ISSN: 2634-9221
European Journal of Applied Sciences; Vol. 14 No. 03 (2026) (299-328)
https://doi.org/10.14738/ejas.1403.10518

Revision of Mathematical Principles of Natural Philosophy Based on the UCST Realism Framework

Weicheng Cui[1],[2]*

1. Zhejiang Engineering Research Center of Micro/Nano Photonic/Electronic System Integration, Westlake University, Hangzhou, China
2. Department of Electronic and Information Engineering, School of Engineering, Westlake University, Hangzhou, China

Abstract: Newton's *Mathematical Principles of Natural Philosophy* established the paradigmatic foundation of classical mechanics. Nevertheless, its theoretical system suffers from profound inherent defects including ontological vacancy, circular definition, action-at-a-distance, and ambiguous origin of motion, failing to provide a self-consistent realist interpretation of the physical world. While modern physics has improved predictive accuracy, it has further introduced abstract hypotheses such as spacetime curvature, carrier-free energy, vacuum fluctuation, probabilistic wave function, and nonlocal correlation, exacerbating theoretical fragmentation and ontological ambiguity. To reconstruct the realist foundation of physics and achieve a unified description of universal phenomena, this paper systematically revises *Mathematical Principles of Natural Philosophy* based on the realism framework of the Unified Complex System Theory (UCST). Grounded in three fundamental philosophical ontologies—the Universe, Mind, and Aether—and taking 17 axioms as the sole logical premise, this study strictly distinguishes active force from passive force, proposes generalized living entities as the basic constituent units of the world, and regards the aether as the real medium for the transmission of force, momentum and energy. A unified dynamic equation incorporating the generalized second law of motion is thereby established, unifying macroscopic celestial motion, microscopic particle motion, fluid motion, thermal motion, wave phenomena and radiation phenomena within a single self-consistent and integrated theoretical framework. This paper demonstrates that the primary cause of all motions lies in the active force autonomously generated by living entities, whereas passive force only functions to constrain, transmit and alter motion states. Complex motion patterns such as orbit, periodicity, rotation, vibration and evolution arise necessarily from the coupling of active and passive forces. No purely inanimate entities exist in the real world; macroscopic stationary objects merely represent an ideal limit where active force

approaches zero. The universe maintains perpetual motion without requiring an external "First Mover", with its fundamental origin rooted in the active force inherent in all basic constituent units. Through the ontological reconstruction of traditional mechanics, thermodynamics, wave theory and cosmology, this paper accomplishes a paradigmatic transformation of physics: from descriptive to explanatory, from fragmented to universal, and from abstraction to realism. It provides a logically self-consistent and empirically verifiable unified foundation for natural philosophy and theoretical physics.

Keywords: Natural Philosophy, Mathematical Principles, Unified Realism, Active Force, Passive Force, Generalized Living Entity, Aether, Absolute Space, Unified Dynamics, Ontological Reconstruction

INTRODUCTION

Historical Contributions and Inherent Limitations of Newton's Principia

In 1687, Newton published Mathematical Principles of Natural Philosophy (Newton, 1687). For the first time, he systematically formulated mechanical laws in an axiomatic mathematical form, unified the motion of terrestrial objects and celestial bodies, and established the system of classical mechanics (Goldstein et al., 2002), marking a milestone in modern science. Core concepts proposed by Newton—including mass, momentum, force, centripetal force and inertia—together with the three laws of motion and the law of universal gravitation, have profoundly transformed human cognition of nature and laid a theoretical foundation for the Industrial Revolution and modern engineering technology.

Nevertheless, examined from the perspectives of ontology and logical consistency (Cui, 2021; Cui et al., 2025a), Newton's system bears insurmountable inherent flaws:

1. **Absence of a real carrier for absolute spacetime**: Absolute space and absolute time are posited as an abstract background without an observable material substrate.
2. **Unexplainable action-at-a-distance**: Gravitation is described as instantaneous cross-space interaction without a medium, violating the locality principle of causality.
3. **Unresolved origin of motion**: The law of inertia only characterizes passive motion states but fails to explain the initiation of object motion and the sustained orbital motion of celestial bodies.
4. **Circular definition of fundamental concepts**: Basic notions such as mass, force and motion are mutually dependent, lacking independent ontological support.
5. **Inability to interpret the essence of waves**: No unified mechanical carrier and action mechanism are provided for wave phenomena including light, sound and

thermal radiation.

6. **Closed and conservative theoretical system**: Rejection of intrinsic active causes treats the universe as a mechanically operated passive system.

These deficiencies stem not from insufficient experimental precision, but from systemic problems including ontological vacancy, redundant hypotheses and logical fragmentation, which directly restrict the further development and unification of classical mechanics.

Progress and Ontological Crisis of Modern Physics

Since the late 19th century, breakthroughs in electromagnetism (Maxwell, 1865), thermodynamics (Gyftopoulos & Beretta, 1990), relativity (Einstein, 1916), quantum mechanics (Fitzpatrick, 2015; Valentini, 2026), particle physics and other fields have greatly enhanced human capability to predict and regulate natural phenomena. Meanwhile, however, physics has gradually deviated from the realist tradition and fallen into an increasingly severe ontological crisis:

1. **Relativization and geometrization of spacetime**: Relativity regards spacetime as a deformable dynamic field, negating absolute space and objective simultaneity and making physical laws observer-dependent.
2. **Substantialization of energy**: Energy is treated as an abstract quantity capable of independent existence without material carriers, giving rise to carrier-free concepts such as vacuum energy, zero-point energy and field energy.
3. **Non-realization of quantum mechanics**: The wave function is interpreted as a probability amplitude (Fitzpatrick, 2015); particles follow no deterministic trajectories, and observation determines reality, which contradicts causal determinism.
4. **Fragmentation of interactions**: Gravitation, electromagnetic force, strong interaction and weak interaction lack a unified carrier and mechanism.
5. **Absolutization of the second law of thermodynamics**: The entropy increase principle for isolated systems is unconditionally extrapolated, denying the autonomous motion capability of living systems, celestial systems and microscopic systems.
6. **Erroneous negation of the aether**: Null results of the late 19th-century aether drift experiments were one-sidedly interpreted, leading to the abandonment of the mechanical medium, the absence of a force transmission mechanism, and ontological ambiguity of wave phenomena (Cui, 2026a).

The core dilemma of modern physics lies in prioritizing the completeness of mathematical formalism at the cost of ontological reality, and improving local accuracy while undermining global self-consistency (Cui, 2026b). Physics urgently requires a thorough return to ontology to rebuild a theoretical framework centered on reality, determinacy and unity.

Proposition and Objectives of the UCST Unified Realism Framework

To address the above dual crises, the author's research team formally proposed the Unified Complex System Theory from 2019 to 2025 (Cui et al., 2025b), and further established in 2026 the conceptual and axiomatic system indispensable to any scientific theory—denoted herein as the UCST unified realism framework (Cui, 2026c). This paper conducts a systematic revision of *Mathematical Principles of Natural Philosophy* on the basis of the unified realism framework. The framework adheres to four fundamental principles:

1. **Ontology Priority Principle**: All physical concepts must be attached to real carriers, and abstract hypotheses without ontological grounding are prohibited.
2. **Non-Circular Definition Principle**: Basic concepts are established in a dual symbiotic manner, free from mutual dependence and circular reasoning.
3. **Minimum Axiom Principle**: The theoretical system takes the fewest and most independent axioms as its logical starting point and rejects redundant assumptions.
4. **Global Unification Principle**: All phenomena, from celestial bodies to microscopic particles and from mechanical motion to thermal radiation, abide by the same set of laws. Notably, the "globality" in science refers to the observable world of humanity rather than the entire universe.

The core objectives of this paper are as follows:

1. To establish three solid ontological pillars for physics: the Universe, Mind, and Aether.
2. To propose a dual unified dynamics of active and passive forces, explaining the origin and maintenance mechanism of motion.
3. To define generalized living entities and reveal the intrinsic cause of the universe's perpetual motion.
4. To restore the ontological reality of the aether and interpret phenomena such as force transmission, wave propagation and radiation.
5. To reconstruct the dual structure of absolute space and relative time, returning to an objective and realistic view of spacetime.

6. To construct a self-consistent system consisting of 17 axioms and realize the global unification of mechanics, celestial motion, fluid dynamics, thermology, radiation and wave theory.
7. To abandon non-realist hypotheses including action-at-a-distance (Newton, 1687), spacetime curvature (Einstein, 1916), carrier-free energy (Einstein, 1916) and probability waves (Fitzpatrick, 2015).
8. To prove that the universe requires no external First Mover, with active force serving as the ultimate source of all motions.

Principles of Philosophical Reasoning

All deductions in this paper strictly follow the four principles of philosophical reasoning derived directly from the 17 fundamental axioms, with no additional hypotheses introduced:

- **Principle I**: Admit only true causes that suffice to explain phenomena, and introduce no superfluous causes.
- **Principle II**: Attribute the same natural phenomena to the same causes wherever possible.
- **Principle III**: Attributes of bodies that can neither be augmented nor diminished, and are common to all bodies accessible to experiments, shall be regarded as universal attributes of all bodies.
- **Principle IV**: In experimental philosophy, propositions generalized from phenomena shall be deemed strictly or approximately true, and no contradictory hypotheses shall be introduced until new phenomena emerge.

The above principles ensure that the theoretical system remains realistic, concise, unified and testable, avoiding metaphysical fiction and the abuse of mathematical formalism.

REVISED MAIN TEXT OF MATHEMATICAL PRINCIPLES OF NATURAL PHILOSOPHY

Philosophical Foundation and Definition of Core Ontologies

Distinction between the Universe and the World

Definition 1 The Universe:

The Universe is the greatest existential totality comprehensible to human reasoning. It is boundless in space, eternal and everlasting in time, uncreated and indestructible. Belonging

to the category of philosophical ontology, the Universe transcends the boundary of human empirical capacity and cannot be fully observed, measured, or described. Its sole function is to provide the ultimate boundary for the entire theoretical system, without directly participating in the construction of physical laws.

Definition 2 The World:

The World refers to the limited spacetime scope accessible to human senses, instruments, experiments and reasoning, together with all matter, particles, aether and observable motions contained within it. The World is the only legitimate and empirically verifiable research object of natural philosophy. All physical laws, dynamical equations, interaction mechanisms and measurement criteria are valid only within the World and cannot be extrapolated unrestrictedly to the entire Universe.

Significance of Distinguishing the Universe and the World

- Avoid paradoxes arising from unlimited extrapolation of limited observational conclusions;
- Clarify the legitimate scope of physics and prevent metaphysical overstepping;
- Lay a reasonable boundary for realist presuppositions such as absolute space, aether and causality.

Mind Ontology: The Ultimate Origin of Active Force

Definition 3 Mind:

Mind is a non-material primordial existence that forms a dual symbiotic relationship with matter. It is not the superficial consciousness, sensation, emotion or will of living beings, but an underlying primordial ontology capable of initiating autonomous motion, constructing cognitive concepts, bearing information, and driving material entities.

Core Attributes of Mind

- **Immateriality**: Occupies no space, possesses no mass, and is not directly observable;
- **Autonomy**: Can independently issue directives, generate motive force and alter motion states when united with physical bodies and supported by medium conditions;
- **Duality**: Must integrate with matter to produce observable motion and life

phenomena;

- **Indestructibility**: Mind is uncreated and imperishable, only uniting with or separating from matter.

The integration of Mind and matter forms a complete living entity; their separation deprives the entity of autonomous motion capacity and leads to the state of death. Mind constitutes the ultimate source of all active forces.

Aether Ontology: The Real Medium of Matter, Force and Motion

Definition 4 Aether:

The Aether is a cluster of subtle particles permeating the entire absolute space, unobservable directly. Classified as a generalized living entity, the aether possesses faint yet pervasive capacity for autonomous motion. The aether fulfills three irreplaceable physical functions:

- **Substrate Carrier**: Provides the primordial material basis for all physical particles and serves as the underlying carrier for motion and evolution;
- **Interaction Transmission**: Conveys momentum, energy and all passive forces, eliminating action-at-a-distance;
- **Wave Formation**: Enables microscopic particles to follow periodic and undulating trajectories in motion, manifesting wave phenomena.

Without the aether, space would be mere void, rendering force transmission, motion bearing and wave formation impossible. The aether is a logically necessary, indispensable and irreplaceable underlying carrier of the entire realist system (Cui, 2026a).

Absolute Space and Relative Time

Definition 5 Absolute Space:

By its inherent nature, absolute space remains always identical and stationary, independent of all external entities. It constitutes an objective, real, eternal, undeformable and motionless ultimate background independent of observers. Filled with aether, absolute space bears genuine physical significance rather than being a purely mathematical abstraction. The position, motion, orbit and interaction of all objects take absolute space as their ultimate reference frame.

Definition 6 Relative Time:

Relative Time is a cognitive scale constructed by human Mind (Kant, 2002) to measure the sequence of motion, the rate of change and the periodicity of processes. Time is neither an objective substance nor an intrinsic dimension of the Universe, possessing no capacity to flow independently, drive events or alter states. The Universe contains only material motion, particle collision and state transition, with no fluid-like entity termed "time". Conventional units such as hour, day, month and year are merely human conventions and markers of periodic motion established by human minds.

Dual Relationship between Absolute Space and Relative Time:

- Space is objective ontology; Time is subjective cognition;
- Space is a static background; Time is a dynamic measure;
- Space is a real carrier; Time is a cognitive tool;
- The two cannot be merged into a bendable, deformable or compressible continuum, nor altered by observers.

This dual structure eliminates the ontological confusion introduced by relativistic spacetime view and returns to an objective, deterministic and realistic spacetime framework.

Dependent Definition of Fundamental Physical Quantities

Quantity of Matter (Mass)

Definition 7 Mass:

Mass is a fundamental measure introduced to describe the amount of matter contained in an object. Independent of density, volume, weight or motion state, it is defined as an invariant determined by direct comparison with a recognized standard object.

Core Properties of Mass:

- **Intrinsic Attribute**: Mass is an inherent identifier of material ontology, representing the absolute quantity of matter contained in an object;
- **Conservation**: Its magnitude remains constant, ungenerable and indestructible, only

accumulating by component partition or combination;

- **Standard Criterion**: Mass serves as the fundamental criterion for defining physical entities. Entities without mass attributes are categorized as immaterial existences such as mind, time and space. The consciousness of living beings subsists attached to physical bodies as a manifestation of the interaction between mind and body;
- **Universality**: All particles (including photons), macroscopic objects and celestial bodies possess mass.

As the most fundamental measure of the dynamical system, mass remains invariant regardless of motion, coordinate systems or interactions.

Quantity of Motion (Momentum)

Definition 8 Momentum:

The quantity of motion, namely momentum, is a measure derived jointly from velocity and material mass. The momentum of a whole object equals the sum of the momenta of all its constituent parts.

Core Properties of Momentum:

- **Dependence**: Momentum is an attached attribute of matter and can never exist independently without a material carrier;
- **Transmissibility**: Momentum can only be transmitted, distributed and transferred between objects and particles, incapable of spontaneous generation or annihilation;
- **Relativity**: As the description of motion relies on coordinate systems, the magnitude of momentum varies with different reference frames;
- **Vector Nature**: Momentum possesses direction, consistent with the direction of motion.

There exists no "pure momentum" detached from particles, mass or physical objects. The conservation of momentum is essentially an inevitable consequence of motion transmission among material entities.

Energy

Definition 9 Energy:

Energy is a unified measure of material motion, interaction and state intensity, forming a dual attribute with momentum.

Core Properties of Energy:

- **Dependence**: Energy must be carried by physical particles or aether particles and cannot exist in free form within void space;
- **Unified Nature**: Kinetic energy, potential energy, thermal energy, radiant energy, electromagnetic energy and other forms are essentially measures of particle motion and interaction;
- **Transmissibility**: The transmission, transformation and dissipation of energy are all grounded in material carriers;
- **Relativity**: Since energy is associated with object motion, its magnitude varies across coordinate systems.

Concepts such as "field energy", "vacuum energy" and "radiant energy" essentially refer to energy carried by physical or aether particles, rather than abstract energy without carriers. The conservation of energy is inherently a necessary outcome of material motion and state transformation.

Active Force and Passive Force: Dual Origins of Motion

Passive Force: Passive Response and Constraint

Definition 10 Passive Force:

Passive Force is a secondary, conductive and non-autonomous interaction. It cannot spontaneously generate motion, but only alter the magnitude or direction of existing motion, constrain motion paths, transmit interactions, and produce resistance or attraction.

Main Types of Passive Force:

Gravitation; electromagnetic force; strong interaction; weak interaction; inertial force; resistance and friction; centripetal force and constraint force; pressure and buoyancy.

Fundamental Laws of Passive Force:

- **Passivity**: Incapable of autonomous initiation, only responding to pre-existing motion or interaction;

- **Locality**: Interaction intensity decays with increasing distance;
- **Medium Dependence**: Must be transmitted via the aether, with no action-at-a-distance;
- **Compliance with the Third Law**: Every passive force is accompanied by an equal and opposite reaction force.

Passive force acts as the constrainer and transmitter of motion, rather than its initiator.

Active Force: The Primordial Cause of Autonomous Generation

Definition 11 Active Force:

Active Force is an inherent, self-sufficient and primordial motive force endogenous to living entities. Its generation arises from the synergistic coupling of mind, physical body and supporting medium, all three being indispensable and complementary.

Generation Mechanism of Active Force:

1. Mind issues operative directives to the physical body;
2. The physical body relies on the reaction of the supporting medium;
3. The coupling of the three generates controllable autonomous active force.

Examples:

- Human walking generates active force with the ground as the supporting medium;
- Human swimming takes water as the supporting medium;
- Particle motion relies on surrounding aether as the supporting medium;
- Celestial motion takes cosmic aether as the supporting medium.

Core Properties of Active Force:

- **Autonomy**: Initiated and controlled independently by living entities;
- **Primordial Causality**: Constitutes the initial cause of all motion and the fundamental origin of the Universe's perpetual motion;
- **Volitional Determinacy**: Its direction and magnitude are determined by the free will of living entities;

- **Exclusive to Life**: Exists only in living entities and vanishes upon the death of the organism.

Without active force, sustained motion cannot be maintained solely by passive force. Objects would remain stationary or in uniform rectilinear motion, incapable of forming orbits, periodicity, rotation, vibration or evolutionary motion.

Fundamental Distinction between Active Force and Passive Force

The attribute comparison between active force and passive force is presented in Table 1 with marked disparities. The UCST points out that the fundamental limitation of classical mechanics lies in its complete neglect of the inherent function and role of active force.

Table 1: Comparison of Attributes between Active Force and Passive Force

Property	Active Force	Passive Force
Origin	Coupling of Mind and matter (body+support)	Interaction between material entities
Character	Primordial, autonomous, spontaneous	Secondary, conductive, passive
Function	Initiate, sustain and alter motion	Constrain motion, transmit interaction, change state
Carrier	Living entities	Physical objects
Medium	Supporting medium (ground, water, aether)	Aether+air
Governing Rule	Determined by free will	Obeys quantitative laws such as inverse-square and linear relations
Scope of Existence	Exclusive to living entities	All material systems

Generalized Living Entities: Fundamental Units of the World

Criterion for Generalized Living Entities

Definition 12 Generalized Living Entity:

Any entity capable of independently generating active force, initiating autonomous motion and altering its own motion state, regardless of scale or visibility, is defined as a generalized living entity.

This definition fundamentally breaks the limitations of traditional life definitions, attributing the essence of life to autonomous motion capacity rather than superficial features such as cellular structure, metabolism and reproduction.

Universal Distribution of Generalized Living Entities

The core conclusion running throughout this text is derived directly from the criterion above:

- **Celestial Scale**: All celestial bodies including the Sun, planets, satellites, comets and stars are generalized living entities;
- **Microscopic Scale**: Molecules, atoms, electrons, protons, neutrons and all subatomic particles are generalized living entities;
- **Medium Scale**: Aether particles, as subtle existences permeating space with autonomous motion capacity, belong to generalized living entities;
- **Macroscopic Objects**: There exist no purely inanimate entities in the real world entirely devoid of active force and passively responsive only.

Essence of Inanimate Entities

Inanimate entities represent merely the ideal limit where active force approaches zero. When numerous molecules and atoms aggregate to form liquids and solids that appear stationary relative to human observers and move only under external perturbation, they can be treated conventionally inanimate objects, such as still water and stones. The perpetual motion of the World arises not from external propulsion, but from the inherent autonomous motion capacity of all fundamental constituent units that are themselves living entities.

Seventeen Fundamental Axioms of the Unified Realism Framework

The entire theoretical system is established upon the following 17 axioms, with no additional hypotheses, circular reasoning or redundant presuppositions:

1. **Axiom of Infinite Universe and Finite World**: The Universe is infinite, eternal and empirically unascertainable; the World is finite, observable and verifiable, constituting the sole research scope of natural philosophy.
2. **Axiom of Existence**: Human beings and the observable World possess objective reality, rather than being pure mental illusions.
3. **Axiom of Mind-Matter Dual Ontology**: Mind and matter are mutually independent and symbiotic, constituting all existence; their integration forms living entities,

while separation results in death.

4. **Axiom of Hierarchical Objects**: Physical entities can be classified by scale into multiple hierarchical levels; macroscopic inanimate objects may exhibit living attributes at the microscopic level.
5. **Axiom of Causality**: The observable World follows deterministic causal laws; there is at least one cause for every effect, and every cause gives rise to at least one effect.
6. **Axiom of Locality**: The interaction intensity between any two objects decays with increasing distance.
7. **Axiom of Knowability**: Human beings possess rational capacity to cognize, reveal and express the operational laws of the World.
8. **Axiom of Extrapolation**: Laws induced within a limited scope can be reasonably extrapolated to similar spacetime domains.
9. **Axiom of Consistency-Completeness Antinomy**: Not all formal theoretical systems can simultaneously achieve strict logical self-consistency and theoretical completeness; thus scientific construction prioritizes logical self-consistency.
10. **Axiom of Determinism-Probabilism Unification**: System behavior appears deterministic or probabilistic depending on information completeness; complete information yields determinism, while incomplete information results in probability.
11. **Axiom of Precision-Correctness Balance**: With fixed total information, higher descriptive precision may correspond to lower correctness.
12. **Axiom of Closed Systems**: A closed system exchanges no matter with the external environment but permits energy and information transmission; no strictly closed systems exist in reality.
13. **Axiom of Passive Force**: Passive forces comprise four fundamental forms: gravitation, electromagnetic force, strong interaction and weak interaction.
14. **Axiom of Active Force**: Active force arises from the coupling of mind, physical body and supporting medium within living entities, initiated autonomously with direction and magnitude determined by the free will of the entity.
15. **Axiom of Universal Gravitation and Coulomb's Law**: Gravitation between any particles is proportional to the product of their masses and inversely proportional to the square of their separation; charged particles obey Coulomb electrostatic interaction.
16. **Axiom of Action and Reaction**: Every action force is inevitably accompanied by an

equal and opposite reaction force.

17. **Axiom of Generalized Second Law of Motion**: The product of particle mass and acceleration equals the vector sum of total passive force and active force.

The above 17 axioms form the current set of the entire theoretical system, from which all laws of motion, interaction rules, thermal laws, wave principles and cosmological conclusions can be deduced.

Unified Laws of Motion

Law of Passive Inertia

Law I Law of Passive Inertia:

Everybody maintains its state of rest or uniform rectilinear motion provided it is free from active force and subjected to balanced passive forces. This law describes only the passive responsive capacity of objects, without addressing the origin and maintenance of motion. It serves as a fundamental rule governing passive forces rather than the dominant law of universal motion. Inertia is not the cause of motion but a manifestation of passive motion.

Generalized Second Law of Motion

Law II Unified Dynamical Equation:

The alteration of motion is proportional to the total applied force, namely the vector sum of passive force and active force, and occurs along the straight line of the applied force.

$$m\frac{d^2\vec{s}}{dt^2} = \sum \vec{F}_p + \vec{F}_a \quad (1)$$

Where:

- m = mass of the object;
- $\sum \vec{F}_p$ = vector sum of all passive forces (gravitation, electromagnetic force, resistance, centripetal force, etc.);
- $\vec{F}_a$ = autonomous active force generated by the living entity.

As the core universal equation of this system, this law applies to:

- Macroscopic celestial motion;
- Microscopic particle motion;

- Fluid motion;
- Thermal motion;
- Wave and radiation phenomena;
- Motion of living entities;
- All scales and natural phenomena.

The generalized second law transcends Newton's second law, unifying passive and autonomous motion within a single framework and explaining the origin, maintenance, alteration and evolution of motion.

Law of Action and Reaction

Law III Law of Action and Reaction:

To every action there is always an equal and opposite reaction; the mutual interaction between two bodies is always equal in magnitude and opposite in direction. **Scope of Application**: Both active force and passive force strictly comply with this law. When a living entity exerts active force upon another object, the object simultaneously imposes a reaction force upon the entity.

Centripetal Force and Orbital Motion

Essence of Centripetal Force

Definition 13 Centripetal Force:

Centripetal Force is a passive force that drags, propels or inclines an object toward a central point. It is not autonomously generated, but a passive constraint transmitted jointly by the mass of the central object, particle interaction and aether coupling.

Key Properties of Centripetal Force:

- Centripetal force alone cannot initiate motion in a stationary object;
- Centripetal force cannot sustain orbital motion independently;
- Stable curved orbital motion requires the coupling of centripetal passive force and tangential active force.

Three Measures of Centripetal Force

Definition 14 Absolute Measure of Centripetal Force:

Proportional to the ontological intensity of the central generalized living entity, namely its mass and output intensity of active force. A central entity with greater mass and stronger active force exerts a more prominent centripetal effect transmitted outward.

Definition 15 Accelerative Measure of Centripetal Force:

Proportional to the velocity generated within a given time and inversely proportional to the mass of the subjected object. It describes only the intensity of passive response, excluding autonomous motion components.

Definition 16 Motional Measure of Centripetal Force:

Proportional to the quantity of motion generated within a given time, i.e., the magnitude of transmissible momentum.

Unified Origin of Orbital Motion

Proposition 1 Principle of Orbital Motion Composition:

All orbital, periodic, rotational and vibrational motions can be decomposed into:

- Tangential propulsion driven by active force;
- Centripetal constraint imposed by passive force.

Without active force, objects would depart along tangential straight lines with no closed orbit sustained; without passive force, objects would follow rectilinear paths with no curved trajectory formed. Both are indispensable.

Proposition 2 Law of Areal Velocity:

For the radius drawn from an object to the force center, if only passive force acts, the object sweeps equal areas in equal times. If active force exists, the areal velocity deviates in a calculable manner. **Corollary**: In the actual motion of generalized living entities such as planets, satellites and comets, the areal law holds only approximately, with active force serving as the primary source of deviation.

Elliptical Orbits and the Inverse-Square Law

Proposition 3 Centripetal Force Law for Elliptical Orbits:

If an object moves along an ellipse with force directed toward one focus, the centripetal force obeys the inverse-square law of distance. This derivation applies exclusively to passive forces, excluding the contribution of active force. Planets orbit the Sun along elliptical paths with the Sun located at one focus. The gravitational force exerted by the Sun on planets is a passive force complying with the inverse-square law. Nevertheless, the sustained orbital motion of planets relies not merely on gravitational traction, but on the coupling of the planet's intrinsic active force and the Sun's gravitational passive force.

Celestial Motion, Perturbation and Resistance

Motion of Central Celestial Bodies and Orbital Drift:

Central celestial bodies such as the Sun are not stationary but move slowly in absolute space driven by their own active force. Consequently, all planetary orbits are not fixed ellipses but dynamic trajectories drifting integrally with the Sun. The essence of this phenomenon lies in that the central celestial body, as a generalized living entity, alters its own position via intrinsic active force, thereby driving the overall force field and orbital system into synchronous motion.

Complete Origins of Celestial Perturbation

When two or more generalized living entities (planets, satellites, stars) interact, each object is constrained by central passive force, perturbed by passive forces from other celestial bodies, and simultaneously influenced by the coupling of its own active force and those of surrounding entities. Such deviation from ideal orbital trajectories is defined as perturbation. Traditional mechanics attributes perturbation solely to gravitational superposition; this system demonstrates that mutual interference of active forces constitutes a non-negligible vital source of perturbation. The autonomous motion of planets modifies orbital parameters, rendering them incapable of precise description by pure passive force models.

Essence of Medium Resistance

When an object moves within a fluid or aether medium, medium particles—as generalized living entities—exert resistance via autonomous collision and repulsion toward the moving

object. Resistance magnitude correlates with velocity, medium density and the intensity of particles' autonomous motion.

Laws of Resistance:

- Resistance is proportional to velocity at low speeds;
- Resistance is proportional to the square of velocity at high speeds.

Resistance is essentially the macroscopic manifestation of interaction between active and passive forces among particles.

Motion of Fluids and Aether Medium

Realist Definition of Fluids

Definition 17 Fluid:

A Fluid is a deformable, flowable material system composed of numerous microscopic generalized living entities (molecules, atoms, aether particles) capable of continuously transmitting pressure and motion. A fluid is not a passive, inanimate mass driven solely by external forces, but a living dynamical system aggregated from countless micro-entities with autonomous motion. All fluid phenomena including motion, pressure, resistance, diffusion, vortex and wave arise from the combined action of internal particles' active force and externally imposed passive force.

Essential Distinction between Solids and Fluids:

- Particles in solids are strongly constrained in autonomous motion, only capable of in-situ vibration;
- Particles in fluids bear minimal constraint on autonomous motion, permitting free migration, diffusion, collision and repulsion.

Essence of Fluid Pressure

Pressure at any point in a static fluid is uniform. Fluid pressure is essentially the statistical average of autonomous particle collisions.

Proof:

Fluids consist of microscopic particles with autonomous motion. Static equilibrium denotes that the statistical average of particles' active forces offsets each other in all directions. Pressure originates from persistent autonomous collisions between particles and vessel walls as well as adjacent internal particles. If pressure dominates in one direction, particles diffuse spontaneously toward lower-pressure regions until pressure re-equilibrates.

Corollary:

- Fluid pressure correlates solely with the intensity of particles' autonomous motion and particle density, independent of vessel geometry and fluid volume;
- Fluid pressure is transmitted uniformly via the aether medium, acting upon solid surfaces across spatial distances.

Complete Mechanism of Fluid Resistance

Definition 18 Fluid Resistance:

The hindrance exerted by a fluid upon a moving object is termed fluid resistance. It is not merely friction or viscosity, but the macroscopic aggregate effect of autonomous collision, repulsion and obstruction imposed by generalized living particles within the fluid.

Three Categories of Resistance:

1. **Particle Collision Resistance**: The object displaces fluid particles, which rebound via active force to generate obstruction;
2. **Viscous Resistance**: Autonomous traction between fluid particles produces internal friction;
3. **Rear Negative Pressure Resistance**: Rapid object motion causes delayed autonomous replenishment of rear particles, forming a low-pressure zone.

Laws of Resistance:

- Low speed: Resistance $\propto$ Velocity;
- High speed: Resistance $\propto$ Velocity^2.

All resistance arises from the interaction of active forces among generalized living entities; no genuine resistance exists in the absence of active force.

Essence and Limitation of Vortices

Definition 19 Vortex:

A Vortex is a phenomenon in which numerous fluid particles sustain circular motion around a central point.

UCST Ontological Interpretation of Vortices:

The genuine formation mechanism of vortices:

1. A central generalized living entity generates active force to drive surrounding particles;
2. Surrounding particles are drawn by central active force while subject to centrifugal tendency;
3. Circular motion propagates outward via particle autonomous collision and aether coupling;
4. Passive forces (pressure, gravitation) provide centripetal constraint.

Proposition 4 Vortices Cannot Drive Planetary Motion:

The laws governing planetary elliptical orbits contradict those of fluid vortex motion; hence planetary motion is not driven by aether vortices.

Proof:

1. Particle velocity within vortices decreases with increasing distance, conflicting with Kepler's Third Law;
2. Vortices cannot provide stable elliptical orbital constraint for planetary motion;
3. Highly eccentric cometary orbits cannot maintain stability within vortex systems;
4. Vortices rely on sustained active force to persist, failing to explain the eternal motion of celestial bodies.

Conclusion: The genuine motive power of celestial motion originates from intrinsic active force, with the aether acting merely as a transmission medium rather than forming vortices to propel planets.

Aether: The Real Substrate of Absolute Space

Logical Proof of Aether's Existence

Proposition 5 The Aether Necessarily Exists:

The transmission of nonlocal forces, the formation of wave phenomena, the support of particle motion, and the propagation of momentum and energy all necessitate the existence of a universal medium—the aether—regardless of whether it is homogeneous or not.

Proof:

1. Without the aether, passive forces such as gravitation and electromagnetic interaction would require action-at-a-distance, violating the axioms of causality and locality;
2. Without the aether, microscopic particles cannot form undulating trajectories, rendering wave-particle duality inexplicable;
3. Without the aether, momentum and energy cannot transmit independently of physical objects, making radiation phenomena impossible;
4. Without the aether, absolute space would reduce to pure void devoid of physical reality.

The aether is a logically necessary, indispensable and irreplaceable underlying carrier of the entire physical system.

Fundamental Properties of the Aether

- The aether is composed of subtle particles classified as generalized living entities;
- Permeating the entire absolute space, all aether and physical particles maintain high-speed motion, following the universal rule that smaller particle scale corresponds to higher motion velocity;
- Aether waves transmit force, momentum, energy and information;
- The aether exerts negligible resistance on macroscopic celestial motion yet exerts significant influence on microscopic particle motion.

Unified Realist Interpretation of Wave Phenomena

Essence of Waves

Definition 20 Wave:

All waves (water waves, sound waves, radiation waves, quantum waves) are not

independently subsistent entities, but external manifestations of collective motion among generalized living particles. Different types of particles manifest specific wave frequencies; waves are essentially trajectory appearances formed by the transmission of particles' autonomous motion.

Unified Principle of Waves:

Particles constitute ontology; waves are phenomenal manifestation. No waves exist without particles, and no wave propagation occurs without the aether.

Mechanism of Wave Propagation

Wave propagation is a chain transmission process of particles' autonomous motion:

1. Source particles initiate autonomous vibration or emission;
2. Adjacent particles respond autonomously upon collision;
3. The aether medium transmits momentum;
4. Motion diffuses sequentially outward to form wave profiles.

Unified Interpretation of Various Wave Phenomena

- **Water Waves**: Manifestations formed by the transverse transmission of vertical autonomous vibration of water particles under gravitation and surface tension;
- **Sound Waves**: Manifestations of density vibration transmitted via autonomous collision among particles in gas, liquid or solid media;
- **Radiation Waves (Original Light Waves)**: Undulating trajectories formed by high-speed microscopic particle motion perturbed by aether coupling.

Unified Conclusion: All waves share identical essence: autonomous particle motion + passive aether transmission = phenomenal wave manifestation.

Realist Interpretation of Interference and Diffraction

- **Interference**: When two waves superpose, particles receive dual motion directives simultaneously, autonomously synthesizing new motion states to produce reinforcement or attenuation;
- **Diffraction**: As waves pass obstacle edges, boundary particles diffuse autonomously

into shadow regions, enabling waves to propagate around obstacles.

Interference and diffraction both arise from the synthesis of particles' autonomous motion, requiring no presuppositions of probability waves or abstract fields.

Cosmological System Theory

All Celestial Bodies Are Generalized Living Entities

All celestial bodies including the Sun, planets, satellites, comets and stars are generalized living entities endowed with intrinsic active force. Celestial motion is synthesized from three components:

- Active force: Tangential propulsion;
- Passive force: Centripetal constraint (gravitation);
- Aether coupling: Subtle perturbation and wave modulation.

Complete Interpretation of Planetary Motion

Planets follow elliptical orbits with the Sun at one focus. Planetary active force sustains tangential motion, while solar gravitation provides centripetal passive constraint. Planetary perturbation originates from:

- Superposition of gravitational passive forces;
- Coupling of active forces among celestial bodies;
- Subtle interaction with the aether medium.

Irregular Motion of the Moon

As a generalized living entity with intrinsic active force, the Moon's irregular motion arises from the synthesis of:

- The Moon's own active force;
- Active and passive forces of the Earth;
- Active and passive forces of the Sun;
- Coupling interaction with the aether.

Tides, Precession and Comets

- **Tides**: Arise not merely from solar and lunar gravitation, but from the coupling of celestial active forces;
- **Precession**: Originates from the torque synthesis of the Earth's integral active force and the active-passive force moments of the Sun and Moon;
- **Comets**: Belong to generalized living entities with intense active force; comae and tails form from autonomous particle emission and aether coupling.

Essence of Gravitation

Gravitation is not action-at-a-distance, but a passive force transmitted via the aether medium. Complying with the inverse-square law, its intensity is jointly determined by the central celestial body's mass, active force output and aether transmission efficiency.

The Universe Requires No Prime Mover

The World necessitates no external Prime Mover. All celestial bodies, particles and aether entities are generalized living entities, with active force serving as the intrinsic primary cause. The Universe is self-sufficient, autonomous and perpetually in motion.

Unification of Heat, Blackbody Radiation and Thermodynamics

Essence of Heat

Definition 21 Heat:

Heat denotes the intensity of autonomous motion of microscopic generalized living particles.

Definition 22 Temperature:

Temperature is a cognitive measure constructed by human minds to quantify the average autonomous motion velocity of microscopic particles. Heat is neither caloric fluid, energy flow nor field excitation, but the macroscopic manifestation of particles' autonomous motion.

Mechanism of Heat Transfer and Heating

All heat transfer follows the process: High-speed microscopic particle directional emission → collision coupling → autonomous motion transmission.

- **Heating**: Injection of exogenous high-speed particles elevates the intensity of particles' autonomous motion;
- **Combustion**: Massive release and high-speed emission of bound particles drastically intensify autonomous motion;
- **Heat Conduction / Convection / Radiation**: All constitute distinct forms of autonomous motion transmission among particles.

Realist Interpretation of Blackbody Radiation

Blackbody radiation is not electromagnetic waves, but a continuous flow of high-speed microscopic particles autonomously emitted by high-temperature objects, inevitably accompanied by synchronous variation of energy and mass. Radiation particles moving within the aether form undulating trajectories manifesting as wave phenomena.

Reconstruction of Thermodynamic Laws

First Law of Thermodynamics:

Derived directly from the conservation of momentum and energy, not an independent axiom.

Second Law of Thermodynamics:

Downgraded to a statistical law applicable only to passive isolated systems devoid of active force, and invalid within living systems. Autonomous systems such as life forms, celestial bodies and microscopic particles can spontaneously reduce internal disorder and sustain ordered motion.

Third Law of Thermodynamics:

The full physical connotation of the third law includes the lower bound of thermal motion, the unattainability of absolute zero, and zero entropy of perfect crystals at absolute zero. All connotations can be logically deduced from the complete description of microscopic particle motion via Newton's second law combined with classical particle system conservation laws. Introducing no new fundamental hypotheses, interactions or motion rules beyond Newtonian dynamics, the third law is not an independent axiom but merely a derived corollary of Newton's second law at the statistical level of thermal motion.

SUMMARY AND CONCLUSIONS

Universal Unified Law

From the aether to galaxies, and from atoms to stars, all physical phenomena obey an identical set of laws:

Generalized living entities' autonomous motion + passive force constraining trajectory + aether transmitting interaction. This law uniformly explains:

- Mechanical motion and celestial motion;
- Microscopic particle motion and wave phenomena;
- Fluid motion, pressure, resistance, and vortices;
- Heat, temperature, heat transfer, and blackbody radiation;
- Gravitation, electromagnetic force, strong/weak interactions;
- Periodicity, orbits, rotation, vibration, and evolution.

Core Theoretical Conclusions

- **The World is composed of generalized living entities**: Celestial bodies, particles, and the aether can all autonomously generate active force; there is no absolutely passive matter. Macroscopic "inanimate entities" are merely approximations where active force approaches zero.
- **Active force is the primary cause of motion**: Without active force, only rest or uniform rectilinear motion exists, making it impossible to form orbits, periodicity, rotation, vibration, or evolution. Inherent in all basic units, active force is the fundamental source of the universe's perpetual motion.
- **The unified dynamical equation is universally valid**: The generalized second law $m\frac{d^2\vec{s}}{dt^2} = \sum \vec{F}_p + \vec{F}_a$ uniformly describes all motion, where passive force is responsible for constraint, and active force is responsible for initiation and maintenance.
- **The aether is a real physical medium**: The aether eliminates action-at-a-distance, carries waves, transmits energy and momentum, endows absolute space with physical reality, and is logically necessary for the theoretical system.
- **The duality of absolute space and relative time holds**: Spacetime returns to objective reality, rejecting curvature, relativization, and geometrization, and eliminating the ontological confusion of modern physics.

- **The theory is self-consistent**: This system is built on 17 axioms, with a rigorous logical foundation: no circular definitions, no isolated concepts, and no fictional entities. It should be noted that whether these 17 axioms are all mutually independent and irreducible remains to be further tested and verified by readers; no scientific theory should aim for completeness. The reason is that a complex system itself is an open system, and for an open system, completeness is inherently an unprovable proposition. For some closed systems (such as a dictionary), if completeness of concept definition is forcibly required, the logical self-consistency of the system must be sacrificed (Cui et al., 2025a; Cui, 2026b]. Based on this, this system does not pursue the completeness of axioms, and in the process of future development and improvement, relevant axioms may be added according to theoretical expansion and practical verification.
- **The world moves self-sufficiently without the need for a prime mover**: The world itself is composed of autonomously moving living entities; motion is its intrinsic nature, and no external initial impetus is required.

Criticism and Transcendence of Traditional and Modern Physics

Based on realism, this paper criticizes and transcends the following non-realist hypotheses:

- Reject the caloric theory and the substantialization of energy, adhering to the principle that energy must be attached to matter;
- Reject the absolute universality of the second law of thermodynamics, restoring the self-organization ability of active systems;
- Reject medium-free radiation and the substantialization of electromagnetic waves, reducing waves to the manifestation of particle motion;
- Reject the non-realist interpretation of quantum mechanics, returning to causal determinism and the reality of particle trajectories;
- Reject spacetime curvature and the relativistic spacetime view, restoring absolute space and objective reality;
- Reject action-at-a-distance, taking the aether as the unified transmission medium;
- Reject the mechanical worldview, reconstructing the cosmic life picture with generalized living entities and active force.

Final Conclusions

Based on the UCST realist framework, this paper completes a systematic ontological reconstruction of Newton's *Mathematical Principles of Natural Philosophy*, establishing a universal physical system with mind–aether as the ontology, active force–passive force as the core, generalized living entities as the basic units, the aether as the medium, and the generalized second law of motion as the unified equation.

This system achieves:

- **Ontological return**: All concepts have real carriers, rejecting abstract fiction;
- **Universal unification**: Complete unification from the microscopic to the cosmic scale, from mechanics to thermodynamics, and from waves to the fields in the world;
- **Logical self-consistency**: Constructing a contradiction-free system based on a currently minimal set of axioms;
- **Causal determinism**: Restoring determinism and eliminating paradoxes of probability and non-locality;
- **Clear mechanisms**: Explaining the underlying mechanisms of motion origin, force transmission, waves, radiation, heat, etc.;
- **Paradigm shift**: From a passive mechanical universe to an active living world.

The Unified Realism Framework provides a testable, extensible, and consistent foundation for natural philosophy and theoretical physics, and is expected to lead physics back to the classical scientific spirit of reality, unification, and simplicity.

ACKNOWLEDGMENTS

This work was financially supported by the Scientific Research Project of Westlake University (Grant No. WU2025A006).

The author also appreciates the technical support from Doubao for language polishing, formula derivation, translation assistance and manuscript formatting during the paper preparation. Meanwhile, the author takes full responsibility for all academic viewpoints, content and conclusions presented in the final version.

Conflict of Interest

The author declares no conflicts of interest. The funding agency had no role in the design of the study, collection, analysis, interpretation of data, writing of the manuscript, or the decision to publish.

Data Availability

This is a theoretical framework paper. No original data was generated in this study.

REFERENCES

Cui, W.C. (2026a). On the rationality of aether as an ontological candidate in physics. *Philosophy Study*, 16(5) (in press).

Cui, W.C. (2026b). A new proposal for scientific standards: Modified Hilbert axiomatic standards and dynamic demarcation criteria. *Philosophy Study*, 16(1), 30–44. https://doi.org/10.17265/2159-5313/2026.01.003

Cui, W.C. (2026c). Exploration of the fundamental principles of physics from the perspective of UCST. *Philosophy Study*, 16(6) (in press).

Cui, W.C. (2021). On the philosophical ontology for a general system theory. *Philosophy Study*, 11(6), 443–458.

Cui, W.C., Li, R., Pan, L.L., & Zeng, L.L. (2025a). The problem of logical self-circulation in modern scientific theories and its resolution.*Philosophy Study*, 15(6), 291–314.

Cui, W.C., Li, R., & Pan, L.L. (2025b). Unified complex systems theory (UCST): Resolving materialist dilemmas through dualist ontology and active force. *European Journal of Applied Sciences*, 13(5), 517–545.

Einstein, A. (1916). *Relativity: The special and general theory*. Dover Publications, Meneola.

Fitzpatrick, R. (2015). *Quantum mechanics*. World Scientific, Singapore.

Goldstein, H., Poole, C., & Safko, J. (2002). *Classical mechanics* (3rd ed.). Pearson, London.

Gyftopoulos, E.P., & Beretta, G.P. (1990). *Thermodynamics: Foundations and applications*. Macmillan, New York.

Kant, I. (2002). Metaphysical foundations of natural science. In H. Allison & P. Heath (Eds.), *Theoretical philosophy after 1781* (pp. –). Cambridge University Press, Cambridge.

Maxwell, J.C. (1865). A dynamical theory of the electromagnetic field. *Philosophical Transactions of the Royal Society of London*, 155, 459–512.

Newton, I. (1687). *Philosophiæ Naturalis Principia Mathematica; & Correspondence with Bentley (1692–1693)*.

Valentini, A. (2026). *Beyond the Quantum: A Quest for the Origin and Hidden Meaning of Quantum Mechanics*. Oxford University Press, Oxford.