

Beyond Qubits: Multilevel Quantum Sensing for Axion Dark Matter

Thursday 13 November 2025 14:40 (20 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 axion 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.

Presenter: MA, Xiaolin

Session Classification: Parallel session - Phenomenology II