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Engineering Interactions in Waveguide-QED STUART MASSON, ANA ASENJO-GARCIA, Columbia University — By drawing on spectacular advances on trapping with optical tweezers, it is now possible to create one-dimensional ordered chains with perfect filling fraction. With small enough lattice constant, these chains feature dark states that allow for dissipationless transport of photons, allowing one to consider the array as a waveguide. Here, I demonstrate how to use such an atomic waveguide to mediate interactions between qubits, and between photonic excitations. A qubit, or multiple qubits, can be strongly coupled to the guided modes of the waveguide, as the group velocity of the guided modes can be made to be slow. This produces non-Markovian interactions between qubits due to time-delay, and between the waveguide and qubit, resulting in population trapping and the formation of bound states. Moreover, due to the two-level nature of the atoms, atomic waveguides are necessarily quantum. I show how this feature can be used to collide counter-propagating photons. This non-linearity is tunable through the system parameters, and allows for the exploration of many-body physics between guided photons.

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