

THE SINGLE MONAD MODEL / DUALITY OF TIME THEORY

SMM/DTT research: the route from source to physics

The central objective is a common source dynamics that constrains geometry, physical clocks, and matter together. This map shows the main constructions and the next mathematical questions.

Complete printable foundation guide
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<https://www.smonad.com/research/index.html>

The central idea

The programme is strongest when one source law reduces several independent choices at once. A construction can establish possibility; a necessity theorem selects a structure; physical matching identifies what an observer can measure.

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Explore the new research guides

Continue through geometry, quantum foundations, matter, and constants, then use the paper guides and book guides to follow the sources.

Continue into the expanded programme

Follow relativity, gauge interactions, cosmology, and the open research problems. Add context with philosophy and history, or read the Arabic foundations.

1. The central research objective

The common-source ambition of SMM becomes a precise research objective when spatial records, physical clocks, and matter propagation are generated by one specified dynamics. Each sector must have an independent operational definition. Their agreement then becomes a theorem or a testable constraint, rather than a consequence of defining one quantity in terms of another.

A useful starting specification contains a complete state, retained memory, an autonomous update, admitted local operations, a completion instrument, and a physical resource budget. Geometry is read from relations among completed records. A clock is read from a declared observable. Matter is represented by stable states or excitations with a specified propagation law. The same update should constrain all three.

For theoretical development, the most productive next step is often to identify one remaining freedom and remove it with a justified principle. Examples include selecting a clock that ignores a certain kind of internal work, deriving a local adjacency rule, or fixing a response normalization. Such a result can be more informative than combining many separately chosen models into a longer description.

2. Three published points of entry

Published foundations and their explanatory guides

Published work	Role in the programme	Accessible guide
Completion principles, real commutants, and positive-frequency geometry for orthogonal Hilbert representations	A modular mathematical framework linking completed observations, compatible phase structures, and conditional geometric readouts.	Completion, commutants, and positive frequency
Real-commutant phase selection from real Hilbert representations	The selection of compatible complex structure from a real representation and oriented dynamics.	Real-commutant phase selection: a paper guide
Dual-Time Topological Geometry and the Emergence of Temporal Asymmetry in Non-Equilibrium Dynamics	Coupled temporal evolution and its relation to projected memory and temporal asymmetry.	Temporal asymmetry: reading the published model

These papers address defined mathematical problems. The website also develops later working constructions that connect them to the broader source programme. Read each result with its own hypotheses: the published two-parameter temporal framework, real-representation phase selection, and a nested source schedule are not automatically the same model.

The brief calculations below are explanatory examples. They show why the mathematical structures matter and which physical bridges still have to be supplied. The original papers remain the references for their theorem statements, domains, and proofs.

3. Phase: an exact finite-dimensional illustration

Let A be an invertible real skew-adjoint matrix, so $A^T = -A$. Then $-A^2 = A^T A$ is positive definite. Set $|A| = \sqrt{-A^2}$ and $J = A|A|^{-1}$. Because A commutes with functions of $-A^2$, a short calculation gives a compatible complex structure.

$$J = A(-A^2)^{-1/2},$$
$$J^2 = A^2(-A^2)^{-1} = -I, J^T = -J.$$
$$A = J|A|.$$

J can act as multiplication by the ordinary imaginary unit on the real vector space. The generator supplies more than a formal relabelling: its oriented motion determines a phase structure on the dynamic sector. In the two-dimensional example $A = \omega J_0$ with $J_0(q,p) = (-p,q)$, positive ω selects J_0 and negative ω selects $-J_0$.

If A has a kernel, the formula is used on the dynamic complement. The zero modes do not select an orientation through this motion, and extending J to them may involve residual freedom or an obstruction. Infinite-dimensional versions also require the relevant operator domains and spectral

assumptions. A finite-dimensional illustration should not silently stand in for those analytic details.

The SMM/DTT connection is the possibility that generative activity constrains quantum kinematics. The remaining physical task is to explain why the selected carrier, generator, composition rules, and observable access arise from the source and how the resulting description constrains more than an equivalent ordinary quantum model.

4. Geometry: rank, metric, and cone are separate steps

A three-dimensional readout can arise as an algebraic sector, but dimensionality alone does not select a physical metric. One must also specify how records are compared, which transitions are local, and how the comparison changes under refinement. A stable geometry requires those properties to survive allowed perturbations or to emerge in a controlled limit.

A useful algebraic cone example uses a two-by-two Hermitian matrix $X = tI + x\sigma_1 + y\sigma_2 + z\sigma_3$, where the σ matrices are the Pauli matrices. Its eigenvalues are $t \pm \sqrt{x^2 + y^2 + z^2}$, so positivity is equivalent to a future-cone inequality.

$$\det X = t^2 - x^2 - y^2 - z^2.$$

$$X \geq 0 \Leftrightarrow t \geq \sqrt{x^2 + y^2 + z^2}.$$

This is an algebraic identity for a specified Hermitian readout. The coordinates have not yet been identified with physical durations and distances.

The example explains why Lorentzian-looking structures can appear naturally in representation-based constructions. To obtain physical relativity, clock and ruler readouts must realize the relevant transformations, and material propagation must respect the same calibrated causal structure. Curvature dynamics and gravitational field equations are further questions.

The central geometry target is therefore a joint statement: the source selects local record relations, their metric or spectral comparison, a physical clock law, and a compatible propagation bound. The bare-source obstruction shows why too little initial structure cannot select these quantities, while the locality discussion distinguishes constructing local examples from selecting them.

5. Clocks: identify the exact remaining freedom

For a refinement with B children and scale ratio q , the exponent $D = \log B / \log q$ follows from the count and scale laws. A common logarithmic encoder can give activities $u = a \star \log B$ and $\tau = a \star \log q$. This makes $u/\tau = D$ a conditional identity with separately defined endpoints.

If a material clock is protected from branch activity and reads τ , a matter band evolving against u has a velocity coefficient $Dv(g)$ against that clock. If another allowed clock reads $u + \tau$, the coefficient becomes $Dv(g)/(D+1)$. The two cases preserve the same record geometry. The difference reveals which premise selects the desired relation.

A high-value theoretical advance would derive the protected clock coupling from the same dynamics that selects the geometry and matter sector. The proof should also identify its regime of validity and the errors introduced by finite memory, contact widths, incomplete outcomes, or

approximate isolation. A universal statement must control the admitted class of physical clocks, not only one convenient observable.

6. Constants: from a structural count to response

A selected reconstruction grammar can produce an exact integer. For example, take $Q_0 = 0$ and the recurrence $Q_d = 10Q_{d-1} + (2^d - 1)$. The first three steps give 1, 13, and 137. Equivalently, $Q_3 = 100 + 30 + 7$. Each number follows exactly once the radix and branch rule are fixed.

$$Q_0 = 0, Q_1 = 1, Q_2 = 13, Q_3 = 137.$$

$$Q_3 = 1 \cdot 10^2 + 3 \cdot 10 + 7.$$

One proposed algebraic motivation for ten is the dimension of the symmetric second-power receiver of a four-real-dimensional carrier: $4(4+1)/2 = 10$. The numbers 1,3,7 count nonempty subsets of one, two, and three binary directions. Selecting this receiver, this branch grammar, and its physical role remains part of the reconstruction problem; other permitted receivers or weight rules could give other counts.

The additional bridge is a response law. For a positive invertible response operator K and a source vector f , consider $C = \langle f, K^{-1}f \rangle$. Rescaling K by λ leaves the dimension of the carrier unchanged but changes C to C/λ . A count alone therefore does not determine this response.

$$C = \langle f, K^{-1}f \rangle; K \rightarrow \lambda K \Rightarrow C \rightarrow C/\lambda.$$

The source f is written differently from the complex-structure operator J to keep the two roles distinct.

A physical coupling derivation must fix the operator, source normalization, and matching to matter. The ideal vacuum value $\alpha_0 = 1/137$ is a label for a proposed ideal-model identification; it should not automatically be renamed a bare coupling or a low-energy measured value. A comparison with a particular physical coupling needs its own definition, scale, and correction mechanism.

The [α explorer](#) displays the dependencies and numerical consequences of the current models. The other constants require a dimensional dictionary as well: a dimensionless structure does not supply a numerical value in SI units without explaining the relevant action, length, mass, and time scales.

7. Matter: binding and the hydrogen connection

A neutral pair of degrees of freedom does not automatically form a bound atom. The source model needs an attractive interaction, a kinetic term, an admissible state space, and a normalizable bound state. If a mediator is eliminated, the resulting interaction must be derived under the stated conditions rather than inserted afterward as a familiar potential.

Once the nonrelativistic Coulomb Hamiltonian $H = p^2/(2\mu) - \kappa/r$ is supplied, its ground-state relations give a useful consistency check. The reduced mass is μ and $\kappa = e^2/(4\pi\epsilon_0)$ in SI electromagnetic matching. With $\alpha = \kappa/(\hbar c)$, the ground-state energy and relative root-mean-square speed satisfy the displayed relations.

$$E_1 = -\mu\kappa^2/(2\hbar^2), \langle p^2 \rangle = \mu^2\kappa^2/\hbar^2.$$
$$v_{\text{rel,rms}} = \sqrt{\langle p^2 \rangle}/\mu = \kappa/\hbar = \alpha c.$$

The second relation follows from the virial theorem for this Hamiltonian: $\langle p^2 \rangle/(2\mu) = -E_1$. In the centre-of-mass frame the electron speed instead contains the factor μ/m_e , approaching αc for an infinitely heavy nucleus. These statements concern ground-state expectation values, not a classical electron orbit.

This connects α with atomic motion after Coulomb dynamics and electromagnetic matching have been specified. It does not independently determine α . A source-based derivation would select κ , the action scale, and the mass relation without fitting the same hydrogen observable used as its final check. [The ground-state guide](#) and [the coupling discussion](#) develop that distinction.

8. A focused mathematical development plan

Next theoretical targets

Work package	Useful result to pursue	What it would clarify
Source and memory	An autonomous model with an explicit finite resource budget and completion rule.	Whether the apparent unity relies on an unaccounted controller or archive.
Locality	A mechanism selecting and stabilizing a local relational structure.	Why a suitable geometry appears rather than being encoded as input.
Clock selection	A theorem constraining the admitted material-clock couplings.	When geometric scaling and physical time share one law.
Phase and composition	Selection of the carrier, orientation and compatible composite rule.	How generative dynamics constrains quantum kinematics.
Response and matter	A normalized response coupled to a bound matter sector.	When structural counts constrain interaction strengths and spectra.
Limits and comparisons	Controlled finite-to-continuum limits and explicit alternative models.	Which conclusions survive approximation and what distinguishes the theory.

For each target, state a theorem precise enough that a counterexample could refute it. If a counterexample exists, use it to identify the missing selection principle. If a proof succeeds only under an extra interface law, retain that law explicitly. This makes progress cumulative: later work can replace one supplied interface with a derived relation without obscuring the earlier valid result.

9. How to assess progress

A constructive model demonstrates that the ideas can coexist in one specified system. A uniqueness or necessity theorem shows that stated assumptions constrain the alternatives. A physical prediction requires an observable quantity with inputs fixed independently. A successful comparison then tests that prediction against relevant alternatives and uncertainties. These are complementary achievements.

The present research collection includes philosophical foundations, published mathematical results, and proposed physical reconstructions. It should be read as a connected programme with explicit intermediate successes and open dependencies. The most significant advances will be those that make several previously adjustable choices follow from one source dynamics.

Use the reading paths to enter a particular work package. The constants explorer is useful for dependency tracing, while the detailed articles provide examples, simplified derivations, and links to their underlying sources.

Further reading

Continue with the individual articles and their source references.

- [Why a record count is not yet a coupling](#)
Explain why the static response depends on the source and inverse response operator, not simply on the number of records. This is the central bridge required by the coupling proposal.
- [The conditional ideal value one over 137](#)
Summarize the extra normalization and electromagnetic matching needed for the ideal model coupling. Explain why the draft's alpha-zero notation does not denote the measured low-energy constant.
- [Why quaternions appear in the reconstruction](#)
Introduce the positive norm, associativity, and incompatible-phase hypotheses that select a quaternionic carrier. Present the conclusion as conditional algebraic rigidity.
- [Why the symmetric receiver has ten modes](#)
Count the independent symmetric quadratic combinations of a four-component envelope. Explain the receiver interpretation and why selecting that construction is a substantive modeling choice.
- [Alternating branches and the ranks one, three, seven](#)
Explain how positive-degree exterior sectors produce the branch counts used by the reconstruction. Keep the counting argument separate from any identification with particle families.
- [A dependency map for physical constants](#)
Introduce the constants program as a chain from completion dynamics to response and then physical matching. Identify which quantities are structural, calibrated, or still free.
- [A common dimensional dictionary](#)
Introduce the conversion between dimensionless model outputs and quantities expressed in physical units. Explain why unit consistency is necessary but does not determine an absolute action, length, or time scale.
- [A quantum source for generation and completion](#)
Introduce the positive phase-dilation model as an explicit realization within quantum mechanics. Explain how it distinguishes inner work from completed observation without deriving quantum kinematics itself.

- **From record refinement to a joint clock-band relation**
Introduce the conditional relation connecting geometry, clock response, and matter transport. Explain why the interfaces and coefficients must be independently calibrated.
- **Why local geometry can be statistically rare**
Explain the entropy barrier to lattice-like relational memories in the stated permutation ensemble. The result concerns a specified preparation problem, not every possible mechanism for emergent space.
- **Why a bare source does not imply spacetime**
Introduce the obstruction showing that source order alone lacks enough structure to fix Lorentzian geometry. Use it to explain the role of the reconstruction's additional assumptions.
- **One clock direction plus three readout directions**
Explain the rank-one clock and rank-three readout used in the conditional four-dimensional construction. Clarify why a soldering map is needed to identify them with tangent directions.
- **A neutral pair is not yet an atom**
Explain why neutrality alone does not establish binding. Introduce the need for a localized state below the separated-particle threshold in the minimal hydrogen model.
- **Eliminating a mediator to obtain attraction**
Describe the local quadratic mediator and its exact Green-function interaction. Explain how the chosen source signs and response operator enter the effective pair energy.
- **A normalizable hydrogen-like ground state**
Introduce the lower-bound and bound-state results of the effective model. Explain how the supplied kinetic and potential rules produce a meaningful atomic test case.
- **Why binding does not fix the coupling**
Introduce the dilation argument showing that a family of positive couplings remains compatible with binding and completion. Identify the extra source-selection law needed to obtain a specific interaction strength.
- **Completion, commutants, and positive frequency**
A reading guide to the published paper's relationship between completion principles, real representations, and positive-frequency geometry. Focus on the theorem assumptions before discussing physical interpretations.
- **Real-commutant phase selection: a paper guide**
Introduce the paper's phase-selection question in real Hilbert representations. Prepare an accessible route from the commutant to compatible complex structures and their physical interpretation.
- **Temporal asymmetry: reading the published model**
A reading guide to the published temporal-asymmetry model. Organize its geometrical assumptions, reduction mechanism, and interpretation before comparing it with later working drafts.

Continue the connection. Follow the next guide, or return to the reading paths.

Choose a technical reading path →