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Crystallization in Ising quantum magnets and Rydberg superatoms[1]

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Dominating finite-range interactions in many-body systems can lead to intriguing self-ordered phases of matter. For quantum magnets, Ising models with power-law interactions are among the most elementary systems that support such phases. These models can be implemented by laser coupling ensembles of ultracold atoms to Rydberg states. In this talk, I will report on the experimental preparation of crystalline ground states of such spin systems. We observe a magnetization staircase as a function of the system size and show directly the emergence of crystalline states with vanishing susceptibility. Recent results connect these findings with the picture of Rydberg superatoms. We investigated their scalability and observed collective Rabi oscillations with the perspective of using Rydberg superatoms as collective qubits.

[1]Experiments performed at Max-Planck Institute of Quantum Optics, Garching, Germany