Resonant electron-capture in ion-atom collisions: Fraunhofer diffraction pattern

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Diffraction with atomic matter waves is a rich branch of atomic physics and quantum optics. It has been investigated in the first time by Estermann and Stern [1] in which helium atoms were reflected and diffracted from the surface of a LiF crystal.

Recently, diffraction patterns have been observed experimentally for electron processes in ion-atom collisions. For instance, Wang *et al.* [2] have observed oscillations in the angular distribution of projectile for single electron-capture in He^{2+} -He collisions at intermediate energies. These structures are attributed to Fraunhofer diffraction. At low projectile energies, this phenomenon has already been observed by van der poel *et al.* [3] for Li^{+} -Na single electron-capture collisions. However, to the best of our knowledge, this phenomenon has not been identified and discussed theoretically before in connection with double electron-capture in slow and intermediate He^{2+} -He collisions.

In the conference, we shall investigate the presence of the Fraunhofer diffraction patterns in the resonant electron-capture process in He^{2+} -He collisions for energies ranging from 10 to 75 keV/u (v=0.6-1.7 $a.u$). To study this collision system, a semi-classical close-coupling (SCCC) approach is used to solve the time-dependent Schrödinger equation where the electron-electron correlation is taken into account. Differential cross sections (DCS) are calculated by using eikonal method [4,5] in which the probability amplitudes from the SCCC calculations are augmented by a coulombic phase. Our DCS will be discussed, where the observed diffraction patterns (Fig. 1) can be interpreted as resulting from diffraction of matter waves of projectile He^{2+} by target He.

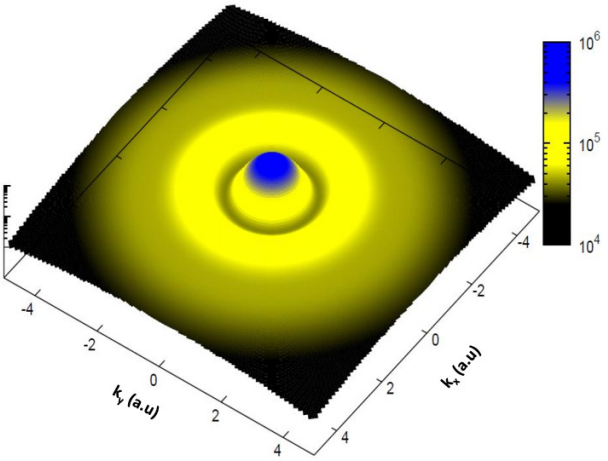

Figure 1: *(color online). Two-dimensional differential cross sections in the transverse plane at the collision energy 25 keV/u a.u. for double electron-capture collision:* $He^{2+} + He(1s^2) \longrightarrow He(1s^2) + He^{2+}$

References

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