Contribution ID: **118** Type: **Oral**

Nuclear structure studies based on energy density functionals

Tuesday, 14 May 2019 10:00 (20 minutes)

The microscopic self-consistent mean-field (SCMF) framework based on universal energy density functionals provides an accurate global description of nuclear ground states and collective excitations, from relatively light systems to super-heavy nuclei, and from the valley of beta-stability to the particle drip-lines. Based on this framework, structure models have been developed that go beyond mean-field approximation and include collective correlations related to restoration of broken symmetries and fluctuation of collective variables. In particular this includes i) generator-coordinate method with projections on particle number, angular momentum and parity, ii) implementations for the solution of the collective Hamiltonian for quadrupole and octupole vibrational and rotational degrees of freedom, iii) microscopically determined interacting boson model. These models have become standard tools for nuclear structure calculations, able to describe new data from radioactive-beam facilities and provide microscopic predictions for low-energy nuclear phenomena of both fundamental and practical significance.

In this talk some of the recent applications of the SCMF framework will be highlighted: studies of shape evolution and coexistence, quadrupole and octupole shape phase transitions and SCMF based analysis of the dynamics of spontaneous fission process. Finally, perspectives for future calculations will be discussed.

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Session Classification: Session V