## Comment on "Interference Effect in Electron Emission in Heavy Ion Collisions with $H_2$ Detected by Comparison with the Measured Electron Spectrum from Atomic Hydrogen"

Recently, Misra *et al.* [1] investigated interferences in electron emission from $H_2$ by $\sim$ MeV/$u$ C and F ions. It was argued that ratios of measured emission cross sections for $H_2$ and H are more appropriate for revealing interferences than previously used ratios of measured $H_2$ to theoretical H cross sections [2–4]. We show, however, that normalization to measured H cross sections introduces structures due to differences in the Compton profiles (electron velocity distribution along the beam direction) for $H_2$ and H that can obscure expected interference structures.

To identify the relatively small interference structures, a normalized ratio is used [2,3]:

$$(\sigma_{H_2})_{\text{norm}} = \frac{d^2\sigma_{H_2}}{d\Omega d\varepsilon} \Big/ \frac{d^2\sigma_{2H}}{d\Omega d\varepsilon} = \int \frac{d^3\sigma_{2H}}{d\mathbf{q}d\Omega d\varepsilon} \times \left[1 + \frac{\sin|\mathbf{k}-\mathbf{q}|d}{|\mathbf{k}-\mathbf{q}|d}\right] d\mathbf{q} \Big/ \int \frac{d^3\sigma_{2H}}{d\mathbf{q}d\Omega d\varepsilon} d\mathbf{q}, \quad (1)$$

where $\sigma_{H_2}$ and $\sigma_{2H}$ are the cross sections for electron emission from $H_2$ and two H atoms, respectively, and $d\Omega$ and $d\varepsilon$ are the solid angle and energy of the ejected electron. The sinusoidal term represents the interference due to coherent emission from the H centers, where $\mathbf{k}$ is the ejected electron velocity, $\mathbf{q}$ the momentum transfer, and $d$ the $H_2$ internuclear separation. Previously [3], measured $H_2$ cross sections were normalized to theoretical continuum distorted wave–eikonal initial state (CDW-EIS) [5] H cross sections using $Z_{\text{eff}} = 1.19$ ($Z_T$ in Ref. [1]) in Eq. (1) to represent the molecular Compton profile [6].

Measured $H_2$ electron emission cross sections for 1 MeV/$u$ $C^{6+}$ normalized to measured H cross sections from Ref. [1] are reproduced in Fig. 1 along with the calculated interference behavior (dashed curves) from CDW-EIS theory. The broad peak near 4 a.u. is attributed to interference in Ref. [1]. Also shown is the calculated CDW-EIS ratio (solid curves) obtained in the present work [5] using $Z_{\text{eff}} = 1.19$ in the numerator of Eq. (1) with the sinusoidal term set to zero (i.e., no interference) and $Z_{\text{eff}} = 1.0$ in the denominator to represent the noninterfering cross section ratio for $H_2$ to H but including effects due to the different Compton profiles. These differences are most important in the electron velocity range of the binary encounter peak centered at the positions indicated by the arrows. The minima and maxima in the solid curves are due, respectively, to the smaller central value and broader Compton profile of $H_2$ compared to H.

The calculations without interference predict rather well the behavior of the data contrary to the calculations of Ref. [1] that include interference. Thus, the structure in the 1 MeV/$u$ $C^{6+}$ data presented in Ref. [1] can be explained mainly on the basis of differences in the Compton profiles of $H_2$ and H, demonstrating that if ratios of experimental data are used particular attention must be paid to contributions from these noninterference structures [6] before interference behavior can be revealed.

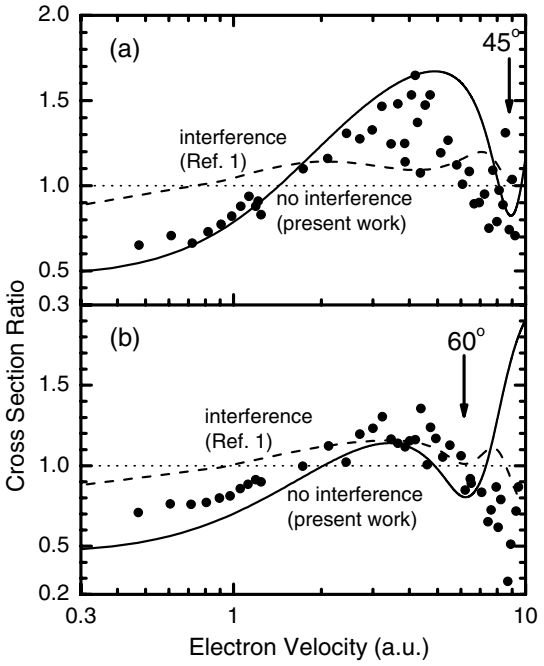


FIG. 1. Cross section ratios [from Eq. (1)] for electron emission from $H_2$ by 1 MeV/$u$ $C^{6+}$ for (a) 45° and (b) 60°. The data and the dashed curves (interference) are from Ref. [1]. The smooth curves (no interference) were calculated in the present work [5] (see text).

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