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The unconventional photon blockade: Overview and recent developments

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Abstract

One of the main challenges in quantum science and technology is the generation of non-classical light, where the field fluctuations cannot be described by a classical probability distribution but only by the laws of quantum mechanics. The most paradigmatic case is that of photon antibunching, where photons are unlikely to occur simultaneously. Photon antibunching can be produced through a phenomenon called photon blockade, whereby a classical light field becomes antibunched by interacting with a nonlinear optical medium. It is the foundational element of single-photon sources, which play an essential role in many quantum information protocols.

Photon blockade is typically achieved in optical systems with strong single-photon nonlinearities, such that the presence of a single photon is enough to produce a sizeable change to how the system responds to an additional incoming photon. Recently, we proposed a class of quantum optics schemes whereby strongly antibunched light is produced by a system with a vanishingly small optical nonlinearity. This unconventional photon blockade (UPB) has recently been demonstrated in two different experimental contexts.

Here I will give an overview of the photon blockade mechanism, focusing in particular on the UPB case. I will discuss its basic properties, its most recent developments and its feasibility in various photonic platforms. I will conclude with a discussion of UPB as a potential new paradigm for single photon sources

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