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**Steady-State Superradiant Laser with an Atomic Beam Source**[1]
HAONAN LIU, JOHN COOPER, ATHREYA SHANKAR, MURRAY HOLLAND, University of Colorado, Boulder — The steady-state superradiance of atoms that possess an ultranarrow linewidth transition has promised to serve as a coherent light source with a linewidth as narrow as millihertz. However, due to radiative heating caused by the incoherent pumping process, the required parameter regime can be difficult to realize in experiments. Here we propose a new configuration of the superradiance laser, a superradiant atomic beam laser, which uses a continuous beam of excited atoms as its energy source instead of in situ incoherent pumping. The fact that the Lamb-Dicke approximation is not valid in the atomic beam configuration requires us to study the system with transverse Doppler effects and consider the effects of atomic beam spread. Our numerical simulations show that in the limit of large atomic flux, it is possible to realize steady-state superradiance with an ultranarrow linewidth. A wide parameter range for the cavity to atomic decay rate ratio has been explored, covering the lasing regime to the bad-cavity superradiance regime. A simple analytical model is given and real experimental parameters are suggested.

[1]DARPA QuASAR program

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