ULTRAFAST SINGLE-SHOT DIFFRACTION IMAGING OF NANOSCALE DYNAMICS

A. Barty, CFEL, Hamburg, Germany

Abstract

The ultrafast, ultrabright, coherent X-ray pulses offered by X-ray FELs open the doors to a range of new capabilities in X-ray science. The ultrafast pulses from X-ray FELs enable X-ray imaging beyond conventional radiation damage limits enabling the ultrafast single-shot images of transient phenomena and material structure to be captured. Although sufficient dose is deposited in a single pulse to completely destroy the sample, it is nevertheless possible to collect meaningful diffraction patterns from the undamaged sample before it is destroyed using ultra-short X-ray pulses that terminate pulse before the effects of sample damage are manifested. Experiments in recent years at the first operational FELs in the X-ray regime – FLASH and LCLS - have demonstrated the feasibility of flash imaging using soft X-ray FELs. In particular it has been shown that measurements can be made before sample damage occurs. Single-pulse X-ray imaging has been used to study the time evolution of non-cyclic phenomena such as laser-induced ablation with nanoscale resolution and a shutter speed measured in femtoseconds.

CONTRIBUTION NOT RECEIVED