

Differential Measurements of Ionization and Excitation of H₂ by 250 eV Positrons

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Synopsis Ejected electron-recoil ion and scattered projectile-recoil ion coincidences are measured for 250 eV positron impact on molecular hydrogen. The electron detector is also sensitive to photon emission. Various combinations of these coincidence spectra are used to extract differential information about ionization and excitation of H₂.

For some time we have been studying differential ionization for positron impact with the main goals being to obtain kinematic complete information and to make direct comparisons between positron and electron impact data[1,2]. Here, we report a preliminary analysis of differential ionization and excitation of H₂ resulting from 250 eV positron impact. These data were obtained by measuring ejected electron-recoil ion and scattered projectile-recoil ion coincidences. Alone, or in combination, these coincidence data provide doubly and triply differential information about ionization of H₂. However, because the electron and recoil detectors are also sensitive to photons, differential information about excitation and ionization-excitation processes can also be obtained.

The position-sensitive electron channelplate, located perpendicular to the beam direction, was sensitive to ~17% of the full solid angle. The recoil detector was sensitive to ions extracted from the beam-target overlap region plus photon emission within ~1.5% of the full solid angle. Projectiles scattered between approximately $\pm 5^\circ$ (theta angle) and $\pm 2.4^\circ$ (phi angle) were energy analyzed and detected by a position-sensitive channelplate. Multi-hit electronics initiated coincidence events for both channelplates with a delayed signal from the recoil detector providing a common stop.

The figures show a preliminary interpretation of some of the results. The upper figure shows detection of either electrons or photons (the hit 1 curve) or electrons associated with photons (the hit 2 curve) by the electron detector in coincidence with detection of recoil target or background ions. The lower figure curves show the same coincidences with the additional restrictions that a scattered projectile was detected and the recoil ion was H₂⁺.

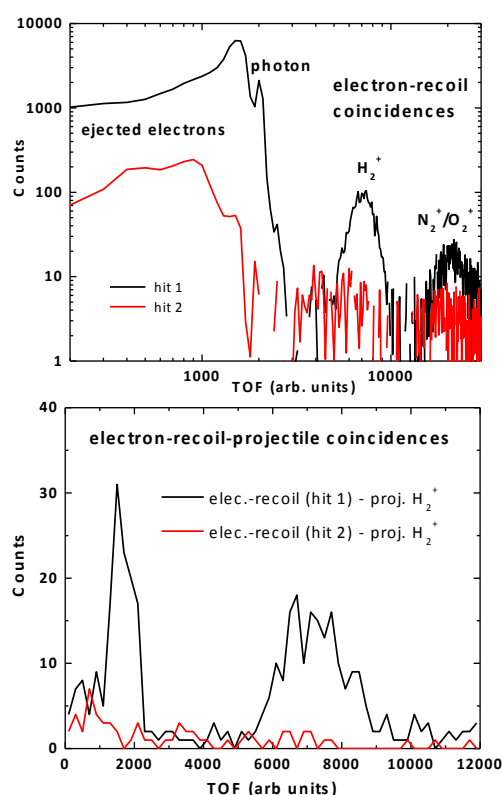


Figure 1. Coincidence spectra associated with ionization, excitation, and ionization-excitation of H₂ and background gases. Upper figure: all projectile scattering; lower figure: restricted to small scattering angles and H₂⁺ production.

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References

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