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Benchmark measurements of H_3^+ fragmentation in intense ultrashort laser pulses[1]

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A fundamental grasp of how molecules respond to short intense laser pulses is essential to advance applications in laser- molecular science. Basic research on this topic lays the foundation for many vibrant areas of physics. Traditionally research begins on the simplest system and gradually expands to more complex systems as knowledge and understanding grows. For this reason H_2^+ is considered the prototype diatomic molecule and can be credited for the discovery of many of the strong field molecular phenomena known to us. In a similar manner H_3^+ is considered the prototype polyatomic molecule — composed of three protons, bound by two electrons, in an exotic triangular configuration. Modeling the full quantum mechanical response of H_3^+ to intense lasers is a serious challenge for theory, thus experiments can help provide the necessary simplifying assumptions. To date, though, this system remains experimentally unexplored for a combination of reasons. At this meeting we present the first measurements of the fragmentation of H_3^+ and its isotopologues in intense fields using coincidence 3D momentum imaging. The imaging gives kinetic energy release and angular distributions that provide information on the breakup mechanisms. For example, we find that three-body dissociative ionization of H_3^+ is strongly enhanced when the molecular plane aligns to the laser polarization and, moreover, when one of the nuclei within the plane aligns to the polarization. It is hoped that these benchmark measurements will guide future theoretical and experimental work on H_3^+ and larger polyatomic molecules.

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