Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Selfbound quantum droplets TIM LANGEN, MATTHIAS WENZEL, MATTHIAS SCHMITT, FABIAN BOETTCHER, CARL BUEHNER, IGOR FERRIER-BARBUT, TILMAN PFAU, 5th Institute of Physics and Center for Integrated Quantum Science and Technology, Universitat Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, Germany — Self-bound many-body systems are formed through a balance of attractive and repulsive forces and occur in many physical scenarios. Liquid droplets are an example of a self-bound system, formed by a balance of the mutual attractive and repulsive forces that derive from different components of the inter-particle potential. On the basis of the recent finding that an unstable bosonic dipolar gas can be stabilized by a repulsive many-body term, it was predicted that three-dimensional self-bound quantum droplets of magnetic atoms should exist. Here we report on the observation of such droplets using dysprosium atoms, with densities 10^8 times lower than a helium droplet, in a trap-free levitation field. We find that this dilute magnetic quantum liquid requires a minimum, critical number of atoms, below which the liquid evaporates into an expanding gas as a result of the quantum pressure of the individual constituents. Consequently, around this critical atom number we observe an interaction-driven phase transition between a gas and a self-bound liquid in the quantum degenerate regime with ultracold atoms.

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Date submitted: 07 Feb 2017 Electronic form version 1.4