DAMOP19-2019-020078

Abstract for an Invited Paper
for the DAMOP19 Meeting of
the American Physical Society

Strong interactions between photons in a Rydberg medium[1]

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Recent years have seen a remarkable development in our ability to manipulate individual photons and make them interact. I will present an unusual optical medium that is nonlinear at the individual-photon scale: In this medium, photons travel slowly, acquire mass, and exhibit strong mutual attraction, so strong that two photons can even form a bound state, or repel each other. The optical medium is an ultracold trapped atomic gas where photons travel under the conditions of electromagnetically induced transparency (EIT) that involves a highly excited Rydberg state. The strong interactions between two Rydberg atoms are then mapped onto the photons that travel through the medium as slow-light polaritons. Attractive interactions can be created in the standard EIT scheme, while repulsive interactions between photons are implemented in a double-EIT scheme.

[1]We acknowledge support by ARO and NSF CUA.