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Beyond Qubits: Multilevel Quantum Sensing for Dark Matter

Tuesday, 9 December 2025 15:30 (30 minutes)

Quantum sensing with qubits has advanced fundamental physics searches, but higher dimensional systems offer untapped potential. We present a universal qutrit framework that yields a sequence-independent fourfold increase in quantum Fisher information and a twofold gain in sensitivity. In ultralight dark matter searches, spin-1 NV-center qutrits can enhance the axion-electron coupling reach by an order of magnitude beyond qubits. This principle applies broadly to multilevel quantum systems including superconducting, neutral atom and trapped-ion qutrits, establishing higher dimensional sensing as a powerful tool for probing new physics.

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