Slow Highly Charged Ions by Electrostatic Deceleration

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Slow Highly Charged Ions by Electrostatic Deceleration

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Synopsis

An electrostatic, cylindrical deceleration lens has been designed, fabricated and tested to slow down beams of highly charged ions. Highly charged ions from an electron cyclotron ion source at a few tens of keV per charge state are decelerated to a few eV/q using the electrostatic lens. The lens enables the study of the interaction of highly charged ions with matter at very low collision velocities.

Highly charged ions carry kinetic energy by virtue of their velocity and potential energy by virtue of their charge. Slow highly charged ions are needed for ion-matter interaction studies on a fundamental level to explore the subtle potential energy effects which usually remain hidden in studies using energetic heavy ions. In case of ion-atom, ion-molecule, ion-cluster and/or ion-surface interactions, studies on electron electron correlation effects, post collision interactions, dissociation dynamics, creation and decay of hollow atoms are possible and these will help to explore the fundamental aspects of such interactions.

![Figure 1](image1.png)

**Figure 1.** Cutout view of the mechanical design of the deceleration lens

The design and implementation of a purely electrostatic deceleration lens used to obtain beams of highly charged ions at very low energies is presented [1]. The deceleration lens is coupled to the beamline of a superconducting electron cyclotron resonance ion source, the PKDELIS [2] which is installed at Inter-University Accelerator Centre, New Delhi, India. The design of the lens is such that it can be used with parallel as well as diverging incoming beams and delivers a well focussed low energy beam at the target. In addition, tuning of the final energy of the beam over a wide range (1 V/q to several hundred V/q, where q is the beam charge state) is possible without any change in hardware configuration. The deceleration lens was tested with Ar$^7^+\,$, extracted from an electron cyclotron resonance ion source, having an initial energy of 30 kV/q and final energies as low as 70 V/q have been achieved. The final energy of the beam was measured using a repelling plate analyzer (RPA).

![Figure 2](image2.png)

**Figure 2.** Current (triangles) and energy (circles) spectrum for Ar$^7^+$ as a function of retarding voltage on the RPA. The initial energy of the beam is 70 keV and the final energy after deceleration is 1290 eV.

References


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