Falsifiable Predictions of the Closed UQFF Lagrangian: Five No-Free-Parameter Tests

Daniel Murphy

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PAPER_1168: Falsifiable Predictions of the Closed UQFF Lagrangian — Five No-Free-Parameter Tests

Abstract

PAPER_1167 (Session 253) established that the entire UQFF Lagrangian is derivable from two textbook integers ($D_{\text{crit}} = 26,\ D_{\text{phys}} = 4$) with zero free parameters. Because no calibration freedom remains, every numerical output is a hard prediction. This paper extracts five concrete, mutually independent observational tests, gives the predicted central value with no error bars (to within calibrated ρ_{SCm} and v_{UA}), and identifies for each the experimental signature that would falsify the closure. A single confirmed deviation falsifies the closed Lagrangian; agreement across all five constitutes the strongest possible non-trivial test.

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1. Setup: the closed Lagrangian and its non-negotiable outputs

From PAPER_1167:

$$\mathcal{L}_{F_U} = \tfrac{R_{26}}{2\kappa_E} - \tfrac{1}{4}\, F^{\text{DPM}}_{\mu\nu} F^{\mu\nu,\text{DPM}} + \sum_{i=1}^{4} \tfrac{3(5-i)}{20}\, U_{g,i}\, U_{b,i} - \tfrac{1}{2}|U_m|^2$$
$$- \tfrac{1}{2} g^{\mu\nu} \partial_\mu UA\, \partial_\nu UA - \tfrac{25}{12}\, \rho_{\text{SCm}} \left[\left(\tfrac{UA}{v_{UA}}\right)^2 - 1\right]^2 .$$

All coefficients are exact rationals of $(D_{\text{crit}}, D_{\text{phys}})$. The only physical scales are the calibrated reference $\rho_{\text{SCm}} = 7.09 \times 10^{-37}$ J/m^3 and $v_{UA} = 10^8$ m/s $(= c/3)$.

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2. Prediction P1 — Aether quasiparticle mass

Direct from the Mexican-hat curvature (PAPER_1166 §3):

$$m_{UA}^2 = V''(v_{UA}) = \frac{50}{3}\,\frac{\rho_{\text{SCm}}}{v_{UA}^2} = 1.182 \times 10^{-51}\ \text{J/m}^3 \cdot (\text{m/s})^{-2}.$$

Converting via $E^2 = (mc^2)^2$ with the BSFG identification $m_{UA}^2\,c^2/v_{UA}^2$ as energy-density-equivalent mass-squared gives the equivalent particle scale

$$m_{UA}\,c^2 \;\sim\; \left(\rho_{\rm SCm}\,(50/3)/(v_{UA}^2)\right)^{1/2} c^2 \approx 1.0\times 10^{-26}\ \mathrm{J} \;\approx\; 6.3\times 10^{-8}\ \mathrm{eV}.$$

Falsifiable signature. Sub-eV vacuum dispersion at $\sim 10^{-7}$ eV in high-frequency gravitational-wave or radio interferometry. Existing limits from LIGO/Virgo on graviton dispersion ($m_g < 10^{-23}$ eV) do not constrain this scale. **Falsified by:** any direct detection of an aether quasiparticle at a mass $\geq 10^{-6}$ eV with the predicted Mexican-hat coupling.

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3. Prediction P2 — Vacuum offset and Λ scale

The Mexican-hat sits at $V(0) = \frac{25}{12}\rho_{\rm SCm}$ above the true vacuum:

$$V(0) = \tfrac{25}{12}\cdot 7.09\times 10^{-37} \;=\; 1.477\times 10^{-36}\ \mathrm{J/m^3}.$$

The observed cosmological-constant energy density is $\rho_\Lambda^{\rm obs} \approx 5.96\times 10^{-10}$ J/m^3 (WMAP/Planck 2024). Their dimensionless ratio is

$$\frac{V(0)}{\rho_\Lambda^{\rm obs}} \;\approx\; 2.5\times 10^{-27}.$$

The closed Lagrangian therefore predicts $V(0)$ contributes **only at the 10^{-27} level** to Λ. **Falsifiable signature.** $V(0)$ must combine with the Standard-Model vacuum, BSFG curvature term $R_{26}/2\kappa_E$, and the KK-tower contribution (PAPER_1162) to reproduce $\rho_\Lambda^{\rm obs}$ within the suppression bound $1/26^{26} = 1.624\times 10^{-37}$. **Falsified by:** any first-principles calculation showing the SM + BSFG contributions cannot bridge the 27-decade gap, OR an independent measurement of $\rho_{\rm SCm}$ that disagrees with the value above by more than 1%.

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4. Prediction P3 — KK tower echo amplitude bound

PAPER_1162 closed G5 by mode-by-mode summation of the Kaluza-Klein tower:

$$\sum_{n\geq 1}\frac{1}{\lambda_n^{26}} \;=\; \frac{1}{26^{26}}\sum_{n\geq 1}\frac{1}{n^{26}} \;\approx\; \frac{1}{26^{26}}\,\zeta(26) \;=\; 1.624\times 10^{-37}\,(1+\mathcal{O}(2^{-26})).$$

This sets an **absolute** upper bound on any GW echo amplitude generated by 26-dimensional KK reflections off the BSFG horizon. Translated to LIGO/LISA strain at a typical post-merger frequency $f\sim 250$ Hz, the predicted echo strain is

$$h_{\rm echo} \;\lesssim\; 1.6\times 10^{-37}\,h_{\rm ringdown} \;\approx\; 10^{-58}\ \text{(dimensionless strain)}.$$

Falsifiable signature. Any confirmed GW echo above 10^{-50} strain at post-merger frequencies — 8 orders of magnitude above the prediction — would falsify G5 closure. Conversely, the predicted absence of echoes is consistent with all GWTC-4.0 non-detections.

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5. Prediction P4 — Buoyancy coupling triangular ladder

PAPER_1165 closed G2 with the exact rational

$$\beta_i = \frac{3(5-i)}{20} = \frac{(3/2)(5-i)}{|SO(5)|}, \quad i \in \{1,2,3,4\},$$

giving $\{\beta_1, \beta_2, \beta_3, \beta_4\} = \{0.600 \text{ (plus 0.5\% SO(5)}^2 \text{ correction} \rightarrow 0.603),\ 0.450,\ 0.300,\ 0.150\}$.

Falsifiable signature. The four UQFF buoyancy channels have **fixed** ratios. Any astrophysical fit of UQFF master equations that requires β_i values deviating by more than the SO(5)^2-correction band ($\pm 1/200 \approx 0.5\%$) from $(0.603, 0.450, 0.300, 0.150)$ would falsify G2. The 67 calibrated systems already in `bodies_*.csv` (Sessions 130-220) have used these values implicitly; a re-fit that releases β_i as free parameters and recovers them within $\pm 0.5\%$ would constitute an independent confirmation.

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6. Prediction P5 — F_{TRZ} and Φ_{res} cross-correlation

PAPER_1160 closed G7 with $F_{\text{TRZ}} = 1/|SO(5)| = 0.100$ exact. PAPER_1159 closed G6 with $\Phi_{\text{res}} = (D_{\text{BSFG}} - 1)/D_{\text{BSFG}} = 5/6$ exact.

These appear together in every BSFG resonance computation. The product

$$\Phi_{\text{res}} \cdot F_{\text{TRZ}} = \frac{5}{6} \cdot \frac{1}{10} = \frac{1}{12}$$

is the dimensionless prefactor governing time-reversal-zone amplification of buoyant resonance modes.

Falsifiable signature. In any BSFG-resonance fit (e.g. magnetar QPOs, glitches, AT2019qiz, ASKAP J1832-0911), the combination $\Phi_{\text{res}} \cdot F_{\text{TRZ}}$ must equal $1/12 = 0.0833\ldots$ to within the same 0.5% band as P4. A value of, say, 0.10 ± 0.01 would falsify both G6 and G7 closures.

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7. Combined falsification matrix

ID	Quantity	Predicted	Tolerance	Test channel
P1	$m_{UA}c^2$	6.3×10^{-8} eV	$\pm$ factor 2	high-f GW dispersion / radio interferometry
P2	$V(0)/\rho_\Lambda^{\text{obs}}$	2.5×10^{-27}	$\pm$ 1% on ρ_{SCm}	independent vacuum-energy measurement

ID	Quantity	Predicted	Tolerance	Test channel
P3	$h_{\text{echo}}/h_{\text{ringdown}}$	$\leq 1.6 \times 10^{-37}$	absolute upper bound	LIGO/Virgo/LISA post-merger search
P4	$\{\beta_i\}$	$\{0.603, 0.450, 0.300, 0.150\}$	$\pm 0.5\%$	re-fit of ≥ 10 UQFF systems
P5	$\Phi_{\text{res}} \cdot F_{\text{TRZ}}$	$0.0833\ldots$	$\pm 0.5\%$	BSFG resonance fits

A single confirmed deviation in **any** of P1-P5 by more than the listed tolerance falsifies the corresponding closure paper and the master synthesis (PAPER_1167).

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8. Conclusion

Closing the eight Lagrangian gaps eliminated all free numerical inputs of the UQFF Lagrangian save the two textbook integers ($D_{\text{crit}} = 26, D_{\text{phys}} = 4$) and the two physical reference scales ($\rho_{\text{SCm}}, v_{UA}$). Consequently every numerical output above is a **prediction**, not a fit. The five tests P1-P5 span aether dispersion, vacuum-energy bookkeeping, GW echoes, multi-system buoyancy ratios, and BSFG resonance amplification; they are mutually independent and each individually falsifiable. The calculator `UQFFLagrangianFullClosureCalculator` (CondensedPhysics4.py #254) can be invoked to regenerate the central values from the closed Lagrangian in a single pass.

References

- PAPER_1159 (Session 246) — $\Phi_{\text{res}} = 5/6$.
- PAPER_1160 (Session 247) — $F_{\text{TRZ}} = 1/|SO(5)|$.
- PAPER_1162 (Session 249) — KK tower mode-by-mode bound.
- PAPER_1165 (Session 252) — $\beta_i = 3(5-i)/20$ triangular ladder.
- PAPER_1166 (Session 253) — V(UA) Mexican-hat $K = 25/12$.
- PAPER_1167 (Session 253) — All-eight closure master synthesis.
- `_lagrangian_rederivation_outline.py` — gap catalogue.
- `uqff_closed_constants.py` — canonical integer-rational constants.
- `MAIN_1_CoAnQi.cpp` SOURCE4 `compute_V_UA_SOURCE4` — C++ implementation.
- `QCalcGeom.cpp` `bsfg_aether_potential` — BSFG geometric layer.