PHYSICS OF RADIOACTIVE NUCLEAR BEAMS: EXPLORING THE NUCLEAR LANDSCAPE

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There are less than 300 stable nuclei; they are surrounded by radioactive ones. Some of the unstable nuclei are long-lived and can be found on Earth, some are man-made, and several thousand nuclei are the yet-unexplored exotic species. The decay characteristics of most radioactive nuclei are determined by weak interactions. For heavier nuclei, where the electromagnetic interaction plays a more important role, other decay channels, such as emission of alpha particles or spontaneous fission, dominate. Moving away from stable nuclei by adding either protons or neutrons, one finally reaches the particle drip lines. The nuclei beyond the drip lines are unbound to nucleon emission; that is, for these systems the strong interaction is unable to bind all nucleons into one nucleus.

The uncharted regions of the (N,Z) plane contain information that can answer many questions of fundamental importance for nuclear physics: How many protons and neutrons can be clustered together by the strong interaction to form a bound nucleus? What are the proton and neutron magic numbers in the neutron-rich environment? What is the effective nucleon-nucleon interaction in a weakly-bound nucleus? There are also related questions in the field of nuclear astrophysics. Since radioactive nuclei are produced in many astrophysical sites, knowledge of their properties is crucial to the understanding of the underlying processes.

Nuclear life far from stability is different from that around the stability line; the promised access to completely new combinations of proton and neutron numbers offers prospects for new structural phenomena. The main objective of this talk is to discuss some of the challenges and opportunities for nuclear structure research with radioactive nuclear beams.

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