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Self-adapted Floquet Dynamics of Ultracold Bosons in a Cavity XI-WANG LUO, CHUANWEI ZHANG, The University of Texas at Dallas — Floquet dynamics of a quantum system subject to periodic modulations of system parameters provide a powerful tool for engineering new quantum matter with exotic properties. While system dynamics are significantly altered, the periodic modulation itself is usually induced externally and independent of Floquet dynamics. Here we propose a new type of Floquet physics for a Bose-Einstein condensate (BEC) subject to a shaken lattice generated inside a cavity, where the shaken lattice and atomic Floquet bands are mutually dependent, resulting in self-adapted Floquet dynamics. In particular, the shaken lattice induces Floquet quasi-energy bands for the BEC, whose back action leads to a self-adapted dynamical normal-superradiant phase transition for the shaken lattice. Such self-adapted Floquet dynamics show two surprising and unique features: *i*) the normal-superradiant phase transition possesses a hysteresis even without atom interactions; *ii*) the dynamical atom-cavity steady state could exist at free energy maxima. The atom interactions strongly affect the phase transition of the BEC from zero to finite momenta. Our results provide a powerful platform for exploring self-adapted Floquet dynamics, which may open an avenue for engineering novel quantum materials.

Xi-Wang Luo
The University of Texas at Dallas

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