Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Strong atom-light interaction with trapped atoms on a micro-ring resonator TZU-HAN CHANG, BRIAN FIELDS, MAY KIM, CHENG-AN CHEN, CHEN-LUNG HUNG, Purdue University — We describe the design and fabrication of an efficient, scalable atom-light photonic interface based on silicon nitride micro-ring resonator on a transparent silicon oxide-nitride multi-layer membrane. This novel photonic platform is fully compatible with freespace cold atom laser cooling and stable trapping at around 100 nm from the micro-ring surface using optical tweezers or a two-color evanescent wave optical trap running at magic wavelengths. We demonstrate small radius (R $\sim 15\mu$m) micro-rings with high quality factor Q = 338,000, projecting a single atom cooperativity parameter of C > 25 and a vacuum Rabi frequency of $g/2\pi = 174$ MHz. We demonstrate that single atoms can be directly loaded near the surface of a micro-ring structure using optical tweezers and can be fluorescence imaged with high fidelity. We discuss our on-going experiment effort for coupling single atoms to a micro-ring and further fabrication improvements for quality factor Q > 1 million for creating strong atom-photon coupling.

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Date submitted: 01 Feb 2019 Electronic form version 1.4