# Time-resolved X-ray studies of phonon dynamics and phase-transitions.

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Studying atomic motion in real time through ultrafast X-ray diffraction has enabled new insights in solid-state physics, chemistry and biology. Experiments on melting/resolidification of semiconductors and on acoustic phonon generation in solids are ongoing at beamline D611 at MAX II. This is one of the first few beamlines for time-resolved X-ray science in the world, but more are coming. The scientific field stands before a revolutionary quantum leap as novel femtosecond X-ray sources are under development. In 2008 the Linear Coherent Light Source (LCLS; the 1 Å free-electron laser at SLAC (Stanford linear accelerator center)) is estimated to be in operation.

For almost two years, SPPS (the Sub-Picosecond Pulse Source) which is a pre-cursor to SPPS has been in operation. Electron bunches extracted from the SLAC linac are compressed and sent through an undulator, producing 8-10 keV X-ray pulses with a few times $10^7$ photons/pulse at 10 Hz, and a calculated pulse duration of only 80 fs (FWHM). The first experiments at SPPS have revealed the inertial dynamics which constitutes the first steps in the light induced phase-transition from the solid to liquid phase.

In this talk, we will review some of the scientific achievements, in time-resolved X-ray science over recent years, show recent results from MAX-Lab and SPPS and discuss the new possibilities which arrive with LCLS.