

Premetric Structural Unification

From the AASC Kernel to Einstein-Form and Free-Scalar Dynamics

A Cross-Corpus Lean Formalization

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Abstract

We present a cross-corpus Lean formalization of premetric structural unification through a connected theorem of canonical licensing, Einstein-form response and free-scalar Schrödinger dynamics. The construction instantiates the AASC Kernel, ametric authority restrictions and canonical Lmetric licensing on two actual original-use tasks. Licensed receivers preserve their declared readouts and continuations and map into the bounded Einstein–Hilbert (EH) and scalar receiving constructions. A common-preparation map connects the invariant one-particle Klein–Gordon core to both branches, preserving the quantum preparation, independently admitted metric operand, complete original records and registered answers. Its evolved version retains the scalar core evolution. The EH endpoint joins actual action derivatives, response equivalence and canonical Kernel source profiles; all six premises of its direct Einstein-form classifier are discharged. The scalar endpoint supplies the exact free generator, complete weak graph and calibrated comparator theorem. The composed Lean theorem has 49 proved fields; its dependency closure includes the actual licensing, source, analytic endpoint and common-map proofs. A public-source replay rebuilt ten production modules and four audits byte-identically, reusing 839 hash-verified local dependency objects and pinned compiler/library binaries. Structural emergence denotes this explicit dependency and derivation within the declared constructions. It retains the controlled nonrelativistic step, physical anchors, nonzero EH coupling and comparator calibration. The result establishes shared premetric governance and actual source-preserving maps, without identifying the branch quotients, choosing a preferred projection, or proving coupled Einstein–scalar dynamics, unrestricted candidate exhaustion or a unique spacetime solution.

Keywords. Lean 4; AASC Kernel; ametric boundary; Lmetric licensing; Einstein-Hilbert variation; source profiles; free scalar dynamics; exact operator domains; formal verification

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1 Introduction

Premetric structural unification identifies common Kernel governance and a constructed standing-source origin for distinct faithful dynamical realizations. The explanatory order begins before a metric tensor or Hamiltonian has authority for a specified physical use. The AASC (Admissibility And Standing Constraint) Kernel supplies reference, standing, admissibility and historical-retention roles for determinate original incidence. The AMetric boundary constrains additional distinctions and warrants. Canonical Lmetric licensing then governs faithful use of interpreted interior descriptions. The downstream geometric and quantum constructions supply their declared carriers and analytic data within this dependency chain.

The formal outcome is a connected canonical-licensing theorem for a bounded Einstein–Hilbert (EH) metric-source receiver with Einstein-form response classification and a calibrated free-scalar Schrödinger receiver. Both branches retain the same ten AASC.Core modules and constructed Klein–Gordon (KG) standing source. Beyond shared dependencies, actual licensed receivers map into the two downstream constructions. A common-preparation map preserves the quantum source, independently admitted metric operand, complete old records and registered answers on the invariant one-particle core. The geometric branch connects actual admitted action derivatives to canonical Kernel source profiles. The scalar branch connects original standing data, isolated-sector transport and a controlled nonrelativistic construction to an exact generator and complete operator graph. The common maps preserve the stated source data without identifying the branches’ observation quotients or supplying a simultaneous gravitational and quantum solution.

We call this structural emergence: the dependency and derivation of a dynamical realization from the stated Kernel-governed source, licensed uses and downstream construction data. The term describes explanatory order, not temporal genesis, an assumed microscopic substrate, or an unproved coarse-graining or universality limit. The Einstein-form response and free-scalar Schrödinger dynamics emerge as derived endpoints in this sense. The Kernel does not by itself select the EH action, predict the physical anchors or replace the scalar domain and calibration hypotheses. Premetric structural unification identifies their common governing origin while preserving the distinct constructions through which each dynamical form becomes available.

The central declaration, `kernel_faithful_canonical_licensing_to_eh_and_free_schrodinger`, proves a proposition with 49 fields. Its only outer arguments are positive physical parameters, a real source parameter and an open region. The fields construct the two licensing applications and their receiving maps, retain the analytic endpoint theorems, and prove common-preparation and evolved-preparation squares. Nonzero EH coupling and the conditions for comparison with an arbitrary scalar operator remain explicit within those fields. This is a checked composition of the previously separate licensing and dynamics stages, with coverage delimited by the actual original-use tasks.

The paper gives a mathematical account of the cross-manuscript dependency chain, a source-to-declaration map with exact endpoints and premises, and a versioned artifact specification binding the statements to sources and replay evidence. The actual consumers and their inputs delimit the bounded formal target.

Three principles govern the exposition. First, the Kernel constrains faithful downstream constructions, which supply their additional geometric and analytic data. Structural admissibility alone does not supply those data, and downstream geometry does not ground the Kernel. Second, every uniqueness claim retains its object and comparison class: a canonical source factor, an Einstein-form coefficient pair,

or a calibrated operator with its complete graph. Third, formal checking certifies encoded implications under their hypotheses. It does not certify empirical truth, the adequacy of every source interpretation, or semantic exhaustion beyond the encoding.

2 Sources and formal scope

2.1 Manuscripts and exact editions

The principal source sequence is Kernel [1], AMetric Boundary [2], Structure of Admissibility [3], Fixed-Domain Exhaustion [4], Metricity [5], Gravity [6], Einstein Dynamics [7], Schrödinger Dynamics [8], and Structural Unification [9]. These works supply different kinds of argument. The Kernel paper explains functional necessity and same-object governance. The boundary and licensing papers constrain the passage from retained original content to warranted interior descriptions. The dynamics papers develop normal-form arguments in declared geometric or scalar comparison envelopes. Structural Unification discusses a larger paired-interior and joint-ledger target. Its existence as a source manuscript does not make that larger target a conclusion of the selected Lean endpoints.

The editions recorded in Appendix C are identified by the file-backed Institute Research Companion catalogue, retained PDF page texts and source mappings. Bibliographic metadata was checked against the corresponding landing pages where available. Page references denote PDF pages. Edition dates, work identifiers and publisher release identifiers are distinguished. The Kernel reading edition is dated 26 September 2026; the imported Core modules retain their v51_3 project provenance. A later reading edition or a matching title does not replace the bytes of an imported source. Historical AMetric and Structure citations embedded in downstream manuscripts are interpreted with the same distinction.

Source arguments explain the mathematical program; exact Lean declarations delimit its mechanized instances. The use of manuscript terminology in a module does not establish that a complete manuscript theorem has been formalized. A conditional formal theorem establishes the implication stated by its actual consumer. Stronger source theorems require their own instantiations and coverage arguments.

2.2 Definitions, assumptions and derived results

A definition fixes the object being studied; it does not establish that every intended physical situation falls within it. The parameters structure, for example, contains real mass, speed and action scale together with proofs that each is positive. An open region Ω and real source parameter s are also supplied. The EH branch fixes real κ and Λ with $\kappa \neq 0$. The original preparation, admissible metric neighborhood and observe/vary/frame repertoire define a bounded source class. The scalar branch declares complex scalar L^2 on Euclidean three-space with Lebesgue measure, free autonomous potential $V = 0$, a maximal full-space weak domain, and compatible comparison and composition data. We write Lmetric in the exposition and retain L-metric in exact source titles; both refer to the same licensing terminology.

Results derived from these inputs must be distinguished from the construction choices. The actual EH action derivative is proved and identified with an LF-continuous linear functional. The canonical source factor and its injectivity are proved from equality of all compact-test observations. The six analytic premises of the response classifier are discharged for the actual action-derived EH response. The scalar reference's exact generator, weak graph, zero-potential multiplication domain and inertial dispersion are proved. The connected theorem also proves canonical licensing for the two actual original-use tasks

and the receiving/coverage squares. An independently supplied comparator still brings its own finite differential data, complete graph and calibration hypothesis. These remain conditions of an implication.

We use “receiving” for a construction that retains the declared source questions and proves the appropriate reference squares into a downstream carrier. The word does not mean that an arbitrary mathematical carrier has acquired physical standing by declaration. A receiving theorem depends on its original source, the meanings of its observations and the exact maps that preserve them. Section 5 examines these obligations before the physics-specific normal forms.

2.3 Assumptions and construction data

Table 1. Inputs, declared scope and established conclusions.

Layer	Inputs or declared scope	What is established
Kernel	An independently specified incidence or partial-reference system; determinacy and nondegeneracy, or an appropriate witnessed reference failure.	Canonical Kernel conclusions for that system; no metric or Hilbert geometry is generated by this alone.
AMetric and Lmetric	Complete original-use semantics, original answer determinacy, declared local conditions and every promised redescription/continuation edge; actual incidence when asserting Kernel realization.	Canonical safe-use licensing with L1–L5. Both actual EH/scalar task instances, determinacy and sound universal regions are proved in the connected construction.
Common KG source	$a = (m, c, \hbar)$ with $m, c, \hbar > 0$; $s \in \mathbb{R}$; open Ω ; declared original KG family and algebraic tensor/comparison operations.	Raw-to-standing source and concrete Kernel objecthood; source fidelity within this family.
EH receiver	The admitted original preparation/program restriction, fixed $\kappa, \Lambda \in \mathbb{R}$ and $\kappa \neq 0$.	Actual directional source, canonical profile factor, same-current-metric representation, and Einstein-form coefficient classification.
Scalar reference	Isolated scalar sector, physical Fourier/unitary transport, controlled nonrelativistic construction, $L^2(\mathbb{R}^3)$, full-space maximal weak domain and $V = 0$.	Free receiving instance, exact generator and graph, self-adjoint realization and coefficient $-\hbar^2/(2m)$.
Comparator	Generic finite scalar differential data, complete weak graph, uniform nonzero scalar principal coefficient, zero first/free zeroth terms and admitted dispersion calibration.	Equality with the reference as a partial linear operator, including its domain.
Common preparation	A licensed scalar preparation in the invariant .kg one-particle core, an independently admitted metric operand H , and an empty initial EH program.	Actual source, metric, complete-record and registered-answer squares; all declared core preparations are covered. No coverage of every EH history or completed Hilbert ray follows.
Optional matching	Correctly normalized geometric variation, matter-source data, total metric stationarity and any additional action regularity required by the invoked wrapper.	A separate conditional matching implication; these are not premises of the selected coefficient classifier.

3 The Kernel precedes geometric representation

3.1 Original incidence and functional necessity

The source-level starting point is not a differential equation. It is an original incidence: an occurrence or performance assessed for a fully specified relation or use. Its bearer, complete question, qualification and occurrence can be fixed without borrowing a later verdict. Kernel Theorem 3.1 [1, pp. 24–25] reconstructs four functional roles from target-adequate realization: reference preserves what is concerned; standing records actual qualification for a specified use; admissibility retains the joint satisfaction of its conditions; irreversibility prevents replacement of the original occurrence and conditions by a later performance. Theorem 3.6 [1, p. 27] concerns genuine functional deletion, including work performed implicitly or by distributed mechanisms. It does not assert four physically separate components.

Theorem 7.1 [1, pp. 41–43] states the broader same-object exhaustion result relative to complete original observation questions. Two separately warranted answers at the same bearer and complete query must agree; a proposed extra classification either changes the query or bearer, lacks answer-standing there, or introduces no new profile distinction. A failed original historical use cannot become successful while its occurrence and conditions remain unchanged. These are manuscript arguments about the constitutive and preservation obligations of determinate construction. They must not be collapsed into the narrower type of any one formal theorem.

In the Core formalization, an incidence system has a determinacy condition and a nondegeneracy condition. The theorem `kernel_necessity` constructs a Kernel with reference uniqueness and nontriviality. The partial-reference variant consumes a witnessed absence of reference. Its exact signature appears in Appendix A. This is an encoded construction under explicit hypotheses. The interpretive connection from an actual domain to its incidence system remains part of the source warrant; Lean's acceptance of a supplied structure does not prove that the structure captures every intended original assessment.

$$\text{Determinate}(X) \wedge \text{Nondegenerate}(X) \Rightarrow \exists K : \text{Kernel}(X), \text{ReferenceUnique}(K) \wedge \text{Nontrivial}(K)$$

3.2 Profiles and the restriction on quotient claims

The contextual-quotient construction identifies source presentations exactly when every declared observation agrees. If O is the complete observation family for a specified role, the relation $q \sim_O r$ means that $O(q, u) = O(r, u)$ for every admitted query u . A map constant on these equivalence classes factors uniquely through the canonical quotient. If equality of its values also reflects the original observation equivalence, the factor is injective. This is the mathematical mechanism used in the EH source-profile endpoint.

Its force depends on the query family. Equality of a present qualification bit need not preserve a future operation's domain, a joint-use condition, an earlier failure, or a different readout. A quotient exact for one role is not automatically the quotient for every original use. In particular, equality of EH first variations need not imply equality of metrics or agreement of all future variations. We therefore retain the full original response q for current operands, program continuation and first failures, and use a coarser profile quotient only for the geometric source role.

This distinction carries the common-origin argument. Both downstream branches use the Kernel's original incidence, standing and faithful-profile machinery, but they observe different downstream

content. Their use of common governance does not require their quotients to be equal. A shared origin is a statement about dependency and source preservation, not a theorem that all branch distinctions have been erased.

4 From the ametric boundary to Lmetric licensing

4.1 Premetric authority and warranted enrichment

The AMetric boundary concerns priority in justification, not an epoch before a physical universe acquired geometry. An actual proposal, apparatus or mathematical object already incurs Kernel governance. “Premetric” here says that an authoritative target-specific metric discrimination has not yet been supplied at the retained interface. It does not forbid formal calculations, carriers, equality relations, or all invariant metrics. AMetric Proposition 3.8 [2, pp. 21–22] explicitly allows equality-based formal structure; its boundary theorem permits independently warranted richer input.

Theorem 7.2 [2, p. 36] provides the exact information test. Let $p : Z \rightarrow X$ forget the added structure of richer presentations, and let $w : Z \rightarrow V$ be the proposed answer. A reader on the attained image of p exists exactly when w is constant on p -fibres. Here $\tilde{p} : Z \rightarrow \text{im}(p)$ is p corestricted to its image; equality of functions is on Z . Uniqueness holds on that image. Total recovery on all of X additionally requires coverage or an independently justified extension. The theorem establishes determination; a concrete application must still establish what was retained, what was forgotten, and why the proposed answer has standing for the original question.

$$\exists! \bar{w} : \text{im}(p) \rightarrow V, w = \bar{w} \circ \tilde{p} \Leftrightarrow \forall z, z', p(z)=p(z') \Rightarrow w(z)=w(z')$$

Theorem 7.4 [2, p. 38] supplies a separate grounding test. For independently grounded judgments B and a rule registry R , let $\text{CLR}(B)$ be the intersection of all rule-closed supersets of B . If a proposed license family C has no seed in B and every rule concluding in C already needs a premise in C , then $\text{CLR}(B)$ avoids C . This includes mutual licensing and arbitrary premise sets. An independently warranted entrance into C defeats the obstruction's premise and is allowed. A consistent larger fixed point alone is not the same thing as a grounded derivation.

Theorem 7.5 [2, pp. 39–40] assembles the information, eligible-selector, equality-pattern, fixed-qualification and grounding restrictions into the boundary package called “Axiom 6” by downstream sources. In that source it is a derived theorem, not a new physical axiom asserted here. The Lean module `AMetricMetricUseRestrictions` formalizes the routes actually used by Metricity. It proves the fibre descent criterion, the unseeded-family obstruction, eligible stabilizer restrictions, equality-pattern factorization and unique fixed-locus qualification. It does not claim to encode every application in the AMetric manuscript. Each concrete obstruction still needs the actual forgetting map, action, grounds or rules satisfying its hypotheses.

4.2 Canonical safe use and the licensing relation

Lmetric licensing is the next constructive stage. Metricity Theorem 6.2 [5, pp. 20–21] does not make a metric generate its own standing. It constructs a relation from interpreted original-use records, descriptor meanings, qualification and complete answer graphs, and every promised operation. Write C for these records, α for their original act, μ for their descriptor, A for the local validity test, R for declared edges and W for their original warrants. Local validity includes readiness for every required redescription; a missing operation is not allowed to pass by leaving the edge set empty.

The safe records are those for which every finite declared path retains its original local requirements and edge warrants. Equivalently they form the greatest fixed point of the monotone safety operator Φ . The canonical licensing relation projects those records to act/descriptor pairs. Structure Theorem 6.3 [3, pp. 20–21] and Exhaustion Theorem 5.3 [4, p. 20] supply the corresponding greatest-safe-region argument; Metricity equations (4)–(7) specialize it to original metric uses.

$$\Phi(U) = \{c : A(c) \wedge \forall t,d, R(c,t,d) \Rightarrow [W(c,t,d) \wedge d \in U]\}$$

$$S = \Phi(S) = U\{U : U \subseteq \Phi(U)\}; \text{Lic}(a,m) \Leftrightarrow \exists c \in S, \alpha(c)=a \wedge \mu(c)=m$$

The checked theorem `kernel_ametric_canonical_metric_licensing` takes an `OriginalMetricTask`, determinacy of its original answer relation, and an actual qualification incidence. The task structure contains data, not proof fields asserting licensing, safety, agreement or minimality. The theorem returns actual public Kernel roles, the original standing/qualification equivalence, the derived AMetric discipline, the fixed and greatest characterizations of S , and all five licensing conclusions. Agreement of complete profiles is derived from separately warranted original answer incidences and determinacy, rather than assumed as an agreement certificate.

L1 gives original standing for a licensed act. L2 retains every required redescription and descriptor-meaning equivalence. L3 preserves the original context and complete boundary work, together with the complete profile. L4 retains warrants and licensing along every finite declared path. L5 prevents membership from supplying a missing original incidence or replacing a failed unchanged original subject with later success. Sound realizations of the same original obligations are included in the canonical relation. These conclusions establish the canonical licensing role [11].

The occupied-clock application supplies a positive example under its original metric, action, mass and finite-dimensional source assumptions. Its descriptor must denote the actual complete duration contract, including the valid-use domain, every real marked record and every declared real redescription. A sector name or one numerical duration is insufficient. Its immediate task adds no arbitrary physical-future promise. The construction proves a positive entry, not coverage of every descriptor sector or every metric realization.

4.3 Licensing does not select the downstream projection

Metricity Corollary 6.3 and Remark 6.5 [5, p. 21] separate licensing from generation, positive realization and order minimality. The relation records warranted metric articulation. If original conditions fix a metric, their theorem fixes it; bare licensing does not. If several faithful realizations satisfy the original obligations, licensing retains them. The result is neutral among faithful projections and introduces no communication channel between physical loci.

The greatest safe region and exact complete-content quotient do not prove existence of a locally minimal metric-supporting interface in the original physical prerequisite order. That stronger existence assertion remains reserved. Nor is firstness of the full Lorentz representation a premise of canonical licensing. The passage from boundary to interior should consequently be read as an order of warrants and constructions: the original conditions qualify a use, licensing records its safe articulation, and a physical realization then supplies its own geometric or quantum carrier and laws. It is not a metric creation process or a selector among physical solutions.

5 The common source and the intervening maps

5.1 The original KG standing construction

The downstream formalization makes the common origin concrete through a declared KG family. The raw source is not merely named as a Kernel instance. The roots `kg_family_kernel_objecthood`, `kg_specific_raw_to_standing_source` and `kg_constraint_first_standing_source` establish the relevant incidence/reference/nondegeneracy and raw-to-standing conclusions for the constructed family. The objecthood root supplies determinacy, nondegeneracy, reference uniqueness, nontriviality and the asymmetry of standing-to-failure at its declared family object. The source theorem passes from its specific raw quantum-predictive certificate to a standing source.

This family retains declared comparison arrows, regional restrictions, continuation and finite algebraic independent composition. The scalar receiving structure's upstream field is filled by `kg_constraint_first_standing_source` as Ω . The geometric branch uses the same original KG object and its prepared source, current admitted metric act and ledger/reference squares. The connected construction now adds an actual map from licensed scalar core preparations and independently admitted metric operands to licensed original EH histories. Identical hashes for the ten Core modules corroborate dependency identity; the source roots and common-map proofs establish the mathematical connection.

The maps serve distinct roles. The full original response quotient is equivalent to the prepared-history receiver; prepared execution yields the actual current metric act, whose action is differentiated. A coarser contextual quotient retains exactly the EH source observations. The scalar branch instead passes from standing reception through original-sector/core identification, physical unitary transport and the free nonrelativistic construction. The connected adapters preserve the relevant source readouts through these distinct maps.

5.2 Licensing and the downstream source maps

The source-level role of Lmetric licensing is to retain original qualification through faithful downstream uses. The connected construction [15] supplies two concrete `OriginalMetricTask` instances and applies `kernel_ametric_canonical_metric_licensing` to each. For the EH task, the complete meaning retains every raw history and finite observe/vary/frame continuation, the actual admitted metric, finite relative action and directional action, Option-valued answers, and retained first failure. Its original local test is the actual finite EH use domain. Redescription is full raw-program equivalence; continuation is actual program append. Determinacy, local validity and the warrants for every declared edge are proved. The universal record region is postfixed for the safety operator, giving actual canonical licenses for all declared histories when $\kappa \neq 0$.

The scalar task's meaning retains original preparation, complete registered references and outputs, actual invariant-core continuation, full projection, kinetic domain and graph, free flow and reference dispersion. Its redescription edges are nonzero-scalar equivalences; continuation edges are the declared core unitary flow. The proof establishes the actual source qualification, local tests, scalar-redescription and continuation warrants, and a sound universal region. Each original core pure preparation therefore has a canonical licensed presentation. The meaning contains the already constructed analytic operator and flow: licensing warrants these original uses; the earlier analytic constructions and proofs establish their dynamical laws. Neither the task definition nor licensing alone derives a physical Hamiltonian from bare objecthood.

The canonical receivers retain actual presentations, meanings and complete answers. On the EH side, `presentLicensedHistory` is surjective, and the maps to the full original response and bounded source-profile quotient are also surjective. Current metric, action, derivative and continuation are read from the full receiver. A licensed record can truthfully report failure; licensing does not convert a rejected metric request into a successful execution. On the scalar side, `licensedScalarState` covers the physical rays of each declared invariant core, while `licensedScalarFullState` maps those rays into the completed spatial carrier. Reference, compatible comparison-arrow, regional and finite algebraic tensor squares are proved. Scalar first-failure preservation reindexes finite question words by time advance; it is distinct from append-only retention of an EH history's past failure.

5.3 The common-preparation diagram

Let r be a licensed scalar preparation for the one-particle object `.kg`, let H be any independently admitted original metric operand, and let J denote the actual isometric embedding of that scalar core into the original KG carrier. The construction `scalarToLicensedMetric` sends (r,H) to the canonical licensed presentation of the initial raw history whose source is J applied to the scalar pure preparation, whose metric operand is H , and whose program is empty. Thus the source connection is supplied by an actual map with checked readback, rather than by a comparison of names or imports.

$$C_{\kappa,\Lambda}(r,H) = \text{presentLicensedHistory}(\text{initialHistory}(J(\text{pure}(r))), H, [])$$

The common squares identify the resulting EH quantum ray with the original embedded scalar preparation and its current metric with `originalEHActMetric H.val`. Every old KG question has the same complete source record; every registered old question has the same Option-valued reference answer, with the scalar answer inserted into the original sum-valued answer type by `Sum.inr`. Equality therefore retains absent or failed answers. For each nonzero preparation in the declared `.kg` core and each admitted H , a licensed scalar presentation realizes this diagram.

For real t , `licensedScalarContinue t r` embeds into the original KG preparation produced by the actual NR invariant-core evolution. Applying the same common map to this evolved preparation and the same independent H gives the proved evolved common-preparation square. This compares two constructions of the evolved quantum preparation. It supplies neither an EH metric evolution nor a commutation law between scalar time and arbitrary EH program append. Coverage concerns these initial and evolved core preparations; the full EH history space and completed Hilbert-space rays are larger.

5.4 Dependency structure and theorem map

The dependency chain is original incidence and Kernel governance, derived ametric discipline and canonical licensing for actual use tasks, faithful receivers and common original preparations, then the bounded Einstein-form and free-scalar analytic endpoints. The operator/action data enter through their declared source constructions and analytic proofs, which the licensing tasks retain and the receiver squares preserve. Kernel and downstream Kernel-faithful machinery together supply this direction of justification. Appendix A identifies the exact declarations, consumed hypotheses and root-field bindings; Table 2 records the geometric classifier's six analytic discharges.

6 The geometric branch

6.1 Actual original operands and action derivatives

Fix a, s, Ω and the typed original compact-neighborhood preparation/program restriction. A response q retains its current prepared act H_q and an actual metric g_q . The admitted act bound supplies the metric's Lorentz frame and nondegeneracy proofs; the metric is not postulated on the coarser geometric source quotient. The original program repertoire retains finite requests, rejections and first failures. Admissibility of sufficiently small directional variations does not erase a prior rejected finite request.

For a compactly supported symmetric metric probe K , the observation is the derivative at zero of the original relative EH action evaluated on $H_q + tK$. Its raw-history counterpart uses the raw-history execution map's computed current act before introducing the EH source quotient. `restricted_eh_raw_observation_square` proves that these are the same observation after passage through the retained response equivalence. The derivative theorem is a genuine `HasDerivAt` statement, supplied by the independently computed action variation, and its value agrees with the existing prepared first-variation functional.

$$O_{\kappa, \Lambda}(q, K) = (d/dt)|_{t=0} S^{\text{rel}}_{\text{EH}}(\eta, H_q + tK) = D_q(K)$$

Here η denotes the retained flat reference metric in the relative-action construction, not an extra spacetime solution. LF denotes the locally convex test-function topology used by the compact-source construction. D_q is an LF-continuous linear functional on the declared compact metric-probe space. Equality with that functional and the raw/received square are proved; neither is an input agreement field. The directional result does not by itself become two-parameter finite-dimensional differentiability, Hadamard differentiability or regularity along arbitrary curves. Those stronger hypotheses matter only for consumers that actually require them.

6.2 Source profiles and canonical Kernel descent

Represent D_q by its ten symmetric source components S_q . The retained convention gives the half-pairing identity: one half of the metric-source pairing of S_q with K is $D_q(K)$. This factor is part of the normalization and must be retained when comparing geometric and matter-source conventions. The theorem `restricted_eh_sources_exact_original_profiles` proves that $S_q = S_r$ exactly when every compact directional observation agrees. One direction uses the half-pairing identity; the other first identifies the actual LF functionals on all probes, then applies the represented-source construction.

The contextual-quotient universal property gives a unique injective factor from the EH observation quotient into symmetric source-component distributions. Raw-history coverage of this quotient is proved. It means that each class of the declared source-profile quotient has an original raw-history representative. It does not mean that every distribution, Lorentz metric or original candidate is in its image.

$$q \sim_{\text{EH}} r \Leftrightarrow \forall K, O_{\kappa, \Lambda}(q, K) = O_{\kappa, \Lambda}(r, K) \Leftrightarrow S_q = S_r; \bar{S}([q]) = S_q$$

The resulting factor is canonical for this observation family. It is a role projection of the fuller response. The proof does not descend g_q , continuation or partial operations to it, and it does not recover q from S_q . These fibres classify only the declared EH source observations. This is the same fixed-query discipline that made the Kernel and ametric fibre arguments meaningful upstream: retaining one family of answers cannot silently certify another.

6.3 The action-derived geometric response

The response E_{EH} is constructed from the computed bulk first-variation density $B_{\kappa,\Lambda}(g)$, lowering with the same metric and dividing by its volume density. Thus an Einstein tensor is not inserted as a new source-identification premise. On the declared regular Lorentzian stratum, the subsequent tensor-identification theorem proves its Einstein expression. With the formalization's source conventions, the expression has the following sign and coupling normalization.

$$E_{EH}(g) = \text{vol}(g)^{-1} g [2B_{\kappa,\Lambda}(g)] g = -\kappa^{-1} [G(g) + \Lambda g]$$

The same-current-metric source representation is not an arbitrary identification with a matter tensor. For every retained q , component i in $\text{Fin } 10$ and compact scalar test φ , the canonical source evaluated on φ is the integral of φ against the corresponding raised tensor density of $E_{EH}(g_q)$. The scalar tests have support in Ω ; the density is raised using that same current metric. This accompanies the classifier but is not a seventh classifier premise.

$$\bar{S}([q])i(\varphi) = \int \rho_i(g_q, E_{EH}(g_q))(x) \varphi(x) dx$$

6.4 The direct six-premise classifier

The exact direct consumer is `original_curvature_general_response_has_unique_einstein_form`. Its response variable E has six premises: regular Lorentz naturality; actual two-jet locality; original actual-curvature first response; symmetry on the declared C^2 Lorentz stratum; general normal-metric response closure; and active full Lorentz-envelope response. The conclusion is a unique real pair (a,c) , with $a \neq 0$, satisfying `CoordinateEinsteinResponseForm` E a c . The type of that conclusion is reproduced in Appendix A. The real normal-form coefficients in this paragraph are distinct from the construction parameter tuple a and its speed component.

For the actual E_{EH} , the corresponding `eh_original_geometric` declarations discharge every premise. Naturality and two-jet locality concern the actual field response. The first-response condition is formulated on actual normalized Levi-Civita curvature, not as an assumed Ricci expansion or a preselected desired coefficient ratio. Symmetry is proved on the regular stratum. The closure proof uses the established divergence identities, and activity excludes a response that is only a homogeneous metric baseline throughout the full declared envelope. The final receiving proof applies this exact consumer to those six established laws.

Table 2. The six premises consumed by the direct classifier and their proofs for the EH response.

Consumed premise	Discharging theorem
<code>RegularLorentzResponseNatural E</code>	<code>eh_original_geometric_response_regular_natural</code>
<code>RegularLorentzTwoJetLocal E</code>	<code>eh_original_geometric_response_twojet_local</code>
<code>OriginalCurvatureFirstResponse E</code>	<code>eh_original_geometric_curvature_first_response</code>
<code>Symmetry on C2LorentzMetricAt</code>	<code>eh_original_geometric_response_symmetric</code>
<code>GeneralNormalMetricResponseClosure E</code>	<code>eh_original_geometric_general_closure</code>
<code>FullLorentzEnvelopeResponseActive E</code>	<code>eh_original_geometric_full_envelope_active</code>

The source manuscript's route explains the normal form $E_{\mu\nu} = aR_{\mu\nu} + bRg_{\mu\nu} + cg_{\mu\nu}$ and the divergence-compatible relation $b = -a/2$ [7, Theorems 21.9 and 23.1]. The formal classifier encodes its particular actual-curvature/general-envelope route. It does not automatically identify every prose S1–S18 candidate in Einstein Definition 20.3. The response itself is defined on an analytic envelope of regular metric fields, while the original all-test source readback is proved only on metrics arising from the bounded histories. The theorem does not equate that bounded image with the entire analytic envelope.

At fixed κ and Λ the coefficient pair of E_{EH} is $(-1/\kappa, -\Lambda/\kappa)$. Uniqueness of this pair is a response-form statement. It determines neither κ nor Λ from the Kernel and proves neither a unique g nor a unique global spacetime, topology, boundary condition or matter history. Choosing the EH action and freezing those anchors are downstream branch choices. Lmetric licensing does not select them.

6.5 Relation to the larger gravity theorem

Gravity Theorem 8.2 [6, p. 20] concerns an admissible physical interior in a regular-stratum Hamiltonian observable-evaluation comparison class, called AER in the source, with presentation arbitrariness AER-P. AER fixes a local symplectic carrier, standing surface, smooth quotient, redescription distribution and compatible physical observables; AER-P adds the presentation freedom used to obtain multiplier form. Its proof consumes observable descent, separation, maximality and multiplier-typing conditions to obtain the GR-type constraint role. These conditions belong to the broader gravity-role theorem. They are not additional hypotheses of the selected direct response classifier.

The historical declaration `kg_original_core_poisson_extensions_descend` is a pointwise theorem for representable covectors and extensions on an original unit core. A complete Gravity AER-P instantiation would also have to discharge the other premises of that comparison framework. Neither such an instantiation nor its stronger conclusion follows from the EH formula. The source attack map and nonclaims [6, pp. 34–35; 7, pp. 69–70] distinguish structural role, metric normal form, calibration and richer-scope dynamics.

7 The free-scalar branch

7.1 From original standing to an isolated scalar sector

The scalar construction begins from the same declared KG standing source, not from the EH source-profile quotient. Its isolated one-particle sector and core identifications retain the original scalar/Poincaré data. Covariant measure, weighted momentum and physically scaled spatial Fourier maps supply the specific unitary transports. These are substantive downstream constructions; an arbitrary Hilbert-space isomorphism would not establish the same source or time-action connection.

The free nonrelativistic step keeps mass m and action anchor $\hbar$ fixed while varying the admitted positive speed c . After removal of the homogeneous rest-energy phase, the original KG time action has the rationalized dispersion below. Its pointwise limit is the nonrelativistic kinetic energy, and the retained construction proves strong convergence of the corresponding transported rest-subtracted flow on each state at fixed time.

$$E_c(p) - mc^2 = |p|^2 / [\sqrt{(m^2 + |p|^2/c^2)} + m] \rightarrow |p|^2/(2m) \text{ as } c \rightarrow \infty$$

The construction uses continuum carriers throughout and requires no spatial lattice, mesh or discretization-to-continuum passage. It retains the controlled analytic contraction $c \rightarrow \infty$ described above. That isolated scalar contraction does not identify the entire relativistic Fock evolution with nonrelativistic evolution.

SSQ1 is the source name for the minimal same-scope scalar quantum comparison predicate. The receiving theorem `kg_nr_free_receiving_ssq1` combines `KGNRReceivingQS` a $s \Omega$ with the constructed `SameScopeQuantumSpatial1` instance for `kgNRSpatialKinetic` a and zero potential. Its upstream standing field is filled by the actual source theorem. The receiving and differential witnesses are supplied, not inferred from a resemblance between the final operator and a familiar equation.

7.2 Exact generator and maximal weak graph

Let H_0 denote `kgNRSpatialKinetic` a on the declared complex Hilbert space $L^2(\mathbb{R}^3, dx)$, and $U_0(t)$ its phase-fixed free flow. The construction gives a densely defined self-adjoint operator with exact generator information. On its domain, the derivative of the flow is $-iH_0/\hbar$ in the retained phase convention, so the usual Schrödinger differential form follows there. The exact-generator statement additionally identifies the full domain through existence of the corresponding strong derivative; a sufficient core differentiation rule alone would be weaker.

$$i\hbar (d/dt) U_0(t)f = H_0 U_0(t)f, H_0 = -(\hbar^2/2m)\Delta \text{ on its declared full domain, } f \in D(H_0), t \in \mathbb{R}$$

The all-time Schrödinger relation displayed above is the mathematical consequence of the exact generator, group law and domain invariance, and is not a separately named audited endpoint root. The graph theorem is formulated using Schwartz tests and tempered-distribution embeddings. A pair (f, g) belongs to $\text{graph}(H_0)$ exactly when every Schwartz test τ gives the stipulated weak equality with the test response $T_0\tau = -(\hbar^2/2m)\Delta\tau$. In particular, it is a biconditional for the complete graph, rather than agreement only on smooth compactly supported vectors. In Fourier coordinates the corresponding domain is the maximal multiplication domain for the real kinetic symbol $k_0(\xi)$.

$$(f, g) \in \text{graph}(H_0) \Leftrightarrow \forall \tau \in \mathcal{S}(\mathbb{R}^3, \mathbb{C}), \langle g, \tau \rangle_{\text{dist}} = \langle f, T_0\tau \rangle_{\text{dist}}$$

$$D(H_0) = \{f \in L^2 : k_0 \cdot \mathcal{F}f \in L^2\}; k_0(\xi) = (\hbar^2/2m)(2\pi)^2|\xi|^2$$

The factor 2π records the library Fourier convention in frequency variables; it is reconciled with the physically scaled momentum transform by the proved transport. The distribution bracket above is notation for evaluation of the encoded distribution on a test, not an added pointwise plane-wave state or an unstated Hilbert inner-product convention. Plane waves are not treated as normalizable L^2 vectors.

The exact-graph endpoint also proves that the zero-potential multiplication operator has every Hilbert vector in its domain and fixes the principal coefficient to $-\hbar^2/(2m)$, which is negative because m and $\hbar$ are positive. This full multiplication domain is the domain of the $V = 0$ potential operator, not a claim that the unbounded kinetic operator is everywhere defined. The kinetic domain remains the maximal weak/Fourier domain just described.

7.3 The receiving SSQ1 witness and its scope

The formal predicate SameScopeQuantumSpatial1 is the nonemptiness of a typed KGScalarSSQ1Witness for the declared operator and potential. Its nineteen numbered Q fields retain the source clause numbering and receiving interpretation. Five supporting fields supply generic finite scalar differential data, a test response, their identification, the complete weak graph and closed evolution. The numbered clauses include dense domain, self-adjointness, linearity, projective compatibility, locality, Euclidean covariance, second-jet dependence, uniform principal coefficient, absence of first-order gauge terms, scalar fibre, spatial-only response, no nonlinear or nonlocal response, closed norm preservation, reversible flow, maximal full-space domain, potential ledger and nontriviality. The reference construction supplies these fields by prior theorems.

The witness is a concrete free instance. It is not a proof that every paper-level SSQ1 candidate has been represented by this Lean structure, nor an exhaustion theorem for all potentials or self-adjoint extensions. Schrödinger Theorem 36.1 [8, pp. 47–48] is a larger source statement with a faithful projective-Hilbert projection, closed-continuation/Wigner/phase-lift/Stone hypotheses, a scalar comparison envelope, action/inertial anchors, potential data and domain certificates. The paper's adversarial closures explicitly distinguish these burdens [8, pp. 55–65]. We retain their distinction when reporting the narrower mechanized construction.

7.4 Calibrated comparators and operator equality

The comparator theorem addresses an independently supplied partial complex-linear operator H . A KGScalarFreeComparator H contains generic finite scalar differential data and a continuous linear Schwartz-test response identified with those data. It gives a complete weak graph for H , a uniform nonzero real scalar principal coefficient c , no first-order terms, and zero free zeroth-order term. The desired identity $H = H_0$ is not one of its fields. The strong graph requirement prevents an operator from agreeing on a convenient test core while carrying an extra domain restriction or extension. Here c denotes the principal coefficient, not the speed parameter.

Within this one-parameter principal class, the continuous polynomial Fourier symbol is $\sigma_c(\xi) = -c(2\pi)^2|\xi|^2$. KGFreeAnchoredDispersionAt requires equality of that symbol with the reference kinetic energy at a fixed proved nonzero calibration frequency ξ^* . This is an explicit admitted physical anchor. It is not deduced from positivity, scalarity or the existence of a self-adjoint generator.

$$\sigma_c(\xi^*) = k_0(\xi^*), \xi^* \neq 0 \Rightarrow c = -\hbar^2/(2m) \Rightarrow \text{graph}(H) = \text{graph}(H_0) \Rightarrow H = H_0$$

One nonzero frequency is sufficient only after the uniform one-parameter normal form has been established. Division by $(2\pi)^2|\xi^*|^2$ fixes c , and equality of the complete graphs then gives equality as partial operators, including their domains. An arbitrary variable-coefficient symbol cannot be calibrated by one value in this way. The reference comparator separately satisfies KGFreeInertialDispersion at every frequency by theorem. The general comparator result remains an implication whose graph/class and dispersion premises are visible.

The assembly `kg_source_free_s36_comparator_endpoint` packages receiving, reference dispersion, calibrated comparator equality, and the corresponding implication for a supplied free SSQ1 witness with full dispersion. It is the free specialization associated with the source's Section 36. The reference's proved dispersion and an independently supplied comparator's calibration remain distinct hypotheses and conclusions.

8 Premetric structural unification and the precise endpoint

8.1 Structural emergence from common governance

The principal theorem proves `KernelFaithfulLicensedEndpoints a s Ω`. It has 49 proved fields, rather than an input certificate asserting the desired connection. In its exact namespace `AASCKleinGordon.CanonicalLicensing`, the declaration is:

```
theorem kernel_faithful_canonical_licensing_to_eh_and_free_schrodinger
  (a : Parameters) (s : ℝ) (Ω : Opens CoordinatePoint) :
  KernelFaithfulLicensedEndpoints a s Ω
```

The first three fields establish the actual KG standing source, current free receiving construction and bounded Einstein-form receiving endpoint. Seventeen further fields construct and connect the actual EH licensing task and receiver, including coverage, continuation, same-current-metric source representation and failure preservation. Twenty-two scalar fields construct actual licensing and reference/continuation/comparison maps and retain the domain, graph, flow, generator, free SSQ1 witness, dispersion and calibrated comparison. Seven common-source fields prove the preparation, metric-operand, complete-record, registered-answer, scalar-evolution, evolved-preparation and declared-core coverage statements of Section 5.3. The companion retains the full proposition and exact field-to-proof ledger, so the short root type is not used as a substitute for its content.

At every κ, Λ with $\kappa \neq 0$, the EH endpoint represents the action's source at the metric read from the full licensed receiver and classifies that same constructed response by its unique nonzero Einstein-form coefficient pair. For each declared scalar core, the licensed meaning is exactly the original scalar meaning; its Hamiltonian and flow are the constructed free spatial operator and flow. The exact generator and maximal weak graph remain statements on the full completed spatial Hilbert space, while licensed state and common-source coverage remain statements about the declared core. Arbitrary comparator equality still quantifies over the admitted finite scalar class and its calibration or dispersion hypothesis. The theorem does not provide an EH-profile-to-scalar-state map, a metric-selected scalar flow or a simultaneous solution.

8.2 The optional matter and background connection

Geometric own-source representation must be distinguished from matching a matter source. Let W_{grav} be the gravitational first-variation functional and $D_{\text{grav}} = \text{representedMetricSource}(W_{\text{grav}})$ its scalar-test source distribution, with the half-pairing convention of Section 6.2. The own-source identity is $D_{\text{grav}} = \rho g(E_{\text{EH}})$. The optional total-action bridge requires the geometric-variation identity $-\gamma D_{\text{grav}} = \rho g(E_{\text{match}})$. Its compatible matching response is therefore $E_{\text{match}} = -\gamma E_{\text{EH}}$. With $E_{\text{EH}} = -(G + \Lambda g)/\kappa_{\text{EH}}$, this gives $E_{\text{match}} = (\gamma/\kappa_{\text{EH}})(G + \Lambda g)$. If $\gamma = \kappa_{\text{EH}}$, E_{match} is $G + \Lambda g$, not E_{EH} .

$$E_{\text{match}} = -\gamma E_{\text{EH}} = (\gamma/\kappa_{\text{EH}})(G + \Lambda g)$$

The optional theorem `original_total_action_implies_scalar_clock_matching` also consumes total metric stationarity for the actual gravitational-plus-matter action, source-density regularity, finite-parameter differentiability and LF continuity as stated by its action-functional interface. The established ray derivative and prepared linear functional do not supply all those hypotheses. Without the additional data, own-source representation and coefficient classification do not yield a matter equation at an actual complete source.

A one-way background-to-quantum extension is a different, useful target. It would take the actual declared metric g_q , construct the corresponding scalar measure, operator, potential and full domain, provide a unitary evolution or propagator, and prove a reference square using that same g_q . Even that would not by itself solve backreaction. A coupled Einstein-scalar solution would additionally need the appropriate matter matching, joint equations, existence conditions and continuation. These extensions preserve the established dependency direction while adding explicitly named mathematics.

9 Mechanization and replay trust

9.1 Project replay and logical assumptions

The connected construction [15] was accepted in four stages: actual original-use licensing, the EH adapter, the scalar adapter and the final common-source composition. Across those stage audits, 252 new compiled declarations, including private and generated declarations, were scanned and 230 exact public axiom reports were collected. Only `Classical.choice`, `Quot.sound` and `propext` occur in the permitted axiom union. The final connected scan covers 70 declarations and 69 public reports. A traversal of the actual compiled root proof value reaches 66,526 constants and confirms seven required dependencies, including canonical licensing, the KG standing source, the EH endpoint, exact scalar generator, calibrated comparator and the registered/evolved common-preparation squares. This tests the root's actual use of those proofs, beyond their presence among imports.

The earlier sealed private successor replay started with an empty new build directory and rebuilt ten production modules plus the connected audit. All eleven new objects were byte-identical to the independently reviewed originals. It checked and reused 839 previously accepted local dependency objects, together with pinned compiler/library binaries. It did not rebuild those 839 modules or bootstrap the external dependencies. Sixteen reviewed lint warnings concern unused proof binders in proposition fields; no errors or placeholder proof terms passed the audit. The full-local replay mode exists but was not executed. These facts are distinct from the earlier 786-module replay and separate 64-module licensing audit.

The public source export was then replayed separately at the immutable commit identified in Appendix B.6. That run rebuilt the same ten production modules and all four stage audits: fourteen byte-identical objects, 252 scanned declarations and 230 public axiom reports. It reproduced the standard axiom union and seven required actual proof dependencies, with sixteen expected warnings and zero errors. It hash-verified and reused 839 local baseline objects and 183 external direct-import objects. This exported-source replay tested the relocated source package against supplied dependency paths; it was not a full-local rebuild or an independent clean-machine replay.

The earlier bounded-dynamics replay [10] freshly rebuilt 786 local modules, scanned 12,609 compiled declarations and collected official axiom reports for 42 exact loaded roots. Its inventory initially failed to parse after compilation; a separately verified correction rechecked the source/object/log/command/import bindings and completed the inventory. The failed source and log remain retained. The receipt discloses 713 lint-warning lines, hash verification of all 112,334 ZIP members and preservation of 2,558 prior files. The original failed driver is not reported as having passed; Appendix B preserves the corrected procedure.

Compilation, compiled declaration scans, exact axiom collection, proof-value dependency traversal and byte/import receipts address different questions. Together they bind accepted encoded implications to

the actual sources and objects used. Independent source-to-proof reviews examine their mathematical scope. None of these checks establishes empirical truth or semantic exhaustion of every intended physical use. The successor's 839 cached baseline objects form the hash-identified union of the earlier accepted closures; their count must not be added to the predecessor rebuild figures as a new fresh combined rebuild.

9.2 Separate audits and historical roots

The reconciliation ledger contains 44 source declarations, but only 42 belong to the earlier bounded-dynamics replay's fresh loaded-root closure. The remaining two are historical optional source-only evidence: `kg_original_core_poisson_extensions_descend` and `original_total_action_implies_scalar_clock_matching`. Their retention is not represented as fresh proof checking in that earlier replay. In particular, the optional matter bridge is not used to enlarge the completed endpoint.

The upstream licensing construction has its own earlier audit [11]: 64 local modules rebuilt, 2,606 project constants inspected and 885 exact transitive axiom reports. The successor composition imports and actually applies that assembly. Its historical audit remains a separate execution record; the successor's fresh eleven-object replay reuses the accepted local baseline. The common mathematical root connects the stages, while the compilation histories retain their respective boundaries.

9.3 Compiler, library and provenance boundary

The pinned compiler is Lean 4.28.0 [14], commit 7e01a1bf5c70fc6167d49c345d3bf80596e9a79b. The retained mathlib manifest pin is 8f9d9cff6bd728b17a24e163c9402775d9e6a365. Appendix B records the remaining manifest revisions, including the public Kernel package. Existing Lean and external library binaries were copied and reused; they were not rebuilt from source or bootstrapped. Their source-to-binary correspondence was not newly established. The project replay is fresh at the local project layer, not a fully fresh dependency build.

Fresh Git HEAD/status inspection of the retained dependency checkouts was denied. Declared manifest revisions and copied-byte hashes are therefore reported as distinct evidence. A retained Cli search root was missing; the module/import records identify the objects actually resolved. The replay used the packaged runtime and dependencies without fetching or changing their configuration.

Lean's system architecture and mathlib's role are described in [12–13]. In this project, the practical trust boundary includes the reused compiler and external objects, the selected library facts, the audit and import-resolution code, the correctness of statement encoding, and the original source interpretation. Axiom auditing narrows logical assumptions of the encoded roots. It does not remove those implementation and interpretation boundaries or test the physical world.

Appendix B identifies the connected source snapshot, sealed composition records, replay evidence and the earlier separately retained 2.79 GB dynamics archive. The compact manuscript project supplies the ten new production sources, full root proposition, audit sources, dependency manifest and selected bound records. It is an inspectable source companion, not a portable runtime image. The dated source snapshot is distinguished from the unreleased runtime/archive bytes and any future DOI.

10 Scope and further developments

The geometric target uses the admitted compact-neighborhood source/program class. It establishes no coverage of every original SameScopeMetric1 candidate, general S1–S18 exhaustion, minimum raw-event storage or universal metric selector. The scalar target fixes a free full-space envelope. It establishes no general equivalence between prose SSQ1 and the formal witness structure, all-potentials classification, arbitrary-boundary extension theorem or transfer of the EH metric to scalar evolution.

The connected theorem establishes actual canonical licensing for both declared tasks and an explicit common-preparation diagram. It does not establish a complete shared physical interior. The common map uses an invariant one-particle preparation, an independently admitted metric operand and an empty initial EH program. Its scalar comparison arrows require compatible accepted lifts; tensor composition is the declared finite algebraic family. No surjection onto all original KG/Fock preparations, arbitrary EH histories or completed Hilbert-space rays follows. The exact full-space operator theorem does not enlarge these preparation-coverage statements.

The source corpus distinguishes these issues at the level of its own arguments. Gravity separates a structural constraint role from Einstein dynamics. Einstein distinguishes fixed-envelope response form from constants, matter history and richer-scope gravity. Schrödinger distinguishes transition-preserving rays from norm preservation, exact domains from formal differential expressions, admitted scale calibration from boundary-generated constants, and a separately constructed spatial carrier from a transfer out of a different constrained carrier. The formalization reported here instantiates the bounded constructions and comparison classes described in Sections 6–8 within those distinctions.

Further development includes a same-metric background-to-scalar operator/domain/evolution square, matter matching with the correct normalization and total stationarity, and then existence or continuation on a declared interacting class. A common interior or joint-ledger theorem would need its own comparison and continuation obligations. Broader candidate exhaustion, general potentials and boundary domains, completed tensor/Fock coverage, full AER specialization, a portable connected replay package and rebuilding external dependencies from source are distinct extensions. The actual licensing applications and common-source maps reported here are completed parts of the bounded result.

11 Conclusion

The connected Lean theorem establishes premetric structural unification in a bounded, explicit sense: original Kernel governance and derived licensing are instantiated on actual EH and scalar use tasks; faithful receiver maps preserve their declared source content; and a common KG core preparation connects them to Einstein-form response and free-scalar Schrödinger dynamics. Kernel and downstream Kernel-faithful machinery together supply the dependency direction. The dynamical laws follow from their stated analytic constructions, with the controlled nonrelativistic step, physical anchors, nonzero coupling and comparator calibration retained. The theorem completes the licensing composition and common-source diagram without identifying the two branch quotients, selecting a preferred projection or proving a coupled physical solution.

Appendix A Source-to-theorem map and selected statements

Table 3 relates source-manuscript arguments to their formalized instances and endpoint contributions. Its hypotheses are read together with Table 1. A source theorem with a broader candidate class is not identified with a narrower Lean instance. The connected root applies the canonical licensing assembly to actual original-use tasks and combines the resulting receivers with the accepted dynamics and common-source maps. The execution records of the predecessor and successor audits remain distinct.

A.1 Manuscript arguments, declarations and endpoint contributions

Table 3. Manuscript-source arguments, exact declarations and their formal contribution.

Source argument	Exact Lean declaration(s)	Contribution and retained conditions
Kernel [1], Theorems 3.1, 3.6 and 7.1.	kernel_necessity; kernel_necessity_of_partialReference; original_incidence_constructs_kernel.	The Core constructors use determinacy/nondegeneracy or witnessed partial-reference failure. The public original_incidence_constructs_kernel instead uses an actual-original-incidence witness and belongs to the separate licensing closure. Manuscript functional arguments and actual-domain interpretation remain distinct.
AMetric [2], Theorems 7.2, 7.4 and 7.5.	constructed_ametric_licensing_discipline.	Selected fibre, grounding, selector and qualification restrictions, with actual maps/actions/rules satisfying the relevant hypotheses; checked in the licensing closure.
Structure [3], Theorems 6.3–6.8; Exhaustion [4], Theorem 5.3; Metricity [5], §6.1 and Theorem 6.2.	kernel_ametric_canonical_metric_licensing; faithful_original_consumer_supplies_license.	Canonical greatest safe-use relation and L1–L5 from original-use data, determinacy and actual incidence. The connected task instances discharge their own local/edge warrants. No interface-order minimum or preferred projection follows.
Shared formal KG construction used by the downstream corpus.	kg_family_kernel_objecthood; kg_specific_raw_to_standing_source; kg_constraint_first_standing_source.	Concrete shared source at positive $a = (m, c, \hbar)$, real s and open Ω , with the declared KG tensor/comparison family. Both branches retain this construction and the same ten Core modules.
Metricity [5], actual original-use applications in the connected construction [15].	current_metric_use_constructs_kernel_and_canonical_license; scalar_use_constructs_kernel_and_canonical_license.	Actual EH history and scalar core task meanings, determinacy, incidence and sound universal regions; canonical licenses for their declared uses. Scalar meanings retain prior analytic operator/domain/flow data.
Einstein [7], actual first-response route; Kernel exact-profile factorization.	restricted_eh_raw_observation_square; restricted_eh_sources_exact_original_profiles; restricted_original_eh_kernel_einstein_receiving.	Admitted H+tK derivative, response equivalence, canonical source factor and same-current-metric readback, at fixed $\kappa \neq 0$ and Λ on the bounded source/program family.

Source argument	Exact Lean declaration(s)	Contribution and retained conditions
Einstein [7], Theorems 21.9 and 23.1; broader Theorem 30.1 retains its stated scope.	original_curvature_general_response_has_unique_einstein_form.	Unique nonzero Einstein-form coefficient pair in the declared analytic envelope. All six premises are discharged for the action-derived response (Table 2); general S1–S18 coverage is not inferred.
Schrödinger [8], scalar comparison/domain construction and Section 36 free specialization.	kg_nr_free_receiving_ssq1; kg_nr_free_receiving_exact_graph.	Constructed $V = 0$ receiver, exact generator, complete weak graph and principal coefficient on the declared $L^2(\mathbb{R}^3)$ carrier and maximal full-space domain, with physical anchors and controlled nonrelativistic construction.
Schrödinger [8], calibration and operator-comparison obligations.	kg_free_calibrated_comparator_eq; kg_nr_free_comparator_inertial_dispersion; kg_source_free_s36_comparator_endpoint.	Reference dispersion is proved. An independent comparator equals the reference under its complete finite scalar graph/class and dispersion calibration assumptions.
Structural Unification [9], common-source aim; bounded explicit construction [15].	common_original_registered_reference_square; common_evolved_original_preparation_square; common_preparation_covers_declared_core; kernel_faithful_canonical_licensing_to_eh_and_free_schrodinger.	49-field root with actual receiver/coverage/continuation and common-source maps. Shared preparation is the invariant .kg core with independent admitted H and empty initial history. No full interior or joint dynamics is inferred.
Gravity [6], Theorem 8.2; Structural Unification [9], Theorem 48.1 and Remark 48.2.	-	No application of these complete larger source theorems is claimed by the selected endpoint roots. Full AER/AER-P, common-interior/joint-ledger coverage and interacting solutions remain separate targets. The optional action-matching theorem retains normalization, regularity and total stationarity.

A.2 Selected exact declarations

The excerpts below preserve the source text of the selected declarations. Theorem proof bodies are omitted; the displayed definitions and comparator data are complete excerpts. Section parameters and implicit universe/carrier variables are those of the named module. In the restricted EH modules, the generalized section parameters are $a : \text{Parameters}$, $s : \mathbb{R}$ and $\Omega : \text{Opens CoordinatePoint}$. The electronic ledger evidence/EXACT_ENDPOINT_ROOTS.json records all 44 reconciliation entries with source spans and SHA256 identities. Its two historical source-only entries are excluded from the 42 roots freshly audited in the earlier bounded-dynamics replay (Section 9.2).

Parameters

KGMassShell, source line 11.

```
structure Parameters where
  mass : ℝ
  speed : ℝ
  hbar : ℝ
  mass_pos : 0 < mass
  speed_pos : 0 < speed
  hbar_pos : 0 < hbar
```

kernel_necessity_of_partialReference

AASC.Core.KernelNecessity, source line 82.

```
theorem kernel_necessity_of_partialReference
  {Carrier : Type u}
  {Scope : Type v}
  {Value : Type w}
  (R : PartialReferenceSystem Carrier Scope Value)
  (hBoundary : exists carrier scope,
    R.referenceAt carrier scope = none) :
  exists K : Kernel R.incidenceSystem,
    K.ReferenceUnique ∧ K.Nontrivial
```

kg_family_kernel_objecthood

KGFamilyNondegeneracy, source line 127.

```
theorem kg_family_kernel_objecthood (a : Parameters) (s : ℝ) (Ω : Opens CoordinatePoint) :
  let D := kgRawRegisteredOrbit a s Ω
  (kgFamilyTensor (kgOriginalObject a) (kgOriginalObject a))
  D.references.incidenceSystem.Determinate ∧ D.references.incidenceSystem.Nondegenerate ∧
  D.kernel.ReferenceUnique ∧ D.kernel.Nontrivial ∧
  AASC.Asymmetric D.kernel.StandingToFailure
```

kg_specific_raw_to_standing_source

KGConstraintStandingSource, source line 215.

```
theorem kg_specific_raw_to_standing_source (a : Parameters) (s : ℝ) (Ω : Opens CoordinatePoint) :
  KGSpecificRawQP a s Ω ∧ KGSpecificStandingSource a s Ω
```

original_curvature_general_response_has_unique_einstein_form

EinsteinOriginalCurvatureResponse, source line 78.

```
theorem original_curvature_general_response_has_unique_einstein_form
  (E : MetricFieldResponse) (natural : RegularLorentzResponseNatural E)
  (locality : RegularLorentzTwoJetLocal E) (original : OriginalCurvatureFirstResponse E)
  (symmetric : ∀ g p, C2LorentzMetricAt g p → ∀ i j, E g p i j = E g p j i)
  (general_closure : GeneralNormalMetricResponseClosure E)
  (active : FullLorentzEnvelopeResponseActive E) :
  ∃! ac : ℝ × ℝ, ac.1 ≠ 0 ∧ CoordinateEinsteinResponseForm E ac.1 ac.2
```

restricted_original_eh_kernel_einstein_receiving

OriginalRestrictedEHKernelReceiving, source line 116.

```
theorem restricted_original_eh_kernel_einstein_receiving ( $\kappa \wedge : \mathbb{R}$ ) (coupling :  $\kappa \neq 0$ ) :
  ( $\forall$  (q : RestrictedOriginalResponse a s  $\Omega$ ) (i : Fin 10) ( $\phi$  : ScalarSourceProbe  $\Omega$ ),
    restrictedEHKernelSource a s  $\Omega$   $\kappa \wedge$  coupling
      (ContextualQuotient.classify (restrictedEHObserve a s  $\Omega$   $\kappa \wedge$ ) q) i  $\phi$  =
         $\int$  p, sourceDensityCoordinates (raisedSourceTensorDensity (restrictedEHMetric a s  $\Omega$  q)
          (originalEHGeometricResponse  $\kappa \wedge$  (restrictedEHMetric a s  $\Omega$  q))) i p *  $\phi$  p)  $\wedge$ 
  ( $\exists!$  ac :  $\mathbb{R} \times \mathbb{R}$ , ac.1  $\neq 0$   $\wedge$ 
    CoordinateEinsteinResponseForm (originalEHGeometricResponse  $\kappa \wedge$ ) ac.1 ac.2)
```

kg_nr_free_receiving_ssqr1

KGNRFreeReceivingAssembly, source line 15.

```
theorem kg_nr_free_receiving_ssqr1
  (a : Parameters) (s :  $\mathbb{R}$ ) ( $\Omega$  : Opens CoordinatePoint) :
  KGNRReceivingQS a s  $\Omega$   $\wedge$ 
  SameScopeQuantumSpatial1 a
    (kgNRSpatialKinetic a)
  ( $\emptyset$  : KGSpatialSpace  $\rightarrow \mathbb{R}$ )
```

kg_nr_free_receiving_exact_graph

KGNRFreeReceivingAssembly, source line 23.

```
theorem kg_nr_free_receiving_exact_graph (a : Parameters) :
  GlobalCharge.ExactGenerator (Translation.coefficient a.hbar)
    (kgNRSpatialFreeFlow a) (kgNRSpatialKinetic a)  $\wedge$ 
  ( $\forall$  f g : KGNRSpatialHilbert, (f,g)  $\in$  (kgNRSpatialKinetic a).graph  $\leftrightarrow$ 
     $\forall$  test :  $\mathcal{S}(\text{KGSpatialSpace}, \mathbb{C})$ ,
      (g : KGSpatialDistribution) test =
        (f : KGSpatialDistribution) (kgNRSpatialTestResponse a test))  $\wedge$ 
  ( $\forall$  f : KGNRSpatialHilbert, f  $\in$  (kgNRPotentialOperator ( $\emptyset$  : KGSpatialSpace  $\rightarrow \mathbb{R}$ )).domain)  $\wedge$ 
  (kgNRPrincipalCoefficient a = -(a.hbar^2/(2*a.mass))  $\wedge$  kgNRPrincipalCoefficient a < 0)
```

KGScalarFreeComparator

KGScalarFreeComparator, source line 13.

```
structure KGScalarFreeComparator (H : KGNRSpatialHilbert  $\rightarrow_1$  [ $\mathbb{C}$ ] KGNRSpatialHilbert) where
  data : KGScalarDifferentialData
  response :  $\mathcal{S}(\text{KGSpatialSpace}, \mathbb{C}) \rightarrow L[\mathbb{C}] \mathcal{S}(\text{KGSpatialSpace}, \mathbb{C})$ 
  response_data :  $\forall$  f x, response f x = kgScalarJetResponse data f x
  complete_graph :  $\forall$  f g, (f,g)  $\in$  H.graph  $\leftrightarrow$   $\forall$  test :  $\mathcal{S}(\text{KGSpatialSpace}, \mathbb{C})$ ,
    (g : KGSpatialDistribution) test = (f : KGSpatialDistribution) (response test)
  uniform_principal :  $\exists$  c :  $\mathbb{R}$ , c  $\neq 0$   $\wedge$   $\forall$  x i j,
    data.principal x i j = if i=j then (c :  $\mathbb{C}$ ) else 0
  no_first :  $\forall$  x i, data.first x i = 0
  free_zeroth :  $\forall$  x, data.zeroth x = 0
```

KGFreeAnchoredDispersionAt

KGScalarComparatorFourier, source line 118.

```
def KGFreeAnchoredDispersionAt (a : Parameters)
  {H : KGNRSpatialHilbert  $\rightarrow_1$  [ $\mathbb{C}$ ] KGNRSpatialHilbert} (C : KGScalarFreeComparator H) : Prop :=
  kgScalarPrincipalFourierSymbol C.data kgScalarCalibrationFrequency =
    (kgNRFrequencyKineticEnergy a kgScalarCalibrationFrequency :  $\mathbb{C}$ )
```

KGFreeInertialDispersion

KGScalarComparatorFourier, source line 125.

```
def KGFreeInertialDispersion (a : Parameters)
  {H : KGNRSpatialHilbert →1.[C] KGNRSpatialHilbert} (C : KGScalarFreeComparator H) : Prop :=
  ∀ ξ, kgScalarPrincipalFourierSymbol C.data ξ = (kgNRFrequencyKineticEnergy a ξ : C)
```

kg_source_free_s36_comparator_endpoint

KGSS36FreeComparatorAssembly, source line 14.

```
theorem kg_source_free_s36_comparator_endpoint
  (a : Parameters) (s : ℝ) (Ω : Opens CoordinatePoint) :
  KGNRRceivingQS a s Ω ∧
  KGFreeInertialDispersion a (kgNRFreeComparator a) ∧
  (∀ (H : KGNRSpatialHilbert →1.[C] KGNRSpatialHilbert)
    (C : KGScalarFreeComparator H),
    KGFreeAnchoredDispersionAt a C → H = kgNRSpatialKinetic a) ∧
  (∀ (H : KGNRSpatialHilbert →1.[C] KGNRSpatialHilbert)
    (W : KGScalarSSQ1Witness a H (θ : KGSpatialSpace → ℝ)),
    KGFreeInertialDispersion a (kgScalarFreeComparatorOfSSQ1 a W) →
    H = kgNRSpatialKinetic a)
```

kg_free_calibrated_comparator_eq

KGScalarComparatorFourier, source line 147.

```
theorem kg_free_calibrated_comparator_eq
  (a : Parameters) {H : KGNRSpatialHilbert →1.[C] KGNRSpatialHilbert}
  (C : KGScalarFreeComparator H) (calibration : KGFreeAnchoredDispersionAt a C) :
  H = kgNRSpatialKinetic a
```

kg_nr_free_comparator_inertial_dispersion

KGScalarComparatorFourier, source line 166.

```
theorem kg_nr_free_comparator_inertial_dispersion (a : Parameters) :
  KGFreeInertialDispersion a (kgNRFreeComparator a)
```

Separate canonical licensing assembly

This assembly was first checked in the separate 64-module licensing audit. The connected construction imports and applies it to the actual EH and scalar tasks. Its Task data and surrounding source are retained in `MetricityOriginalUseAssembly.lean`; no generic physical-model interpretation is supplied by the assembly alone.

```
theorem kernel_ametric_canonical_metric_licensing (D : Task)
  (determinate : DependentConservation.Determinate D.originalAnswer)
  (actual : ∃ origin witness, D.qualification origin witness) :
  AASC.Instances.KernelPaper.Manuscript.DerivedKernelRoles
    (ObjecthoodNecessity.canonicalRegime (originalIncidence D)) ∧
  (∀ origin, (ObjecthoodNecessity.canonicalRegime (originalIncidence D)).Standing (origin,()) ↔
    IncidenceNecessity.Qualified (originalIncidence D) origin ()) ∧
  AASCAMetricMetricUse.AMetricLicensingDiscipline ∧
  canonicalSafeUses D=originalSafetyOperator D (canonicalSafeUses D) ∧
  canonicalSafeUses D=Uo {U : Set C | U ⊆ originalSafetyOperator D U} ∧
  FiveLicensingConclusions D
```

A.3 Connected receiving and common-source statements

The following exact signatures expose the principal connecting obligations. The full KernelFaithfulLicensedEndpoints proposition and proof are retained in evidence/lean/KernelFaithfulLicensedEndpoints.lean. Its 49 fields consist of the three leading source/endpoint assignments and the 46 assignments in evidence/connected/ROOT_FIELD_BINDINGS.json. Each field is proved; the ledger is provenance for those assignments, not an additional mathematical assumption.

Actual EH licensing application

KGCanonicalMetricLicensing.lean, source line 115; namespace AASCKleinGordon.CanonicalLicensing. Original a, s, Ω are section parameters.

```
theorem current_metric_use_constructs_kernel_and_canonical_license ( $\kappa \wedge : \mathbb{R}$ ) (coupling :  $\kappa \neq 0$ ) :
  let D := originalMetricTask a s  $\Omega$   $\kappa \wedge$ 
  AASC.Instances.KernelPaper.Manuscript.DerivedKernelRoles
    (ObjecthoodNecessity.canonicalRegime (originalIncidence D))  $\wedge$ 
  AASCAMetricMetricUse.AMetricLicensingDiscipline  $\wedge$ 
  FiveLicensingConclusions D  $\wedge$ 
  ( $\forall h$ , constructedLicensing D h (originalMetricUseMeaning a s  $\Omega$   $\kappa \wedge$ ))
```

Actual scalar licensing application

KGCanonicalScalarLicensing.lean, source line 147; namespace AASCKleinGordon.CanonicalLicensing. Original a, s, Ω and A : KGNRObjct a are section parameters.

```
theorem scalar_use_constructs_kernel_and_canonical_license :
  let D := originalScalarTask a s  $\Omega$  A
  AASC.Instances.KernelPaper.Manuscript.DerivedKernelRoles
    (ObjecthoodNecessity.canonicalRegime (originalIncidence D))  $\wedge$ 
  AASCAMetricMetricUse.AMetricLicensingDiscipline  $\wedge$  FiveLicensingConclusions D  $\wedge$ 
  ( $\forall x$ , constructedLicensing D x (originalScalarUseMeaning a s  $\Omega$  A))
```

Licensed EH source at the retained metric

KGLicensedEHReceiver.lean, source line 163; namespace AASCKleinGordon.CanonicalLicensing.

```
theorem licensed_eh_same_metric_representation ( $\kappa \wedge : \mathbb{R}$ ) (coupling :  $\kappa \neq 0$ )
  (r : LicensedMetricReceiver a s  $\Omega$   $\kappa \wedge$ ) (i : Fin 10) ( $\phi$  : ScalarSourceProbe  $\Omega$ ) :
  restrictedEHKernelSource a s  $\Omega$   $\kappa \wedge$  coupling (licensedEHSourceProfile a s  $\Omega$  r) i  $\phi$  =
   $\int p$ , sourceDensityCoordinates (raisedSourceTensorDensity (licensedReadout a s  $\Omega$  r []).metric
    (originalEHGeometricResponse  $\kappa \wedge$  (licensedReadout a s  $\Omega$  r []).metric)) i p *  $\phi$  p
```

Licensed scalar complete weak graph

KGLicensedScalarReceiver.lean, source line 175; namespace AASCKleinGordon.CanonicalLicensing.

```
theorem licensed_scalar_complete_weak_graph (r : LicensedScalarReceiver a s  $\Omega$  A)
  (f g : KGNRSpatialHilbert) :
  (f, g)  $\in$  (licensedScalarHamiltonian a s  $\Omega$  A r).graph  $\leftrightarrow$ 
   $\forall$  test :  $\mathcal{S}(\text{KGSpatialSpace}, \mathbb{C})$ , (g : KGSpatialDistribution) test =
    (f : KGSpatialDistribution) (kgNRSpatialTestResponse a test)
```

Common original registered-reference square

KGCommonLicensedPreparation.lean, source line 64; namespace AASCKleinGordon.CanonicalLicensing.

```
theorem common_original_registered_reference_square (κ Λ : ℝ) (coupling : κ ≠ 0)
  (r : LicensedScalarReceiver a s Ω (scalarBaseObject a))
  (H : {H : MetricSourceProbe Ω // H ∈ wickOriginalMetricNeighborhood Ω}) :
  (q : RegisteredQuestion (KGFamilyQuestion a Ω (kgOriginalObject a))) :
  (licensedReadout a s Ω (scalarToLicensedMetric a s Ω κ Λ coupling r H) []).answer
  (.inr (mapRegisteredQuestion kgFamilyQuestionInChart q)) =
  (licensedScalarReference a s Ω (scalarBaseObject a) r (mapRegisteredQuestion kgNRoldQuestion
    q)).map Sum.inr
```

Common evolved preparation square

KGCommonLicensedEvolution.lean, source line 23; namespace AASCKleinGordon.CanonicalLicensing.

```
theorem common_evolved_original_preparation_square (κ Λ : ℝ) (coupling : κ ≠ 0)
  (t : ℝ) (r : LicensedScalarReceiver a s Ω (scalarBaseObject a))
  (H : {H : MetricSourceProbe Ω // H ∈ wickOriginalMetricNeighborhood Ω}) :
  kgPreparedQuantum s Ω (wickOriginalMetricNeighborhood Ω) (kgOriginalObject a)
  (restrictedEHPrepared a s Ω (licensedEHResponse a s Ω
    (scalarToLicensedMetric a s Ω κ Λ coupling
      (licensedScalarContinue a s Ω (scalarBaseObject a) t r) H))) =
  rayMap _ (kgNRSpatialOriginalPreparation a t
    (licensedScalarPure a s Ω (scalarBaseObject a) r))
```

Coverage of the declared one-particle core

KGCommonLicensedEvolution.lean, source line 35; namespace AASCKleinGordon.CanonicalLicensing.

```
theorem common_preparation_covers_declared_core (κ Λ : ℝ) (coupling : κ ≠ 0)
  (x : PureVector (kgOriginalSpatialCore a))
  (H : {H : MetricSourceProbe Ω // H ∈ wickOriginalMetricNeighborhood Ω}) :
  ∃ r : LicensedScalarReceiver a s Ω (scalarBaseObject a),
  licensedScalarPure a s Ω (scalarBaseObject a) r = x ∧
  kgPreparedQuantum s Ω (wickOriginalMetricNeighborhood Ω) (kgOriginalObject a)
  (restrictedEHPrepared a s Ω (licensedEHResponse a s Ω
    (scalarToLicensedMetric a s Ω κ Λ coupling r H))) =
  rayMap _ (kgPureIsometryMap (kgSpatialCoreOriginalEmbedding a) x)
```

Appendix B Versioned electronic formal artifact

B.1 Identity, contents and separate distribution

Two electronic evidence layers identify the result. The connected source and review records [15] are dated 19 October 2026 and bound by the composition seal below. They contain ten new production modules and four stage audit sources, the full 49-field proposition and proof, exact field bindings, dependency manifest, accepted mathematical/replay reviews and the successor replay receipt. The source snapshot identified in Section B.6 supplies the public version reference; the seal records the checked local evidence independently of later publication metadata.

The earlier bounded-dynamics artifact remains the Windows x86-64 archive kernel-downstream-bounded-replay-private-20261018.zip: 2,794,959,803 bytes and 112,334 members. Its package/, audit/ and additive audit-repair/ sidecar retain the 786-module local union, source/import/object manifest, exact 44-entry reconciliation ledger, 42-root fresh audit, reused runtime/library files and corrected replay machinery. It does not contain the new connected licensing composition. Its archive identity and correction bindings are preserved below.

The compact manuscript project contains the editable article, all ten connected production sources and stage audit sources, selected earlier Lean sources, source-edition evidence, dependency manifests, sealed review/receipt records and manuscript review/QA. It contains neither the 2.79 GB archive nor the 839 baseline objects or external runtime needed by the connected replay. The full proposition and field ledger enable direct source inspection; they do not turn this compact companion into a standalone replay environment.

B.2 Cryptographic bindings

Predecessor bounded-dynamics archive SHA256

608d4913908dd1911c7778be989d6c36c0069def8508d462edecb4812552f76e

Predecessor bounded-dynamics package manifest SHA256

e64ba63ff7d63f27dddc5d3160cb750a5401c307af3f78bc4044d7cc83c54c7b

Predecessor bounded-dynamics replay receipt SHA256

6ddfc5994d929a42563a6e85d227263fa123d752646fd2da34a88b0121940612

Predecessor bounded-dynamics independent delivery review SHA256

89056b89b5810479bec130e0661b79eef20c0ae0ab2ae58ee550aac4282487ed

Predecessor bounded-dynamics delivery manifest SHA256

10feabff58df043c1061dec6ca6aef8047ea030d25b26ede1598c9cc94d74255

Predecessor bounded-dynamics audit-correction manifest SHA256

4da0c9b5d34334c34f24a903b7764283091bfc2351f0adf5f876b45fcfee2a2a

Predecessor bounded-dynamics corrected replay driver SHA256

65d3c4085d1a1bc44924bbc671b52d5f5b257304735e2af18039edede931a9be

The package manifest hashes the sealed package files; the outer delivery bindings identify that manifest, the replay receipt, correction and review. These are integrity and provenance bindings, not an independent signature, proof of source interpretation or empirical certification. The archive-member

hash verification belongs to the retained delivery audit. Preparation of the present article did not rerun the full proof replay.

B.3 Pinned compiler and dependency revisions

The compiler is Lean 4.28.0, source commit 7e01a1bf5c70fc6167d49c345d3bf80596e9a79b. Table 4 reproduces the retained manifest revisions. They are declared pins, not freshly observed Git HEAD identities. The retained Cli search root is marked missing; actual import records determine which objects were resolved.

Bundled lean.exe SHA256

6a66c4a5739fa17146b88ac81bab2bca1924806cac321ddad6b96006dde9c691

Table 4. Declared dependency revisions in the retained manifest.

Package	Declared revision
NonDegenerateConstruction AndKernelOfAdmissibility	96978f41a08347f36650d3757cfe0ef79bf864f8
mathlib	8f9d9cff6bd728b17a24e163c9402775d9e6a365
plausible	55c8532eb21ec9f6d565d51d96b8ca50bd1fbef3
LeanSearchClient	c5d5b8fe6e5158def25cd28eb94e4141ad97c843
importGraph	85b59af46828c029a9168f2f9c35119bd0721e6e
proofwidgets	be3b2e63b1bbf496c478cef98b86972a37c1417d
aesop	f642a64c76df8ba9cb53dba3b919425a0c2aeaf1
Qq	b8f98e9087e02c8553945a2c5abf07cec8e798c3
batteries	495c008c3e3f4fb4256ff5582ddb3abf3198026f
Cli	4f10f47646cb7d5748d6f423f4a07f98f7bbcc9e

B.4 Reproduction procedure and retained correction

The earlier 786-module bounded-dynamics replay requires Windows x86-64, an existing Python 3.11 or later, and sufficient space for a separate bundle copy and fresh build output. Extract the supplement to a short path, retain package/ and audit-repair/ as siblings, and inspect the corrected replay.py and its manifest. From audit-repair/, the following commands check the sealed package and perform a complete fresh 786-module bounded-dynamics replay. Choose a new, nonexistent work directory outside the sealed package.

```
python -B -X utf8 replay.py --check
python -B -X utf8 -u replay.py --run --work-dir C:\short\new-replay --jobs 2
```

The corrected driver supersedes the original package README command. It verifies and copies the sealed package, compiles the 786 local sources into a new build directory, checks first-resolved imports and compiles the corrected inventory against that fresh build. It invokes the copied runtime with explicit

dependency roots and requires no network fetch, package installation or global configuration change. It preserves logs and completed files on failure and refuses to overwrite the chosen work directory.

The retained execution used a verified resume after the original inventory parser failed on the local identifier matches. The correction renamed that audit-local identifier to rootCandidates at three uses; it changed no mathematical source or project import. The resumed audit revalidated every original fresh source/object/direct-import/log record, required the object hashes to equal their predecessors, rechecked BundleEndpoint and completed the corrected inventory into new files. The original failed source and log remain in the artifact. The receipt's 507.588-second duration measures the resumed phase after its initial integrity check; it is not an end-to-end build or bootstrap time.

B.5 Verification boundary and artifact availability

The predecessor's fresh guarantee concerns its 786 local modules and 42 loaded roots, with reused external compiler/library binaries. The sealed private successor rebuilt ten new production modules and one audit; the later public-source replay rebuilt the same production modules and all four audits. Both reused 839 pinned local objects. Correspondence of the reused binaries to all declared external source pins was not newly proved. Earlier dependency Git inspection was denied; no fresh dependency HEAD/status proof is asserted. Historical missing-root, lint and correction disclosures remain attached to the runs in which they occurred.

The exact earlier archive remains separately retained under author control without a public archive/audit URL or DOI for those bytes. Its manuscript DOI links identify source editions. The connected source snapshot is cited separately in Section B.6; a source commit is not the old binary archive or a new portable connected replay bundle. No Zenodo release or DOI for the connected formal artifact is asserted here.

B.6 Connected source snapshot and successor replay

The public source snapshot [15] is commit 21bf87b79635e451ffb05f6fef764360a32d486d of somamaley-ux/AASC-Premetric-Structural-Unification, with Git tree 3b1f25edb732695a1677da0bd52373c9001d126a. The export contains 1,035 files and 11,319,164 bytes. A complete comparison of remote Git blob identities with the published local export found zero mismatches; all fourteen companion composition production/audit sources match that export. The commit preserves the predecessor history, LICENSE and accepted mathematical source bytes. These version bindings identify the available sources; they are not an additional mathematical proof or a digital signature of the scientific claims.

Connected composition seal SHA256

52fdb8d6fe0d22cdae504f07234b93992265197126af88b91869ef457664b9ae

Sealed private eleven-object replay receipt SHA256

2cb2e24d1341b719b65eab559841ca6940437e46e225394dc6d123032a8d7c70

Independent sealed private replay review SHA256

878e7f8f8c902bcd04317ffd09e678f6eaa042b4f020ab335d24da4afac8e0f0

The earlier sealed private successor replay was invoked from the retained 15 October task workspace with the following command. The helper is bound to that workspace's source/object locations, the dependency manifest and existing pinned Lean runtime. Copying the helper into this manuscript project does not relocate those dependencies. Its original helper remains workspace-bound. The public export

supplies a separate helper accepting explicit dependency paths, as described below. No standalone portable runtime bundle was verified.

```
& 'C:\Users\admin\AppData\Local\Programs\Python\Python311\python.exe' -B -X utf8 -u
'physical-work\connected-canonical-licensing-20261019\replay_connected.py'
```

The private helper's default mode rebuilt ten production modules and the connected audit against the 839 checked cached objects; all eleven objects matched the reviewed originals. Its --full-local mode was not executed. The composition seal binds 118 files. The public exported-source replay is a later, separate run: it rebuilt ten production modules and four audits, with all fourteen objects byte-identical, against the reused 839 baseline and 183 external direct-import objects. Its receipt and script are retained with the public snapshot and selected copies in this companion. The recorded result is source replay with supplied dependencies, not a compiler bootstrap, complete local-baseline rebuild or independent clean-machine test.

Public exported-source fourteen-object replay receipt SHA256

5073182c51c029f863071b4ca792255f526097214c637005616c520ab2ff50e4

Public export manifest SHA256

57ccd92e38cbe625dc8c8f300ceaad23843cc05c1a7a39e343f49291ca9278b3

For the public source snapshot, scripts/verify_export.py checks the export identities. scripts/replay_composition.py first checks the composition source bindings and then accepts --lean, --baseline-cache and repeated --library-root inputs for a fresh replay. The supplied dependency paths must resolve to the pinned identities; an arbitrary installed library is not equivalent evidence. The public README, reproducibility account and replay receipt describe the actual invocation and retained outputs. The compact manuscript ZIP includes selected sources and receipts for inspection, but omits the baseline object cache and external runtime.

Appendix C Source editions

The following records identify the retained PDF editions by SHA256 and the source passages used in the exposition. The 8 October 2026 Institute Research Companion snapshot supplies a file-backed retrieval index. It is not a proof audit. Extracted page texts support edition and passage inspection; exact formal signatures are taken from the Lean sources in Appendix A. Landing-page metadata for the principal works was checked on 19 October 2026. For Fixed-Domain Exhaustion, the edition identity rests on the retained catalogue and source mapping; fresh landing-page verification was unavailable.

[1] Non-Degenerate Construction and the Kernel of Admissibility. Exact edition 10.5281/zenodo.22968658; 73 pages. Theorems 3.1 and 3.6, pp. 24–27; Theorem 7.1 and support direction, pp. 41–43.

SHA256 4e1bafc4844d90ca7ba5268d1b6b5ee21bf92f082a2a61b4eea039faed0c037e

[2] The AMetric Boundary as a Unique Regime-Invariant Constraint on Admissibility-Bearing Construction. Exact edition 10.5281/zenodo.22848051; 67 pages. Theorems 7.2, 7.4 and 7.5, pp. 36–40; formal equality-only structure, pp. 21–22.

SHA256 fd0da8feb70e61de9474cc459ca8de6af2619206d439e62425e88334161a535e

[3] The Structure of Admissibility. Exact edition 10.5281/zenodo.22874934; 46 pages. Greatest safe interior and transport, Theorems 6.3–6.8, pp. 20–22.

SHA256 065979305b2fc1593abb343e72a86d0ed9c967c089d1a9cbf91be650de25eff2

[4] A Fixed-Domain Exhaustion Theorem. Exact edition 10.5281/zenodo.22875070; 39 pages. Greatest safe interior, Theorem 5.3, p. 20.

SHA256 d06d39b381edddaafe899f20769b0ba551802b23d7b83121530ecab346feece0

[5] Metricity as Licensed Description: The L-metric Boundary and the Realized Physical Interior. Exact edition 10.5281/zenodo.23226427; 53 pages. Original-use construction, equations (4)–(7), §6.1, pp. 18–22; Theorem 6.2 and Remarks 6.5–6.6.

SHA256 4d14912adef3e276bbbe3d52bbf5b5fd57941ca2ff19735385fd41fdc4d3f781

[6] Gravity as Structural Necessity. Exact edition 10.5281/zenodo.23038472; 44 pages. Theorem 8.2, p. 20; §13 nonclaims and attack map, pp. 34–35.

SHA256 0c4fd70bf6d93fd12d9254db8a4e5273f2556aaeaddb578fdba06769eebf2ade

[7] Einstein Dynamics as the Unique Minimal First-Response Metric Projection of AASC Gravity. Exact edition 10.5281/zenodo.21616067; 76 pages. Theorems 21.9, 23.1 and 30.1; scope Remark 30.2, pp. 42–45 and 53–54; adversarial matrix, pp. 69–70.

SHA256 0ddf56194d7ee5c7f3f2e71aa72f61a2bdef629dd4f6e29b80344d7aeccc063

[8] Schrödinger Dynamics as the Unique Minimal First-Response Hamiltonian Projection of AASC Quantum Standing. Exact edition 10.5281/zenodo.21824200; 67 pages. Definition 24.3, pp. 35–36; Theorem 25.10, p. 39; Theorem 36.1, pp. 47–48; adversarial closures, pp. 55–65.

SHA256 a05b2c3c07d433caa0178b701b590bd5ff02aeacf3ccc6a936be4c59239e6cad

[9] Structural Unification of Gravity and Quantum Dynamics under AASC. Exact edition 10.5281/zenodo.21616108; 52 pages. Theorem 48.1 and Remark 48.2, pp. 37–38; joint-square and closure conditions, §§34–42.

SHA256 4e3be8e23e4775cfc9bfa6d8a22c11304eae30ea98eac983a2224f0484302930

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- [2] Amos Jay Maley. The AMetric Boundary as a Unique Regime-Invariant Constraint on Admissibility-Bearing Construction: Pre-fixational authority, non-transmissivity, and complete interfaces. Reference edition dated 20 September 2026; publisher release 19 September 2026. DOI 10.5281/zenodo.22848051. <https://doi.org/10.5281/zenodo.22848051>
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- [4] Amos Jay Maley. A Fixed-Domain Exhaustion Theorem. Retained edition dated 21 September 2026. DOI 10.5281/zenodo.22875070. <https://doi.org/10.5281/zenodo.22875070>
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- [6] Amos Jay Maley. Gravity as Structural Necessity. Retained edition dated 29 September 2026. DOI 10.5281/zenodo.23038472. <https://doi.org/10.5281/zenodo.23038472>
- [7] Amos Jay Maley. Einstein Dynamics as the Unique Minimal First-Response Metric Projection of AASC Gravity. Retained edition dated 27 July 2026. DOI 10.5281/zenodo.21616067. <https://doi.org/10.5281/zenodo.21616067>
- [8] Amos Jay Maley. Schrödinger Dynamics as the Unique Minimal First-Response Hamiltonian Projection of AASC Quantum Standing. Retained edition dated 6 August 2026. DOI 10.5281/zenodo.21824200. <https://doi.org/10.5281/zenodo.21824200>
- [9] Amos Jay Maley. Structural Unification of Gravity and Quantum Dynamics under AASC. Retained edition dated 27 July 2026. DOI 10.5281/zenodo.21616108. <https://doi.org/10.5281/zenodo.21616108>
- [10] Amos Jay Maley. Combined Kernel/downstream bounded replay: source package, reconciliation and audit. Version dated 18 October 2026. Unpublished electronic formal artifact; exact identity and availability in Appendix B.
- [11] Amos Jay Maley. Canonical metric licensing assembly: target specification, source-to-Lean semantic mapping and audit. 15 October 2026. Unpublished technical records, including independent semantic review and audit receipts.
- [12] Leonardo de Moura and Sebastian Ullrich. The Lean 4 Theorem Prover and Programming Language (System Description). 2021. <https://lean-lang.org/papers/lean4.pdf>
- [13] The mathlib Community. The Lean Mathematical Library. 2020; arXiv:1910.09336. Library background, distinct from the exact mathlib4 pin used here. <https://arxiv.org/abs/1910.09336>
- [14] Lean project. Lean 4.28.0 release and source tag, commit 7e01a1bf5c70fc6167d49c345d3bf80596e9a79b. <https://github.com/leanprover/lean4/releases/tag/v4.28.0>
- [15] Amos Jay Maley. Connected canonical licensing to Einstein-form and free-scalar Schrödinger endpoints. AASC-Premetric-Structural-Unification, source snapshot dated 19 October 2026, commit 21bf87b79635e451ffb05f6fef764360a32d486d. Exact field bindings, mathematical reviews and private/public-source replay records are distinguished in Appendix B. <https://github.com/somamaley-ux/AASC-Premetric-Structural-Unification/commit/21bf87b79635e451ffb05f6fef764360a32d486d>