

Recent developments at the FLASH facility

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FLASH, the free electron laser facility for VUV and soft X-ray radiation at DESY in Hamburg, has made rapid progress since it started user operation in summer 2005. The free electron laser (FEL) can now be tuned to any wavelength between ~50 nm and 6.5 nm in the first harmonic, with significant intensity available also in the third and fifth harmonics. Long bunch trains with variable bunch spacing ranging from single bunch to several hundred bunches at MHz repetition rates, and high peak power in the GW range with photon pulse energies of up to 170 μ J can be generated. During dedicated user runs, approximately 75% actual beam delivery could thus far be achieved. A further upgrade of electron beam energy is planned in 2009 in order to extend the spectral range of FLASH towards shorter wavelengths well into the water-window.

User experiments at FLASH have been covering a broad range of applications. The projects can be grouped into four broad categories:

- Femtosecond time-resolved experiments dealing both with technical developments and the first pump-probe experiments.
- Studies of the interaction between extreme-ultraviolet radiation and matter, including experiments dealing with multi-photon excitation of atoms, molecules and clusters. The first diffraction experiments on artificial as well as biological nano-objects have successfully demonstrated that images can indeed be taken and structures resolved with a single FEL pulse even though the objects explode after the radiation impact.
- Investigations of very dilute samples. These projects deal with photodissociation of molecular ions, spectroscopy of highly charged ions, and mass-selected clusters.
- Research on surfaces and solids including experiments on laser induced desorption, surface dynamics, luminescence, Raman and photoelectron spectroscopy of surfaces and solids with nanometer spatial resolution.

The talk will review the recent technical and experimental achievements at FLASH and highlight some prominent examples.