

Exploring the Universe - the scientific opportunities at radioactive ion-beam facilities

Karlheinz LANGANKE

GSI Helmholtzzentrum Darmstadt

How and where does Nature produce precious metals? How do cataclysmic events like supernovae and neutron-star mergers dynamically evolve and explode? Nuclear physics plays an essential role in unravelling the fundamental questions underlying the origin of the elements in the Universe and in understanding the astrophysical objects which produce them. But it is not only its astrophysical importance why nuclear physics is currently experiencing an exciting renaissance. It also reflects the tremendous progress achieved in recent years in deepening our understanding of nuclear structure and dynamics, in particular at the limits of nuclear existence. Not the least this was made possible by the unique research opportunities at the Radioactive Ion Beam Facilities which allow to produce and study short-lived exotic nuclei far off stability, which often play crucial roles in explosive astrophysical objects and nucleosynthesis.

Motivated by these successes several large-scale nuclear physics facilities of the next generation are currently under construction worldwide. The European flagship is the Facility for Antiproton and Ion Research (FAIR), being built as an international research center at the campus of the GSI Helmholtzzentrum fuer Schwerionenforschung in Darmstadt (Germany). With its new suites of accelerators, storage rings and instrumentation FAIR will open up unprecedented research opportunities in many fields of science, including nuclear astrophysics. In particular FAIR will allow to explore hot and dense matter at conditions existing in neutron-star mergers and to produce and study the neutron-rich heavy nuclei which are crucial to synthesis the precious metals in these events.

The talk will summarize the current and future landscape of nuclear physics facilities and will highlight how these facilities will bring us to a deeper understanding of the evolution of the Universe and the objects within.