

Unified Variational Principle Model (UVM)

Benefits for Science and Industry

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The UVM unifies classical dynamics, quantum-gravitational corrections, causality constraints, and information preservation into one global equilibrium principle. By treating physical behavior, quantum corrections, causal limits, and informational identity as mutually balancing terms, it provides a single coherent language for analyzing stability, transformation, and breakdown across physical, informational, and human systems. The genuinely new contribution of Borrego is the global equilibrium condition itself — a single variational principle that did not exist before, in which the generalized action and its quantum-gravity corrections are balanced against causal-separation constraints and a holographic informational invariant, so that one stationarity condition simultaneously recovers classical motion, quantum regularization, chronology protection, and information preservation, and extends the same equilibrium law beyond physics into informational and human systems.

Benefits for Science

Single unifying equilibrium principle	Introduces a previously non-existent variational law that balances action, quantum-gravity corrections, causality, and information in one stationarity condition — unifying in a single principle what had only ever been treated as four separate fields.
Fundamental physics & cosmology	Provides a singularity-free, information-preserving description of gravity and the early universe. Replaces the Big Bang / black-hole singularity with a finite quantum bounce, offers an inflation-free route to the primordial power spectrum, and frames the cosmological-constant value as a natural equilibrium cancellation rather than fine-tuning.
Quantum gravity research	Couples Loop-Quantum-Gravity discrete area/volume spectra to a variational action, giving a concrete framework to test how granular spacetime smooths into classical, continuous geometry after the bounce.

Foundations of time & causality	Treats time as an emergent variable arising from a system's departure from equilibrium and enforces chronology protection, offering a testable interpretation of the 'problem of time' in quantum gravity.
Quantum information & black-hole physics	Embeds a holographic informational invariant ('quantum fingerprint') guaranteeing unitarity, directly addressing the black-hole information paradox and connecting information theory to gravitation.
Complex-systems & interdisciplinary modeling	Extends a single equilibrium formalism beyond physics into systems theory, enabling unified modeling of stability and resilience in ecological, economic, and socio-informational systems.

Benefits for Industry

Aerospace & space technology	A unified equilibrium framework for analyzing complex dynamical and gravitational scenarios supports advanced navigation, orbital-stability analysis, and long-horizon mission planning.
Energy & advanced materials	Equilibrium-based analysis of vacuum-energy and field interactions can guide research into novel energy concepts and the behavior of materials under extreme regimes.
Information security & data integrity	The information-preservation invariant translates into principles for provably durable, tamper-evident data identity — valuable for archival integrity and trustworthy record-keeping.
Scientific software & simulation	A common variational structure lets simulation vendors share solvers across physics, reducing duplicated modeling effort and accelerating cross-domain R&D; tooling.
Strategic risk & governance analytics	As a formal model of equilibrium and imbalance, the UVM offers decision-makers a structured tool for assessing systemic risk, sustainability, and resilience in large socio-technical systems.

Benefits in 10 Years and Beyond — with AI and Emerging Technologies

AI-driven theory discovery	AI systems trained on the unified equilibrium formalism could autonomously search for new equilibrium solutions, propose testable cosmological predictions, and accelerate the path toward a verified theory of quantum gravity.
Quantum-simulated cosmology	Fault-tolerant quantum computers could simulate the quantum-bounce and spacetime-emergence regimes directly, turning the UVM from an analytical framework into an experimentally explorable model of the early universe.

Self-stabilizing complex systems	Coupled with AI, the equilibrium principle could power real-time governance of energy grids, climate systems, and global supply chains that detect imbalance and self-correct before collapse.
Information-preserving infrastructure	The information-preservation invariant could underpin civilization-scale archival systems that guarantee the durable, tamper-proof continuity of human knowledge across centuries.
Unified planetary risk modeling	A mature UVM-plus-AI platform could model physical, informational, and human systems in one framework, giving humanity an early-warning and resilience tool for systemic, civilization-level risks.