SHANGHAI SYNCHROTRON RADIATION FACILITY

General Information

Accelerators

* Linac: 150 MeV

* Booster: 150 MeV-3.5 GeV

* Storage Ring: 3.5 GeV, Circumference = 432 m 20*DBA, ~3 nm.rad

Phase-I beamlines

* Macromolecular crystallography

* High resolution X-ray diffraction

* X-ray absorption fine structure spectroscopy

* Hard X-ray micro-focus and application

* X-ray Imaging and biomedical application

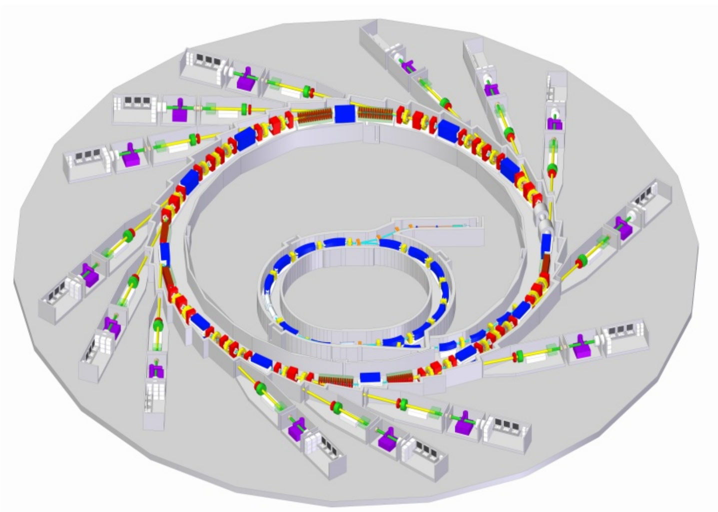
* Small angle X-ray scattering

* Soft X-ray microscopy

Overview

The Shanghai Synchrotron Radiation Facility (SSRF), an intermediate-energy third generation light source, is the largest scientific user facility ever in China. Located at the Zhangjiang campus of Shanghai Institute of Applied Physics (SINAP), Chinese Academy of Sciences (CAS), SSRF consists of an electron linac, a full energy booster synchrotron, a 3.5 GeV storage ring, and 7 phase-I beamlines.

Since its user operation started in May 2009, SSRF has served for more than 4800 users from 1100 research groups affiliated with about 270 institutes, universities, hospitals and high-tech companies all over the country. The first seven beamlines can only provide ~20% of the beam time that users require.



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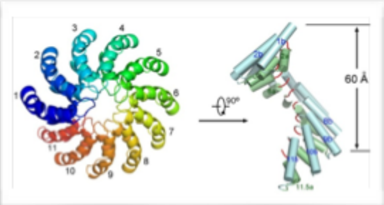
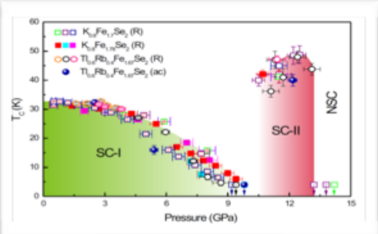
SSRF OPERATION

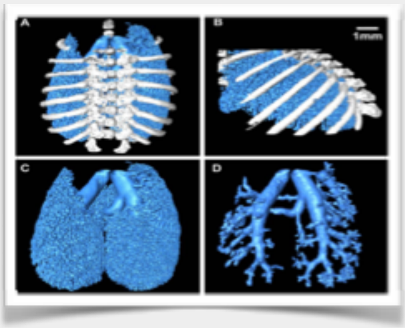
Research Highlights



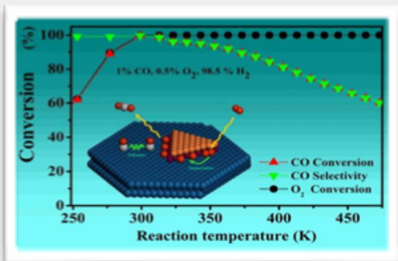
Y.G. Shi & N. Yan group, TALE
Science Top-10 breakthrough 2012



Z.X. Zhao group, Nature 2012
Phase transition in iron-based SC



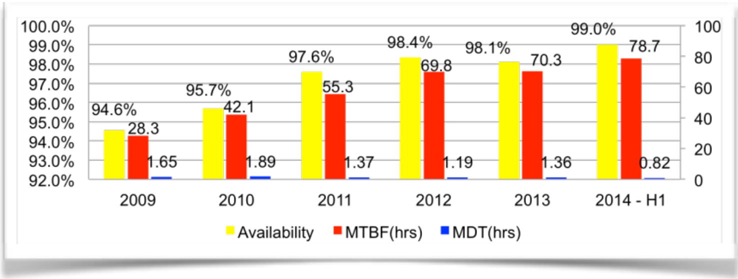
S.Q. Luo group, Plos One (2011)
In vivo 3D imaging of alveoli



X.H. Bao, Science 2010, Catalysis

Performance of the SSRF Accelerator Complex

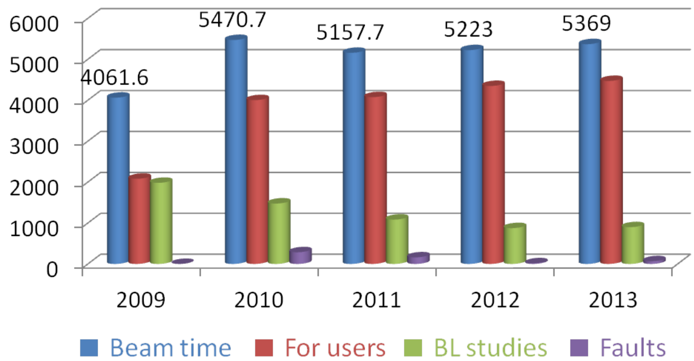
The SSRF accelerator complex has operated reliably since its commissioning. The availability and MBTF are improved year by year and reached 98.1% and 70.3 hours respectively in 2013. The longest non-trip operation time is 307 hours. The availability of the SSRF linac and booster is over 99.5%.



Performance of the SSRF storage ring is continuously improved along with user operation. Emittances of 2.88 nm.rad at 3.5 GeV and 2.12 nm.rad at 3.0 GeV have been achieved. The vertical emittance of 3 pm.rad has been achieved by adjusting the coupling and careful spurious vertical dispersion suppression. Low alpha optics and double waist optics are also tested.

Top-up operation for user experiments was commenced on Dec. 6, 2012. The nominal current is operated at 240+/-0.5mA. Orbit stability with 0.25 um and 0.56 um in the vertical and horizontal planes respectively has been achieved even without fast orbit feedback system during a 12-day user operation.

User beam time statistics of the past five years is shown below.



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PHASE-II UPGRADES

Accelerator upgrades

The storage ring energy of 3.5 GeV was chosen for SSRF based on the international recommendation and following considerations in 1998. (1) intermediate energy slightly above 3.0 GeV is a preferable cost-effective choice for approaching high energy X-rays; and (2) the high brightness X-ray radiation depends mostly on the in-vacuum undulators.

However, great advances in undulator technologies have been made recently, especially on CPMU and SCU, which makes the 3.0 GeV option for SSRF more cost-effective. The beam current can reach above 500 mA at 3.0 GeV instead of 300 mA at 3.5 GeV with the same RF power installation and comparable radiation power. It is foreseen to use a third harmonic cavity to increase the lifetime by lengthening the bunch in the storage ring.

A proposal on extending the photon energy from the high field bending magnet and creating extra short straight sections in the arc is under study, which leads to an upgrade based on 4 double superbend lattice cells in the SSRF storage ring.

Phase-II beamlines

* Energy materials (E-line)
* Dynamics (D-line)
* Biosafety P2 protein crystallography
* Radioactive materials
* Compton gamma-ray source (SLEGS)
* Membrane protein crystallography
* Time-resolved USXAS
* Hard X-ray nano-probe
* Medium-energy X-ray spectroscopy
* Ultra hard X-ray applications
* Magnetic dichroism
* Laue micro-diffraction
* 3D nano imaging
* Surface diffraction
* Fast X-ray imaging
* Hard X-ray spectroscopy