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Rydberg Atom Quantum Hybrid Systems[1] YUANXI CHAO, JITENG SHENG, SANTOSH KUMAR, Homer L. Dodge Department of Physics and Astronomy, The University of Oklahoma, OK 73019, USA, NICHOLAS P. BIGELOW, Department of Physics, The University of Rochester, NY 14627, USA, JAMES P. SHAFFER, Homer L. Dodge Department of Physics and Astronomy, The University of Oklahoma, OK 73019, USA — We report on our recent experimental and theoretical work with Rydberg atom-cavity and Rydberg atom-surface hybrid quantum systems. In the atom-cavity system, Rb contained in a dipole trap is transported into a high-finesse optical cavity using a focus-tunable lens. Cavity assisted Rydberg EIT is observed in the cavity transmission and used to characterize the electric fields in the cavity. The electric fields are attributed to surface adsorbates adhering to the cavity mirrors. We also investigate the coupling of a Rydberg atom ensemble to surface phonon polaritons (SPhPs) propagating on piezoelectric superlattices made from thin film ferroelectric materials. Strong coupling between the atomic and surface excitations can be achieved, due to the large Rydberg transition dipole moments and the local field enhancement of the SPhP modes. The system has many advantages for information transport since the atoms need only be placed at distances on the order of mms from the surface and the SPhPs do not couple to free space electro-magnetic fields. Experimental progress will be discussed, including the fabrication of submicron-period periodically poled Lithium Niobate using the direct e-beam writing technique.

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