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 ~ 15μm) 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/2π = 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.