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IFIN-HH/ELI-NP Training and Conference Center
Sydney Benjamin Galès / main conference hall

From Stars to Laser-Driven Experiments: The Role of the Nuclear Quasi-Continuum

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Understanding how atomic nuclei absorb and emit γ radiation is of central importance to nuclear physics, nuclear astrophysics and applications. Over the past decade, we have focused on developing and applying innovative experimental and analytical methods to study the nuclear quasi-continuum, with particular emphasis on photon strength functions (PSF) and nuclear level densities (NLD). These quantities are key inputs for modeling reaction rates within the Hauser–Feshbach statistical framework, which in turn supports nucleosynthesis calculations in stellar and explosive astrophysical environments, as well as a wide range of applied modeling efforts from medical isotope production and nuclear energy to nonproliferation and national security.

In this seminar, I will present an overview of recent advances in PSF and NLD measurements, including extensions to the Oslo Method, as well as newly established techniques such as the Shape Method. These analytical approaches enable the systematic and consistent extraction of statistical nuclear properties across wide regions of the nuclear chart. I will highlight how these efforts have contributed to studies of i-process and p-process nucleosynthesis.

Complementary to the PSF and NLD program, I will also discuss our recent experiments at the Berkeley Lab Laser Accelerator (BELLA) facility, where laser-accelerated electron beams were used to induce photonuclear reactions. By varying the temporal and spatial structure of the electron beam, isomer-to-ground-state population ratios in ^{80}Br , populated via feeding from the quasi-continuum, were investigated. The results demonstrate clear dependencies of the isomeric yield ratios on the temporal and spatial characteristics of the electron beam, provide new benchmarks for reaction modeling in extreme environments and highlight the potential of high-power laser facilities to investigate nuclear excitation pathways in novel ways.

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