Production of low energy "cusp" electrons in slow ion-atom collisions

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Synopsis This contribution discusses the production of low energy electrons in slow ion atom collisions.

The production of so-called "cusp-electrons" in relatively high energy ion-atom collisions was the subject of intense research around 30 years ago [1]. How these electrons were produced and differential cross-sections in energy and angle were thoroughly investigated. But how such electrons are produced in slow ion-atoms collisions has not been so well investigated. In a paper from 1999 Tanis et al. [2] showed that in collisions of O^{6+} on He atoms, at a projectile energy of 60 keV, these low energy electrons were produced in coincidence with O5+ ions, i.e. the projectile ions having captured at least one, and retained, one electron. A few years before the work presented in [2] Stolterfoht et al. [3] had presented the idea of correlated double electron capture in similar collisions as discussed in [2], i.e. 60 keV O^{6+} ions colliding on He atoms. Correlated capture meant that both electrons from the He target atom were captured at the same time to the O^{6+} ion and would end up in states such as 2pnl where the n quantum number could be very large. Before the work of Stolterfoht [3] it was assumed the capture of the two electrons were independent events but still from the same target atom, and producing states such as 3l3l'. However, if we consider correlated capture and n being very large, then the O^{4+} ion will be very large, and if n is high enough, the cross-section for stripping off the high n electron can become large, even in low energy collisions. If such were the case, then it could manifest itself in that the number of low energy electrons would have a different dependence on the target pressure than say Auger electrons from the same collision system. Such a difference was seen, but not understood, in [4] by Hutton et al., see figure 1. Also this would indicate that no "cusp electron" should be observed in slow collisions oh highly charged ions with hydrogen atoms. This model of "cusp" electron production will be further investigated using the newly established highly charged ions research platform in Shanghai [5].

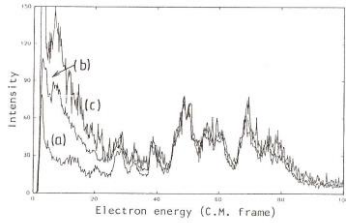

Figure 1. Auger spectrum of 90 keV Kr9+ ions colliding on a He gas target. Note the intensity of the low energy electron decreases with incrasing gas pressure. The spectra have been normalized for target pressure, a = 0.4 mTorr, b = 0.24 mTorr, c = 0.1 mTorr.

References

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[2]] J. Tanis et al., 1990 Physical Review **A42**, 5776
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