Inner-shell photodetachment: effect of strong correlation in negative ions

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Inner-shell photodetachment of negative ions stand out as extremely sensitive probe and theoretical test-bed for important effects of electron-electron interaction because of the weak coupling between photon and target electrons. Many-body effects play a pronounced role here not only between the outer electron but also between the inner-shell electrons and outgoing electron. For our theoretical investigation we have chosen especially strong correlated system: open-shell (half-filled) negative ions.

We use our method for simultaneous inclusion of the dynamic polarization potential generated in a system "neutral atomic core + electron", dynamic relaxation (screening) (these correlations are treated within the Dyson equation method, DEM) and electronic correlation within the RPAE. One may pick out certain infinite series of Feynman diagrams in the perturbation expansion over electron-electron interaction with the definite physical meaning. We include the related many-particle corrections one-by-one and analyze their particular contributions to calculated observables.

The strong near-threshold resonance in the photodetachment from inner 1s-shell of the carbon negative ion has been investigated recently. The shape-resonance parameters are determined. The complex, mixed ("shape-Feshbach") nature of the resonance is revealed. The calculated cross sections are in fair agreement with the recent experimental data (Gorczyca 2004). The collective character of the response to the external electromagnetic field in the strongly correlated C^- target is clearly demonstrated, with the dynamical relaxation of the core being the most pronounced of the collective effects.

The very new result on inner-shell photodetachment for Si^- negative ion will be presented at the Conference. The system is even more complex compared to C^- since we need consider partial cross section for 4 close inner subshell (6 transitions). So the RPAE correlations become very important. Strong near 2s-threshold resonance is predicted like to the case of C^-. However, the cross section also reveals the additional peculiarities of the Fano-profile type which are strongly influenced by the dynamical relaxation as well.