A HIGH-EFFICIENCY, LOW CHARGE-STATE ECR ION SOURCE FOR RIB GENERATION

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Chemically active radio-nuclei target-release products often arrive at the ionization chamber of the source as atomic constituents in a variety of molecular carriers. Since hot-cathode sources, such as the CERN-ISOLDE electron-beam-plasma ion source, presently used at the HRIBF, do not efficiently dissociate and ionize the atomic constituents of such carriers, the species of interest are often distributed in a variety of side-band ion beams with different masses, and thereby, their intensities are diluted. In order to realize maximize RIB intensities, it is important to concentrate the species of interest into a single mass-channel. The ECR ion source is arguably the best source for completely dissociating strongly bound molecules and ionizing their atomic constituents. While these sources are most frequently used for generating multiply-charged ion beams for which the plasma confining magnetic field must be optimized at high field values, the magnetic field can also be customized to accentuate low charge-state ion beam generation as required for radioactive ion beam (RIB) generation at the HRIBF. Therefore, we have designed a low-charge-state, volume-type, ECR source for potential use in the HRIBF research program. A three-dimensional, schematic representation of the source is illustrated in Fig. 1. The source design is predicated on recent advances to the technology through the creation of a uniform central magnetic field or large ECR zone.[3] The source features an all electromagnetic field with a variable mirror-ratio field at ion extraction as required for optimizing low-charge-state ion beam generation. The axial magnetic field profile for the source is shown in Fig. 2. For this application, the plasma chamber will be made of Ir lined Ta as required for high-temperature operation. Ir is used to reduce the residence times of atoms/molecules that are adsorbed on the surface.

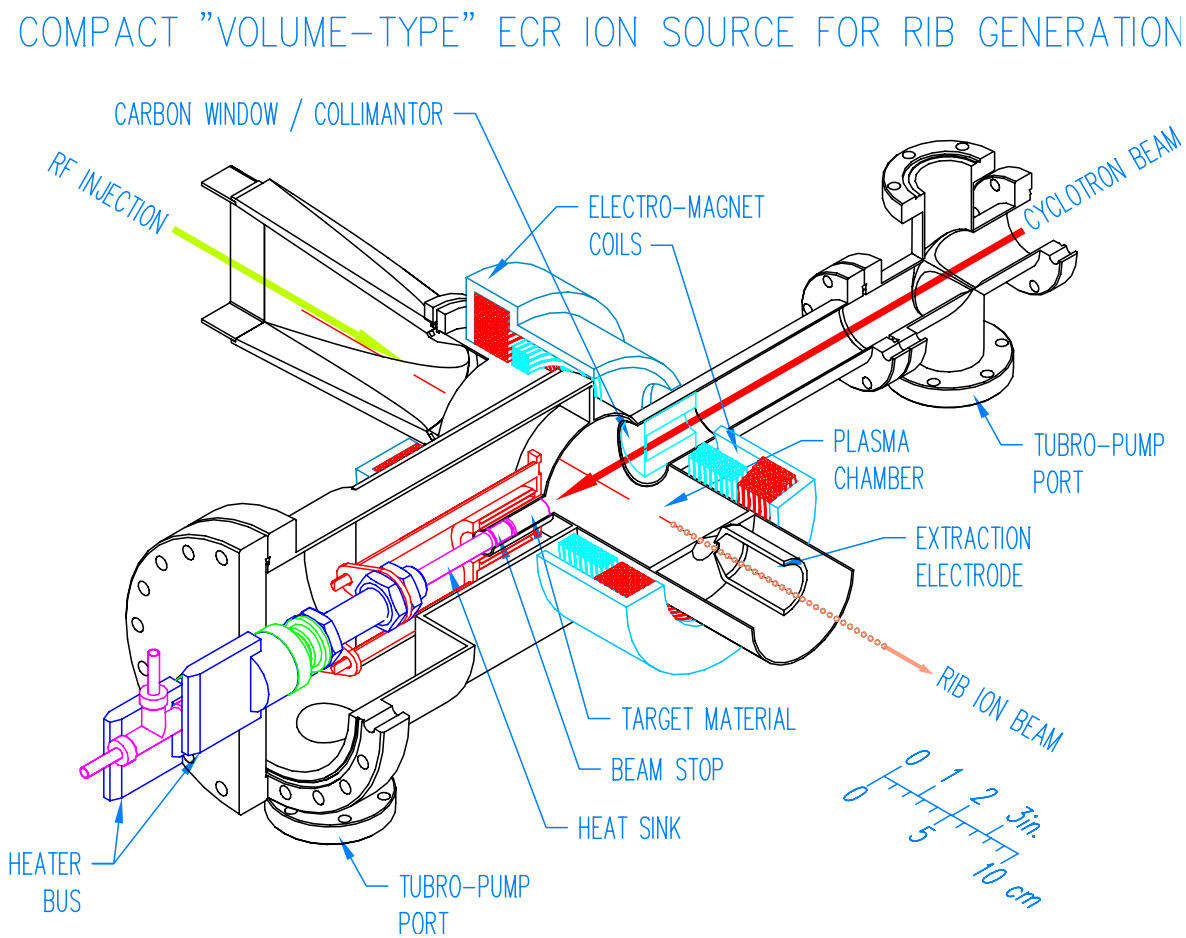

Fig. 1. Schematic representation of the low-charge-state ECR source.

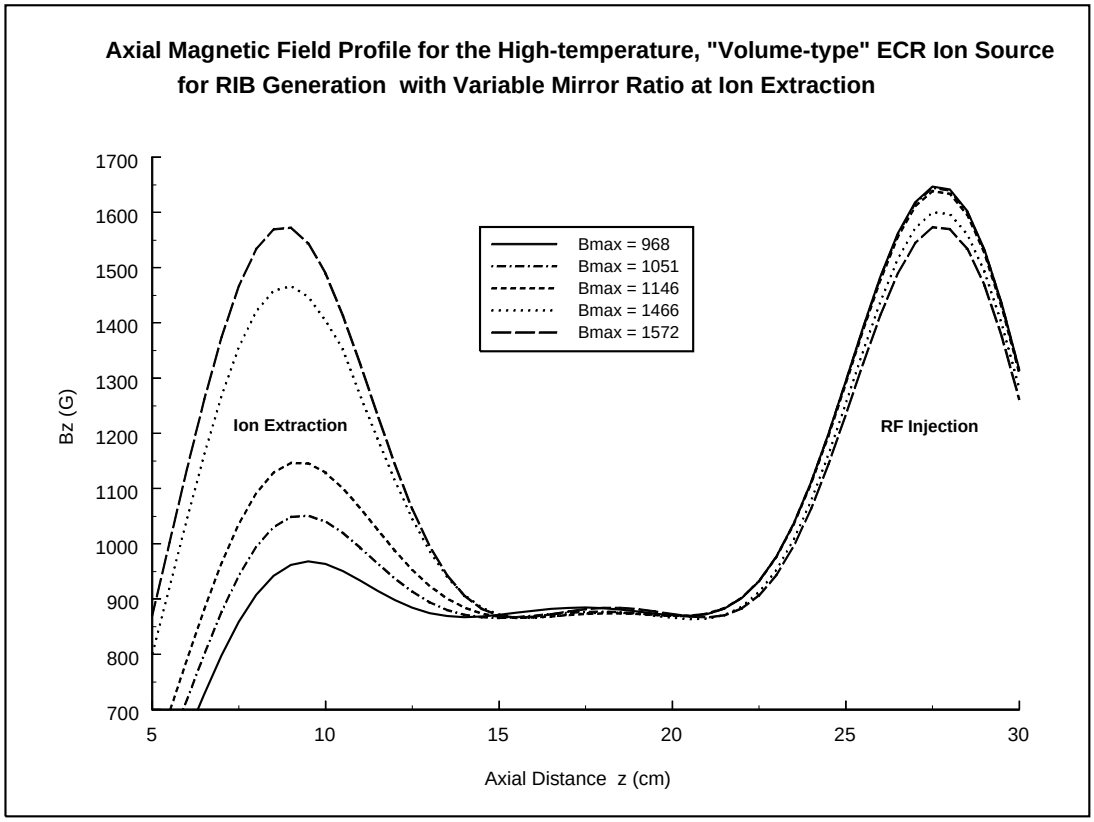

Fig. 2. Axial magnetic field profile for the low-charge-state ECR ion source.

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[3] G. D. Alton and D. N. Smithe, *Rev. Sci. Instrum.* **65** (1994) 775.