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22d April 2021, 13:00–14:00h

Zoom virtual meeting https://desy.zoom.us/j/91202137161

(Meeting-ID: 912 0213 7161, Password: 845021)

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Exotic chemical reactions of molecules in strong fields

The existence of organic molecules and water in the universe is due in great part to the existence of H_3^+, because, as a Brønsted–Lowry acid, H_3^+ donates protons to carbon and oxygen atoms as well as to more complex organic molecules. Alcohols under strong laser fields undergo exotic chemical processes involving making and breaking of multiple chemical bonds that result in the formation of H_3^+, H_2O^+, and H_3O^+. The formation of H_3^+, following strong-field photodissociation of methanol, is preceded by the formation of a neutral H_2 molecule that roams the parent ion and extract a proton [*Sci. Rep.* **7**, 4703 (2017)] as illustrated in Figure 1. Site-specific details and femtosecond time-resolved dynamics of H_3^+ formation for a series of alcohols have been obtained through a combination of time-resolved mass spectrometry, photoion-photoion coincidence measurements, and *ab initio* calculations [*Nat. Commun.* **9**, 5186 (2018)]. Our findings provide mechanistic and dynamic information about the chemistry of H_3^+. The yield of these and related strong-field reactions has been recently found to be sensitive to the spectral phase of femtosecond laser pulses [*J. Chem. Phys.* **150**, 044303 (2019)]. The sensitivity of nonlinear optical processes including second harmonic generation and tunnel ionization to a phase step [*Comm. Phys.* **3**, 35 (2020)] led to the development of a new method for compressing femtosecond pulses. Chemical reactions in larger molecules involve rearrangements and the cleavage and formation of multiple bonds. We have recently completed a time-resolved study of retro-Diels-Alder reactions following electron rescattering.

Host: Jochen Küpper/ CFEL Molecular and Ultrafast Science Seminar

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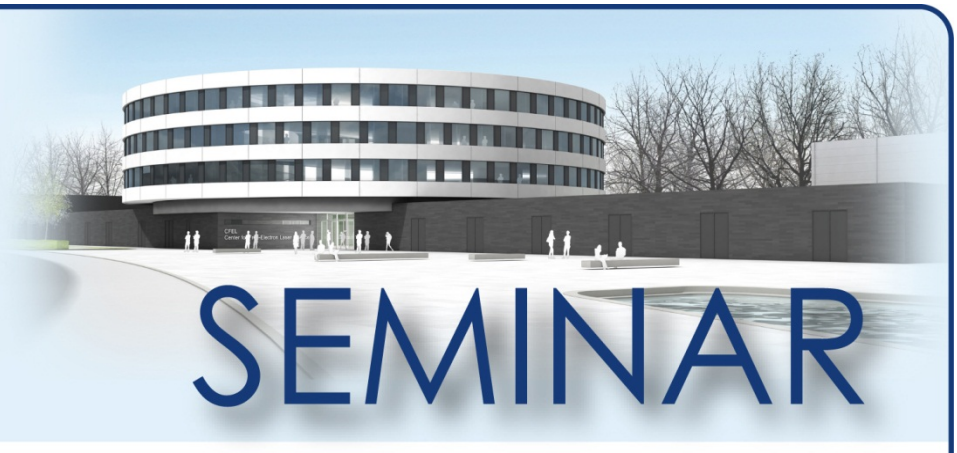

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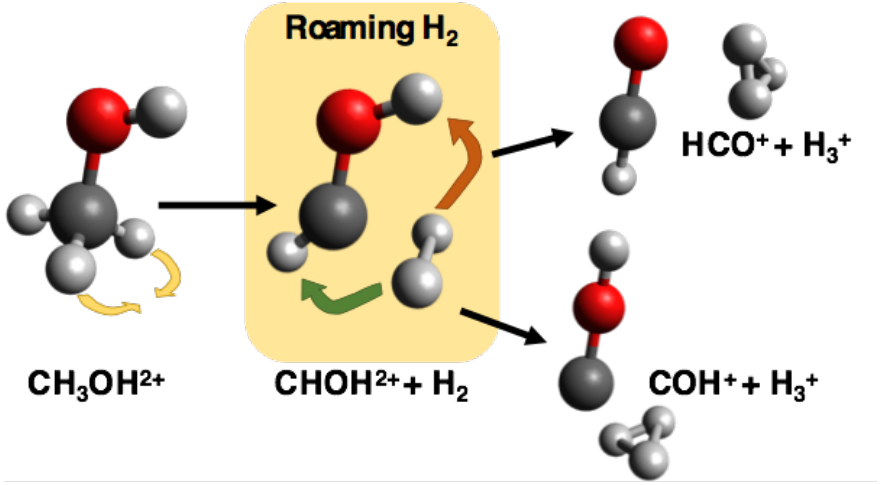

Figure 1. The strong-field triggered fragmentation of methanol in the gas phase includes a chemical reaction producing H_3^+ and either HCO^+ or CHO^+.