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Abstract for an Invited Paper
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Single-Photon Level Nonlinear Optics with Nanophotonic Cavity QED[1]

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An outstanding challenge in quantum optics is to realize optical nonlinearities at the single photon limit, where a single photon can deterministically control the transmission of another optical field. Cavity Quantum Electro-Dynamics (QED) provides a coherent atom-photon interface that allows a single atom to mediate such photon-photon interactions. In this talk, I will talk about how we realize a coherent spin-photon interface in a solid-state platform by using a nanophotonic cavity QED platform [1], and the use of this device to realize a single-photon switch and transistor [2]. I will highlight the applications of these devices in optical quantum information processing by introducing one of our recent theory works on deterministic generation of loss-tolerant photonic cluster states [3]. Ref: [1] Sun et al., Nature Nanotechnology 11, 539–544 (2016); [2] Sun et al., Science 361 (6397), 57-60 (2018); [3] Zhan and Sun, Physical Review Letters 125, 223601 (2020).

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