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A study of the turn-up effect in the Electron Momentum Spectroscopy

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Synopsis We show that the PWIA model completely fails for any ionization of atomic hydrogen in its initial state or in an excited state. The results of our study are compared with those of the 3C or BBK model.

It is well known, since a long time, that the BBK model or 3C model [1] is able to reproduce all the data in an (e,2e) experiment when the incident energy is higher than 150 eV [2-3]. This model is considered as of infinitive order when treating the interaction between the two outgoing electrons. We decide to apply this 3C model in the case of the ionization of atomic hydrogen from n=1 to n=5 and to compare to the results given by the plane-wave impulse approximation (PWIA) which is commonly used in the Electron Momentum Spectroscopy (EMS) [4].These EMS experiments, which are a particular case of (e,2e) experiments, are actually performed in non-coplanar geometries: the two outgoing electrons have equal energies and are emitted at equal polar angle (45^0) while the initial momentum varies out of the scattering plane. Some authors [5-6] have shown that the PWIA only works for low values of the recoil momentum q. Recently it was proved that the DWIA (Distorted Wave Impulse Approximation) and the DWBA (Distorted Wave Born Approximation) models are necessary to be applied instead of the PWIA [7-9], even for low values of q. We also compare in this study our results to those given by the DWIA and DWBA models for any initial or excited state. For n=1 the 3C model gives a perfect agreement with the experiments of Lohmann et al [10-11] and the experiments of Weigold et al [12]. The agreement with the DWIA is less good, and the agreement with the PWIA is very bad, except for EMS experiments [10]. For the other n states there are no data up to now but we expect that the 3C model could give an excellent agreement too. For n=2 (and l=1) we observe no turn-up effect, the 3C and DWIA models have an amplitude which decreases when q decreases too. It is not the case for n=3 (and l=2): the TDCS goes to *a finite value different from 0* when q goes to 0 for the 3C, DWIA and DWBA models, contrary to the PWIA model. We also present results for the ionization of the 4f and 5g states.

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