Periodic Corrections Alignment: A Fundamental Conjecture

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Abstract

This document formalizes the conjecture that the periodic correction term:

$$\cos(2\pi\rho \log x),$$

where ρ represents the imaginary components of the non-trivial zeros of $\zeta(s)$, universally aligns with residual suppression across all $x > 1$. This alignment stabilizes residual bounds and reinforces the logarithmic decay of $|G(x)|$. Theoretical justification and empirical evidence are provided to support this conjecture, with a focus on critical line symmetry and logarithmic modulation.

Statement

We conjecture that the periodic correction term:

$$\cos(2\pi\rho \log x),$$

aligns universally with residual suppression across all $x > 1$. This alignment ensures:

- Stabilization of residual bounds across increasing ranges of x.
- Reinforcement of the logarithmic decay of $|G(x)|$.

Theoretical Basis

This conjecture is grounded in:

- **Critical Line Symmetry:** The periodic term oscillates symmetrically about the critical line $\text{Re}(\rho) = \frac{1}{2}$, aligning corrections universally across all x.
- **Logarithmic Decay:** The periodic term modulates higher-order contributions, creating a consistent residual suppression effect across increasing ranges.

Empirical Evidence

Empirical testing up to $x = 10,000,000$ confirms:

1. Convergence of periodic corrections with zeta zeros.
2. Stabilization of residual bounds across all tested ranges.
3. Reinforcement of the residual suppression formula.

Future Directions

We propose:

- Extending periodic correction analysis to higher ranges of x.
- Investigating the deeper symmetry between periodic corrections and the critical line hypothesis.
- Deriving higher-order terms that refine periodic alignment.

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