The Buffer-Gas Cells for the MLL-IonCatcher and for SHIPTRAP ◇

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After extensive off- and on-line tests first on-line mass measurements were performed with the SHIPTRAP facility at GSI based on the successful operation of the buffer-gas cell/extraction-RFQ combination contributed by the LMU group [1]. In parallel a new buffer-gas cell/extraction-RFQ set-up was installed in Garching [2], allowing for further optimisation studies as well as for a physics program, especially in combination with the double Penning-trap system which is actually under construction at the MLL [3].

The present overall efficiency of around 0.5 % of SHIPTRAP (including the total efficiency of the buffer-gas cell/extraction-RFQ set-up of 4-8 %) allows for mass measurements of isotopes with production rates of several thousands per second after the SHIP separator. The first measurements with SHIPTRAP were performed in the rare earth region around A=147, using the reaction $^{92}Mo(^{58}Ni$,xpxn) with a primary beam energy of 4.36 MeV/u. In this run the masses of ^{147}Ho and, for the first time experimentally, of ^{147}Er and ^{148}Er were determined. The detailed data analysis of these measurements, aiming at quantified systematic uncertainties, is still in progress. Figure 1 shows the time-of-flight resonance of ^{147}Ho with a Fourier-limited resolution. In the near future a carbon cluster ion source [4] will be installed in order to improve the accuracy of the mass measurements.

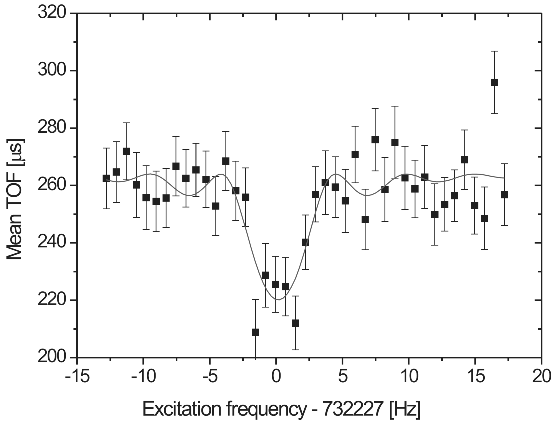

Fig. 1: Time-of-flight resonance of $^{147}Ho^{+}$.

Presently the efficiency of SHIPTRAP is still distinctly limited. While one main efficiency limit is given by the ion detection behind the SHIPTRAP Penning-trap system, where the optimisation is actually in progress, especially the efficiency of the buffer-gas cell needs further improvement.

Optimisation studies concerning the cell parameters will be continued with the MLL-IonCatcher device, which recently has been installed at the MLL. The new buffer-gas cell was designed for a longitudinal ion injection (in contrast to the perpendicular injection at SHIPTRAP), resulting in different dimensions compared to the SHIPTRAP buffer-gas cell. A more detailed description is given in [1] and [2]. Figure 2 shows a picture of the MLL-IonCatcher placed at the Munich test set-up with the 90^o dipole magnet for the ion separation and the chamber containing the Si-detector for the determination of the extracted ions behind the (RFQ-)extraction chamber.

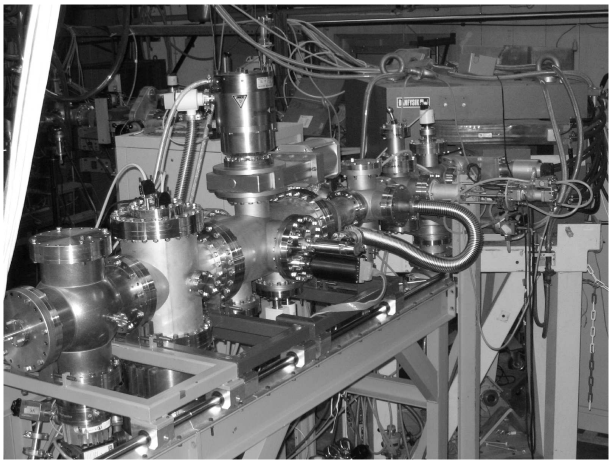

Fig. 2: Photograph of the MLL-IonCatcher placed at the Munich test set-up with the separator dipole magnet in the back. Following the extraction chamber the cross containing the Si-detector is visible.

In the first successful commissioning measurement at the Tandem accelerator the newly-built MLL-IonCatcher was studied using the α emitter ^{152}Er, which was created in the reaction $^{121}Sb(^{35}Cl$,4n) at a beam energy of 150 MeV [1]. The reacion products entered the cell through a Ti-foil with a thickness of 3.5 μm and were then stopped in the He buffer gas at a pressure of 60 mbar. An overall stopping and extraction efficiency of $\geq$1.5 % could be immediately achieved. Taking into account that the system could not be baked before the measurement, leading to limitations in the achievable electrical guiding fields inside the gas cell, a significant improvement of this value can be expected. Avoiding present geometrical acceptance losses at the entrance window by moving the gas cell closer to the dipole magnet will further improve the efficiency value. Thus besides proving the successful operation of the newly-built device its presently determined efficiency value should only be regarded as a lower limit.

References

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