Comment on double differential cross sections in ionization of the atomic hydrogen by electron impact

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In this decade double differential cross sections in the ionization process of the atomic hydrogen by electron impact were measured [1] and has been studied theoretically with the eikonal approach [2] and another method which incorporates some theoretical modification with electron correlation [3]. In this experiment, a beam of mixed atomic and molecular hydrogen was used and these are expected to be mainly in the ground state.

As shown below in Fig. 1 by curves labeled 1s, however, there are large discrepancies between the results calculated for the ionization from the ground state and the experimental ones in the forward region of the ejection angle. These theoretical results underestimate the cross section in this region and the similar situation is also found for the other collision geometries in this experiment. It is a problem not yet understood for the double differential cross section in the ionization of hydrogen atoms by electron impact.

In this paper, we will discuss possibility of the ionization from the atomic 2s state. And we calculate double differential cross sections with direct Born and Glauber approaches at 250 eV of the incident electron energy and at 5 eV of the ejected electron energy.

The results of double differential cross sections in the ionization from the 2s state are shown in Fig. 1 by curves labeled 2s. These results have sharp peaks at about 80 degrees of the ejection angle for both of the Born and the Glauber approaches. These peaks are attributed to sharp binary peaks in the triple differential cross section. Such appreciable peak is not found in the experimental result, although the ionization from the 2s state contributes to the magnitude of the cross section for becoming larger in the whole region of the ejection angle.

In conclusion, it seems that there would be no possibility of the ionization from the atomic 2s state. The problem of the large discrepancy between experimental results and theoretical estimates in the region of small ejection angles is still open question in the present stage.

[1] T. W. Shyn, *Phys. Rev.* A**45** 2951 (1992).
[2] T. Onaga, S. Ohara and H. Narumi, *Ab. Int. Conf. on Atomic Physics* **14** 2P-13 (Boulder, 1994); *ibid.* **16** J24 (Windsor, 1998).
[3] J. Berakdar and H. Klar, *J. Phys.* B**26** 3891 (1993).

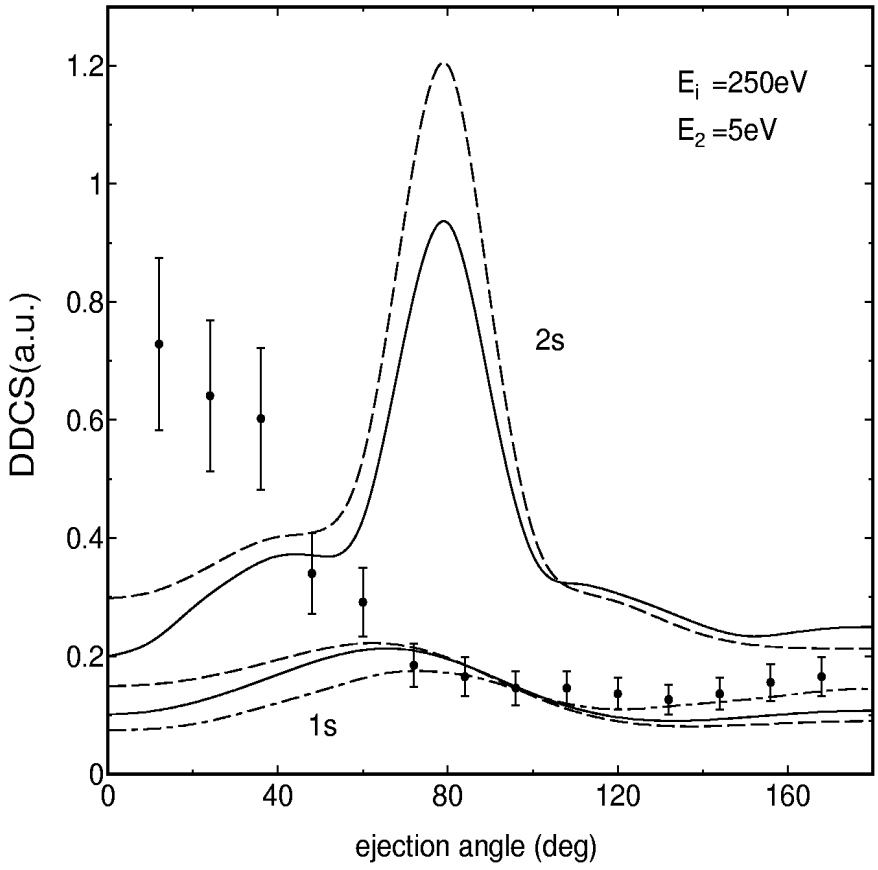

Figure 1: The double diffrential cross section at the incident electron energy E_i=250eV and the ejected electron energy E_2=5eV as a function of ejected electron angle(in the atomic unit). Curves labeled 1s and 2s are results for the ionization from atomic 1s and 2s states, respectively. The representation of curves are as follows: solid, Glauber; dashed, Born; dot-dashed, Berakdar and Klar [3]. The experimental result is given by solid circles [1].