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Triply Differential Measurements for Positron Impact Ionization of Argon

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Synopsis: We report triply differential cross sections for positron impact ionization of argon. Among other features, we note evidence of post collision interactions.

Differential triple coincidence measurements for positron impact ionization can provide in-depth insight into antimatter interactions with matter. This information is critical for understanding the formation of antihydrogen and the subsequent fundamental studies of antimatter interactions. In addition, understanding these interactions is essential for modeling for tomographic imaging for medical purposes.

We report our first results of triply differential ionization cross section (TDCS) measurements for 190eV positrons on Argon. These triple coincidence measurements reflect the efficiency of the positron reaction microscope (PRM) technique in that all energies and nearly all angles are included in the measurements. An axial magnetic field prevents the loss of the electron and positron, and a weak axial electric field extracts the electron, positron and ion from the interaction region effectively resulting in 4π solid angle detection.

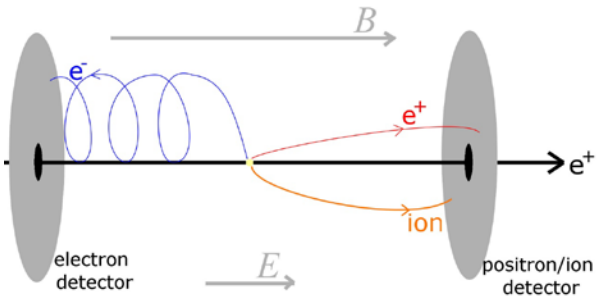

Figure 1 Positron Reaction Microscope with 4π detection

Measurement of positions where the electron and positron strike the detector and of the relative time of flight allows one to determine the kinematics of the ionization process.

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A histogram of the ratio of measured longitudinal momenta shows a double peak structure. The smaller peak lies in the region where the ejected electron velocity is approximately ½ that of the scattered positron, corresponding to electron motion on the Wannier ridge. This graph includes the entire range of transverse momenta for each particle for each measured event.

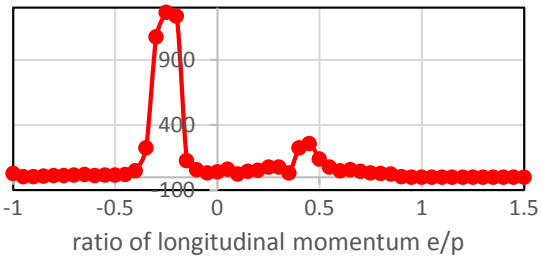

Figure 2 Histogram of the ratio of longitudinal momenta.

In addition, the positron scattering angle and the electron ejection angle for each event pair are determined although not presented here.

These measurements were performed using a room temperature atomic gas jet target with a thermal momentum distribution

It is worth noting that the data are not inconsistent with the measurements of Lucio *et al.* [1] which used a different technique and focused on comparison of electron and positron ionization of argon, but provides some additional insights into the processes being studied.

References

[1] Lucio *et al.* 2010 PRL **104** 163201