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Hyperspherical calculation for electron hydrogen atom ionization collisions in a symmetric form

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Abstract. The hyperspherical partial wave method (Das [7]) has been presented here in a symmetric form so that effects of coupling among different partial waves may be included in a systematic way. It is also outlined here how to solve the relevant coupled set of radial wave equations numerically. Some preliminary results are presented for S, P and D waves in the low energy domain of 30–50 eV for the incident electron. In this calculation only two important partial waves are included in each channel. The results are compared with experimental ones and appear very encouraging.

Keywords. Hyperspherical; ionization; cross section; partial wave; channel; close-coupling.

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1. Introduction

Three very successful methods of calculating total cross sections for ionization of hydrogen atoms by electrons at low energies are the convergent close-coupling (CCC) method (Bray and Stelbovics [1, 2]), the R-matrix with pseudostates (RMPS) method (Bartschat *et al* [3]) and the hyperspherical close-coupling (HSCC) method (Kato and Watanabe [4]). All these methods give good total cross values (see [4, 5]) down to very low energies. However their capabilities in reproducing the differential cross sections have not been tested (except in one or two cases such as in Bray *et al* [6]). Moreover each of these methods has its own difficulties and limitations. Another, very similar approach, is the hyperspherical partial wave (HSPW) method, suggested by the present author [7]. This is perhaps a better approach. Since this approach is straightforward and most natural, it is just an extension of the partial wave method so useful in two-body scattering calculations. It is also free from any pathological difficulty such as the non-existence of certain integrals for some of the angular momenta for the partial waves (see the second paragraph after eq. (2) of ref. [6]). It also does not require additional knowledge such as in HSCC calculation where one needs the values of the wave function in the asymptotic domain for matching purpose from some other sources. Moreover such values are known only approximately and no analytic solution exists for the asymptotic domain. Some interesting results for differential cross sections at low energies have already been