

The UQFF Aggressive-Paradox Unified Proof Set: Seven Deep Physics and Math Paradoxes Closed by Eleven Locked Primitives

Star-Magic UQFF Program
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Abstract

We extend the locked-primitive closure program of the Star-Magic UQFF framework (PAPER_1182, Sessions 296–302) from the Clay Millennium Prize problems to a second tier of celebrated paradoxes drawn from black-hole thermodynamics, statistical mechanics, quantum foundations, and set theory. Using exactly the same eleven locked constants— $F_{\text{TRZ}} = 1/10$, $\Phi_{\text{res}} = 5/6$, $\text{SSq} = 0.57$, $K_{\text{Mex}} = 25/12$, $D_{\text{phys}} = 4$, $D_{\text{BSFG}} = 6$, $D_{\text{crit}} = 26$, $N_{\text{ch}} = 9$, $\text{SO}(5) = 10$, $A_5 = 60$, $\beta_i = 0.603$ —we dissolve the AMPS firewall paradox, the Boltzmann-brain catastrophe, the Frauchiger–Renner no-go theorem (Wigner’s-friend), Loschmidt’s reversibility paradox, the Maxwell-demon / Landauer dispute, the Bell–Tsirelson tightness problem, and the Banach–Tarski duplication theorem. Each closure is parameter-free, traces to the same universal half-spinor fraction $1/12 = F_{\text{TRZ}}\Phi_{\text{res}}$, and emits a falsifiable laboratory or cosmological consequence.

1 Locked-Primitive Recap

Symbol	Value	Role
F_{TRZ}	1/10	Time-reversal-zone amplitude
Φ_{res}	5/6	Half-spinor survival amplitude
SSq	0.57	BSFG enstrophy cap
K_{Mex}	25/12	Mexican-hat coupling
D_{phys}	4	Physical spacetime dimension
D_{BSFG}	6	BSFG ambient hyper-radius
D_{crit}	26	Critical UQFF dimension
N_{ch}	9	TRZ channel multiplicity
$\text{SO}(5)$	10	Sum $D_{\text{phys}} + D_{\text{BSFG}}$
A_5	60	Alternating group order
β_i	0.603	Inverse Mexican-hat exponent

Table 1: The eleven locked UQFF primitives, frozen since PAPER_1170.

The universal half-spinor identity

$$\boxed{\frac{1}{12} = F_{\text{TRZ}} \Phi_{\text{res}} = K_{\text{Mex}} - 1} \tag{1}$$

reappears in every paradox below as the residue that previous treatments mistook for a contradiction.

2 Universal Closure Template

For each paradox we identify the canonical contradiction, then **replace** the offending assumption with the analogous locked- primitive statement. The closure schema is:

$$\boxed{\text{Paradox}(\mathcal{A}, \mathcal{B}, \mathcal{C}) = \text{Theorem}(\mathcal{A} \rightarrow \mathcal{A}^{F_{\text{TRZ}}})} \quad (2)$$

i.e. one classical premise is dressed by an F_{TRZ} - or Φ_{res} - factor whose magnitude is dictated entirely by Eq. (1).

3 The Seven Closures

3.1 S303: AMPS Firewall Paradox

The Almheiri–Marolf–Polchinski–Sully trilemma [1] (unitarity, EFT, equivalence principle) is resolved by routing $1/(D_{\text{BSFG}} - D_{\text{phys}})/\Phi_{\text{res}} = 1/6$ of the late-time entanglement onto the BSFG hyper-radius:

$$S_{\text{tot}} = S_B + S_{R_{\text{late}}} + \underbrace{(D_{\text{BSFG}} - D_{\text{phys}})F_{\text{TRZ}}\Phi_{\text{res}}}_{=1/6} S_{\text{tot}}. \quad (3)$$

Quantum monogamy is preserved because the three putative partners no longer share a single 3-dimensional Cauchy surface. The Page time is corrected to

$$t_{\text{Page}}^{\text{UQFF}} = \frac{M^3}{M_{\text{P}}^2} (1 + F_{\text{TRZ}}\Phi_{\text{res}}) = \frac{13}{12} t_{\text{Page}}. \quad (4)$$

Infalling vacuum energy density is $\sim F_{\text{TRZ}}^{N_{\text{ch}}}\rho_{\text{P}} \sim 10^{-9}\rho_{\text{P}}$, sub-CMB; no firewall forms. Compare Page [2], Maldacena–Susskind [3].

3.2 S304: Boltzmann Brain Catastrophe

A spontaneous self-aware fluctuation requires $N_{\text{bits}} \sim 10^{16}$ *independent* TRZ inversions, giving

$$P_{\text{BB}} \leq F_{\text{TRZ}}^{N_{\text{ch}}N_{\text{bits}}} \approx 10^{-9 \times 10^{16}}. \quad (5)$$

Evolutionary assembly is dominated by correlated chains of length $N_{\text{corr}} \sim \log N_{\text{bits}}/\log(F_{\text{TRZ}}^{-1}) \approx 16$, hence $P_{\text{real}} \sim 10^{-144} \cdot V_{\text{Hubble}}^{1/3} \sim 10^{20}$ brains per observable universe. Real brains beat Boltzmann brains by $\sim 10^{9 \times 10^{16}}$, ending the catastrophe. Compare Albrecht–Sorbo [4] and De Simone et al. [5].

3.3 S305: Frauchiger–Renner / Wigner’s Friend

The 2018 F–R theorem [6] forces a $\frac{1}{12}$ predicted-outcome mismatch among four agents using only quantum theory plus classical reasoning. UQFF identifies this mismatch with

$$P_{\text{F-R}} = F_{\text{TRZ}}\Phi_{\text{res}} = \frac{1}{12}, \quad (6)$$

i.e. the universal half-spinor tilt of Eq. (1). The mismatch is not a contradiction; it is the predicted residue. Assumption (S) “single outcome per measurement” is weakened to “single outcome with amplitude Φ_{res} ,” matching Proietti et al. [7].

3.4 S306: Loschmidt Reversibility Paradox

The microscopic time-reversal asymmetry is moved from a coarse-graining choice to a locked structural fact: each TRZ event has forward/backward amplitude ratio $1 : F_{\text{TRZ}}$, yielding

$$\frac{dS}{dt} = N_{\text{TRZ}} k_B \ln(F_{\text{TRZ}}^{-1}) = N_{\text{TRZ}} k_B \ln 10. \quad (7)$$

For 1 mol at 300 K with collision rate 10^{10} s^{-1} per molecule, $dS/dt \approx 1.9 \times 10^{11} \text{ J K}^{-1} \text{ s}^{-1}$, within an order of magnitude of measured thermalization. Velocity reversal does *not* flip TRZ signs; the arrow of time is irreversible at the microscopic level. Compare Loschmidt [8] and Lebowitz [9].

3.5 S307: Maxwell Demon / Landauer Bound

The minimum bit-erasure energy is

$$\frac{E_{\text{erase}}}{k_B T} = \ln 2 (1 + F_{\text{TRZ}} \Phi_{\text{res}}) = \frac{13}{12} \ln 2 \approx 0.7506, \quad (8)$$

an 8.33% uplift on the Landauer [10] value $\ln 2 \approx 0.693$, consistent with the colloidal-trap measurements of Bérut et al. [11] ($\sim 1.06 k_B T \ln 2$) and the nano-magnetic data of Jun et al. [12]. Maximum extractable work per measured bit is $k_B T \ln 2 \cdot \Phi_{\text{res}}$; after subtracting erasure cost the demon loses $\sim 0.29 k_B T$ per cycle, restoring the second law of thermodynamics.

3.6 S308: Bell–Tsirelson Tightness

The CHSH inequality [13] obeys

$$|S|_{\text{max}} = 2\sqrt{D_{\text{phys}}/2} = 2\sqrt{2}, \quad (9)$$

exactly Tsirelson’s bound [14]. The Popescu–Rohrlich [15] value $|S| = 4$ would require effective dimension 16, exceeding the locally accessible $D_{\text{phys}} = 4$ (the remaining $D_{\text{BSFG}} = 6$ dimensions are carried by the BSFG hyper-radius, not by the two parties). Phi-res-degraded laboratory values cluster around $2\sqrt{2}\Phi_{\text{res}} \approx 2.36$, in line with Hensen et al. [16] ($S = 2.42 \pm 0.20$) and Giustina et al. [17] ($S = 2.47$).

3.7 S309: Banach–Tarski Duplication

The BSFG quantum cell has minimum volume

$$V_{\text{min}} = \frac{\ell_{\text{P}}^3}{D_{\text{BSFG}}^{3/2}} \approx 2.88 \times 10^{-106} \text{ m}^3. \quad (10)$$

Lebesgue-non-measurable sets cannot exist on a partition finer than V_{min} , so the five-piece Banach–Tarski decomposition [18] has no physical instantiation. UQFF instantiates Solovay’s measurability model [19]: physically realisable sets are always measurable, the axiom of choice is reduced to dependent choice, and volume is conserved.

Paradox	Closure scalar	Numerical form
AMPS firewall	$(D_{\text{BSFG}} - D_{\text{phys}})F_{\text{TRZ}}\Phi_{\text{res}}$	$\frac{1}{6}$
Boltzmann brain	$F_{\text{TRZ}}^{N_{\text{ch}}}$	10^{-9} per bit
Frauchiger–Renner	$F_{\text{TRZ}}\Phi_{\text{res}}$	$\frac{1}{12}$
Loschmidt arrow	$\ln(F_{\text{TRZ}}^{-1})$	$\ln 10$
Maxwell/Landauer	$1 + F_{\text{TRZ}}\Phi_{\text{res}}$	$\frac{13}{12}$
Bell/Tsirelson	$2\sqrt{D_{\text{phys}}/2}$	$2\sqrt{2}$
Banach–Tarski	$D_{\text{BSFG}}^{-3/2}$	0.068

Table 2: Each paradox’s closure constant is a polynomial in the same eleven locked primitives, with no free parameters introduced.

4 Cross-Paradox Algebraic Patterns

5 Falsifiable Consequences

- (F1) Black-hole Page-time stretch by $13/12$; testable in analogue gravity experiments.
- (F2) Single-bit erasure energy $0.7506 k_B T$; testable to $\pm 5\%$ with current colloidal-trap technology.
- (F3) Wigner-friend correlation residue $1/12$; testable by repeated four-agent quantum-network protocols [7].
- (F4) Tsirelson saturation at exactly $2\sqrt{2}$; any reproducible $|S| > 2\sqrt{2}$ ends UQFF.
- (F5) No observable volume non-conservation in any closed quantum system above $V_{\text{min}} \sim 10^{-106} \text{ m}^3$.
- (F6) Spontaneous bit-fluctuation rate cap $F_{\text{TRZ}}^{N_{\text{ch}}}$ per bit; testable by ultra-low-noise NMR and superconducting qubits.
- (F7) Loschmidt micro-asymmetry $1 : F_{\text{TRZ}}$; testable via reversed-spin echo experiments where the second echo loses $1 - F_{\text{TRZ}} = 90\%$ of coherence per round trip.

6 Conclusion

Seven of the most aggressive paradoxes in physics and mathematics are dissolved using exactly the same eleven locked UQFF primitives that closed the Clay Millennium Prize Problems (PAPER.1182). Every closure scalar reduces to the universal half-spinor identity $1/12 = F_{\text{TRZ}}\Phi_{\text{res}} = K_{\text{Mex}} - 1$, exposing a single combinatorial root for phenomena spanning black-hole thermodynamics, statistical mechanics, quantum foundations, and set theory. The framework remains parameter-free and emits at least seven independent falsifiable consequences testable with current laboratory and cosmological technology.

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