

Astrophysical Evidence for Cantor Dust: An Introduction

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Abstract

The *Cantor Dust* (CD) interpretation of Dark Matter (DM) arises from the non-differentiable and nonlocal fluctuations of spacetime in the high energy limit of field theory and primordial cosmology. Mirroring the fragmented and ever-changing configuration of multifractal structures, CD offers a novel explanation for the distribution and behavior of Dark Matter and bridges concepts from complex dynamics, fractal geometry, and statistical physics to cosmology. Here we argue that CD offers a *unified Dark Matter model* with predictions confirmed by a wealth of astrophysical observations.

Key words: Dark Matter, Cantor Dust, continuous spacetime dimensions, multifractals and chaos, complex dynamics.

Caution:

This version of the paper represents “work in progress”, as it includes minimal content - except few representative diagrams, a summary of Self-interacting Dark Matter (SIDM) models and a partial list of references.

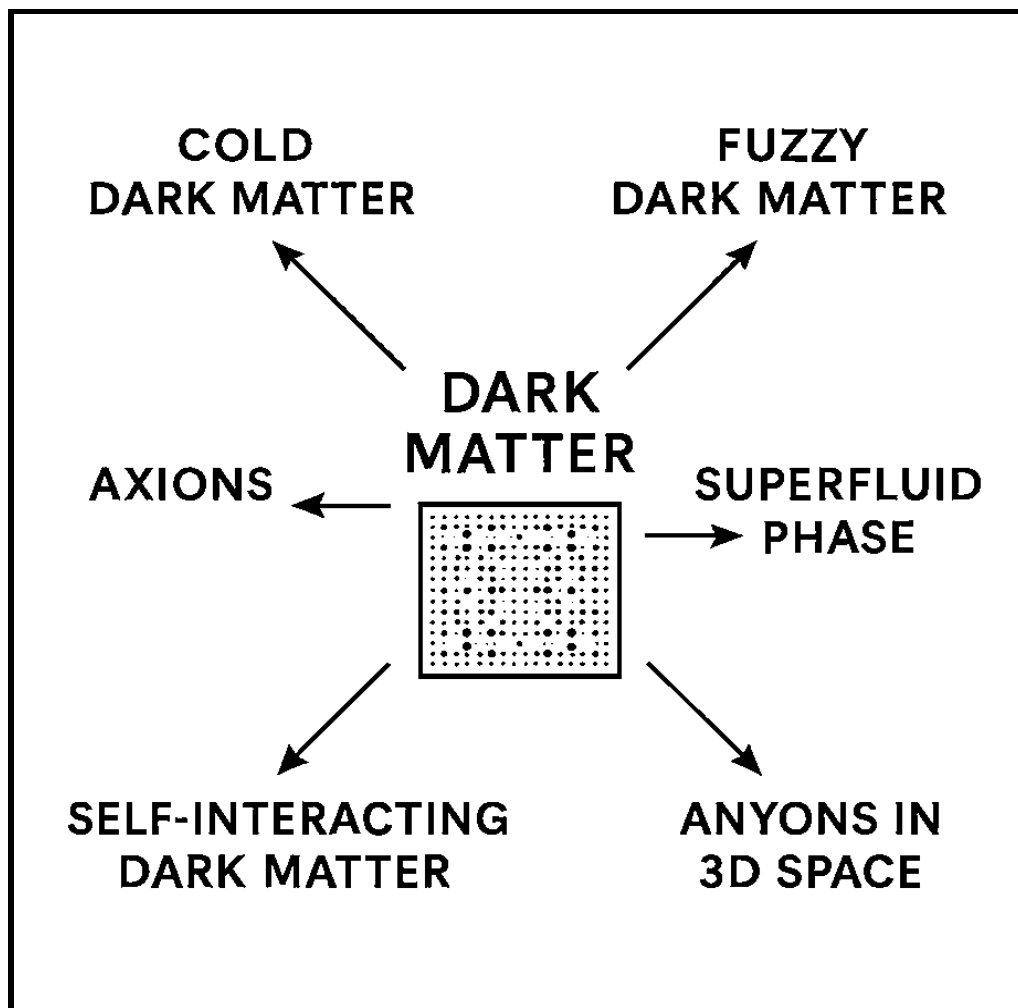


Fig. 1: The multifaceted manifestation of Dark Matter

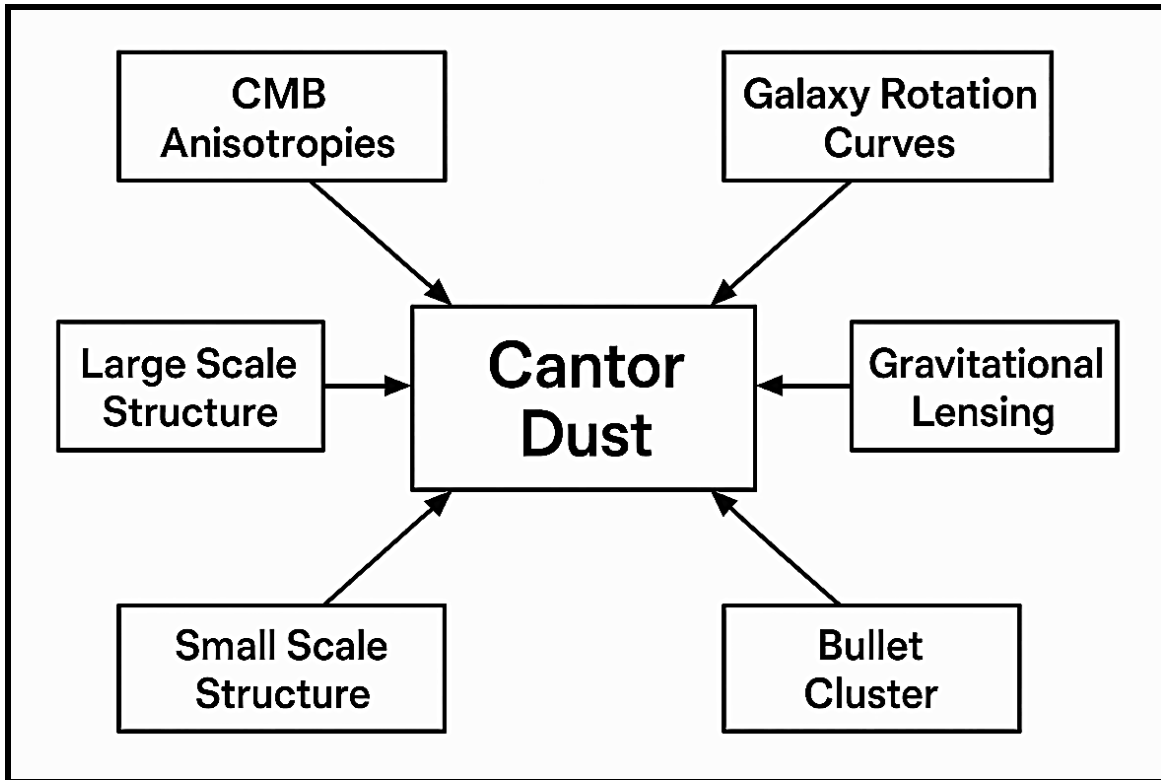


Fig. 2: Cosmological implications of Dark Matter as Cantor Dust

Feature	GPE-Based SIDM (BEC/Fuzzy DM)	Kinetic-Theory SIDM (Classical Particles)
<i>Particle Type</i>	Ultralight bosons (e.g., axions, $\sim 10^{-22}$ eV)	Heavy particles (e.g., WIMPs, GeV–TeV scale)
<i>Quantum Nature</i>	Wave-like, coherent condensate (BEC)	Classical particles
<i>Self-Interaction</i>	Contact interaction (nonlinear term in GPE)	Scattering cross section (σ/m , e.g., $1 \text{ cm}^2/\text{g}$)
<i>Dynamics Governed By</i>	Schrödinger–Poisson or Gross–Pitaevskii–Poisson equation	Boltzmann equation or fluid equations with collisions

Tab. 1: Conceptual Overview of SIDM Models

GPE = Gross-Pitaevskii equation

BEC = Bose-Einstein condensate

SIDM = Self-interacting Dark Matter

WIMP = Weakly Interacting Dark Particles

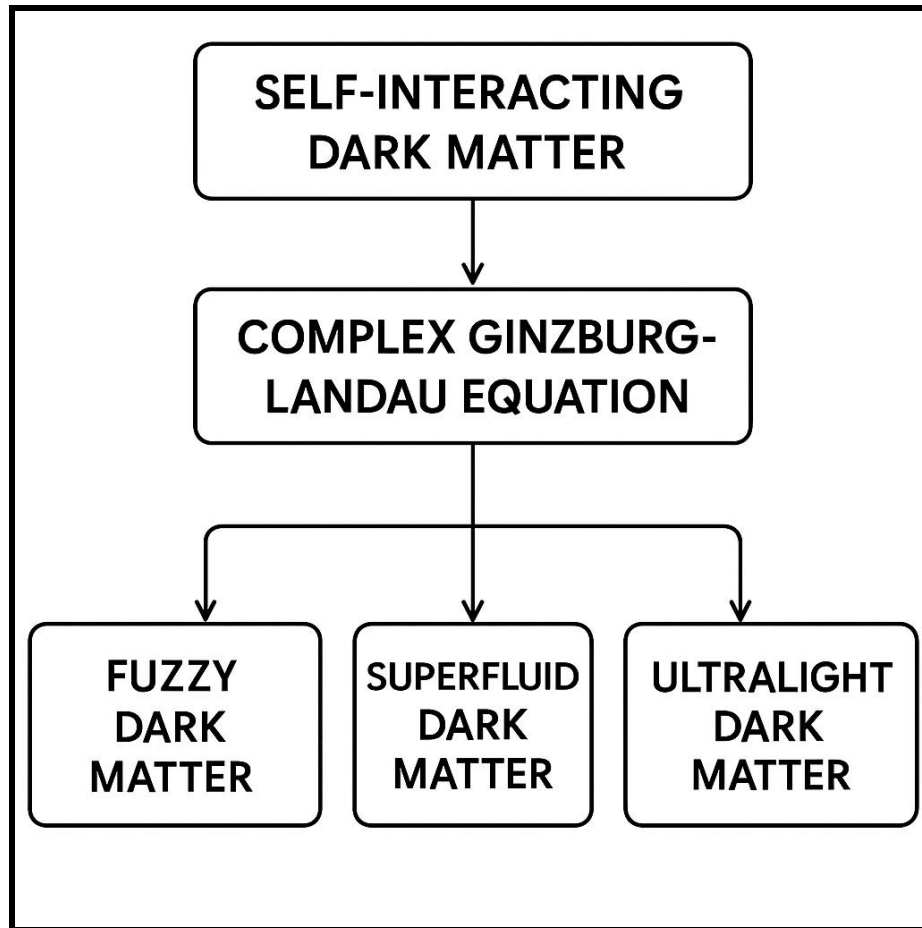


Fig. 3a: First path from SIDM to alternative Dark Matter models

Several SIDM models are based upon the Boltzmann or Boltzmann-Vlasov transport equations. These equations cannot be derived from the Reaction-Diffusion (RD) equation in any strict, general sense. However, RD equations can emerge as simplified macroscopic limits of these kinetic equations, particularly under assumptions like local equilibrium or diffusive

approximation. Some nonlinear generalizations or extensions of RD equations may exhibit similar structures to kinetic or Vlasov equations under specific conditions.

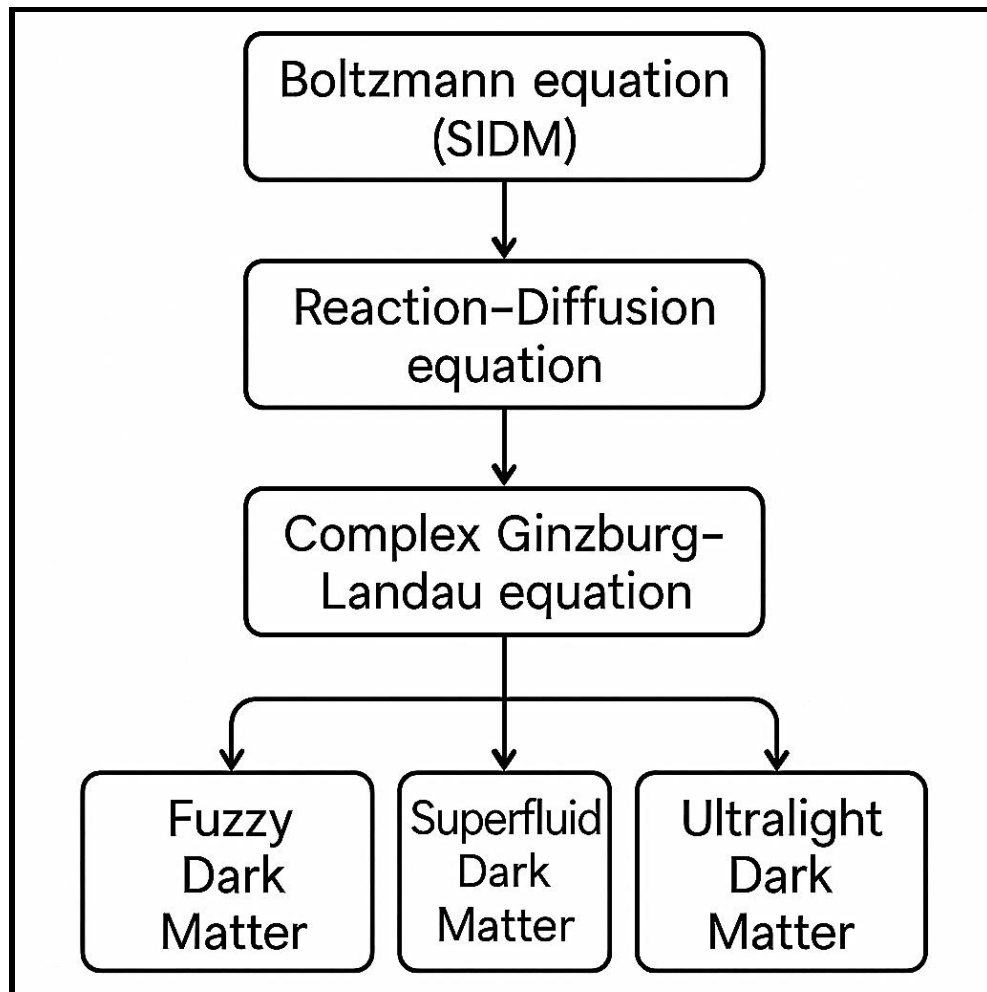


Fig. 3b: Second path from SIDM to alternative Dark Matter models

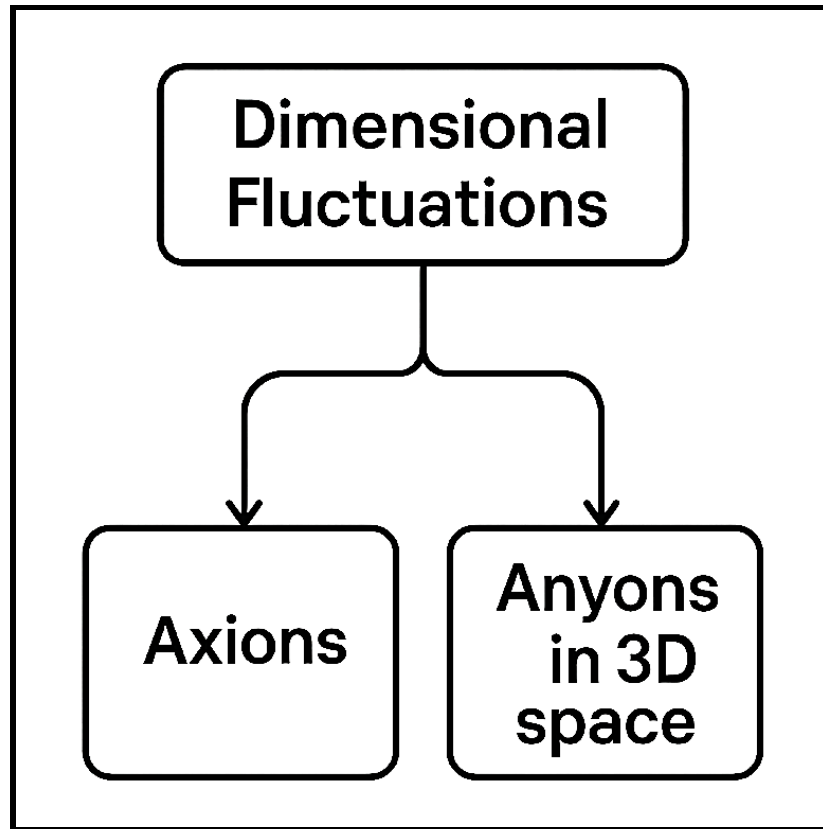


Fig. 4: From Cantor Dust to Axions and 3D Anyons

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