

Sam Benz – Colloquium - 2/7/2019
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Title: Superconductive Electronics for Quantum-based Voltage Metrology

Abstract: Brian Josephson's discovery in 1962 of the quantum behavior of superconducting junctions enabled a revolution in precision voltage measurement, where quantum-based standards that are intrinsically accurate replaced electrochemical battery standards whose behavior depends on environmental conditions. I will describe the major technological advances in junction fabrication, superconducting integrated circuits, instrumentation, and measurement techniques that led to the present generation of practical dc and ac voltage standard systems. Quantum-based 10 V programmable Josephson voltage standards and 2 V rms Josephson arbitrary waveform synthesizers at audio frequencies are used in electrical metrology, primarily for calibration of dc and ac voltage, ac power, and impedance. They were also key instruments in the 2017 precision measurements of "the kg" and the triple point of water. The results of these measurements contributed new "defined" values of the Planck and Boltzmann constants, which are part of the redefinition of the international system of units (SI) that goes into effect on May 20, 2019. Finally, and time permitting, I will describe the latest research to realize quantum-accurate synthesis at radio-frequencies that we hope will revolutionize RF metrology and address immediate measurement challenges in spectrum sharing and future 5G communications.