4 - 11 Cusp Electron Emission in Transfer Ionization of Intermediate-energy He^{2+} Collision with Argon

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Ever since the first observation of electron capture to the continuum state of projectile (ECC) by Rudd in single ionization[1], it is appeared that the energy and angle differential cross sections for electron transfer provide astoundingly detailed information about the dynamics of electron ejection, such as single ionization, transfer ionization process. Using the COLTRIMS techniques[2], the electron emission in transfer ionization of He^{2+} collision with argon was . investigated. The interested transfer ionization (T1I1) is described as follows.

$$He^{2+} + Ar \rightarrow He^{+} + Ar^{2+} + e$$

Double differential cross sections for electron capture to the continuum of the projectile (cusp-shaped electrons) for collision energies from 17.5 to 75 keV/u (Fig. 1), and the dependence of the total cross sections of cusp electrons on the projectile energies have been obtained[3]. We have found that a velocity matching between the projectile velocity and orbital velocity of 3p electron of argon atom leads to the maximum of total cross section at the projectile energy of 30 keV/u. Since the electron-electron correlation in the present transfer ionization can be neglected, the T1I1 processes could be separated as two sequential processes of first ionization followed electron capture or first capture followed single ionization. The results show that the first ionization followed single capture processes is dominant in the cusp electron emission of the present transfer ionization process[3].

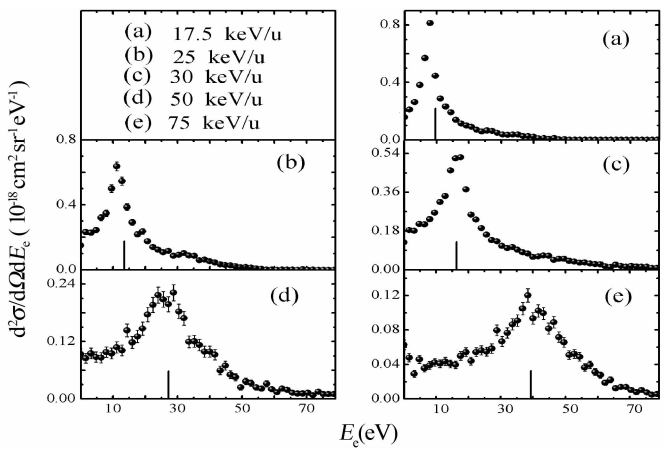

Fig. 1 Double differential cross sections with respect to the energy and 0 degree of electron emission for the projectile energy of 17.5, 25, 30, 50, 75 keV/u, respectively. The short vertical lines represent the theoretical positions of cusp shaped peak.

References

[1] G. B. Crooks, M. E. Rudd, Phys. Rev. Lett., 25(1970)1599.
[2] X. Ma et al., Phys. Rev., A83(2011)052707.
[3] R. T. Zhang, et al., Phys. Rev., A87(2013)012701.