

100 ns Bunch Spacing of Post-accelerated RIBs for the High Intensity and Energy ISOLDE Upgrade

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The feasibility of pre-bunching at a sub-harmonic frequency into the REX-ISOLDE RFQ was investigated to respond to a request for a 100 ns bunch spacing from several new experiments striving to operate at the HIE-ISOLDE facility, see e.g. [1]. The HIE-ISOLDE project [2] represents a major upgrade of the ISOLDE nuclear facility with a mandate to increase the energy and intensity, as well as improve the quality, of post-accelerated radioactive ion beams produced at CERN. The focus of the upgrade is a new superconducting linac providing 40 MV of accelerating potential capable of delivering to experiments all the radioisotopes available at ISOLDE at energies of over 10 MeV/u. The 100 ns bunch spacing would facilitate the identification of reaction products by time-of-flight techniques, which is not currently possible with the bunch spacing determined by the RFQ frequency of 101.28 MHz. A scheme involving a 10.1 MHz multi-harmonic buncher delivering bunches separated by 98.7 ns was studied. The RFQ beam dynamics was modeled using the PARMTEQM program [3] and single-particle simulations were carried out with a batch routine such that the acceptance, transmission and emittance could be characterized systematically as a function of the pre-buncher design variables: voltage, distance before RFQ, number of harmonics and relative amplitude of each harmonic component. The single-particle routine was important for characterizing the acceptance and for understanding how the satellite bunches are populated with the PARMTEQM model of the RFQ. Transmissions of well over 70% could be achieved in the main bunch; a chopper will be needed to remove the populated satellite bunches and to attain the <1% background specified by the experiments. The results of a comprehensive beam dynamics study will be presented in this contribution. The opportunity of using the pre-buncher to reduce the longitudinal emittance formed in the RFQ was also investigated.

References

- [1] S.J. Freeman et al., Letter of Intent for Physics at HIE-ISOLDE: HELIOS, CERN-INTC-2010-031, CERN, 2010.
- [2] M. Lindroos et al., Nucl. Instrum. Meth. B 266, pp. 4687–4691 (2008).
- [3] K.R. Crandall et. al., RFQ Design Codes, LANL report, LA-UR-96-1836, revised 2005.

Primary author: FRASER, Matthew Alexander (CERN)

Presenter: FRASER, Matthew Alexander (CERN)

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