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Ionization of Methane in Strong and Ultrastrong Fields¹

SAMANTHA L. WHITE, University of Delaware

The photoionization of methane is reported for intensities up to 10^{19} W/cm² with linear and circular polarized light. While fragmental ions (e.g. CH₃⁺, CH⁺, C⁺, C⁺²) created from 10^{14} W/cm² to 10^{15} W/cm² are formed by Coulomb explosion, ionization to form C⁺³ and C⁺⁴ involves Coulomb explosion and tunneling ionization. In ultrastrong fields, removal of a carbon K-shell electron from methane proceeds via tunneling and rescattering ionization, without the influence of molecular channels. Photoelectrons from methane at 10^{19} W/cm² extend up to kinetic energies of 0.6 MeV.

¹In collaboration with S. Palaniyappan, R. Mitchell, R. Sauer, I. Ghebregziabher, M.F. Decamp, and B.C. Walker, Physics and Astronomy Department, University of Delaware, Newark, DE 19716.