ones (Davies, 2008). Thus, an individual's moral "energy-matter" reaches equilibrium (Lavis & Frigg, 2025; Menin, 2023). The aim of the Stoic path is to achieve a "density" of rationality that aligns with the "critical density" of the universal Logos (Currivan, 2017). When a person's judgments accurately reflect reality, their moral universe becomes stable and "flat." They

attain a deep psychological balance that allows them to flourish, regardless of external circumstances (Sellars, 2003).

$$\Omega_{\Delta} = \mathcal{F}_{\epsilon} \Leftrightarrow \mathcal{H}_{E} = \neg\Pi$$

> **Note on Formalization:** This equation draws a parallel between the Density Ratio of the universe (Ω_{Δ}) and the internal state of the agent. When the total energy-matter of the universe equals the critical density ($\mathcal{F}_{\epsilon} = 1$), the result is a "Flat Universe" (Guth, 1981), a state of perfect gravitational and expansive balance.
>
> This smoothness of spacetime is logically equivalent ($\Leftrightarrow$) to the state of eudaimonia ($\mathcal{H}_{E}$). For the Stoic, a virtuous life is one that achieves a similar internal balance, or "flatness," where no irrational passion creates distortion in judgment (Inwood, 1985). This is achieved through the Evaluation of the Passions ($\neg\Pi$), the active questioning of emotions caused by irrational beliefs. Just as a flat universe avoids the extremes, the Sage avoids the extremes of desire and aversion, maintaining a steady, harmonious trajectory through existence.

6. Cosmological Constant

The final number, represented by the Greek letter λ (lambda), quantifies the *cosmological constant*, which likely drives the expansion of spacetime and manifests as dark energy. The value of λ is needed for determining the universe's future, as it plays a vital role in its total energy-matter density. It has been determined that the exact strength is needed for the overall density value, Ω, to equal one (Currivan, 2017, p. 90).

The cosmological constant, applied to Stoicism, is closely linked to the concepts of fate and the internal rational will that guides a virtuous life. The Logos, which represents fate, corresponds to a predetermined chain of events. This inescapable force, which expands one’s life experiences over time, brings every external event into one’s

life (Long, 2002). While modern physics views this as a force, the Stoics interpret the underlying Logos as the rational blueprint that governs this expansion (Davies, 2008).

The individual's internal counterpart to this cosmic expansion is their moral choice, the internal driving force that shapes the trajectory of one's moral life. The sage uses the exact strength of reason in their judgments, ensuring that their will aligns with the universal order (Aurelius, 2002). By actively and rationally accepting one's fated reality, individuals find the steady "dark energy" that propels them through life in a virtuous manner (Hadot, 1995).

$$\lambda_{\mathcal{K}} \propto \Lambda \Leftrightarrow \mathcal{B} \propto \mathcal{E}$$

> **Note on Formalization:** This equation identifies the Cosmological Constant ($\lambda_{\mathcal{K}}$) as being proportional to the Universal Reason (Λ) that governs the expansion of the cosmos. As discussed by Carroll (2001), λ it represents an intrinsic energy density that governs the ultimate fate of spacetime.
>
> This universal movement is logically linked ($\Leftrightarrow$) to the individual's Rational Will ($\mathcal{B}$). The equation posits that our will is proportional to Fate ($\mathcal{E}$), the external and inescapable force of the universe. For the Stoic Sage, there is no friction between these two; the internal choice is aligned with the external propulsion of the cosmos.

5.4 The Ethical Implications of Intentropy

By consciously disseminating rational information through one's thoughts and actions, one can deepen human accountability within the broader cosmic context. This leads to the introduction of a concept called *Intentropy*, which synthesizes Stoic ideas with Jude Currivan's informational foundations of reality (Currivan, 2017) as a form of ethical implication with intent, that explicitly includes the human characteristics of

responsibility and accountability. This idea extends the ancient Stoic view of virtue by integrating a modern understanding of information as a fundamental aspect of physical reality (Wheeler, 1989).

The holographic universe theory posits that reality is fundamentally composed of information bits, as discussed before ('t Hooft, 2000). This concept is linked to Stoic Logos, which serves as a blueprint for universal intelligence that organizes the cosmos (Long, 2002). The coherence of this system, governed by intentropy, describes the "intentional", ordered action of the individual mind in alignment with this cosmic information field. It encompasses the conscious process of ensuring that the information we process as judgments and express through our actions is rational and coherent, rather than chaotic or disordered (Sellars, 2003).

For the Stoics, managing information through our thoughts begins with the conscious effort to manage impressions or internal information flow (Long, 2002). Considering also Currivan's viewpoint on a finite thought existing within an infinite and eternal cosmos, which is rich with meaning. The precise calibration of physical laws leads to an inherent evolutionary drive and a fundamental purpose: to progress from initial simplicity toward increasingly complex and distinct levels of self-awareness and relational existence (Currivan, 2022, p. 6).

Such awareness allows individuals to discern truth from falsehood, embracing rational judgments and rejecting irrational ones (Inwood, 1985; Voncken, 2015). This process involves maintaining coherence within one's own mind regarding the informational reality encountered (Fisher, 2013; Lloyd, 2006).

Virtuous actions, seen as an outward expression of this coherent information,

follow the second law of infodynamics, which states that the informational content of the universe is constantly increasing in meaning (Currivan, 2022, p. 272). These actions manifest as acts of justice, courage, and wisdom, transmitting rational order into the physical world and society. This dynamic creates additional opportunities for personal self-awareness and a range of social interactions and cultures, broadening experiences and explorations of unity within diversity (Currivan, 2022, p. 161).

Consequently, one becomes a conscious agent who translates cosmic order into physical and experiential reality, gaining a profound understanding of human accountability. Humans are responsible for their contributions because in the Stoic view, they uniquely possess the capacity to choose rationality over chaos (Long, 2002).

An equation that conceptually builds on this core idea states that eudaimonia is achieved through the conscious act of maximizing the rational information we process and disseminate (Adami, 2016). The equation posits that true human flourishing is not a passive state but an active, continuous process of information management and dispersal (Currivan, 2017). We are accountable for maximizing intentropy, thereby ensuring our conscious participation in the rational evolution of the cosmos (Chaisson & Chaisson, 2002; Fisher, 2016). As seen here:

$$\mathcal{E} \propto \hat{\mathcal{I}}_{\mathbb{R}} = \left(\frac{\Sigma}{\Phi_{\text{irr}}} \right) \times (\mathcal{K} \cdot \Delta H)$$

Note on Formalization: This equation treats Eudaimonia ($\mathbf{E}$) as proportional to Intentropy ($\hat{\mathcal{I}}_{\mathbb{R}}$)—the degree to which an individual responsably aligns with and disperses the universal Logos.

The internal component, $(\Sigma/\Phi_{\text{irr}})$, represents a type of "Information Filter." Here, Rational Assent (Σ) is the numerator, while Irrational Impressions (Φ_{irr}) act as the denominator (Floridi, 2011). A high ratio indicates a mind capable of extracting truth from sensory flux (Long, 2002). This internal order is then expressed through Appropriate Action ($\mathbf{K}$), which interacts with the universe's information field (ΔH).

The concept of intentropy underscores ethical implications that emphasize human accountability within a rational cosmic order (Adami, 2016; Currivan, 2017). This perspective shifts the focus of ethics from external behaviors to internal coherence and active participation in the universe's evolution (Chaisson & Chaisson, 2002; Fisher, 2016). The primary ethical implication revolves around one's internal world, for which one bears full responsibility in balancing rational assent with irrational impressions (Long, 2002; Inwood, 1985; Voncken, 2015).

This also promotes the importance of agency in cultivating virtue and societal well-being (Annas, 1993; Inwood, 1985). Virtue acts as a mechanism for distributing rational order throughout the universe, in line with the second law of infodynamics (Currivan, 2022). Thus, virtue can be understood as complex informational structures that enhance cosmic order by providing meaning, purpose, and a sense of belonging to the cosmos (Adami, 2002; Fisher, 2013; Stoic Mentality, 2024).

An individual's ethics serves as a connection to a universal blueprint, integrating all elements of Stoicism into a cohesive whole. Each person's intentropy must resonate with the information present at the holographic boundary of the universe ('t Hooft, 2000). We are accountable to the entirety of existence because we are inherently part of it. This means that eudaimonia is not simply a passive occurrence but a state that arises

systematically from aligning oneself with the fundamental laws of reality (Sellars, 2003).

A conceptual equation that captures the synthesis of an individual's ethical framework with the universal blueprint of the holographic universe must incorporate the specific physical details of the holographic boundary. This boundary is not merely an abstract surface, but a concrete informational screen composed of the Planck area at the length scale (Bekenstein, 1973), which also undergoes expansion according to the principles of infodynamics (Currivan, 2017). The condition of this physical boundary is similar to the concept of *soft hair*, which is a type of record of very low-energy light and gravity particles (Pasterski et al., 2015). These particles permanently exist on the edge of flat space, serving as a physical mechanism for storing information. The crucial role of soft hair is to ensure the integrity of fundamental physics; its existence guarantees that core conservation laws, such as energy and momentum conservation, are always respected (Pasterski et al., 2015), serving as a dynamic recorder of all information that has crossed the boundary. This affirms that information is never lost from the universe; it is merely transferred from the internal space to the surrounding informational boundary (Hawking et al., 2016). This mechanism directly links the informational dynamics on the boundary to the gravitational effects within the space, offering a powerful physical realization of the holographic principle where the information of the bulk space is encoded on its edge.

$$\mathcal{E} \propto \hat{\mathcal{I}}_{\mathbb{R}} \subseteq \Lambda_U \quad \text{where} \quad \hat{\mathcal{I}}_{\mathbb{R}} \leftrightarrow \frac{A_H \cdot \Delta H_{\mathbb{R}}}{l_P^2 \cdot \Delta S_{\mathbb{R}}}$$

Note on Formalization: This equation posits that Eudaimonia ($\mathbf{E}$) is proportional to Intentropy ($\hat{\mathcal{I}}_{\mathbb{R}} \subseteq \Lambda_U$), which is contained within ($\subseteq$) the Universal Logos (Λ_Γ).

Following Currivan (2017), the equation models the mind as aligned with the Holographic Boundary (A_H). As the universe expands and its total information content increases (ΔH_ι), the density of that information is constrained by the Planck Area l_P^2 and the internal entropy ΔS_ι (Bekenstein, 2003). In this case, virtue is the act of maintaining intentropy that resonates with this fundamental informational architecture.

A fine example of sage-like behavior and the application of intentropy is found in the autobiographical accounts of Austrian neurologist and psychiatrist Viktor Frankl[111] in his book *Man's Search for Meaning* (Frankl, 2006). Frankl was a pragmatic realist who recounted the atrocities of Auschwitz and the ethical decay of those involved. His philosophy did not entail ignoring these issues or pretending they did not exist; instead, it acknowledged them in their stark reality, however, arguing that clinging to hope was crucial for survival (Muldoon, 2020).

Frankl asserted that individuals should seek to discover meaning rather than fabricate it. This led him to establish *Logotherapy*, a therapy centered on meaning that is rooted in an understanding of human nature derived from existential analysis (Frankl, 2006). His research focused on humanity's quest for purpose in life (Hoefle, n.d.). This search for and commitment to meaning serve as a primary method for humans to combat what he termed the *existential vacuum*, a loss of hope and a sense of nothingness, which can be viewed, for our purposes, as a form of psychological entropy or disorganization.

[111] Viktor Emil Frankl was an Austrian neurologist, psychiatrist, philosopher, and Holocaust survivor, who founded logotherapy, a school of psychotherapy that describes a search for a life's meaning as the central human motivational force.

The suffering and despair observed in the camps could, from a Stoic perspective, represent irrational impressions that might easily lead to an entropic mental state and false beliefs, as discussed earlier in Carhart-Harris' entropic brain theory (Carhart-Harris et al., 2014). When referring to "irrational impressions" from suffering, it is not meant to diminish the cruelty and inhumanity of these events; rather, it implies that one could irrationally judge such horrors as sufficient to strip an individual of all hope. By applying rational choice and believing that his suffering had a purpose, Frankl found meaning in remembering his wife and in helping others. These were rational, value-driven decisions that actively countered the irrationality of hopelessness (Frankl, 2006).

Frankl poignantly describes his fellow prisoners who had given up on life by losing all sense of hope. Throughout his book, he quotes Friedrich Nietzsche[112], stating, "He who has a why to live for can bear almost any how" (Kushner, 2006, p. ix). This quote resonates with Stoic doctrine, suggesting that Logotherapy might be rooted in Epictetus's *Discourses* (Dobbin, 2008).

American rabbi and author Harold Kushner[113] highlights that Frankl's most enduring insight is that forces beyond one's control can take away everything a person possesses, except for one thing: the freedom to decide how to respond to a given situation (Kushner, 2006, p. x). This idea echoes Epictetus's lesson on the dichotomy of control. Consequently, no one is ever left with absolutely nothing, as long as they maintain the freedom to choose their response to events (Kushner, 2006, p. xi).

Logotherapy, deriving its name from the Logos as we've understood it in this

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[112] Friedrich Wilhelm Nietzsche was a German atheist philosopher. He began his career as a classical philologist, turning to philosophy early in his academic career.

[113] Harold Samuel Kushner was an American rabbi, author, and lecturer. He was a member of the Rabbinical Assembly of Conservative Judaism and served as the congregational rabbi of Temple Israel of Natick, in Natick, Massachusetts, for 24 years.

dissertation, emphasizes the need for freedom and responsibility to coexist (Frankl, 2006; Hoefle, n.d.). By accepting responsibility for their actions and responding to situations honorably and ethically, individuals introduce intentionality into the world, as guided by the cosmos (Brennan, 2005; Muldoon, 2020). This illustrates the concept of intentropy at work, which evolves informationally as the universe expands, facilitating the emergence of increasingly advanced levels of consciousness and self-awareness that can be realized, experienced, and embodied (Currivan, 2017, p. 114). Frankl asserts that by acknowledging individuals' responsibility and recognizing the meaningful potential of their lives, the genuine significance of their existence lies in the external world rather than being confined to their internal psyche, as if it were an isolated system (Frankl, 2006, p. 110).

As inherently integral beings whose consciousness ultimately transcends spacetime, we participate in the experiential co-creativity of our finite universe, which shapes itself within the infinite expanse of the cosmic mind. The more one forgets themselves, by giving themselves a cause to serve or another person to love, the more human they become and the more they actualize themselves, making self-actualization possible only as a side effect of self-transcendence (Frankl, 2006, pp. 110-111). This grand perspective on humanity and the universe resonates with ancient spiritual wisdom (such as Stoicism), offering us an expanded and newly articulated vision of reality. It emphasizes the fundamental roles in the universe's development as inherently purposeful and meaningful (Currivan, 2017, p. 191).

The search for meaning is, in essence, a way for humans to connect with the Logos. Frankl believed that life holds meaning in all circumstances, even the most

horrific ones, because this meaning exists as part of an enduring, objective reality (Muldoon, 2020). By viewing meaning as an objective reality that can be uncovered and responded to with responsibility, Frankl positions human life within a rational cosmic order. He argues that individuals should use their reason to create internal coherence and ethical behavior, thus responding with rational purpose in all facets of life (Long, 2002; Hadot, 1998; Robertson, 2020).

CHAPTER VI
Eudaimonia: Love as Cosmic Fulfillment

> *Nature bore us related to one another... She instilled in us a mutual love and made us compatible... Our fellowship is very similar to an arch of stones, which would fall apart if they did not reciprocally support each other.*
>
> — Seneca the Younger, *Moral Letters to Lucilius*

6.1 The Eudaimonic Imperative

The final chapter of this dissertation must anchor the broad and complex concept of ethics in a single word that has been widely used since antiquity, yet still lacks a precise definition: eudaimonia. This term encompasses the idea of achievement and represents an endpoint that, according to all the ancient Greek schools of philosophy, signifies the pinnacle of living a virtuous life (Long, 2002). However, defining it simply as “human flourishing” or “living well” feels too subjective and vague. Perhaps it is precisely in this subjectivity and simplicity that we can recognize how truly attainable it is to live in accordance with nature (Sellars, 2003). The mysteries and wonders of life stem from this simplicity, echoing Einstein's assertion that the universe is as simple as it can possibly be, but not simpler, to fulfill its evolutionary purpose (Currivan, 2017, p. 181).

The Stoics did not view eudaimonia as an incorporeal entity but rather as a supreme goal. In Stoic physics, incorporeals are defined as things that exist but cannot

physically act or be acted upon, as previously stated. The Stoics recognized only four categories of incorporeals: place, void, time, and "sayables" (Rubarth, n.d.). While a goal may initially seem like something to attain, such as either a location or a state of being, flourishing or living well is seen as a quality of the corporeal soul. Similarly, virtue, which is considered the necessary and sufficient condition for eudaimonia, is also a corporeal state or quality of the soul and is composed of pneuma (Durand et al., 2023). This carries significant implications for us, as in ancient theories, virtue is not considered separately; it is viewed as a component of a broader system whose central idea is happiness (Annas, 1998, p. 37).

This pursuit of flourishing is directly linked to the rational quest for happiness, which is indispensable in leading a fulfilling life. As Aristotle noted, happiness stems from the rational exercise of virtue (Aristotle, 2009). He argued, as did most philosophers, that only humans possess reason, and human happiness must arise from the active use of reason to perform virtuous deeds, which are unique to humanity, and to do so to the best of one's ability. Those best suited to this, some by nature or circumstance, will be the happiest (Crowe, n.d.). The main difference here, however, was Aristotle’s claim that virtue wasn’t all that was necessary to attain eudaimonia, whereas the Stoics and Platonists agreed that it was sufficient.

Matthew Sharpe explains that both Socrates and the Stoics hold the belief that virtue is the only true good for us (Sharpe, 2014). This is because virtue is always beneficial and cannot harm its possessor. In contrast, we can see that individuals may be negatively impacted by their wealth, fame, or arrogance regarding their appearance or possessions. However, no one is ever harmed by their virtue (Pierce, 2022).

It is possible to observe people who are poor yet happy because they know how to make the best of their limited resources. The Stoics recognize this. On the other hand, someone may be wealthy but, lacking the virtue of knowing how to make the most of their external circumstances, may find their possessions turn into sources of discontent and ways to bring unhappiness to others. This straightforward and compelling argument forms the core of Stoic virtue ethics (Sharpe, 2014, p. 31).

Although the Stoics claim that eudaimonia is objective, modern psychologists have infused the term with significant subjectivity in their efforts to understand its meaning. This shift can be linked to psychology's more sympathetic approach toward the nuanced Aristotelian definition of eudaimonia, in contrast to the Stoics' more straightforward interpretation (Long, 2002). Unfortunately, this has led to confusion and has undermined the historical significance of eudaimonia in Greek philosophy, ultimately serving only to satisfy the misunderstandings of a few.

Alan S. Waterman[114] from the Department of Psychology at The College of New Jersey in Roxbury, Vermont, discusses the concept of eudaimonia in his paper, *Reconsidering Happiness: A Eudaimonist's Perspective* (Waterman, 2008). He notes that modern eudaimonist philosophers explicitly define eudaimonia as a unique set of subjective experiences. For instance, it includes the feeling of "being where one wants to be, doing what one wants to do," where these desires are considered meaningful pursuits. Eudaimonia encompasses various subjective experiences, such as feelings of alignment and centeredness in one's actions, a sense of identity, a strong purpose, and competence.

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[114] Alan S. Waterman is Professor Emeritus in Department of Psychology at The College of New Jersey. Social psychology, Identity, Happiness, Eudaimonia and Developmental psychology are his primary areas of study. The concepts of his Eudaimonia study are interwoven with issues in Cognitive psychology, Intrinsic motivation and Meaning.

Waterman concludes that eudaimonia, viewed as a set of subjective experiences, represents a highly positive emotional state. He argues that operational definitions of eudaimonia based on these subjective experiences can be more effectively established (Waterman, 2008, p. 236).

The issue at hand, and likely the reason for subjectifying eudaimonia, stems from the inevitable comparison between eudaimonia and hedonism (Annas, 1993). The Stoics, along with other schools of ancient Greek philosophy, did not see a need to justify the distinction between these two terms, which represent polar extremes in the concept of "flourishing" (Long, 2002; Whiting & Konstantakos, 2021). Even the Epicureans were adept at distinguishing between the two. For Epicurus, eudaimonia was achieved through the experience of pleasure (*hedone*), specifically through the absence of pain and mental disturbance. Pleasure was viewed as the means to attain a flourishing state (Aranda, 2024).

However, despite the Epicureans being categorized as hedonists, their definition of pleasure led them to a life of quiet moderation. This lifestyle, while appearing outwardly similar to asceticism, starkly contrasts with the modern understanding of hedonism as the pursuit of excessive indulgence. The Epicureans regarded eudaimonia as a life lived wisely, nobly, and justly, believing that this was the only way to ensure the most profound and lasting form of pleasure (Lake et al., 2021).

The shortcomings and misconceptions surrounding the modern definition of subjective eudaimonism should be clarified. In Stoicism, eudaimonia is considered an imperative because it represents the natural and rightful goal of a rational human life (Hadot, 1995). It is intrinsically connected to the moral obligation to live virtuously and

in harmony with the rational order of the universe. Eudaimonia is not simply a desirable outcome; it is a duty that arises from a proper understanding of human nature and the reality of the cosmos (Currivan, 2017).

Cognitive behavior therapist, author, and Stoic philosopher Donald Robertson has aptly articulated this perspective by stating:

> In classical philosophy, a distinction is often made between more passive sensory "pleasure" (hedone) and the kind of "happiness" (eudaimonia) that comes from rational activity in accord with the psychological virtues. According to this view, true happiness is constant and self-generated; it comes from within, as the cliché goes. For example, an authentic sense of happiness may come from the knowledge that one has acted freely and with genuine integrity, courage, and wisdom, in accord with one's highest psychological strengths and values. The pleasure that comes from indulging in sex, food, drink, drugs, or glorying in praise from others is passive in the sense that it depends upon external stimulation. It is, therefore, transient and not entirely under our control, but it depends upon fortunate circumstances. The happiness that comes from loving truth, reason, integrity, and wisdom, by contrast, is autonomous; it depends only upon itself (Robertson, 2020, p. 3).

In this spirit of duty, rooted in an understanding of human nature and the realities of the cosmos, seeking to explore the holographic universe from a Stoic perspective is an objective of this dissertation. The notion of eudaimonia does not arise from subjective expression; rather, it originates from a necessary and rational alignment with the Logos

(Annas, 1993; Long, 2002; Whiting & Konstantakos, 2021). Each individual possesses unique gifts and talents to contribute to the universe, but eudaimonia represents an objective state of coherence where a person's internal rational framework aligns perfectly with the external rational order of the cosmos (Annas, 1993; Fisher, 2013). This is not about personal belief; it focuses on accurate information processing and alignment (Hadot, 1995).

In envisioning what the path of the sage might look like in achieving eudaimonia, we must consider that their consciousness provides a perfectly clear, undistorted signal to the universe, free of fear, grief, and unhealthy desires. Their state rests in a verifiable instance of maximum coherence of intentropy within the human form. To achieve this, there must be a shift toward a new paradigm of unified reality, relationship, and regeneration, which can be termed a science of unitive love (SOUL) (Currivan & Storry, 2025).

6.2 Humanity's Next Step Towards Eudaimonia

In light of the previous section's argument on the intentional objective definition of eudaimonia over its misinformed modern view in psychology, portraying a subjective framework to fit its needs, this dissertation will further add to the importance of this position by stating that Stoicism, reflecting the natural order of the universe, is a living philosophy, akin to any organism that is alive and evolving. Evolving with the cosmos and expanding with the universe, one follows the arrow of time towards more complex relationships, towards a universal self-awareness flowing with meaning and purpose, towards relational diversity and interdependent richness (Currivan & Storry, 2025, p. 3). This entails a loosening of the ego, a relaxation of the brain's DMT network, which

increases entropy in the brain's structure and increases intropy in its informational content (Carhart-Harris et al., 2014).

The prokopton is respectful and grateful for their individual experiences because it is through their personal efforts that training occurs (Dobbin, 2008; Robertson, 2020). This process involves aligning one's inner self with the outside world, managing self-perceptions, questioning beliefs, and ultimately becoming aware of one's divinity and unity with everything that has existed since the beginning of time. Eudaimonia is not an incorporeal place that is reached; it is an embodied becoming (Annas, 1993; Hadot, 1995). This transformation cannot be limited to simply attaining inner peace. By the fruits gained from a whole-world view of nature, the Stoic becomes responsible for its stewardship, and in this transcendence, they shed the subjective view by seeing the world with one thousand eyes (Inwood, 1985; Stoic Mentality, 2024). This is what eudaimonia means. It is not a state of well-being, but a new being that has emerged to become one with the whole (Long, 2002; Hadot, 1998; Aurelius, 2003).

Dr. Jude Currivan and entrepreneurial executive Grant Storry[115], who focuses on human-centered solutions and systems healing, have introduced a new framework called the Science of Unitive Love (SOUL) (Currivan & Storry, 2025). This transdisciplinary approach recognizes love not just as an emotion but as a fundamental principle that organizes reality. The SOUL proposal suggests that love is a coherent motion—an informed signature that is vibrational, structural, and meaningful within our evolving, sentient universe (Currivan & Storry, 2025, p. 1).

[115] Grant Storry spent the first half of his professional life as a technology entrepreneur. He is the co-founder of Kiiren, an AI enterprise focused on aligning AI in right relationship to human values and also the co-founder of ePatron, a platform designed to empower Creators by helping them cultivate their creativity, share their work with communities, and earn a dignified livelihood.

As previously discussed regarding the coherence of our universe and Stoic cosmology, the universe is relational and filled with meaningful experiences. Love is the human experience that aligns with this coherence and supports the Stoic concept of *apatheia*, which refers to freedom from unhealthy passions and disturbing emotions (Hadot, 1998). This leads to a rational and balanced mind. It is important to distinguish between a misguided notion of love, driven by irrational emotions linked to isolated egoic impulses such as possession or lust, and the unifying love that strengthens relationships, nurtures creativity, and promotes care (Currivan & Storry, 2025). Stoicism embraces love as a generative force that encourages cosmopolitanism, ultimately benefiting all of humanity (Aurelius, 2003).

To enhance the coherence of this idea and align it with the Stoic principle of only assenting to truthful and rational impressions, Currivan and Storry explain that emotional frequencies, such as love, can be seen as vibrational imprints that interact with and encode the holographic structure of reality (Currivan & Storry, 2025, p. 3). The Stoic sage uses love as a regenerative and coherence-enhancing force. This consciousness is holographically distributed and participatory in the evolution of the universe, guiding humanity towards eudaimonia.

SOUL emphasizes the critical concept of intentropy and responsibility by highlighting the duty that human beings have as custodians of the universe. Dr. Rollin McCraty[116] of the HeartMath Institute[117] has studied the impact of individual emotional coherence on a global scale, as well as its connection to solar activity. His research

[116] Rollin McCraty, Ph.D., is the director of research at the HeartMath Institute, and professor at Florida Atlantic University. McCraty is a psychophysiologist whose interests include the physiology of emotion.
[117] HeartMath Institute is a non-profit that has developed reliable, scientifically validated tools that help people reduce and avoid stress while experiencing increased peace, satisfaction and self-security.

suggests that when the rhythms of the human heart and brain align with the planet's electromagnetic field, which ranges from 0.01 to 300 Hz, they mirror the frequencies associated with sustained states of love, gratitude, and meditation. This alignment may assist a reciprocal coherence between individual human physiology and the Earth's geomagnetic field, reinforcing the idea that love is not only of the essence for personal well-being but also for planetary harmony. In this context, when human emotional states are properly managed and understood, like in the practice of Stoicism, they contribute not only to individual well-being but also to the overall health of our shared energetic environment (Currivan & Storry, 2025, p. 4).

To live in accordance with nature's laws means that love is a virtuous act. All Stoics would agree that love serves as a mode of knowing and an embodied truth that grants us access to deeper insights. It integrates emotion, intuition, and direct experience with analytical thought, allowing us to participate as micro-cosmic co-creators of the universe (Currivan & Storry, 2025, p. 4).

A conceptual equation for eudaimonia within the Stoic framework calculates that flourishing, achieved by living in harmony with nature and reason, incorporates love as a vital and dynamic component of its structure. This can be examined through the Stoic tripartite of ethics, logic, and physics, in conjunction with SOUL's formula, all of which are needed for the proper functioning of the rational self (Fisher, 2013; Whiting & Konstantakos, 2021). Love serves as a bridge between the self and others, expanding the self's concern outward in alignment with nature.

$$\mathcal{E} = \sum_{t=0}^{t_{\text{final}}} (\mathbf{A}_{\rho\tau\eta,t} + \mathcal{L}_t + \hat{\mathcal{I}}_{\mathbb{R},t}) \times \Delta\ell_{\mathcal{X}}\Phi$$

Note on Formalization: This equation defines Eudaimonia ($\mathbf{E}$) as continuous, rather than a single destination, represented by the summation ($\sum_{t=0}^{t_{final}}$). The values of Virtue ($\mathbf{A}_{\rho\tau\eta_t}$), Rational Love ($\mathbf{L}_t$), and Intentropy ($\hat{\mathcal{I}}_{\mathbb{R},t}$) accumulate and are practiced daily throughout a person's entire life span (Seneca, 1969).

Virtue at time t represents moral excellence and the four cardinal virtues: wisdom, justice, courage, and temperance; for the Stoics, this is the sole good and sufficient foundation for eudaimonia (Stephens, 2007). Rational Love ($\mathbf{L}_t$) at time t is a conscious, unifying force rather than an irrational passion (Nussbaum, 1994).

This entire sum is multiplied by the Dichotomy Factor ($\Delta l_{\mathcal{X}}\Phi$), which applies the Dichotomy of Control (Irvine, 2009). This determines the effectiveness of one's actions, ensuring that the practice of virtue, love, and wisdom is directed toward what is within one's power to achieve a flourishing life.

6.3 Serving the Cosmos

In Stoicism, duty and virtue are inextricably linked elements. They shape the individual as an active agent in service to the natural world (Long, 1986). The Stoic theory of *Oikeiosis*, which roughly translates as "affinity" or "appropriation," describes the process by which individuals naturally broaden their concern from themselves to their family, friends, community, and ultimately to all of humanity (Ramelli & Konstan, 2009). This theory illustrates how a person evolves from an initially self-centered state to a mature, rational being focused on ethical action (Sharpe & Ure, 2021). This growth in the sense of "self" is considered a rational duty; acting justly and kindly toward others is simply aligning with our social nature, which is itself part of the universal nature.

In Cicero's *De finibus* (Cicero, 1931), through the voice of Cato the Younger[118], he introduces the Stoic definition of the Stoic concept:

> Again, it is held by the Stoics to be important to understand that nature creates in parents an affection for their children; and parental affection is the source to which we trace the origin of the association of the human race in communities… Hence, as it is manifest that it is natural for us to shrink from pain, so it is clear that we derive from nature herself the impulse to love those to whom we have given birth. From this impulse develops the sense of mutual attraction that unites human beings as such; this is also bestowed by nature. The mere fact of their common humanity requires that one man should feel another man to be akin to him… Again, they hold that the universe is governed by divine will; it is a city or state of which both men and gods are members, and each one of us is a part of this universe; from which it is a natural consequence that we should prefer the common advantage to our own. For just as the laws set the safety of all above the safety of individuals, so a good, wise and law-abiding man, conscious of his duty to the state, studies the advantage of all more than that of himself or of any single individual (Cicero, 1931, pp. 283-285).

Marcus Aurelius also expresses the concept of oikeiosis in various sections of *The Meditations* (Aurelius, n.d.):

> Now the good for the reasonable animal is society; for that we are made for society has been shown above. Is it not plain that the inferior exist for the sake of

[118] Marcus Porcius Cato was a great-grandson of Cato the Censor and a leader of the Optimates (conservative senatorial aristocracy) who tried to preserve the Roman Republic against power seekers, in particular Julius Caesar.

the superior? But the things which have life are superior to those which have not life, and of those which have life the superior are those which have reason (Aurelius, n.d., book 5, section 16).

When thou risest from sleep with reluctance, remember that it is according to thy constitution and according to human nature to perform social acts, but sleeping is common also to irrational animals. But that which is according to each individual's nature is also more peculiarly its own, and more suitable to its nature, and indeed also more agreeable (Aurelius, n.d., book 8, section 21).

The intelligence of the universe is social. Accordingly, it has made the inferior things for the sake of the superior, and it has fitted the superior to one another. Thou seest how it has subordinated, co-ordinated and assigned to everything its proper portion, and has brought together into concord with one another the things which are the best (Aurelius, n.d., book 5, section 20).

Art thou not content that thou hast done something conformable to thy nature, and dost thou seek to be paid for it? Just as if the eye demanded a recompense for seeing, or the feet for walking. For as these members are formed for a particular purpose, and by working according to their several constitutions obtain what is their own; so also as man is formed by nature to acts of benevolence, when he has done anything benevolent or in any other way conducive to the common interest, he has acted conformably to his constitution, and he gets what is his own (Aurelius, n.d., book 9, section 31).

Oikeiosis emphasizes the growth of reason and the recognition of our connection not only to other people but also to all of nature and the universe (Long, 2001). This forms the foundation of the Stoic ideal of "living in accordance with nature." It involves understanding that our well-being is interconnected with the well-being of the universe as a whole (Sellars, 2006). This realization leads to a life characterized by virtue, wisdom, and harmony with the natural order.

As one's sense of oikeiosis expands to include others, it naturally cultivates empathy and a sense of justice, since all humans share the same rational nature (Annas, 1993; Inwood, 1985). This understanding challenges narrow perspectives and encourages a universal ethical viewpoint that commits us to treat everyone with fairness and compassion (Long, 2002; Robertson, 2020). One's duties extend beyond self-interest; acts of kindness, justice, and cooperation are viewed as fulfilling our natural roles within the human community and contributing to the stability and prosperity of society (Weaver, 2024).

An ethical life dedicated to the common good can be understood through the integration of three key Stoic concepts that work harmoniously together. The first concept, *kathēkon*, refers to appropriate actions within the framework of a socially responsible life (Inwood, 2003). However, merely performing a kathēkon is not sufficient for a Stoic. The true moral worth of an action lies in aretē, the virtue or moral excellence (Annas, 1993; Robertson, 2020). Aretē represents the internal, rational state of mind that guides an individual to choose the appropriate action for the right reasons (Hadot, 1995; Whiting & Konstantakos, 2021). Actions undertaken solely out of fear of punishment or hope of reward lack virtue; instead, true virtuous actions are performed with a clear

understanding that they align with rationality and the natural order, irrespective of their external outcomes (Inwood, 2003).

The connection between action and virtue is embodied in prohairesis, which, as discussed, is the faculty of choice or moral purpose. This internal ability is the only aspect of our lives that one can truly control, and it is here that one's commitment to service resides. Prohairesis determines whether an action is performed with virtue or not. A Stoic dedicates themselves to service by consistently exercising prohairesis to align their will with nature and reason. By focusing their intention on acting justly and contributing to the universal community, the Stoics ensure that every kathēkon becomes a fully virtuous act of service, thereby achieving both inner harmony and a positive impact on the common good (Long & Sedley, 1987; Hadot, 1995; Robertson, 2020).

Looking again to Marcus Aurelius, the head of the Roman state but a Stoic philosopher first, for his poignant reminders about how the Stoic mindset can benefit the world, he stated:

> Everything material soon disappears, and in a little time is absorbed into the universal substance; but the prohairesis is otherwise engaged, and by frequent exercise of itself purifies even the passion... It makes itself an impression of whatever can be judged and measured, and of the whole of a man's life it forms a judgment, without being stopped by the noise which surrounds it (Aurelius, n.d., book 6, section 15).

> A rational soul is better than a bad rational soul... a social soul than an unsocial soul, a just soul than an unjust soul... In fine, a soul is better than any other thing

> that is not rational, for the purpose of being a social animal and of producing fellowship (Aurelius, n.d., book 5, section 16).

“Consider if it is not right to do this... For you have received a power to observe and to think. See that you never feel towards misanthropes as such people feel towards the human race” (Aurelius, n.d., book 10, section 4).

"That which is not good for the swarm, neither is it good for the bee" (Aurelius, n.d., book 6, section 54).

In synthesizing the concepts of prohairesis, kathēkon, and aretē to fit this model of the holographic universe, one can create a conceptual equation that expresses the highest form of human flourishing, eudaimonia, being achieved by consciously aligning one’s internal self and external actions with the reasoning of the cosmos (Currivan, 2017; Fisher, 2013; Whiting & Konstantakos, 2021). Love will be represented with (**Φ**) to show that it is not just an emotion but an imperative component of the universe's structure and an individual's ethical obligation to recognize and act upon this universal interconnectedness (Brown, 2012; Long, 2002; Robertson, 2020).

$$\mathcal{E} = \sum_{t=0}^{T} (\mathbf{A}_{\rho\epsilon\tau\eta,t} + \Phi_t + \hat{\mathcal{I}}_{\mathbb{R},t}) \times \Sigma$$

Note on Formalization: This equation defines Eudaimonia **(E)** as a holographic integration of a life's totality ($\sum$ from $t = 0$ to T). It treats the human experience as a unified "complete life" where every moment contributes to a singular, resonating state of being.

Aretē **(**$\mathbf{A}_{\rho\epsilon\tau\eta_t}$**)** is here to ensure that the individual's internal data is coherent with the universal "in-formation" field (Currivan, 2017). Fellowship **(**Φ_t**)** acts as the unitive field of consciousness, bridging the gap between the individual and the cosmos through the Stoic practice of *oikeiosis* and the Science of Unitive Love (Currivan & Storry, 2025).

Intentropy **(**$\hat{\mathcal{I}}_{\mathbb{R},t}$**)** represents the intellectual evolution that drives this coherence, where increased wisdom results in a higher responsibility within the system. The final term, Σ (Symphonia) serves as the multiplier of harmony that represents prohairesis (moral choice). By aligning the individual will with the Logos, (Σ) filters out irrational passions, allowing the sum of one's life to vibrate in perfect agreement with the universal system (Seneca, 1969; Irvine, 2008).

6.4 The Fractal Match to the Universal Pattern

Humans are naturally inclined to form bonds with one another. This tendency to create associations based on mutual concern explains current human behavior, such as the reason one lives in cities, and establishes an ideal for how one should conduct oneself. The Stoics find an explanation for this inclination to form communities, as well as a vision of the best type of human community, within the teleological framework of nature (Shogry, 2020, p. 386).

From the concept of oikeiosis, the Stoics derive the idea of cosmopolitanism as a way of life. The will of nature serves as the law of the cosmopolis. According to the Stoics, this law represents the right reason of nature, which they consider to be divine law. A human being is a citizen of the cosmos as long as they align with divine law, which is synonymous with natural law and is found within each person as consciousness and right reason (Eliopoulos, 2014).

In the Stoic view, individuals can be seen as a type of microscopic citizens who find their purpose and harmony by recognizing their place within the unified, rational

system of the cosmopolis (Aurelius, 2003). Existence has a fractal nature (Currivan, 2017, p. 101), meaning that each individual contains within themselves the same rationality that structures the entire universe. The internal quest for self-knowledge and virtue reflects a simultaneous alignment with cosmic order (Hadot, 1998). By understanding that their personal Logos is part of the greater Logos, a person can move beyond narrow self-interest and embrace a life dedicated to the whole (Long, 2002). Their actions, driven by virtuous intent, become meaningful contributions to the universal order rather than isolated events, leading to a profound sense of purpose, tranquility, and true human flourishing (Cicero, 1931; Diogenes Laertius, 1925; Long & Sedley, 1987).

This fractal existence unites human rationality with the universe's structure, which is expressed through the geometric shapes that define our dimensions. In the 1970s, Polish mathematician Benoit Mandelbrot[119] discovered that beneath the appearance of complex objects, such as coastlines, lie simple, self-similar geometric patterns that he called *fractals* (Mandelbrot, 1983*)*. These patterns exhibit logarithmic replication on both small and large scales, demonstrating that underneath the chaos and diversity of complex systems lies a profound and universal harmonic order, as ancient sages had intuitively sensed (Currivan, 2017, p. 101).

This suggests that one’s rational capacity is a smaller, self-similar iteration of the universal reason (Long, 2001). Just as a small section of a fern reveals the pattern of the entire plant, the individual mind contains the potential for the same order and coherence found in the cosmos. The internal quest for self-knowledge and virtue is, therefore, a process of tuning the personal fractal to match the universal pattern. By understanding

[119] Benoit B. Mandelbrot was a Polish-born French-American mathematician and polymath with broad interests in the practical sciences.

that their personal logos is an inherent part of the greater Logos, a person moves beyond narrow self-interest and embraces a life of duty towards the whole (Aurelius, 2008). Their actions, driven by virtuous intent, become meaningful contributions to the universal order, leading to a profound sense of purpose. This harmonious relationship between the individual and the cosmos reinforces the Stoic idea that ethical living is the most natural state of being (Sellars, 2006).

To illustrate how humanity's microscale rational capacity acts as a fractal match to the universal pattern, and how virtuous actions transform into meaningful contributions to the universal order, it can be interpreted with the following equation:

$$\mathbf{V}_{\mu} \propto \mathcal{F}(\Lambda_{\mu}, \Lambda_{U}) \Rightarrow \mathbf{A}_{V} \rightarrow \mathcal{H}_{\kappa}$$

Note on Formalization: This equation formalizes the Stoic principle of living in agreement with Nature through the lens of fractal geometry and informational physics. It states that the virtue of the individual ($\mathbf{V}_{\mu}$) is proportional to the fractal resonance ($\mathcal{F}$) between their personal reason (Λ_{μ}) and the universal intelligence Λ_{U} (Aurelius, 2008).

This alignment brings individual agency to cosmic integration; when an agent recognizes this fractal self-similarity $\Rightarrow$(Mandelbrot, 1983), their virtuous actions ($\mathbf{A}_{V}$) cease to be isolated occurrences and instead become a coherent contribution toward the realization of total Cosmic Harmony $\mathcal{H}_{\kappa}$(Currivan, 2017; Long, 2002).

CHAPTER VII

Conclusion: Toward a Holographic Stoicism

> *He who sees the present looks upon all things: both all which has come to pass from all eternity and all which shall be throughout the infinite future. For all things are of one kin and of one form.*
>
> —Marcus Aurelius*, Meditations*

7.1 **Conclusion**

As this dissertation has explored, the origins of Stoic thought reveal a profound quest for understanding the natural world that resonates deeply with contemporary cosmology. The central observation that the early Stoics likely constructed their entire philosophical system based on observations of the universe's meaning suggests a framework that moves beyond mere analysis of surviving texts to a deeper appreciation for its evolutionary development as a functional way of life (Hadot, 1995; Robertson, 2020). This synthesis with modern cosmology and the concept of an informationally meaningful universe has allowed us to link a 2,000-year gap in our understanding, illuminating how a seemingly ancient philosophy can provide a coherent roadmap for a modern perspective of the universe (Fisher, 2013; Stoic Mentality, 2024).

In understanding that reason is the most fundamental "qubit" of information in the universe, pixelated at the Planck scale, and remaining invariant across spacetime, it serves as the prime ingredient for the formulation of the universe's hologram (Currivan,

2017). This dissertation has drawn this conclusion by applying the second law of thermodynamics through the interpretive lens of infodynamics. This perspective reveals that the apparent rise of organization in the universe is a manifestation of intropy, the inherent drive for self-organization and information gain. The Stoics, through their contemplation of nature, arrived at a similar conclusion: that a pervasive, rational principle underpins all existence and guides its evolutionary trajectory from conflagration to conflagration (Long, 2002).

This cosmological interpretation fundamentally informs the Stoic tripartite system of physics, logic, and ethics, which includes divine guidance and culminates in the final picture of the universe as a hologram (Susskind, 1994). It also posits that the Stoic concept of cosmopolitanism is not merely an ethical principle, but a metaphysical truth, in which the individual is a microcosmic citizen and their rational capacity is a fractal match to the universal pattern (Eliopoulos, 2014). This realization, shown in the equations, shows how virtuous actions cease to be isolated events and become meaningful contributions to the universal order.

The conceptual equations within this dissertation provide a highly original and cohesive interpretation of the core arguments presented. By translating abstract philosophical and cosmological principles into a unifying language, these formulas offer a novel way to connect ancient Stoicism and contemporary physics into a single expression. The equations seamlessly integrate key concepts such as virtue, love, intropy, and cosmic harmony, demonstrating their interdependence within a Stoic model of cosmic evolution. Their strength lies in their ability to visually and viscerally represent complex cosmological relationships, expressed in the universal language of mathematics,

while remaining consistent with the underlying Stoic emphasis on intention and the holographic model of reality. This formalization not only clarifies the interdisciplinary nature of the research but also integrates all the dissertation's main points, enabling them to be viewed as components of a single, cohesive system.

Ultimately, this demonstrates that the goal of living in accordance with nature is rooted in the intropic pathway of information (Currivan, 2017; Fisher, 2013). This purpose, therefore, is to carry the torch of responsibility, using reason to drive the evolutionary process forward, with the destination being a state where humanity's collective consciousness reflects the unified, harmonious, and truly magnificent picture of the cosmos (Chaisson & Chaisson, 2002; Okamoto, 2023). This is the eudaimonic objective of a holographic universe, a state of flourishing that is the natural outcome of every part of the fractal recognizing its connection to the whole (Sharpe, 2014). By embracing this truth, we come to understand that we are one with all that exists, mirroring the wonder and beauty of all creation and reaching the ultimate goal of humanity's realization of its own divinity (Currivan, 2023).

Here is the final conceptual equation for this dissertation, designed to summarize the thesis and unify the Stoic pursuit of eudaimonia with the principles of the informationally meaningful, holographic universe.

$$\mathcal{E} = \mathcal{E}(\Lambda_\mu) \propto \mathcal{F}(\Lambda_\mu, \Lambda_U) \implies \sum_{t=0}^{T} (\mathbf{A}_{\rho\epsilon\tau\eta,t} + \Phi_t + \hat{\mathcal{I}}_{\mathbb{R},t}) \times \Sigma$$

Note on Formalization: This equation represents the complete ethical circuit. It establishes that Eudaimonia ($\mathcal{E}$) is the emergence of individual reason (Λ_μ),

which is proportional to ($\propto$) the fractal match ($\mathcal{F}$) to universal reason (Λ_U). This reflects the metaphysical insight of the universe as a self-similar, rational pattern, where the individual agent is a holographic iteration of the whole (Aurelius, 2008; Mandelbrot, 1983). This alignment leads to ($\Rightarrow$) the summation ($\sum$) starting from the inception of a process ($t = 0$) through to its completion (T). Within this lifetime, the accumulation of virtue ($\mathbf{A}_{\rho\epsilon\tau\eta_t}$), love ($\Phi_t$), and Intentropy ($\hat{\mathcal{I}}_{\mathbb{R},t}$) is modulated by conscious coherence (Σ) with universal information, ensuring that the total flourishing of the soul is in perfect agreement with the Logos (Currivan, 2017; Long, 2002).

The reader is encouraged to adapt these ideas with their own insights to further develop an evolution of Stoicism that fits with their understanding of an informationally meaningful universe. The advancement of this philosophy relies on new scholars who will continuously update its wisdom as new scientific discoveries emerge. It calls also embrace new methodologies to explore the vast potential of the human mind and its connection to the Logos.

That said, the human mind is not limited to a single, static state of everyday waking consciousness; rather, it possesses a spectrum of consciousness that, according to the principles of a holographic universe, offers insights into the cosmos's underlying unity and structure (Carhart-Harris et al., 2014). The pursuit of wisdom is the refinement of our fractal understanding of universal reason, therefore rationally extending the exploration of these varied states of perception. The responsible study of altered states of consciousness, particularly those induced by psychedelics, and the systematic practice of meditation and breathwork, offer powerful tools for this purpose (Robertson, 2020; Whiting & Konstantakos, 2021). These modalities can facilitate direct, intuitive experiences of the universe's interconnectedness, providing a deeper understanding of the

unitive love that underpins reality and enabling a more profound sense of coherence between the individual and the cosmic system (Currivan & Storry, 2025).

Applying these tools in Stoic practice is to move beyond purely intellectual understanding to experiential wisdom (Hadot, 1995). The modern Stoic, committed to their duty and the pursuit of virtue, can use these methodologies to enhance their capacity to process universal information and further develop the philosophy (Robertson, 2020). This does not abandon the Stoic emphasis on reason; instead, it expands the ability to access it, acknowledging that the path to aligning our internal logos with the universe might require exploring all facets of human awareness (Hadot, 1995; Robertson, 2020). This allows us to assert that Stoicism understands the universe's evolution as an informational process reaching humanity via philosophy, offering one the potential to become aware of their divine composition and the inherent meaning arising from the universe's birth (Currivan, 2017; Fisher, 2013). This understanding facilitates for humanity an approach to cultivate virtue and pursue eudaimonia as a conscious participant in cosmic evolution.

I must acknowledge, however, that this research is not without its limitations. While the conceptual equations I have developed offer a novel heuristic for linking philosophy and physics, they are not intended as formal mathematical proofs. Furthermore, my synthesis relies on a specific interpretation of the Holographic Principle and the ECKS theory, both of which remain subject to ongoing debate within the cosmological community. I have also focused primarily on the Early Stoa, and while this provides the most complete physical foundation within Stoicism, it certainly leaves room for future scholars to investigate how the later Roman and Enlightenment-era

developments might further nuance this informational model.

Ultimately, I argue that this body of work connects the birth of the universe directly to the reasoning in our own thoughts. I am particularly moved by the spirit of Marcus Aurelius, whose *Meditations* remind us that the internal quest for self-knowledge is, in fact, a simultaneous alignment with the cosmic order. By recognizing our own composition as iterations of the universal Logos, we move beyond self-interest to become conscious participants in cosmic evolution. By embracing this unified model, we finally see the magnificent, unfolding Logos of the cosmos not as a mystery to be solved, but as the essence of who we are and the miracle we are intended to be.

Appendix A

Glossary of Terms

Active inference: (*Computational Neuroscience/Theoretical Biology*) A principle in cognitive science and neuroscience suggesting that all biological systems, including the brain, minimize their prediction error or uncertainty by actively sampling the world (perception) and changing the world (action). It is closely related to the Bayesian principle.

Action Functional: (*Mathematics*) A mathematical tool in physics that takes a system's entire path or "trajectory" as an input and returns a single number, the action, which represents the "cost" of that path.

Apatheia: (*Stoicism*) The state of mind where one is without passion, or free from destructive emotions like grief, fear, or lust. It does not mean apathy, but rather clear judgment and emotional stability.

Archai: (*Stoicism/Greek*) The first principles or fundamental components of the universe. For the Stoics, these were typically two: the active principle (Logos) and the passive principle (unqualified matter).

Aretē: (*Stoicism/Greek*) Virtue or excellence; the highest human good, often translated as moral virtue. The Stoics considered Aretē the only true good and the path to eudaimonia.

Bayesian principle: (*Physics/Statistics*) A mathematical theory, based on Bayes' theorem, describing how to update the probability of a hypothesis as more evidence or

information becomes available. It is fundamental to theories of perception, learning, and active inference.

Bekenstein bound: (*Physics/Information Theory*) A physical limit on the maximum amount of information that can be contained within a finite region of space with a finite amount of energy.

Colocation: (*Philosophy/Metaphysics*) A concept referring to the presence of two or more distinct entities in the same spatial location at the same time.

Conflagration (Ekpyrôsis): (*Stoicism*) The periodic, catastrophic fire that the Stoics believed would consume the entire universe, after which the universe would be reborn in a cycle of eternal recurrence.

Cosmological constant: (*Cosmology*) A term in the equations of general relativity, representing the energy density of the vacuum of space. It is currently the leading candidate for explaining dark energy and the accelerated expansion of the universe.

Criticality: (*Physics/Complex Systems/Ecology*) A state poised at a phase transition between order and disorder, enabling an optimal balance between resilience and adaptability. In healthy ecosystems, this state maximizes in-formation flow and maintains holarchic coherence through biodiversity. Being nonlinear and resonantly coupled, criticality allows these systems to maintain stability while remaining sensitive enough for small changes to trigger system-wide evolution or emergence.

Degrees of freedom: (*Physics/Statistics*) The number of independent parameters that define the state of a system. For example, a single particle moving in three-dimensional space has three translational degrees of freedom.

Density parameter (**Ω**): (*Cosmology*) The measure of the total amount of energy and matter in the universe, including both visible and dark forms, expressed as the ratio of its actual density to the 'critical density' required to remain geometrically flat.

Diakosmesis: (*Stoicism/Greek*) The orderly arrangement, ordering, or orchestration of the universe (*cosmos*) by the divine, rational principle (*Logos*).

Entanglement: (*Quantum Physics*) A precedent to universal nonlocality, which is fundamental for all the phenomena predicted by quantum theory as demonstrated at a cosmological scale in 2018 and recognised by the 2022 Nobel Prize for Physics as denoting 'settled science'.

Epochē: (*Stoicism/Greek*) Suspension of judgment or withholding assent.

Equilibrium density: (*Physics/Thermodynamics*) The state where a system's properties (like temperature, pressure, and density) are uniform and stable over time, and there are no net macroscopic flows of matter or energy.

Eudaimonia: (*Stoicism/Greek*) Often translated as flourishing, living well, or the highest human good. For the Stoics, this state is achieved through a life lived according to Reason and virtue (Aretē).

Expected Free Energy: (*Mathematics*) a core concept in Active Inference, representing the "cost" or "surprise" an agent predicts it will experience in the future, which it aims to minimize through action, balancing goal-seeking (exploitation) with information-gathering (exploration) by resolving uncertainty about its environment and its own preferences.

Functional: (*Mathematics*) The term originates from the calculus of variations, where one searches for a function that minimizes (or maximizes) a given functional. A critical application in physics is the search for a state of a system that minimizes (or maximizes) the action, i.e., the time integral of the Lagrangian in relation to the minimal use of energy.

Fractals: (*Mathematics/Chaos Theory*) Geometric patterns that are self-similar across different scales, meaning they look the same when zoomed in or out. They often emerge in systems at the point of criticality.

Hedonē: (*Greek*) Pleasure. The Stoics acknowledged it as a biologically natural impulse but rejected it as the ultimate good, which was the central tenet of the rival school, Epicureanism.

Hêgemonikon: (*Stoicism/Greek*) The commanding faculty of the soul; the ruling part of the mind or intellect, located by the Stoics in the chest. It is the seat of Reason, judgment, and assent.

Holarchic coherence: (*General Systems Theory*) A concept suggesting that an entity (holon) is simultaneously a whole and a part. Holarchic coherence refers to the harmonious, ordered relationship between these nested whole/part systems.

Hylomorphic: (*Aristotelian/Metaphysics*) A concept describing all physical objects as a composite of two principles: matter and form.

Information: (*Physics*) The data about a system's state, essentially describing its organization or configuration. It is an intrinsic attribute of all physical systems.

In-formation: (*Physics*) The fundamental, nonphysical essence of reality[120]. The intelligent and meaningful instruction of the cosmos. More primary than matter or energy, it acts as the causative ground state that literally "in-forms" the physical world and guides the evolution of the universe toward increasing complexity and self-awareness.

Infodynamics: (*Physics*) A field of study exploring the relationship between information, energy-matter and spacetime.

Integral over volume: (*Calculus/Physics*) A mathematical operation that sums an infinitely[121] large number of infinitesimal quantities of a function over a three-dimensional region (volume). It is used to calculate total mass, charge, or energy within a given space.

Intentropy: (*Stoic Metaphysics/Informational Philosophy*) A form of ethical implication with intent, derived from Stoicism and Jude Currivan's informational foundations of

[120] As it is expressed in complementary ways as energy-matter and spacetime it is as 'physical' as they are. These are what we describe as the 'physical' appearance of our universe that emerge from deeper 'non-physical' realms of causation.
[121] While mathematical - any integral within spacetime is by nature finite.

reality that explicitly includes the human characteristics of responsibility and accountability.

Intropy: (*Physics*) Expanded from the thermodynamic concept of entropy, it is a measure of the energetic microstates of a system to the infodynamic concept as its informational content (with the same equation describing both) and extending the measure further as the **in-tropy** of our universe recognizes its inherently meaningful in-formed nature. *Note: This is not a standard term in physics.*

Kathēkon: (*Stoicism/Greek*) A fitting action or appropriate act; a duty that is rational to perform, even if not perfectly virtuous. It is an intermediate step toward full aretē (virtue).

Kataleptic: (phantasia kataleptikē): (*Stoicism*) A cognitive impression or an impression so clear and vivid that it compels assent because it could only come from a real, existing object. It is the Stoic criterion for truth.

Kathekon: (*Stoicism*) a Stoic philosophical term meaning "appropriate action," "befitting duty," or "proper function," derived from a word meaning "to reach to" or "be fitting".

Katorthoma: (*Stoicism/Greek*) An accomplishment, success, achievement, or a "very worthy deed," originating from roots meaning "to make right" or "fully upright," often referring to a perfect, virtuous action, especially in Stoic philosophy.

Krasis: (*Stoicism/Greek*) Mixture or blend. The Stoics used it to describe the blending of two bodies, such as the complete interpenetration of the active principle (pneuma) and passive matter.

Landauer's principle: (*Physics/Information Theory*) A fundamental principle in the thermodynamics of computation stating that there is a minimum theoretical amount of energy required to erase one bit of information.

Lekton: (*Stoicism/Greek*) The sayable; the incorporeal meaning, proposition, or sense expressed by a statement, which is distinct from the sound (voice) and the object it refers to.

Logos: (*Stoicism/Greek*) Reason, logic, word, or divine principle. For the Stoics, the rational, organizing, and active principle pervading the universe is essentially God, Nature, or Fate.

Logotherapy: (*Psychology*) A school of existential analysis founded by Viktor Frankl, which posits that the primary motivational force in human beings is the will to meaning.

Oikeiosis: (*Stoicism/Greek*) Appropriation or affinity. The process by which an organism is initially focused on self-preservation, which expands to include family, community, and eventually all of humanity, driven by Logos and Reason.

Philia: (*Greek*) Friendship or brotherly love. In Stoicism, it is the natural bond and affinity that arises among human beings living according to Reason and virtue.

Pneuma: (*Stoicism/Greek*) Breath or spirit. In Stoicism, the active, corporeal tension that pervades and structures matter. It is a mixture of air and fire and is the vehicle for the universal Logos.

Phronesis: (*Stoicism/Greek*) The essential intellectual virtue, the ability to discern the right action in complex situations, guiding one to apply universal moral truths (like Virtue) to real life for human flourishing (Eudaimonia).

Principle of Least Action: (*Physics*) a core physics concept stating that a physical system, moving between two points in time, takes the path that minimizes a quantity called "action," which is the integral of the system's Lagrangian (Kinetic Energy minus Potential Energy) over time; it's a fundamental way to derive equations of motion (like Newton's laws) and applies from classical mechanics to quantum physics, showing nature follows paths of "least effort" or stationary change.

Prohairesis: (*Stoicism/Greek*) Moral purpose or volitional choice. The faculty of the mind that is entirely within one's control, encompassing one's judgments, attitudes, and intentions.

Prokopton: (*Stoicism/Greek*) A person making progress toward wisdom and virtue (Aretē); an advanced student of Stoicism who is not yet a sage.

Prosochē: (*Stoicism/Greek*) Attention or heedfulness. A constant, vigilant focus on one's moral intentions and judgments (prohairesis) to ensure they align with Reason and virtue.

Quanta: (*Quantum Physics*) The minimum amount of any physical entity (such as energy, light, or matter) involved in an interaction. The plural of quantum.

Sage (Sophos): (*Stoicism*) The ideal human being; a person who has attained perfect virtue (Aretē) and wisdom, whose judgments are always correct, and who is free from all destructive passion (apatheia).

Scala naturae: (*Philosophy/Biology*) The Great Chain of Being; an ancient concept describing a hierarchical structure of all matter and life, from the most basic elements to God, with perfect, linear gradation.

Spermatikoi logoi: (*Stoicism/Greek*) Seminal Reasons or Germinal Logoi. The rational, creative principles (parts of the universal Logos) are embedded in matter, acting as the blueprint for all things that will come into being.

Sphairos: (*Stoicism/Greek*) Sphere. Used in Stoicism to describe the shape of the cosmos during the conflagration, when everything has been resolved into a perfectly uniform, fiery sphere.

Spacetime torsion: (*Theoretical Physics*) A potential addition to general relativity that describes a twisting or rotational deformation of the fabric of spacetime, often linked to the angular momentum (spin) of matter.

Stoicheion: (*Stoicism/Greek*) Element or basic principle. The Stoics recognized the four traditional elements (earth, water, air, fire) as the fundamental constituents of matter.

Strong nuclear force: (*Physics*) One of the four fundamental forces of nature. It binds protons and neutrons together to form the nucleus of an atom. It is the strongest of the four forces.

Sympatheia: (*Greek*) the mutual interdependence, interconnectedness, and "fellow-feeling" of all things in the universe.

Symphonia: (*Greek*) Agreement or harmony. In Stoicism, it refers to the inner congruence of a person living virtuously in agreement with Nature and the Logos.

Tonos: *(Stoicism/Greek)* Tension or strain. The active, intrinsic property of pneuma that gives form and quality to matter. The degree of tonos determines the coherence and structure of a thing.

Variational Principle: (*Mathematics*) A mathematical procedure that renders a physical problem solvable by the calculus of variations, which concerns finding functions that optimize the values of quantities that depend on those functions.

Appendix B:

The Unified Lexicon of Informational Stoicism

I. Cosmological and Physical

$\Lambda_U / \Lambda_\Gamma$: The Universal Logos; the rational intelligence and information field of the cosmos.

Π (Pneuma): The continuous material entity interlinking the cosmos; the carrier of the Logos.

$\hat{\Pi}$: Pneuma Operator; the force driving organized complexity and cosmic coherence.

$\mathbf{\Pi}_l$: Pneuma in its latent, concentrated form.

$\mathbf{\Pi}_U$: Pneuma in its expanded, cosmic state.

ϵ_Σ: The Strong Nuclear Force; interpreted as the "binding mechanism" of reality.

$\lambda_\mathcal{K}$: The Cosmological Constant; the intrinsic energy density governing cosmic expansion.

$\mathbf{G}_{\mu\nu}$: Einstein tensor representing spacetime curvature.

$\mathbf{Q}_{\mu\nu}$: Torsion tensor; representing the geometric "twist" of spacetime (ECKS theory).

$\mathbf{\Sigma}_{\mu\nu}$: Spin density tensor; representing the intrinsic angular momentum of matter.

$\mathcal{Q}_{\Sigma}$: Primordial Smoothness of Space; the degree of subtle fluctuations whose fixed arrangement is exposed in the cosmic microwave background, or CMB.

V_Z: Vacuum-Zero state; the hypothesis that the total energy of the universe is zero.

$\neg\emptyset$: Negation of the Void; the Stoic plenum or unbroken fabric of reality.

$\mathcal{C}\,\mathcal{C}$: The continuous, unbroken fabric of reality.

A_H: The surface area of the Holographic Boundary of the universe.

Σ_{Π}: The two-dimensional holographic boundary of the pneuma (the Stoic conceptual equivalent to the Holographic Boundary of the universe).

l_P^2: The Planck Area; the fundamental "pixel" of cosmic information.

ΔH_{ι}: The continuous growth of total universal complexity/information.

$\tau\,\tau/\tau_C$: Cyclical Time; the total temporal order of the cosmic cycle, also comparable to a Universal Time Cycle.

t/τ_L: Linear Time; the temporal flux or "waves" of time (a subset of cyclical time).

II. Cognitive and Psychological

Λ_{μ}: The Micro-Logos; the individual's holographic fragment of universal intelligence.

$\mathbb{H}/\mathcal{H}$: The Hēgemonikon; the commanding faculty or ruling part of the soul.

Φ(Prohairesis): The moral will or character; the primary agent of the system.

Π_{Ψ}: Prosochē; rational attention or mindfulness.

$A_s / S\,S$: Assent; the mental act of agreeing to or rejecting an impression.

$\mathcal{S}_{\Sigma}$: Sound Assent; a true proposition synchronized with universal structure.

$\pi / \mathcal{F}$: Phantasia; raw sensory impressions or data entering the mind.

Ψ (Pathos): Irrational passion; modeled as high informational entropy or "noise."

Ψ (Wave-function): The non-deterministic state containing system probabilities.

$\mathbf{\Psi}_a / \Psi_{\Delta}$: The actualized, deterministic state of the wave-function (Certainty).

F: Variational Free Energy; the measure of "surprise" or informational misalignment.

$\mathcal{P}_{ego}$: Prior beliefs; the agent's current mental model of the world.

$\mathcal{L}_{info}$: Likelihood; the incoming flow of cosmic information.

$\Delta l_{\mathcal{X}}$: The "Dichotomy Factor"; the cognitive distance between internal and external control.

$\hat{\mathcal{I}}_{\mathbb{R}}$ (Intentropy): The measure of an agent's active alignment with the Logos, specifically accounting for the responsibility and intent behind their rational order.

$\dot{W}$: Moral "Work"; the psychological energy spent converting passion into reason.

III. Ethical and Existential

$\mathbf{A}_{\rho\epsilon\tau\eta}$: Aretē (Virtue); the state of optimal, coherent informational ordering.

$\mathbf{E}/\mathbf{E}_S$: Eudaimonia; the total system output; a flourishing life.

$\mathbb{S}$: The Sage; the asymptotic ideal of perfect rational order.

$\lim_{t\to\infty}$: the process of moral and rational progress practiced over the span of a lifetime.

$\mathbb{P}\approx$: Phronesis (Wisdom); the time-integral of moral progress and in-tropic expansion.

κ(Kathekon): Appropriate action; duty aligned with one's role and the social web.

$\mathcal{K}$(Katorthoma): A "right action"—a perfect virtuous deed performed with the correct intent.

$\mathbf{A}_V$: Virtuous Actions; agency viewed as a contribution to cosmic order.

$\mathbf{L}_t/\Phi_t$: Rational Love or Fellowship; the unitive force of rational connection.

$\mathbb{O}$: Oikeiōsis Operator; the force driving the practitioner toward the cosmic ideal.

Σ(Symphonia): The multiplier of harmony; alignment with the cosmic flow.

$\mathcal{H}_\kappa$: Total Cosmic Harmony; the ultimate state of universal realization.

$\mathcal{F}$(Fractal): The Fractal Function; representing the self-similarity between the person and the universe.

$\mathcal{E}$: Emergence; the process by which a state arises from rational alignment.

$\mathbf{V}_\mu$: The virtue of the individual human being.

$\sum_{t=0}^{T}$: The temporal integration of life from birth to completion.

IV. Logical and Relational

$\propto$: Proportionality; indicating that moral results scale with rational alignment.

$\equiv / \Leftrightarrow$: Logical and ontological equivalence.

$\rightarrow / \Rightarrow / \Longrightarrow$: Logical necessity, directional flow, or implication.

$\subseteq$: Containment; indicating the individual is a part of the greater whole.

$\langle \cdots \rangle$: Expected value or tensional motion.

$\mathcal{T}$: Tensional Motion of the pneuma.

$\ll / \gg$: Significant hierarchy (e.g., Judgment over External Realities).

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