Development of a KONUS based High Energy Linac for the UNILAC*

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To meet the requirements of 15 mA U^{28+} at 11.4 AMeV for injection into the SIS18, the GSI UNILAC has to be upgraded. The Alvarez linac in the poststripper U^{28+} section of the UNILAC is nearing 40 years of operation and therefore has to be replaced to ensure reliable and efficient operation for FAIR. We propose an IH-DTL linac as replacement for the current GSI UNILAC Alvarez. The new design is based on the KONUS beam dynamics concept and delivers high beam quality well within FAIR requirements. It will drastically reduce the fabrication costs and will leave about 30 m within the UNILAC (Fig. 1) for later linac energy upgrades by e.g. 325 MHz CH-DTL cavities as in [1].

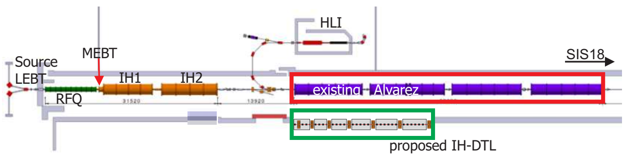

Figure 1: Sketch of the UNILAC accelerator (adapted [2]).

The proposed linac consists of six 108 MHz IH-tanks and seven quadrupole triplet lenses (Fig. 2). It is designed to accelerate 15 mA U^{28+} from 1.4 MeV/u to 11.4 MeV/u. The beam dynamics simulation includes realistic estimations of necessary drift lengths for tank walls, lens housing and phase probes for all lenses. The drift tube aperture is 25 mm and the lens aperture 40 mm with a maximum pole tip field of 1.05 T for the highest gradient of 50.1 T/m. The maximum on axis field is 11 MV/m.

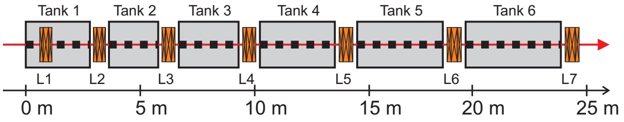

Figure 2: Sketch of the proposed IH-DTL.

Beam Dynamics (preliminary)

Beam dynamics simulations (LORASR) for the proposed high energy linac already show very promising results. The used input emittances are a pessimistic estimation based on the prestripper output emittances using the MEBT upgrade as proposed by the authors in [3]. The transversal input emittances are 0.8 mm mrad (90 %) and the longitudinal input emittance is 6.3 keV/u ns (90 %). A matching section with buncher will be necessary in front of the proposed design.

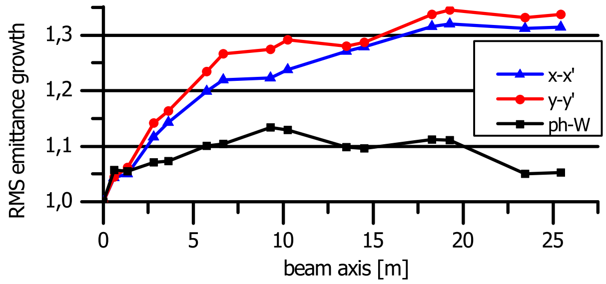

Figure 3: RMS emittance growth of the proposed high energy linac section.

The rms emittance growth along the proposed linac is shown in Fig. 3, indicating only 5.3 % in the longitudinal plane and about 30 % in the transversal planes. Further improvement in the transversal planes is expected to be achieved by adjusting the focusing scheme (Fig. 4).

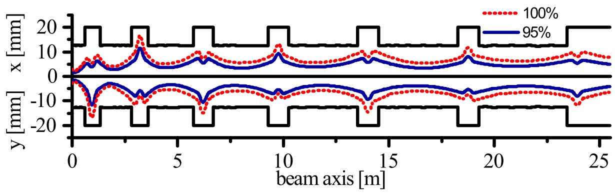

Figure 4: Transversal beam envelopes of the proposed high energy linac section.

In conclusion the proposed concept provides a modern alternative to the Alvarez concept. With a higher RF efficiency and lower production cost it can provide good beam quality. Further optimizations regarding beam quality as well as first CST model studies are currently ongoing at IAP. Final judgment on beam quality relies on the availability of beam dynamics simulations for the proposed new Alvarez.

References

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