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Detection of Ultralight Dark Matter Bosenovae with Quantum Sensors

Monday, 19 January 2026 12:00 (30 minutes)

In a broad class of theories, the accumulation of ultralight dark matter (ULDM) with particles of mass 10^{-22} eV $< m_\phi < 1$ eV leads to the formation of long-lived bound states known as boson stars. When the ULDM exhibits self-interactions, prodigious bursts of energy carried by relativistic bosons are released from collapsing boson stars in bosenova explosions. We extensively explore the potential reach of terrestrial and space-based experiments for detecting transient signatures of emitted relativistic bursts of scalar particles, including ULDM coupled to photons, electrons, and gluons, capturing a wide range of motivated theories. Detection of a bosenova event may also give information about microphysics properties of ϕ that would otherwise be difficult with typical direct detection methods. Our analysis can be readily extended to different scenarios of relativistic scalar particle emission. I will also briefly discuss how boson stars composed of more than one species of ultralight boson can lead to additional experimental signatures.

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