Journal of Atomic, Molecular, Condensate & Nano Physics
Vol. 3, No. 2, pp. 133–135, 2016
ISSN 2349-2716 (online); 2349-6088 (print)
Published by RGN Publications

http://www.rgnpublications.com

Comments on Scattering of Electrons/ Positrons by H-atoms and H_2 Molecules under Weakly Coupled Plasmas

Research Article: Comments

A.K. Bhatia

Heliophysics Science Division, NASA/Goddard Space Flight Center Greenbelt, Maryland 20771, USA
Anand.K.Bhatia@nasa.gov

Abstract. In a recent publication by Modi et al. [*Jour. of At. Mol. Cond. and Nano Phys.* 2 (2015), 41], cross sections for the scattering of electrons and positrons from hydrogen atoms and molecules have been calculated in the Debye plasma, using the Born approximation. Using the exchange approximation for the scattering, it is shown here that at low energies they have considered, the cross sections for the triplet and the singlet states are not equal. Moreover, they differ considerably from their results.

Keywords. Cross sections for electron scattering from atomic hydrogen in a laser field; Screening in Debye plasma

PACS. 34.80.Qb; 34.50 Rk

Received: November 5, 2015 **Accepted:** February 1, 2016

1. Introduction

Modi et al. [1] have calculated cross sections for the scattering of electrons and positrons from hydrogen atoms and hydrogen molecules in the presence of Debye-Hückel potential [2], using the Born approximation. In Ref. [3], we calculated such cross sections for the scattering of very low energy electrons from hydrogen atoms in the presence of Debye-Hückel potential [2] and also in the laser field. The cross sections are calculated in the exchange approximation by using the target function obtained in the Debye-Hückel potential and the interaction potentials also suitably modified. Recently, this calculation has been extended to other hydrogenic systems [4] as well. We carry out such calculations at alow energy used in Ref. [1] and we find that the results differ considerably from those given in Ref. [1]. Also, the triplet and the singlet cross sections are not equal. No distinction is made in [1] between such cross sections because of use of the Born approximation. The ground state wave function of the target hydrogen atom is determined from

$$\langle \phi_0 H \phi_0 \rangle = E_0 \phi_0 . \tag{1.1}$$

The target Hamiltonian is given by

$$H = -\nabla^2 - \frac{2e^{\mu r}}{r}, \tag{1.2}$$

and the target wave function is given by

$$\phi_0 = e^{-r} \sum_i C_i r^i . \tag{1.3}$$

The parameter $\mu = 1/\lambda_D$ and there are 10 terms in the expansion. The energies are −0.7580 and −0.8491 Ry for $\lambda_D = 7.5$ and $\lambda_D = 12.5 a_0$, respectively. It seems that in Ref. [1] the target function has not been calculated in the Debye potential. The convergence of cross sections with respect to the maximum number of partial waves for the triplet and singlet states are given in the table for two values of the Debye lengths at incident energy of 50 eV. We see that the cross sections have converged within 0.003 and 0.04 a_0^2 for $\lambda_D = 7.5$ and $\lambda_D = 12.5$, respectively. The triplet cross sections, σ_t, are 8.2913 and 9.3410 a_0^2 for $\lambda_D = 7.5$ and $\lambda_D = 12.5$, respectively, while the singlet cross sections, σ_s, are 7.5220 and 8.7067, respectively. The total cross sections $\left(\sigma_{Total} = \frac{3\sigma_t}{4} + \frac{\sigma_s}{4}\right)$ are 8.0990 and 9.1824 a_0^2 for $\lambda_D = 7.5$ and $\lambda_D = 12.5$, respectively. The cross sections increase with the increase of λ_D. As λ_D decreases, the screening increases and the size of the target increases, finally becoming unbound.The cross section obtained in [1] is 11.58 a_0^2 at 50 eV for $\lambda_D = 7.5$, which differs considerably from the present results which are more accurate compared to those obtained using the Born approximation.

Table 1. Convergence of the cross sections (a_0^2) with partial waves L.

L^a_{max}	$\lambda_D = 7.5$		$\lambda_D = 12.5$	
	$E = 50$ eV		$E = 50$ eV	
	Triplet	Singlet	Triplet	Singlet
30	8.0891	7.1839	8.4581	7.5886
35	8.1912	7.2860	8.7798	7.9103
45	8.2683	7.3631	9.1392	8.5048
55	8.2880	7.5188	9.2988	8.6644
60	8.29123	7.5220	9.3410	8.7067

L^a_{max} represents the maximum number of partial waves

Competing Interests

Author declares that he has no competing interests.

Authors' Contributions

Author wrote, read and approved the final manuscript.

References

[1] H.S. Modi, M.J. Pindariya and K.N. Joshipura, *Jour. of At., Mol. Cond. and Nano Phys.* **2** (2015), 41.

[2] P. Debye and E.Hückel, *Phys. Z.* **24** (1923), 185.

[3] A.K. Bhatia and C. Sinha, *Phys. Rev. A* **86** (2012), 053421.

[4] A.K. Bhatia, *Jour. of At. Mol. Cond. and Nano Phys.* **2** (2015), 55.