

LETTER TO THE EDITOR

MOMENTUM TRANSFER CROSS SECTION OF ELECTRON
ELASTICALLY SCATTERED ON ARGON

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Received 4 June 1987

UDC 530.145

Original scientific paper

The phase shifts for elastic scattering of electrons on argon, obtained recently by Amusia et al. for energies below the ionization threshold, are used for the calculation of corresponding momentum transfer cross section. Comparison is made with other calculations and experimental data.

A number of many-body calculations of electron elastic scattering on argon exists. Among them there are many-body perturbation theory (MBPT) results of Pindzola and Kelly¹⁾, results in the one-channel Tamm-Dankoff approximation, called also the simplified random-phase approximation with exchange (SRPAE) Amusia et al.²⁾, and our recent results with Amusia et al.³⁾. The first two mentioned calculations are done in the first order of optical potential (i. e. in Born approximation), while in the recent one (Amusia et al.³⁾) the optical potential calculated in the SRPAE has been included to all orders.

Although the phase shifts, describing the elastic scattering, do not differ much in the different many-body approaches, the various cross sections are sensitive to the approximation used (Amusia et al.³⁾). The aim of this paper is to compute the momentum transfer cross section and see the influence of various approximation on it.

The momentum transfer cross section is important when considering diffusion of electrons through gases. This cross section is expressed in terms of the scattering amplitude $f(\theta)$ as (Mott and Massey⁴)

$$\sigma_M = 2\pi \int_0^\pi |f(\theta)|^2 (1 - \cos \theta) \sin \theta d\theta,$$

or in terms of phase shifts δ_l

$$\sigma_M = \frac{4\pi a_0^2}{k^2} \sum_{l=0}^{\infty} (l+1) \sin^2(\delta_l - \delta_{l+1}).$$

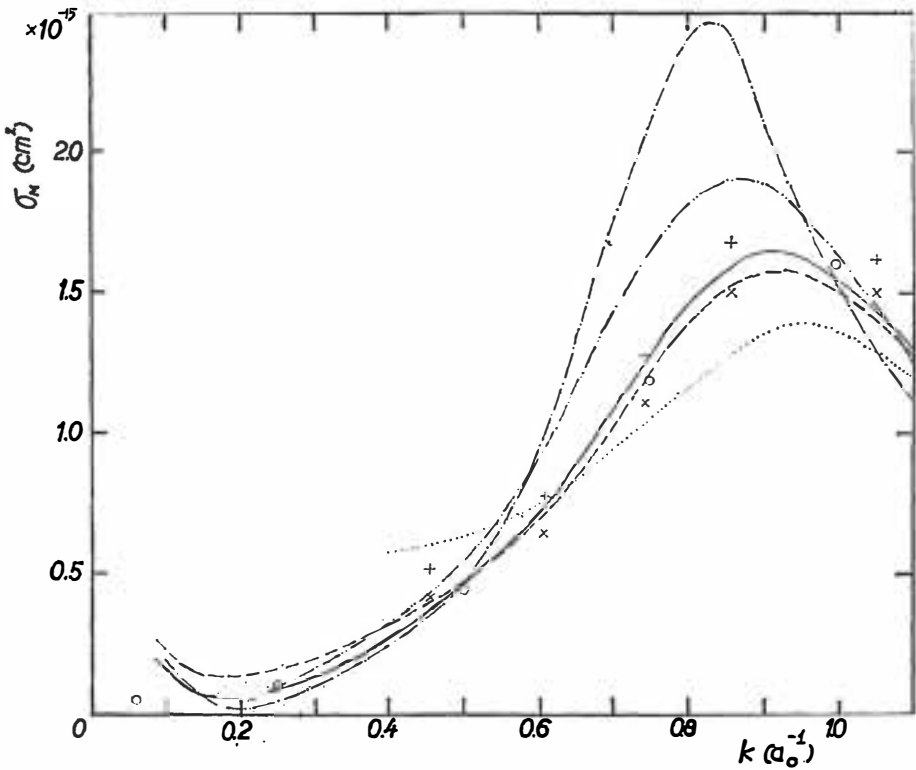


Fig. 1. Momentum transfer cross section σ_M for the electron-argon scattering vs. electron wave number k expressed by means of Bohr radius a_0 . Theoretical results: —, present work, ·····, HF approximation, - - -, optical potential to first order in SRPAE (Amusia et al.²), 0, MBPT results (Pindzola and Kelly¹), - · - ·, Polarized-core calculations (Yau et al.^{7,8}). Experiments: - · - ·, Williams⁵, +, Srivastava et al.⁶ derived from phase shifts, ×, Srivastava et al.⁶ derived from the normalization. All results are calculated in the present work using the phase shift in the references, with exception of Srivastava et al.⁶.

We present in this paper the results for momentum transfer cross section of electron elastic scattering on argon, using the phase shifts we recently obtained (Amusia et al.³⁾). The phase shifts in the Hartree-Fock (HF) approximation are also reproduced. The results for momentum transfer cross section are plotted in Fig. 1, and compared there with available MBPT results by Pindzola and Kelly¹⁾. The results of polarized-orbital calculations by Yau et al.^{7,8)} are also shown in Fig. 1. All these theoretical results are compared in the same figure with the experimental data by Williams⁵⁾ and Srivastava et al.⁶⁾. Let us note that we have calculated σ_M from available phase shifts in all cases represented in Fig. 1, except in the case of Srivastava et al.⁶⁾, where σ_M is given directly.

Inspecting the figure one sees that, apart from the HF, all the results are fairly close to each other for electron momentum corresponding to the wave number values up to about 10^8 cm^{-1} , while for higher energies the differences become larger. In the latter energy range our results are in good agreement with calculations of Pindzola and Kelly¹⁾ and with the experimental data by Srivastava et al.⁶⁾. The experimental data by Williams⁵⁾ overestimate our results in the some region, although both curves have the same trend. The results of polarized-orbital calculations by Yau et al.^{7,8)} around the maximum of cross section σ_M are well above our and all other results.

Acknowledgement

The work was supported by Research Funds of S. R. BiH (RZN), Yugoslavia.

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UDARNI PRESJEK ZA PRENESENI IMPULS ELASTIČNO RASEJANOG
ELEKTRONA NA ARGONU

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Originalni naučni rad

Fazni pomjeraj elastično rasejanog elektrona na argonu, za energije ispod praga jonizacije, dobijen u ranijem radu (Amusia et al. 1982), iskorišćen je za računanje odgovarajućeg udarnog presjeka za preneseni impuls. Izvršeno je poređenje sa ostalim proračunima i eksperimentalnim podacima.