§16. Electron-Impact Excitation Cross Sections between Excited States in He

Shevelko, V.P. (P.N. Lebedev Physics Institute, 117924 Moscow, Russia)
Tawara, H.

Cross sections σ and corrresponding maxwellian rate coefficients <vσ> have been calculated for all 153 spin-allowed and spin-forbidden transitions between excited states n, n′ =2, 3and 4 in He induced by electron impact in a wide range of electron-impact energies. Calculations have been performed by the ATOM code using the Coulomb-Born approximation with exchange (CBE) in the partial wave representation with orthogonilized wavefunctions of the initial and final states. The fitting parameters for σ and <vσ> of spin-allowed transitions are given. The results are compared with experimental data and other calculations.

In the case of optically alowed transitions (Δl= ±1, ΔS=0), some calculated excitation cross sections display a double-peack structure (Fig.1). As was shown, the first maximum is connected with the exchange effects (dot-dash curve) which are very strong in He even for dipole transitions. CBE cross sections for dipole transitions are also compared with the Born approximation using a model potential

$$V_{dip}^{M}(r) = \frac{\lambda r}{(r^2 + r_0^2)^{3/2}}, \quad \lambda = (f / 2\Delta E)^{1/2},$$

where f is a dipole oscillator strength, ΔE is a transition energy, r_0 is the effective (cutting-off) radius.

Typical example of the intercombination transition with ΔS=1 is shown in Fig.2. It is seen that the Ochkur approximation can be used at relatively high electron energies E > 10 eV.

In general, a comparison of the calculated excitation cross sections in He performed in this work by CBE method using the orthogonolized wavefunctions showed that at the incident electron energies E > 20 eV our results are close to recommnded data and sophisticated calculations. At low energies E < 20 eV our cross sections are relatively high as compared to the other calculations. However, to make further conclusions, the experiments have to be carried out for transitions between excited states in He.