Nuclear structure and dynamics at finite temperature

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Nuclear reactions in stellar environments such as core-collapse supernovae and neutron star mergers proceed under extreme thermal conditions, where temperatures reach up to billions of kelvin and profoundly modify nuclear structure and reactions. This talk presents recent advances in the microscopic description of hot nuclei based on relativistic energy density functional theory. First, a comprehensive mapping of neutron and proton drip lines at finite temperature, up to 23 GK, is explored within the finite-temperature relativistic Hartree–Bogoliubov framework including the particle continuum. Temperature dependencies of neutron emission lifetimes, quadrupole deformations, neutron skins, and pairing gaps are analyzed, revealing modest effects below $T \approx 1$ MeV and pronounced structural changes at higher temperatures. Finite temperature effects are also important in electromagnetic response in hot nuclei. A microscopic finite-temperature description of electric (E1) and magnetic (M1) γ-ray strength functions shows strong low-energy modifications due to thermal unblocking. Notably, the M1 contribution becomes increasingly important at finite temperature, in contrast to zero-temperature behavior, with direct implications for neutron-capture rates. Finally, the emergence of hot pygmy dipole strength is explored using finite-temperature relativistic quasiparticle random-phase approximation calculations for Ni isotopes. Significant enhancement of low-energy dipole strength is predicted with increasing temperature, especially in neutron-rich systems, providing key benchmarks for ongoing experiments and nucleosynthesis modeling in explosive astrophysical scenarios.