Contribution ID: **303** Type: **Invited Talk**

Nuclear Dynamics in the Framework of Time-Dependent Density Functional Theory with Pairing Correlations

Friday, 23 August 2024 10:00 (30 minutes)

Superfluidity and superconductivity are remarkable manifestations of quantum coherence at a macroscopic scale. The existence of superfluidity has been experimentally confirmed in many condensed matter systems, in He-3 and He-4 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. Pairing correlations in nuclear systems are one of the most important characteristics of non-magic atomic nuclei. Various features related to high spin phenomena or to large amplitude collective motion, e.g., fission, indicate that these correlations are crucial for our understanding of nuclear structure and dynamics.

The time dependent density functional theory (TDDFT) is, to date, the only microscopic method that allows to investigate fermionic superfluidity far from equilibrium. In nuclear physics, it offers a microscopic description of low energy nuclear reactions, where fermionic degrees of freedom and pairing field dynamics are explicitly taken into account. Using the most powerful supercomputers, we are currently able to study real-time 3D dynamics without any symmetry restrictions, evolving up to hundreds of thousands of superfluid fermions.

During the talk, I will review several applications and qualitatively new results concerning nuclear collisions, including solitonic excitations and pairing instability in collision processes. I will also discuss the problem of effective mass determination for nuclear impurites in the neutron star crust. Last but not least, I will present the mechanism for vortex generation due to nuclear dynamics in the crust.

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