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Development progress of a charge breeder for HIE-ISOLDE and TSR@ISOLDE

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As part of the HIE-ISOLDE design study options for a new high-performance successor to the REXEBIS charge breeder have been investigated. In a parametric study based on the HIE-ISOLDE linac upgrade, and a possible future extension of HIE-ISOLDE by TSR@ISOLDE, a set of design requirements for the new breeder was elaborated.

In collaboration with the Advanced Ion Sources group at Brookhaven National Lab a research program was initiated. Based on a BNL design a high-compression electron gun was built at CERN and shipped to BNL, commissioned, tested and brought to operation on the full scale TestEBIS. The electron beam was extracted from the gun, guided to the full compression region, transported through the ionization region, which has a comparable length to a HIE-ISOLDE breeder, and efficiently absorbed in the collector. The beam was transmitted in a magnetic field strength up to 3.3 T over about 4 meters distance. In these experiments we achieved electron currents up to 1.7 A and the electron energy was approximately 35 keV. This is a significant step towards the full HIE-ISOLDE charge breeder specifications of 3.5 A and 60 keV (up to 150 keV for TSR@ISOLDE). We have identified potential sources of a 20 mA loss current limiting the transmitted current to 1.7 A. At the moment, a series of design modifications is on the way to address and mitigate the limiting loss. In a series of preliminary experiments the electron beam was used to ionize residual gas in the unbaked EBIS vacuum chamber.

During the autumn of 2014 the experimental research is continued. At BNL an upgraded electron gun with enhanced optics is under preparation. At CERN we are building diagnostics tools to analyze the charge-state distribution, energy distribution and emittance of the charge bred ions during the commissioning. Furthermore we continue the design studies by addressing the required modifications in order to allow changing the electron collector optics from immersed flow electron-beams with 20-25% duty cycle to high compression beams of near 100% duty cycle.

In this presentation we would like to give a summary of the R&D on the upgrade of the HIE-ISOLDE charge breeder. We will present a revised parametric study, recent experimental results, experimental plans for the nearest future and the longer development perspective.

Primary author: SHORNIKOV, Andrey (CERN)

Co-authors: Dr PIKIN, Alexander (BNL); WENANDER, Fredrik John Carl (CERN); MERTZIG, Robert Christian (Technische Universitaet Dresden (DE))

Presenter: SHORNIKOV, Andrey (CERN)

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