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Abstract for an Invited Paper
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Expansion and Dipolar Collapse of a Quantum Ferrofluid

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I will report on the realization of a chromium Bose-Einstein condensate (BEC) in the regime of strong dipolar interaction[1] by using a magnetic Feshbach resonance to suppress the isotropic contact interaction. In this way, the anisotropic magnetic dipole-dipole interaction between ^{52}Cr atoms, which possess extraordinarily large magnetic moments, becomes comparable in strength to the contact interaction and can even be dominant in the condensate. We examine the system by observing the change in the expansion of the condensate when the s-wave scattering length is reduced close to the resonance. In the strongly dipolar regime, we even observe a suppression of the inversion of ellipticity during the expansion that is often considered the "smoking gun" evidence of Bose-Einstein condensation. The expansion dynamics is described by superfluid hydrodynamic equations where dipole-dipole interaction terms are included, similar to the way classical ferrofluids can be described by including such terms in classical hydrodynamics. When the contact interaction is reduced further by going even closer to the resonance, such that the s-wave scattering length becomes smaller than a critical value, we observe the collapse of the condensate due to the dipole-dipole interaction[2]. Since the interaction is anisotropic, this critical value depends on the trap geometry. The condensate can be stabilized against dipolar collapse by trapping it in a pancake shaped trap such that we are able to tune the scattering length to zero and thus to generate a purely dipolar BEC.

[1]T. Lahaye et al. Nature 448, 672 (2007)
[2]T. Koch et al. arXiv:cond-mat 0710.3643 to be published in Nature physics