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Probing correlated electron systems on the femtosecond timescale at SwissFEL's Experimental Station B

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The SwissFEL hard X-ray free electron laser at PSI will produce femtosecond X-ray pulses from 2-12 keV at a repetition rate of 100 Hz and 10^11 to 10^12 photons per pulse. Experimental Station B at SwissFEL proposes to combine time-resolved laser spectroscopy methods and X-ray scattering techniques to study the dynamics of cooperative interactions in crystalline materials that exhibit long-range elecronic and magnetic order. One important class of these types of materials are strongly correlated electron systems ('quantum materials') that exhibit competition between lattice, charge, orbital and spin degrees of freedom. Such materials also show complex phase diagrams. We propose to install a dedicated instrument for X-ray pump-probe scattering and diffraction including polarization control and flexible sample environment. Photon-in/photon-out scattering experiments allow to directly correlate the electronic, magnetic and structural dynamics. The focus of the experimental station will be on performing pump-probe experiments on crystalline samples (thin films, bulk crystals) with excellent time resolution (<50 fs) and a variety of excitation sources, with an emphasis on sample excitation with THz fields. The techniques available will initially include grazing incidence X-ray diffraction and resonant X-ray diffraction with a variety of sample environments, including low temperatures (10K). The future plans of the instrument, including the ability to perform polarization analysis using phase retarders and inelastic X-ray scattering (RIXS) measurements, will also be presented.

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