Contribution ID: **24**

Type: **Invited talk**

Nuclear structure and dynamics at finite temperature in the relativistic nuclear energy density functional approach

Tuesday, January 28, 2025 2:40 PM (40 minutes)

Nuclear processes in stellar environments, such as those occurring in core-collapse supernovae and neutron star mergers, occur at extremely high temperatures, ranging from millions to billions of kelvin. These conditions differ markedly from the zero-temperature limit typically assumed in traditional nuclear studies. In a recent study, we presented the first comprehensive mapping of nuclear drip lines at finite temperatures, extending up to 23 billion kelvin, using the finite-temperature relativistic Hartree-Bogoliubov model combined with the particle continuum subtraction technique. Our results reveal a counterintuitive increase in the number of bound nuclei at elevated temperatures, attributed to the thermal quenching of shell effects, particularly for isotopes with closed neutron shells at N=82, N=126, and N=184. Additionally, we explored key nuclear properties such as neutron emission lifetimes, quadrupole deformations, neutron skin thickness, and pairing gaps as functions of temperature. While finite-temperature effects are modest up to approximately 1 MeV, they become more pronounced at higher temperatures, leading to reduced nuclear deformations and the weakening of shell closures. We also developed a novel theoretical framework for calculating gamma strength functions, nuclear beta decays, and electron capture at finite temperatures. These insights into the behavior of hot nuclei have important implications for understanding nuclear reactions in astrophysical environments, particularly in explosive stellar phenomena.

Primary author: PAAR, Nils (Faculty of Science University of Zagreb)

Presenter: PAAR, Nils (Faculty of Science University of Zagreb)

Session Classification: Oral Presentation