The two-photon detachment of O^-

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The two-photon detachment of the $O^-(1s^22s^22p^5\ ^2P^o)$ state has not been widely studied, and the agreement between the few results available is not particularly good. The only existing experiment gives a generalized cross section of $4.2 \times 10^{-50}\,cm^4\,s$ at a wavelength of 1064 nm [1]. An early calculation based on perturbation theory and a model potential [2] however yields, after interpolation, a value of $1.8 \times 10^{-49}\,cm^4\,s$, more than four times larger. The results obtained using an adiabatic theory [3] are almost an order of magnitude larger than the experimental value. Clearly there is room for improvement. Here we report new experimental and theoretical results.

The two-photon detachment cross section has been measured with a 12 ns seeded Nd:YAG laser. The effects of the interaction volume were disentangled by repeatedly sweeping the laser beam across the ion beam [4]. The deconvolution of the detachment signal with the ion current density and its inverse Abel transformation were performed with Gaussian basis functions, and provided the instantaneous detachment probability under the assumption of a cylindrically symmetric laser beam. The absolute cross section is then expressed in terms of easily measurable quantities such as the pulse energy and the ion beam current.

Calculations were performed using the *R*-matrix Floquet (RMF) method. Wave functions for the three $1s^22s^22p^4$ states of the residual Oxygen atom, together with three pseudo-states, were built from Slater-type orbitals chosen to optimize the polarizability of the ground state [5]. The binding energy of O^- is -0.053800 Hartree, compared to the experimental value of -0.053695 Hartree. As the laser field breaks the spherical symmetry of space, the generalized cross sections for $O^-(|M_L| = 0, 1)$ are computed separately and subsequently averaged.

The results, in excellent mutual agreement, are presented in Fig. 1, together with previous experimental and theoretical data [1, 2].

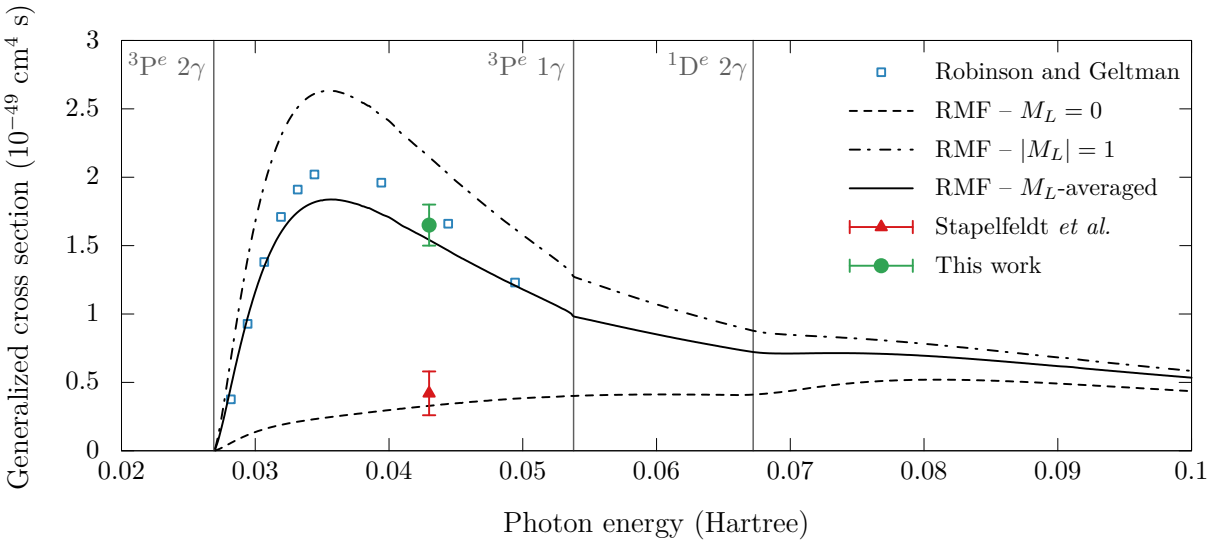

Figure 1: *Generalized cross sections. The vertical lines indicate the position of thresholds.*

References

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