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Probing the roton excitation spectrum of a stable dipolar Bose gas GABRIELE NATALE, DANIEL PETTER, University of Innsbruck, RICK VAN BIJNEN, Institut fuer Quantenoptik und Quanteninformation, ALEXANDER PATSCHEIDER , MANFRED J. MARK, LAURIANE CHOMAZ, FRANCESCA FERLAINO, University of Innsbruck, ERBIUM TEAM — To understand the fundamental thermodynamical properties of superfluid 4He, the concept of roton, a particular elementary excitation, has been important. Such elementary excitation, which gives rise to an energy minimum at finite momentum in the dispersion relation, results from the strong interactions occurring in this dense quantum liquid. A similar phenomenon has been predicted in dipolar quantum gases[1] despite their weakly interacting character. Such an interesting finding roots in the long-range (momentum-dependent) and anisotropic nature of the dipole-dipole interaction. We here report the measurement of the excitation spectrum of a stable dipolar BEC[2], in a cigar shape trap, over a wide range of momenta which include the roton momentum. We also find that for a narrow range of interaction strengths, when the roton gap vanishes, it is possible to drive our system in a metastable supersolid state. Remarkably, this state possesses both density-modulation and phase-coherence whose lifetime is limited by 3 body losses. [1] L Santos, et. al., PRL 90, 250403, 2003 [2] D. Petter, et. al., arXiv:1811.12115 (2018)

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