The Unified Structure and Theoretical Closure of the Nakaza New Relativity Theory

From the Relativity Principle to a Universal Standard, the Observation Map, and Observational Spacetime

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Abstract

The origin of the Nakaza New Relativity Theory (NNRT) appears in the author's 2015 English-language paper, which called for a complete separation of the physical roles of the Galilean transformation (GT) and the Lorentz transformation (LT). Partial elements of NNRT were subsequently presented in several Japanese papers, and its overall structure was assembled in a 363-page Japanese monograph published in 2023. An English paper published in the same year may be regarded as an international summary of that structure. Taking the 2023 English paper as its foundation, the present study restates the full architecture of NNRT and integrates the subsequent investigations that led to the present formulation. The arguments concerning special relativity, general relativity, phase universality, the observation map, real motion, and observational spacetime are reconstructed as a single non-circular logical chain.

The most important point of NNRT is that universal spacetime is not posited as an entity discovered by observation, nor as a background containing an absolute rest frame. It is defined instead as a physical standard of time and space applied identically to every inertial frame. This standard implements the relativity principle in real motion and yields the GT. Because the GT can transfer every inertial observer to a representation of mutual rest, the physical law of real motion need only be defined as the local process by which an infinitesimal relative velocity arises from rest. Newton's law of motion is thereby restored as the fundamental law of real motion, whereas the relativistic law of motion at finite velocity is reassigned to observational spacetime constructed through electromagnetic measurement.

Mutual observation mediated by electromagnetic waves is described by an observation map Φ. Under phase universality and preservation of the characteristic structure of Maxwell's equations, this map leads to a Lorentz-type observational transformation, the simultaneous shift of frequency and wave number, and the observational invariance of the speed of light. In a gravitational field, the relativistic metric is not identified with a deformation of real spacetime; it is assigned to the observational metric $g_{\mu\nu}^{\mathrm{obs}}$ that unifies relations among clocks, phase, frequency, wave number, ranging, propagation time, light paths, and observed motion. The Einstein equation and its solutions are inherited in full as the mathematics of $g_{\mu\nu}^{\mathrm{obs}}$. NNRT is not an independent numerical theory that excludes conventional relativity. It is a revolution in physical interpretation that removes relativistic spacetime from physical reality and transfers relativistic mathematics to observational spacetime constructed with reference to a universal spacetime standard. NNRT further judges the interpretation of four-dimensional contraction in special relativity and four-dimensional curvature in general relativity as the form of real spacetime to be the greatest physical error introduced by Einstein into the history of physics, while sharply separating that error from the correctness of relativistic mathematics.

The audit presented here confirms that this transformation is not a change of terminology but a closed theoretical structure supported by mathematical continuity. GPS and airborne atomic clocks are treated with exactly the same Schwarzschild observational metric. The circular-motion term is interpreted not as real time dilation caused by uniform rectilinear motion but as an observational clock-rate effect of gravity and rotational or centripetal acceleration. The paper also outlines how black-hole physics, gravitational-wave observation, cosmology, quantum theory, and quantum gravity may be reconstructed once physics is released from the ontology of an expanding, contracting, and curved real spacetime.

Keywords: *Nakaza New Relativity Theory; relativity principle; universal spacetime; observational spacetime; observation map; phase universality; Galilean transformation; Lorentz transformation; Einstein equation*

1. Research Problem and Central Thesis

Relativistic experiments return clock readings, electromagnetic phase and frequency, wave number, arrival time, measured distance, direction of arrival, interference fringes, and trajectories of material bodies. The agreement of these observations with the Lorentz transformation, the Minkowski metric, the Einstein equation, and the Schwarzschild solution is a robust empirical fact. It does not, however, immediately follow from this agreement that the relativistic metric is identical with time and space themselves behind observation:

$$D_{\text{obs}} = D_{\text{rel}} \quad \not\Rightarrow \quad g_{\mu\nu}^{\text{obs}} = g_{\mu\nu}^{\text{real}}.$$

The central proposition of NNRT is to remove this unproved equality. Relativistic mathematics is not rejected; rather, the object described by that mathematics is restricted to observational spacetime. NNRT therefore asks not whether relativistic calculations are correct, but whether there is a logical necessity to identify the correct metric with real spacetime.

On this view, what relativistic experiments have established is the metric structure of the observed world. Experiment can determine $g_{\mu\nu}^{\text{obs}}$ with extraordinary precision, but the same observables cannot by themselves select the ontological identity $g_{\mu\nu}^{\text{obs}} = g_{\mu\nu}^{\text{real}}$. NNRT declines that additional identification and closes relativity within the domain of observables.

2. The Relativity Principle and the Universal Spacetime Standard

NNRT begins with the relativity principle: all inertial frames are physically equal, and no inertial frame can be identified as an absolute rest frame. To apply this principle consistently to real motion, NNRT defines standards of time and space common to all inertial frames. Universal spacetime is neither a material entity captured by observation nor a privileged coordinate system. It is a physical standard structure applied in the same manner in every inertial frame:

$$\mathcal{U} = (T, \mathbf{X}), \qquad \Delta T' = \Delta T.$$

Universality does not mean that one coordinate system is true. It means that the definitions of time and space used for real motion are not altered when a relation is described from either frame A or frame B. Universal spacetime is therefore not a preferred-frame spacetime.

The relativity principle alone does not uniquely determine a transformation group. NNRT adds the standard definitions of universal time and universal space. From this compound foundation, real motion between inertial frames is described by the GT. It would overstate the logic to say that the GT follows from the relativity principle alone; it is fixed by the relativity principle together with the common physical standard.

3. Real Motion and the Galilean Transformation

For inertial frames S and S' with relative velocity $\mathbf{v}$, their real-motion relation with respect to the common standard is

$$T' = T, \qquad \mathbf{X}' = \mathbf{X} - \mathbf{v}T, \qquad X'_{\text{real}} = G_{\mathbf{v}} X_{\text{real}}.$$

The GT is not a formula for detecting motion with respect to an absolute stationary space. It relates physically equal inertial frames by one and the same standard of time and space. Velocity composition at the real-motion layer is Galilean. Clocks and rods themselves are not postulated to stretch or contract physically as a function of relative velocity.

There is no need to treat the LT as an approximation to, or limit of, the GT. Their operands are different in NNRT. The GT acts on real motion; the LT acts on electromagnetic observational relations defined below. They are not competing transformations of one object but mappings with mathematically and physically distinct roles.

3.1 Physical Law in a Rest Frame and the Modified Newtonian Law of Motion

An important consequence stated in the 2023 Japanese monograph and English paper is that, under the GT, it is sufficient to define a physical law in a rest frame. This does not select a privileged absolute rest frame. Because every inertial frame is equal, the constant velocity of any observer or object can be subtracted by a GT, transferring that observer or object to a representation of mutual rest:

$$\mathbf{X}^* = \mathbf{X} - \mathbf{v}_0 T, \qquad \frac{d\mathbf{X}^*}{dT} = \frac{d\mathbf{X}}{dT} - \mathbf{v}_0.$$

Constant relative velocity need not therefore be introduced twice inside the physical law. One first selects a representation in which observer and object are mutually at rest, and then defines the law as the local process by which a force produces an infinitesimal relative velocity $d\mathbf{v}$ from that rest state:

$$d\mathbf{p} = \mathbf{F}\,dT, \qquad d\mathbf{v} = \frac{d\mathbf{p}}{m}, \qquad \mathbf{F} = m\frac{d\mathbf{v}}{dT}\bigg|_{\mathbf{v}=\mathbf{0}\to d\mathbf{v}}.$$

Newton's law is thereby modified so that it does not superpose "being at rest" and "already moving with constant velocity" within a double initial definition. It is the law of real motion that generates an infinitesimal velocity change from mutual rest. Finite motion is represented by repeatedly taking a mutually resting representation through the GT and continuously composing the infinitesimal changes. Because the subtraction of a constant velocity leaves acceleration invariant, this construction does not violate the equality of inertial frames:

$$\frac{d^2\mathbf{X}^*}{dT^2} = \frac{d^2\mathbf{X}}{dT^2}, \qquad \mathbf{v}(T) = \mathbf{v}(T_0) + \int_{T_0}^{T} \frac{\mathbf{F}(T')}{m}\,dT'.$$

The law of real motion is consequently not forced to satisfy conditions imposed by a curved four-dimensional spacetime. Real motion is described by universal time, universal space, and the GT; relativistic spacetime is restricted to observational spacetime formed by remote electromagnetic observation.

3.2 The Relativistic Law of Motion in Electromagnetic Observational Spacetime

Relativistic dynamics at finite velocity is not erased. Its equations are retained in full as observational laws that appear in Lorentz-type coordinates when a moving body is measured through electromagnetic waves:

$$\mathbf{p}_{\text{obs}} = \gamma m \mathbf{v}_{\text{obs}}, \qquad E_{\text{obs}} = \gamma m c^2, \qquad \mathbf{F}_{\text{obs}} = \frac{d\mathbf{p}_{\text{obs}}}{dt_{\text{obs}}}.$$

Here γ does not signify an increase in the mass of the real body or a slowing of universal time. It is an observational coefficient relating velocity, momentum, energy, and force obtained through the observation map. The modified Newtonian law and relativistic dynamics therefore do not compete. The former describes real motion under the GT; the latter describes apparent motion in electromagnetic observational spacetime constructed by the LT:

$$\boxed{\text{real motion under GT: } d\mathbf{p} = \mathbf{F}dT \qquad \text{electromagnetic observation under LT: } \mathbf{F}_{\text{obs}} = \frac{d}{dt_{\text{obs}}}(\gamma m \mathbf{v}_{\text{obs}})}.$$

4. Separation of the Real and Observational Layers

Physical measurement requires a distinction between the definition of a standard and the outcome of measurement. Universal spacetime $\mathcal{U}$ belongs to the former; the values returned by instruments belong to the latter. Results mediated by electromagnetic waves, clocks, ranging procedures, and material detectors depend on the observational process:

measurement standard ≠ measurement outcome.

Let $\mathcal{R}$ denote a real state and $\mathcal{O}$ an observational state, with an observation map Φ between them:

$$\Phi: \mathcal{R} \to \mathcal{O}, \qquad \mathcal{R} \neq \mathcal{O}.$$

$\mathcal{R}$ includes matter, fields, and states of motion described under the universal standard. $\mathcal{O}$ includes phase Θ, angular frequency ω, wave vector $\mathbf{k}$, clock readings, observed distance, arrival direction, propagation time, and the observational metric. This separation removes the need to read a transformation of observational coordinates as a transformation of real spacetime itself.

5. Phase Universality and Electromagnetic Observation

NNRT takes electromagnetic phase Θ as a fundamental observational quantity. Angular frequency and wave number are not independent entities but temporal and spatial gradients of a common phase:

$$\omega = -\frac{\partial \Theta}{\partial t_{\mathrm{obs}}}, \qquad \mathbf{k} = \nabla \Theta.$$

Phase universality states that the same phase event corresponds across observational frames:

$$\Theta' = \Theta.$$

Consequently, a change of observational frame does not shift ω and $\mathbf{k}$ separately; it transforms them together as components of the four-wavevector K_μ. The simultaneous frequency–wave-number shift of NNRT follows from this common phase.

NNRT additionally preserves the characteristic structure of the vacuum Maxwell equations, linearity and homogeneity between observational coordinates, invertibility of the transformation, and reciprocity between inertial frames. Under this set of conditions it adopts the Lorentz-type transformation of observational coordinates:

$$x'_{\mathrm{obs}} = \gamma(x_{\mathrm{obs}} - v t_{\mathrm{obs}}), \qquad t'_{\mathrm{obs}} = \gamma\left(t_{\mathrm{obs}} - \frac{v x_{\mathrm{obs}}}{c^2}\right),$$

$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}}, \qquad X'_{\mathrm{obs}} = L_{\mathbf{v}} X_{\mathrm{obs}}.$$

The parameter v is the relative velocity of the two inertial systems that form the observational relation. The mathematical form is identical to the standard LT, but its referent is not real spacetime. It is the observational coordinate system constructed by mutual electromagnetic observation.

6. Observational Invariance of the Speed of Light

The characteristic structure of the vacuum Maxwell equations gives the dispersion relation

$$\omega^2 - c^2|\mathbf{k}|^2 = 0.$$

If the observation map preserves this characteristic structure, the same null set is preserved after transformation:

$$\omega'^2 - c^2|\mathbf{k}'|^2 = 0.$$

Thus $\omega = c|\mathbf{k}|$ and $\omega' = c|\mathbf{k}'|$ hold in both observational systems:

$$\frac{\omega'}{|\mathbf{k}'|} = \frac{\omega}{|\mathbf{k}|} = c.$$

In NNRT, c is not an independent axiom that determines the entire ontology as the speed of a material object through real space. It is invariant as the ratio obtained in observations based on electromagnetic phase and Maxwell dispersion. Light-speed invariance is thereby moved to a theorem of observational structure. Phase universality alone, however, is insufficient: preservation of the Maxwell characteristic structure and the stated conditions on the observational transformation are also required. Explicitly preserving these premises prevents a circular derivation of the LT or of light-speed invariance from phase universality alone.

7. Minkowski Observational Spacetime and Special Relativity

The invariant form in Lorentz-type observational coordinates is expressed by the Minkowski metric:

$$ds_{\mathrm{obs}}^2 = c^2 dt_{\mathrm{obs}}^2 - dx_{\mathrm{obs}}^2 - dy_{\mathrm{obs}}^2 - dz_{\mathrm{obs}}^2 = \eta_{\mu\nu}\, dx_{\mathrm{obs}}^{\mu} dx_{\mathrm{obs}}^{\nu}.$$

NNRT does not read $\eta_{\mu\nu}$ as the metric of real spacetime itself. It is the observational metric that unifies electromagnetic observational relations when gravitational interaction can be neglected. Time dilation, length contraction, and relativity of simultaneity are relations within this observational metric, not contractions of the universal standard.

This allocation also distinguishes local measurement from remote electromagnetic observation. Local comparison of rods and clocks within one inertial system uses that system's common standard. Observation of another system in relative motion through light is mediated by $\Phi_{\mathbf{v}}$. The special-relativistic part of NNRT closes by refusing to make the GT and LT compete as transformations of the same spacetime.

8. The Observation Map in a Gravitational Field

In the presence of gravitational interaction, the observation map is generalized to Φ_g, dependent on position and physical state. Observed phase, frequency, and wave number become position dependent and generate consistent changes in clock comparisons, ranging, propagation time, light paths, and interference phase:

$$\omega \to \omega(x), \quad \mathbf{k} \to \mathbf{k}(x), \quad \Theta \to \Theta(x), \qquad \delta\Theta = \int \delta k_{\mu}\, dx^{\mu}.$$

NNRT does not place the observational metric first as a real cause. Matter, energy, and gravitational interaction produce responses in the observational medium and its phase; these responses are read as observables and finally integrated into one metric structure:

$$\mathcal{R} \xrightarrow{\Phi_{\mathrm{int}}} \xrightarrow{\Phi_{\mathrm{phase}}} \xrightarrow{\Phi_{\mathrm{read}}} \xrightarrow{\Phi_{\mathrm{geom}}} g_{\mu\nu}^{\mathrm{obs}}.$$

This composite notation does not introduce an unknown particle or an additional field equation. Φ_{int} denotes the state of the observational medium under interaction; Φ_{phase} extracts phase quantities; Φ_{read} gives clock, distance, and propagation readings; and Φ_{geom} geometrizes the relations among observables. The observation map is thus the structural mapping that prevents an unmediated identity between reality and observation.

9. The Observational Metric and the Einstein Equation

When relations among observables are unified by a Lorentzian observational metric, standard differential geometry applies without alteration:

$$g_{\mu\nu}^{\mathrm{obs}} \to \Gamma_{\mu\nu}^{\rho}[g_{\mathrm{obs}}] \to R^{\rho}{}_{\sigma\mu\nu}[g_{\mathrm{obs}}] \to R_{\mu\nu}[g_{\mathrm{obs}}] \to G_{\mu\nu}[g_{\mathrm{obs}}].$$

The Einstein–Hilbert action is assigned to the observational metric:

$$S_{\mathrm{EH}}[g_{\mathrm{obs}}] = \frac{c^3}{16\pi G} \int d^4x \sqrt{-g_{\mathrm{obs}}}\, R[g_{\mathrm{obs}}].$$

Variation with respect to $g_{\mu\nu}^{\mathrm{obs}}$ together with the matter action $S_m[g_{\mathrm{obs}}, \psi]$ yields

$$G_{\mu\nu}[g_{\mathrm{obs}}] = \frac{8\pi G}{c^4} T_{\mu\nu}.$$

This is not a different gravitational equation newly derived by NNRT. It is the established Einstein equation reassigned as the dynamics of the observational metric. Its empirical success is therefore preserved in full. What that success establishes is the structure of $g_{\mu\nu}^{\mathrm{obs}}$, not the identity $g_{\mu\nu}^{\mathrm{obs}} = g_{\mu\nu}^{\mathrm{real}}$.

This is not an unprincipled borrowing; it specifies the kind of theory NNRT is. Its primary purpose is not to create an independent numerical prediction system but to change the physical referent of relativistic mathematics. Preserving the existing mathematics is therefore part of the definition of the theory, not an omission.

10. The Schwarzschild Observational Metric and Established Experiments

For a static, spherically symmetric vacuum region, the vacuum Einstein equation for the observational metric yields the Schwarzschild form:

$$ds_{\mathrm{obs}}^2 = \left(1 - \frac{2GM}{c^2 r}\right) c^2 dt^2 - \left(1 - \frac{2GM}{c^2 r}\right)^{-1} dr^2 - r^2 d\Omega^2.$$

The same observational metric yields the standard values for gravitational redshift, Shapiro delay, light deflection, and perihelion advance. In the weak field, for example, $\Delta\phi = 4GM/(c^2 b)$ and $\Delta\varpi = 6\pi GM/[a(1-e^2)c^2]$. NNRT changes none of these values.

The difference lies in the causal and ontological reading. The standard account places the curvature of real spacetime as the antecedent cause. NNRT reads $g_{\mu\nu}^{\mathrm{obs}}$ as geometrically integrating observational relations formed through gravitational interaction. Curvature is not eliminated; it remains exactly as the curvature of the observational metric.

11. Empirical Non-Identification and the Responsibility of the Theory

Even when observational data D_{obs} agree with relativistic predictions, if two theoretical arrangements are completely equivalent for all observables, the same data cannot select the ontology of only one arrangement. This is not a shortage of precision but logical non-identification arising from equality of observables:

$$D(\mathcal{T}_{\mathrm{geometry}}) = D(\mathcal{T}_{\mathrm{NNRT}}) \quad \Rightarrow \quad D \text{ alone cannot select ontology.}$$

The same logic applies symmetrically to NNRT. Observation does not prove the universal spacetime standard as an independently existing entity. NNRT does not impose that proof as an empirical obligation. Universal spacetime is the definition of a physical standard common to all inertial frames; empirical responsibility concerns agreement between observations obtained through Φ and the established relativistic results.

The demand to "measure real spacetime directly" would convert something NNRT does not define as an observational object into such an object. At the same time, NNRT cannot claim that observation has proved the existence of universal spacetime as an entity. Stating this boundary distinguishes a strong claim from an excessive one.

12. A Single Non-Circular Logical Chain

The structure can be stated as one chain without confusing logical roles:

Axiom: all inertial frames are physically equal, and no absolute rest frame is identifiable.
Standard definition: universal time and universal space are physical measurement standards applied identically to every inertial frame.
Rule of real motion: the GT relates real motion among inertial frames under this standard.
Layer separation: the standard is distinguished from measurement outcomes, and $\Phi: \mathcal{R} \to \mathcal{O}$ separates real and observational states.
Principles of electromagnetic observation: phase universality, preservation of the Maxwell characteristic structure, linearity, homogeneity, invertibility, and reciprocity are imposed.
Observational transformation: this set of conditions constructs a Lorentz-type observational transformation and transforms ω and $\mathbf{k}$ together.
Observational theorem: preservation of Maxwell dispersion gives the observational invariance $\omega/|\mathbf{k}| = c$.
Geometry of special relativity: observational relations are integrated into the Minkowski observational metric $\eta_{\mu\nu}$.

Generalization to gravity: Φ is generalized to Φ_g, and observational relations of phase, clocks, ranging, propagation, and trajectories are integrated into $g_{\mu\nu}^{\mathrm{obs}}$.

Adopted dynamics: the Einstein–Hilbert action and Einstein equation are used as the mathematics of $g_{\mu\nu}^{\mathrm{obs}}$, preserving established relativistic predictions.

Physical interpretation: the curvature of $g_{\mu\nu}^{\mathrm{obs}}$ is not identified with deformation of real spacetime; it is curvature of observational structure under gravity.

No conclusion is returned to the premises in this chain. The LT is not derived from the GT, nor the GT from the LT. Maxwell structure is not derived from phase universality alone, and the Einstein equation is not claimed to follow independently from a phase principle. By fixing the logical position of every element, the reconstruction removes possible over-derivation and circularity.

13. Mathematical Continuity and Physical Revolution

NNRT is not an independent theory that excludes conventional relativity. It inherits in full the Lorentz transformation, Minkowski metric, Einstein equation, Schwarzschild solution, and the experimental values they yield. What changes is not the formula but the physical object described by the formula. Conventional relativity places the relativistic metric as the structure of real spacetime. NNRT moves it to the metric of observational relations measured with reference to a universal spacetime standard:

$$\text{relativistic mathematics preserved} + \text{physical referent transformed} = \mathrm{NNRT}.$$

This transformation is not a substitution of names. First, it removes an expanding, contracting, and curved relativistic real spacetime from the standard structure of physics. Second, it physically defines a universal spacetime scale common to all inertial frames. Third, it constructs observational spacetime from measurements of electromagnetic waves, clocks, ranging, phase, and motion using that scale. The logical position of the metric moves from a real cause that produces observations to a mathematical expression integrating observational relations:

$$\mathcal{U} \to \Phi \to D_{\mathrm{obs}} \to g_{\mu\nu}^{\mathrm{obs}}.$$

NNRT is therefore not a mathematical revolution, but it is a physical revolution: it changes the objects of physics, causal order, the concept of spacetime, and the meaning of experiment. Preserving mathematics does not weaken this revolution. By retaining the same equations and experimental values, NNRT demonstrates that the conventional ontology is not logically unique. Mathematical continuity is precisely what supports the physical revolutionary character of NNRT.

14. Einstein's Physical Error

Any complete view of the NNRT revolution requires an unavoidable final judgment. From the standpoint of NNRT, Einstein's definition in special relativity of relativistic time, relativistic length, and the four-dimensional interval as contraction of real time and space themselves, followed in general relativity by the definition of four-dimensional metric curvature as curvature of real spacetime itself, constitutes the greatest physical error introduced by Einstein into the history of physics:

$$\text{SR:}\quad g_{\mu\nu}^{\mathrm{obs}} \equiv g_{\mu\nu}^{\mathrm{real}} \quad \Rightarrow \quad \text{real time dilation and real length contraction,}$$

$$\text{GR:}\quad R_{\mu\nu\rho\sigma}[g_{\mathrm{obs}}] \equiv R_{\mu\nu\rho\sigma}[g_{\mathrm{real}}] \quad \Rightarrow \quad \text{real spacetime curvature.}$$

The error identified here is not the mathematics of the Lorentz transformation, Minkowski metric, Einstein equation, or Schwarzschild solution. That mathematics is correct, and its effectiveness is established by agreement with observation. The error is the ontological identity assigned—without independent experimental warrant—between the metric integrating observations and real spacetime existing independently of observation:

$$\boxed{g_{\mu\nu}^{\mathrm{obs}} \equiv g_{\mu\nu}^{\mathrm{real}}} \qquad \text{is not established by} \qquad D_{\mathrm{obs}} = D_{\mathrm{rel}}.$$

This is more than a misunderstanding. A misunderstanding may be locally dissolved once concepts are clarified. The identification of observational spacetime with real spacetime, by contrast, has been built into the foundations of relativity, textbook exposition, interpretation of experiments, gravitational theory, and the entire cosmological worldview. For more than a century it has fixed in physics the picture that "time itself slows," "length itself contracts," and "spacetime itself curves." Because this identification has produced prolonged and systematic confusion, NNRT judges it not as a temporary misunderstanding but as a physical error.

This judgment does not deny Einstein's mathematical achievement. On the contrary, a strict separation of mathematics from its physical reading makes it possible to state for the first time what was correct and what was mistaken. Relativistic mathematics was correct as the mathematics of observational spacetime. Its interpretation as contraction and curvature of real spacetime was wrong:

$$\boxed{\text{correct mathematics} + \text{incorrect physical reading} = \text{relativistic ontology}}.$$

The historical task of NNRT is therefore not to discard relativistic mathematics. It is to return correct mathematics to the observed world that the mathematics has in fact described. SR time dilation and length contraction are restored to relations in observational spacetime, while GR curvature is restored to curvature of the observational metric under gravity. Through this double restoration, the universal spacetime standard and relativistic observational spacetime can be separated without contradiction.

If NNRT failed to state this error explicitly, the object of its physical revolution would become ambiguous and its difference from the conventional interpretation would retreat into a change of terminology. Because it inherits every mathematical success, NNRT can identify the physical error without ambiguity. This judgment is not an incidental criticism; it is the reason for the theory's existence.

15. Closure Audit

The closure of NNRT is judged by whether complete inheritance of relativistic mathematics and the consistent transformation of its physical referent are maintained without contradiction throughout the system. No separate audit axis is imposed that would recast NNRT as a rival numerical theory required to differ from standard relativity.

Table 1 NNRT Closure Audit

Issue	Logical position	Judgment	Audit result
Universal spacetime	Standard definition	Closed	A physical standard of time and space common to all inertial frames, not an observed entity.
Relativity principle and GT	Axiom and motion rule	Closed	GT is placed with the common standard definition; it is not claimed to follow from the relativity principle alone.
GT and LT	Layer separation	Closed	GT acts on real motion and LT on electromagnetic observation; they are neither approximations nor competitors.
Physical law in a rest frame	Domain of real motion	Closed	GT subtracts constant velocity; the modified Newtonian law generates infinitesimal velocity change from mutual rest.
Relativistic law of motion	Observational dynamics	Closed	Finite-velocity relativistic dynamics is retained as observational dynamics in electromagnetic measurement spacetime.
Phase universality	Observational principle	Closed	Frequency and wave number are gradients of one phase, grounding their simultaneous shift.
Conditions for LT	Conditional construction	Closed	Maxwell structure, linearity, homogeneity, invertibility, and reciprocity accompany phase universality.
Invariance of light speed	Observational theorem	Closed	The preserved vacuum dispersion relation yields the invariant observational ratio.

Issue	Logical position	Judgment	Audit result
Minkowski metric	Geometric representation	Closed	Assigned as the metric integrating flat electromagnetic observational relations.
Gravitational observational metric	Semantic reassignment	Closed	Defined as the metric integrating gravitational observables; identity with a real-spacetime metric is removed.
Einstein equation	Adopted established dynamics	Closed	Retained for the observational metric without claiming an independent circular derivation.
Established observations	Empirical content	Closed	Identical predictions follow from the same SR and GR observational mathematics under the same conditions.
GPS and airborne clocks	Schwarzschild reinterpretation	Closed	The circular term is an observational clock-rate effect in an acceleration environment; standard corrections remain.
Mathematical continuity	Constitutive principle	Closed	Relativistic equations and values are inherited; their physical referent is transferred to observational spacetime.
Physical revolution	Interpretive transformation	Closed	Relativistic real spacetime is removed from the foundation; this is not a change of terminology.
Einstein's physical error	Historical physical judgment	Closed	Mathematical success is separated from the category error identifying observational metric with real spacetime.
Direct proof of universal spacetime	Ontological demand	Not required	The standard definition is not converted into an observed object or claimed as an empirically proved entity.

16. Final Judgment on Closure

NNRT is internally closed as a revolution in physical interpretation that transfers the physical referent of successful SR/GR mathematics from real spacetime to observational spacetime. Its point of departure, universal standard, operands of the transformations, observables, meaning of the metric, adopted field equation, and empirical responsibility are connected in one order and do not contradict one another. Empirical proof of universal spacetime, an approximation from the GT to the LT, and an independent rederivation of the Einstein equation from a phase principle are not necessary conditions of this closure.

To demand an NNRT-specific Einstein equation or numerical predictions different from standard theory would be to demand that NNRT become another theory competing with conventional relativity. Its task is not to discard established relativistic mathematics but to inherit that mathematics and its empirical success in full while releasing it from identification with real spacetime. Relative to this theoretical purpose, mathematical continuity and physical transformation are not contradictory; the former supports the latter.

17. Physics Opened Beyond the Revolution

The transformation introduced by NNRT does not end with correction of past interpretations of special and general relativity. If relativistic spacetime is removed as the real world itself, the physical worldviews of black holes, cosmic expansion, the early universe, quantum fields, and quantum gravity that developed on that premise must be re-examined through the separation of observational spacetime from reality.

Conventional physics has identified the relativistic metric with the metric of real spacetime and explained time dilation, length contraction, event horizons, spacetime singularities, and cosmic expansion as properties of real time and space themselves. NNRT releases this ontological identity:

$$g_{\mu\nu}^{\text{obs}} \not\equiv g_{\mu\nu}^{\text{real}}.$$

The limits shown by a relativistic metric no longer have to be read directly as limits of the real world. The first question concerns limits of observability formed by the observation map, clocks, frequency, ranging, and information transfer:

$$\text{limit of } g_{\mu\nu}^{\text{obs}} \quad \Rightarrow \quad \text{limit of observation and information transfer.}$$

17.1 Reinterpretation of Black-Hole Physics

In standard general relativity, the metric structure at the Schwarzschild radius is read as an event horizon formed in real spacetime, and a curvature singularity inside it is interpreted as a breakdown of real spacetime itself. NNRT preserves the Schwarzschild metric and all its observational consequences but assigns it to the observational metric:

$$r_\text{s} = \frac{2GM}{c^2}, \qquad g_{tt}^{\text{obs}} \to 0 \quad (r \to r_\text{s}).$$

The limit of observational time at a horizon does not mean that universal time itself stops. It means that the relations of frequency, wave number, phase, and information transfer of electromagnetic waves reaching a distant observer approach a limit. Similarly, divergence of a curvature invariant calculated from the observational metric does not by itself prove a breakdown of real spacetime.

This change releases a black hole from being fixed as a “hole in real spacetime” or an “end of time and space.” It can be reconsidered as a physical system in which material states, gravitational interaction, the frequency, wave number, and phase of electromagnetic waves, and external observability reach extreme limits. Event horizons, singularities, information loss, and black-hole thermodynamics may thereby be reconstructed without presupposing curvature of real spacetime.

17.2 Reinterpretation of Gravitational-Wave Observation

Gravitational-wave interferometers send laser light back and forth through two long orthogonal arms and read the differential phase of the recombined light. In the conventional real-spacetime interpretation, passage of a gravitational wave distorts four-dimensional spacetime, the proper lengths of the two arms change differently in accordance with that distortion, and the apparatus measures the strain of spacetime:

$$\frac{\delta L_x}{L} = -\frac{\delta L_y}{L} \simeq \frac{1}{2} h_+(t), \qquad h(t) = \frac{\Delta L(t)}{L}.$$

NNRT preserves the established relativistic mathematics of the waveform, polarization, propagation equation, and interferometer response. It does not, however, interpret universal space between the arms as alternately stretching and contracting, or the mirrors and apparatus as deforming because real spacetime deforms. The geometric arm separation in the universal spacetime standard is maintained as an unstrained reference, while a dynamic gravitational interaction acts on the electromagnetic wave propagating through it.

As light propagates along each arm, the dynamic observational field corresponding to the gravitational wave produces direction-dependent changes in phase, frequency, and wave number. A differential phase then arises between the light returning from the two arms and is read as the photodetector output:

$$K_\mu \to K_\mu + \delta K_\mu^{\text{GW}}, \qquad \delta\Theta_A = \int_A \delta\, K_\mu^{\text{GW}}\, dx^\mu,$$

$$\Delta\Theta_{\text{GW}} = \delta\Theta_x - \delta\Theta_y = \mathcal{R}_{\text{IFO}}[h_+, h_\times; \omega, L, \hat{\mathbf{n}}].$$

Here K_μ is the phase four-vector of the laser, δK_μ^{GW} its phase response to dynamic gravitational interaction, and $\mathcal{R}_{\text{IFO}}$ the interferometer response function containing arm length, optical frequency, propagation direction, cavities, and readout scheme. Using the effective optical-path difference ΔL_{eff} of the conventional mathematics, the differential phase may also be written

$$\Delta\Theta_{\text{GW}} = \frac{4\pi}{\lambda} \Delta L_{\text{eff}}.$$

In NNRT, ΔL_{eff} is not the real extension or contraction of the arms placed in universal space. It is an observable that geometrically expresses, as an equivalent optical-path difference, the phase change produced by interaction of the gravitational wave with the electromagnetic wave. The causal sequence therefore runs not from deformation of real spacetime to deformation of the apparatus, but from dynamic gravitational interaction through electromagnetic phase change to differential phase:

$$\text{dynamic gravitational interaction} \to \delta K_\mu \to \Delta\Theta_{\mathrm{GW}} \to \text{detector output.}$$

This interpretation corresponds directly to the measurement fact that interferometers such as LIGO, Virgo, and KAGRA acquire laser phase difference as their primary signal. Gravitational-wave observation establishes the existence of a dynamic interaction corresponding to a gravitational wave, the accurate description of its waveform by the relativistic observational metric, and a detectable response in the phase of interfering light. It does not by itself establish the ontological identity that universal space itself has stretched and contracted.

The emphasis of instrument development may consequently change. A transition from "an apparatus measuring spacetime strain" to an apparatus that maximizes and separates from noise the phase interaction between gravitational and electromagnetic waves would integrate laser-frequency stabilization, phase accumulation in cavities, coupling of arm direction and polarization, optical delay, quantum noise, and readout phase as one interferometer-response problem.

This interpretive shift alone does not guarantee sensitivity beyond existing instruments. To establish a new instrumental advantage, the transfer function must be explicitly derived from the NNRT phase-response description, compared with the standard response, and tested for distinguishable improvements in optical configuration, frequency band, or readout. Nevertheless, defining the measured object as an electromagnetic phase response rather than a mechanical deformation of real spacetime directly connects detector design to the quantity actually measured and may guide more physically appropriate instrument development.

17.3 Reinterpretation of GPS and Airborne Atomic Clocks

Comparisons of atomic clocks on GPS satellites, at ground stations, and aboard aircraft have been treated as emblematic demonstrations of the time dilation of special and general relativity. The standard account combines a general-relativistic contribution from gravitational-potential difference with a special-relativistic contribution from velocity. NNRT changes neither the correction formula nor the observed values. It changes the physical classification that reads the circular-motion term as contraction of real time caused by uniform rectilinear motion.

Describing the exterior of Earth with the Schwarzschild observational metric and restricting it to the equatorial plane $\theta = \pi/2$ gives

$$c^2 d\tau_{\mathrm{obs}}^2 = \left(1 - \frac{r_{\mathrm{s}}}{r}\right) c^2 dT^2 - \left(1 - \frac{r_{\mathrm{s}}}{r}\right)^{-1} dr^2 - r^2 d\varphi^2, qquad r_{\mathrm{s}} = \frac{2GM}{c^2}.$$

For a circular orbit, $dr = 0$ and $d\varphi = \Omega dT$, so the observational clock rate follows from the same line element:

$$\left(\frac{d\tau_{\mathrm{obs}}}{dT}\right)^2 = 1 - \frac{2GM}{rc^2} - \frac{r^2\Omega^2}{c^2},$$

$$\frac{d\tau_{\mathrm{obs}}}{dT} \simeq 1 - \frac{GM}{rc^2} - \frac{r^2\Omega^2}{2c^2} + O(c^{-4}).$$

The conventional interpretation calls the gravitational term a GR effect and the angular-motion term $r^2\Omega^2/c^2$ an SR effect due to $v = r\Omega$. A GPS satellite, however, is not in uniform rectilinear inertial motion. Even when the magnitude of velocity is nearly constant, its direction changes continuously, and it has centripetal acceleration in universal space:

$$\mathbf{a}_{\mathrm{c}} = \frac{d\mathbf{v}}{dT}, \qquad |\mathbf{a}_{\mathrm{c}}| = \frac{v^2}{r} = r\Omega^2, \qquad r^2\Omega^2 = r|\mathbf{a}_{\mathrm{c}}|.$$

For the circular orbital condition of GPS, the angular-motion term can therefore be rewritten exactly as $r|\mathbf{a}_{\mathrm{c}}|$. Under that condition it is the rotational and centripetal-acceleration action generated by orbital motion itself. This does not mean axial spin of the satellite body. It denotes revolution around Earth—the rotation of the orbital velocity direction and its associated centripetal action. On this exact identity, NNRT reads the term conventionally called an SR effect not as a slowing of universal time due to uniform rectilinear motion, but as a change in observational clock rate in an orbital and centripetal-acceleration environment:

$$\Delta T_{\mathrm{SR}}^{\mathrm{real}} = 0, qquad \Delta t_{\mathrm{GPS}}^{\mathrm{obs}} = \Delta t_{\mathrm{grav}}^{\mathrm{obs}} + \Delta t_{\mathrm{rot/acc}}^{\mathrm{obs}}.$$

This reclassification requires no additional equation or parameter. The Schwarzschild solution, orbital conditions, weak-field expansion, and every correction value used by GPS are identical to those of the conventional theory. The NNRT principle—same mathematics, same experimental values, different physical interpretation—therefore holds directly for GPS.

GPS satellite oscillators are adjusted so that atomic clocks realize the prescribed rate relative to the ground reference in orbit. The official GPS interface specification states that, to compensate for relativistic effects, the satellite frequency standard is given an offset $\Delta f/f = -4.4647 \times 10^{-10}$, changing 10.23 MHz to 10.22999999543 MHz. If $\varepsilon_{\mathrm{orb}}$ is the predicted clock-rate difference between orbit and ground, the operation may be represented conceptually as

$$f_{\mathrm{pre}} = \frac{f_0}{1 + \varepsilon_{\mathrm{orb}}} \simeq f_0(1 - \varepsilon_{\mathrm{orb}}), \qquad f_{\mathrm{orbit}}^{\mathrm{obs}} \simeq f_0.$$

The mathematics and numerical calculation used for this frequency adjustment are completely shared by conventional relativity and NNRT. Yet the fact that the operation has physical meaning, and that the adjusted oscillator realizes in orbit a clock display corresponding to the ground reference, shows that the display is not real time itself following a distorted real spacetime unconditionally and immutably. What is physically changed is the oscillator frequency; what is compared is the accumulated cycle count and displayed time. The adjustment does not invalidate Schwarzschild mathematics or relativistic correction values. It invalidates the conventional physical identification of a calculated observational clock rate with distorted real time itself.

For NNRT the decisive fact is that the same Schwarzschild mathematics accurately prescribes the physical operation of frequency adjustment and that its outcome agrees with observation. This shows both that relativistic mathematics is correct as the mathematics of observational spacetime and that experiment directly determines frequency, cycle count, clock display, and signal-arrival time—not deformation of universal time or curvature of real spacetime itself. GPS frequency adjustment is evidence that NNRT and conventional theory share the mathematics, while also being an operational fact supporting transfer of the physical referent of that mathematics from real spacetime to observational spacetime.

GPS also requires a distinction between satellite clock-rate correction and the Sagnac correction for transmission and reception on rotating Earth. The former follows from the Schwarzschild observational metric and orbital conditions; the latter corrects the propagation path and arrival time of electromagnetic signals:

$$\Delta t_{\mathrm{GPS}}^{\mathrm{corr}} = \Delta t_{\mathrm{clock}}^{\mathrm{corr}} + \Delta t_{\mathrm{Sagnac}}^{\mathrm{corr}} + \Delta t_{\mathrm{orbit}}^{\mathrm{corr}}, \qquad \Delta t_{\mathrm{Sagnac}}^{\mathrm{corr}} \not\equiv \Delta t_{\mathrm{clock}}^{\mathrm{corr}}.$$

The same distinction applies to airborne atomic clocks. An aircraft flies in Earth's gravitational field and is a non-inertial system whose direction changes relative to the rotating Earth. Eastward–westward clock differences are calculated by integrating along the route a gravitational term associated with altitude and rotational or acceleration terms associated with Earth rotation and curved motion. This is not an experiment comparing only two acceleration-free inertial systems moving uniformly on one straight line. The result cannot therefore be a direct demonstration that universal time slows under uniform inertial motion.

GPS observations establish that the Schwarzschild observational metric accurately unifies clock rates and navigation signals, and that both gravitational and circular-motion corrections are indispensable. NNRT inherits this empirical success in full. By exactly rewriting the circular-motion term as an effect of centripetal acceleration and rotation, and by restricting the measured object to adjustable atomic frequency and clock display, NNRT shows that the success does not establish contraction of real time through uniform rectilinear motion. GPS is not a mathematical obstacle to NNRT; it is its most concrete case of transforming physical meaning while preserving relativistic mathematics.

17.4 Reinterpretation of Cosmology

Standard cosmology reads the scale factor in the FLRW metric as expansion of real space itself. NNRT preserves the FLRW mathematics and the relations among redshift, angular-diameter distance, luminosity distance, and cosmological time, while transferring the metric to cosmological observational spacetime:

$$ds_{\text{obs}}^2 = c^2 dt^2 - a^2(t)\left[\frac{dr^2}{1-kr^2} + r^2 d\Omega^2\right],$$

$$1 + z = \frac{a(t_0)}{a(t_\text{e})}.$$

The scale factor $a(t)$ is then read not as an expansion rate of universal space itself but as a quantity integrating observational relations among cosmic distance, redshift, arrival time, flux, and matter distribution. The interpretations of the Big Bang as a point at which universal space itself was generated, cosmic expansion as the substantial expansion of space, and a cosmological horizon as the end of the real world again become subjects for physical investigation.

This reassignment alone does not imply the absence of dark matter or dark energy. NNRT releases not the observations but the physical interpretation that constrains them exclusively to expansion and curvature of real spacetime. Cosmological observations may be reconsidered as a compound structure of matter distribution, redshift, light propagation, and observation maps.

17.5 Quantum Theory and Reconstruction of the Observation Problem

The mathematics of nonrelativistic quantum mechanics does not directly presuppose curved spacetime; this distinction must be maintained. Yet the relation between quantum states and relativistic spacetime is central in relativistic quantum field theory, concepts of vacuum and particle, black-hole radiation, the early universe, and quantum gravity.

If the NNRT separation of real and observational layers is extended to quantum theory, the mathematical representation of a quantum state need not immediately be identified with the real world itself. One may investigate a map by which quantum observables are formed from real physical states:

$$\mathcal{R}_\text{Q} \xrightarrow{\Phi_\text{Q}} \mathcal{O}_\text{Q} = \{x, p, E, \Delta\varphi, \text{detector outcomes}, \dots\}.$$

This structure opens a route to reconsider superposition, uncertainty, and state reduction as relations between real states and observables before declaring them to be indeterminacy of the real world itself. It does not mean that NNRT has already derived a complete new interpretation of quantum mechanics. It provides a principled starting point for re-examining an issue common to relativity and quantum theory: identification of mathematical representation with reality.

17.6 Mathematical Constraints Retained and Ontological Constraint Released

NNRT does not release physics from relativistic mathematics. Every mathematical constraint established by observation is retained. What is released is the ontological constraint that bound this mathematics exclusively to a contracting, expanding, and curved real spacetime:

$$\boxed{\text{mathematical constraints retained} \qquad \text{ontological constraint released}}.$$

This principle permits reconsideration of what established experimental values, field equations, and metric solutions represent without losing any of them. Must a black hole be a hole in real spacetime? Must cosmic expansion be expansion of space itself? Must quantum probability be indeterminacy of the real world itself? NNRT returns answers previously fixed by conventional spacetime ontology to the domain of physical research.

The full transformation that may follow cannot yet be exhaustively predicted. New concepts, models, and research questions emerging after removal of the contraction and curvature of real spacetime—premises of physics for more than a century—can only be made concrete by future theoretical and experimental work. But once questions closed by the conventional spacetime picture are reopened, NNRT may be expected to produce a major transformation of the physical worldview in atomic clocks and timekeeping, quantum theory, cosmology, black-hole dynamics, gravitational-wave observation, and quantum gravity, and to lead to developments beyond present imagination.

The physical revolution of NNRT is therefore not a backward-looking revolution that merely corrects a past error. While preserving correct mathematics, it releases physical imagination and gives physics new questions for the future.

18. Conclusion

Relativistic experiments have established the relativistic structure of the observed world composed of clocks, phase, frequency, wave number, distance, propagation time, light paths, and trajectories. Their success does not entail an equality between the observational metric and real time and space themselves. NNRT removes that equality and reassigns relativistic mathematics as the mathematics of observational spacetime.

Universal spacetime in NNRT does not proclaim the discovery of an unobservable entity. It is the physical standard of time and space applied identically to every inertial frame, introduced to carry the relativity principle through real motion. On this standard, the GT describes real motion, while mutual electromagnetic observation forms a Lorentz-type structure through Φ. Under gravity, the Einstein metric is transferred to the observational metric by the same separation principle.

Because any constant relative velocity can be subtracted by the GT to select a mutually resting representation, the physical law of real motion need only be defined as the local process generating an infinitesimal velocity change from rest. In this sense, the modified Newtonian law returns to the foundation of real motion. The relativistic law at finite velocity is not discarded; it is retained as an apparent law of motion in observational spacetime formed by electromagnetic measurement. Newtonian and relativistic dynamics are thus not rival theories competing for one object, but descriptions of distinct layers: real motion and electromagnetic observation.

Universal standards and relativistic observational time, the GT and LT, real motion and relativistic observation, and standard spacetime and curved observational spacetime can therefore coexist as different layers in one system. NNRT does not oblige physics to measure an unobservable real spacetime. It closes relativity over measurable observables and rejects the additional identity that makes observational structure into real spacetime itself. Here lie the unity and theoretical closure of NNRT.

Comparisons of GPS and airborne atomic clocks do not disturb this separation. NNRT uses the Schwarzschild observational metric and all established correction mathematics without alteration. The circular-motion term conventionally called the SR term is rewritten exactly as $r^2\Omega^2 = r|\mathbf{a}_\mathrm{c}|$ and, with the gravitational term, forms the observational clock rate in an orbital and centripetal-acceleration environment. The actual operation of frequency pre-adjustment shows that the measured objects are oscillator frequency, accumulated cycle count, and clock display. GPS therefore does not establish a slowing of universal time under uniform inertial motion; it is a representative example of NNRT's transformation of physical interpretation under identical mathematics.

NNRT is not a mathematical revolution. Yet because it removes relativistic real spacetime from physics, installs a universal spacetime standard, and defines observational spacetime measured using that standard, it is not a change of terminology. It is a revolution in physical interpretation made possible by complete inheritance of relativistic mathematics. Mathematical continuity is not evidence against the revolutionary character of NNRT; it is the theoretical support that makes the revolution possible.

Avoiding the final judgment would obscure the reason NNRT exists. The mathematics of the Lorentz transformation and Einstein equation was correct. The physical reading that made four-dimensional contraction in SR and four-dimensional curvature in GR the form of real spacetime was an error. NNRT separates this mathematical correctness from that physical error and returns the correct mathematics to observational spacetime. In this sense, NNRT inherits Einstein's mathematics while overturning Einstein's physical picture of spacetime.

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