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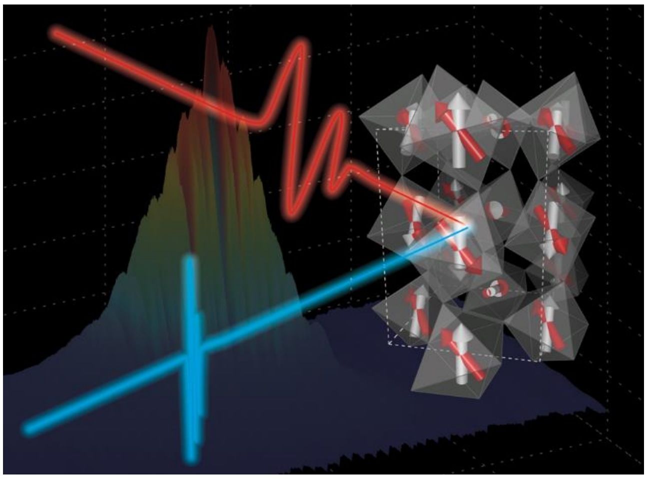
SONDERTERMIN

Driving atomic-scale structure with light

Prof. Dr. S. L. Johnson, *Institute of Quantum Electronics, ETH Zurich, 8093 Zurich, Switzerland*

The long-standing idea of using intense, short light pulses as a means of reversibly controlling the structure of condensed matter systems holds interest from an applications perspective and additionally serves as a fundamental challenge for understanding the strongly out-of-equilibrium properties of materials. A complete experimental approach to this problem requires simultaneous development of tailored high-intensity "control" light pulses as well as a means of measuring as directly as possible the influence of these pulses on the structure and dynamics of a particular material.

Here I discuss several representative examples of light-driven structural excitations that are quantitatively characterized using time-resolved x-ray diffraction. These examples fall roughly into two categories. The first category uses light at near-optical wavelengths to indirectly excite dynamics of long-range structural order via electronic transitions [1,2]. The second category of examples involves using long-wavelength, THz-frequency radiation to directly excite electric-dipole active collective structural modes of the lattice and/or spin systems [3,4]. I conclude with an outlook on the future potential of these methods to achieve reversible control over domains in ferroelectrics and multiferroics.



[1] T. Huber et al., Phys. Rev. Lett. **113**, 026401 (2014).
[2] P. Beaud et al., Nature Mater. **13**, 923 (2014).
[3] T. Kubacka et al., Science **343**, 6177 (2014)
[4] S. Grübel et al., in preparation.