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Photon number-selective dipolar-exchange induced transparency with Rydberg atoms DAVID PETROSYAN, Inst of Elec Structure & Laser, FORTH, Greece — A three-level atomic medium can be made transparent to a resonant probe field in the presence of a control field acting on an adjacent atomic transition to a long-lived state, which can be represented by a highly excited Rydberg state. The long-range interactions between the Rydberg state atoms then translate into strong, non-local, dispersive or absorptive interactions between the probe photons. These interactions can be used to achieve deterministic quantum logic gates and single photon sources. We show that long-range dipole-dipole exchange interaction with one or more spins – two-level systems represented by atoms in suitable Rydberg states – can play the role of control field for the optically-dense medium of atoms. This induces transparency of the medium for a number of probe photons n_p not exceeding the number of spins n_s, while all the excess photons are resonantly absorbed upon propagation. The system can thus serve as a photon-number filter or a transistor, with the number of appropriately prepared spins $n_s = 0, 1, \ldots$ being the switch.

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