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Ion-source development for the LERIB test facility

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At the off-line test facility of the Low-Energy Radioactive-Ion Beam, or LERIB [1] project, at iThemba LABS, two ion-sources are being developed: a surface ion source, and a Forced Electron Beam Induced Arc Discharge, or FEBIAD, plasma ion-source [2].

The hot-cavity type surface ionization source has already undergone some development at the LERIB off-line test facility. The production of ions from group 1 was accomplished with the creation of stable beams of $^{39}\text{K}^+$, $^{41}\text{K}^+$ and $^{23}\text{Na}^+$, and beam currents were measured in the μA range. This source is a good choice as a pilot beam for similar mass beams that could eventually be used for RIB experiments - stable and bright beams can be created, and they can be switched on or off quickly by limiting heating current through the tantalum oven. The LERIB FEBIAD is in its initial stages of development. The FEBIAD will be essential for the production of RIBs, as a wide variety of elements can be ionized with it through the process of electron-impact ionization. The FEBIAD under consideration will include the use of magnetic fields for the confinement of the electron beam. Magnetic fields produced by solenoids have been shown to improve the ionization in plasma ion sources [3]. Electromagnetic solenoid fields as well as arrays of permanent magnets will be studied for use in the LERIB FEBIAD.

[1] J. Conradie, et al., Progress with a New Radioisotope Production Facility and Construction of Radioactive Beam Facility at iThemba LABS, (2016).

[2] T. Stora, Radioactive Ion Sources, CERN Yellow Report CERN-2013-007 pp.331-349 (2014).

[3] J. Ballof, et al., A cold electron-impact ion source driven by a photo-cathode, (2022).

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