Abstract Submitted
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**Observation of a Rosensweig Instability and Stable Quantum Droplets in a Dipolar Bose Gas** TILMAN PFAU, IGOR FERRIER BARBUT, HOLGER KADAU, MATTHIAS SCHMITT, MATTHIAS WENZEL, University of Stuttgart, IQST — Ferrofluids show unusual hydrodynamic effects due to the magnetic nature of their constituents. For increasing magnetization a classical ferrofluid undergoes a Rosensweig instability and creates self-organized ordered surface structures or droplet crystals. We observe a related instability in a Bose-Einstein condensate with strong dipolar interactions resulting in surprisingly stable droplet crystals. We find that quantum fluctuations which are the origin of genuine quantum many-body effects cannot be neglected and provide a stabilizing mechanism. We study experimentally individual stable quantum droplets containing about 800 atoms which are expected to collapse at the mean-field level due to the essentially attractive interaction. By systematic measurements on individual droplets we demonstrate quantitatively that quantum fluctuations stabilize them against the mean-field collapse. We observe in addition interference of several droplets indicating that this stable many-body state is phase coherent.

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