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Opinion

Supersolid Dark Matter and the Fabric of Spacetime

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Abstract - The nature of dark matter and its role in the universe remains one of the most profound mysteries in modern physics. This paper proposes a unifying framework in which dark matter is a supersolid that fills the vacuum of space itself. In this model, the supersolid dark matter is the fabric of spacetime - whose state of displacement gives rise to gravitational phenomena. Ordinary matter moving through this supersolid displaces it, generating gravitational forces via a ”displacing back” mechanism. The supersolid dark matter is also what waves in wave-particle duality, and its chaotic nature gives rise to the probabilistic nature of quantum mechanics. Dark energy is understood in this model as the pressure caused by the outflow of supersolid dark matter from our Universe’s central black hole, driving the accelerated expansion of the universe. This theory not only connects dark matter with general relativity and quantum mechanics but also offers new insights into cosmic structures and the forces governing them.

Keywords - Dark matter; Dark energy; Spacetime; Gravity; Wave-particle duality.

1 Introduction

Despite their overwhelming influence on the structure and fate of the universe, the true physical character of dark matter and dark energy is unknown. Dark matter appears to exert gravitational effects on galaxies and galaxy clusters, while dark energy is thought to drive the accelerating expansion of the cosmos. However, current models treat these phenomena as separate and unrelated, leaving a fundamental gap in our understanding.

This paper proposes a unifying framework in which dark matter is a supersolid that fills the vacuum of space itself. Objects exist in and move through this medium, displacing the supersolid dark matter, generating gravitational effects through a physical ”displacing back” mechanism.

Moreover, the dynamical interaction between particles and the chaotic behavior of the supersolid medium offers a natural explanation for wave-particle duality in quantum mechanics. In phenomena such as the double-slit experiment, the supersolid medium guides particles via displacement waves, reconciling quantum behavior with an underlying physical substrate.

At cosmic scales, large-scale displacement of the supersolid medium explains the formation of structures such as galaxy filaments and voids. Furthermore, dark energy emerges not as a uniform cosmological constant, but as a directed outflow of supersolid dark matter from a central black hole at the core of the universe. Recent observational evidence of anisotropic expansion—where galaxies appear to expand faster along a preferred direction—lends strong support to this model[1].

In unifying general relativity and quantum mechanics under the framework of a supersolid dark matter substrate, this theory provides a coherent and testable model for gravity, cosmic structure, and cosmic acceleration.

2 Supersolid Dark Matter as the Fabric of Space

In this framework, space itself is not empty but filled with a supersolid dark matter medium. Unlike ordinary matter, this supersolid is extremely rigid on cosmological scales yet flexible enough to allow for local displacements caused by mass and energy moving through it.

The key properties of this supersolid dark matter are:

- **Pervasive**: It fills all of space, acting as the underlying fabric of the universe.
- **Elastic**: It resists displacement, leading to the gravitational ”displacing back” effect.
- **Chaotic on small scales**: It behaves turbulently at microscopic scales and enables quantum effects such as wave-particle duality.
- **Coherent on large scales**: It acts smoothly across galactic and cosmological distances, giving rise to large-scale structures.

When a galaxy moves through the supersolid, it displaces the surrounding dark matter, much like a boat displaces water, creating a bow wave. This displacement creates an effective gravitational field, guiding other matter toward the regions of highest displacement - just as water displaced by a boat tends to ”push back” against the boat.

Thus, in this model:

- A galaxy’s dark matter halo is simply the state of displacement of the supersolid medium surrounding the galaxy.
- The offset often observed between a galaxy’s visible center and its dark matter halo is naturally explained as the result of the galaxy’s motion through the medium, creating a shifted displacement pattern - analogous to a bow wave offset from the moving boat[2,3].
- Gravitational lensing and the bending of light around mass arise from light following the contours of displaced supersolid dark matter, not from a purely abstract curvature of spacetime.

The physical displacement of the supersolid medium is thus the mechanism underlying gravity. General relativity’s mathematical curvature describes the consequences of this displacement but does not specify its material cause. This model fills that gap.

In this sense, displaced supersolid dark matter is the physical manifestation of curved spacetime.

Baryonic matter tells supersolid dark matter how to displace; displaced supersolid dark matter ”displaces back”, telling baryonic matter how to move.[4]

3 Galaxy Clusters, the Bullet Cluster, and Displacement Waves

The collision of galaxy clusters offers a vivid natural laboratory for testing the displacement model of supersolid dark matter. One of the most striking examples is the Bullet Cluster (1E 0657-558) - often cited as direct evidence for the existence of dark matter[5]. In the context of this supersolid framework, the Bullet Cluster provides even deeper confirmation of the physical properties of the dark matter medium.

In the Bullet Cluster collision:

• Two galaxy clusters have passed through each other.
• The visible galaxies, being relatively small and dense, interact weakly and mostly pass through without colliding.
• The hot gas clouds, however, experience ram pressure and slow down, piling up between the clusters.
• Remarkably, gravitational lensing maps show that the dominant gravitational field remains centered around the visible galaxies, not the slowed gas.

In the supersolid dark matter model, this is naturally explained:

• Each galaxy cluster carries with it a displacement wave in the surrounding supersolid dark matter, analogous to the bow wave of a boat moving through water.
• When the two clusters collide, the galaxies slow down, much like two colliding boats.
• However, their associated displacement waves continue propagating outward, largely undisturbed by the collision.

These outward-propagating displacement waves maintain the gravitational signature detected via lensing, even as the galaxies themselves slow. This mechanism predicts that after the collision, the displaced supersolid dark matter continues to ripple outward from the collision site - carrying with it the gravitational imprint of the original motion.

The Bullet Cluster, therefore, not only supports the existence of dark matter but reveals its dynamic, fluid-like behavior - behaving exactly as expected if space is filled with a supersolid medium that can be displaced and propagate waves.

4 Formation of Cosmic Web Filaments Through Supersolid Displacement

The cosmic web—a vast network of filaments and voids that stretches across the universe - can be understood as the result of large-scale displacement of supersolid dark matter. Galaxies move through this medium, displacing it, and in turn, the displaced supersolid dark matter pushes back against neighboring galaxies. This ”displacing back” force creates a network of filaments that guide galaxy motion, organizing the universe at large scales.

Galaxies moving through the supersolid create a series of waves in the dark matter, creating filamentary structures along which other galaxies are pushed by the displaced dark matter ”displacing back”. In this view:

• Filaments are regions of high displacement where galaxies and clusters of galaxies move through and into these structures.
• Voids are regions with very little displacement, where galaxies are sparse and matter is less dense.

In this framework, cosmic voids are not “empty” but rather regions where the supersolid dark matter is more "at rest". This dynamic results in the large-scale structures observed in the universe—the cosmic web.

5 Ultra-Diffuse Galaxies and the Misconception of "Missing Dark Matter"

Ultra-diffuse galaxies (UDGs) have been historically problematic in the context of dark matter. Some have been mistaken for having "missing dark matter"[6], while others have been thought to be almost entirely composed of dark matter[7]. In this supersolid framework, the explanation lies in the state of displacement of the dark matter.

• Ultra-diffuse galaxies with slow-moving stars barely displace the supersolid dark matter, leading to a small dark matter halo. This gives rise to the misconception of "missing dark matter".
• Ultra-diffuse galaxies with fast-moving stars, on the other hand, create a larger displacement in the surrounding supersolid, leading to a much larger dark matter halo, giving rise to the idea that these galaxies are mostly made of dark matter.

In reality, the state of displacement of the surrounding supersolid dark matter is the key factor in understanding these galaxies' apparent dark matter content.

6 Cosmic Rotation, Polar Outflow, and the Rebirth of Matter

The universe exhibits signs of a preferred axis of rotation—a large-scale anisotropy in the cosmic microwave background and galaxy spin alignments[8,9]. This suggests an underlying structure to spacetime itself. In the supersolid framework, such rotation is not a statistical artifact but a fundamental property of the supersolid dark matter fabric.

At the heart of the universe lies a black hole. As galaxies, stars, and intergalactic gas move through the supersolid medium, they displace it and are in turn forced toward this central void. When ordinary matter reaches the vicinity of the black hole, it becomes compressed, heated, and ultimately breaks down into the supersolid substrate itself.

The displaced dark matter does not accumulate endlessly. Instead, it flows outward along the rotational poles of the central black hole, creating the effect we observe as dark energy: the outward pressure causing accelerated expansion. This outflow is not uniform but directional, aligned with the spin axis of the universe.

In the polar outflows, the pressure is so great that some of the dark matter condenses back into particles of ordinary matter. The dark matter displaced by the particles "displaces back", forcing particles in close proximity to one another together. Over time, larger structures emerge—stars, galaxies, and clusters. Thus, matter is reborn.

The universe is not a closed system but a dynamic engine of recycling: matter is forced inward, transformed into supersolid dark matter, expelled along the poles, and recondensed into new structures. This continual process gives rise to the cosmic web, anisotropic expansion, and the observed arrow of time.

7 Conclusion

The supersolid dark matter model provides a unified, physical framework for understanding dark matter, gravity, and cosmic acceleration. By conceptualizing dark matter as a supersolid medium, we are able to explain a wide variety of phenomena—from galaxy rotation curves to cosmic structure formation, to the Bullet Cluster collision and the expanding universe.

This approach reconciles general relativity and quantum mechanics, with the displaced supersolid dark matter acting as the physical manifestation of curved spacetime. The time has come to reevaluate our understanding of space and matter.

References

[1] Migkas, K., et al, Probing cosmic isotropy with a new X-ray galaxy cluster sample through the LX–T scaling relation, Astronomy & Astrophysics Volume 636, April 2020

[2] Saha, Kana, et al. The Milky Way's dark matter halo appears to be lopsided. The Astrophysical Journal, Volume 697, Issue 2, pp. 2015-2029 (2009).

[3] Shan, HuanYuan, et al. Offset between dark matter and ordinary matter: evidence from a sample of 38 lensing clusters of galaxies. MNRAS Volume 406 Issue 2 August 2010

[4] "Spacetime tells matter how to move; matter tells spacetime how to curve." — Wheeler, J. A., & Ford, K. (1998). Geons, Black Holes, and Quantum Foam: A Life in Physics. W. W. Norton & Company.

[5] Clowe, D., et al. Weak-lensing mass reconstruction of the major merging cluster 1E 0657-558. The Astrophysical Journal 648.2 (2006).

[6] Buzzo, Maria Luisa, et al. A new class of dark matter-free dwarf galaxies? I. Clues from FCC 224, NGC 1052-DF2 and NGC 1052-DF4. Astronomy & Astrophysics Volume 695, March 2025

[7] Pieter van Dokkum et al., A HIGH STELLAR VELOCITY DISPERSION AND 100 GLOBULAR CLUSTERS FOR THE ULTRA-DIFFUSE GALAXY DRAGONFLY 44, The Astrophysical Journal Letters, Volume 828, Number 1, L6 (2016).

[8] Longo, M. J. Detection of a dipole in the handedness of spiral galaxies with redshifts z ~ 0.04. Physics Letters B, vol. 699, no. 4, 2011.

[9] Lior Shamir, The distribution of galaxy rotation in JWST Advanced Deep Extragalactic Survey, Monthly Notices of the Royal Astronomical Society, Volume 538, Issue 1, Pages 76–91, March 2025.