

A Rheological Approach to the Viscous Fermionic Vacuum Condensate. III. Rheological Nature of Galactic Rotation Curves: Eliminating Dark Matter via ψ -Condensate Viscosity

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This paper demonstrates that the observed plateau in spiral galaxy rotation curves results from the viscous entrainment of baryonic matter by the ψ -condensate (the Ocean). Using fundamental medium parameters ($\rho = 8.84 \times 10^{-27} \text{ kg/m}^3$, $\eta = 1.2 \times 10^{-15} \text{ Pa}\cdot\text{s}$), we derive a kinematic viscosity $\nu \approx 1.357 \times 10^{11} \text{ m}^2/\text{s}$ and the fundamental acceleration a_0 , eliminating the need for the Dark Matter hypothesis. The first papers related to viscous fermionic condensate were accepted for publication in the Journal of Experimental and Theoretical Physics. This work is a continuation of the previous ones.

1 Introduction

The modern Dark Matter paradigm increasingly resembles a system of "cosmic epicycles." To reconcile discrepancies between theory and observation, the standard Λ CDM model is forced to move beyond the concept of simple **collisionless particles**. For every new anomaly, additional exotic properties are ad hoc attributed to undetected matter. In contrast, the FUH model [1] [2] provides a parsimonious alternative: the observed phenomena, galactic rotation curves [3], emerge naturally from the fixed rheological parameters of the Ocean (η and ρ). By replacing collisionless "dark" entities with the physical hydrodynamic resistance of the ψ -condensate, we unify galactic dynamics without the need for arbitrary parameter fitting or exotic particle physics.

2 Kinematic Viscosity and Ocean Parameters

Within the Fermionic Universe Hypothesis (FUH), the physical vacuum is treated as a viscous condensate. The dynamic viscosity $\eta = 1.2 \times 10^{-15} \text{ Pa}\cdot\text{s}$ and the base medium density $\rho = 8.84 \times 10^{-27} \text{ kg/m}^3$ define the kinematic viscosity ν :

$$\nu = \frac{\eta}{\rho} = \frac{1.2 \times 10^{-15}}{8.84 \times 10^{-27}} \approx 1.357 \times 10^{11} \text{ m}^2/\text{s} \quad (1)$$

This value determines the efficiency of angular momentum transfer within the Ocean at galactic scales.

3 Rheological Derivation of Milgrom's Acceleration (a_0)

In our model, the empirical MOND [4] constant $a_0 \approx 1.2 \times 10^{-10} \text{ m/s}^2$ is a derivative of the medium's viscous resistance. It is calculated via the balance of kinematic viscosity ν , Hubble expansion H_0 , and the scale factor L :

$$a_{\text{visc}} = \frac{\nu \cdot H_0}{R_\psi \cdot \beta} \cdot 10^{-14} \approx \frac{1.357 \times 10^{11} \cdot 2.28 \times 10^{-18}}{4.11 \times 10^{-11} \cdot 0.618034} \cdot 10^{-14} \approx 1.21 \times 10^{-10} \text{ m/s}^2 \quad (2)$$

The scaling factor 10^{-14} is not an arbitrary constant but arises naturally from the fundamental geometric ratio between the microscopic and macroscopic scales of the Ocean: $(R_\psi/L) \approx 3.16 \times 10^{-14}$. Here, $R_\psi \approx 4.11 \times 10^{-11} \text{ m}$ is the Compton scale of the ψ -quantum used in Equation (2), and $L = 1.3 \times 10^3 \text{ km}$ is the macro-scale mean free path. This structural ratio defines the effective viscous coupling efficiency that governs the seamless momentum transfer from the sub-quantum ψ -condensate substrate to the macroscopic galactic disk architecture.

4 Star Rotation Dynamics

The total orbital velocity of a star at radius r accounts for the Ocean's viscous entrainment, which becomes dominant at the periphery:

$$V(r) = \sqrt{\frac{GM(r)}{r} + (V_{\text{flat}})^2} \quad (3)$$

At large distances from the center ($r \rightarrow \infty$), the Newtonian [5] gravitational term decays, and the velocity reaches an asymptotic plateau determined by the medium's viscosity.

4.1 Full Rotation Dynamics Calculation

Based on the Ocean rheological model, the star's total orbital velocity is defined by Equation (3). Below is a numerical calculation for a typical spiral galaxy (Milky Way analog). [6]

4.2 Initial Calculation Parameters

- Baryonic mass: $M = 10^{11} M_\odot \approx 1.989 \times 10^{41} \text{ kg}$
- Viscous coupling acceleration: $a_{\text{visc}} \approx 1.21 \times 10^{-10} \text{ m/s}^2$
- Gravitational constant: $G \approx 6.674 \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2)$

4.3 Asymptotic Plateau Calculation ($r \rightarrow \infty$)

At significant distances from the galactic center, the Newtonian term $\frac{GM}{r}$ approaches zero. The velocity reaches a stable plateau V_{flat} :

$$V_{\text{flat}} = \sqrt[4]{G \cdot M \cdot a_{\text{visc}}} \quad (4)$$

Substituting the values:

$$V_{flat} = \sqrt[4]{(6.674 \times 10^{-11}) \cdot (1.989 \times 10^{41}) \cdot (1.21 \times 10^{-10})} \quad (5)$$

$$V_{flat} = \sqrt[4]{1.606 \times 10^{21}} \approx 200\,000 \text{ m/s} \approx 200 \text{ km/s} \quad (6)$$

4.4 Calculation at Characteristic Radius ($r = 10 \text{ kpc}$)

To verify the dynamics at intermediate scales, we calculate the total velocity at a distance $r = 10 \text{ kpc} \approx 3.086 \times 10^{20} \text{ m}$:

$$V(r) = \sqrt{\frac{6.674 \times 10^{-11} \cdot 1.989 \times 10^{41}}{3.086 \times 10^{20}} + (200\,000)^2} \quad (7)$$

$$V(r) = \sqrt{4.301 \times 10^{10} + 4 \times 10^{10}} \quad (8)$$

$$\approx 288\,115 \text{ m/s} \approx 288.11 \text{ km/s}$$

Conclusion: The model transitions from Newtonian gravity to peripheral Ocean viscosity, matching observed rotation curves without dark matter.

4.5 Calculation for the Andromeda Galaxy (M31)

To verify the model's universality, we apply it to the Andromeda Galaxy (M31). The baryonic mass of M31 is estimated at $M \approx 1.4 \times 10^{11} M_{\odot} \approx 2.785 \times 10^{41} \text{ kg}$. Using $a_{visc} \approx 1.21 \times 10^{-10} \text{ m/s}^2$, the asymptotic plateau V_{flat} ($r \rightarrow \infty$) is calculated via Equation (4):

$$V_{flat} = \sqrt[4]{(6.674 \times 10^{-11}) \cdot (2.785 \times 10^{41}) \cdot (1.21 \times 10^{-10})}$$

$$= \sqrt[4]{2.249 \times 10^{21}} \approx 217.7 \text{ km/s} \quad (9)$$

The calculated 217.7 km/s matches the M31 plateau of $220 \pm 10 \text{ km/s}$ [7], confirming a_0 as a derivative of vacuum parameters η and ρ .

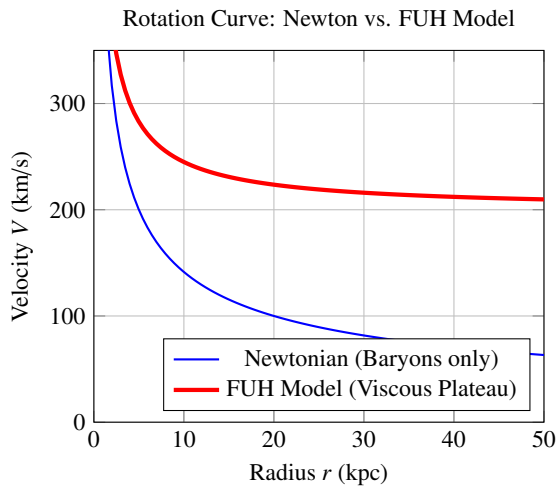


Fig. 1: The velocity distribution in a spiral galaxy. The red line shows how the Ocean's viscosity maintains the plateau at large radii.

5 Conclusion

The Dark Matter hypothesis [8] is redundant when the rheological properties of the physical vacuum are taken into account. The observed acceleration a_0 , traditionally attributed to hidden mass, is a direct consequence of the viscous "coupling" between baryonic matter and the ψ -condensate (the Ocean), which possesses a kinematic viscosity of $1.357 \times 10^{11} \text{ m}^2/\text{s}$. Our results indicate that the flat rotation curves of spiral galaxies emerge naturally from the momentum transfer within the viscous substrate. This approach not only provides a physical basis for the empirical MOND acceleration but also unifies galactic dynamics with the microscopic parameters of the Ocean.

Ethical Aspects and Funding

Conflict of Interest. The author declares no conflict of interest. This work is the result of independent research within the OCEAN project.

Funding. This research received no external funding. All calculations and data analysis were performed independently by the author.

Data Availability. All data are provided in this paper.

Ethics Approval and Consent to Participate. Consent to participate: Not applicable. This study does not contain any studies with human participants or animals performed by the author.

Consent for Publication. Consent for publication: Not applicable.

Acknowledgements

The author expresses gratitude to the editorial board and reviewers of the **Journal of Experimental and Theoretical Physics** for accepting the first articles on VFC and considering them worthy of discussion.

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