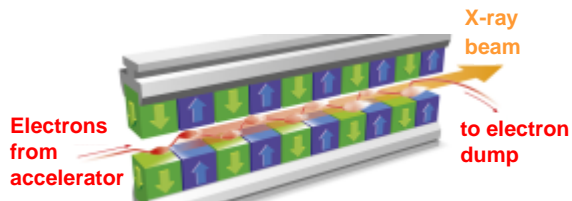




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ESI 2019 Project Day Technologies - XFEL

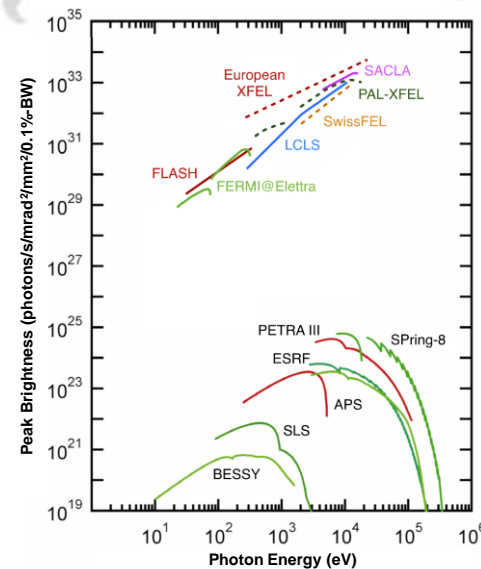
X-ray free-electron lasers: high-intensity coherent X-ray sources



Bunches of electrons are accelerated to high energies and then directed through special arrangements of magnets (undulators). In the process, the particles emit radiation that is increasingly amplified until an extremely short and intense X-ray flash is finally created.

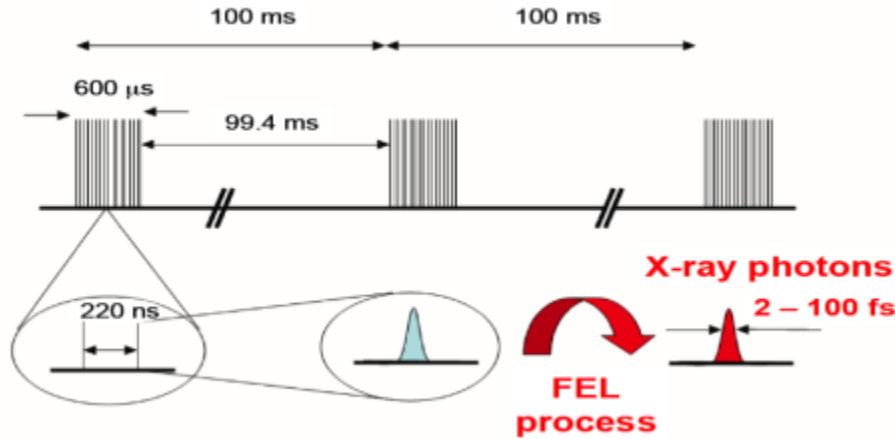


Facility	LCLS USA	LCLS-II CuRF	LCLS-II SCRF	SACLA Japan	European XFEL	SwissFEL Switzerland	PAL-XFEL South Korea	SCLF China
Max. electron energy (GeV)	14.3	15	5.0	8.5	17.5	5.8	10	8
Wavelength range (nm)	0.1–4.6	0.05–5.0	0.25–5.0	0.06–0.3	0.05–4.7	0.1–7	0.06–10	0.05–3.1
Photons/pulse	$\sim 10^{12}$	2×10^{13}	3×10^{13} (soft X-rays)	2×10^{11}	$\sim 10^{12}$	$\sim 5 \times 10^{11}$	10^{11} – 10^{13}	10^{10} – 10^{13}
Peak brilliance (with seeding)	2.7×10^{24}	2.7×10^{24}	1×10^{20}	1×10^{20}	5×10^{20}	1×10^{20}	1.3×10^{20}	1×10^{20}
Pulses/second	120	120	1000000	60	27000	100	60	1000000
Date of first beam	2009	2019	2020	2011	2017	2016	2016	2025
Start of user operation	2009	2019	2020	2012	2017	2018	2017	2025

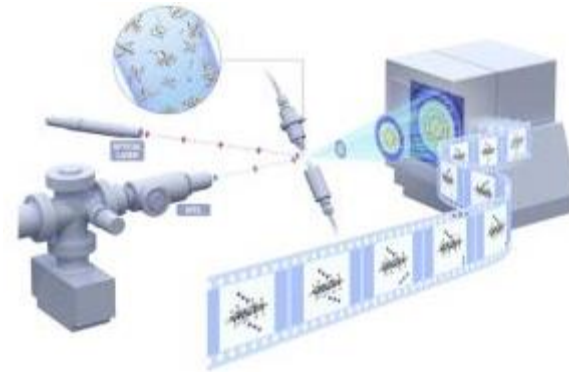


More information: https://www.xfel.eu/facility/overview/index_eng.html

European XFEL: MHz coherent X-ray flashes of femtoseconds duration



- The European XFEL can produce 27 000 X-ray laser flashes per second
- Experiments formerly worked with max 120 flashes per second
- Bunch trains: 4.5 MHz total repetition rate



Special Performances

- ➔ **X-ray light**
Samples at atomic resolution
- ➔ **Ultrashort flashes**
Femtosecond dynamics
- ➔ **Intense X-ray pulses**
Low intensity sample

More information:

http://xfel.desy.de/technical_information/tdr/tdr/

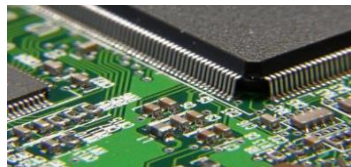
http://xfel.desy.de/technical_information/photon_beam_parameter/

European XFEL: Applications

Characterization of unseen sample and phenomena



Enhancing structure and behaviour of nanomaterials



Studying materials magnetic structure to build ultrahigh-capacity hard drives



Uncover catalyst action to improve catalytic converters and lessen impact of emissions



Investigating extreme states of matter to study material stress response

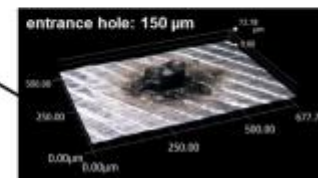
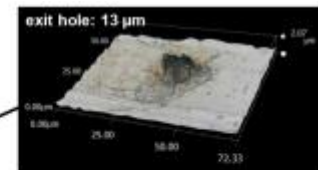
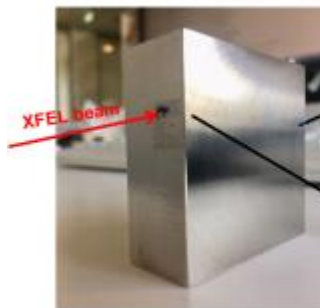


Understanding disease mechanism to make more effective drugs



Realizing artificial photosynthesis after comprehending its process

Possible process looking for applications



Drilling with XFEL beam through 50 mm of steel in 26 seconds

Thank you

Antonio Bonucci (XFEL)
IMKTT WG Co-Chair EIROforum

