Single photon sources using a coherently driven Rydberg atom gas

D. Petrosyan
Institute of Electronic Structure and, Laser, Foundation for Research and Technology - Hellas, GR-71110 Heraklion, Crete, GREECE
E-mail: `dap@iesl.forth.gr`

Single photons can serve as flying qubits for many important applications, including all-optical quantum computation and long-distance quantum communication and cryptography. Various sources of single photons are being explored, most of them use single emitters coupled to resonant cavities or waveguides. Free-space schemes typically rely on the DLCZ protocol for low-efficiency heralded preparation of a collective spin excitation of an atomic ensemble followed by its stimulated Raman conversion into a photon. Creating a deterministic source of single photons without requiring coupling to resonant optical structures remains an outstanding challenge.

I will discuss free-space techniques, employing strong, long-range dipole-dipole exchange interactions between Rydberg-excited atoms, to filter out single photons from a multiphoton light pulse propagating in an optically dense atomic medium [1], or to map a single atomic excitation to a collective excitation of an atomic ensemble which in turn can be coherently converted to single photon emitted into a well defined spatial and temporal mode [2, 3].

[1] D. Petrosyan, New J. Phys. **19**, 033001 (2017)

[2] D. Petrosyan, K. Mølmer, arXiv:1806.07094 [quant-ph]

[3] A. Grankin, P. O. Guimond, D. V. Vasilyev, B. Vermersch, P. Zoller, arXiv:1802.05592 [quant-ph]