Development of a MEBT Design to replace current UNILAC Superlens*

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As part of the UNILAC upgrade, a new MEBT section is proposed [1]. It will provide improved matching to the IH-DTL and therefore a significant reduction in emittance growth and lossless transmission at 20.75 mA U^{4+}. This way the FAIR requirement of 18 mA U^{4+} behind the IH-DTL can easily be reached with the new MEBT. The design comprises of two quadrupole triplet lenses and a two-gap buncher cavity (see Figure 1), providing more flexibility than the existing "Superlens" MEBT [2]. This layout allows to reuse the existing XY-steerer, the vacuum valve and the diagnostics box. It also provides some spare room for additional/redesigned components.

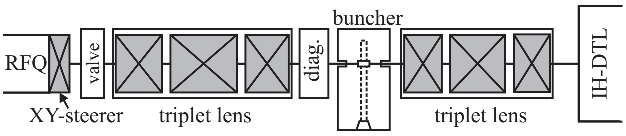

Figure 1: Layout of the proposed MEBT section.

The overall length of the new MEBT is 1.82 m which is 0.4 m longer than the existing MEBT section. The posibility of providing the extra length by moving the IH-DTL is currently being investigated.

At 20.75 mA the simulated losses in the Superlens using the RFQ output distribution after the 2008 upgrade amount to 12 % [1][3]. Losses are caused by insufficient transversal focusing and the limiting aperture of the Superlens.

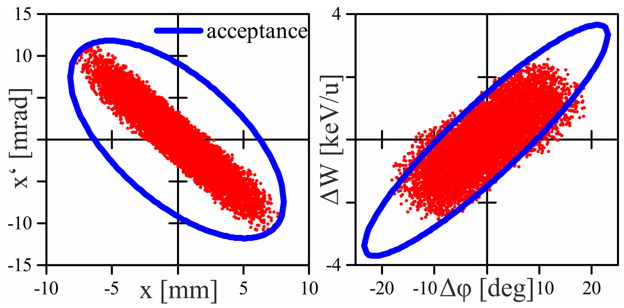

Figure 2: Output distribution of new MEBT with IH-DTL acceptance as reported in [4].

The new MEBT ensures transversal and longitudinal focusing matched to the IH-DTL input acceptance (Figure 2). By using two quadrupole triplet lenses, the design provides some flexibility to compensate changes in the input distribution. The gap voltage of the buncher cavity can also be adjusted if necessary to change longitudinal focusing.

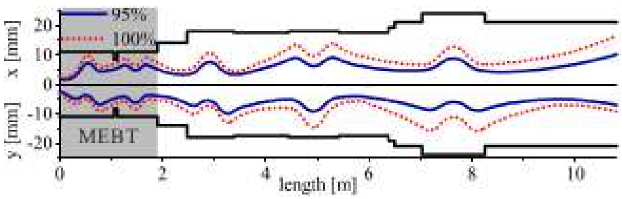

Figure 3: Envelopes of new MEBT and IH1 at 20.75 mA.

Table 1: Prestripper output parameter comparison.

	SL MEBT	New MEBT
Total length	1.4 m	1.82 m
Design current	16.5 mA	20.75 mA
Design A/q	65	59.5 (U^{4+})
MEBT-out	for 20.75 mA U^{4+}	
Transmission	87.94 %	100 %
ϵ_{rms} [mm mrad]	x:0.108 y:0.09	x:0.072 y:0.073
ϵ_{rms} [$\frac{keV}{u}$ ns]	0.389	0.358
IH-out		
Transmission	85.7 %	100 %
ϵ_{rms} [mm mrad]	x:0.162 y:0.158	x:0.117 y:0.138
ϵ_{rms} [$\frac{keV}{u}$ ns]	1.279	0.517

A comparison of output parameters of the prestripper section is made in Table 1 showing a reduction of rms emittance growth of 27.8 %, 12.7 % for x-x',y-y' and 59.6 % for the longitudinal plane behind the IH-DTL. Simulations with currents from 10 to 20.75 mA U^{4+} show lossless transmission for the MEBT+IH and even low losses at 35 mA U^{4+}. Upgrading the MEBT section would significantly improve the overall UNILAC efficiency and provide flexibility for high current operation which is required for FAIR.

References

[1] H. Hähnel, U. Ratzinger, R. Tiede, MOPP062, Proc. LINAC2014

[2] U. Ratzinger, R. Tiede, MOP31, Proc. LINAC96

[3] All simulations were performed with LORASR.

[4] R. Tiede, "HSI IH-DTL Acceptance Studies", Talk at IAP-GSI UNILAC-Upgrade meeting, Frankfurt, January 16th, 2014

* Work supported by BMBF 05P12RFRB9

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DOI:10.15120/GR-2015-1-FG-UNILAC-07