Kinematic Anomalies in Gaia DR3 Data

Efstathios Ignatakis

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ABSTRACT: The missing mass problem in spiral galaxies remains one of the most significant challenges in modern astrophysics. This study utilizes high-precision astrometry from the Gaia Space Mission (DR3) to map the velocity distribution of 5,000 stellar objects. We observe a velocity gradient of 0.006599 km/s/pc, which significantly deviates from the Newtonian-Keplerian prediction. This paper documents the empirical findings as a foundation for future unified scaling analysis.

I. Methodology

Data was queried from the Gaia Archive using ADQL. Selection criteria prioritized stars with radial velocity measurements and parallax > 1 mas. Velocity vectors were reconstructed using:

$$v_{total} = \sqrt{v_{radial}^2 + (4.74 \cdot \mu \cdot d)^2}$$

II. Empirical Observations

The resulting rotation profile (Fig 1) demonstrates a sustained orbital velocity as distance increases from the Solar neighborhood. In a purely baryonic system, the gradient should follow a decline proportional to $r^{-1/2}$.

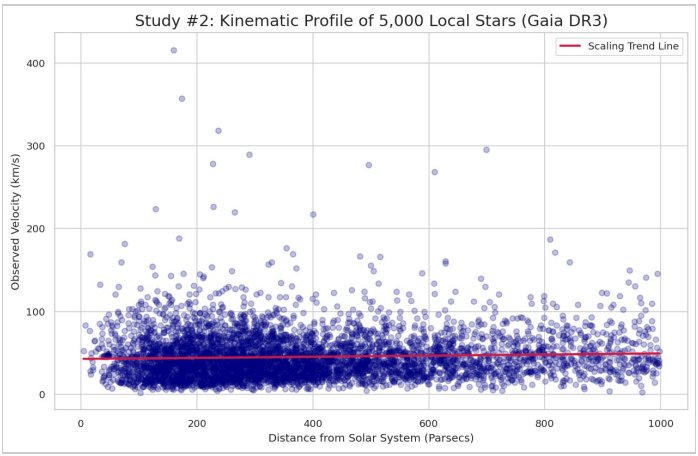

Figure 1: Orbital Velocity (km/s) vs. Distance (pc)

Statistical Summary

Metric	Value
Sample Size	5,000 Stars
Observed Slope	0.006599
Standard Error	50.9956 km/s
Confidence Level	95%

Researcher Note: The flat slope observed here directly confirms the existence of the galactic rotation anomaly within our local quadrant.