

17.03.2026 / 10 Uhr c.t., Raum MG 272  
Campus Duisburg

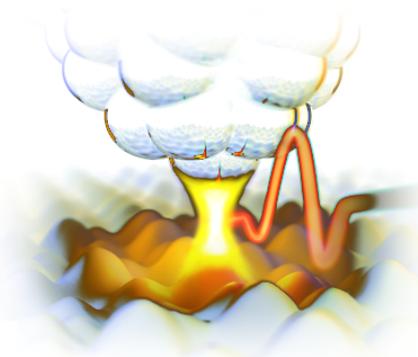
## Ultrafast Lightwave-Driven Microscopy and Spectroscopy on the Atomic Scale

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Lightwave-driven scanning tunneling microscopy offers a powerful new window into quantum phenomena at the atomic scale [1–8]. By combining single-cycle terahertz pulses with scanning tunneling microscopy (THz-STM), we achieve simultaneous picometer and picosecond spatio-temporal resolution, enabling terahertz time-domain spectroscopy and microscopy with unprecedented precision [7–9]. We have used this technique to explore terahertz-driven tunneling dynamics across a wide range of materials, including noble metals [4,7], conventional semiconductors [3,7,9], graphene nanoribbons [5], and a topological Weyl semimetal [8]. THz-STM also enables visualization of how local surface potentials influence the ultrafast evolution of photoexcited charge carriers near atomic defects [9]. Further yet, the tightly confined and strongly enhanced THz fields can be used to drive local phase transitions such as in  $WTe_2$ , where a terahertz-induced interlayer shear displacement triggers a reversible topological switch of the topmost surface layer near the tip apex [8]. By combining picometer resolution with sub-cycle temporal precision, THz-STM opens the door to an entirely new regime of quantum measurement, transforming how we observe, understand, and control matter at its most fundamental scale.

- [1] T. L. Cocker et al., Nat. Photon. **15**, 558 (2021).
- [2] T. L. Cocker et al., Nat. Photon. **7**, 620 (2013).
- [3] V. Jelic et al., Nat. Phys. **13**, 591 (2017).
- [4] Y. Luo et al., Phys. Rev. B **102**, 205417 (2020).
- [5] S. E. Ammerman et al., Nat. Commun. **12**, 6794 (2021).
- [6] S. E. Ammerman et al., Phys. Rev. B **105**, 115427 (2022).
- [7] V. Jelic et al., Nat. Photon. **18**, 898 (2024).
- [8] V. Jelic et al., Nat. Photon. **19**, 1048 (2025).
- [9] V. Jelic et al., (in preparation 2026).



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

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