A new method to measure photoabsorption cross-sections questions the value of the photodetachment cross-section of H^-

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A new method is described to measure photoexcitation cross-sections, relying on the asymptotic behavior of the signal in the saturated regime, when excitation is provided by a Gaussian laser beam. The method is implemented on a negative ion beam, with a single-mode pulsed Nd:YAG laser, to measure the photodetachment cross-section of the atomic anion H^-, at the wavelength 1064 nm.

This is the first laser measurement of the photodetachment cross-section of H^-. This cross-section is of primary importance both as the photodetachment cross-section of the most elementary negative ion and as a key parameter for the production of fast neutral H^0 or D^0 atoms, for plasma heating in the ITER and DEMO projects, by photodetachment from accelerated anions. A more classical numerical fitting method, including both the linear and the saturated regime, confirms a $4.5(6) \times 10^{-21}\mathrm{m}^2$ value, whereas most calculations performed for the last 50 years, including the most recent ones [1], have found $3.6 \pm 1 \times 10^{-21}$ m^2, in agreement with the older experiments [2,3]. Meanwhile, a few calculations relying on the adiabatic approximation in hyperspherical coordinates happened to find a 4.2×10^{-21} m^2 value [4,5], which would be compatible with our measurement.

The present result could suggest to revisit ab initio calculations of the H^- system and set more stringent constraints on the models used to represent H^- in atomic and molecular processes.

References

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