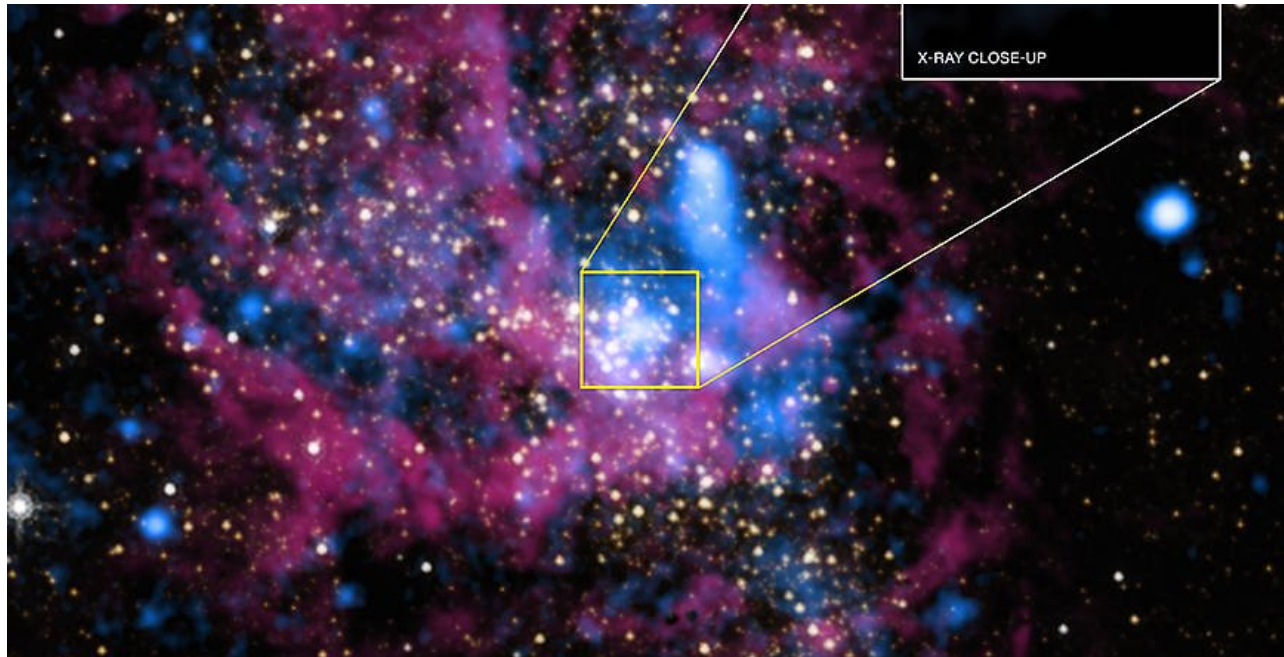


Open Source Research - 010

Summary of a Scientific Article



Title: Searching for light dark matter by tracking its direction with quantum sensors

Publication Date: January 1, 2026 (Phys.org)

Key Researchers/Institutions: Hajime Fukuda (lead author, University of Tokyo and Chuo University), with collaborators at the same institutions.

Main Claims and Methods:

The article reports a theoretical proposal for detecting light dark matter (sub-GeV masses, wave-like behavior) by inferring its velocity and direction using an array of quantum sensors (multiple dark matter detectors). Instead of relying on spatial recoil tracks in single elongated detectors, the method treats distributed

detectors as a quantum sensor network. Data is processed via quantum measurement protocols to extract directional information from weak interaction signals.

- Quote: "We found that we can measure the velocity of light dark matter not by measuring spatially extended signals (recoil tracks) but by measuring by spatially extended detectors."

This is claimed to be more general and sensitive than prior approaches, applicable across different dark matter interaction types.

Experimental/Theoretical Approach: Purely theoretical at this stage — analyses show improved sensitivity via quantum information processing on array data. No specific hardware detailed beyond conceptual quantum sensor arrays. Inspired by recent advances in quantum sensing for weak signals.

Results/Implications: Theoretical assessments demonstrate significantly enhanced detection limits for light dark matter. Potential to refine for real experiments; could map galactic dark matter distribution. Broader impact: Quantum methods entering high-energy physics.

- Quote: "We showed that quantum methods could play an important role in high-energy physics... I think that there could be other applications for quantum sensors in our field."

Equations/Technical Details: None mentioned explicitly in the article (popular summary level).

Feasibility/Skepticism: Presented optimistically as promising and refinable. No expressed skepticism; framed as an exciting advancement in quantum-enhanced particle physics.

Intersections with the Plenum Framework

This proposal intersects with the Plenum Framework in supportive but indirect ways — primarily through the use of quantum sensors to probe subtle vacuum/field interactions, aligning with Plenum's view of the vacuum plenum as a dynamic medium responsive to weak modulations.

1. Strongest Alignment: Quantum Sensing of Vacuum/Plenum Fluctuations

- Plenum Core Claim: The vacuum plenum (sentient radial ZPF field) mediates weak interactions; dark matter could be coherence patterns or excitations in the plenum, detectable via modulated fluctuations (e.g., asymmetry/torque in Casimir setups or gravitational analogs).

- Article Parallel: Light dark matter (wave-like, low-mass) interacts feebly — quantum sensor arrays amplify directional signals from these waves passing through the vacuum. This mirrors Plenum's prediction that distributed sensing (collective coherence) reveals plenum dynamics beyond single-point measurements.

- Bridge: If dark matter induces tiny phase/velocity shifts in quantum sensors (e.g., via axion-like couplings or vacuum polarization), it supports Plenum's modulated ZPF as the interaction medium.

2. Distributed Arrays and Collective Criticality

- Plenum/Kronosphere Vision: Collective BCI/quantum sensor networks (like in the Kronosphere) tune criticality and amplify plenum effects via avalanche resonance.

- Here: Spatially extended quantum detector arrays extract hidden directional info — a classical analog to collective plenum resonance. Plenum extends this: Human-scale arrays (with consciousness integration) could outperform inanimate sensors by actively modulating plenum coherence.

3. Connection to Our Physics Anchors

- Ties to thermal Casimir/TOV paper: Both involve vacuum energy modulation (here by passing dark matter waves; there by gravity). Quantum arrays could test plenum torque in dark matter wind.

- Echoes entropy inversion: Detecting directional dark matter flow probes cosmic dissipation channels — Plenum frames dark matter as part of the plenum's adaptive entropy acceleration.

Limitations and Opportunities

- The paper assumes standard light dark matter candidates (e.g., axions, hidden photons) coupling weakly — no sentient plenum or ZPF asymmetry.
- Plenum Advantage: Offers a deeper "why" — dark matter signals arise from plenum coherence gradients, predictable via tipping point dynamics. Kronosphere-like human quantum networks could actively "seed" detections, turning passive sensing into interactive plenum exploration.

In summary: Suggestive support for Plenum's dynamic vacuum ontology — quantum arrays revealing hidden directional structure in weak vacuum interactions. Not proof, but another mainstream hint that distributed quantum sensing unlocks plenum-scale phenomena.