Contribution ID: **981** Type: **Invited talk**

Attosecond Pump-Probe Spectroscopy of Liquid Water

Thursday 29 August 2024 15:30 (30 minutes)

Electronic motion in nature underlies chemical reactions and occurs on the attosecond timescale. Attosecond snapshots of evolving electronic structure during light-induced chemical reactions have been captured with high-harmonic generation probes [1]. However, all x-ray attosecond-pump/attosecond-probe experiments that directly observe electron dynamics in real time with all nuclear motions frozen awaited the advent of intense, attosecond pulses from free-electron lasers [1] delivered as synchronized pairs [2]. Such x-ray pump-probe experiments represent a means to understand, with site- and chemical-selectivity, ionization-induced electronic dynamics in simple gas-phase to complex condensed-phase systems. Employing synchronized two-color x-ray pulse pairs we experimentally developed and theoretically modelled observables for all x-ray attosecond transient absorption spectroscopy (AX-ATAS) where spectroscopic snapshots free from nuclear motion are acquired [4]. Our initial study on pure liquid water resolved a long-standing debate concerning the interpretation of the 1b1 x-ray emission doublet, demonstrating the power of attosecond experiments to also reveal equilibrium structure information. An outlook for studying radiation-induced chemistry from sub-femtosecond to much longer timescales in complex aqueous systems will be presented.

[1] P. Kraus et al., *Nature Reviews Chemistry* **2,** 82–94 (2018).
[2] J. Duris et al., *Nature Photonics* **14**, 30–36 (2020).
[3] Z. Guo et al., *Nature Photonics* (2024).
[4] S. Li et al., *Science* **383**, 1118-1122 (2024).

I plan to submit also conference proceedings

No

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