

The X-ray Free Electron Laser A New and Emerging Research Tool

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Abstract

The laser was invented 50 years ago. About ten years later John Madey of Stanford University published a seminal paper entitled "Stimulated Emission of Bremsstrahlung in a Periodic Magnetic Field" describing the induced coherent radiation from the motion of a relativistic electron through a periodic magnetic field. This was the birth of the free electron laser, FEL. In this talk I will describe the recent developments that culminated with the successful first lasing in the spectral region 0.15-1.5 nm at the Linac Coherent Light Source (LCLS) at Stanford in April 2009. The first hard x-ray FEL became a reality. LCLS is based on the last 1000 m of the 3 km long linear accelerator (with electron beam energies 4-15 GeV), a 130 meter long undulator to produce the coherent x-rays, and two experimental halls separated by 200 m.

The FEL radiation has unprecedented properties in terms of brilliance with femtosecond pulse widths, 2-3 mJ pulse energies (10^{12} photons per pulse), and tunability. LCLS will open up novel research opportunities in a number of fields: high-field and femtosecond physics of atoms and molecules, imaging of nanoparticles and biomolecules (non-periodic structures), diffraction studies of stimulated dynamics (e.g. phase transitions, charge transfer reactions), coherent-scattering studies of nanoscale fluctuations, and high-energy density science (warm dense matter and plasma physics). In the talk I will discuss the revolutionary science and show a few results that have been obtained since LCLS started operation for users in October 2009. The experimental program is still in its infancy but major efforts are underway for developments of advanced instrumentation. Finally I will outline the planned upgrades of LCLS during the next five years to further its experimental capabilities for a broad user community.

Friday March 26 at 14:30

Auditorium C1, Electrum, Kista

Coffee and tea with cake will be served in the ground floor open area starting at 14:00.

**Most welcome!
The KSS team**

