Micro-Optical Cavities for Scalable Coherent Coupling

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Project Summary: As quantum sensing, computing, and communication have garnered substantial interest in the national and global arenas, it has become increasingly evident that this technology requires more robust and scalable means of transferring quantum state information between systems. Optical resonators are a convenient platform to achieve high coupling between photon states and other systems, such as atomic or ionic ensembles. Using arbitrary control of surface ablation, it is possible to realize a network of coupled atom and micro-optical cavity systems. Such a coupled network can be used to extend research for non-local interactions within single optical cavities to coupling separated but tightly coupled, non-local quantum systems. Further, networks of cross-cavity coupling will allow investigation of broader many-body physics effects with photonic systems. Using micro-optical cavity-atom systems, high-bandwidth cavity tuning should be possible and allow for *in situ* observation of atomic interference and transduction of controlled-excitations within ensembles of cold atoms for future atomic sensors with enhanced-robustness.
