Radioactive ion beam experiments at ISOLDE-CERN*

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On-Line Isotope Separator ISOLDE is a facility dedicated to the production of a large variety of radioactive ion beams for a number of different experiments in the fields of nuclear and atomic physics, solid-state physics, life sciences and material science. The facility is located at the Proton Synchroton Booster (PSB) of CERN.

At ISOLDE, radioactive nuclides are produced in thick high-temperature targets via spallation, fission or fragmentation reactions. The targets are placed in the external proton beam of the PSB, which has an energy variable from 1 to 1.4 GeV. The target and ion-source together represent a small chemical factory for converting the nuclear reaction products into a radioactive ion beam. An electric field accelerates the ions, which are mass separated and steered to the experiments. Until now more than 600 isotopes of more than 60 elements (Z= 2 to 88) have been produced with half-lives down to milliseconds and intensities up to 10^{11} ions per second. Major new developments in selective laser ionization technique have allowed the inclusion of over 20 new elements as pure beams of short-lived nuclei.

Physics at ISOLDE is pursued in several directions. The large variety of available species allows the systematic study of atomic and nuclear properties and exotic decays far from the line of stability. The key instrumentation developed and operational at ISOLDE consists of various laser and other atomic spectroscopy set-ups, high-precision ion traps, the spectrometer for Mass measurements at ISolde with a Transmission RAdiofrequency (MISTRAL) facility, and the nuclear orientation facility. In addition, new detector technologies are constantly developed to meet the new requirements set by the experiments on rare isotopes and decays. The results obtained have implications for the basic understanding of the atomic nucleus, but also for related fields like astrophysics and weak-interaction physics. The possibility of pure radioactive implants opens acess, to the investigation of problems in solid-state physics, in particular concerning impurities and defects in semiconductors. Bio-medical studies using radioactive isotopes for diagnosis and therapy have introduced life-science into the research programme.

Currently, the work is going on in accelerating radioactive ions further to energies high enough for nuclear reactions to occur. This experiment called REX-ISOLDE is to start its operation this year and will address novel phenomena predicted to occur in extreme neutron-rich isotopes of light elements and astrophysical processes.

At the end of the presentation the future of the ISOLDE facility will be discussed with a special emphasis on the potential synergies at CERN, including the high-power superconducting linac as a driver for RNB production as well as the exotic probes such as muons and antiprotons in studies of exotic nuclei far from stability.

* http://isolde.web.cern.ch/ISOLDE/