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Dicke time crystals in driven-dissipative quantum many-body systems[1] BIHUI ZHU, ITAMP, Harvard-Smithsonian Center for Astrophysics, Harvard University, JAMIR MARINO, Department of Physics, Harvard University, NORMAN YAO, Department of Physics, University of California, Berkeley, MIKHAIL LUKIN, EUGENE DEMLER, Department of Physics, Harvard University — Recent experimental progress has opened up an opportunity to explore nonequilibrium phenomena in AMO systems, which can exhibit interesting behavior absent in equilibrium, with time crystals—phases of quantum matter that spontaneously break time translational symmetry—as an example. In particular, the paradigmatic Dicke model, which describes an ensemble of atoms collectively coupled to a leaky cavity mode, has recently been shown to host time-crystalline-like behavior of the collective spin in the presence of periodic driving [1]. Here, we investigate the situation where the mean-field solvability of the conventional Dicke model is explicitly broken by the addition of short-range interactions between the atoms. In this context, the interplay between driving, dissipation and interactions yields a rich set of dynamical responses including long-lived and metastable Dicke time crystals. Interestingly, when the additional short-range interactions are ferromagnetic, we observe time crystalline behavior at non-perturbative values of the interaction strength, suggesting the possible existence of stable order in a driven-dissipative quantum many-body system. [1] Z. Gong, R. Hamazaki, and M. Ueda, Phys. Rev. Lett. 120, 040404 (2018)

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