Implementation of a Canonical Phase Measurement with Quantum Feedback

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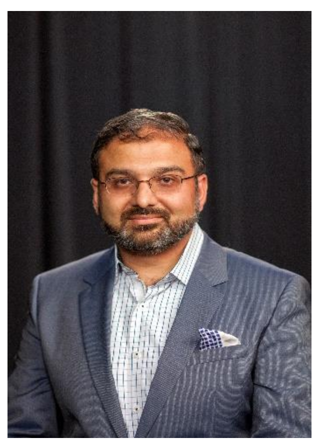
Abstract :

In many sectors of modern metrology and communication technology, information is encoded in electro-magnetic waves, typically as an amplitude or phase. While current hardware can perform near-ideal measurements of photon number or field amplitude, a device that can perform an ideal phase measurement is elusive. In this work, we implement a single-shot canonical phase measurement on a one-photon wave packet, which surpasses the current standard of heterodyne detection and is optimal for single-shot phase estimation. By applying quantum feedback to a Josephson parametric amplifier, our system adaptively changes its measurement basis during photon arrival and allows us to validate the detector's performance by using single quantum trajectories to track the quantum state of the photon source. These results provide an important capability for optical quantum computing, and demonstrate that quantum feedback can both enhance the precision of a detector and enable it to measure new classes of physical observables.

Bio:

Irfan Siddiqi is a Faculty Scientist at Lawrence Berkeley National Laboratory and a Professor of Physics at the University of California, Berkeley. He completed his undergraduate degree in chemistry & physics and PhD in applied physics from Harvard University and Yale University, respectively. Siddiqi and his research group, the Quantum Nanoelectronics Laboratory, focus on the development of advanced superconducting circuits for quantum information processing, including computation and metrology. Additionally, he serves as the director of the Advanced Quantum Testbed and the Quantum Systems Accelerator at Lawrence Berkeley National Laboratory. Siddiqi is known for key contributions to quantum measurement science, including real time observations of wavefunction collapse, tests of the Heisenberg uncertainty principle, quantum feedback, and the development of a range of microwave frequency, quantum noise limited amplifiers and detectors. He is a fellow of the American Physical Society, and was the recipient of the APS George E. Valley Jr. prize in 2006 for the development of the Josephson bifurcation amplifier and the APS Joseph F. Keithley Award in 2021 for fundamental advances in superconducting parametric amplifiers. He has also received the Berkeley Distinguished Teaching Award.



Virtual Talk
Friday, April 16th, 2021

Talk begins: **12:00pm**

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