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Optomechanics of Antiferromagnetic Bose-Einstein Condensates
HUI JING, DAN GOLDBAUM, LUKAS BUCHMANN, PIERRE MEYSTRE, The University of Arizona — We investigate the matter-wave analog of rotational optomechanics. That is, in stead of considering the optomechanical coupling of a rotating mechanical element, we study the optomechanical effects associated with spin-wave excitations of a macroscopic mode in an antiferromagnetic Bose-Einstein condensate (BEC) inside a unidirectional ring cavity, relying on the well established fact that the antiferromagnetic BEC can be effectively described as a single quantum rotor characterized by angular momentum and angular displacement. We show that under suitable conditions the optomechanical coupling can be quadratic in angular displacement, and demonstrate how one can measure its eigen-energy nondestructively by observation of the cavity output signal. This model opens the door to the observation of spin-wave quantum jumps, as well as to controllable entanglement between a quantum spin gas and a mechanical element.

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