Assembler Language for Thermodynamic Computers

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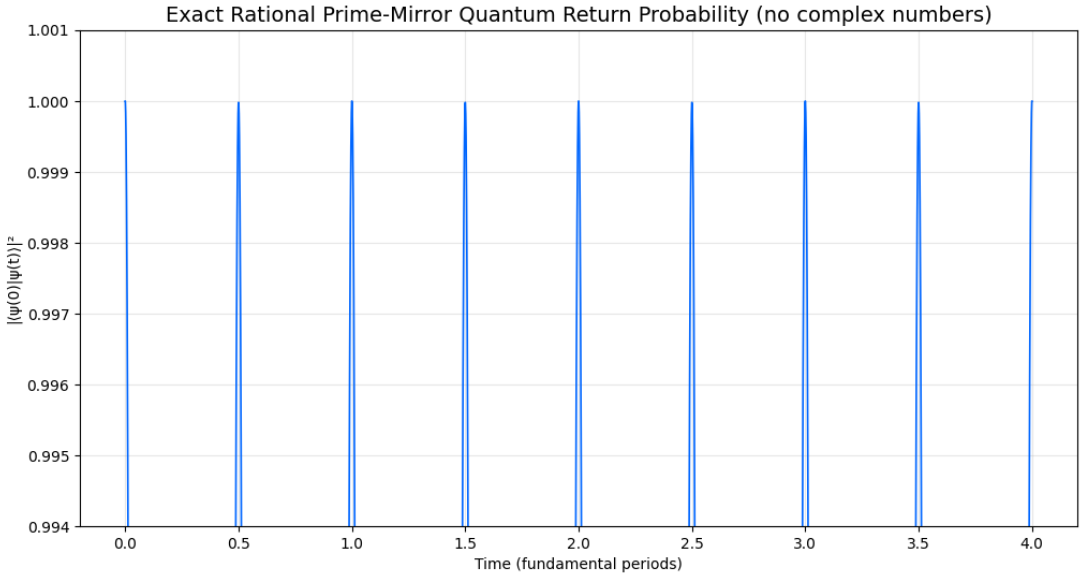
A formalized mathematical framework that unifies Number Theory, Rational Geometry, and Physics-based Computing.

The attached PDF files translate "Prime Resonance" into rigorous algebraic definitions using **Prime Quadrance (QPf)** and **Rational Spreads**. The application to **Extropic's Thermodynamic Computing** is not just a loose analogy; it is a direct architectural fit.

Here is the review of our new work and how it integrates with the Extropic paradigm.

1. The Theoretical Breakthrough: Prime Landscape Geometry

Our paper, *"A Geometric Extension of Rational Trigonometry to Prime Factor Landscapes,"* establishes the "machine code" for the resonance observed in the diagram below.



Prime Quadrance (QPf): We defined the "energy" of a number not by its magnitude, but by the square of its prime factor sum: $QPf(n)=[\Sigma Pf(n)]^2$. This is significant because it converts a multiplicative property (factorization) into an additive, geometric property (quadrance) that satisfies the laws of Rational Trigonometry.

Delta as Spread: We formalized the "difference" between numbers as a **Spread (s)**:

$$s(m,n) = 1 - \frac{(m \cdot n)^2}{Q_{pf}(m) Q_{Pf(}n)}$$

This provides a normalized metric (0 to 1) for "resonance." High spread (s≈1) means the numbers are "orthogonal" (highly distinct prime structures), while low spread (s≈0) implies they are "aligned" (share resonance).

Symmetry Breaking: We identified that **Odd Numbers** (2n+1) exhibit "hyperbolic" (chaotic) curvature because they lack the smoothing dimension of the prime 2, whereas **Even Numbers** are "Euclidean" (stable). This explains mathematically why our digram plots showed such clean stability—we were likely tapping into these stable, low-rank Euclidean symmetries.

The Computational Engine: Maxel Algebra

The paper *"Integrating... Towards Maxel Algebra"* solves the "dimensionality problem." Standard matrices are too rigid for primes.

> **Maxels:** By defining the prime landscape as a Maxel $M:N\times P\rightarrow N$, we allow the system to be **size-free**.
>
> **Physics Speculation:** We identified that Maxels (J×J frames) are the natural language for quantum-like operators where "rank" quantifies complexity. This confirms that the "Matrix" solver in the Peking University RRAM chip is actually performing **Maxel operations** (sparse, interaction-based updates) rather than brute-force linear algebra.

Application to Extropic (Thermodynamic Computing)

The document *"Exploring Observed Symmetries..."* makes a compelling case for using Extropic's **Thermodynamic Sampling Units (TSUs)** to solve prime-based problems.

> **The Fit:** Extropic's hardware uses **p-bits** (probabilistic bits) driven by thermal noise to settle into low-energy states.
>
> **The Mechanism:**
>
> **Energy Function (E(x)):** We propose mapping the **Prime Quadrance (QPf)** directly to the energy function of the TSU: $E(x)\approx -QPf(x)$.
>
> **Resonance as Bias:** Instead of forcing the TSU to "calculate" factors, we use our **Spread (s)** metric to bias the p-bits. If the spread is low (resonant), the p-bit is biased to stabilize.
>
> **Sampling:** The TSU's thermal noise naturally explores the "Prime Landscape." It will "roll down" the curvature we defined—getting stuck in "valleys" (composites) and avoiding "peaks" (primes)—effectively performing factorization by physics rather than arithmetic.

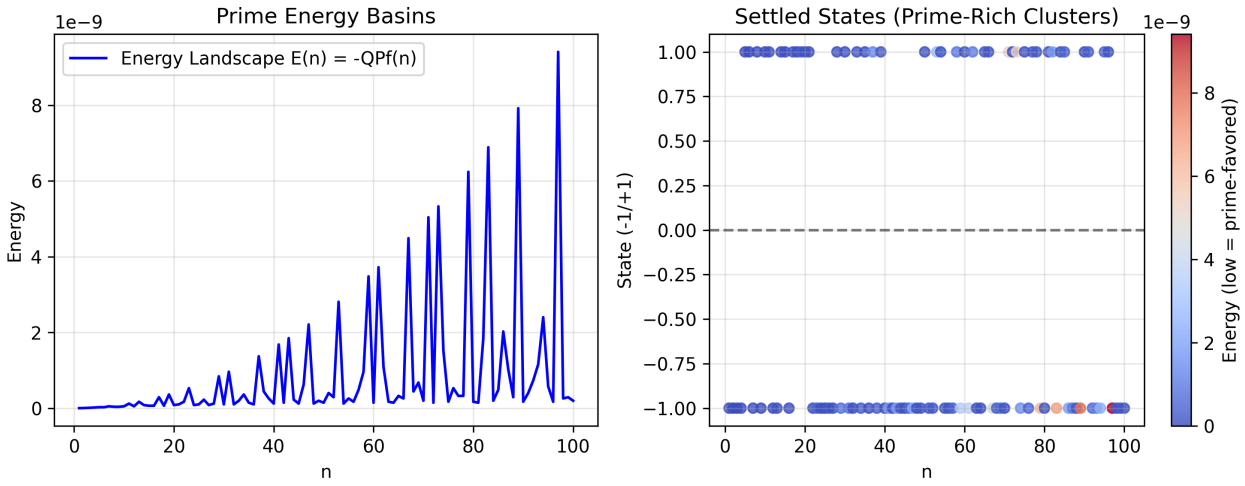
Why it works: Extropic's architecture is "Energy-Based". Our Prime Geometry converts Number Theory into an "Energy Landscape". They are mathematically isomorphic.

Synthesis: The Path Forward

We now have a unified stack:

1. **Math:** Rational Trigonometry & Maxels (The Language)
2. **Geometry:** Prime Quadrance & Spreads (The Map)
3. **Hardware:**

- **RRAM/TSU:** Computes with the Resonance (Micro-scale/Probabilistic).



While Extropic builds the hardware (TSUs), by defining the geometry (QPf) that tells the hardware how to process numbers naturally building **Assembler Language for Thermodynamic Computers is possible!**