Problems of theoretical interpretation of COLTRIMS results on ionization of helium by fast bare-ion impact

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The basic theory of the ionization processes in collisions of fast ionic projectiles with atomic systems at small momentum transfer is well established (see, for instance, the textbooks [1,2]). The emergence of the cold-target-recoil-ion-momentum spectroscopy (COLTRIMS) [3] made it possible to measure fully differential cross sections for the ionizing ion-atom collisions with high precision, thus providing a new, very stringent test of the theory. In this context, theoretical explantation of the COLTRIMS results on singly ionizing 100-Mev/u C^{6+}+He [4] and 1-Mev/u H^{+}+He [5] collisions at small momentum transfer presents a real challenge. Specifically, so far none of the well-known approaches has been able to obtain reasonable agreement with the measured electron angular distributions in a P-plane that contains the projectile momentum but is perpendicular to the scattering plane. At the same time, all the approaches reasonably explain the experimental data for the scattering plane.
We present a theoretical analysis of the above puzzles. In particular, we show [6] that a finite momentum resolution due to a velocity spread in a supersonic helium jet can be responsible for the disagreement in the "C^{6+} puzzle" case. It is also found that the so-called coherence effects claimed by M. Schulz et al [7] are not relevant for the discussed problem [8].

References

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