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Steady-state crystallization of Rydberg excitations in optically driven atomic ensembles MICHAEL HOENING, Department of Physics and Research Center OPTIMAS, University of Kaiserslautern, Germany, DAVID PETROSYAN, Institute of Electronic Structure and Laser - FORTH, 71110 Heraklion, Crete, MICHAEL FLEISCHHAUER, Department of Physics and Research Center OPTIMAS, University of Kaiserslautern, Germany — We study the emergence of many-body correlations in the steady state of strongly-interacting, driven dissipative systems. Specifically, we examine resonant optical excitations of Rydberg states of a confined gas of atoms interacting via long-range van der Waals potential employing numerical semiclassical Monte-Carlo simulations. At high atomic densities, all atoms within the so-called blockade radius form "superatoms," each accommodating at most one Rydberg excitation. Under strong uniform driving, the saturation of superatoms leads to quasi-crystallization of Rydberg excitations whose correlations exhibit damped spatial oscillations. Main features of the system can be understood in terms of an analytically soluble rate equation model with a "hard-rod" interatomic potential. Moreover we discuss the effect of a finite detuning of the optical excitations for which in the ground state of the corresponding unitary system incompressible phases have been predicted. To this end we apply DMRG simulations of the steady state density matrix.

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