# Results of the experiments on emittance transfer EMTEX

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## Introduction

EMTEX is an experimental setup to proof the principle of transverse emittance partitioning on an ion beam. According to simulations it is possible to transfer emittance by changing only the magnetic field of a solenoid with a charge state changing stripper inside. The change of charge state in the solenoid changes the set of eigen-emittances and the skew quadrupoles serve to remove inter-plane correlations. The field strength of the solenoid determines the amount of transfer between the eigen-emittances. A detailed description of the concept and the beam line itself is given in [1].

## Experimental setup

Besides some matching quadrupoles, the setup shown in Figure 1 consists of a stripping foil inside a magnetic solenoid field to couple the transverse planes and for the emittance transfer. Behind the solenoid a skew quadrupole triplet rotated by 45° is used to remove the coupling.

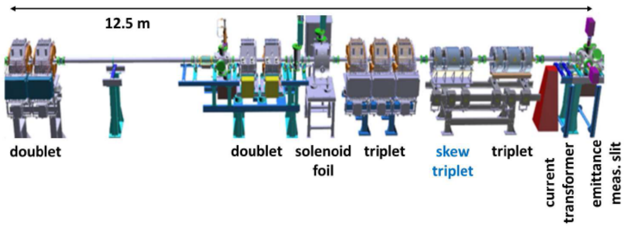


**Figure 1: Beam line of EMTEX (Emittance Transfer Experiment) in the transfer channel of GSI.**

## Results

For the experiment a low intensity beam of $^{14}N^{3+}$ at 11.4 MeV/u was fully stripped to $^{14}N^{7+}$ in a 200µg C-foil placed at the centre of the solenoid. For each solenoid setting full transmission was preserved and the emittances were measured for both planes.

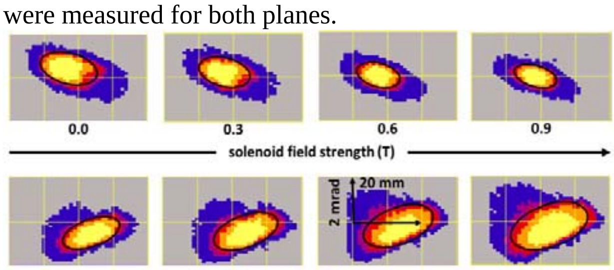


**Figure 2: Vertical (upper) and horizontal (lower) phase space distribution measured behind EMTEX for varied solenoid field strength. The black ellipses represent the 4*rms emittances.**

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Figure 2 shows the measured emittances behind EMTEX for different solenoid field strengths. All other magnet settings were kept constant and the Twiss parameters remained constant. Yet for these solenoid field settings the emittance partitioning changes and, as shown in Figure 3, matches the simulation results [2] very well. For this reason the multi turn injection efficiency into SIS18 has been investigated using this technique [3]. As expected, the reduced horizontal emittance directly translates into increased multi turn injection efficiency shown in Figure 4.

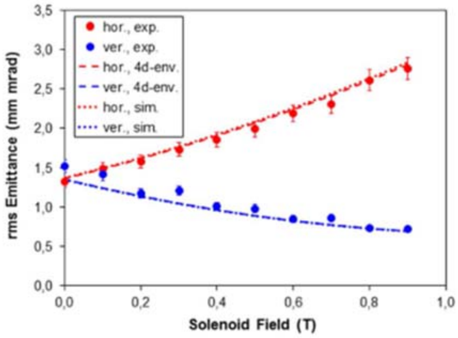


**Figure 3: Measured transverse emittances behind EMTEX for different solenoid field strength compared to the simulations.**

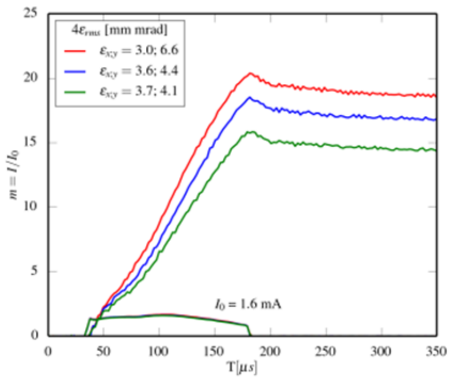


**Figure 4: Improved multi turn injection efficiency using EMTEX.**

## Outlook

To quantify the possible gain factor of this technique the limits should be investigated. This could be achieved by increasing the macro pulse length and thus the injection time above the regularly used 150µs.

## References

[1] C. Xiao, et al. PRSTAB **16**, 044201 (2013).
[2] L. Groening et al., PRL **113**, 264802 (2014).
[3] S. Appel, GSI Report 2013-03 (2013).



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