

Laser Wakefield Accelerator Based Photon Sources

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Recent progress in laser wakefield acceleration has led to the emergence of a new generation of electron and X-ray sources that may have considerable benefits for ultrafast science. Laser wakefield acceleration provides radiation pulses that have femtosecond duration and intrinsic synchronisation with the laser source, allowing for pump-probe measurements with unprecedented temporal resolution. These pulses can be used to study ultrafast dynamical phenomena in plasma and dense material, such as transient magnetic fields, rapidly evolving plasma dynamics and crystal lattice oscillations. I will review our recent experiments in laser wakefield acceleration and energetic photon generation using the laser systems at the University of Michigan and STFC Rutherford Appleton Laboratory and their use for capturing the dynamics of laser-pumped samples. Single-shot, spectrally resolved absorption measurements in laser pumped foils can be made on ultrafast timescales using this broadband photon source. X-ray and electron diffraction using beams from laser-plasma sources capture structural dynamics in crystalline samples. I will also discuss the technological needs for and potential impact of such revolutionary compact radiation sources for ultrafast science in the future.