IONIZATION AND DISSOCIATION OF MOLECULAR ION BEAMS CAUSED BY ULTRASHORT INTENSE LASER PULSES

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Studies of the simplest one-electron molecule, H_2^+, are the first step toward understanding the interaction of ultrafast intense laser pulses with molecules. Numerous such studies have been conducted using H_2 dilute gas targets and generating the H_2^+ of interest within the same laser pulse that initiates the dissociation of the daughter molecule. In contrast, direct studies of H_2^+ targets are few, mainly because beam targets are much less dense. The additional experimental effort is rewarded by the ability to study dissociation of highly excited vibrational states at peak intensities extending way below the ionization threshold of H_2 (e.g., [1]). Furthermore, the fast motion of the molecular ions in the laboratory frame enables measurements of both neutral and charged fragments in coincidence, thus allowing kinematically complete measurements.

We will present an overview of selected results from recent experiments in which molecular ion beams were interrogated by 7-135 fs laser pulses having 10^{13}-10^{15} W/cm^2 peak intensity.

Examples of such results are: (i) dramatic changes of the dissociation spectra due to different pulse duration [2], and (ii) a surprising structure observed near the ionization threshold, which we call above threshold Coulomb explosion (ATCE) [3]. Currently we are studying the behavior of H_2^+ and other molecular ions in intense few-cycle laser pulses (6-10 fs FWHM).

Thanks are due to Professor Zenghu Chang and Dr. Charles Fehrenbach for their invaluable help. Supported by the Chemical Sciences, Geosciences, and Biosciences Division, Office of Basic Energy Sciences, Office of Science, U.S. Department of Energy.

References

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