Laser ion source development at IGISOL *

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The ion guide isotope separator on-line (IGISOL) is a fast and universal method for the production of exotic radioactive isotopes, however it lacks in both selectivity and efficiency. These important issues are being addressed via the construction and development of a laser ion source, coupled to the IGISOL facility. The conceived ion source will provide singly charged ionic species without compromising either the speed or universality inherent in the IGISOL system, and will allow future experiments to proceed with isotonically pure beams produced at greatly improved absolute efficiency.

Two forms of ion source development are being undertaken. The first is the well-developed laser ionization of elements within the gas volume of the ion guide. The second direction of development is toward the high selectivity achievable with a LIST (laser ion source trap) [1]. Unlike a conventional laser ion source, ion production in a LIST is achieved outside of the recoil stopping and thermalization region. The proposed JYFL LIST uses a RF-sextupole placed immediately after the ion guide in the gas expansion region. Counter-propagating lasers directed through the mass separator window selectively ionize the fast neutral atoms as they exit the ion guide within the effective trapping volume of the sextupole. By repelling any non-neutral fraction at the entrance to the sextupole, any produced ion transported to the extraction and acceleration stage of the mass separator is guaranteed to be a resonantly produced photo-ion.

The proposed laser ion source is of particular interest as a means to improve the efficiency and selectivity of refractory elements produced in proton-induced fission of ^{238}U. At present, the typical stopping efficiency for recoiling reaction products within the fission ion guide is 1%. Severe recombination losses due to the presence of strongly ionizing particles under on-line conditions limit the total efficiency of the ion guide to ~10^{-4}. It is expected that with higher buffer gas pressures and a longer residence time within the gas cell, more than 99% of recoils will be neutralized. With increased stopping efficiency and selective reionization we expect the total efficiency to improve by at least a factor of 100. This improvement will allow the continuation of both the mass measurement program at JYFLTRAP and the collinear laser spectroscopy program to proceed on the study of refractory isotope chains further from stability than is presently possible.

Recent results from the laser ion source will be discussed in this presentation. Furthermore, the status of the newly developed LIST technique will be presented.

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[1] K. Blaum *et al*., Nucl. Instr. And Meth. **B204**, 331 (2003)