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Superconducting radio frequency technology enabling new transformative applications in QIS and dark matter searches

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Superconducting radio frequency (SRF) cavities are the core technology for particle acceleration in modern accelerators, due to their extremely high quality factors as high as $Q > 10^{11}$. These make possible the continuous wave (CW) sustainment of very high electromagnetic fields inside the cavities with minimal dissipation in the cavity walls.

A few years ago, it was realized that the extreme high Q factors of SRF cavities can bring multiple orders of magnitude improvements in the coherence of the quantum computing building blocks, as well as dramatic advances in the sensitivities of dark sector and dark matter searches. These technologies provided the unique foundation of the Fermilab-led Superconducting Quantum Materials and Systems Center (SQMS), one of the five national QIS Research Centers, which includes more than 280 researchers in the national labs, industry, and academic institutions, working towards the focused mission of building the world-leading 3D quantum processor unit based on SRF technology, as well as physics and sensing advances for several open fundamental physics questions.

In this talk I will review these emerging applications of SRF technology, including the record-breaking coherence levels achieved in 3D SRF Quantum Systems, and the highest sensitivity searches for dark photons and axions realized and planned in the context of SQMS effort at Fermilab and partners.

In-person participation

Yes

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