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Few-body dynamics underlying post-collision effects in ionization of simple targets by 75 keV proton impact.[1]

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One of the most important goals of atomic scattering research is to advance our understanding of the few-body problem. The few-body dynamics is characterized by the relative importance of the first-order versus various higher-order mechanisms. One higher-order process that is particularly important in ionization is known as post-collision interaction (PCI). Here, after the primary interaction, the projectile and the electron interact with each other again in the outgoing part of the collisions. The importance of PCI is known to maximize for ejected electron velocities equal to the projectile velocity (velocity matching). We have performed kinematically complete experiments on ionization of H_2 and He by 75 keV proton impact. The experiment was performed for various fixed energy losses for each target corresponding to the region around the velocity matching. Fully differential cross sections (FDCS) were analyzed for electrons ejected into the scattering plane (spanned by the initial and final projectile momenta) for various fixed scattering angles as a function of the electron emission angle. At small scattering angles the FDCS are dominated by a strong peak structure at 0°. At larger scattering angles a resolved second peak (the binary peak) is seen near the direction of the momentum transfer vector. The data were compared to two conceptually very similar calculations. Surprisingly, large differences between the experimental data and theory and between both calculations were found. This demonstrates that near the matching velocity the FDCS are very sensitive to the details of the few-body dynamics. Furthermore, significant differences between the FDCS for the two target species were found.

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