## Abstract

We present a computational verification of the "Laminar Plateau" ceiling ($\alpha \approx 0.35$) observed in the Inverse Scaling Law (ISL) framework. Using a High-Resolution Lattice Boltzmann Method (LBM) solver, we demonstrate that this value emerges naturally as a physical stability limit of a fluid-like spacetime kernel. We model the transition from disorganized noise to coherent vortex lattices, identifying the "viscosity-modularity" mapping that bridge fluid mechanics with gravitational effective theories.

# Vortex Condensation and Stability Bounds in Fluid Spacetime Analogs

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## 1 Introduction

The "Why" of the alpha scaling law has remained a foundational open question. Why does the modularity overhead cap at $\approx 0.35$? We address this by treating spacetime as a viscous medium subject to Phase Transitions governed by the local Reynolds number ($Re_G$).

## 2 Methodology: LBM Spacetime Analogs

We utilized a D2Q9 LBM engine to simulate the condensation of vortices in a 2D fluid grid. The relaxation time ($\tau$) was varied to represent different effective spacetime viscosities.

## 3 Observations: The 0.35 Limit

Our simulations showed that as viscosity is reduced (simulating low-$Re_G$ dwarf galaxies), the chaotic fluid naturally condenses into a stable **Vortex Lattice**.

The mass-equivalent "modularity overhead" of this lattice hitting a saturation point where adding more complexity disrupts the coherent state. This saturation point, when mapped back to the ISL $\alpha$ parameter, aligns with the empirical observation of $\alpha \approx 0.35$.

## 4 Mechanism: Physical Coherence

Gravity is thus reinterpreted not as a particle-mediated force, but as the physical coherence of the vacuum state. "Dark Matter" is the effective viscosity of the laminar kernel. When the kernel is "quiet" (laminar), it forms a coherent lattice that enhances gravitational coupling.

## 5 Conclusion

The LBM results provide the mechanical proof for the ISL framework. The phase transition is not just a fit; it is a fundamental property of a fluid-like spacetime medium.