The Architecture of Persistence

Cyclic Forcing, Prime Entropy, and the Plasma Continuum

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Abstract

Conventional physics treats entropy as the master vector of thermodynamic

decay and plasma as a chaotic, localized state of ionized gas. This paper proposes a structural inversion. Drawing on recent experimental observations of *fractional Fermi seas* in cyclically driven ultracold gases and on the theoretical distribution of the prime numbers, we advance the hypothesis that reality is a continuous, macroscopic phase-plasma forced into coherence through cyclical structural quenches. Within this framework, the prime numbers function as a mathematical analogue to physical thermodynamic quenches: they supply the bounded, non-linear entropy that prevents sequence from collapsing into either uniformity or broadband noise. We formalize this duality as **Comprecisance** — the boundary at which compression and precision are held in tension — and propose a benchtop, pass/fail experiment that applies cyclical electromagnetic

forcing to a constrained plasma to test for the emergence of hidden macroscopic order.

Keywords: plasma continuum; cyclic forcing; non-equilibrium physics; prime distribution; fractional Fermi sea; entropy; coherence; Comprecisance

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I. Introduction: The Universal Refusal to Fall Apart

One question repeats across physics, biology, and arithmetic. It is always the same question: **What keeps sequence from becoming noise?**

The traditional assumption is that order is a temporary, highly localized accident in an otherwise entropic universe. But a different reading is now available. Order

surviving noise may not be an accident of any one domain — it may be the fundamental filtering mechanism of reality itself. A genome replicates against error. The Riemann zeta zeros hold the distribution of primes in a stable pattern. In each case the same architecture appears: coherence holding sequence together against entropy.

This framework replaces the concept of a *randomly generated* universe with a *filtered* one. Order is not sprinkled in by chance. It is honed into existence through specific constraints.

II. The Substrate: Plasma as the Universal Continuum

To ask how sequence persists, we first redefine the medium in which it persists. Plasma is usually treated as a fourth state of matter — an ionized gas. We

argue instead that plasma represents a continuous spectrum of states, each governed by distinct organizing constraints, running from the initial cosmological helium condensate to the structured "biofields" of living systems.

We do not merely exist within this medium. Biological organisms are composed of it. In this reading, matter is plasma that has been locked into a localized, stable sequence by the fine-structure constant ($\alpha \approx 1/137.036$), which acts as a selection ratio — filtering wave states into stable mass. When matter learns to *hold* that pattern across time, it becomes memory. DNA is the biological score of that resonant structure.

III. The Mechanism: Cyclic Forcing and the Fractional Fermi Sea

If matter is filtered plasma, what does the filtering?

A proof of concept has recently emerged from out-of-equilibrium experimental physics. Working with a one-dimensional gas of ultracold cesium, the Nägerl group at the University of Innsbruck — with theory developed by Alvise Bastianello (CNRS / Université Paris-Dauphine) — drove the system through hard, cyclic interaction quenches, ramping it back and forth between strong attraction and strong repulsion [1, 2]. Standard thermodynamics predicts one outcome: the system should heat and shred into thermal noise.

That is not what happened. Instead, the atoms organized into a highly excited but measurably *ordered* state — a **fractional Fermi sea**, a non-equilibrium phase whose correlations (including

characteristic Friedel oscillations) lie beyond conventional Tomonaga–Luttinger liquid theory [1, 2]. The state is excited, yet it is not random; its order becomes visible in its correlations.

The lesson is structural, not incidental. Cyclic forcing acts as a filter. It rejects chaos and actively hones order into existence.

IV. Primes as the "Quench" of Reality

We now link the arithmetic irregularity of the primes directly to the physical survival of matter.

Prime numbers appear out of sync — structurally irregular, resistant to closed-form prediction. Rather than treating this irregularity as a defect, we propose that it is the foundational engine of a *universal*

cyclic forcing. Just as the Innsbruck system required cycling between attraction and repulsion to force order into being, the mathematical universe requires the unpredictable gaps between primes to generate the bounded entropy that contains reality.

Consider the alternative. If the primes were perfectly distributed and predictable, the mathematical foundation of the universe would behave like a perfect crystal — rigid, static, and incapable of generating complex sequences such as DNA or consciousness. The "weirdness" of the primes acts as a constant, non-linear thermodynamic quench.

This is the principle of **Comprecisance** — a juxtaposed duality of *compression* and *precision*. The primes supply the chaotic entropy (compression). A hidden

harmonic structure — mapped by the zeta zeros and anchored by ratios of the form **t_N = 700 / N** (resolving, at N = 17, to a candidate invariant near **41.176 Hz**) — supplies the constraint (precision). These bounded parameters act as strict universal "metro stops." Anything that steps outside the duality dissolves into noise. Anything held within it is honed into physical reality.

V. The Falsifiable Threshold: Constrained Plasma Forcing

This framework is meant to leave the realm of speculation. It offers a clear, benchtop test with a definitive pass/fail metric.

Hypothesis. If cyclical forcing can drive hidden order in a quantum gas, then cyclical electromagnetic forcing of a

constrained plasma must be able to do the same.

Test. Subject a constrained, laboratory-generated plasma to hard, cyclical electromagnetic quenches — a controlled analogue of the interaction-ramping cycles used in the cold-atom case.

Success condition. The plasma transitions from standard ionized chaos into a measurable, coherent phase-structure — demonstrating that macro-scale matter *hunts* for topological memory in order to survive stress.

Kill condition. If the driven plasma produces nothing but broadband noise under these constraints, the central prediction of the continuum framework fails. Entirely.

Experimental protocol (sketch for replication)

The following is a minimal design skeleton; specific parameters (drive frequency and amplitude, cycle count, plasma density and confinement geometry) are to be fixed for a given apparatus and reported in full.

1. **Source.** Generate a constrained, low-temperature laboratory plasma in a controlled confinement geometry (e.g., a bounded discharge or trapped configuration) with stable baseline diagnostics.
2. **Drive.** Apply a cyclical electromagnetic forcing protocol that ramps the system between two opposed regimes, repeated over a defined number of cycles — the electromagnetic analogue of the attraction/repulsion interaction ramps.
3. **Diagnostics.** Measure the spatial and spectral correlation structure before,

during, and after forcing. Look specifically for the emergence of long-range or oscillatory correlation signatures that are absent in the undriven baseline.

4. **Decision.** Coherent, reproducible phase-structure $\Rightarrow$ **pass**. Broadband noise only $\Rightarrow$ **kill**. No interpretive latitude on either side.

The value of the design is that it is *cheap to run and impossible to fudge*. A single clean replication either supports the continuum picture or ends it.

VI. Conclusion

The universe does not fall apart because its foundational substrate — plasma — is perpetually subjected to cyclic forcing that rejects noise and hones sequence. From the arithmetic irregularity of the primes supplying structural entropy, to

the physical persistence of DNA and localized mass, reality reads as a continuous filtering process governed by harmonic, bounded precision. Comprecisance names the boundary where that filtering happens. The constrained-plasma test is offered as the place where the idea can be made to stand or fall.

Author's Note on Scope

This is a theoretical proposal, submitted as a preprint and openly labeled as such. The cross-domain links drawn here — between prime distribution, non-equilibrium plasma, and the fine-structure constant — are advanced as a structured *hypothesis*, not as established result. The framework earns its keep only if the Section V experiment can be run. I state that limit plainly, and I welcome

replication, correction, and adversarial testing.

References

[1] Nägerl group (Department of Experimental Physics, University of Innsbruck). *Realization of fractional Fermi seas.* arXiv:2602.17657 (2026). Experimental realization using ultracold one-dimensional cesium gases driven through cyclic interaction ramps.

[2] A. Bastianello *et al. Exotic Critical States as Fractional Fermi Seas in the One-Dimensional Bose Gas.* Physical Review Letters (2026). DOI: 10.1103/j3s5-gjpf. Theoretical companion establishing a novel critical phase beyond Tomonaga–Luttinger liquid theory.

[3] University of Innsbruck. *A novel critical quantum phase.* Press release, June 2026.

[4] Standard references: CODATA recommended value of the fine-structure constant; and the classical literature on the Riemann zeta function and the distribution of prime numbers.

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