

Observation of the Roton Mode in a Dipolar Quantum Gas

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Author(s):

Lauriane Chomaz, Rick M. W. van Bijnen, Daniel Petter, Giulia Faraoni, Simon Baier, Jan Hendrik Becher, Manfred J. Mark, Falk Waechtler, Luis Santos, Francesca Ferlaino

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<https://arxiv.org/abs/1705.06914> [2]

The concept of a roton, a special kind of elementary excitation, forming a minimum of energy at finite momentum, has been essential to understand the properties of superfluid 4He. In quantum liquids, rotons arise from strong interparticle interactions, whose microscopic description remains debated. In the realm of highly-controllable quantum gases, a roton mode has been predicted to emerge due to dipolar interparticle interactions despite of their weakly-interacting character. Yet it has remained elusive to observations. Here we report momentum-distribution measurements in dipolar quantum gases of highly-magnetic erbium atoms, revealing the existence of the long-sought roton. We observe the appearance of peculiar peaks at well-defined momentum matching the inverse of the tight confinement length as expected for dipolar rotons. Our combined theoretical and experimental work demonstrates unambiguously the roton softening of the excitation spectrum and provides a further step in the quest towards supersolidity.

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