PCSI

Room Canyon/Sugarloaf - Session PSCI-SuE

Single Photon Detectors

Moderator: Christopher Palmstrom, University of California, Santa Barbara

7:30pm **PSCI-SuE-1 Theory of Single Photon Detection by a Photoreceptive Molecule and a Quantum Coherent Spin Center***, N Harmon,* University of Evansville*; **Michael Flatté,*** University of Iowa **INVITED**

The long spin coherence times in ambient conditions of color centers in solids, such as nitrogen-vacancy (NV−) centers in diamond, make these systems attractive candidates for quantum sensing. Quantum sensing provides remarkable sensitivity at room temperature to very small external perturbations, including magnetic fields, electric fields, and temperature changes. A photoreceptive molecule, such as those involved in vision, changes its charge state or conformation in response to the absorption of a single photon. We show the resulting change in local electric field modifies the properties of a nearby quantum coherent spin center in a detectable fashion. Using the formalism of positive operator values measurements (POVMs), we analyze the photo-excited electric dipole field and, by extension, the arrival of a photon based on a measured readout, using a fluorescence cycle, from the spin center. We determine the jitter time of photon arrival and the probability of measurement errors. We predict that configuring multiple independent spin sensors around the photoreceptive molecule would dramatically suppresses the measurement error[1].

[1] N. J. Harmon and M. E. Flatté, arXiv:1906.01800

8:10pm **PSCI-SuE-9 From Dark Matter Detection to Artificial Intelligence: Uses for Superconducting Nanowire Single Photon Detectors***, **Sae Woo Nam,*** National Institute of Standards and Technology, UUSA **INVITED**

Single-photon detectors are an essential tool for a wide range of applications in physics, chemistry, biology, communications, computing, imaging, medicine, and remote sensing. Ideally, a single photon detector generates a measurable signal only when a single photon is absorbed. Furthermore, the ideal detector would have 100% detection efficiency, no false positive (dark counts), and transform-limited timing resolution. Since the first reported detection of a single photon using a superconducting nanowire in 2001[1], steady progress has been made in the development and application of superconducting nanowire single photon detectors (SNSPD or SSPD) with ideal properties. The performance of these detectors is fundamentally related to characterizing and understanding the materials used in these quasi-1D wires that are able to detect photons. I will briefly describe progress in detector developments, use of these detectors in new applications, and opportunities for future work.

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