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Opinion

Co-Located Centers: Observational Support for Displaced Supersolid Dark Matter as the Source of Spacetime Curvature

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Abstract - In a wide range of dynamically disturbed galaxy clusters, the center of the dark matter halo—as determined by non-lensing methods—coincides with the center of spacetime curvature as inferred by gravitational lensing. This co-location persists even in systems where the baryonic matter, including dominant gas components, is spatially displaced from the dark matter. We argue that this empirical pattern is not naturally explained by models in which spacetime curvature is generated by the total mass-energy content. Instead, it is more consistent with the notion that the dark matter halo is not an independent structure, but a displaced region of a gravitationally responsive medium—supersolid dark matter—displaced by the ordinary matter [1]. This interpretation accounts for both the observed co-location and the absence of any measurable baryonic influence on the curvature center.

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

1 Observational Evidence for Co-Located Dark Matter Halo and Curvature Centers

A foundational claim of general relativity is that spacetime curvature arises from the total mass–energy content of a system. In astrophysical contexts, this is often interpreted to mean that gravitational lensing reflects the combined distribution of dark and baryonic matter. However, observational evidence from dynamically disturbed systems challenges this assumption. In a number of galaxy clusters where the centers of dark matter and baryonic matter are spatially offset, the center of gravitational lensing does not lie between them, as the total-mass hypothesis would predict. Instead, the lensing center remains aligned with the dark matter halo, regardless of the mass or displacement of the luminous matter.

Below, we examine four such systems. In each case, we describe the offset between baryonic and dark matter, outline the method by which the dark matter halo center is determined—using only non-lensing techniques—and show that the gravitational lensing signal consistently traces the dark matter halo, with no measurable influence from the baryonic component.

1.1 Bullet Cluster (1E 0657–56)

The Bullet Cluster remains the most well-known example of spatial separation between dark matter and baryonic matter. A high-velocity collision between two clusters has displaced the hot intracluster gas—visible in X-rays—from the galaxies and associated dark matter halos. The majority of the baryonic mass resides in this gas component, which is offset from both the galaxy distribution and the gravitational lensing peaks.

The dark matter halo centers are determined from the distribution of galaxies and dynamical modeling of the cluster components. Weak and strong lensing both show mass peaks that coincide with the dark matter halos, with no measurable influence from the gas on the location of the curvature center [2, 3].

1.2 Abell 520

Known as the "Train Wreck Cluster," Abell 520 presents a particularly striking case. A large central dark core is detected through lensing, but it is nearly devoid of galaxies. Meanwhile, the bulk of the visible matter—including galaxies and X-ray-emitting gas—is distributed around the periphery.

The dark matter halo center is reconstructed through the spatial distribution of intracluster gas and the dynamical behavior of member galaxies, independent of lensing data. Nonetheless, the gravitational lensing signal peaks at the location of the central dark core, not near the galaxies or gas. Weak and strong lensing both trace this dark region, with no measurable influence from the surrounding baryonic matter on the location of the curvature center [4, 5].

1.3 MACS J0025.4-1222

This system presents a structure similar to the Bullet Cluster, in which two galaxy clusters have passed through one another. As in the previous cases, the galaxies have moved ahead of the collisional gas, leaving the baryonic mass centered between the dark matter concentrations.

The dark matter halo centers are determined from the distribution and motion of galaxies, without the use of lensing data. Gravitational lensing reveals that the curvature center coincides with the dark matter, not the gas. Weak and strong lensing maps show no measurable influence from the displaced gas on the location of the lensing peaks [6].

1.4 Abell 2744 (Pandora's Cluster)

Abell 2744 is a complex merging system composed of at least four distinct subclusters. It contains multiple regions where the relative displacement between ordinary matter and the surrounding supersolid dark matter can be studied in detail, without assuming that dark matter is stripped or spatially detached.

Non-lensing methods—including galaxy dynamics, X-ray gas morphology, and mass modeling—are used to locate the dark matter halo centers. The gravitational lensing signal, derived from both weak and strong lensing, consistently traces the dark matter halo, with no measurable influence from the baryonic matter on the location of the curvature center [7, 8].

1.5 Clarifying the Meaning of Co-Location

In standard models, non-lensing techniques—such as galaxy dynamics, velocity dispersion, or X-ray gas morphology—are used to infer the location of the dark matter halo based on the assumption that it represents a concentrated mass. In the supersolid dark matter framework, however, these techniques do not reveal the location of hidden mass, but rather the displaced state of the surrounding medium. What is identified as the "dark matter halo" is the physical manifestation of that displacement. When comparing this with the center of curvature inferred from lensing, apparent mismatches may stem from interpreting non-lensing results through a mass-based lens, rather than recognizing them as measurements of displacement. Misunderstanding this can lead to the mistaken conclusion that the centers are not co-located, when in fact they are—once the medium's displaced state is correctly understood.

2 Theoretical Interpretation in the Supersolid Dark Matter Framework

The persistent co-location of the dark matter halo center and the gravitational lensing center suggests a common physical origin for both. In the supersolid dark matter model, this origin lies in the displaced state of a physical, gravitationally responsive medium. The dark matter halo is not an independent structure, but a displaced region of supersolid dark matter—displaced by the ordinary matter.

This interpretation reframes the role of baryonic matter. It does not directly generate curvature; rather, it acts as the agent that displaces the supersolid dark matter. The curvature we observe is not due to the mass of the ordinary matter itself, but to the effect it has on the medium in which it is embedded.

This framework explains both alignment and divergence among clusters. In the Bullet Cluster, ordinary matter moves coherently through the medium, displacing it in a bow-wave-like pattern that remains aligned with the galaxies. In Abell 520, multiple interacting mass flows displace the medium from several directions, producing an interference zone near the system's center. The lensing signal, in this case, peaks in a region devoid of visible matter—not because of an independent dark matter clump, but due to the structure of overlapping displacement fields in the medium.

Thus, the behavior of the lensing signal—whether it appears as a bow wave aligned with galaxies or as a core offset from them—reflects the underlying dynamics of how ordinary matter displaces the supersolid dark matter.

3 Predictions and Tests

A) Lensing Center Should Always Co-Locate with the Displaced Supersolid Dark Matter

The lensing signal should align with the supersolid dark matter halo, regardless of baryonic distribution.

- Supported by: Bullet Cluster, MACS J0025.4-1222, Abell 520, Abell 2744.
- Falsifiable: If baryonic matter is found to exert a systematic and persistent influence on the location of the gravitational lensing center—not explainable by transient displacement dynamics—this would contradict the model.

B) Central Dark Cores Can Form Without Galaxies

Complex mergers may create gravitational centers unrelated to galaxy locations due to multi-directional displacement.

- Already supported by Abell 520.

C) Time-Dependent Displacement Patterns

The medium may exhibit sloshing, interference, or persistence after interactions.

- Predicts transient lensing peaks or delayed relaxation after mergers.

D) Ultra-Diffuse Galaxies (UDGs) with Minimal Displacement

Galaxies that weakly displace the medium should exhibit minimal halo effects.

- Supported by DF2 and DF4.

E) UDGs with High Apparent Dark Matter Content

In the supersolid dark matter model, galaxies with fast-moving stars displace the surrounding medium more strongly, producing a larger apparent dark matter halo. UDGs thought to be dominated by dark matter are interpreted as systems where high stellar velocities generate strong displacement fields. Therefore, UDGs with similar stellar velocities that are not inferred to have large dark matter content would present a challenge to this model.

- Supported by: Dragonfly 44, a UDG with stellar velocity dispersion consistent with a high dark matter-to-baryon ratio.

4 Discussion

The observational co-location of halo and curvature centers—even in the presence of displaced baryonic mass—poses a challenge to standard curvature models based on total mass-energy. In the supersolid dark matter model, curved spacetime is not a fundamental entity, but a mathematical description of a physical state. What is traditionally called "curvature" corresponds to the displacement field of the supersolid medium. Ordinary matter does not curve spacetime directly—it physically displaces the surrounding dark matter, and that displacement is the manifestation of curvature.

This view preserves general relativity as an emergent geometric framework while grounding it in a physically real medium. The displaced supersolid dark matter both defines the dark matter halo and embodies what is interpreted as spacetime curvature—not by causing it; by being it.

This model also provides a natural framework to explore quantum gravitational effects, particularly if the same medium also supports wave-like behavior consistent with de Broglie's double-solution theory.

References

[1] Cavedon, M. (2025). Supersolid Dark Matter and the Fabric of Spacetime. IPI Letters, 3(2), O81-O85. https://doi.org/10.59973/ipil.197.

[2] Clowe, D., et al. "A direct empirical proof of the existence of dark matter." The Astrophysical Journal Letters 648.2 (2006): L109.

[3] Bradac, M., et al. "Strong and weak lensing united. II. Mass reconstruction of the merging galaxy cluster 1E 0657-56." The Astrophysical Journal 652.2 (2006): 937–947.

[4] Mahdavi, A., et al. ”A dark core in Abell 520.” The Astrophysical Journal 668.2 (2007): 806–814.

[5] Jee, M. J., et al. ”A study of the dark core in A520 with Hubble Space Telescope: the mystery deepens.” The Astrophysical Journal 747.2 (2012): 96.

[6] Bradac, M., et al. ”Revealing the properties of dark matter in the merging cluster MACS J0025.4-1222.” The Astrophysical Journal 687.2 (2008): 959–967.

[7] Merten, J., et al. ”Creation of cosmic structure in the complex galaxy cluster merger Abell 2744.” Monthly Notices of the Royal Astronomical Society 417.1 (2011): 333–347.

[8] Medezinski, E., et al. ”CLASH: Weak-lensing shear-and magnification analysis of 20 galaxy clusters.” The Astrophysical Journal 817.1 (2016): 24.