Multiquanta Photodetachment from the H^- Ion

by

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Abstract

Multiphoton detachment (MPD) of an electron from the loosely bound H^- system (binding energy= 0.7542 eV) has been studied at various photon energies and laser intensities. In the center of mass of 800-MeV H^- ions the CO_2 laser photon energy, 0.117 eV, was Doppler tuned over a wide range, from 0.15 to 0.39 eV. The peak laser intensity in the lab frame was varied from 2 to 12 GW/cm^2. The general behavior of MPD versus photon energy and the ac-Stark/ponderomotive effects are of special interest in the study.

Characteristic threshold structures by absorption of 2, 3, 4, and 5 photons were observed, as evidenced by rapid changes in the signal amplitudes. These thresholds provide a straightforward picture of channel opening in MPD as the photon energy is increased. A fit of two-photon detachment data to the Wigner threshold law showed a good match with a small intensity-induced shift in the threshold energy. A study of laser intensity effects demonstrated departures from the simple power law predicted by lowest-order perturbation theory, which is possibly another indication of ponderomotive shifts in the threshold. The absolute MPD rates have been estimated and found to be in fairly good agreement with the results of Floquet theory.