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Shape resonances for electron scattering on N_2 and CO_2 in modified effective range theory

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$^2\Pi$ temporary negative ion states in N_2 and CO_2 at 2.1 eV and 3.8 eV [1] respectively, are the best known examples of so-called shape resonances, in which the incoming electron is captured into the potential well of the target, rather than to a specific electronic orbital. In the previous work [2] the modified effective-range theory using analytical solutions of the Schrödinger equation with the polarization potential has been applied to positron scattering on Ar and N_2 up to 2 eV energy. In this work [3] we apply a similar procedure for electron scattering on N_2 and CO_2. The modified effective range analysis have been performed explicitely for the two lowest partial waves, using experimental integral elastic cross sections in the $0.1 - 1.0$ eV energy range. The parameters (i.e. the scattering length and the efective range for the two partial waves) of the scattering potential obtained are used again for the scattering problem at higher energies. Both for N_2 and CO_2 resonant maxima appear in the few eV energy range, sligthly higher than well known experimentally resonances in total cross sections. Agreement with the experiment can be improved by assuming the position of the resonance in a given partial wave. These observations allow to classify the structures in N_2 and CO_2 cross sections as pure shape resonances, i.e. occuring due to a particular shape of the scattering potential rather than to presence of virtual orbitals in the electronic structure of the target.

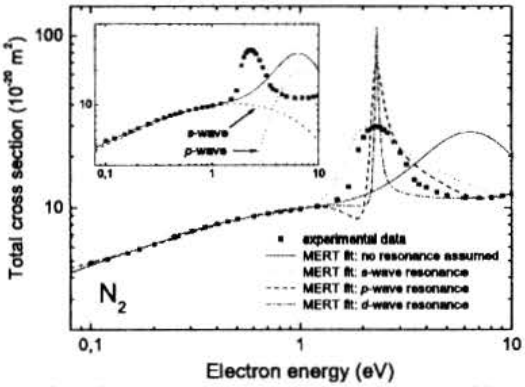

Figure 1: Total cross-section for the scattering of electrons on N_2 versus the energy. Depicted are: recommended experimental data from review [4] (stars), the theoretical fits based on MERT, assuming the resonance at 2.1eV in s wave (dotted line), p wave (dashed line), and d wave (dot-dashed line), and without assumption with respect to the position of the resonance (solid line). The inset shows in addition the s-wave and p-wave contributions to the MERT fit not assuming the position of resonance.

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