THE INFLUENCE OF A DIFFUSE TARGET ON ELECTRON LOSS INTO THE CONTINUUM DOUBLE DIFFERENTIAL DISTRIBUTIONS

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Measurements of double differential electron loss into the continuum (ELC) distributions in energy-or speed v-and angle θ of electrons ejected in $H^\circ \rightarrow He$ collision have been recently reported (1). In that case electrons initially bound to the projectile are transferred to continuum states centered on the resulting ionic projectile.

If v_i is the initial H° velocity and v' the electron velocity relative to the final proton, we have $v' << v_i$ and a first Born perturbation treatment could be applied (2)(3)(4).

The apparatus and method of measurement were identical to those described in a preceding paper (5). To compare experiment and theory we had assumed that the electrons were originated at a point source given by a localized gas stream emerging from a hipodermic needle and the results for the $H^\circ \rightarrow He$ system at 105 keV beam energy were not in good agreement with the theoretical description of the ELC peak based in the first Born approximation (1). This leads us to a more careful analysis of the experimental setup.

The measured distribution showed an elongated shape-in v'-space-at small angles which suggest us that we were dealing with an extended gas target.

We checked the shape of the He target through some additional experiments. In these we compared the spectra obtained using the needle source with: a) Spectra from a uniform distribution of the gas at constant pressure inside the electron spectrometer, b) Spectra resulting after setting an electron suppressor electrostatic field on the beam path just behind the needle. From this comparision we conclude that an additional contribution of electrons came from the whole beam trajectory inside the inner cylinder of the spectrometer. To evaluate the extended electron source effect,a model was developed considering a row of point sources located along the beam path.The row is confined by the lenght of the proton beam in the spectrometer inner cylinder. The target gas density distribution in this zone can be approximately evaluated. Outside this limit the beam path -i.e. the electron sources- is exposed to the analyzer electric field.

Through a geometrical analysis the electron contribution along the extended collision region at each observation angle θ and angular acceptance θ_0 can be assessed.

To show the consequences of an extended source, we considered a theoretical 1/v' cross section and performed the convolution with the analyzer resolution. We found that the "experimental" electron distribution $Q'(v,\theta)$ resulting from the computed extended source can be related with that obtained from a point target $Q(v,\theta)$ by:

$$Q'(v,\theta) = Q(v,\theta)\ B(\theta) \qquad [1]$$

There is a simple factor $B(\theta)$, which depends on the angle θ as well as on the angular and velocity resolution of the equipment. It should be noted that it is independent of v and therefore previous studies performed on $\theta=0^\circ$ spectra are not affected by the extended target correction.

In Fig. 1 we compare contour lines in v'-space. These lines correspond to constant values of the double differential distributions Q and Q' relative to the maximum at v'=0. It is seen that the lower level lines are the most affected by the extended target.

Data of electron experimental distributions from $H^\circ \rightarrow H_e$ collision at 105 keV and $\theta_0 = 1.5^\circ$ are shown in Fig. 2.

The evolution of the experimental peak height-taken at each peak velocity v_p -as a function of the emission angle θ is plotted in Fig. 3 together with the corresponding values of $Q(v,\theta)$(dashed line). The experimental and theoretical results have been normalized at $\theta=0^\circ$.

The difference monotonically increases with θ.

The full line represents $Q'(v,\theta)$, i.e. $Q(v,\theta)$ multiplied by $B(\theta)$, Eq.[1]; good agreement with our experimental values is obtained.

Comparison between theory including anisotropic terms (4) (6) in $d\sigma/d\vec{v}$ and measured distribution including extended target corrections is in progress.

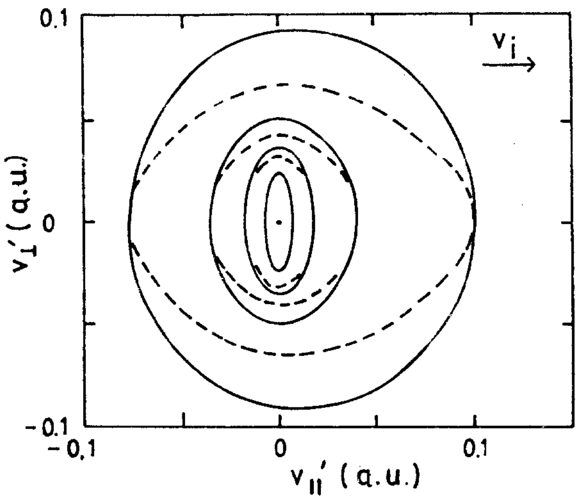

Fig. 1: Contour lines of Q(full lines) and Q'(dashed lines) distributions corresponding to a theoretical 1/v' cross section. Angular acceptance θ_0 = 1°. Levels represent 0.2, 0.4, 0.6 and 0.8 fractions of the v'=0 peak height.

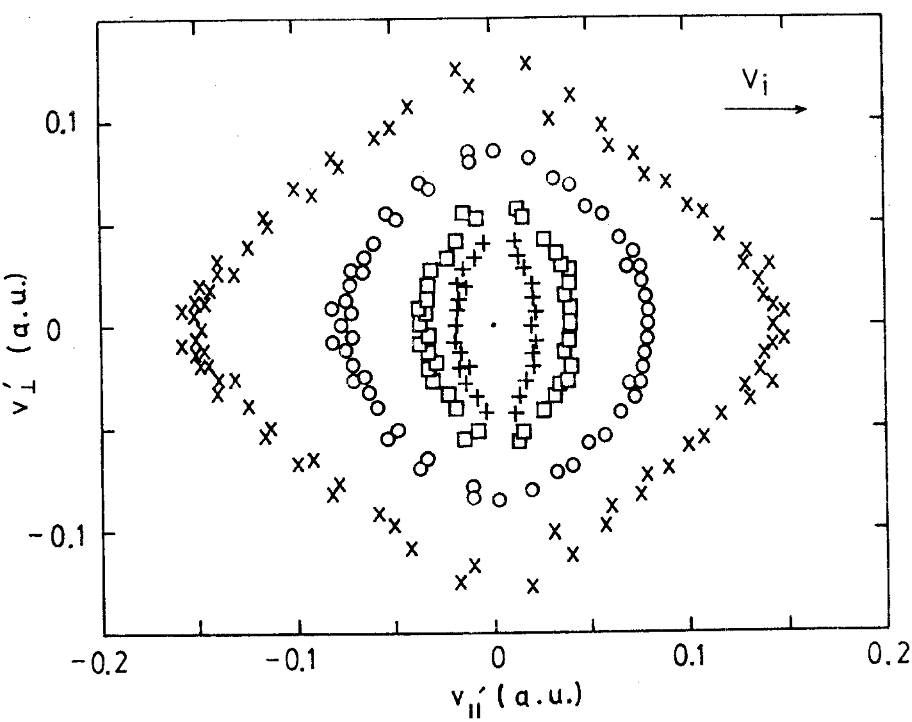

Fig. 2: Experimental contour lines for $H^\circ \rightarrow H_e$ collision at 105 keV beam energy and θ_0 = 1.5°. Levels lines at : (x), 0.1; (O), 0.2; (□), 0.4; (+), 0.6 of full peak height.

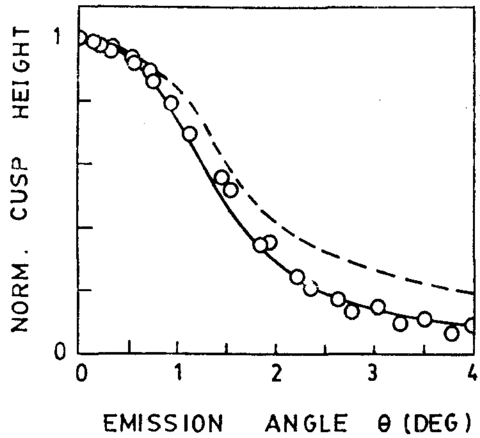

Fig. 3: Comparison of experimental (o) peak height variation with theoretical curves obtained from Q(---) and Q'(——) electron distributions.

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