

Superfluid quantum Bose gas on a shell

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Quantum gases provide us with a very convenient and widely tunable system for the study of superfluidity. In particular, they can be confined in a large variety of geometries (harmonic traps, optical lattices, box traps, lower dimensional traps...), enabling the study of superfluid dynamics with specific constraints. In this talk I will present the behaviour of a superfluid quantum gas confined at the surface of an ellipsoid: the atoms can move freely in directions parallel to the surface and are strongly confined in the transverse direction. In a first series of experiments, the atoms initially at rest at the bottom of the shell —because of gravity— are set into rotation[1]: a vortex lattice develops at moderate rotation, and melts for large rotation speeds or low atom numbers. We explore the transition from a vortex crystal to a disordered vortex and eventually random phase fluctuations. In a second series of experiment, we implement a way to compensate gravity on the shell. We evidence new effects that prevent the atoms to fill the entire shell, leading to an annular density distribution at equilibrium [2]. These effects are of high relevance to microgravity shell experiments, as performed in particular in the ISS.

[1] Y. Guo et al., Phys. Rev. Lett. **124**, 025301 (2020).

[2] Y. Guo et al., Preprint arXiv:2105.12981