X-ray Free Electron Lasers
Current performance, planned upgrades and future perspectives

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With the advent of X-ray Free Electron Lasers (XFEL), a novel type of X-ray light source with unprecedented beam properties has become available. Key parameters are an intensity of about 10^{12} photons per pulse, a pulse duration that can be tuned form several hundreds down to a few femtoseconds, and a very high degree of coherence (and thus of photon degeneracy). Started as the TESLA Test Facility, FLASH in Hamburg (Germany) was the first XFEL opening as a general user facility in 2005. As a result of a series of accelerator upgrades, the FLASH covers today with its first harmonic the photon energy range from a few tens up to about 300 eV (XUV-FEL). In 2009, first lasing in the hard X-ray photon energy range was demonstrated at LCLS in Stanford (USA). The hard X-ray FEL SACLA in Japan and the XUV-FEL FERMI in Italy complete since 2012 the suite of XFEL sources available to the interested user community. And with the three hard X-ray FELs European XFEL in Hamburg, the SwissFEL at the PSI in Switzerland and the PohangFEL in South Korea scheduled to become operational within the next few years, the current access bottleneck of these highly requested facilities will be removed soon. It is thus very timely to update the communities interested in time resolved X-ray (or more generally, photon based) experiments about the current performance of these sources as well as the currently planned upgrade plans and to indicate the future perspectives of these sources. For this, a series of recent experiments will be discussed, which exploit the different key properties of these unique facilities.

XFEL Source References

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