

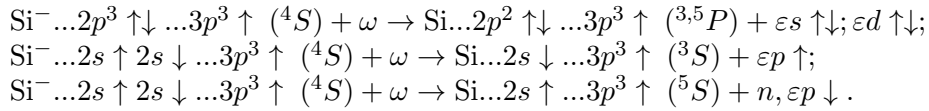
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Inner-shell resonance photodetachment of Si^- negative ion.

Photodetachment from the deep inner shells 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.

One can expected that the possibility of a photoexcitation to the ion state $\text{Si}^{-*} (1s^2 2s^2 p^6 3s^2 3p^4 \ ^4P)$ reveals itself as a resonance structure in photodetachment cross sections in the energy range of the 2s and 2p inner shells thresholds similar to the 1s inner-shell photodetachment from C^- where where the strong near-threshold resonance is predicted within the DEM&RPAE (Kashenock and Ivanov 2006) in good agreement with the experiment (Walter *et al.* 2006) and the complex, mixed (“shape-Feshbach”) nature of the resonance is revealed. The system is more complex compared to C^- since we need to consider the partial cross sections for 4 close spin-polarized inner subshells (6 phototransitions):



For the last phototransition we have emphasized the existence of photoexcitation to the $3p \downarrow$ ($n = 3$ discrete state in half-filled outer p-shell. This channel is expected to be a “resonance channel” as we have seen in the case of “ $1s 2s^2 2p^4$ ” resonance in C^- . However, the resonance channel for Si^- inner-shell photodetachment is open at the $2s \downarrow$ threshold in the vicinity of the thresholds of the others inner-shells photodetachment channels. So the RPAE correlations become important together with the strong influence of the dynamical relaxation. The problems becomes especially intriguing in the presence of the resonance “ $\dots 3p^4$ ” where a simultaneous account of all-type many-electron correlations in its one-channel description as well as inter-channel interference becomes crucial. We have performed the analysis of the collective response of the ionic many-electron system Si^- on electromagnetic field in the different levels of approximation: the “frozen-field” RPAE, the static relaxation approximation (GRPAE) and also within the DEM&RPAE approach when the dynamic relaxation and polarization are included simultaneously with the RPAE corrections.

The existence of the both limit “ $3p \downarrow$ ” states - as a bound state, or Feshbach resonance, in the “frozen-core” approximation and a quasi-bound state, shape resonance, in the static relaxation approximation - allow us to suppose that the real situation is subtler.

Due to strong electron correlation in many-electron system the resonance type should be considered as a mixed Feshbach-shape structure. To investigate the many-electron mechanism of forming the resonance near $2s \downarrow$ threshold in details we have used DEM&RPAE approach. We predict the strong resonance peak at the energy $E_{res} = 11.82$ Ry, $\varepsilon_{res} = 0.04$ Ry with resonance width of $\Gamma = 0.02$ Ry. The photoelectron phaseshift and parameters of angular anisotropy behaviour reveals the dual nature of the " $3p \downarrow$ " resonance. The additional peculiarities of the Fano-profile type appear due to RPAE interactions in the total photodetachment cross section. However, the total Si^- photodetachment cross section in the energy region under investigation is dominated by the strong resonance peak of complex "shape-Feshbach" nature at the $2s$ threshold. Our conclusion is that the dynamical relaxation is the most pronounced effect in this strong correlated system.