Measuring the dipolar interaction shift of the BEC critical temperature

The presence of interactions in many-body bosonic systems shifts the critical temperature for Bose-Einstein condensation compared to the ideal gas result. The case of contact interactions has been thoroughly studied, both theoretically and experimentally. This work presents our experimental effort to measure the ‘mean-field’ critical temperature shift due to magnetic dipole-dipole interactions in a harmonically trapped, ultracold erbium gas. Analysing the transition temperature dependence on the orientation of the dipoles in a highly prolate trap, we can isolate the contribution of the anisotropic dipolar interactions and demonstrate the agreement with predictions [1]. Additionally, we investigate the contribution of dipolar interactions to the non-saturation of the thermal gas past the transition [2], and outline a Thomas-Fermi approximation based model to explain the observation. These findings may enhance imaging calibration accuracy in cold atom experiments and could enable studies of beyond-mean field effects in the BEC transition in dipolar gases.

[1] Phys. Rev. Lett. **98**, 080407 (2007)   
[2] Phys. Rev. Lett. **106**, 230401 (2011)