Single and double charge exchange cross sections at very low energies

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Charge transfer between ions and atoms has been studied extensively for high-energy collisions (> 1 keV), but there have been relatively few studies for lower energy collisions.[1, 2] It is important to study ion-atom collisions at low energies, not only to provide data for theorists to help generate a more complete understanding of atomic collisions physics, but also to gain accurate knowledge of the underlying processes in astrophysical and fusion plasmas, which typically have interactions with kinetic energies in the range of 0.1 to 100 eV/amu. Experimental cross section measurements taken at low energies can assist theorists in developing a more complete model.

In this experiment, an octopole ion-beam guide (**OPIG**) technique is used in conjunction with the **K**ansas **S**tate **U**niversity **(KSU) C**ryogenic **E**lectron **B**eam **I**on **S**ource **(CRYEBIS)**, to facilitate the study of these low energy collisions. An r-f field applied to the **OPIG** confines the ions radial motion, but does not affect the motion along the beam axis. The **OPIG** is also floated on a DC potential in order to decelerate the projectile ion to the desired collision velocity. The r-f field serves to prevent the beam from blowing up, which reduces the beam intensity. In a conventional collision cell without an **OPIG** it is then difficult to measure ions that have a large scattering angle. However, an additional benefit of the **OPIG** is its ability to collect product ions having a large angular spread. In a collision cell with an **OPIG**, the product ions having a positive axial velocity component in the laboratory frame are guided along the beam axis in the downstream direction. After exiting the **OPIG** these ions can then be measured.

The Si^{q+} + He collision system has been studied at energies as 100eV, 500eV, and 1200eV for q = 3, 4 and 5, respectively. These results will be presented. The low energy limitation of these results was due to our ion detection system. This has now been improved and we anticipate measurements down to a few eV/amu. Progress on this experiment will be reported.

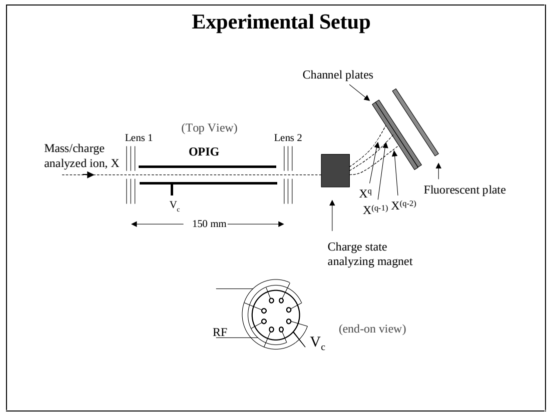

Figure 1. Experimental setup schematic: An Octapole Ion Beam Guide, **OPIG**, is used to decelerate the ion beam while simultaneously confining the ion beam in the transverse direction. Single and double electron captured ions are separated from the primary beam by a charge state analyzing magnet, and detected on the beam viewer.

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References

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