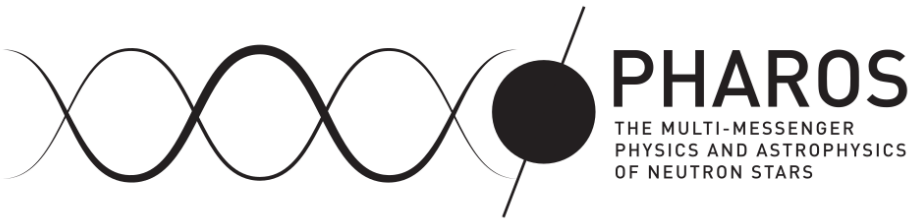

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From quantum theory of nuclear matter to hydrodynamics of neutron stars.

Thursday 27 September 2018 17:10 (20 minutes)

Neutron stars are the biggest objects in the universe that are thought to contain superfluid matter. However, almost fifty years after the first observation of pulsar, detailed theory of dynamics of the stellar interior still remains open to debate.
The reason for that is a large discrepancy of length scales - quantum theory operates at distances of fm and have to provide input to relativistic hydrodynamics describing motion of matter at ranges of km. In my talk I will propose a consistent connection between microscopic and macroscopic theory with an intermediate step –mesoscopic model. This model is validated by underlying quantum approach and can be utilized to construct hydrodynamic equations.
To illustrate the procedure I will concentrate on a case of neutron star crust, where nuclei immersed in neutron superfluid are expected to coexist with quantum vortices. After presentation of preliminary vortex-nuclei scattering simulations in quantum regime, I will demonstrate how obtained results can be used to legitimize semi-classical treatment of vortex moving through the lattice of nuclear impurities.
Due to strict validation, the proposed hierarchy of models can be considered as possibly the most accurate way to investigate the origin of dynamical phenomena like glitches (events of sudden spin-up of a whole neutron star).

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