Properties of the Trapped Dipolar Ultracold gases at Finite Temperatures

Y. Endo and T. Nikuni

Tokyo University of Science, Tokyo, Japan

Interest in dipolar gases has been growing since the realization of Bose-Einstein condensates (BECs) of ^{52}Cr atoms, which have large magnetic dipole moments. [1] The anisotropic and long-range nature of the dipolar interaction confers interesting properties to the equilibrium and dynamics of dipolar gases. On the other hand, the experimental effort is put into creating heteronuclear polar molecules whose large electric dipole moments give rise to strong dipolar interactions. However, despite many groups conducting experiments, no groups have succeeded in cooling polar molecules down to the quantum-degenerate regime.[2] It is thus important to investigate the temperature range in which the dipolar interaction has appreciable effects.

We study the properties of dipolar Bose and Fermi gases at finite temperatures. By developing a variational ansatz for the phase-space distribution function of a dipolar gas at finite temperatures, we discuss the effect of dipolar interactions on thermal equilibrium both of the Bose and Fermi systems. In addition, we study the stabilities and the dynamics of the dipolar gases and discuss how the dipolar effects can be observed in the relatively high-temperature regime, which is relevant to the current experiments.

[1] A. Griesmaier, J. Werner, S. Hensler, J. Stuhler and T. Pfau Phys. Rev. Lett. **94**, 160401 (2005).
[2] K. K. Ni, S. Ospelkaus, M. H. G. de Miranda, A. Peéer, B. Neyenhuis, J. J. Zirbel, S. Kotochigova, P. S. Julienne, D. S. Jin and J. Ye Science **322** 231 (2008)