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Nuclear landscape for hot nuclei

Understanding nuclear structure and dynamics at finite temperatures is of crucial importance in both nuclear physics and nuclear astrophysics since the nuclei in the universe appear at finite temperatures; examples include the late stages of core-collapse supernovae and neutron star mergers [1]. Up until now, the nuclear energy density functional (NEDF) theory has become the standard tool to explore nuclear properties across the entire nuclide chart. However, the majority of large-scale calculations conducted so far have focused on nuclear properties at zero temperatures, overlooking the relevance of nuclei at finite temperatures. To address this, we have recently developed the relativistic finite temperature Hartree-Bogoliubov (FT-RHB), which also includes treatment of thermal scattering of nucleons in the continuum. Then, we mapped the nuclear landscape at temperatures up to around 20 billion kelvins [2,3].

In this talk, I will present our findings on the temperature dependence of various nuclear properties as well as the nuclear drip lines, and discuss the significant impact of temperature on these properties by comparing the results with the calculations at zero temperature. Our findings shed light on the nuclear landscape for hot nuclei, indicating that nuclear drip lines should be considered as limits that change dynamically with temperature.

1. F. Osterfeld, Rev. Mod. Phys. 64, 491 (1992).
2. A. Ravli, E. Yüksel, T. , N. Paar, Nat. Commun. 14 (1), 4834 (2023).
3. A. Ravli, E. Yüksel, T. Niki, N. Paar, Phys. Rev. C 109, 014318 (2024).

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