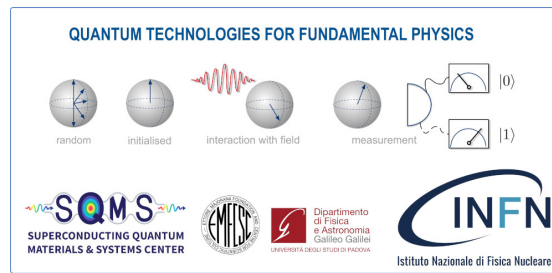


Quantum Technologies for Fundamental Physics



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Advances in SRF cavity architectures for quantum computing and sensing

Sunday, September 3, 2023 10:00 AM (15 minutes)

Superconducting radio frequency (SRF) cavities offer an excellent platform for storing and processing quantum information due to their exceptionally long lifetimes and large accessible Hilbert spaces. A common strategy to manipulate the quantum states is to use a nonlinear element like a transmon. Nevertheless, constructing a 3D SRF architecture with sustained cavity lifetimes presents several challenges. In this talk, we present our successful integration of transmons with single-cell Nb SRF cavities, enabling the preparation of several non-classical states. Preliminary results reveal the potential of this platform to build a qudit-based quantum computer, departing from traditional qubit-based architectures. We discuss strategies to enhance coherence times, develop high-fidelity gate schemes, and expand the system for constructing a multi-qudit quantum processor. Furthermore, we explore how this architecture can bolster dark matter detection efficiency through multi-photon quantum state preparation.

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Session Classification: Superconducting cavities, materials, and quantum technology for detection of weakly-coupled particles