

The European XFEL Project: Overview of Scientific Applications and Challenges to X-ray Optics

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The European XFEL will provide free-electron laser radiation in the photon energy regime of a few 100 eV up to ~14 keV. Using self-amplified spontaneous emission one obtains highly coherent, ultrashort and intense x-ray pulses with a repetition rate of up to 30000 per second. The project was launched officially in June 2007 and first beam is scheduled for 2014.

In the startup configuration the facility foresees three SASE undulators and six scientific instruments for the soft and hard x-ray domains. These instruments are dedicated to various experimental techniques each serving several scientific domains. A brief overview of proposed scientific applications will be given.

The development of X-ray optics for the European XFEL has to overcome several challenges in order to preserve the high extreme peak brilliance, while delivering very intense X-ray pulses at extreme repetition rates to the instruments. For reflective optical elements the requirement of coherence preservation implies sub- μ rad to nrad slope errors and height tolerances in the range of nanometers rms. In addition to the damage potential from individual x-ray pulses, extreme thermal loads on the millisecond time scale are mayor concerns.