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Spectral signatures of vibronic coupling in trapped cold atomic Rydberg systems

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Atoms and ions confined with electric and optical fields form the basis of many current quantum simulation and computing platforms. When excited to high-lying Rydberg states, long-ranged dipole interactions emerge which strongly couple the electronic and vibrational degrees of freedom through state-dependent forces. This vibronic coupling and the ensuing hybridization of internal and external degrees of freedom manifest through clear signatures in the many-body spectrum. In this talk, we briefly discuss the recent results in Ref. [1] wherein we consider the case of two trapped Rydberg ions that realize a quantum Rabi model due to the interaction between the relative vibration and Rydberg states. We proceed to demonstrate that this hybridization can be probed by radio frequency spectroscopy and discuss observable spectral signatures at finite temperatures and for larger ion crystals.

[1]. J. W. P. Wilkinson, W. Li, and I. Lesanovsky, Spectral signatures of vibronic coupling in trapped cold atomic Rydberg systems, arXiv:2311.16998 (2023)

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