Upgrade preparation for the 1.4 MeV/u gas stripper system for FAIR

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A key projectile for the FAIR facility will be ^{238}U. In routine operation of the GSI UNILAC, ^{238}U is generated by a MEVVA ion source that delivers ions with comparably low charge states (4^+), which are accelerated to 1.4 MeV/u in the high current injector (HSI). The 1.4 MeV/u beam passes a region of high gas density, in which the charge is increased to 28^+ by stripping of electrons. [1] Generally, higher intensities at charge states, preferably above 28^+, are desirable. This would allow to operate the accelerator more reliable and efficiently.

To optimize the stripping efficiency and potentially increase the achieved ion charge states a program to upgrade the gas stripper has started. The modified stripper setup is depicted in Fig. 1. As a first modification, switching from the continuously fed supersonic N_2-jet to a pulsed gas injection, synchronized with the beam timing structure, has been implemented. This allows to increase the gas pressure inside the stripper chamber during a beam pulse, while still reducing the total gas flow. The gas injection was positioned inside a T-fitting, which was installed in the main stripper chamber to match the beamline. In a first test the pressure in the main stripping section as function of the opening time of the valve and the pressure along the beamline adjacent to the gas stripper section were measured.

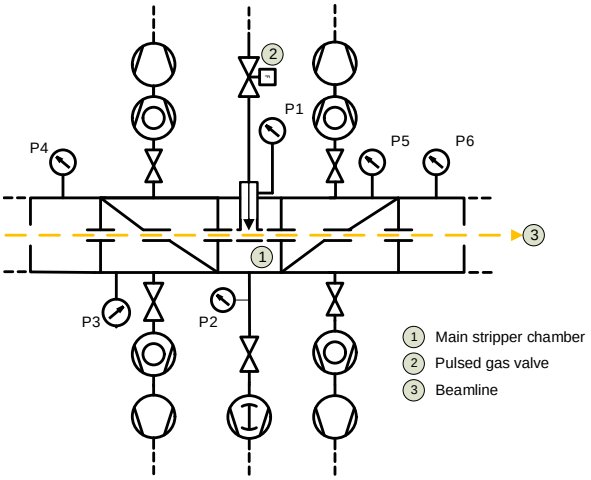

Figure 1: Schematic view of the modified 1.4 MeV/u gas stripper as to be used for first measurements with a pulsed gas valve in beam experiments in 2014.

The gas pressure on the valve was 3 MPa. The dependency of the pressure inside the stripper chamber and the pumping performance on the valve opening time was evaluated

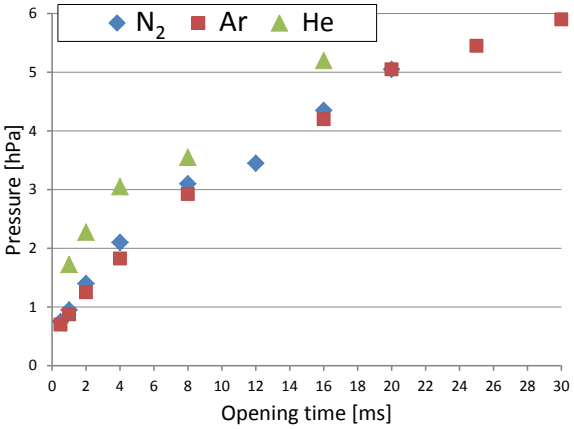

Figure 2: Pressure measurements at the gas stripper for different stripper gases as function of the opening time of the pulsed gas valve.

for three different gases (N_2, Ar and He). These gases are planned to be investigated as potential stripper gases in the future, together with Xe.

The results of the pressure measurements near the gas outlet in the main stripper chamber (diaphragm vacuum gauge at P1, Fig. 1) are shown in Fig. 2. As the pressure varried according to the pulsed gas flow regime, only the maximum pressure values during one pulse are shown. Note that the vacuum gauge was placed at an entry point on top of the main stripper chamber, so the shown pressures do not represent the real pressure in the beamline. The pressure increases with increasing opening time and starts to level off at longer opening times. N_2 and Ar are pumped at about the same rate whereas He is pumped less efficiently. Therefore, the pressure at the vacuum gauge is higher for He at the same opening times. The measured pressure increases to values above 5 hPa, independent of which gas was used. The pressure in the adjacent beamline was also measured (vacuum gauges P2-P6, Fig. 1).

The optimum conditions with respect to the pressure in the main stripping region and the adjacent beamline as well as the experimental charge state distribution will be evaluated in beam experiements in 2014.

References

[1] W. Barth, et. al., The new gas stripper and charge state separator of the GSI high current injector, Proccedings of LINAC, 2000.

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