



# SFB1242

Nichtgleichgewichtsdynamik kondensierter  
Materie in der Zeitdomäne

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ESSEN

Open-Minded

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## **Attosecond soft-X-ray spectroscopy in the gas and liquid phases**

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Attosecond spectroscopy has the potential to address fundamental questions in chemical sciences. A promising approach is offered by the element- and site-sensitivity of X-ray spectroscopy. We have recently demonstrated the potential of table-top X-ray absorption spectroscopy with a water-window high-harmonic source, observing the temporal evolution of unoccupied molecular orbitals and molecular shape resonances during chemical reactions [1]. Compressing the mid-infrared driving pulses to less than 2 optical cycles, we have demonstrated the extension of this light source to fully cover the oxygen K-edge [2]. Using the same technique, we have also demonstrated the generation of isolated attosecond pulses, which have established a new record of the shortest light pulses ever measured (43 attoseconds) [3]. Since the vast majority of chemical processes takes place in the liquid phase, the extension of attosecond spectroscopy to liquids is desirable. I will discuss the first observation of extreme-ultraviolet high-harmonic generation from liquids, achieved through the application of ultrathin ( $0.6 - 2 \mu\text{m}$ ) flat microjets [4]. I will also present the extension of attosecond time-resolved spectroscopy from molecules [5] to liquids [6]. The time delays between photoemission from gaseous and liquid water range from 50-70 attoseconds and are shown to mainly originate from the solvation of water molecules, with liquid-phase electron scattering playing a minor role. These developments set the stage for attosecond time-resolved studies of molecular systems of chemical complexity.

### **References**

- [1]. Y. Pertot et al., *Science* **355**, 264 (2017).
- [2] C. Schmidt et al., *Opt. Exp.* **26**, 11834 (2018).
- [3] T. Gaumnitz et al., *Opt. Exp.* **25**, 27506 (2017).
- [4] T. T. Luu et al., *Nature Communications* **9**, 3723 (2018).
- [5] M. Huppert et al., *Phys. Rev. Lett.* **117**, 093001 (2016).
- [6] I. Jordan et al., submitted (2019).

**Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.**

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