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Towards microscopic simulator of neutron star crust: merging progress in fields of ultracold atomic gases and nuclear physics.

The density functional theory (DFT) is one of physics's most popular methods for simulating systems' microscopic properties. It allows for studies of many-body Fermi systems' static, dynamic, and thermodynamic properties in a unified framework while keeping the numerical cost at the same level as the mean-field approach. The development of (super)computing techniques in the last decade allows for DFT approaches to track the microscopic dynamics of systems consisting of tens of thousands of particles. This progress is supported by the construction of local energy density functionals of high accuracy for strongly interacting Fermi systems, which also include pairing
(superfluid) correlations. In this seminar, I will discuss possibilities that emerge from joint progress in the fields of nuclear and ultracold Fermi gas physics, and high-performance computing in the context of the construction of general-purpose tools for the modeling of neutron star crust. I will focus on the issue of modeling arbitrary phenomena taking place on scales exceeding Wigner-Seit cell size, with protons and neutrons as dynamical degrees of freedom.

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