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Exploring photon-mediated long-range interaction in a cold atom array trapped on a nanophotonic resonator MAY KIM, TZU-HAN CHANG, BRIAN FIELDS, CHEN-LUNG HUNG, Purdue University — Recent experimental demonstrations of trapped atoms near nanoscale photonic waveguides and cavities have proven that such hybrid platforms can offer unprecedentedly strong radiative coupling between single atoms and single photons, capable of mediating long-range interactions between atomic pseudo spins. It opens up the possibility to further engineer long-range quantum spin models that is otherwise difficult to achieve in cold atom experiments. In addition, with the coherent long-range atom-atom interactions mediated by photons with intermediate to high cooperativity, we can explore novel physics arising from few to many-photon induced self-organization. We expect rich physics arising from strong coupling between the atomic and photonic fields, which cannot be described by simple mean-field theory. We report on the design and experimental progress toward realizing such a novel system, using laser cooled cesium atoms localized near the surface of a high quality nanophotonic resonator, and discuss our schemes to control atom-atom interactions as well as ways to probe the resulting quantum states.

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