

Mathematical audit and reproducibility

PDT Foundations R13

Prepared for Graham Fincham and Daniel Hilton

Review draft 1.0 • 24 September 2026

Scope of the audit

The written proofs in [R01](#) through [R12](#) carry the general mathematical claims. The accompanying program checks exact finite cases, explicit counterexamples and numerical implementations. This is not formal verification in a proof assistant, external peer review or experimental evidence. Passing the calculations does not establish that the physical postulates describe nature.

The review applies to the claims as written in this suite. It does not certify every statement in every earlier PDT manuscript. Source versions were recovered for their relevant definitions, proofs and corrections. Where an earlier claim was stronger, the present domain and premise list governs the result.

Reproducibility package

The sources archive contains one Markdown file for every paper, `build_suite.py`, `suite_register.json`, `source_manifest.json`, `verify_foundations.py` and its recorded `verification_results.json`. The builder produces editable Word equations through Pandoc and applies the requested Times New Roman typography. It uses Python with `python-docx` and an installed Pandoc. The mathematical verification uses Python, NumPy and SciPy.

Run the mathematical checks from the extracted archive with

```
python verification/verify_foundations.py
```

Run the document builder with

```
python build_suite.py
```

The random seed is fixed at 20260924. Floating point diagnostics can vary slightly across numerical libraries. Tolerances, case counts and residuals are recorded for each group. The one large sampling run tests an explicitly supplied probability sampler. Its draws are simulated mathematical examples, not measurements of PDT.

Checks performed

All 49 recorded groups passed in the supplied run. This includes one 100000 draw simulation of the adopted key sampler, which is reported separately from exact enumeration and deterministic matrix calculations. The number of sampled cases is not a count of proved theorems. Each group's method and tolerance are available in the JSON report.

The finite structural checks cover a noncommuting transport kernel, a finite restriction of the phase functor, pure vertex flatness, nontrivial loop gauge invariance and the real rotation identities. They corroborate the explicit witnesses in [R01](#) and [R02](#). They cannot prove the universal representation theorem by enumeration.

The selection checks cover distinct and tied loss times, the symmetric pair obstruction, weighted survivor integrals, the exact gap law and the pointer interval boundary inequalities. The instrument checks enumerate complete histories with rational arithmetic, including zero weight candidates. They independently form unread quantum channels and exponentiate the proposed pulse Hamiltonian. Full rank noisy effects retain positive populations in the checked finite updates, illustrating the proved obstruction.

The composite checks enumerate deterministic local CHSH values, evaluate the quantum maximum and the operator square identity, take partial traces after a local channel, and construct an exact no signalling distribution outside the quantum bound. A rare forecast counterexample verifies the need for the issuance probability in the conditional error certificate.

The geometric checks compare the phase frame volume with its Vandermonde expression, inspect singular value bounds, test all 24 vertex permutations and verify the cycle quotient metric. The refinement checks build gamma matrices and finite Wilson operators for independently seeded link configurations, then test inverse residuals, hopping support, determinant phase and the proved decay bound. A graph incidence calculation independently verifies the quadratic link dispersion.

The remaining checks evaluate the calibration exponent solution, the mass tuning formula, the unique vacuum counterexample, the measurement energy change, the exact dust and vacuum solution, finite intervals of the scalar cosmology and a concrete contraction certificate. Numerical future evolution only corroborates the ODE implementation. The global existence assertion rests on the compactness and continuation proof in R11.

General results that still require mathematical reading

The program does not replace review of the following arguments. The minimal faithful real representation uses compact group reasoning. The effect probability theorem uses the full effect space and monotonic extension. The channel inverse theorem uses the Choi rank argument. The positive kernel classification uses Fourier and Fejér convergence. The Einstein action classification relies on its declared derivative class. These premises and proof steps should be assessed in the text.

The most consequential physical identifications are also outside numerical certification. A complex carrier must be identified with preparations and composite systems. The candidate exclusion must be antecedent and physical rather than a list altered after seeing the record. An internal metric must be related to measured displacement and a common clock. A record mechanism coupled to Einstein dynamics must carry conserved total stress.

Provenance and corrections

Source	Material retained or rechecked
September 12 foundations and physical closure	Corrected phase axioms, selection, regular transport, instruments, geometry and compatibility limits
September 13 conditional dynamical closure	Nonlinear coordinate obstruction, regular bisection restriction and reversible operation theorem
September 13 quantum closure	Explicit quantum bridge and finite instrument scope

Source	Material retained or rechecked
September 13 strengthened quantum gravity bridge	Conditional internal geometry and physical interpretation boundary
September 11 selection and identifiability	Survivor distribution freedom and finite selection limits
Revised scale suite version 1.1	Correct dimensional exponents and calibration distinction
September 18 closure gap and refinement test	Uniform Wilson decay and independent response freedoms
September 23 geometry and Einstein action attempt	Quadratic link branch, conditional soft coupling and action classification

The machine readable manifest records filenames, sizes and SHA256 hashes of the recovered source bytes. It is a provenance record, not a statement that all older results have been independently validated. Standard external sources are cited within the relevant papers.

Decision record for the next revision

Dan’s review should record whether A3 remains as a historical coordinate label or is removed from the list of independent axioms. It should also record whether B1 is accepted as a working completion or replaced by another explicit Bell assumption choice. The four vertex and barrier construction should remain conditional unless an independent seed selection law is supplied.

For record formation, the next revision needs an actual E3 proposal or an explicit decision to retain A6 as an interpretation of a supplied quantum instrument. An E3 proposal must state its parameters, robustness domain, reversal behaviour and energy exchange before a discriminating experiment is claimed. The joint physical residuals in R12 must then be instantiated on one common state space.

No independently derived numerical constant is registered in this suite. No arithmetic agreement with an input value should be added to that register as a prediction. Once a candidate prediction exists, its inputs, uncertainty and withheld comparison datum can be added as a separate versioned entry.

Review boundary

The suite is ready for mathematical and physical criticism. Its formal witnesses and conditional proofs are concrete enough to inspect. Its unresolved interfaces are named precisely enough that a later result can close one without being mistaken for closure of the whole theory. Graham’s ultimate realisation boundary remains explicit, while the remaining physical work remains within view.