The 7th Ioannes Marcus Marci Session

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September 1, Thursday, 16:00 – 17:30

7th Ioannes Marcus Marci lecture

Angular and Internal-State Distributions of Photofragments Determined from Time-of-Flight Mass Spectrometry

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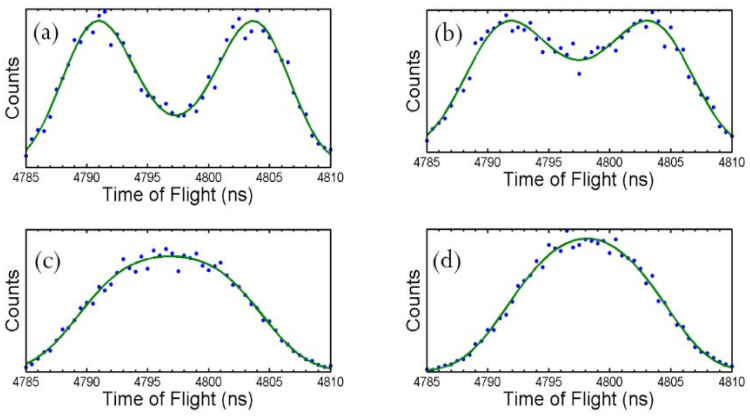
The anisotropy parameter β for the angular distribution of the photoelectron and photoion in (2+1) resonance enhanced multiphoton ionization process of H_2 X $^1\Sigma_g^+$ (v=0, J=0) molecules through the intermediate H_2 E,F $^1\Sigma_g^+$ (v=0, J=0) level (λ = 201.684 nm) is determined without using imaging hardware. Instead, we record the arrival time of the H_2^+ ions using a time-of-flight mass spectrometer when a molecular beam of H_2 is photoionized. Time-of-flight spectra were obtained as the direction of polarization of the ionizing laser was varied with respect to the flight axis and were fitted to an angular distribution in an appropriately rotated coordinate system with the z-axis oriented along the time-of-flight axis. The anisotropy parameter β was found to be 1.72 ± 0.13 by fitting the time-of-flight spectra and agreed with previous measurements. Using secondary ionization with a delayed laser pulse of different wavelength we also determined the vibrational energy distribution of the ions, showing greater than 99% of the ions are generated in their ground vibrational state (v^+=0), in agreement with the calculated Franck-Condon factors between the H_2 E,F $^1\Sigma_g^+$ (v=0) and H_2^+ X $^2\Sigma_g^+$ (v^+). The time-of-flight spectrometry technique presented here has general applicability for photofragmentation processes involving light molecules.



Time-of-flight spectra of the H_2^+ ion for (a) Θ = 0°; (b) Θ = 30°; (c) Θ = 60°; and (d) Θ = 90°. The green curves are fits to the blue data points, based on the fitting for Θ = 0°. The angle Θ describes the angles between the optical field of the laser and the flight axis of the molecular beam.

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