Contribution ID: **81** Type: **Oral Presentation**

Capacitively Coupled Single Photon Detectors: From Classical to Quantum Mechanical Devices

Monday, 10 December 2018 11:00 (30 minutes)

In recent years, the development of Si CMOS quanta image sensors (QIS) has enabled room-temperature, non-avalanche photon counting in the visible spectrum regime by transferring a photoelectron to a tiny capacitor (C~400 aF), thereby inducing a readable voltage change on the order of 0.4 mV using correlated double sampling method. These non-avalanche single photon detectors (SPDs), based on capacitive coupling, greatly benefit from the CMOS scaling and may inspire new ways of envisioning/optimizing electronic-photonic integration on Si. This talk will focus on two aspects: (1) Extending the spectral response of QIS devices (based on classical capacitive coupling) to infrared and ultraviolet regime. Different schemes of spectral extension will be discussed, including hot-electron devices and GeSn nanodots integrated with Si QIS readout methods. (2) Leaping from classical to quantum mechanical capacitive coupling to minimize the timing jitter and maximize the bandwidth of the non-avalanche SPDs. In these quantum capacitive photodetectors, the absorption of a single photon changes the wave function of a single electron trapped in a quantum dot(QD), leading to a charge density redistribution nearby. This redistribution translates into a voltage signal through capacitive coupling between the QD and the measurement probe or a nanoscale MOS gate. Using InAs QD/AlAs barrier as a model system, the simulation shows that the output signal reaches ~4 mV per absorbed photon, promising for high-sensitivity, sub-ps single-photon detection. We will also discuss the fundamental limits and advantages of capacitively coupled photodetectors over avalanche photodetectors in single photon detection and photon counting.

Primary author: Prof. LIU, Jifeng (Dartmouth College)

Presenter: Prof. LIU, Jifeng (Dartmouth College)

Session Classification: Parallel Session: Photodetectors

Track Classification: Photodetectors