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Low-Energy Microscopes of Europe: Revealing the Hidden Features of Atomic Nuclei

Throughout science, researchers advance understanding by exploring the extremes of nature. In nuclear physics, this means investigating nuclei under controlled laboratory conditions, as well as studying those that exist only in vast cosmic environments —from stars to galaxies ($\sim 10^{25}$ m) —and connecting these observations to the microscopic realm ($\sim 10^{-15}$ m). Elucidating the behaviour of nuclei requires state-of-the-art accelerators delivering beams of varied lifetimes and energies, coupled with detectors capable of identifying signals as rare as needles in a haystack. Understanding reaction mechanisms and the underlying nuclear structure demands a broad study across many nuclei —much like needing a complete DNA sequence, rather than a single fragment, to fully grasp complex biological systems.

This talk will provide an overview of major European low-energy nuclear physics facilities —both operational and upcoming —highlighting their unique capabilities and complementarities in addressing key questions. These facilities are central to the Horizon Europe EURO-LABS project, which is building, for the first time in Europe, a unified subatomic research community by promoting the sharing of knowledge, technologies, and infrastructure across the fields of subatomic physics. Beyond their scientific contributions, these facilities play a crucial role in training the next generation of researchers and enabling innovations in nuclear applications. However, their central mission remains the advancement of our understanding of the many facets of this complex many-body quantum system —identifying the key variables that govern nuclear dynamics and uncovering the emergence of simplicity within complexity.

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