Highlights of the ISOLDE Facility and the HIE-ISOLDE project

M. J. G. Borge[1]

[1]Instituto de Estructura de la Materia, CSIC, Serrano 113bis, E-28006-Madrid, Spain
* mj.borge@csic.es

Introduction

The ISOLDE Radioactive Beam Facility is the CERN experiment for the production and acceleration of radioactive nuclei. It is dedicated to the production, study and research of nuclei far from stability. Exotic nuclei of most chemical elements are available for the study of nuclear structure, nuclear astrophysics, fundamental symmetries and atomic physics, as well as for applications in condensed-matter and life sciences. Since more than 15 years it offers the largest variety of post-accelerated radioactive beams in the world today.

In order to broaden the scientific opportunities beyond the reach of the present facility, the on-going HIE-ISOLDE (High Intensity and Energy) project will provide major improvements in energy range, beam intensity and beam quality. The first stage has boosted the beam energy of the current REX LINAC to 5.5 MeV/u where the Coulomb excitation cross sections are strongly increased with respect to the previous 3 MeV/u and many transfer reaction channels become available. The second stage of the energy upgrade is being implemented; most of the infrastructure was installed in the winter of 2017, and it will be completed for the start of 2018, allowing energies of the beam up to 10 MeV/u.

ISOLDE Facility description

The ISOLDE facility is located at the Proton-Synchrotron Booster (PSB) of the European Organization for Nuclear Research, CERN. The use of high-energy protons, 1.4 GeV, from PSB has been recognized to be optimum for the production of radioactive nuclei via spallation, fission and fragmentation reactions on thick targets. An increase of intensity from the injector in factors of 2 to 3 is also expected for 2020 due to the exchange of the primary ion source to the new proton linac (LINAC 4). In addition we plan to use the new higher energy of 2 GeV expected for the PSB in 2020 to boost the production of nuclei by spallation and fragmentation. The combination of these two improvements in the injectors, increases in the production of certain nuclei can reach up to a factor of 30.

The success of ISOLDE is due to the continuous development of new radioactive ion beams and to the improvement of the experimental conditions. More than 20 different combinations of target materials and ionizers are in use. Chemical selectivity is obtained by the right combination of target-ion sources giving rise to a selective production of more than 1300 isotopes of 74 different chemical elements, being the most recent ones Boron and Germanium. The knowledge accumulated over decades on how to construct targets and ion sources tailored to release pure beams of specific elements are one of ISOLDE's strong points.

In order to broaden the scientific opportunities of the facility, the on-going HIE-ISOLDE project was approved by CERN in September 2009 to provide major improvements in energy range, beam intensity and beam quality. The first stage boosting the beam energy of the post-accelerator to 5.5 MeV/u is fully operative delivering the first radioactive post-accelerated beams in September 2016. Beams can presently be accelerated up to 7.5 MeV/u via a combination of the normal conducting, REX-ISOLDE, and superconducting post-accelerator, HIE-linac. In the new energy regime the Coulomb excitation cross sections are strongly increased and many transfer reaction channels become accessible. The second stage is expected to be completed for the start of 2018 and will allow energies of the beam up to 10 MeV/u for A/q = 4.33, and even higher energies for lower A/q. Presently ISOLDE offers the largest variety of post-accelerated radioactive beams around the Coulomb barrier in the World. The intensity and beam quality upgrade addresses many aspects that