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Isotopic effects in bond rearrangement caused by sudden ionization of ammonia and methane molecules[1]

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The production of H_2^+ and H_3^+ fragments upon dissociation of ammonia and methane molecules involves rearrangements of the molecular bonds. Fast ion impact results in ionizations on time scales of 10 attoseconds, thus freezing the nuclear motion. Our earlier studies of H_2^+ formation upon dissociation of water molecules by fast ions showed a strong isotopic dependence. Recently, we measured isotopic effects in the production rate of H_2^+ and H_3^+ from NH_3 and CH_4 ionized by the same ions. Compared to H_2^+, creating H_3^+ requires the rapid cleavage and formation of additional bonds. The process is enhanced, however, by the geometrical similarity of the parent molecules and the triangle-shaped H_3^+ ions. Differences in triangle size result in vibrational excitation and may cause isotopic differences.

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