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Measuring the dynamics of quantum materials over different length scales with X-ray free electron lasers

Monday, June 19, 2023 10:20 AM (25 minutes)

Quantum materials exhibit complex interactions between electron, structural and spin degrees-of-freedom over a wide range of length scales, leading to exotic phenomenon that are challenging to study. Ultrafast excitation can disentangle these degrees-of-freedom, but resolving the different length scales remains challenging. Here I will present recent results using X-ray free electron lasers to resolve femtosecond electronic and structural dynamics in the quantum material vanadium dioxide from the picometer to micrometer length-scale. Hard X-ray total diffraction is used to study incoherent small polaron distortions which have been found to allow efficient seeding of light-induced phase transitions, while soft X-ray coherent imaging is used to measure nanoscale phase co-existence during the light-induced phase transition itself, shedding light on the nature of proposed out-of-equilibrium phases at the nanoscale [1].

[1] A.S. Johnson *et al.*, Nature Physics **19** (2), 215-220 (2023)

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