Application and characterization of CMOS cryogenic electronics

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Abstract:

Cryogenic electronics have a wide range of ever-expanding applications, which span everything from quantum information science to extra-terrestrial electronics to gravitational wave research. However, the most prevalent current application pushing the frontiers of cryogenic electronics, is quantum computing where there has become an unavoidable necessity for electronic functionality at the 4 K level. The most promising candidate to fulfil this functionality is CMOS due to its plethora of analog and digital functions at relatively low power consumption to not perturb the cryogenic environment. Due to these stringent power and performance requirements, accurate device models are desirable for consistent circuit design. Though it has been acknowledged that precise characterization is crucial for reliable low power and low temperature circuit design, obtaining reliable device characterization and reliability at low temperatures has not been sufficiently addressed. This tutorial will review the applications of cryogenic CMOS in various fields and discuss the motivation for creating reliable and accurate cryogenic device characterization tools for consistent high-performance cryogenic CMOS circuit design.

Biography:

Pragya R. Shrestha is a research associate in the Nanoscale Processes and Measurements Group in the Nanoscale Device Characterization Division at the National Institute of Standards and Technology (NIST). She received her Electrical Engineering PhD degree (2013) from Old Dominion University. Her current research work includes developing innovative electrical device characterization techniques for novel devices. The device characterization mainly focuses on low temperature and ultra-fast measurements to understand device physics and reliability. She is also involved in developing the highly sensitive ESR (Electron Spin Resonance) technique relevant to a broad spectrum of material system which is otherwise difficult to realize using conventional ESR setup with a high-Q resonator.