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Status of the ReA Electron Beam Ion Trap Charge Breeder at NSCL

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The rare isotope beam re-accelerator facility ReA3 of the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University (MSU) employs an electron beam ion trap (EBIT) as charge breeder and injector. After breeding, the highly charged rare isotope beams are injected into an achromatic Q/A separator for ion species selection and then re-accelerated to energies of several MeV/u in a room temperature radiofrequency quadrupole accelerator and a subsequent superconducting linear accelerator.
Recent commissioning measurements investigated the performance of the EBIT charge breeder. The electron beam current density was determined to be j = 454 A/cm2 for an 800 mA electron beam in a 4 T magnetic field by an x-ray imaging technique [1]. This current density allowed for a charge breeding efficiency with continuous ion injection of about 5 % for stable 39K15+ ions [2]. Further studies focused on the energy spread of the extracted ions as well as the time structure of the ion bunches [3]. Several different ion extraction schemes were investigated to modify the ion bunch time structure: a slow voltage ramp spreading the bunch to up to 10 ms, aiming for a continuous-like ion beam and a scheme employing a fast switch for extracting a train of short (⊠2 µs) pulses. These schemes provide more flexibility in fulfilling the timing requirements of different experiments at the end stations of ReA.
In 2013, 37K17+ ion beams have been charge bred and re-accelerated for the first successful delivery of radioactive beams to the ANASEN detector array [4]. The latest developments at ReA include the installation of a cooler / buncher in front of the EBIT. This device allows for the injection of bunched ion beams into the charge breeder in addition to the so far utilized continuous injection mode. An overview of the facility and the status of the EBIT, including first results from the cooler / buncher commissioning will be presented.

References
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