Stripping of Bi and U beams in He, N_2, Ar and Xe media in a modified 1.4 MeV/u gas stripper setup using a pulsed gas regime

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Obtaining a fundamental understanding of electron capture and loss processes of slow heavy ions in dilute gaseous media is desirable for a number of applications. Such processes have been studied for a long time, see e.g. the seminal work by Betz [1]. Applications include the separation of super-heavy nuclei in gas-filled recoil separators [2] or the production of highly charged ions for their further acceleration in heavy-ion research centers like GSI, RIKEN or the future FAIR facility [3]. Theoretical modeling of charge-changing cross sections and charge state distributions (see e.g. [4]) provides guidance for the choice of suitable gas media and profits from enhanced experimental data sets.

At the UNILAC linear accelerator at GSI low-charged heavy-ion beams are accelerated to 1.4 MeV/u and then stripped to higher charge states. Classically, an N_2-jet based stripper is in use and provides e.g. U^{28+} ions for further acceleration [5]. The UNILAC will serve as the first stage of the injector chain for FAIR and therefore has to meet high demands, including highest primary beam intensities in the form of ≤ 100 µs long pulses with a repetition rate of 2.7 Hz [6]. As part of a currently ongoing UNILAC upgrade program, a new setup for the 1.4 MeV/u gas stripper has been developed with the aim of increasing the yield of U^{28+} ions by reaching a higher stripping efficiency for this specific charge state.

For the new setup the laval nozzle of the existing gas stripper was replaced by a pulsed gas injection system [7]. The gas injection is synchronized with the beam pulse to reach a maximum pressure inside the interaction zone, kept within a T-fitting inside the main stripper chamber, during beam transit. At the same time, it allows using minimum gas volumes, important to ease pumping operation towards the adjacent beamline.

First measurements with the new stripper setup were carried out with Bi and U beams, using He, N_2, Ar and Xe as stripper gases. Charge state distributions and stripping efficiencies were measured and compared to the performance of the N_2-jet based stripper and to theoretical estimates.

At the conference, the new setup will be presented and the results of these measurements will be discussed and compared to the theoretical calculations. Plans for additional improvements of this new stripper setup will also be presented.

References:

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