Contribution ID: **149** Type: **Oral Presentation**

Quantum vortices in ultracold atomic gases and in neutron stars: similarities and differences

Thursday 2 April 2020 15:30 (15 minutes)

Superfluidity is a generic feature of various quantum systems at low temperatures. It has been experimentally confirmed in many condensed matter systems, in 3He and 4He liquids, in nuclear systems including nuclei and neutron stars, in both fermionic and bosonic cold atoms in traps, and it is also predicted to show up in dense quark matter. Quantized vortices are regarded as hallmark of superfluidity. Nowadays, these excitations are routinely created and imaged in ultracold atomic gases. This platform allows also to tune the system towards regime of strong interactions. In this limit cold atoms become a good approximation for the dilute neutron matter in the inner crust of neutron stars where neutron-rich nuclei form a Coulomb lattice immersed in a neutron superfluid.

In my talk I will overview recent progress related to studies of quantum vortices in strongly interacting ultracold fermionic gases. Impact of spin imbalance on the internal vortex structure will be presented. In context of neutron matter, the spin imbalance is generated as results of very strong magnetic field and thus the results are relevant to vortices in magnetars. Next, I will focus on dynamical properties of the vortices with special emphasis on vortex-vortex and vortex-impurity interaction. Finally, I will discuss how the neutron stars community can benefit from ongoing effort of vortex studies in ultracold atomic clouds, especially in context of constructing accurate hydrodynamic model of glitching neutron star starting from microscopic (nuclear) level.

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Session Classification: Parallel 2A

Track Classification: Pulsar glitches and superfluidity