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Fermionization of strongly interacting photons in one-dimensional nonlinear medium DARRICK CHANG, VLADIMIR GRITSEV, Harvard University, GIOVANNA MORIGI, University of Barcelona, VLADAN VULETIC, MIT, MIKHAIL LUKIN, EUGENE DEMLER, Harvard University — Understanding strongly correlated quantum systems is a central problem in many areas of physics. The collective behavior of interacting particles gives rise to diverse fundamental phenomena such as confinement in quantum chromodyanmics, spontaneous symmetry breaking and phase transitions, and electron fractionalization in one dimensional systems and in the quantum Hall regime. While such systems typically involve strongly interacting massive particles, optical photons can also interact with each other in a nonlinear medium. In practice, however, such interactions are typically very weak. We describe a novel technique that allows the creation of a strongly correlated quantum gas of photons, which is made possible by the tight field confinement that can be achieved in a number of novel, one-dimensional optical systems. This confinement enables the generation of large optical nonlinearities via the interaction of photons with a nearby cold atomic gas, which can be further amplified by an optical Bragg grating that traps these photons within the medium. In its extreme, we show that a quantum light field can undergo *fermionization* in such one-dimensional media, which can be probed via standard photon correlation measurements. Realization of such systems can open a route for quantum simulators of *matter* Hamiltonians using light fields and novel applications in metrology and quantum information.

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