MULTIPLE ELECTRON SCATTERING IN ATOMIC AND SURFACES COLLISIONS

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Abstract. Double differential spectra of electrons ejected in ion-atom or ion-solid collisions are in the focus of general interest for a long time. These spectra are relatively easy to measure, and they show many fine details relevant for the collisions dynamics. In the past decade special effort has been devoted to understand the high energy part of the electron spectra. Significantly enhanced emission of fast electrons far above the so-called binary encounter energy was observed in both ion-atom and ion-solid collisions. In some cases, fast electrons have been identified from double, triple and quadruple scattering by the projectile and target cores. The ejected electron gains energy in every encounter with the projectile in such processes [Sulik et al. 2002, Sulik and Tőkési 2007]. This mechanism is often referred to as Fermi-shuttle acceleration. After a brief history of the study of Fermi-shuttle acceleration mechanisms in atomic collisions, we present classical trajectory Monte-Carlo results of various projectile and target combination to analyze and identify the multiple scattering components of the ejected electron spectra.

We also present a theoretical description of the spectra of electrons elastically scattered from various samples [Tőkési and Varga 2018]. The analysis is based on very large scale Monte Carlo simulations of the recoil and Doppler effects in reflection and transmission geometries. Besides the experimentally measurable energy distributions the simulations give many partial distributions separately, depending on the number of elastic scatterings (single, and multiple scatterings of different types). Furthermore, we present detailed analytical calculations for the main parameters of the single scattering, taking into account both the ideal scattering geometry, *i.e.* infinitesimally small angular range, and the effects of the real, finite angular range used in the measurements. The effect of the multiple scattering on intensity ratios, peak shifts and broadening, are shown. We show results for multicomponent and double layer samples. Our Monte Carlo simulations are compared with experimental data. We found that our results are in good agreement with the experimental observations.

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References

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