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Intense Pulsed Heavy Ion Beam Production by EBIS and its Future Development *

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An Electron Beam Ion Source for the Relativistic Heavy Ion Collider (RHIC EBIS) was commissioned at Brookhaven in September 2010 and since then it routinely supplies ions for RHIC and NASA Space Radiation Laboratory (NSRL) as the main source of highly charged ions from Helium to Uranium. Using three external primary ion sources for 1+ injection into the EBIS and an electrostatic injection beam line, ion species at the EBIS exit can be switched in 0.2 s. Therefore, one species is often provided for NSRL and a second species at the same time provided to RHIC. Also, for asymmetric collisions in RHIC, EBIS has provided, with fast switching, $\text{Au}^{32+} + \text{Cu}^{11+}$, $\text{Au}^{32+} + 3\text{He}^{2+}$, and $\text{Au}^{32+} + \text{Al}^{5+}$. A total of 20 different ion species have been produced to date. Increased use of the relatively newly installed Laser Ion Source (LION) for 1+ ion injection into EBIS has simplified EBIS species changes and has been advantageous for operation in the fast injection mode. Reliability and stability have been very good, with the EBIS running 24/7 for months at a time, and often unattended.

For future *polarized* 3He^{2+} production we are looking into a concept that utilizes an additional superconducting solenoid where gas would be polarized in a high field, followed by injection and ionization at a relatively high pressure ($\sim 10^{-7}$ mB) region by the EBIS electron beam. Ions would then be transferred to the lower pressure ($\sim 10^{-9}$ mB) main trap, similar to the electron manipulation of ions formed from neutrals in a cryogenic EBIS. This would allow us to produce a good ratio of He^{2+} to He^{1+} ions and maintain a high level of polarization. This concept could also allow us to increase EBIS output intensity for ions that can be introduced as light or isotopically pure gases. Options to increase future performance also include addition of isotope separation in the external source injection line for accumulation of ions of low isotopic abundance in the EBIS during slow injection. A substantial increase of EBIS high charge output intensity could be obtained with increased electron beam current and source trap length. The length and the capacity of the ion trap has been previously increased by 20% by extending the trap by two more drift tubes, compared with the original design, and we believe that approximately linear gains in output can be obtained by further increasing the EBIS solenoid and trap length, with no impact to the present electron beam launching and collection schemes. The benefits of two parallel EBIS's working together, each comprised from serial superconducting solenoids / trap section modules similar to the Tandem EBIS concept will also be presented.

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