

XFEL Light Sources

Recent advances in accelerator physics and laser technology have made possible real-time observations at the nanoscale with X-ray free-electron lasers (XFELs). Here we look at the setup for the world's six most powerful XFEL facilities. For more on developments in X-ray lasers, see p. 28.

SwissFEL

Paul Scherrer Institut, Villigen, Switzerland

SWITCH ON: 2017

LIGHT SOURCE: Normal linac technology with one soft- and one hard-X-ray beamline in a 0.7-km-long facility

POWER: Minimum pulse length of 0.4 fs and max photon energy of 12 keV with a repetition rate of 100 Hz

RECENT RESEARCH: Visualizing DNA repair
Science, doi: 10.1126/science.add7795

EU XFEL

Deutsches Elektronen-Synchrotron (DESY), Hamburg to Schenefeld, Germany

SWITCH ON: 2017

LIGHT SOURCE: Superconducting linac technology with one soft- and two hard-X-ray beamlines in a 3.4-km-long facility

POWER: Minimum pulse length of 5 fs and max photon energy of 25 keV with a repetition rate of 27 MHz (bursts)

RECENT RESEARCH: Formation of diamond rain on icy planets

Nat. Astron., doi: 10.1038/s41550-023-02147-x

PAL-XFEL

Pohang Accelerator Laboratory (PAL), Pohang, Republic of Korea

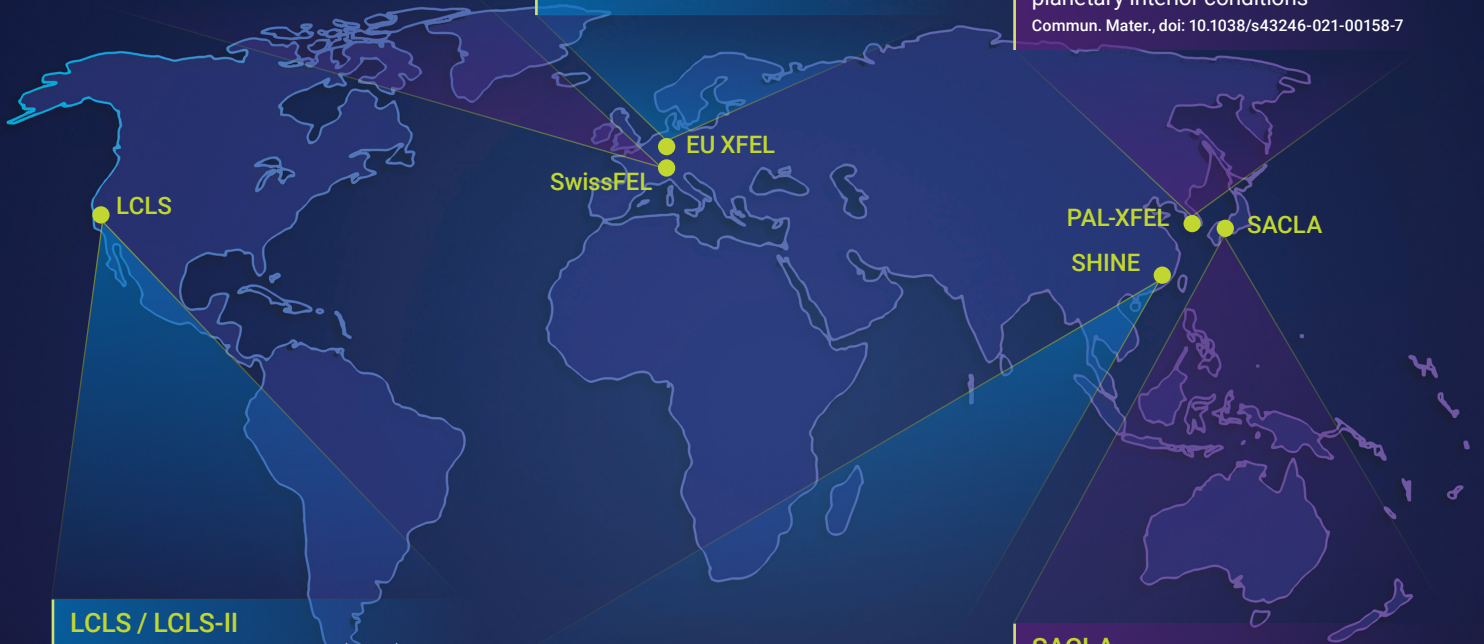
SWITCH ON: 2016

LIGHT SOURCE: Normal linac technology with one soft- and one hard-X-ray beamline in a 1-km-long facility

POWER: Minimum pulse length of 30 fs and max photon energy of 12 keV with a repetition rate of 60 Hz

RECENT RESEARCH: Simulating planetary interior conditions

Commun. Mater., doi: 10.1038/s43246-021-00158-7



LCLS / LCLS-II

Linac Coherent Light Source (LCLS), SLAC National Accelerator Laboratory, Menlo Park, CA, USA

SWITCH ON: 2009 (LCLS) / 2023 (LCLS-II)

LIGHT SOURCE: Superconducting and normal linac technology with one soft- and one hard-X-ray beamline in a 3-km-long facility

POWER: Minimum pulse length of 220 as and max photon energy of 25 keV with a repetition rate of up to 1 MHz

RECENT RESEARCH: Direct observation of electron-phonon coupling in a metal

Sci. Adv., doi: 10.1126/sciadv.adk9051

SHINE

Shanghai High-repetition-rate XFEL and Extreme light facility (SHINE), Shanghai, China

SWITCH ON: 2025 (projected, for soft-X-ray beamline)

LIGHT SOURCE: Superconducting linac technology with one soft- and two hard-X-ray beamlines in a 3.1-km-long facility

POWER: Minimum pulse length of 1 fs and max photon energy of 25 keV with a repetition rate of 1 MHz

SACLA

Spring-8 Angstrom Compact free-electron Laser (SACLA), Harima Science Garden City, Harima, Japan

SWITCH ON: 2011

LIGHT SOURCE: Normal linac technology with one soft- and two hard-X-ray beamlines in a 0.8-km-long facility

POWER: Minimum pulse length of 6 fs and max photon energy of 20 keV with a repetition rate of 60 Hz

RECENT RESEARCH: Resolving hydrogen atoms in small organic molecules

Nat. Chem., doi: 10.1038/s41557-023-01162-9

Sources: clf.stfc.ac.uk/pages/UK-XFEL-science-case; psi.ch/en/swissfel; xfel.eu; pal.postech.ac.kr; lcls.slac.stanford.edu; sari.cas.cn; xfel.riken.jp
Infographic by Alessia H. Kirkland