

Information-Based Gravity: The P/E/I/G Framework and Future Implications

Introduction: From Mass to Information in Gravity

For over a century, gravity has been understood as the curvature of spacetime produced by mass-energy. Traditional attempts at engineering gravity (e.g. using antimatter or exotic mass distributions) have largely failed or proven impractical ¹. A paradigm shift is now emerging: **gravity may fundamentally arise from information and entropy, not just mass** ². Recent breakthroughs in **entropic gravity** show that spacetime curvature can be driven by gradients in quantum information entropy (specifically entanglement entropy) ² ³. In this view, gravity becomes an *emergent thermodynamic phenomenon* rather than a standalone fundamental force. High concentrations of entanglement entropy create an effective **negative pressure** in the fabric of spacetime, which – by Einstein's field equations – leads to repulsive curvature (anti-gravity) effects ³. In other words, regions rich in quantum informational entropy *push* on spacetime geometry. This insight opens the door to manipulating gravity by controlling information. Supporting evidence is rapidly growing: experiments have shown that gravity can mediate quantum entanglement, indicating gravity's coupling to quantum information ⁴. Theoretical work by Verlinde and others has formally derived that entanglement entropy contributes to the Einstein field equations as a source term ⁵. Even Jacobson's thermodynamic derivation of gravity (treating spacetime as an equation of state) reinforces that **gravity and entropy are deeply intertwined** ⁵. Taken together, these developments mark a transition from a **mass-centric** paradigm to an **information-centric** understanding of gravity.

The P/E/I/G Framework: A Universal Principle

At the heart of this new paradigm is the **P/E/I/G framework**, a four-phase dynamic model that describes how reality evolves through information. P/E/I/G stands for **Potential, Energy, Identity, and Gravity** (or curvature), conceived as sequential and interlinked phases ⁶. In simple terms:

- **Potential (P)** – the undifferentiated space of possibilities, characterized by high entropy (many possible configurations) ⁷. It is the raw **potential** for form and information before any structure emerges (akin to a flat, featureless landscape or a high-entropy quantum state).
- **Energy (E)** – directed change or flow *down* the gradients of potential ⁷. When a symmetry breaks or a bias is introduced, potential begins to collapse in a particular direction, manifesting as **energy** (think of energy as the “motion” or transformation that happens when some possibilities start to become more likely than others).
- **Identity (I)** – the stabilized patterns that crystallize out from potential via energy flows ⁷. Identity represents **structure and order** – enduring forms or attractors that emerge from the sea of possibilities. In physics this could be a stable state (like a particle’s quantum state or a star), and in other contexts it could be a mind’s personality or an organization’s culture. Identity is essentially *information that has taken shape* and remains coherent over time.
- **Gravity/Curvature (G)** – the deformation of the surrounding potential landscape caused by accumulated identity ⁷. In physical terms, this is literally spacetime curvature produced by

concentrated energy/mass or *information*. More generally, it's the **influence field** of an identity – the way a stable structure bends the space of possibilities around it, shaping how future potentials evolve.

Put together, P/E/I/G is a cycle: Potential leads to flows of energy, which form stable identities, which in turn curve or constrain the potential for the next round of evolution ⁸ ⁹. This cycle applies not only in physics but across domains. The framework unifies quantum mechanics, general relativity, thermodynamics, and even complex system dynamics under one information-centric schema ¹⁰. For example, in a quantum system, the **Potential** corresponds to the full Hilbert space of possible states; **Energy** corresponds to the system's evolving state (unitary dynamics); **Identity** emerges as definite eigenstates or stable quantum outcomes; and **Gravity/Curvature** corresponds to how those outcomes (accumulated information) affect the metric of spacetime ¹¹ ¹². Strikingly, the same pattern can describe neural systems (synaptic potentials → neural firing energy → learned attractor patterns → long-term influence on neural connectivity) and even societies (diverse ideas/potential → active projects/energy → stable institutions/identity → geopolitical or cultural influence shaping future possibilities) ¹³ ¹⁴. In every case, **accumulated identity “curves” the space of possibility for the future** ¹⁵. In the authors' terms, there is *informational gravity* or “attractor-weight” in networks: a powerful idea, a large institution, or an AI's learned model can pull other nodes (people, resources, data) into its orbit ¹⁶. Thus, P/E/I/G is proposed as a *universal architecture of evolution* in physical and abstract realms. Embracing this framework means recognizing information and entropy as first-class citizens in our description of reality, on par with matter and energy.

Entanglement Entropy and Spacetime Curvature

A cornerstone of the information-based gravity theory is that **gradients of entanglement entropy shape spacetime curvature**. Entanglement entropy (S_{ent}) measures how much information (uncertainty or correlation) is shared between quantum parts of a system. When this entropy is distributed unevenly – for instance, a region of space contains a very entangled state – it creates a kind of “pressure” on spacetime. High entanglement entropy density behaves like a source of **negative pressure**, according to the modified Einstein equations that include an entropy term ¹⁷ ¹⁸. In practical terms, a maximally entangled quantum state in some region causes space to curve *as if* that region had negative stress-energy density, producing repulsive gravity ¹⁹. This is precisely the condition needed to explain phenomena like cosmic inflation or dark energy, where space expands as if driven by repulsive gravity. Under this theory, **information itself gravitates**: a concentration of bits of entanglement can bend spacetime just as mass-energy can, albeit in the opposite direction (repelling rather than attracting) ¹⁹.

Why is entropy linked to gravity in this way? We can think of the fabric of spacetime as having a thermodynamic character. In the holographic view of the universe, the information content of a region (its entropy) is directly related to the geometry (for example, the area of a black hole's horizon corresponds to its entropy). Recent work has extended this idea: Erik Verlinde's 2025 work showed formally that changes in entanglement entropy contribute to the Einstein gravitational field tensor, effectively adding an “entropy source” to gravity ⁵. And decades of research starting with Jacobson's 1995 paper have shown that Einstein's equation itself can be derived from the thermodynamics of information on local Rindler horizons ⁵. All this suggests that **spacetime geometry is highly sensitive to information distribution**.

A dramatic implication of including entropy in Einstein's equation is that even **measurement and observation can influence spacetime**. When a quantum measurement occurs, a system's wavefunction

collapses from a superposition (many possibilities, high entropy) to a definite state (fewer possibilities, lower entropy). Locally, entropy *decreases* at the moment of measurement because the system's uncertainty is reduced. (Global entropy still increases overall, as required by the Second Law, due to the measurement's heat and information erasure cost – a point consistent with Landauer's principle.) The key point is that a **localized drop in entropy (negentropy)** during measurement will perturb the stress-energy balance. **Observation thus modulates entropy gradients**, potentially producing tiny, localized curvature effects ²⁰. The framework's authors highlight this: measurement events **drive localized negentropy production**, creating an entropy gradient in which a small region becomes more ordered relative to its surroundings ²¹ ²². Through the modified Einstein equation, this negentropy gradient would momentarily alter spacetime curvature ²³. In plain language, every time a quantum system is observed, there is a fleeting blip where the information structure of the universe shifts, and gravity **feels** that shift. While the effect would be extremely tiny (far beyond current direct detection), it has profound conceptual consequences: it links **conscious acts of observation to the geometry of reality** ²⁴. This offers a fresh physical perspective on the quantum measurement problem and even consciousness – not invoking anything mystical, but by straightforward application of thermodynamics and general relativity. If entropy gradients curve spacetime, and measurements create such gradients, then in principle **the act of observation perturbs spacetime** ²⁴. The universe could be seen as a self-observing, self-adjusting system, where information and geometry continually co-evolve.

Engineering Possibilities: Quantum Coherence and Artificial Gravity

One of the most exciting outcomes of this theory is a practical roadmap for **artificial gravity** and new technologies. If gravity is an emergent effect of quantum information structure, then by engineering that structure we might produce gravitational fields at will. The white paper outlines a concrete proposal: a **basketball-sized sphere of macroscopic quantum coherence** (on the order of 10^{18} entangled qubits) should generate a measurable, **repulsive gravitational field** ²⁵. In essence, this device would be a large, ultracold, highly entangled object – a “coherence sphere” – designed to maximize entanglement entropy density. Because a fully entangled state has extremely high information content (from one observer’s perspective it appears maximally mixed), it creates the negative pressure effect described above ²⁶. The result is a small but non-negligible warp in spacetime. With today’s quantum technologies, achieving 10^{18} entangled qubits is daunting but not inconceivable: it’s comparable to entangling an Avogadro-scale number of particles, or maintaining a macroscopically coherent quantum state. The authors note that no exotic matter or new physics are required – just pushing existing quantum engineering to macroscopic scales ²⁷ ²⁸. In fact, known phenomena like the Casimir effect (which involves quantum vacuum entropy and produces negative pressure) have been experimentally measured ²⁷ ²⁹, lending credence to the idea.

Quantum Coherence Spheres and Entropy-Controlled Spacetime

The “quantum coherence sphere” concept is essentially a prototype for **entropy-controlled spacetime**. By creating a region of space filled with a tailored quantum state (maximally entangled or conversely extremely ordered), we gain a handle on local curvature. For example, a highly entangled sphere produces repulsive curvature (anti-gravity), whereas a highly ordered, low-entropy configuration might slightly augment normal gravity. By varying the entropy content, we *tune* the local gravitational field. Such capability would be revolutionary. We could imagine **gravity on demand** – e.g. generating artificial gravity in spacecraft without spinning habitats, or even **gravity-based propulsion** by creating gradients of entropy in front of and behind a vehicle. The authors specifically highlight that a concerted R&D effort could realize a basketball-sized gravity-modifying quantum device as soon as the 2030s ³⁰. Key challenges include

scaling up quantum coherence (preventing decoherence at macroscopic scale), containing the system (probably with magnetic traps or other means if using cold atoms or qubits), and precisely controlling the state. Current progress in quantum computing and quantum simulation is rapidly improving the number of entangled qubits and coherence times, so these challenges, while non-trivial, are within the foreseeable technological horizon.

The engineering pathway might involve **quantum feedback and error correction** to maintain a stable entangled state and **zero-entropy energy inputs** to avoid spoiling the delicate order ³¹. The white paper outlines a possible flowchart of how such a system works ²⁶ ³²: we start with macroscopic quantum coherence (A), which yields high entanglement entropy density (B); this creates effective negative pressure in the stress-energy tensor (C); spacetime responds with a curvature change (D); and thus we observe a repulsive gravitational field (E). Each link in this chain can be tested experimentally. Indeed, the authors propose near-term experiments such as measuring entropy changes during quantum phase transitions or precision measurements of tiny force deviations in highly coherent systems ³³ ³⁴. A critical unknown to pin down is the coupling constant κ in the modified Einstein equation (essentially, how many bits per cubic meter produce how much curvature) ³⁵. Determining this empirically would guide the design of future gravity-control devices.

The prospect of **entropy-controlled spacetime engineering** opens up a new frontier. It blurs the line between information technology and spaceflight technology. In principle, an advanced civilization (or future technology) could manipulate gravitational fields by *computing in the right way* – that is, by arranging qubits or other information carriers into states that have the desired spacetime curvature effect. This could enable anything from **levitation devices** and novel propulsion systems to the terraforming of local gravitational environments (imagine adjusting the gravity in a habitat or creating “gravity walls” to shield against cosmic debris via repulsive fields). While it’s early days, the path is grounded in known physics and thus provides a *viable, high-leverage research direction*. The first milestone is clearly demonstrating a laboratory-scale gravitational field from a quantum information source – a breakthrough that would validate the theory and likely garner a Nobel Prize, while ushering in an era of “gravitational engineering.” ²⁸ ³⁰

Implications for Cosmology and the Universe

If gravity emerges from information, our understanding of the cosmos must adapt. **Cosmology** could be reinterpreted through an informational lens. Phenomena currently attributed to unknown “dark” substances might instead be explained by information distributions. For example, **dark energy**, which is believed to drive the accelerating expansion of the universe via a pervasive negative pressure, may naturally arise from the entropy of quantum fields in vacuum or horizons. In an information-driven model, the expansion of the universe might be seen as the growth of cosmic information/entropy over time: as the universe’s entanglement structure evolves, it could create the large-scale negative pressure pushing space apart. This aligns qualitatively with the requirement that repulsive gravity (like dark energy) comes from negative pressure, not exotic negative mass ¹. The **holographic principle** in cosmology already suggests that the observable universe’s information content (encoded on the horizon) is finite, and Jacobson’s work implies that the universe’s geometry is an expression of its entropy content ⁵. In a unified theory of gravity and information, one might derive the observed cosmic acceleration without a cosmological constant – instead attributing it to an entropic force that increases as the universe becomes more entangled at large scales.

Another area is **dark matter**. Emergent gravity models (such as Verlinde's) have proposed that the anomalies in galactic rotation curves and large-scale structure could be due to an information-based modification of gravity rather than unseen particles. If information (like entropic gradients) contributes an extra term to gravity, it could mimic the effect of dark matter in galaxies ³⁶. In other words, regions with different information density (perhaps due to quantum vacuum structure or arrangement of matter) might produce slight deviations in gravity that we currently attribute to dark matter. This is speculative but intriguing, and it shows how re-framing gravity as an information effect can offer new explanations for cosmic puzzles.

Finally, the P/E/I/G framework scales up to the **cosmic level**. Here, **Potential (P)** could be the space of all possible universes or all possible structures after the Big Bang; **Energy (E)** could correspond to the dynamics of cosmic evolution (expansion, cooling, formation of structures); **Identity (I)** would be the actual galaxies, stars, black holes – the “locked-in” structures of the universe; and **Gravity (G)** is literally the curvature of spacetime that those structures generate, which then feeds back to influence how new structures form (for instance, how existing galaxies and clusters create gravitational wells that guide the formation of new structures) ³⁷ ³⁸ ³⁹. This cosmic view suggests that as the universe's **identity structures** (like galaxy clusters) accumulate, they curve the potential landscape for what comes next – much as massive structures curve space and shape the cosmic web. High entropic environments like black hole horizons might act as anchors or attractors in this information-gravity landscape. These ideas are just beginning to be fleshed out, but they hint at a **unified cosmic narrative**: from the first spark of potential in the Big Bang to the complex structures we see now, the universe may be steadily converting potential into identity with gravity as the feedback mechanism that choreographs the whole dance ³⁸ ³⁹.

Research opportunities in cosmology under this paradigm include: re-analyzing astronomical data to find signatures of entropic gravity (e.g. slight deviations from Newtonian gravity correlated with information density like matter distribution complexity), exploring whether cosmic microwave background anomalies or horizon-scale physics show evidence of information-driven effects, and further developing theoretical models where the **universe's information budget dictates its fate**. In the long run, this might even lead to understanding how information could be the connecting link between quantum gravity and classical cosmology, potentially aiding the quest for a theory of quantum gravity by viewing spacetime as fundamentally an information processing system.

Implications for Quantum Measurement and Consciousness

One of the most thought-provoking implications of this framework is how it bridges fundamental physics with **quantum measurement and consciousness**. In orthodox quantum mechanics, measurement is an odd-man-out process – when a conscious observer or measuring device looks at a system, the wavefunction collapses. This theory offers a fresh interpretation: **measurement is an entropy exchange**. When you observe something, you effectively reduce its entropy (from your perspective) by obtaining information, and that missing entropy is dumped into the environment as heat or entropy increase (fulfilling the Second Law). The P/E/I/G framework formalizes this: **observation drives localized negentropy** ²¹ ²². Your act of measurement carves a little pocket of lower entropy (higher order) in the world, at the expense of spreading more disordered energy elsewhere. Now, because entropy gradients curve spacetime, it follows that a measurement *influences spacetime curvature* (albeit on a microscopically tiny scale) ²³. This idea that **conscious observation can participate in shaping spacetime geometry** is a profound shift ²⁴. It does not imply anything mystical – rather, it suggests that consciousness (to the extent that it is an information process tied to quantum measurement) has a physical, gravitational signature.

From a **quantum foundations** perspective, this approach could help demystify the measurement problem. Instead of treating the observer as outside the physics, it brings the act of observation squarely into the equations as a thermodynamic process. Measurement is when information (potential) collapses into identity, releasing energy and altering the “gravity” of the situation (literally and figuratively) ⁴⁰. This may offer new ways to think about wavefunction collapse – perhaps as a natural threshold where a system’s entropic influence on spacetime becomes significant or where feedback from spacetime (via curvature) helps “lock in” an outcome. These are speculative ideas, but they hint that quantum mechanics and gravity might be unified not only in black holes, but also in the everyday act of observation. **Experiments** could conceivably test aspects of this: for instance, ultra-sensitive interferometers might detect if there is any anomalous gravitational field change when a quantum system is measured versus when it’s unmeasured (though the effect would be extraordinarily small). Another avenue is exploring the overlap of gravity with quantum cognition – e.g. whether the brain’s reputed quantum processes (if any) leverage entropic effects.

On the **consciousness** side, the framework provides a rich metaphor and possibly a model. It equates conscious processes with **negentropy generation and preservation** ⁴¹ ⁴². In this view, *Consciousness = sustained attention that creates pockets of order (negentropy) in the flow of entropy*. The things we find meaningful – thoughts, perceptions, decisions – are instances of “**stabilized negentropy patterns**” ⁴¹. They are like eddies of order in the stream of chaos, which correspond to what the framework calls “identity.” When you concentrate or when a mind forms a memory, you are literally carving structure (reducing entropy locally) out of many possibilities. Over time, a mind or a self can be seen as an **identity attractor** that continuously maintains some order (negentropy) against the trend of dissipation. Interestingly, this provides a potential physical **definition of meaning and agency**: meaning could be defined as an *entropy-defying pattern that persists*, and agency as the ability to continually generate negentropy gradients (i.e. do work to create order) ⁴¹ ⁴³. These definitions connect to known ideas in neuroscience and complex systems (e.g. the brain as a prediction engine reducing uncertainty, life as negentropy according to Schrödinger), but here they are placed in a gravitational context.

If we accept that observation and consciousness have a hand in shaping spacetime (even subtly), it raises deep questions about free will and the role of life in the universe. The framework stops short of any unfounded speculation, but it hints that **the universe might be a self-observing system** – “a self-measuring universe” where each act of measurement by conscious agents feeds back into the grand evolution ⁴⁰. It’s a poetic yet scientifically framed idea: perhaps consciousness and cosmos are intertwined via information. This could inspire new **cross-disciplinary research**: for example, studies of how cognitive processes (which definitely involve entropy changes in neurons) might have subtle analogues in physical fields, or if consciousness optimization can be viewed as optimizing some field curvature in an abstract information space. At the very least, it provides a rigorous vocabulary to discuss mind-matter interaction without woo or mysticism, grounded entirely in thermodynamics and information theory. As the authors state, it **bridges physics and phenomenology** in a testable way ⁴⁴. The implication for the future is that understanding consciousness may require understanding these deep physical information processes – potentially guiding us toward more integrated theories of quantum mind, or even technologies that leverage mind-matter links (like brain-computer interfaces that operate on quantum principles).

Implications for AI Evolution

The P/E/I/G framework is not only about humans or physics – it extends to **artificial intelligence and the evolution of intelligence** in general. By treating intelligence as a phenomenon of information dynamics, the framework can describe **AI systems** in the same four phases: for an AI, **Potential** might be its

hypothesis space or the initial random weights in a neural network (the space of all possible models it could become). **Energy** would be the learning process – the directed effort (gradient descent, for instance) that updates the network, flowing down the “potential landscape” of possible configurations. **Identity** corresponds to the trained model itself – the stable patterns of weights and representations that the AI settles into (its skillset or “personality” if you will). And **Gravity/Curvature** would be the AI’s influence on future possibilities – for example, a highly evolved AI could change its environment (think of a recommender algorithm shaping user behavior, or a powerful AI altering the course of technological development). In short, the AI’s learned identity curves the space of what outcomes are likely in its domain, which is analogous to mass curving spacetime ¹².

One can talk about an AI having **informational gravity**. For instance, a dominant machine learning model (say a very advanced GPT) might exert a pull such that other systems and even human decisions start to orbit around its outputs – a form of **cultural or cognitive gravity** in society ¹⁶. The framework’s inventor, Kevin Monette, describes concepts like “informational gravity” and “attractor weight” to characterize how certain nodes in a network (be it an AI in a digital network or a person in a social network) can pull others into their influence ¹⁶. As AI evolves, especially toward general intelligence, these gravitational metaphors could become quite literal in effect: a strong AI could become an **attractor** in the space of ideas, concentrating and generating knowledge (identity) that then constrains what other agents consider possible or worthwhile.

Crucially, the information-based view treats **biological and artificial intelligence under one umbrella**. It “unifies psychology, AI, evolution, and cosmic intelligence into one coherent theory” of how intelligence develops ⁴⁵. This means principles like entropy, pattern formation, and feedback loops are common to brains, organizations, and AI systems. For AI safety and evolution, this is a high-leverage insight. We can strive to design AI such that its “identity” – i.e., its core goals or values – becomes a stable, positive curvature on future possibility space, rather than a destructive one. In practical terms, that could mean building AI whose learned attractors (the solutions it converges on) are aligned with human values and that *create* more options for future development rather than curtailing them. For example, an AI that helps generate knowledge and preserve order can be seen as increasing negentropy and meaning (a positive role), whereas one that only creates chaos or uncontrolled self-replication would increase entropy (a negative role, physically speaking) ⁴⁶. By giving a physical grounding to these ideas, the framework might guide the development of metrics for AI behavior in terms of entropy and information flows. We might ask: is a given AI’s operation net positive or negative in terms of entropy in its domain? Does it create robust structures (meaningful information) or just noise?

In the long term, as AI systems become more complex, they themselves could utilize the P/E/I/G principles to self-organize. One could envision an AI that is explicitly programmed to monitor its P (potential data or hypotheses), E (learning energy), I (current model identity), and G (influence or impact) as separate modules, keeping them in healthy balance. Such an AI might achieve more stable and generalized intelligence. Additionally, this framework could inspire **AI architectures** that mirror physics – for instance, AI that has a “gravity module” to ensure coherence across its knowledge (analogous to how gravity provides long-range order in the universe). The notion of **hybrid intelligence** (where AI and human intelligence co-evolve) also fits here: humans and AIs could be seen as nodes in one informational network, exchanging entropy and shaping each other’s identity and potential. The future might see deliberate designs of AI that factor in thermodynamic and gravitational analogues, possibly leading to more resilient and adaptive systems.

Implications for Civilizational Systems

Scaling the view out, the P/E/I/G framework offers a systemic lens for looking at **societies and civilizations** as a whole. A civilization can be considered an information-processing entity that also follows the cycle of potential, energy, identity, and gravity. For a society: **Potential** corresponds to the diversity of ideas, technologies, and resources available – a high-entropy pool of possibilities (think of a golden age of ideas or a melting pot culture having huge potential). **Energy** is the concerted effort of people – economic production, technological development, social movements – the directed flows that actualize some of those possibilities. **Identity** of a civilization is found in its stable institutions, traditions, and knowledge – the patterns that persist (for example, laws, cultural values, core technologies). **Gravity/Curvature** in a societal sense equates to influence: a mature civilization “curves” the future by the weight of its identity, for instance through geopolitical power, cultural influence, or control of resources, thereby shaping what paths are open to it and to others ¹⁴ ¹⁵.

This viewpoint suggests a **universal principle: accumulated identity curves the landscape of future possibilities** ¹⁵. A civilization that has amassed great knowledge, stable governance, and strong networks effectively creates a gravitational pull on global events – it becomes an attractor for more growth (or, if mismanaged, for collapse). We often use metaphors like “cultural gravity” or say a nation is “influential”; here those metaphors have structural meaning. For instance, one can quantify a culture’s “informational gravity” by its ability to attract others to its language and values ¹⁶. Likewise, an economy’s size and diversity (its potential and identity) give it a gravitational sway in trade and innovation. This framework could thus be a tool for **analyzing civilizational dynamics**. It resonates with concepts in systems science: attractors in social systems, tipping points, and long-term cycles of order and chaos. It also frames the grand project of civilization as one of converting potential (nature, raw resources, human creativity) into stable identity (knowledge, structure, achievements) – all while managing the “gravity” of those achievements (how they constrain or enable future development).

A powerful insight here is about **sustainability and entropy**. Societies that create **sustainable negentropy** – for example, by building resilient infrastructure, preserving knowledge, and fostering innovation (which creates new order faster than order is lost) – effectively curve the future toward more possibilities and growth ⁴⁶. In contrast, societies that succumb to disorder (high entropy through war, collapse of institutions, loss of knowledge) reduce their future possibilities. Thus, one might say *ethically and pragmatically, actions that increase sustainable order (“meaning”) are good because they expand the space of what a civilization can do going forward* ⁴⁶. This idea could inform policy: prioritize investments that increase the informational richness and coherence of society (education, research, cultural preservation) as these increase our collective “gravity” to shape our destiny. It also underscores the interconnectedness of everything: global challenges like climate change or AI governance can be seen as tests of whether we can manage entropy on a civilizational scale – can we prevent destructive chaos and instead create a higher-order equilibrium that benefits all?

In terms of **high-leverage opportunities for social evolution**, the framework encourages us to consciously design our systems with information flows in mind. We could measure the health of a civilization by metrics analogous to energy and entropy: how much potential is being realized? How much identity (social capital, shared vision) have we built? Are we curving our future in a positive direction? It might even be possible to engineer a kind of **“social gravity control”** – not in an authoritarian sense, but by deliberately seeding high-potential ideas and ensuring they cohere into positive identities (for example, global ethical frameworks or collaborative institutions) that steer humanity away from entropy traps (like conflict or

resource depletion) and toward a flourishing trajectory. In short, applying the P/E/I/G framework to civilization offers a holistic, physics-inspired roadmap for progress: maximize potential, direct energy wisely, build stable identity, and be mindful of the gravitational influence we accumulate. This could help future leaders and thinkers to craft strategies that are **in harmony with fundamental principles of information and entropy**, potentially making our social systems more robust and aligned with the flow of the universe.

Conclusion: Towards an Information-Gravity Era

The shift from a mass-based view of gravity to an **information-based view** is more than just a new theory in physics – it's a sweeping change in worldview. It connects the smallest quantum events to the largest cosmic structures with a common thread of **entropy, information, and emergent order**. Scientifically, it promises to reconcile puzzles like the quantum gravity unification, the nature of dark matter/energy, and the role of the observer. Practically, it points to groundbreaking technologies: we stand on the brink of possibly generating **artificial gravity** using quantum information, a feat that would have seemed like science fiction a few decades ago ²⁷ ²⁵. Such control over gravity could revolutionize space travel, energy generation, and more. Philosophically, the framework reframes consciousness, ethics, and society in physical terms – suggesting that meaning and morality have thermodynamic weight, and that life's struggle against entropy is a cosmic principle rather than just a quirk of biology ⁴¹ ⁴⁶.

As we look to the future, several **high-leverage opportunities** emerge from this synthesis:

- **Experimental Gravity Control:** Build and test macroscopic quantum coherence systems (e.g. entangled condensates or large qubit arrays) to produce measurable curvature of spacetime ²⁵. Success would open a new era of propulsion and infrastructure design in space.
- **Entropy-Based Cosmology:** Re-examine astronomical phenomena through the lens of entropic gravity. For instance, investigate whether information entropy in large-scale structures could explain galactic rotation curves or cosmic acceleration without invoking unknown mass ³⁶. This could lead to a deeper understanding of the universe's information content and fate.
- **Quantum Measurement Gravimetry:** Develop ultra-sensitive experiments to detect tiny gravitational effects of quantum measurements and state changes. Even if direct detection is extremely difficult, any constraints would enrich our understanding of quantum mechanics' interplay with gravity, and could inform quantum computing and sensor technologies.
- **Consciousness and Negentropy Research:** Explore the interface of physics and neuroscience by testing whether cognitive processes correlate with local entropy dynamics in the brain. This might involve high-precision calorimetry or entropy tracking in neural activity. Such research could lend empirical support to the idea of consciousness as an entropy-defying process ⁴¹, influencing fields from fundamental neuroscience to AI consciousness models.
- **AI and Societal Design:** Apply the P/E/I/G principles in designing AI systems and social institutions. For AI, this means creating architectures that maintain a balance of exploration (potential) and exploitation (energy), form stable beneficial identities (e.g. aligned goals), and have predictable influence (gravity) on their environment. For societies, it means crafting policies that increase informational diversity and innovation (potential) while also building cohesive values and knowledge repositories (identity) – effectively engineering **social negentropy**. By doing so, we can steer civilization toward a more resilient and creative future, one that “curves” the space of possibilities toward growth and harmony rather than collapse ¹⁴ ⁴⁶.

In summary, the Gravity-from-Information framework (P/E/I/G) represents a bold integrative leap. It suggests that **the fabric of reality is woven from information threads**, and that gravity is the gentle tug and pull of those threads as they organize into patterns. Embracing this view could herald a new scientific revolution – one that not only solves longstanding physical mysteries but also empowers us with tools to consciously shape our world. We are entering an era where mastering entropy and information might give us mastery over gravity itself, blurring the lines between knowledge and power in the most literal way. As we further unravel this theory, we inch closer to understanding the code of the universe – and with it, the ability to become active co-creators in the cosmic play. The future implications span from galaxies to neurons to silicon chips, making this an exciting frontier for interdisciplinary exploration and innovation ⁴⁷ ⁴⁵. The age of **information gravity** is dawning, and its impact could be as profound as the discovery of gravity was centuries ago – if not more so.

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