L-04 **Mon. 16. 06., 10^{20}-11^{00}**

FERMI seeded FEL

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The free-electron laser (FEL) FERMI has recently been opened, as experimental facility, to the scientific community [1]. The electron bunch acceleration scheme makes FERMI unique among the present FEL's operating worldwide. The peculiarity of FERMI to deliver transform limited photon pulses opens up the way to investigations of fundamental properties of matter with unprecedented capabilities. We will discuss the expected impact of FERMI in studies of fast phenomena in solids, liquids and gases, combining scattering and spectroscopic approaches [2].

Moreover FERMI is the proof of principle that table-top laser experiments can now be carried out at much shorter wavelengths making possible to probe dynamical processes occurring in molecular and nanostructured materials with an unprecedented time-space (femtosecond-nanometer) resolution. Indeed, the use of high energy photons allows stimulating and probing electronic transitions from core levels thus providing chemical selectivity. This will advance our knowledge to the very essence of materials science, chemistry, and biology, thus opening the way to future technologies that cannot even be foreseen today [3].

[1] E. Allaria et al., *New J. of Phys.* **14** (2012) 113009.
[2] E. Allaria et al., *Nat. Comm.* **4** (2013) 2476.
[3] F. Bencivenga et al., *New J. of Phys.* **15** (2013) 123023.

L-05 **Mon. 16. 06., 15^{00}-15^{40}**

SACLA Hard X-ray free electron laser based on normal conducting accelerator technology

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SACLA X-ray Free Electron Laser started operation in 2011 June, since then it has been providing intense X-ray ultra-short pulses to users from various filed. SACLA generates hard X-ray at 1 Å wavelength by means of short-period in-vacuum undulator driven by 8 GeV electron beams, provided by the linear accelerator based on high-gradient normal-conducting C-band 5712 MHz rf technology developed in Japan [1, 2, 3]. Thanks to these technologies, the total length of SACLA facility fits within 700 meter available at SPring-8 site.

Special care was taken to ensure high uptime machine reliability and superior electron beam energy stability. The achieved energy stability is as low as 100 ppm for long-period of operation, and 20 ppm jitter in pulse-to-pulse mode. Corresponding wavelength variation in pulse-to-pulse jitter is $<10^{-4}$ on 1 Å X-ray pulses, which enables stable operation of FEL.

Typical X-ray parameter is 1~0.6 Å, peak power 10 GW, pulse length 200~30 fsec, pulse energy 0.1~0.5 mJ.

Figure 1. SACLA constructed at SPring-8 site.

Acknowledgments: Thanks to all SACLA construction team.

[1] T. Shintake *et al.*, *Nature Photonics*, **2** (2008).
[2] T. Ishikawa *et al.*, Nature Photonics **6** (2012) 540-544.
[3] T. Shintake *et al.*, "C-band Linac RF System for e+e- Linear Collider", Proc. 16th Biennial Particle Accelerator Conference: PAC '95, Dallas, TX, USA, 1 - 5 May 1995 - IEEE, New York, 1995. pp. 1099-1101.