

Spontaneous formation of one-dimensional Rydberg crystals in an ultracold gas

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Spontaneous formation of one-dimensional Rydberg crystals in an ultracold gas

P 71

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Rydberg atoms have experimentally interesting properties such as strong long-range Van der Waals interactions and the dipole blockade effect. In optical lattices the blockade effect ensures that only one Rydberg excitation per site is allowed, effectively creating a Rydberg crystal. We theoretically show that it is also possible for a one-dimensional Rydberg crystal to spontaneously form in a random ensemble of atoms, e.g. a magneto-optical trap. This is done using an existing Monte Carlo model [1] to simulate the excitation dynamics inside the intersection of two lasers for a two-step excitation scheme. With a blue-detuned laser for the upper transition, the first Rydberg excitation will occur after a relatively long time. That first Rydberg atom will then seed further Rydberg excitations, as the blockade effect shifts atoms at a certain distance into resonance. If two dimensions of the laser intersection are smaller than the blockade radius, a one-dimensional Rydberg crystal will form.

[1] C. Ates et al., Phys. Rev. A 76, 013413 (2007)

Backaction evasion with an optomechanical trampoline resonator cavity

P 72

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Quantum non-demolition measurements came up in the eighties [1] in connection to the design of interferometric gravitational wave detectors and have recently triggered interest again since several experimental groups succeeded in beating the standard quantum limit [2,3]. We present an optomechanical setup for evading classical measurement-induced backaction. Following a theoretical proposal by Clerk et al. [4], we use a cavity with a movable end mirror (trampoline resonator) and an amplitude-modulated cavity drive. This enables us to measure one single mechanical quadrature of the resonator with in principle infinite precision. We aim to extend the setup so that also quantum measurement backaction coming from the particle nature of light can be evaded.

- [1] Caves et al. Rev. Mod. Phys., Vol. 52, No. 2 (1980)
[2] Teufel et al. Nat. Nanotechnol. 4, 820-823 (2009)
[3] Anetsberger et al. Phys. Rev. A 82, 061804 (2010)
[4] Clerk et al. New J. Phys. 10, 095010 (2008)

Control of light in massively multichannel networks

P 73

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We investigate the propagation of quantum states in massively multichannel networks. The network consists of an array of five thousand nearest-neighbour coupled silicon nitride waveguides. The control is achieved using adaptive phase modulation of the light incident in every waveguide. In this way we realize massively multichannel linear optical networks with programmable quantum correlations, without tuning the network itself. We will report on the progress of this research and show first results.



Quantum optics of lossy asymmetric beam splitters

P 74

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Beam splitters are primitive components in any linear optical quantum network. When two indistinguishable single photons are incident on the two input ports of a lossless symmetric beam splitter, they both exit the beam splitter through the same output port. This is the well-established Hong-Ou-Mandel (HOM) interference. With the advent of complex wavefront shaping of light in a multiple scattering medium, programmable beam splitters for coherent light have been demonstrated. These beam splitters support any arbitrary phase relation between the two output ports and hence are asymmetric. Furthermore, the light lost due to the partial control of the incoupled light in the scattering medium results in lossy asymmetric beam splitters. Here, we derive the output states of these beam splitters and discuss the dependence of the HOM visibility on the phase difference between the output ports. We discuss these calculations in the context of our recent experimental measurements.

