Paper ID: FRC 100.007 | Version: v3.3

The Lambda-Field v3.3: Narrow Rho-Drift Audit and Ontology Separation

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Abstract

> *FRC 100.007 v3.3 preserves the narrow audit of the printed rho-level Lambda drift and removes the unsupported replacement ontology. The printed term is not trace preserving in general. The tested anticommutator completion is trace preserving and positive in the sampled qubit trajectories, but two tested coherence functionals move populations away from their initial Born weights and an ensemble-member extension is decomposition dependent. These findings exclude those implementations in the tested regime; they are not a no-go theorem for every rho-level, stochastic, instrument-level, or linear-unconditioned construction. Microstate-distribution dynamics remains one candidate route, conditional on operational equivalence*

> *and bipartite no-signaling. The paper distinguishes Lambda_obs, Lambda_eq, and optional Lambda_dyn; a fundamental field is a separate conjecture. Version 3.3 restores the canonical/operational reciprocity notation without changing the audit.*

1. Scope

This is an audit and correction note for the Lambda-field drift in FRC 100.007. It is not a full rewrite of the Lambda-field architecture.

What stands: the algebraic trace audit, the sampled population-drift result, the preparation-dependence diagnostic for the tested extension, and the usefulness of operational coherence geometry as a modeling tool.

What changes: these implementations cannot be used as Born-statistics carriers in the tested regime. No replacement level is established. A fundamental Klein-Gordon/Yukawa field is a separate conjecture not audited or supported here.

Use the following notation throughout:

$$\Lambda_{\mathrm{obs}} = \Lambda_0 \ln C_{\mathrm{obs}}, \qquad \Lambda_{\mathrm{eq}} = \widehat{\mathcal{G}}_{\mathrm{eq}}[O, E].$$

Where finite lag is tested, an optional latent state Λ_{dyn} may relax toward Λ_{eq}. The observed transform, target, latent state, and any proposed fundamental field are different objects.

2. Form audit

FRC 100.007 v3 printed a rho-level drift of the form

$$\dot{\rho} = \mathcal{L}[\rho] + \frac{\alpha}{\Lambda_0} \left(\nabla_\rho \Lambda - \mathrm{Tr}[\nabla_\rho \Lambda\, \rho] I\right).$$

For operational coherence functionals this is not trace-preserving. With `C_super = 2|rho_01| + eps`, the trace of the added term is not identically zero.

The corrected canonical completion used in the pilot is

$$\dot{\rho} = \mathcal{L}[\rho] + \frac{\alpha}{\Lambda_0} \left(\frac{1}{2}\{\nabla_\rho \Lambda, \rho\} - \mathrm{Tr}[\nabla_\rho \Lambda\, \rho]\, \rho\right).$$

This is the mixed-state analogue of a norm-preserving state-vector drift. It is trace-preserving identically. In the shipped pilot, the maximum trace error is `6.88e-15` and the minimum eigenvalue remains positive at `3.69e-4`.

This is a canonical completion, not a uniqueness theorem. The important result below comes from the rho-dependence of the nonlinear drift, not from this closure alone.

3. Born audit

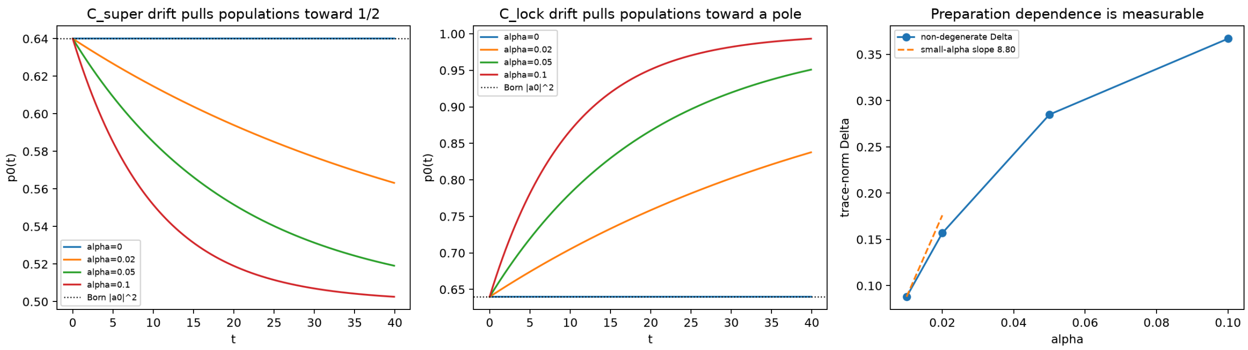
The pilot starts from a pure superposition with `|a0|^2 = 0.64`, pure dephasing rate `gamma = 0.2`, and the corrected rho-level drift. Two operational coherence choices are tested:

1. `C_super = 2|rho_01| + eps`, an inter-branch coherence channel.
2. `C_lock = (1 + |<sigma_z>|)/2`, a pointer-order channel.

Measured final populations:

Coherence choice	alpha	p0 final	Born deviation	early rate
C_super	0.00	0.640000	+0.000000	+0.00000/t
C_super	0.02	0.563245	-0.076755	-0.00253/t
C_super	0.05	0.519148	-0.120852	-0.00549/t
C_super	0.10	0.502611	-0.137389	-0.00874/t
C_lock	0.00	0.640000	+0.000000	+0.00000/t
C_lock	0.02	0.837754	+0.197754	+0.00652/t
C_lock	0.05	0.950928	+0.310928	+0.01413/t
C_lock	0.10	0.993315	+0.353315	+0.02248/t

The sign depends on the coherence channel. `C_super` pulls the populations toward the balanced superposition. `C_lock` pulls the populations toward a pole. Both violate Born statistics at the rho level.



Lambda drift audit. The corrected rho-level drift is trace-preserving and positivity-preserving in the pilot, but the two operational coherence choices move Born populations in opposite directions. The right panel shows non-degenerate preparation dependence with small-alpha coefficient 8.804.

The result is model-specific but consequential. In the two tested functionals, a deterministic rho-level drift that climbs the coherence functional moves populations. This excludes these implementations as Born-preserving carriers in the tested regime. It does not establish a theorem covering every rho-level, stochastic, instrument-level, or linear-unconditioned construction.

The microstate-distribution flow of FRC 100.006 and FRC 100.003 is one candidate carrier, not a required level. It remains admissible only if preparations represented by the same operational state produce identical observable predictions and its bipartite extension satisfies no-signaling.

4. Reconciliation flag

The v3 branch reportedly contained a figure in which `p_n -> |alpha_n|^2` under the drift. This audit contradicts that behavior for the printed rho-level drift and the corrected anticommutator completion.

The likely explanations are:

1. the plotted implementation used a population-blind gradient;
2. the non-trace-preserving printed form masked the drift after normalization;
3. alpha was too small for the population drift to be resolved;
4. the plotted process was already distribution-level rather than single-rho-level.

This must be reconciled before any future version claims Born recovery from a rho-level drift.

5. Nonlinearity and preparation dependence

The obvious mixture-linearity test is a trap. If `rho = I/2` is prepared as `{|0>, |1>}` or `{|+>, |->}`, the two averaged futures agree to machine precision even under the nonlinear drift:

alpha	symmetric-test Delta
0.01	2.22e-16
0.02	2.22e-16
0.05	2.22e-16
0.10	2.22e-16

This does not prove linearity. It is a degenerate-test kill: the decompositions are symmetric about the Bloch center, so the nonlinear changes cancel.

The non-degenerate test uses the same density matrix with Bloch `z = 0.4`, prepared two ways:

1. eigendecomposition: `0.7 |0><0| + 0.3 |1><1|`;
2. equal mixture of two pure states at Bloch `(+-0.917, 0, 0.4)`.

Under `C_super`, the two futures diverge:

alpha	Delta = trace norm difference	z_B final
0.01	0.088043	0.311957
0.02	0.156886	0.243114
0.05	0.284999	0.115001
0.10	0.366997	0.033003

The small-alpha protocol coefficient is

$$\frac{\Delta}{\alpha} \approx 8.804$$

at `t = 25`, `gamma = 0.2` in model units. Across the whole alpha range the least-squares slope is lower, `2.981`, because the effect saturates. The small-alpha coefficient is the relevant number for bound protocols.

This calculation tests an ensemble-member extension of the nonlinear rule; it is not by itself a signaling proof. It exposes decomposition dependence for that extension and therefore identifies the operational-equivalence and remote-steering/no-signaling tests that any admissible completion must pass.

6. Alpha-bound protocols

The audit turns the nonlinearity concern into two concrete protocols:

1. Born-precision bound: population drift rates of order `0.09 alpha` to `0.22 alpha` per model-time unit at `gamma = 0.2` bound alpha from precision Born-frequency tests.
2. Preparation-independence bound: a test of decomposition independence at level `delta` bounds `alpha <= delta / 8.804` in this model normalization.

No physical alpha number is asserted here. Physical translation requires the coupling normalization and experimental time map. That belongs in FRC 100.004 v2 or a dedicated constraints paper.

7. Scale and boundary convention

The canonical reciprocity relation is $dS + k^* d \ln C = 0$. At a declared scale μ, this audit uses the operational instantiation

$$dS_\mu + k^*_\mu d \ln C_\mu = 0.$$

Its physical universality remains conjectural. For an explicit subsystem, $\lambda = -d_e S$ is admissible when it follows from the declared boundary and sign convention. The rho-drift audit neither proves nor rejects that accounting choice.

8. What survives

The Lambda-field remains a useful corpus layer if kept in the right lane:

1. Λ_{obs} provides an operational coherence geometry;
2. alpha -> 0 recovers ordinary quantum evolution;
3. an optional Λ_{dyn} layer can define a finite equilibration time if it beats observation-only and equal-feature latent baselines;
4. the tested rho-level nonlinear drift is constrained by population motion and decomposition dependence;

5. microstate-distribution dynamics remains one conditional candidate;
6. a fundamental field remains a separate conjecture.

This strengthens 100.007 by pricing its risk instead of hiding it.

9. Kill conditions

This audit fails if:

1. the corrected drift fails trace preservation or positivity in the reference pilot;
2. the Born population drift disappears for both `C_super` and `C_lock`;
3. the non-degenerate same-rho preparation test gives zero Delta beyond numerical tolerance;
4. the reported numerical results cannot be reproduced from the shipped code and fixed parameters.

The shipped pilot passes the audit checks and preserves the reconciliation flag.

10. Version note

Version 3.3 restores the canonical/operational reciprocity hierarchy without changing the drift audit. It retains v3.2's separation of Lambda ontologies and removal of the unsupported claim that outcome statistics must use a microstate-distribution level.

11. Source package

`FRC-100-007-v3.3.md`; `FRC-100-007-v3.3.pdf`; `fig1_lambda_drift_audit.png`; `pilot/pilot_lambda_audit.py`; `pilot/lambda_audit_metrics.json`; `pilot/compare_metrics.py`; `requirements.txt`; `README_RELEASE.md`; `render_frc_html_pdf.py`; `CHECKSUMS.txt`. All quoted values are generated from deterministic ODE integrations and verified with `compare_metrics.py`.

References

1. H. Servat, *FRC 100.007 - The Lambda-Field*.
2. H. Servat, *FRC 100.003 v3 - Collapse as Open-System Phase-Locking*.
3. H. Servat, *FRC 100.006 - Born Rule from Resonant Equilibrium*.
4. H. Servat, *FRC 566.030 - Reciprocity in Action*.
5. H. Servat, *FRC 100.004 - Experimental Constraints and Bounds*.
6. N. Gisin, "Stochastic quantum dynamics and relativity," *Helvetica Physica Acta* 62, 363 (1989).

7. N. Gisin, "Weinberg's non-linear quantum mechanics and supraluminal communications," *Physics Letters A* 143, 1-2 (1990).
8. S. Weinberg, "Testing quantum mechanics," *Annals of Physics* 194, 336-386 (1989).