Status of the Compact LEBT Project

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The particle dynamics design of the new high current uranium low energy beam line for FAIR is fixed. Simulations based on uranium beam measurements at the North Terminal 2013 have shown that a straight beam line with quadrupoles as focusing elements allows for best beam quality and transmission [1-3]. The beam line components of this Compact LEBT, to be integrated into the existing High Current Injector (HSI) complex, are now under construction.

Design of the LEBT

Uranium beam measurements at the existing high current ion source North Terminal confirmed the performance of the ion source: From about 50 mA total beam current, 25 mA U^{4+} is provided within an emittance of 280 mm mrad (assumed RFQ acceptance) (Fig. 1).

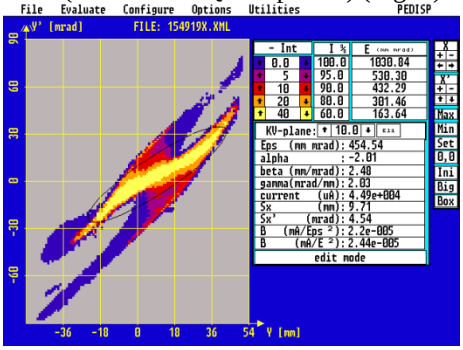

Figure 1: Uranium emittance behind ion source (49 mA tot. beam curr., 32 mA U^{4+}, 15 mA within 280 mm mrad).

Based on these measurements beam dynamics simulations have been performed [2, 3]. Considering a minimum distance of at least 4 meters from the new uranium terminal to the switching magnet (restricted space because of existing branches), two focusing elements must be used in this part of the LEBT. A quadrupole quartet (QQ) and a quadrupole triplet (QT) turned out to be the best solution. With this LEBT a focus 1.5 meter behind the QQ can be achieved, allowing for partly scraping off the undesired U^{3+} partition of the uranium beam with a collimator (see Fig. 2) [3].

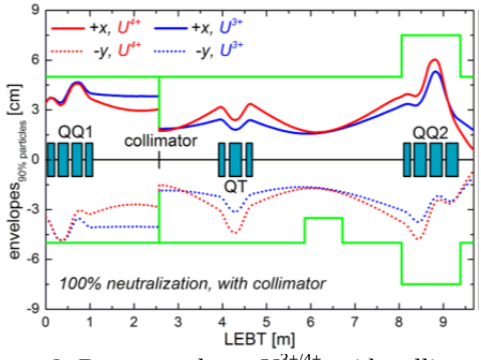

Figure 2: Beam envelopes $U^{3+/4+}$, with collimator.

U^{3+} ions are scraped off in the collimator or will be lost in the following LEBT and RFQ at low energy. Simulations show that more than 15 emA U^{4+} can be transported through the new LEBT [3].

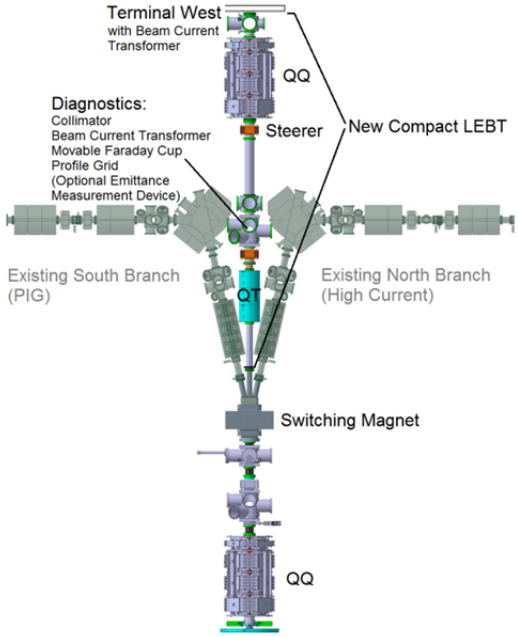

Figure 3: Planned modified HSI-LEBT (Courtesy V. Gettmann).

Besides a beam current transformer with large aperture (115 mm diameter) behind the ion source, a second beam current transformer is foreseen behind the first quadrupole quartet and the collimator, together with a profile grid (width 94 mm) and a movable Faraday cup (diameter 80 mm) as beam diagnostics.

For the commissioning phase, an emittance measurement device is also desirable. To avoid problems from space restrictions, this could be a device measuring only one plane (e.g. only vertically), as the beam shape from the ion source is symmetric.

Status of Components

The tendering for the power supply for the new quadrupole quartet has now started.

Civil construction and stress analysis is starting, magnet design work is going on, and the definition of beam diagnostics components is almost done.

References

[1] L. Dahl, proc. LINAC 2006
[2] S. Yaramyshev et al., proc. IPAC 2014
[3] C. Xiao et al., this report.

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