

Thesis: All observables are manifestations of a single phenomenon—microscopic tensional distortion of S.

Definition (Ontology):

There is one underlying phenomenon—**structural micro-distortion of S**—whose **localized, topological, and propagating configurations** realize all observed entities and interactions. Mass, spin, charge, gauge-like behavior, and gravitational response are **manifestations of tensional geometry and its evolution**, not independent postulates.

Modeling stance:

We use a **single scalar structural field** as the minimal, continuous–discrete *bookkeeping device* for this phenomenon (for simulation, calibration, and proofs). The scalar model is thus a **map of the phenomenon**, not the phenomenon itself.

Corollaries (to prevent misreadings):

- There are **not multiple fundamental forces** added by hand; there is **one medium and one dynamics** whose compatible modes manifest as different forces.
- “Particles” are **persistent, quantized distortion patterns** (e.g., helicoidal/solitonic states), not extra substances.
- “Fields” in the usual sense are **effective descriptions** of interaction patterns generated by the same micro-distortion.
- Calibration choices (e.g., **α -in**) fix units; they do not introduce additional ontic elements.

What SFT is *not* claiming:

- Not that “a scalar field is the only thing that exists.” The scalar is a **descriptor**; the **distortion is the ontic entity**.
- Not that discretization creates the physics. The lattice is a **numerical scaffold**; the physics is the **phenomenon**, which admits a continuum limit.
- Not that we assume the Standard Model by fiat. **Standard features** (charges, spectra, couplings) **must emerge** as constraints of tensional compatibility and topology.

The corpus adopts a single-pass calibration (α -in) and propagates the same parameter set through all staged validations. Each runner produces: (I) compact JSON with thresholds and verdicts; (II) SHA-256 manifests (including self-hash); (III) seed provenance. This design minimizes degrees of freedom and maximizes external auditability.

Abstract

*We present Structural Field Theory (SFT), a unified discrete–continuous framework in which quantum and relativistic phenomena emerge from the dynamics of a single **underlying phenomenon**—the microscopic tensional distortion of a structural medium—**modeled** via a scalar structural field.* In this formulation, space is modeled as an elastic lattice supporting solitonic excitations, collapse processes, and long-range stress gradients that mimic fundamental particles and interactions. The framework is calibrated using the fine-structure constant (α , treated as input), while all other quantities arise from internal consistency and numerical evolution.

We report quantitative validations across multiple physical domains. At the microscopic scale, simulations reproduce electron-like soliton signatures, g-factor (2.003 ± 0.004) (P), Coulomb’s law, and the spin- $\frac{1}{2}$ signature via both Finkelstein–Rubinstein 2π phase inversion and rigid-rotor $j(j+1)$ spectra ($R^2 \geq 0.99$). Radial solvers recover hydrogen and tritium energy levels with meV-level isotope shifts. At macroscopic scales, the theory reproduces classical relativistic tests: Mercury’s perihelion ($\approx 43''/\text{century}$) and Venus’ perihelion advance $\Delta\varpi$ ($8.625 \pm 0.020''/\text{century}$), both in agreement with General Relativity, as well as PPN parameters. Synthetic and real pipelines are provided for reproducibility, including CPU-only smoke tests, GPU-based solvers, and Docker environments with complete provenance, manifests, and SHA-256 checksums.

We also outline SFT’s present limitations (incomplete embedding of the full Standard Model content; possible discretization artifacts; and reliance on an α -in calibration discipline) and we state falsifiable predictions: (I) high-k modified dispersion (stringent tests of Lorentz invariance), (II) sub-mm Yukawa-like deviations in gravity, (III) cosmic birefringence, and (IV) the onset of nonlinear Breit–Wheeler pair production mapped in strong-field parameters (a_0, χ_γ) rather than a single intensity threshold. Together, these results establish SFT as a reproducible, falsifiable program that bridges lattice field simulations with quantum and relativistic observables.

We report $\beta = 1.000 \pm 1.0 \times 10^{-4}$ and $\gamma = 1.000 \pm 1.0 \times 10^{-4}$ (95% CI), consistent with GR; see procedure in Doc 4.

Language guardrail: mark figures/tables as (C) calibrated or (P) prediction; α is treated as input (α -in); **Naming guardrail:** use `alpha_like` for CI/synthetic estimator metrics (Doc 15) and `alpha_out` for the non-circular composition pipeline (Doc 10); β, γ are reserved for PPN; the structural potential uses $\{\alpha_V, \lambda_4, \lambda_6\}$.

> “The reader should keep in mind that all physical phenomena addressed in this corpus—from the electron’s g-factor to Mercury’s perihelion precession, including quantum interference and structural collapse—are not postulated as separate entities. They are local expressions of a single phenomenon: the tensional distortion of the structural medium, **tracked by the scalar descriptor** $S(\mathbf{r}, t)$. This distortion, through its geometry and dynamics, gives rise to what we conventionally call mass, spin, charge, gravity, or time. **We**

do not postulate multiple fundamental forces; there is one medium and one dynamics whose compatible modes **manifest as** different forces.”

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Observed Phenomenon Structural Manifestation of \(\mathcal{S}\)	
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Mass	Local tensional density
Spin	Helicoidal geometry of \mathcal{S}
Electric charge	Structural asymmetry in collapse
Gravity	Sum of tensions across the mesh
Time	Structural frequency
Quantum interference	Tensional superposition

> “The stability of a configuration is not intrinsic to the object, but emerges from its tensional compatibility with the medium.”

—Document 0: Orientation and Structure of the SFT Corpus

Cross-links: DSM → 2_SFT_Discrete Structural Model (DSM); PPN Summary → 4_Quick_Summary_with_figures_with_PPN_integration.docx; Simulation Supplement → 3_SFT_Simulation_Supplement.

This introductory note provides readers and reviewers with a roadmap of the complete Structural Field Theory (SFT) package. The corpus is intentionally modular: each component addresses a different layer of the framework, from theoretical foundations to numerical validation and reproducibility infrastructure.

- Core Foundations (Docs 1–2): Glossary and discrete structural model, defining notation, calibration policy (α -in), and the basic lattice dynamics.
- Simulation Supplement (Doc 3): Numerical schemes (leap-frog, AMR, CFL stability), collapse protocols, and first-principle simulations of electron-like solitons, double-slit behavior, and Coulomb interaction.
- Quick Summary / Draft Paper (Doc 4): Condensed manuscript presenting headline results (g-factor, perihelion shift, PPN compatibility).
- Integrated Technical Report (Doc 5): Comprehensive reference unifying notation, derivations, validation checklists, and reproducible protocols.

- Validation Appendices (Docs 6–7): Synthetic convergence tests (EOC), radial hydrogen/tritium solvers, and Venus perihelion overlays.
- Limitations and Validation Plan (Doc 8): Transparent recognition of scope and a roadmap for falsifiable predictions.
- Reviewer Argument (Doc 9): A concise statement addressing common objections (α tuning, discretization, scope).
- Bundles and Pipelines (ZIPs): Unified release with Docker, configs, scripts, datasets, and fallback smoke tests for CPU-only environments.
- Spin Packages: Independent validation of spin- $\frac{1}{2}$ signatures via FR phase and rigid-rotor spectra.
- Reviewer Quick Start: A 5-minute guide enabling reviewers to reproduce core results with minimal setup.

Readers should therefore expect: (I) a coherent theoretical proposal; (II) quantitative results spanning atomic to orbital scales; (III) a reproducible software and data ecosystem; and (IV) an explicit plan for validation and falsification. This orientation document (“Doc 0”) should be read first, before proceeding to the technical reports.

Addendum — Consistency Notes

- We use $\phi \equiv U/c^2$ (dimensionless) and $S \equiv -U$ as consistent notation across the corpus.
- Convention: $\Delta\varpi_{\text{Venus}} = 8.625 \pm 0.020''/\text{century}$ (golden path); all reported figures are harmonized to this value.
- Tagging (C)/(P): example — $\Delta\varpi$ of Venus (C); CMB birefringence (P).

Quick Verify — Where is each claim checked?

- Electron g-factor \rightarrow Docs 5 and 7 (artifacts and SHA-256).
- PPN (β, γ) and Venus perihelion \rightarrow Docs 4 and 7 (PPN_RESULTS.json).
- $H/{}^3H$ (radial a.u.) \rightarrow Doc 7 (Table E, virial, normalization).
- Reproducibility (EOC/CI, energy/continuity) \rightarrow Docs 6 and 5 (ENERGY_REPORT.json).
- Double slit (phase and visibility) \rightarrow Doc 7 (manifest + traces).

Ontological scale — one grid for micro & macro

- Δx is a numerical regulator, not a physical grain. SI units come from a single-pass calibration of $\{q^*, \hbar^*, \epsilon^*, \mu^*\}$ (α -in), and the same Lagrangian governs both regimes.

- We report scale-invariant, locally extracted coefficients (e.g., PPN $\gamma=c1/a1$, $\beta=1+a2/a1^2$) and dimensionless ratios (e.g., g-factor). These do not depend on the absolute cell size as long as $ak \ll 1$ (continuum regime).
- Multiscale arises from intrinsic field lengths (core size, Yukawa tail, etc.), not from Δx . AMR increases dynamic range but does not retune physics.
- We decouple numerics from physics via dispersion fits ($\omega/(ck)=1+\xi(ak)^2+\dots$), EOC/GCI across 3 grids (target $p\approx 2$), and energy/continuity budgets (with a collapse ledger when freezing is active). Observables are quoted only once grid-independence is reached.

Thermal decoherence — what we test

- Phase dynamics under a thermal bath is modeled by a Langevin process with FDT: $\text{Var}[\varphi](t)=2D\theta t$, $D\theta\propto\gamma k_B T/\hbar^*$. Visibility decays as $V=\exp[-D\theta(T) t]$.
- At fixed grid, $\ln V$ is linear in T and in path length/time-of-flight; at fixed T , V is grid-independent in the converged regime. This cleanly separates physics (T) from numerics (Δx).
- Artifacts: DECOHERENCE.json (T , γ , \hbar^* , V , CI, seed, SHA-256), plus the usual ENERGY_REPORT.json to certify conservation/continuity. Suggested gates: $\text{slope}_T > 0$ for $\ln V$ vs T ; mesh-independence at fixed T .

RC Table — additions (for reviewers)

- Mesh scaling & dispersion → Docs 5–6 (dispersion fits with $\xi\approx -1/12$; EOC/GCI $p\approx 2$; ENERGY_REPORT.json).
- Thermal decoherence → Doc 7 (Appendix—Decoherence) with DECOHERENCE.json and figures $\ln V$ vs T and length.

Master Index — Extended (Docs 10–15)

10 — Appendix A-OUT (v0.3): Alpha-Out (non-circular)

1. Purpose: Estimate α without using α in calibration. CPU-friendly pipeline: c (dispersion, small- k) → \hbar^* (rotor) → $\{q^*, \epsilon^*\}$ (Coulomb) → $\hat{\alpha}$ with uncertainty.
2. Inputs → Outputs: dispersion.csv, rotor_energy.json, coulomb_profile.csv → ALPHA_OUT.json (value, u95, tier) + HBAR_FROM_ROTOR.json, Q_EPS_SOLUTION.json.
3. Tiers/Gates: Tier-1 (1%), Tier-2 (100 ppm), Tier-3 ($1e-5$ – $1e-6$). Saves small- k indices, robust fit method, and full provenance (commit, versions, hashes).
4. Status: Reviewer-ready (appendix-only; not part of the core RC).
5. ZIP runner: alpha_out_runner_pack.zip (README, MANIFEST, verify.py, checksums).

11 — One-Pager: Designed Matter via Tensional Compatibility (SFT)

6. Purpose: One-page landing for reviewers/collaborators/sponsors: thesis, what you get, how to verify (ZIP + JSON + PASS/FAIL).
7. Contents: Tagline; “Who is this for / What you get”; runners with uniform primary gates; output routes (REGION provided vs. synthesized from SCAN + thresholds); mini-JSON examples with schema_version; roadmap with clear “done” criteria.
8. Relations: Links to runner packs, the master validation table, and Appendix A-OUT for anti-circularity.
9. Status: Ready to share.

12 — Dialogue (English)

10. Purpose: Plain-language narrative of the SFT stance (compatibility of the medium), aligned with the RC: preserves SM predictions, reframes mechanism.
11. Reviewer hooks: Adds falsifiability pointers (dispersion $O((ak)^2)$, sub-mm Yukawa, null optics, existence scans) and directs to runner packs for PASS/FAIL evidence.
12. Use: Executive/explanatory; no numeric claims beyond what the RC and runners certify.

13 — atomX: Step-by-Step Recipe (PASS-ready, amended v1)

13. Purpose: Worked example of an existence runner with reproducible thresholds and non-circular verdicts (natural vs maintained).
14. Gates: split_thr=0.19 meV, compat_thr=0.02, r2_thr=0.98; natural requires PASS without controls; maintained requires ablation FAIL when removing controls.
15. Artifacts: EXISTENCE_REPORT_atomX.json, EXISTENCE_REGION_atomX.json, synthetic_atom_scan.csv, checksums_SHA256.txt (schema-validated JSON; NaN/Inf→null).
16. ZIP runner: includes verify_atomX.py (schema check, region rebuild from CSV, PASS mask match, checksum verification).

14 — Capstone (Unified v6c)

17. Purpose: Consolidated code/standards manual for reviewers: JSON policy (schema_version, sanitize), MANIFEST policy (checksums with self-hash), helpers (json_sanitize, thresholds.propagate_thresholds, verdicts.compute_verdict, lifetime.tau_with_ci, units.provenance_scale_setting), and runners v1.0.3 (leptons, quarkonia, CKM, strong nulls, jitter, LOO).
18. External validation: CSV schemas, copy/paste commands, and reminders of α -in discipline (see atomX recipe).
19. Note: make_region_from_scan must rebuild PASS mask from the scan CSV using declared thresholds (placeholder noted in comments), (see atomX for reference).

15 — Appendix: Alpha-Elasticity CI Suite (Synthetic Verification Protocol)

- 20. **Purpose:** Verification-first CI protocol for an **alpha-like estimator** under synthetic inputs. Validates auditability (hashes/manifests), preregistered gates (gate_id + DECISION_RULE.json), anti-leakage discipline, and explicit null/adversarial failure modes. Includes a compact “toy visualization” companion to demonstrate the PASS/FAIL workflow and artifact contract.
- 21. **Outputs:** ALPHA_ELASTICITY_REPORT.json (GLOBAL_PASS + provenance), DECISION_RULE.json (hashed), MANIFEST_SHA256 / checksums, optional plots (e.g., sensitivity_sweep).
- 22. **Status:** CI / Synthetic (appendix-only). **Not** a physical validation of α ; complements Doc 10 (Alpha-Out) by enforcing preregistered-gate discipline and audit semantics for alpha-like pipelines.

Cross-References — How to Read (Additions)

- 23. (→ Doc 10) Questions about predicting α without circularity: see Appendix A-OUT (Doc 10). Results live in ALPHA_OUT.json with uncertainty tiers; appendix-only (not part of the core RC).
- 24. (→ Docs 11–14) For a one-page overview and the review/implementation toolkit, see One-Pager (Doc 11); for pedagogical narrative see Dialogue (Doc 12); for a worked runner see atomX (Doc 13); for standards and code policy see Capstone (Doc 14).
- 25. (→ Doc 15) For the CI/synthetic verification protocol of an **alpha-like estimator** (preregistered gates, decision rule hashing, null/adversarial controls, and artifact contract): see **Doc 15**. This is a methodology/audit appendix and should not be interpreted as physical validation of α .

Quick Verify — Additional Pointers

- 26. Alpha-Out (non-circular) → Doc 10 (ALPHA_OUT.json, provenance + tiers).
- 27. Existence runner (atomX) → Doc 13 (EXISTENCE_REPORT/REGION; region rebuilt from CSV in verify_atomX.py).
- 28. Standards & MANIFEST policy → Doc 14 (JSON sanitize, schema_version, checksums with self-hash).
- 29. **Alpha-Elasticity CI suite (synthetic)** → **Doc 15** (ALPHA_ELASTICITY_REPORT.json + DECISION_RULE.json + decision_rule_sha256 + manifest/checksums; includes null/adversarial PASS/FAIL gates).

Consistency Notes (Additions)

30. Manifest name & format: use checksums_SHA256.txt with lines
'HASH^s, RELATIVE_PATH', plus a final self-hash line for the manifest itself.
31. Schema discipline: every new JSON includes schema_version and passes schema validation (CI blocks otherwise).

Value of the Document

This text is not a final answer, but it is an honest, structured, and falsifiable one. It acknowledges conceptual tensions, documents them, and proposes an empirical path to resolve them: GPU simulations capable of distinguishing between genuine unification and numerical artifact.

Structural Field Theory. Complete theory, documents and runners at: <https://github.com/Xaquer69/sft-theory-and-runners>
<https://doi.org/10.5281/zenodo.17608314>