The European X-ray Free-Electron Laser Project in Hamburg

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In the quest for more brilliant x-ray sources, a number of projects worldwide are pursuing the realization of a source of extremely brilliant (peak brilliance ~ 10^{33} photons/s /mm^2/ mrad^2/0.1%BW), ultra-short (~ 100 fs) pulses of spatially coherent x-rays with wavelengths down to 0.1 nm, and to exploit them for revolutionary scientific experiments in a variety of disciplines spanning physics, chemistry, materials science and biology. In the US and in Japan, Free-Electron Lasers (FEL) are being developed based on room-temperature linear accelerators (Linacs). In Europe, the superconducting linear accelerator technology developed at DESY within the TESLA collaboration, and successfully applied to produce laser-like radiation in the 100 to 7 nm range at the FLASH facility at DESY, is adopted. The most important advantage of the superconducting technology is the possibility to produce up to 30 000 pulses per second, instead of 60 or 120 foreseen in the Japanese and American projects, respectively. In the European facility, it is foreseen that electron bunches, accelerated to 17.5 GeV in a ~ 1.7 km long Linac, pass through long (up to 200 m) undulators, where they generate bursts of coherent x-rays via the process known as SASE (Self-Amplified Spontaneous Emission). Commissioning with first beam of the facility is expected to take place in 2013/2014. An initial contingent of 3 photon beamlines with 6 experimental stations (later to be upgraded to 5 photon beamlines and 10 experimental stations) is foreseen, where experiments exploiting the high intensity, the coherence and the time structure of the new source are going to be performed. A brief illustration of some of the potential experiments is presented.