Information Ontology: Rewriting the Foundations of Physics [PHY-SCI-003]

Paper Outline and Plan

1. Abstract

- Introduction to information ontology as a fundamental paradigm shift in physics
- Overview of how information-based principles can rewrite conventional physical theories
- Summary of key theoretical advances and mathematical framework
- Implications for resolving existing paradoxes and contradictions in physics
- Potential applications across multiple physical domains

2. Introduction

- Historical perspective on physical ontologies: matter, energy, and information
- Limitations of current physical frameworks in addressing foundational questions
- Information as a fundamental substrate rather than emergent property
- Key principles of information ontology and how they differ from conventional approaches
- Overview of paper structure and contributions

3. Information Theoretical Foundation

- Formal definition of information in the physical context
  - Beyond Shannon information to ontological information
  - Mathematical formalism for information states and operations
  - Information conservation and transformation principles
- XOR operations as fundamental information differences
  - Mathematical properties of XOR in information space
  - Relationship to quantum superposition and entanglement
  - Physical significance of information differences
- SHIFT operations as information state transformations
  - Mathematical formalism of SHIFT operations
  - Connection to physical transitions and measurements
  - Conservation laws in information transitions
- Information field concept
  - Mathematical definition of information fields
  - Field equations and propagation dynamics
  - Correspondence with conventional physical fields

4. Rewriting Quantum Mechanics

- Information-based quantum states
  - Wave function as information distribution
  - Quantum superposition as information overlays
  - Mathematical equivalence proofs with standard formulations
- Measurement as information extraction
  - Information-theoretic resolution of the measurement problem
  - Observer role as information processor
  - Derivation of quantum probabilities from information principles
- Quantum entanglement from information perspective
  - Non-locality as information connection
  - Bell's inequalities from information constraints
  - Quantum teleportation as information transfer protocol
- Quantum computing in the information ontology framework
  - Quantum algorithms as information transformation processes
  - Error correction as information preservation
  - Novel computational paradigms emerging from information ontology

5. Rewriting Relativistic Physics

- Spacetime as information structure
  - Derivation of spacetime metrics from information relationships
  - Information-based explanation of relativistic effects
  - Time as information processing sequence
- Gravity as information geometry
  - Curvature from information density gradients
  - Deriving Einstein's equations from information principles
  - Gravitational waves as information propagation
- Causality in information framework
  - Light cone as information accessibility boundary
  - Information-theoretical basis for causal structures
  - Resolving apparent causality paradoxes
- Black holes and information
  - Event horizons as information boundaries
  - Novel resolution to information paradox
  - Hawking radiation as information leakage process

6. Rewriting Thermodynamics and Statistical Physics

- Information and entropy relationship
  - Second law reformulation through information principles
  - Entropy as measure of information distribution
  - Maximum entropy principle from information perspective
- Irreversibility as information cascade
  - Time's arrow emergence from information spread
  - Microscopic reversibility versus macroscopic irreversibility

  - Quantum decoherence as information diffusion
- Thermodynamic equilibrium as information state
  - Balanced information distribution in equilibrium systems
  - Non-equilibrium systems as information gradients
  - Fluctuation theorems from information principles
- Information engines and Maxwell's demon
  - Work extraction through information processing
  - Fundamental limits of information-based work
  - Unified treatment of information and energy

7. Unification Framework

- Unified information field equations
  - Core mathematical formulation integrating quantum and relativistic regimes
  - Derivation of fundamental constants from information principles
  - Dimensional analysis in information context
- Physical forces as information interactions
  - Common information basis for fundamental forces
  - Force unification through information operations
  - Predictions for force behaviors at extreme scales
- Emergence of physical laws from information principles
  - Derivation of conservation laws from information invariants
  - Symmetry principles as information preservation
  - Physical constants emerging from information operations
- Quantum gravity approach through information
  - Resolution of incompatibilities between quantum mechanics and general relativity
  - Information-based approach to Planck scale physics
  - Novel predictions for quantum gravitational phenomena

8. Experimental Predictions and Tests

- Quantum system tests
  - Novel interference patterns in specific experimental setups
  - Modified predictions for quantum computing protocols
  - Testable deviations in quantum measurement statistics
- Mesoscopic system predictions
  - Quantum-classical boundary behaviors
  - Decoherence modifications in specific systems
  - Experimental design for information preservation measurement
- Astrophysical tests
  - Black hole information signature predictions
  - Gravitational wave pattern modifications
  - Dark energy as information field phenomenon
- Laboratory gravity experiments

  - Information-based modifications to precision gravity measurements
  - Proposed tabletop experiments to test information gravity
  - Specific predictions with numerical values and error ranges

9. Computational Methods and Simulations

- Information dynamics simulation framework
  - Numerical methods for information field equations
  - Multi-scale modeling approach
  - Convergence and stability analysis
- Quantum system simulations
  - Information-based quantum circuit simulations
  - Comparison with standard quantum simulations
  - Efficiency advantages of information approach
- Gravitational simulations
  - Information field approach to gravitational dynamics
  - Computational advantages over conventional methods
  - Novel predictions from simulation results
- Universe evolution simulation
  - Cosmological models based on information principles
  - Structure formation from information perspective
  - Comparison with observational data

10. Philosophical and Foundational Implications

- Information as physical reality
  - Ontological status of information in physics
  - Comparison with other foundational perspectives
  - Resolution of realism vs. instrumentalism debate
- Observer role in physics
  - Information extraction and reality
  - Resolution of measurement problem
  - Participatory universe concept in information framework
- Information determinism and free will
  - Causal structure in information ontology
  - Compatibility with quantum indeterminism
  - Novel perspective on free will debate
- Limits of knowledge
  - Information accessibility constraints
  - Fundamental uncertainty principles
  - Ultimate limits of physical theories

11. Applications and Extensions

- Quantum technology advancements
  - Novel quantum computing paradigms
  - Quantum communication efficiency improvements

  - Quantum sensing with information awareness
- Cosmological modeling
  - Information-based dark energy and dark matter models
  - Initial conditions from information principles
  - Universe evolution predictions
- Complex systems analysis
  - Biological systems in information framework
  - Consciousness studies from information perspective
  - Social systems as information processing structures
- Computational physics advancement
  - Information-focused algorithms for physical simulation
  - Efficiency improvements through information principles
  - Novel computational approaches to difficult problems

12. Conclusions and Future Directions

- Summary of information ontology framework
  - Key mathematical advances
  - Core theoretical contributions
  - Experimental verifications and predictions
- Advantages over conventional approaches
  - Parsimony and elegance
  - Explanatory power for existing paradoxes
  - Mathematical consistency across domains
- Open questions and future research
  - Current limitations of the framework
  - Key areas requiring further development
  - Potential breakthrough applications
- Vision for physics based on information ontology
  - Long-term implications for theoretical physics
  - Technological applications and societal impact
  - New research directions enabled by this paradigm

Implementation Timeline

1. **Core Information Ontology Framework** (Deadline: May 31, 2025)
   - Formalize mathematical definitions of information states
   - Develop complete axiom system for information ontology
   - Derive key theorems relating information to physical quantities
   - Establish correspondence with existing physical theories
2. **Quantum Mechanics Reformulation** (Deadline: June 30, 2025)
   - Complete information-based derivation of quantum principles
   - Develop formal resolution of measurement problem
   - Establish information interpretation of quantum entanglement
   - Create mathematical bridge to standard quantum formalism
3. **Relativistic Physics Reformulation** (Deadline: July 31, 2025)

- Derive spacetime structure from information principles
- Complete information-based derivation of Einstein's equations
- Develop black hole information theory
- Establish correspondence with standard relativistic formalism

4. **Thermodynamics and Statistical Physics Reframing** (Deadline: August 15, 2025)
   - Develop information-based entropy foundation
   - Formalize irreversibility principles in information framework
   - Create information engine theoretical models
   - Establish correspondence with standard thermodynamic laws
5. **Unification Framework Development** (Deadline: September 15, 2025)
   - Formulate unified information field equations
   - Develop common framework for fundamental forces
   - Create quantum gravity approach through information principles
   - Establish specific predictions for experimental verification
6. **Computational Implementation** (Deadline: October 15, 2025)
   - Develop simulation algorithms for information fields
   - Create visualization tools for information dynamics
   - Implement test cases across physical domains
   - Validate predictions against existing physical data
7. **Experimental Prediction Refinement** (Deadline: November 15, 2025)
   - Identify key experimental tests with highest differentiation power
   - Calculate precise predictions with uncertainty bounds
   - Design experimental protocols for verification
   - Establish collaboration with experimental groups
8. **Manuscript Development** (Deadline: December 15, 2025)
   - Complete first draft with comprehensive mathematical appendices
   - Prepare visual materials and illustrations
   - Develop supplementary materials package
   - Conduct internal review and refinement

Target Submission Date: January 15, 2026

Authorship and Affiliations

Primary Author: - Auric

Collaborators: - To be determined based on contributions to mathematical formalism, computational implementation, and experimental design.

Institutional Affiliations: - To be confirmed prior to submission.

Publication Strategy Notes

1. Position information ontology as a revolutionary paradigm rather than incremental advance

2. Emphasize mathematical rigor and consistency across physical domains
3. Focus on resolving existing paradoxes through information framework
4. Provide clear experimental predictions that differentiate from conventional theories
5. Balance theoretical innovation with connection to established physics
6. Include comprehensive supplementary materials to support advanced mathematical claims

Last Updated: April 18, 2025