Light scattering experiments in dipolar gases

Ishan Varma,[1,*] Marvin Proske, Rhutwik Sriranga,
Dimitra Cristea, and Prof. Dr. Patrick Windpassinger
[1] *AG QUANTUM,*
Institute of Physics, Johannes Gutenberg University,
Staudingerweg 7, Mainz, Germany

In ultracold atomic ensembles where interatomic spacing is comparable to the wavelength of scattered light, direct matter-matter coupling through electric and magnetic interactions significantly influence sys- tem dynamics, challenging the approximation of atoms as independent emitters. We aim to study the role of magnetic dipole-dipole interactions (DDI) in the cooperative behavior of atomic ensembles using dyspro- sium, which has the highest ground-state magnetic moment (10 Bohr magnetons).

This talk focusses on the recently performed light scattering experi- ments in moderately-dense samples of cold dysprosium atoms. We study the scattering properties of the sample with respect to frequency detuning from resonance, optical depth, and external magnetic field. A detailed analysis of the fluorescence signal reveals first indications of super-radiance, which suggests cooperative behavior in the system. In addition, we also discuss the impact of optical dipole trap polarization on atomic lifetime and highlight the recent technical ad- vancements made in vacuum technology and the design of microscope objectives. These developments enable a higher degree of control and accessibility of the atomic sample.

* ivarma@uni-mainz.de; https://www.qoqi.physik.uni-mainz.de/