Ionization of noble gases by positron impact - threshold studies and progress towards a “complete” experiment

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Synopsis We will present preliminary high resolution measurements of absolute ionization cross sections from positron scattering from noble gases near threshold as well as the latest results from a positron reaction microscope experiment

The Australian Positron Beamline Facility is used to make the positron-atom ionization cross section measurements near threshold, and above, for select noble gases. The positron beamline uses a sodium-22 source, with a solid neon moderator reducing energies to a few eV. Positrons are further cooled and tuned in a Surko buffer style gas trap that produces a high resolution, energy tunable pulsed beam [1]. The positron beam is magnetically confined and electrostatically guided through the beamline, with typical resolutions around 60 meV.

Ionization can be measured using two different experiment arrangements, the first through the use of a scattering cell containing target gas, that can be biased to set a range of scattering energies, with a microchannel plate to detect the scattered beam. This setup utilizes the pulsed beam from the trap, and takes advantage of the subsequent timing signal.

Direct ionization can also be measured using the reaction microscope, which attaches to the beamline, and uses the moderated positron beam. The reaction microscope allows for position and time data to be collected all charged particles resultant from the ionization event, using two delay line anode detectors. The charged particles are separated and extracted through the use of a carefully designed extraction region. This shown schematically in Figure 1.

We report preliminary data and progress towards fully differential cross sections for 190 eV positron ionization of argon. The motivation for the reaction microscope is to obtain measurements resolvable in both energy and angle, in order to reconstruct the momentum distribution of the event. This type of measurement has not been successfully performed for positron impact, despite many successes with electron and photon projectiles, due (mostly) to a lack of sufficiently intense and mono-energetic positron beams [2].

We also report near threshold total single ionization cross sections for select noble gases. The main motivation for near threshold measurements is to study the Wannier regime [3-5], by measuring the energy dependence of the ionization cross section within the region near threshold.

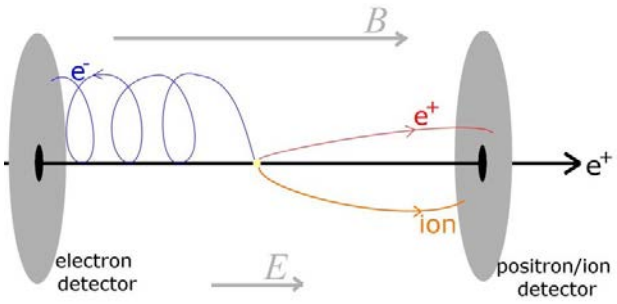

Figure 1. Illustration of the detector arrangement: electrostatic and magnetic fields guide charged particles to either detector.

References

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