Ionization/dissociation of toluene under strong asymmetric two-color laser fields of fs duration

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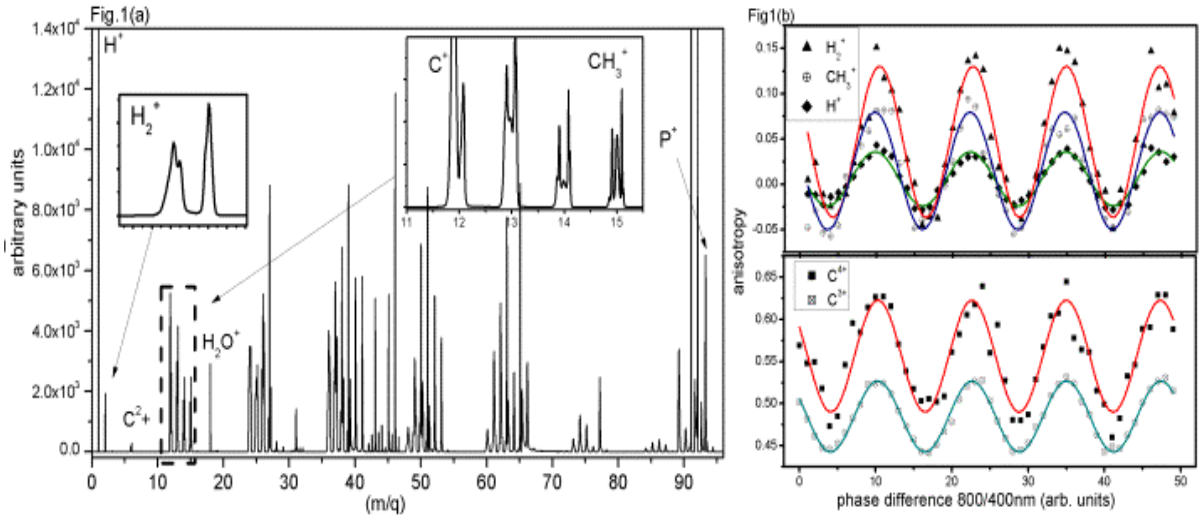
Strong asymmetric phase-controlled two-color laser fields (ω/2ω) consisting of the fundamental of a Ti:Sapphire laser and its second harmonic (800/400 nm) has been proven a powerful tool in investigating a variety of phenomena in the field of laser-matter interaction such as high harmonic generation, gas phase molecular orientation, and selective ionization of oriented polar molecules.

Even though the technique has been employed in numerous studies over the last decade, the majority of the reported results concern diatomic polar and non-polar (charge asymmetric dissociative ionization) gas phase molecules [1,2] with only few exceptions involving polyatomic species [3]. In this work, we present an experimental study on the ionization/dissociation processes of toluene (C_7H_8) interacting with an asymmetric two–color (800/400 nm) 40 fs laser field at moderate strong intensities (10^{14}–10^{15} W/cm^2). Using TOF-mass spectrometry we have recorded the mass spectra of C_7H_8 (fig1.a) as a function of the phase difference between the 800 and 400 nm laser pulses. Efficient control of the directional ejection of both atomic (H^+, C^{2+}, C^{3+}) and molecular (CH_3^+, H_2^+) fragments of multiply charged parent ions is clearly documented (fig1.b). The degree of anisotropy is found to be dependent on the fragment ion properties (charge state, kinetic energy) reflecting in that way the dependence of the phase-control efficiency on the ionization process which results in the formation of different precursor ionic species. Therefore, the phase dependent fragmentation patterns offer additional information, beyond the limitations of single laser pulse mass spectrometry, which is crucial for achieving more insight on the underlying ionization/dissociation mechanism.



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