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LOW ENERGY POSITRON SCATTERING FROM HELIUM

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Abstract. Positron scattering from helium has been historically limited to experiments with energy resolution of 0.5 eV or worse. A new apparatus has been developed that allows the investigation of scattering processes with an energy resolution as good as 30 meV, allowing new experimental insight into positron helium interactions. The experiment is based on the buffer gas trap techniques developed in San Diego by Cliff Surko. A moderated positron beam is magnetically confined and directed into a series of electrodes forming a potential well structure. Positrons are trapped in the potential well through collisions with a buffer gas of N_2 and cool to room temperature through further collisions with the N_2 and CF_4. This cooled reservoir of positrons forms the source for a high resolution beam which can be used to probe low energy scattering processes.

The present work has determined the cross sections for positron scattering from helium from 1 to 60 eV, for a range of different scattering processes. Low energy scattering cross sections have been determined and compared to recent results which suggested the presence of resonances in the elastic scattering channel. Cross sections above the positronium formation threshold have been measured, and are compared to previous measurements as well as theoretical calculations. The positronium formation cross section has also been investigated and is in some disagreement with previous measurements. The likely reason for this disagreement will be discussed. High resolution measurements around various inelastic thresholds will also be presented and compared to predictions for a cusp in the total elastic scattering cross at the positronium formation threshold.