Implementation and Applications of Resonance Ionization Laser Ion Sources at ISOL Facilities

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Abstract

At Isotope Separator On-Line Facilities, isotope purity - extracting a beam of ions with the desired combination of proton number (Z) and atomic mass (A) - is often an essential requirement. This is most effectively achieved by coupling the element-selective process of multi-step laser resonance photo-ionization with mass-selective ion beam transmission using an electromagnetic dipole mass spectrometer.

At CERN/ISOLDE the Resonance Ionization Laser Ion Source (RILIS) comprises an array of industrial, scientific and custom made lasers (Nd:YAG, Ti:Sapphire and dye lasers) and is capable of selectively ionizing more than 35 different elements with efficiencies often exceeding 10%. In recent years state-of-the-art laser technologies and equipment monitoring and control systems have been implemented. These have increased the performance, reliability and capabilities of the RILIS to the extent that it is used for more than 75% of the ISOLDE experimental program. This equates to up to 3000 hours of ion beam production time annually.

In addition to its use as an efficient and selective ion source, the RILIS is itself a powerful spectroscopic tool for fundamental nuclear and atomic physics studies. In some cases this capability enables the delivery of isomer-pure ion beams.

In addition to summarising the key components and operational highlights of the ISOLDE RILIS, the challenges and considerations for the implementation of laser ion sources at ISOL facilities will be discussed.