Recent progress on the light ion guide project

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The Light Ion Guide project entered a new set-up phase in the last year [1]. Two new aluminum chambers were fabricated by Nor-Cal Products, Inc, according to our design and instructions. The chambers accommodate the new 2.5 m long SPIG, the support platform, and the vacuum barriers. The two boxes are electrically isolated through a commercially available 160 ISO ceramic break. The new SPIG has four sections and is constructed using commercially available flat aluminum extruded bars with two rounded edges. The choice of using flat bars was based on reducing the machining time, consequently reducing the machining imprecision and improving the straightness of the bars as well as the sturdiness of the whole SPIG assembly. The rounded tip of the bars has a diameter of 4.76 mm (3/16") and the inscribed circle has a radius of 4.23 mm. The current dimensions are based on the calculations presented in the paper [2] and the references therein.

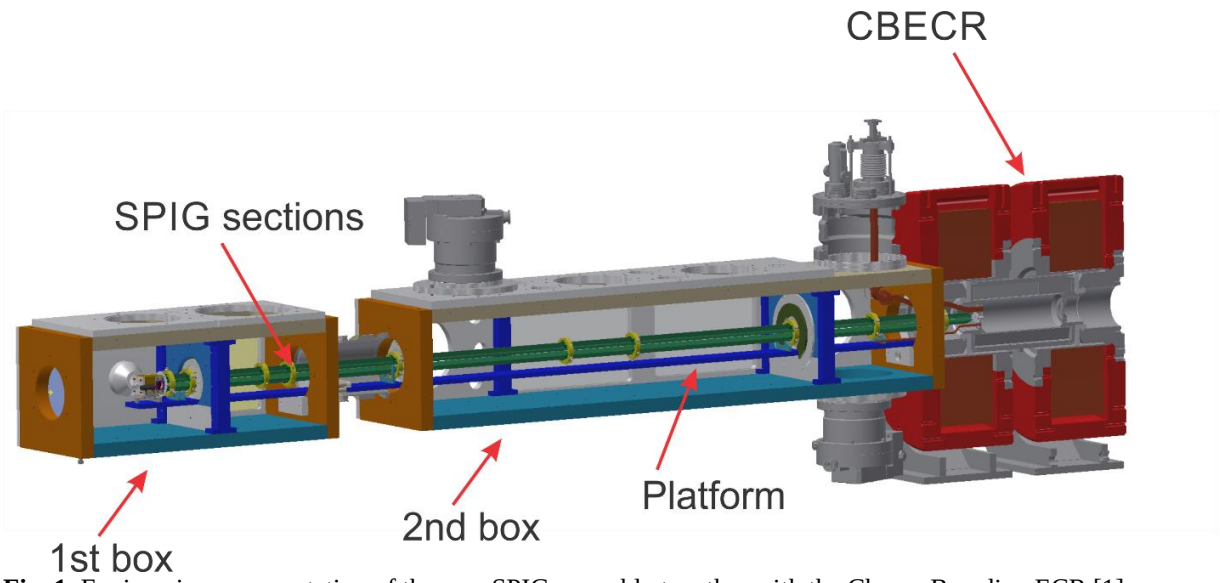

Fig. 1. Engineering representation of the new SPIG assembly together with the Charge Breeding ECR [1].

The transport efficiency of the two different geometry systems rods vs. bars has been tested offline using three different heated alkali sources (Fig. 2) (rubidium, cesium, and potassium) fitted with an extractor, and connected directly to the front-end of the SPIG. We did not notice any change in the transport efficiency, both versions of the SPIG performed in the same way.

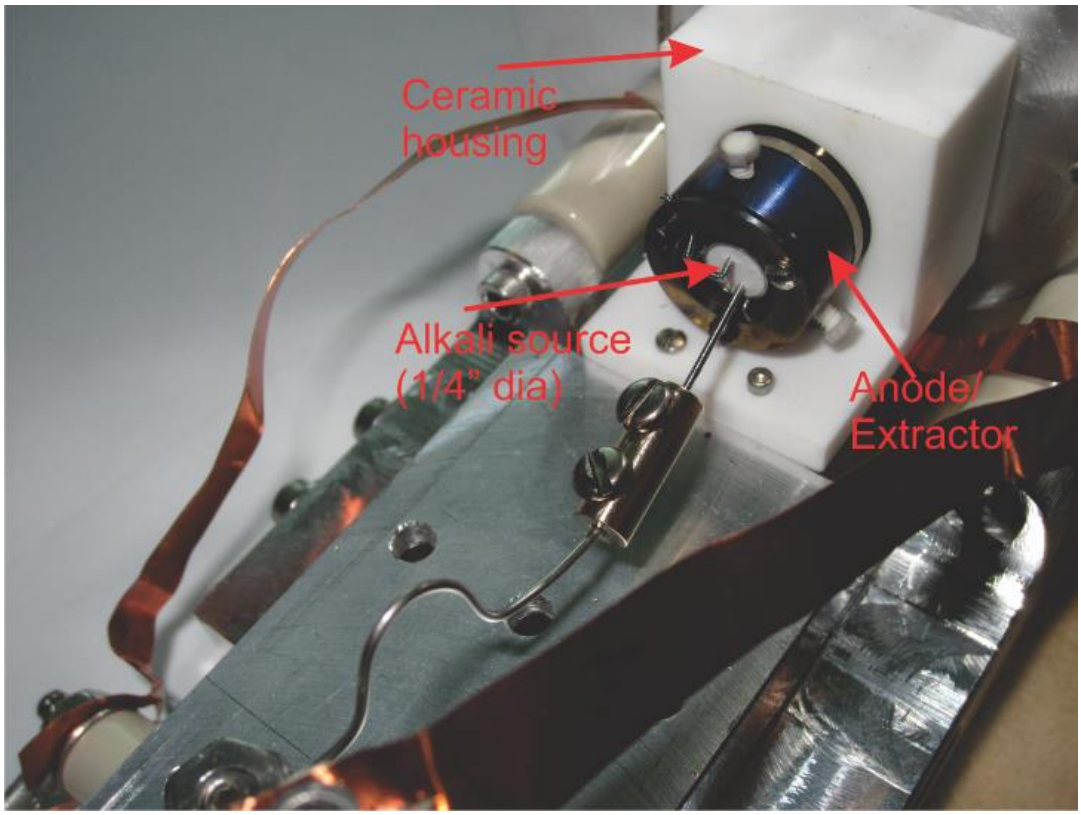

Fig. 2. Picture of the alkali source used in the off-line testing.

The charge breeding efficiency was tested using only the rubidium heated alkali source. The 2.5 m long SPIG was not very difficult to install and align inside the two boxes, pointing into the CB-ECRIS injection aperture. Fig. 3 shows a screenshot of one of the charge distribution spectra. The efficiency of the charge breeding was not calculated due to the contradictory numbers, but it is assumed to be greater than 30%-40%. With this setupit is difficult to measure the injected 1+ rubidium ion beam intensity. The 1+ injected beam can be measured at a very low anode voltage, between 5 V to 7 V, using the plasma chamber as a faraday cup, resulting in an unrealistic very low current. Consequently, the charge breeding efficiency is larger than 100%, which is not possible.

In conclusion, the new setup proved to be easier to work with and less challenging to align. The performance of the new SPIG/CB-ECRIS assembly appears to be very good with a charge breeding efficiency greater than 40%. In the future, we're going to restart the production of the radioactive ion beams and the charge breeding of its products.

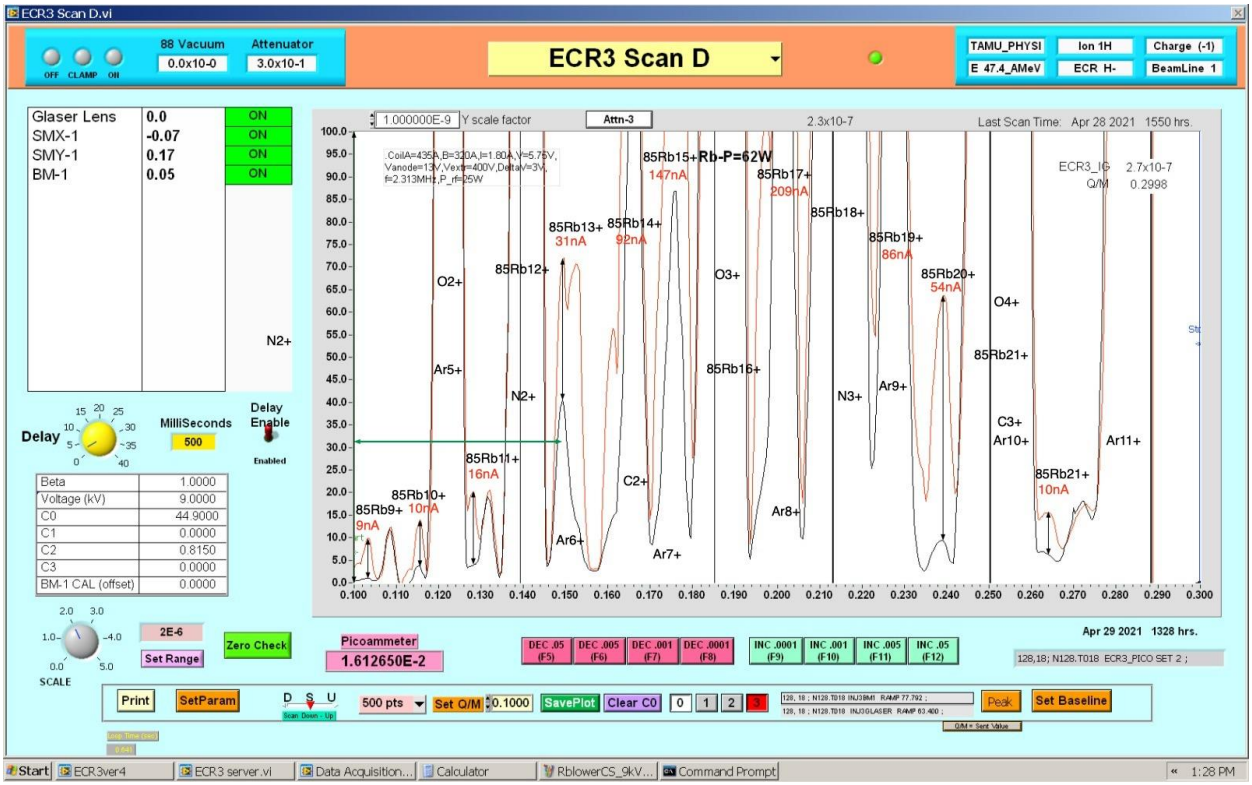

Fig. 3. Charge states distribution for the rubidium charge breeding.

[1] G. Tabacaru *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2018-2019), p. IV-11

[2] T. Brunner *et al.*, Int. J. Mass Spectrom. **379**, 110 (2015).