

Two-electron excitation in helium-like ions by electron impact

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MS received 31 January 1989; revised 8 May 1990

Abstract. Calculation of cross-sections for the two-electron excitation in helium-like ions by electron impact employing Coulomb-Born-Oppenheimer (CBO) approximation is presented. Analytical expressions for the differential and total scattering cross-sections without using partial wave expansion of the wavefunction reported earlier have been used. The total and differential scattering cross-sections for each of the excitations $1s^2\ ^1S^e \rightarrow 2s^2\ ^1S^e, 2s2p\ ^{1,3}P^0, 2p^2\ ^1S^e, ^3P^e, ^1D^e$ in Be^{2+} and B^{3+} are computed. Results for Li^+ reported earlier are also included for comparison.

Keywords. Two-electron excitation cross-section; electron impact; Coulomb-Born-Oppenheimer approximation.

PACS No. 34.80

1. Introduction

Excited states involving simultaneous excitation of two electrons in atoms have gained interest recently (Fano 1983; Rau 1984). Such states not only in neutral species, but also of ions have been identified as important in astrophysics, atmospheric and laboratory plasma physics (Drawin 1981). The production of such states in neutral species by electron impact has been investigated theoretically (Massey and Mohr 1935; Becker and Dahler 1963, 1964; Fano 1964; Kulander and Dahler 1972; Roy and Sil 1976; Srivastava and Rai 1977; Hickerson *et al* 1978a, b; Mohan and Vidhani 1977; Williamson *et al* 1982; Ellis *et al* 1982; Srivastava and Kumar 1985; Srivastava and Williamson 1987; Padhy *et al* 1987) as well as experimentally (Burrow 1970; Westerveld *et al* 1979) in a few cases. It is seen that the simple Born-Oppenheimer (BO) approximation does provide a reasonable estimate for the total cross-sections (Becker and Dahler 1964; Kulander and Dahler 1972; Roy and Sil 1976; Hickerson *et al* 1978a; Srivastava and Rai 1977; Padhy *et al* 1987). No experimental measurement of cross-sections for electron-impact double excitation in any ionic species has been reported so far; but encouraged by the success of the BO approximation we performed (Padhy *et al* 1983a, b) recently a CBO calculation for the total cross-section for electron impact excitation of Li^+ from its ground state to each of the six low-lying doubly-excited states ($2s^2\ ^1S^e, 2s2p\ ^{1,3}P^0, 2p^2\ ^1S^e, ^3P^e, ^1D^e$). Recently, a similar calculation employing the distorted wave (DW) method has been reported by Srivastava and Katiyar (1986).

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