Excitation of singlet and triplet He states by neutral He - He collisions at intermediate energy range

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As was showed in several papers, the anticrossing spectroscopy has been useful to determine the states of He atoms excited by collisions with helium ion of intermediate energy. In this case, the electric field of helium ion strongly affects the evolution of the electron cloud of He atom at a longe distance. In contrast for He - He collision, the interaction between colliding objects occurs for the closest approach. Hoever, also in this case the excited helium atoms have a large electric dipole moments and the anticrossing spectroscopy is appropriate to analyze such post-collisional states.

In this work, the first time, the anticrossing spectra of the helium line λ(1s4l – 1s2p ^3P) = 447.2 nm were measured for 10 $-$ 30 keV helium atom – helium atom collisions. The post collisional He I states are superpositions of the zero-field eigenstates $|1snl\ ^{1,3}L, M_L\rangle$ with different angular momenta. Therefore the transient atomic helium states can have highly asymmetric charge distribution with large electric dipole moments. By measuring the intensity I(F_z) of spectral line at electric field F_z applied to the collision volume the charge distribution can be determined [1]. Due to singlet and triplet anticrossings of Stark sublevels the characteristic anticrossing peaks appear giving especially detailed information about the post-collisional states of the excited He atoms [2]. The theoretical intensity functions were calculated taking into account cascade processes, the inhomogeneity of the axial electric field in the collision volume and the density distribution of the target He atoms [3]. Fitting the theoretical intensities to the measured ones, the post-collisional states of He atoms were determined. Figure 1 shows measured anticrossing spectra.

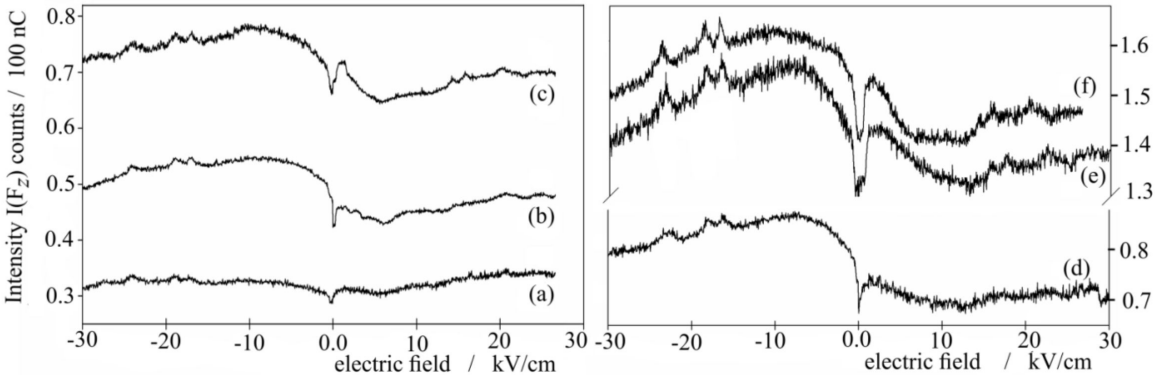

Figure 1: *Anticrossing spectra $I_{447}(F_z)$ measured for transition (1s4l $^3D^3F$ – 1s2p ^3P) for He – He collisions at impact energies of 10 keV (a), 15 keV (b), 20 keV (c), 24 keV (d), 26 keV (e), and 30 keV (f).*

References

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