Abstract (300 word limit)

Quantum photonics enabled new capabilities in computation, communication, imaging and sensing demonstrating ultimate speed, security, low-invasiveness and sensitivity beyond classical limits. Operation in near- and mid–infrared spectral regions offers well recognized advantages in fiber communication and in label-free bioimaging and biosensing. Deployment of the quantum-enhanced methodologies in the mid-infrared range requires development of the new class of the quantum light emitters and single photon counters. The proposed quantum science and technology engineering research center will focus on design and development of mid-infrared quantum photonics devices and demonstration of their utility in the communication and sensing systems. The center will build upon the diverse expertise of co-PIs from the departments of Electrical and Computer Engineering and Physics. The ECE co-PIs will contribute the state-of-the-art semiconductor device fabrication facilities and expertise in design, development and advanced characterization of the narrow gap semiconductor devices and materials for photonic and electronic applications. The Physics co-PIs will bring world class expertise in experimental quantum communication and sensing system demonstration and cutting-edge theoretical calculations. The center initial experimental targets will be design and development of: (1) the quantum dot based efficient on-demand single photon emitters operating near and above 1.3 μm for quantum internet applications and distributed quantum sensing; (2) novel single photon counting avalanche photodiodes with cutoff wavelength above 3 μm for quantum ghost imaging experiments. The center will work on development of the novel heterostructures for realization of the electrically pumped room temperature operated spontaneous parametric down conversion sources of the entangled photon pairs and continue the search for scalable material platform for topological quantum computing. The later will be based on metamorphic epitaxy of the inverted band superlattices. The center will employ diverse group of graduate and undergraduate students contributing to the semiconductor workforce development.