Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Rydberg Excitation Microscopy[1] MARCEL WAGNER, Max Planck Institute of Quantum Optics, Munich Center for Quantum Science and Technology, HOSSEIN SADEGHPOUR, Institute for Theoretical Atomic Molecular and Optical Physics, Harvard-Smithsonian Center for Astrophysics, RICHARD SCHMIDT, Max Planck Institute of Quantum Optics, Munich Center for Quantum Science and Technology — Probing atomic quantum gases at scales below optical wave lengths presents a major challenge, preventing direct observations of many-body dynamics at scales comparable to the interparticle distance. In this work we theoretically investigate a novel tool that employs Rydberg excitations as a means to convert spectroscopic data at optical wave lengths into information about correlations on UV length scales. At the core of such a Rydberg excitation microscope is the formation of ultra-long-range-Rydberg molecules. Since the spectroscopically probed formation of molecules depends crucially on the size of the Rydberg orbit, excitations with different principal quantum numbers probe correlations on tunable lengths scales. We show how the spectroscopic dimer line strengths can be related to correlation functions of fermionic quantum gases and how the probability distribution of Feshbach molecular wave functions can be observed at distances far below optical wave lengths. Our theoretical approach is based on the derivation of approximate sets of wave functions that can be generalized to complex many-body systems. This opens the perspective of Rydberg excitation microscopy as a new tool to study the real-time quantum dynamics of strongly correlated systems in a minimally destructive way.

[1]DFG, SPP 1929 (GiRyd)

Marcel Wagner
Max Planck Institute of Quantum Optics

Date submitted: 19 Mar 2020 Electronic form version 1.4