Probing H_2^+ Formation in Strong-Field Ionization of Water Using Pump-Probe Spectroscopy and Covariance Mapping

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Understanding the ultrafast dynamics governing molecular fragmentation under intense laser fields is crucial for advancing strong-field physics and attosecond science. In this work, we investigate the formation of H_2^+ from water (H_2O) during strong-field ionization using a femtosecond pump-probe technique combined with covariance mapping analysis. A near-infrared femtosecond laser pulse initiates ionization and dissociation, while a delayed probe pulse further ionizes the evolving molecular fragments. By employing covariance analysis of electron-ion momentum distributions, we resolve ionization pathways leading to H_2^+ formation. Our results provide insights into the ultrafast proton migration and charge redistribution mechanisms that facilitate molecular hydrogen cation production.

Keywords: strong field, covariance, proton migration

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