A New Dipolar Quantum Gas Machine

Parvathy Sekhar,[1,2] Giovanni Ferioli,[2] Pietro Lombardi,[3] Luca Tanzi,[1,4] and Giovanni Modugno[1,2,4]

[1] *European Laboratory for Non-linear Spectroscopy(LENS), Sesto Fiorentino, 50019 Firenze, Italy*
[2] *Dip. di Fisica e Astronomica, Universita degli studi di Firenze, Sesto Fiorentino, 50019 Firenze, Italy*
[3] *CNR-INO, Sesto Fiorentino, 50019 Firenze, Italy*
[4] *CNR-INO, Sede Secondaria Adriano Gozzini, 56124 Pisa, Italy*

We present the design and preliminary characterization of a new generation experimental setup aimed at realizing dipolar quantum gases of Dysprosium-162 (^{162}Dy) for studying novel quantum phases, including supersolids. The apparatus combines recent technical innovations with insights from existing literature [1] [2] to create a compact and versatile experimental platform, currently under construction. The setup features a 2D MOT to deliver a collimated flux of cold atoms into a narrow-line 3D MOT. We perform numerical simulations and spectroscopic measurements to validate the atomic velocity distributions at different cooling stages. These efforts lay the groundwork for achieving quantum degeneracy in our setup, with high atom numbers and shall enable future studies of long-range interacting many-body systems.

[1] S. Jin et al., Physics Review A 108, 023719 (2023).
[2] G. Lamporesi et al., Rev. Sci. Instrum. 84, 063102 (2013).