Simulating quantum spin systems using ultracold Rydberg atoms

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There is a currently growing interest in utilizing dipolar interacting Rydberg spin systems to study of non-equilibrium phenomena, like thermalization or relaxation of isolated quantum systems. The tunable strong, long-range interactions as well as the long lifetimes of highly excited Rydberg atoms also provide new opportunities for investigating the dynamics of strongly correlated many-body quantum systems with beyond nearest-neighbor coupling.

We present an experimental realization of a dipolar spin model by coupling two strongly interacting Rydberg states utilizing a microwave field. We study spin dynamics by letting spin systems evolve under designated interactions. The resulting magnetizations after the dynamics are extracted from the systems utilizing a state-tomography technique and a selective ionization. The result of the dynamics will be discussed in the talk.

[1] A. Piñeiro Orioli, A. Signoles, H. Wildhagen, *et al.*, arXiv:1703.05957 (2017).