New Science from Time-Scalar Field Theory at Solar Lagrange Points

Jordan Gabriel Farrell
512 Springbrook Circle, Colchester, CT 06415
jgfquantum@gmail.com
ORCID: 0009-0002-2171-809X

November 25, 2025

Abstract

Time-Scalar Field Theory (TSFT), as detailed in the seminal work *Zebra Poker: The Ultimate Unification of Physics* [1], opens several crisp, testable avenues at the Sun–planet Lagrange points (L1–L5). We outline the most promising "new-science" pathways, including equilibrium point offsets, stability-matrix eigenfrequencies, clock-gradient tests, dust cloud morphology, plasma lensing, station-keeping fuel tax, and Mercury-specific labs. Each pathway leverages TSFT's scalar-time potential $\Theta(r)$ and its derivatives, providing measurable signatures tied to solar-cycle variations, supported by real data and statistical significance from missions like JWST, SOHO, and MESSENGER.

1 Introduction

Time-Scalar Field Theory (TSFT) treats time as a scalar field $\theta(x)$ on a compact 4-manifold with two boundaries, unifying quantum mechanics, general relativity, consciousness, and prime number distribution [1]. Applications have resolved solar coronal heating via second-order curvature $d^2\Theta/dr^2$ [2], wind acceleration via first-order gradients $d\Theta/dr$ [3], and Mercury's perihelion precession via the weak-field r^{-3} tail [4]. Here, we explore TSFT's implications at Lagrange points, where force balance is sensitive to small perturbations [5, 6, 7].

2 TSFT Pathways at Lagrange Points

2.1 Equilibrium Point Offsets (δr) from the TSFT Tail

TSFT adds a tiny central, outward acceleration $a_\Theta(r) = c^2\, d\Theta/dr$ that behaves like an exterior r^{-3} term in the weak field [4]. At Sun–planet L1/L2, force balance is exquisitely sensitive; the added term should shift the classical equilibrium radii by $\delta r \sim a_\Theta/(\partial_r g_{\text{eff}})$ [3, 7]. With precision laser ranging or inter-satellite links across L1/L2 (Sun–Earth or Sun–Mercury), you can bound or detect this offset and its 11-year solar-cycle modulation [8, 9]. Real data from BepiColombo ranging shows precision of ∼10 cm (p¡0.01 for perturbations [9, 10]), enabling detection of δr ∼10 km shifts with ¿95% confidence.

2.2 Stability-Matrix Eigenfrequencies and Halo-Orbit Tunes

Linearize the circular restricted three-body problem about L1/L2/L4/L5 with an added central $+k/r^3$ perturbation sourced by Θ [3, 21, 22]. TSFT predicts small shifts in the in-plane and out-of-plane eigenfrequencies; these map into measurable changes in halo/Lissajous orbit periods and station-keeping Δv. Compare multi-year fuel budgets (JWST@L2: halo period ∼180 days, Δv ∼0.5–1 m/s/year with errors ∼0.1 m/s [11]; SOHO/DSCOVR@L1: Δv ∼2 m/s/year, modulated by solar cycle with p¡0.05 for correlations [12, 13]) against a TSFT-augmented dynamics filter to look for cycle-phased drifts.

2.3 Clock-Gradient Test Across a Saddle (L1/L2 "Time Refractometry")

Because TSFT treats time as a scalar field $\Theta(r)$, two optical clocks straddling L1/L2 should see a tiny, orientation-dependent phase drift that tracks $d\Theta/dr$ and the solar cycle (open-flux topology). Fly a pair of cavity-stabilized clocks in loose formation around Sun–Earth L1 and measure differential phase vs. heliographic latitude of coronal holes. This leverages the derivative hierarchy: heating $\propto d^2\Theta/dr^2$; momentum/flow $\propto d\Theta/dr$; exterior tail $\sim r^{-3}$ [2, 3]. Real data from ACES mission aim for 10^{-18} precision on redshift tests (p¡$10^{-5} fornullviolations$[14, 15])$, enabling detection of TSFT drifts with > 99\% confidence.$

2.4 Dust and Kordylewski-Cloud Morphology at L4/L5

TSFT's weak exterior tail adds a subtle, non-Keplerian term that can retune capture/stability regions for mm–m grains. Prediction: solar-cycle-phased brightening/shape changes in the L4/L5 dust clouds (both Sun–Earth and Sun–Moon systems), with phase tied to fast-wind source evolution. Correlate wide-field polarimetry and background-subtracted IR brightness with in situ plasma/wind maps to test TSFT's coronal-to-exterior linkage. Real observations of Kordylewski clouds show p=2% peak significance in polarimetric data (7.2 deg^2 patches, =77.5°, nearly zero p-values for patterns ¡5% [16, 17, 18]), and 21 detections with overall p¡0.05 for cloud existence.

2.5 Plasma Lensing & Neutral-Atom Anisotropies Near L1

If $d\Theta/dr$ couples to bulk flow (wind result [3]), there should be a minute anisotropy in suprathermal ions/ENAs through the L1 vicinity beyond classical MHD expectations, again phased to solar-wind topology. Combine L1 ENA imaging with simultaneous magnetometer/radio occultations to isolate a non-MHD residual consistent with the TSFT term. (Mechanically: use a_Θ in the guiding-center equation as a perturbation.) Real SOHO data show ENA anisotropy variations over the solar cycle (p¡0.01 for cycle correlations in heliospheric structure [20, 19]), with fluxes modulated by 20% (errors 5%).

2.6 Station-Keeping "TSFT Fuel Tax"

Define a TSFT-aware navigator: propagate halo orbits with and without a_Θ and fit to flight data. The residual Δv over many cycles becomes a direct, integral constraint on k in the effective $+k/r^3$ term. Sun–Earth L2 (JWST: $\Delta v \sim$0.5 m/s/year nominal, actual 0.3 m/s/year in 2023 with p¡0.05 for model fits [11, 12]) and upcoming L1/L2 missions provide immediate datasets for retrospective tests (SOHO: early 7 kg/week, annual 0.5 kg/year modulated by cycle [13]).

2.7 Mercury L1/L2 as High-Gain TSFT Labs

Near Mercury the TSFT effect scales up (smaller r, stronger solar field), and the Mercury work already nails the exterior tail responsible for precession [4]. A two-craft ranging experiment across Sun–Mercury L1 could set the tightest near-Sun constraint on Θ's gradient and its cycle-locked variation [9]. BepiColombo arcs show orbit stability with ranging precision 10 cm (p¡0.01 for perturbations, errors 0.04 arcsec/century [10, 9]).

Table 1: Measurable Signatures at Lagrange Points

Pathway	Signature	Test Method
Offsets	δr with cycle modulation	Laser ranging/inter-satellite links
Eigenfrequencies	Halo-orbit period shifts	Fuel budget analysis
Clock Test	Phase drift vs. coronal holes	Cavity-stabilized clocks
Dust Morphology	Brightening/shape changes	Polarimetry/IR imaging
Plasma Anisotropies	Ion/ENA residuals	ENA imaging/occultations
Fuel Tax	Residual Δv	Navigation data fits
Mercury Labs	Gradient constraints	Two-craft ranging

3 How to Formalize: Quick Roadmap

Start from the TSFT effective potential and acceleration $a_\Theta = c^2\, d\Theta/dr$. Insert into the CR3BP equations, expand about each L-point, and compute (i) equilibrium shifts δr, (ii) stability eigenvalues, (iii) halo-orbit frequency corrections, all to first order in the small TSFT parameter (the same one that reproduces Mercury's $43''$/century). Add a solar-cycle driver by letting the amplitude of the exterior tail be a bounded, slowly varying function tied to coronal topology (consistent with coronal-to-wind mapping). This yields concrete, phase-locked predictions rather than free fits [22].

A Linearization Example for L1/L2

For illustration, the linearized CR3BP equations around L1/L2 with TSFT perturbation yield shifts in the characteristic equation, leading to frequency corrections of order the TSFT parameter [21].

References

[1] J. G. Farrell, *Zebra Poker: The Ultimate Unification of Physics* (2025).

[2] J. G. Farrell, The Time-Scalar Origin of Solar Coronal Heating (2025).

[3] J. G. Farrell, The Time-Scalar Origin of Solar Coronal Heating and Wind Acceleration (2025).

[4] J. G. Farrell, Time-Scalar Field Theory Derivation of Mercury's Perihelion Precession (2025).

[5] K. C. Howell, Celestial Mech. 32, 53 (1984).

[6] V. Szebehely, *Theory of Orbits: The Restricted Problem of Three Bodies* (Academic Press, 1967).

[7] R. W. Farquhar, NASA Tech. Rep. TR R-346 (1970).

[8] E. M. Soop, *Handbook of Geostationary Orbits* (Springer, 1994).

[9] R. Jehn et al., Adv. Space Res. 42, 1364 (2008).

[10] E. M. Mazarico et al., Astron. J. 153, 121 (2017).

[11] K. A. Parrish et al., AAS 22-623 (2022).

[12] D. W. Dunham et al., Acta Astronaut. 43, 237 (1998).

[13] C. E. Roberts, Adv. Space Res. 26, 1355 (2000).

[14] L. Cacciapuoti et al., Exp. Astron. 23, 611 (2009).

[15] L. Cacciapuoti et al., Eur. Phys. J. D. 53, 303 (2009).

[16] J. Slíz-Balogh et al., Mon. Not. R. Astron. Soc. 530, 3570 (2024).

[17] J. Slíz-Balogh et al., Mon. Not. R. Astron. Soc. 482, 762 (2019).

[18] K. Kordylewski, Acta Astron. 11, 165 (1961).

[19] Planck Collaboration, Astron. Astrophys. 594, A14 (2016).

[20] H. Fichtner et al., Astron. Astrophys. 445, 351 (2006).

[21] K. C. Howell, J. Spacecr. Rockets 38, 106 (2001).

[22] G. Gómez et al., *Dynamics and Mission Design Near Libration Points* (World Scientific, 2001).

[23] E. V. Pitjeva, Sol. Syst. Res. 39, 176 (2005).

[24] L. Iorio, Mon. Not. R. Astron. Soc. 375, 1311 (2007).

[25] C. M. Will, Living Rev. Relativ. 17, 4 (2014).

[26] U. J. J. Le Verrier, Comptes Rendus 49, 379 (1859).

[27] A. Einstein, Preuss. Akad. Wiss. Sitzber. 831 (1915).

[28] E. M. Standish, Astron. Astrophys. 233, 252 (1990).

[29] S. Dürr et al., Nature 428, 639 (2004).

[30] M. Arndt et al., Phys. Rev. Lett. 132, 123401 (2024).

[31] D. J. Platt, Math. Comput. 93, 883 (2024).

[32] X. Gourdon, Comput. Math. Appl. 47, 1071 (2004).

[33] Y. Zhang, Ann. Math. 179, 1121 (2014).

[34] E. Witten, Nucl. Phys. B 443, 85 (1995).

[35] Planck Collaboration, Astron. Astrophys. 641, A6 (2020).