

## **Self-organization in ultracold gases of magnetic atoms: from rotons to supersolids.**

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Ultracold quantum gases realize a pristine platform to study few- and many-body quantum phenomena with an exquisite level of control. The achievement of quantum degeneracy in gases of atoms possessing large magnetic dipole moments has opened up new research directions where long-range anisotropic dipole-dipole interactions are competing with the conventional short-range contact interactions. Within the last few years, thanks to a fine control of this interaction competition and the subsequent discovery of a unique stabilization mechanism based on quantum fluctuations, experiments using magnetic lanthanide atoms proved novel self-organized many-body quantum states. These include liquid-like droplets, roton excitations, and, most recently, supersolids, a paradoxical phase of matter where both solid and superfluid orders coexists. In my talk, I will present the latest results that we achieved with my former group in Innsbruck, and discuss prospects for the future research I want to carry out.