Hadron beam sources at Brookhaven National Laboratory

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To operate a particle accelerator, an ion beam must first be generated. At Brookhaven National Laboratory (BNL), currently state-of-the-art four types of ion sources are being operated, including the electron beam ion source (EBIS), laser ion source (LIS), optically pumped polarized ion source (OPPIS) and negative proton ion source. The EBIS is being upgraded. The original version had a single 5T 2m superconducting solenoid for confining the electron beam and 10E8 to 10E9 various ions were provided to relativistic heavy ion collider (RHIC) and NASA space radiation laboratory (NSRL). The new version has two solenoids and the trap length was doubled. Accordingly, the expected particle number will be increased. Moreover, it has the capability to produce a polarized 3He beam for BNL's future project called electron ion collider (EIC). The LIS, developed for providing low-charge state ion beam, is called LION, is used to provide seed beam to the EBIS. Presently, an enhanced version called LION2 is being built. It will provide more than 20 species beams, and species switching can be done in a second. This feature is very advantageous for galactic cosmic ray simulation at the NSRL. Also world highest peak intensities at various species are being explored by using the high charge state LIS with direct plasma injection scheme. This campaign is supported by a fund from the Department of Energy. The OPPIS started to produce polarized proton beam since 2000 and has been continuously modified. Currently beam current from the OPPIS reaches almost one milliampere which is the highest polarized ion beam current in the world. The negative ion source is used to provide proton beam. Typical beam current from the source exceeds 100 mA with 600 microsecond pulse width. This ion source is used to study medical isotope production. In the seminar, features and operation status of each source will be briefly explained.