Science at the BESSY Soft X-Ray HGHG FEL

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BESSY is planning to build a Soft X-Ray FEL facility covering the photon energy range from 20 eV to 1 keV at the site next to the existing third generation storage ring BESSY II. This new facility will complement the existing facility by offering laser like photon beams with fully coherent, high power (mJ) pulses of $\leq$20 fs duration, enabling a whole set of novel experiments dedicated to understand dynamical processes in matter or for the investigations of very dilute systems. These pulses will be generated in a HGHG scheme (High Gain Harmonic Generation) which offers controlled, reproducible pulses as determined by the external seed UV (430-230 nm) laser pulse. Additionally this scheme allows for an inherent synchronization for pump-probe investigations. The HGHG-FEL covers the traditional BESSY II photon energy range, which is especially suited for electronic structure investigations of atoms, molecules, clusters, and solids. With the anticipated temporal resolution of $\leq$ 20 fs charge transfer processes and time resolved 'femtochemistry' studies as well as magnetization dynamics in magnetic materials establish some of the major areas of scientific interest in this new facility. Furthermore in microscopy on soft-matter and biological samples it is possible to acquire an image using a single laser pulse. Thus stroboscopic time resolved images of dynamical processes in living cells become possible.

In general, the science planned at this facility is complementary to the science envisioned for the planned high energy FEL facilities, theTESLA X-FEL facility at DESY and the Linac Coherent Light Source (LCLS) at Stanford.