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Quantum simulations with ultracold polar molecules and Rydberg atoms

Tuesday, 1 August 2023 14:30 (25 minutes)

I will present our results on the properties and non-equilibrium dynamics of few-body quantum systems based on ultracold polar molecules, Rydberg atoms, or their mixtures, and their applications as quantum simulators. On the one hand, we investigated interacting ultracold molecules in a one-dimensional harmonic trap as a fundamental building block of molecular quantum simulators, where we observed an interesting interplay of intermolecular interactions, external fields, and trapping potentials [1,2]. On the other hand, we studied the non-equilibrium properties of a Rydberg electron interacting with a gas of spin-1/2 fermionic atoms and found the dynamical emergence of the Kondo screening cloud. Finally, we explored the quantum simulation of the central spin model with a Rydberg atom surrounded by polar molecules in optical tweezers [3].

[1] A. Dawid, M. Lewenstein, M. Tomza, Two interacting ultracold molecules in a one-dimensional harmonic trap, Phys. Rev. A 97, 063618 (2018)
[2] A. Dawid, M. Tomza, Magnetic properties and quench dynamics of two interacting ultracold molecules in a trap, Phys. Chem. Chem. Phys. 22, 28140 (2020)
[3] J. Dobrzyniecki, M. Tomza, Quantum simulation of the central spin model with a Rydberg atom and polar molecules in optical tweezers, arXiv:2302.14774 (2023)

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