# Recent Achievements of the ISOLDE Laser Ion Source ◇

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During 1997 the laser ion source, where stepwise resonant photo ionization is performed inside a high temperature cavity, became the most used ion source at the on-line isotope separator ISOLDE. The excitation schemes and ionization efficiencies of four new elements (Be, Cu, Zn and Cd) were tested off-line [1]. Thereof Be, Zn and Cd are the first elements with ionization potentials above 9 eV to be laser ionized. The intense UV beam for the first transition was achieved in a new laser set-up via frequency tripling.

## 1. Beryllium

The development of an on-line beryllium beam was triggered by the request of an ion implanted $^{7}$Be target to remeasure the astrophysically important cross section of $^{7}$Be(p,$\gamma$)$^{8}$B with reduced systematic errors. For results of the cross section measurement with a first target collected at ISOLDE see [2].

The magnetic moment of the halo nuclide $^{11}$Be could be measured by $\beta$-NMR spectroscopy [3]. Moreover ion beams of $^{7}$Be, $^{9}$Be, $^{10}$Be and $^{11}$Be were used to derive the isotope shift in the D-lines of Be$^{+}$ by collinear laser spectroscopy.

From an uraniumcarbide/graphite target also the exotic isotopes $^{12}$Be and $^{14}$Be were extracted. The isotopically pure beam of $^{12}$Be allowed to measure its $P_n$ value [4]. All particle stable beryllium isotopes are now available on-line at ISOLDE, with $^{14}$Be being the most short-lived isotope ever separated at ISOLDE.

## 2. Zinc

With the newly developed laser ionization scheme, a beam of $^{58}$Zn could be produced from a niobium foil target, allowing to measure the half-life and to deduce further spectroscopic information of the $T_z = -1$ nuclide [5].

## 3. Manganese

In parallel to an experiment using a laser-ionized $^{57}$Mn beam for on-line Mößbauer spectroscopy in semiconductors [6], nuclear spectroscopy of the neutron-rich Mn isotopes allowed to measure 6 new half-lives up to $^{69}$Mn [7].

## 4. Silver

Finally, the hunt for the $r$-process waiting point nuclide $^{129}$Ag was successful [8], due to the first combined use of:

- the fast beam chopper to suppress the DC background of surface ionized $^{129}$In,
- a thin-walled Nb cavity, which reduces the length of the Ag ion pulses thus improving the efficiency of indium suppression [1], and
- tuning of the laser frequency of the first atomic transition to the expected hyperfine splitting of $^{129}$Ag.

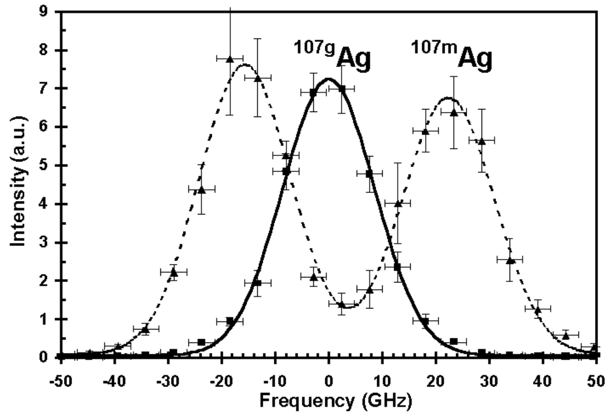


Fig. 1: The laser frequency was calibrated using the hyperfine splitting of the ground and isomeric state of $^{107}$Ag.

The possibility to ionize selectively low- and high-spin isomers was moreover applied for extensive gamma spectroscopy of neutron-rich Ag isomers [8].

Beside these main experiments collections were done of $^{10}$Be, $^{53}$Mn and $^{60}$Fe as calibration samples for AMS.

## 5. Outlook

In principle resonant photo ionization using dye lasers pumped by copper vapor may be applied for all metallic elements. Consequently, the development of ionization schemes for new elements will be continued. Online we want to separate in 1998 exotic copper isotopes on the neutron-deficient ($^{56}$Cu) and neutron-rich side (up to $^{80}$Cu) for a recently approved nuclear spectroscopy proposal [9]. For a better suppression of surface ionized background new ion source cavities will be tested.

The element selective laser ion sources are also ideally suitable for reactor based radioactive ion beam facilities like PIAFE (in Grenoble) and the Munich Fission Fragment Accelerator [10].

### References

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◇ Supported by BMBF (06MZ476) and DFG (436RUS/17/40/97).