Beijing Synchrotron Radiation Facility -Status and future plans

JIANG, Xiaoming

IHEP

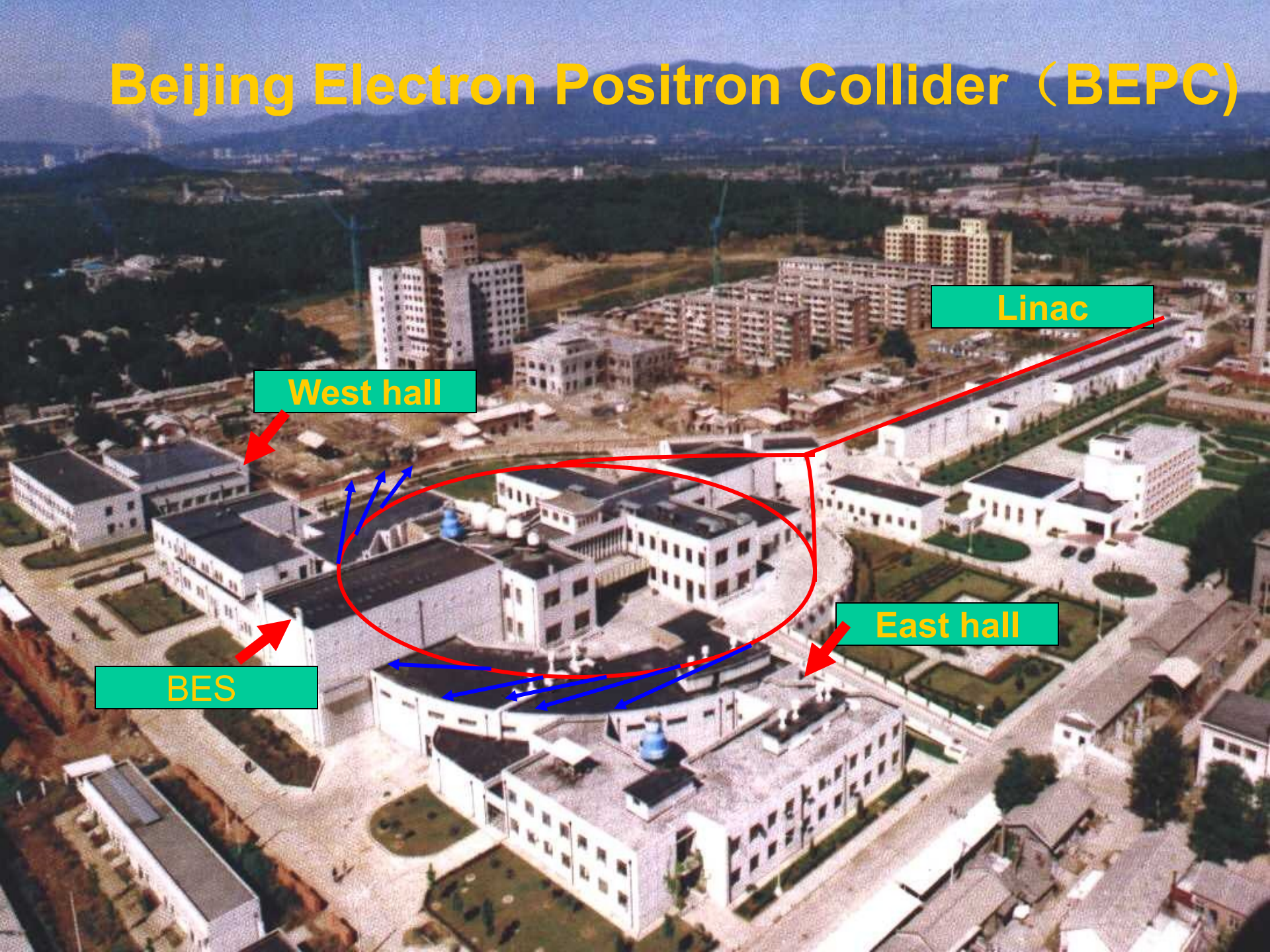
5th FCCPL meegting, Orsay

2012-3-21

Layout

- Status of BSRF
- Progresses and Research highlights
- Future plan
- Collaboration requirements

Beijing Electron Positron Collider（BEPC)



One machine for TWO utilities

BEPC was designed to carry out the experiments on τ-c physics and on synchrotron radiation applications.

Two operation modes for SR:

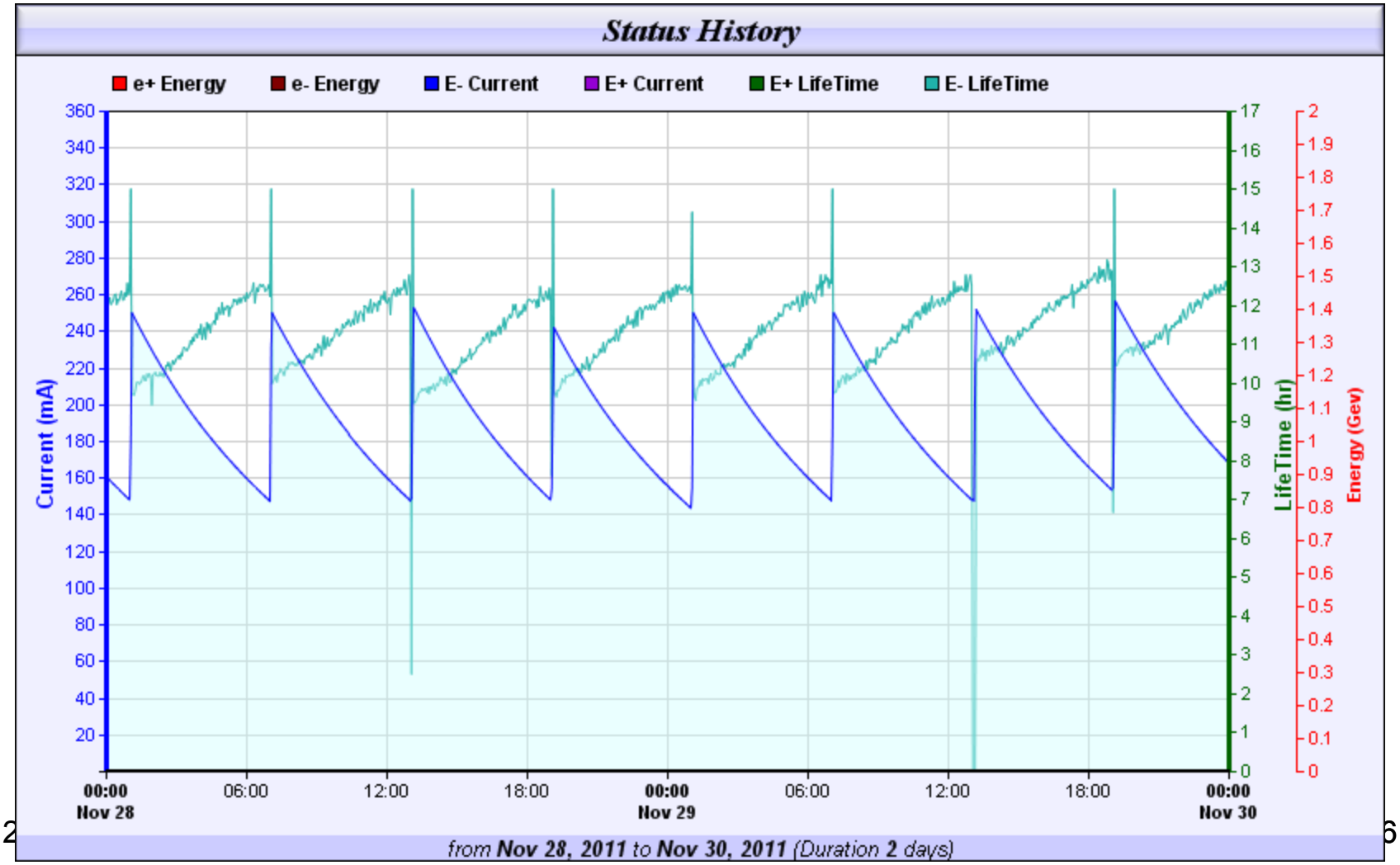
1. The parasitic mode (mainly for soft X-rays)
2. The SR dedicated mode: 3months/Y

Operation modes of BSRF

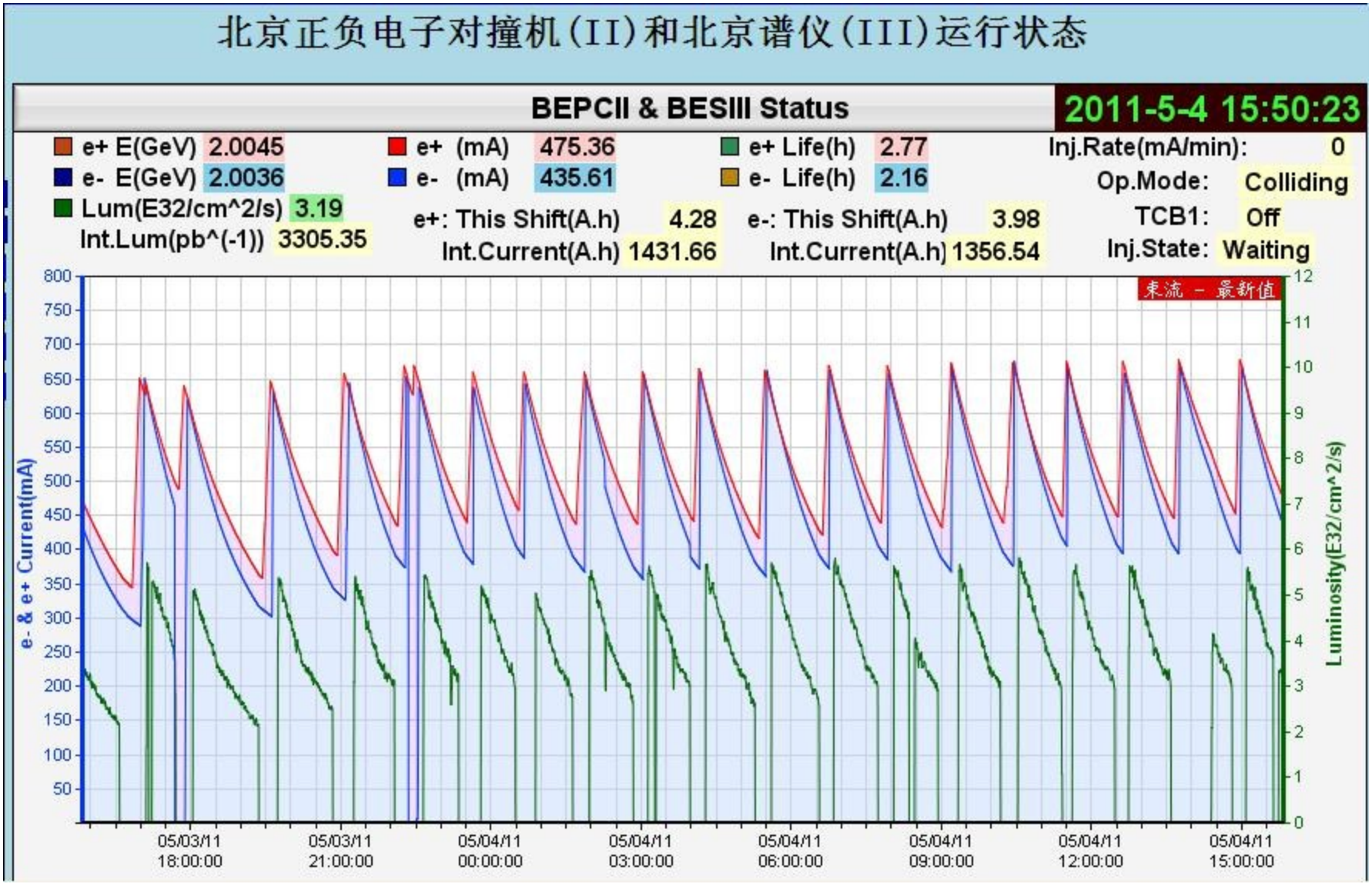
- Dedicated mode: 2.5Gev, 200-250mA;
- Emittance: 144 nm·mrad;
- Life time: >10 hours;

- Parasitic mode: 500mA (910mA);
- The electron energy depends on the HEP experiments: 1.5-2.2 GeV.

Running status of dedicated mode: 2.5GeV， 200-250mA, beam instability < 0.02mm.



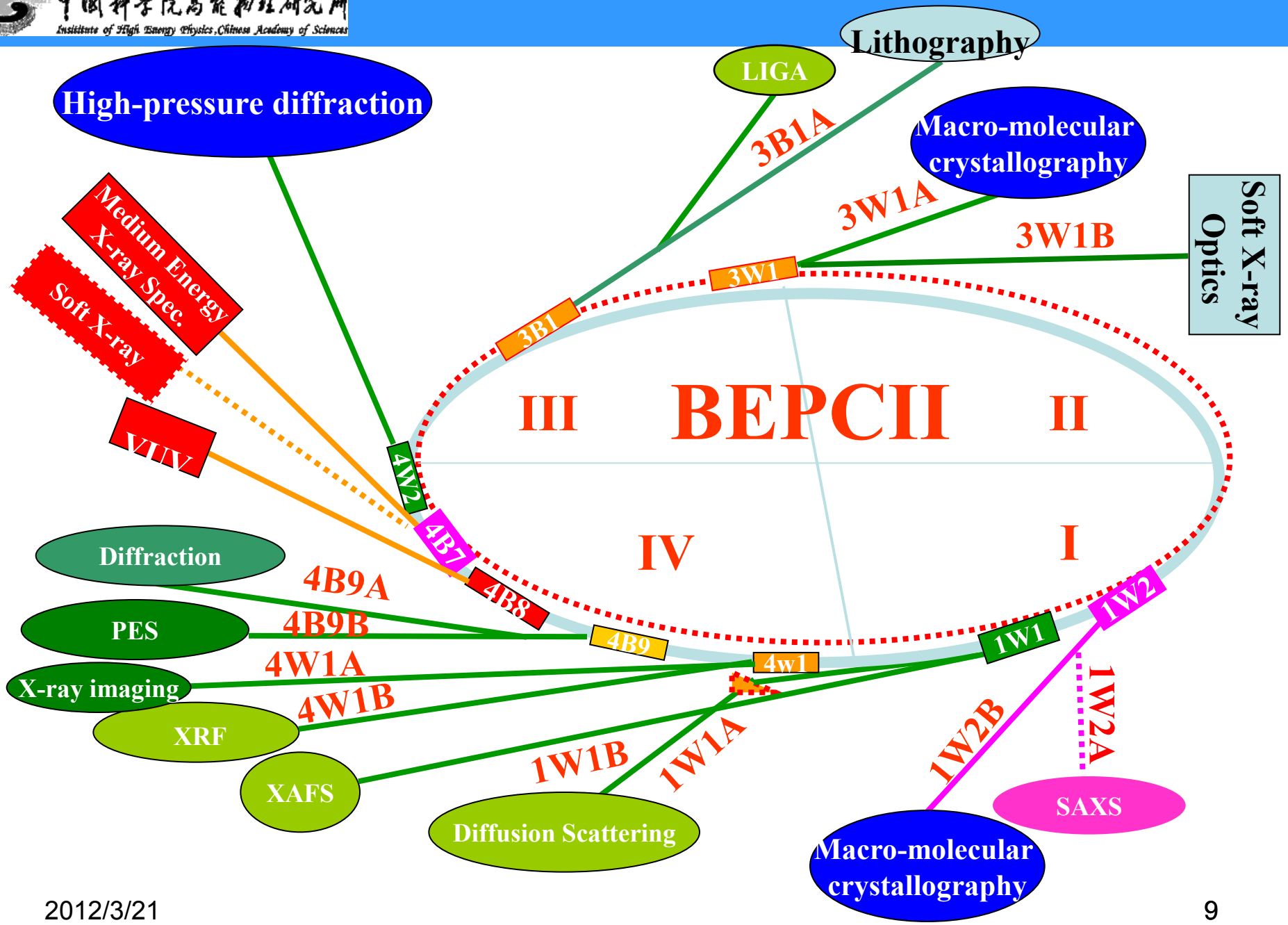
Operation in the parasitic mode



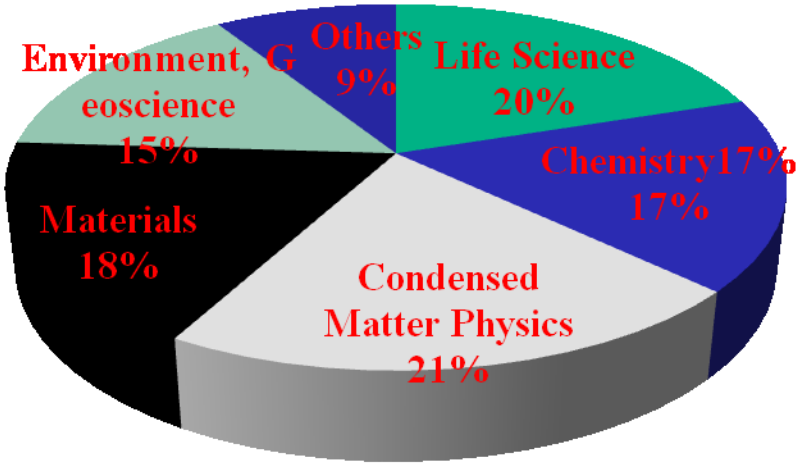
BSRF today

- 9 front areas: 5 from IDs, 4 from BMs.
- 15 beamlines and end stations.
- 2000 hours/year beam time in dedicated mode.

- Some beamlines can operate in parasitic mode.
- First/Second (parasitic/dedicated) generation machine.


Lithography
LIGA
High-pressure diffraction
3B1A
Macro-molecular crystallography
3W1A
3W1B
Soft X-ray Optics
3W1
3B1
Medium Energy X-ray Spec.
Soft X-ray
VUV
III
BEPCII
II
IV
I
4W2
4B7
4B8
Diffraction
4B9A
PES
4B9B
4B9
1W1
1W2
4W1A
X-ray imaging
4w1
4W1B
XRF
1W2A
1W1B
1W1A
1W2B
XAFS
SAXS
Diffusion Scattering
Macro-molecular crystallography

Proposals Distribution



Users Distribution

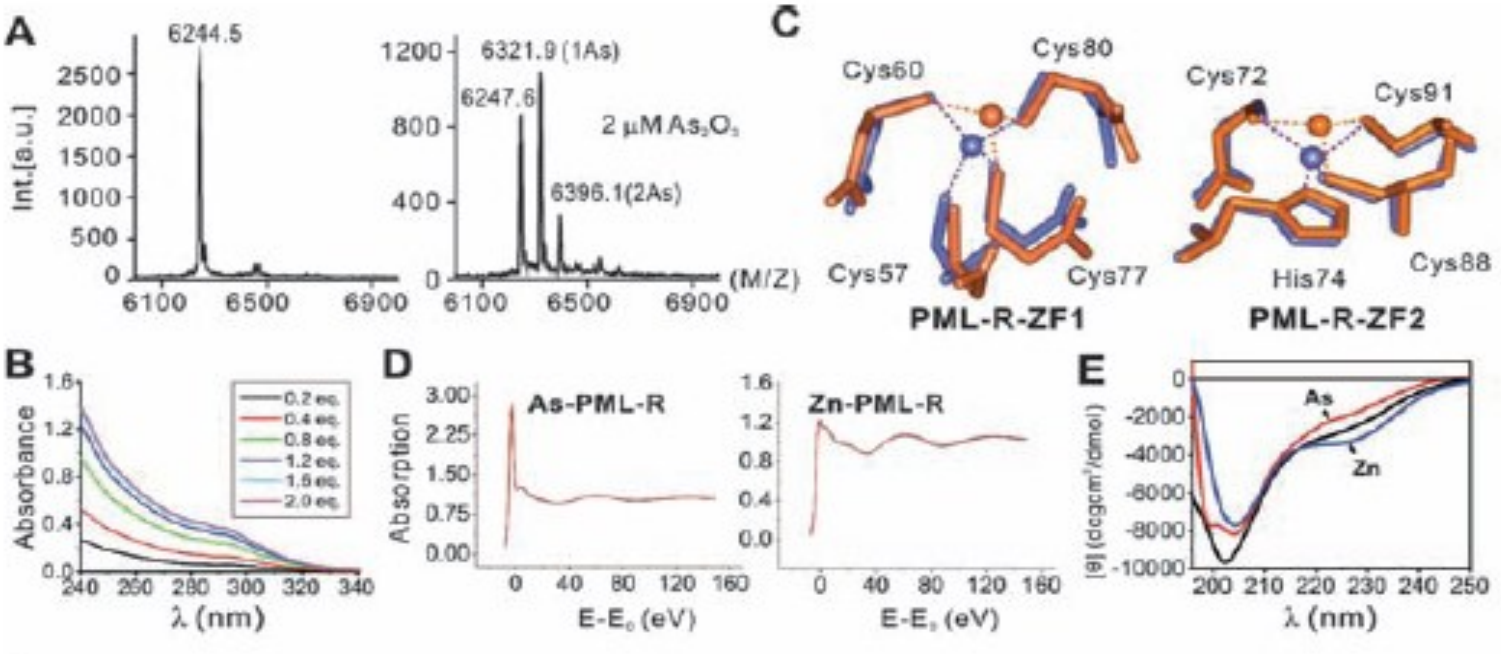
- Providing beamtime
  - For basic scientific researches
  - For national and social needs(Health, environment, etc.)

Average about 1000 users, and 150 publicaitons/year

Progresses and research highlights

- Structure biology
- X-ray imaging
- High pressure
- Catalysis
- CO_2/surfactant system
- Organic Transistor
- Nanopillars
- Remote controlling of user experiments

The therapeutic mechanism of the As_2O_3（砒霜） for acute promyelocytic leukemia (APL)



The promyelocytic leukemia protein (PML, a zinc finger protein) is the direct target of the As_2O_3. The arsenic ions bound directly to cysteine residues in the two Zn finger domains of the PML protein, to alter the structures of the zinc finger domains, then prevent the protein folding and activity.

X.Zhang, and Z. Chen et al, Science 2010, 328, 240.

147 Structure Hits | 84 Citations | 104 Ligand Hits | 2 Web Page Hits

Query Parameters: Query Details | Save Query to MyPDB

Text Search for: bsrf

Query Refinements: *Select an item or pie chart* Show

Organism | Taxonomy | Exp. Method | X-Ray Resolution | Release Date | Polymer Type | Enzyme Classification | SCOP Classification

Refine Query with Advanced Search — Remove Similar: Select Percent Similarity

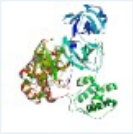
1 Related Molecule of the Month articles Show

Display/Download: | Generate Reports: | Sort by: Release Date | Results per Page:

Displaying results 1 - 25 of 147 total | Page 1 of 6 | Jump to page: GO

1UJ1 Crystal structure of SARS Coronavirus Main Proteinase (3CLpro)

Authors: Yang, H., Yang, M., Liu, Y., Bartlam, M., Ding, Y., Lou, Z., Sun, L., Zhou, Z., Ye, S., Anand, K., Pang, H., Gao, G.F., Hilgenfeld, R., Rao, Z.,



Release: 2003-11-18 **Classification:** Hydrolase

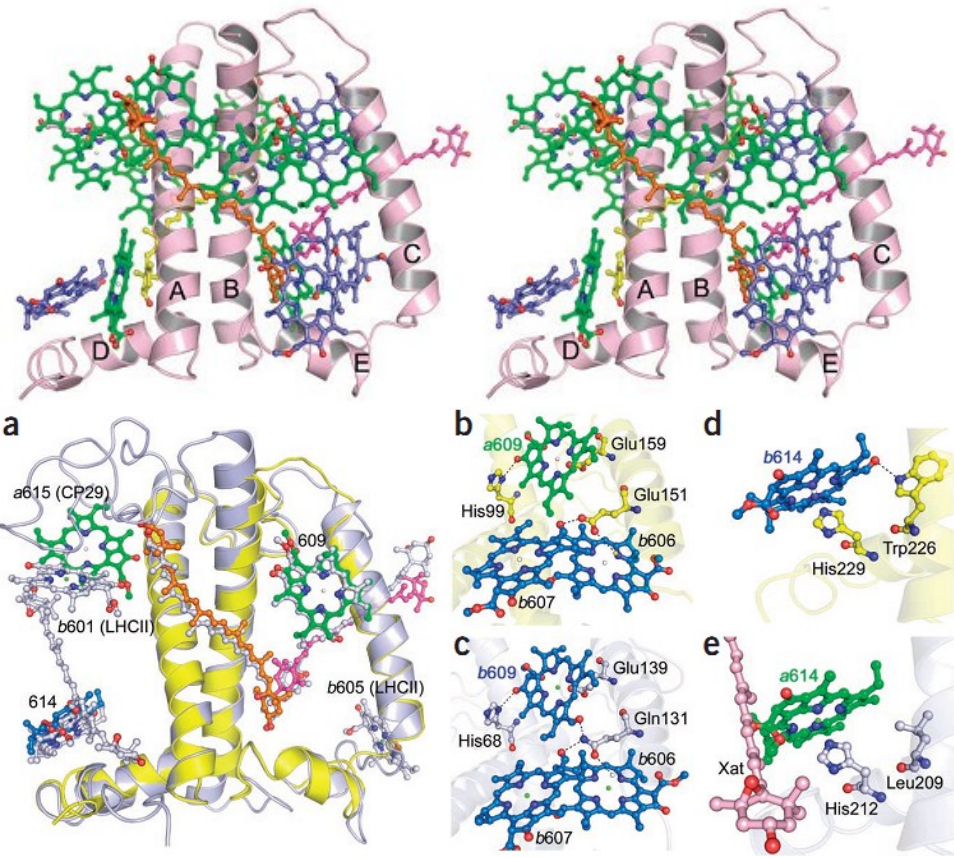
Experiment: X-RAY DIFFRACTION with resolution of 1.90 Å

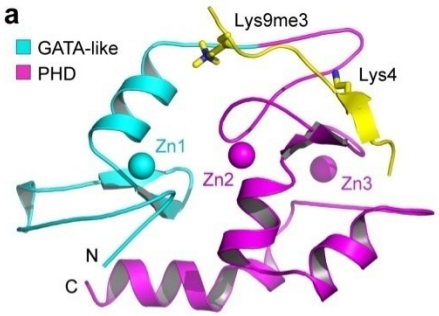
Compound: 1 Polymer *[Display Full Polymer Details | Display for All Results]*

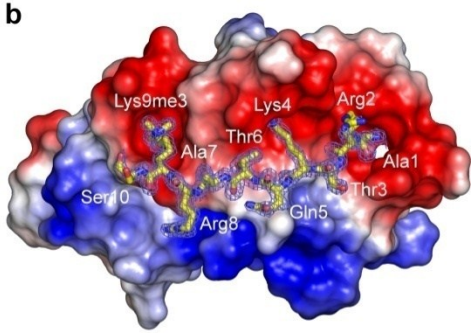
Citation: **The crystal structures of severe acute respiratory syndrome virus main protease and its complex with an inhibitor** (2003) Proc.Natl.Acad.Sci.USA **100:** 13190-13195 *[Display Full Abstract | Display for All Results]*

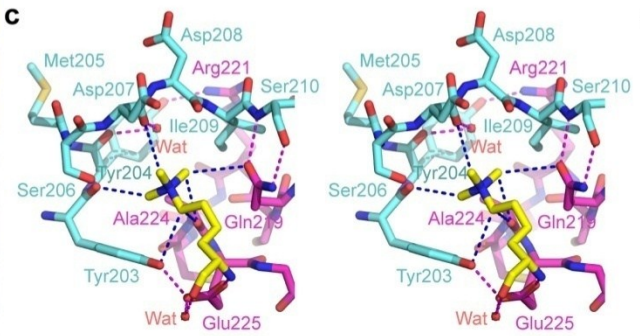
1UK2 Crystal structure of SARS Coronavirus Main Proteinase (3CLpro) At pH8.0

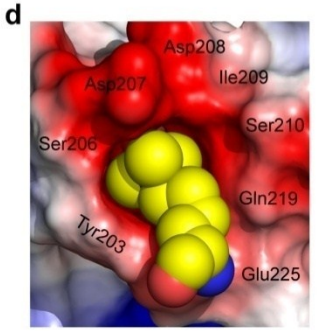
Protein crystallography: totally 147 structures have been released in PDB.











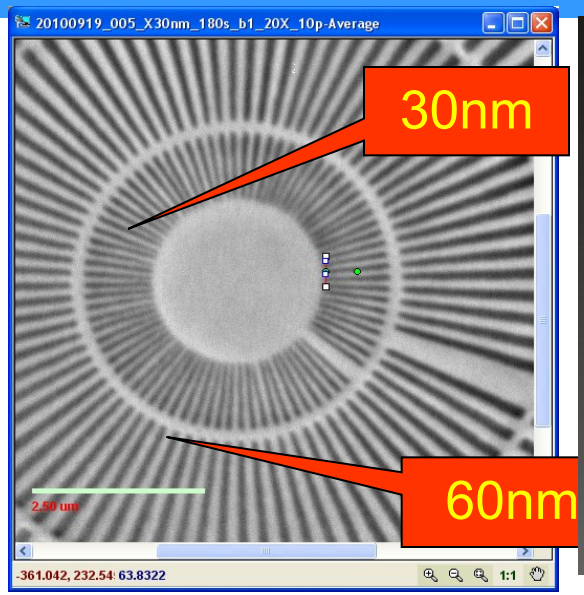
CP29, one of the minor light-harvesting complexes of higher-plant photosystem II.

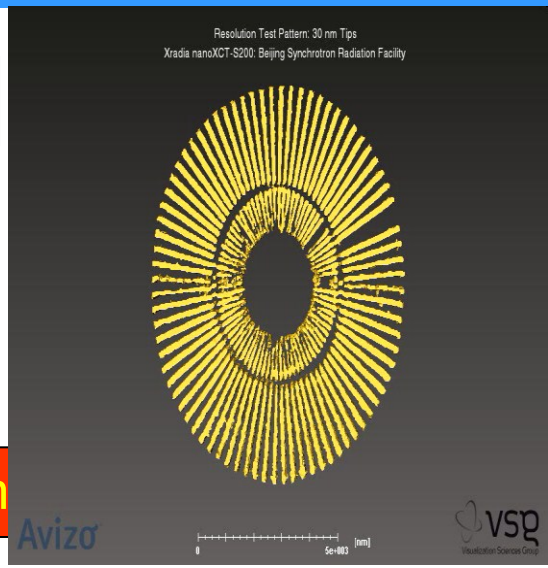
Nat. Struct. Mol. Biol. 2011, 18, 309

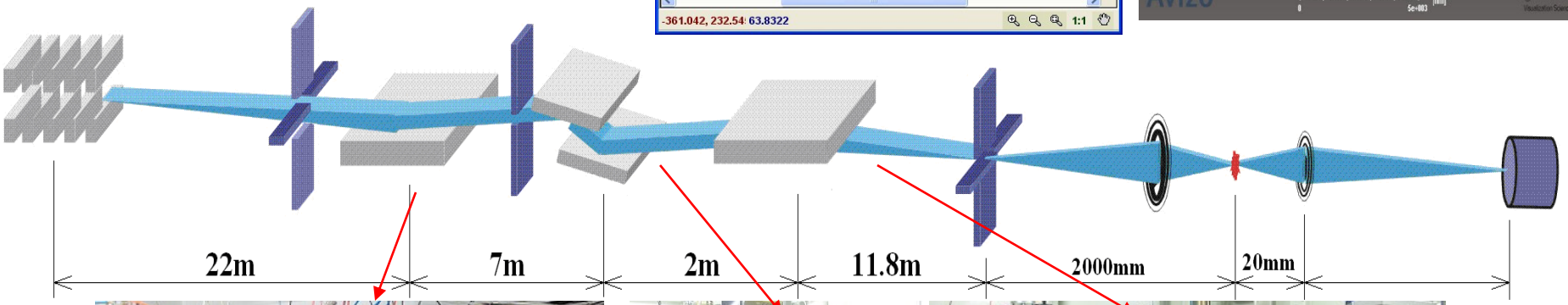
The structure of ATRX ADD domain bound to $H3_{1-15}$K9me3 peptide

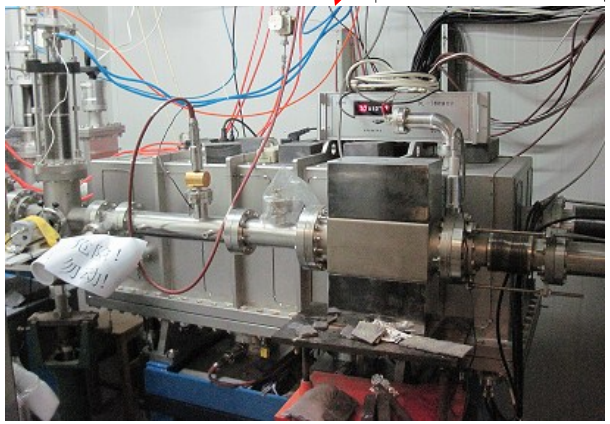
Nat. Struct. Mol. Biol. 2011, 18, 769

(26/10/2010) Nano-imaging facility in commissioning. The resolution is better than 30 nm.

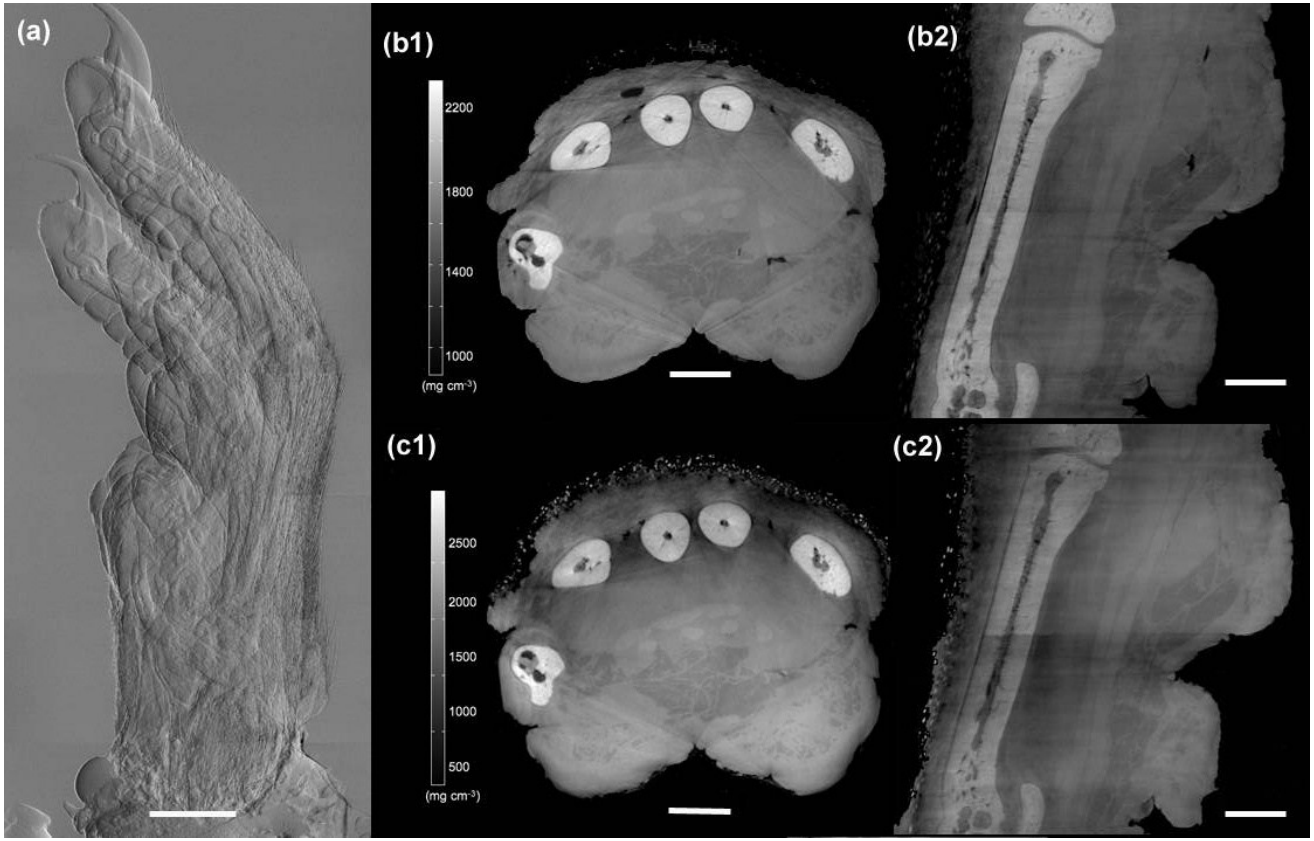








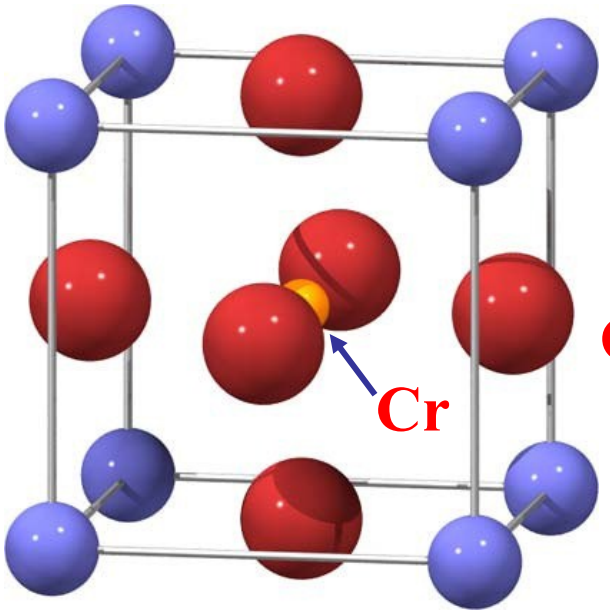
Low-dose, simple, and fast grating-based X-ray phase-contrast imaging



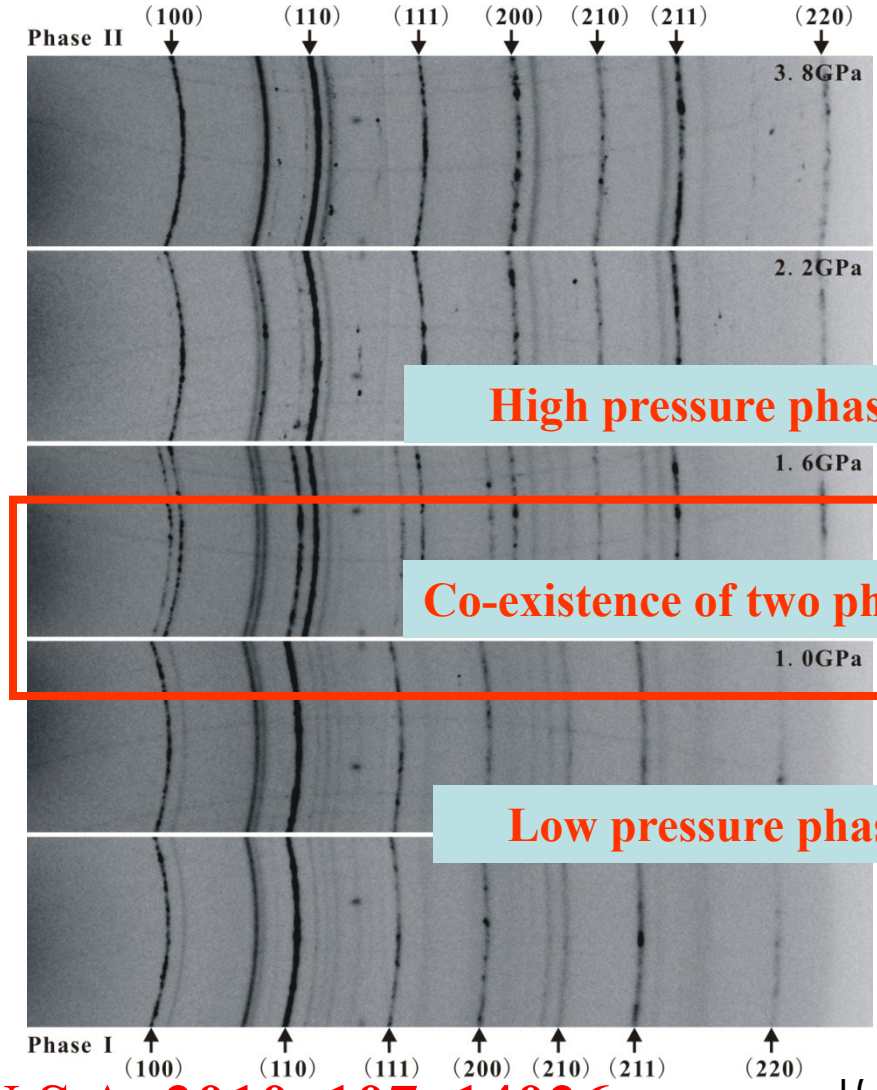
An innovative, highly sensitive X-ray tomographic phase-contrast imaging approach based on grating interferometry, which extracts the phase-contrast signal without the need of phase stepping.

Proc Natl Acad Sci U S A. 2010, 107, 13576.

The iso-strucutral phase transition of cubic perovskite PbCrO3 under high pressure

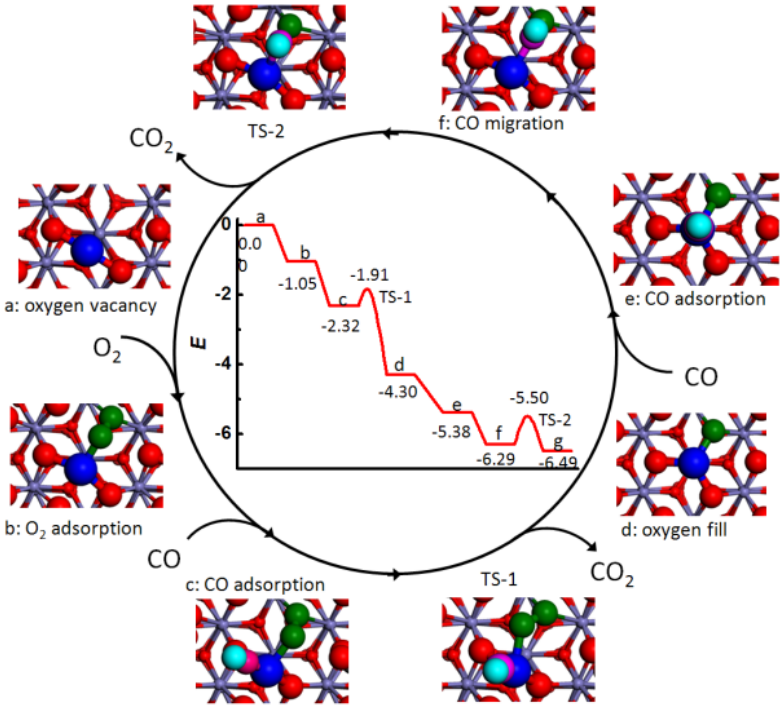


At pressure of ~1.6GPa, the cubic perovskite PbCrO3 transforms into another cubic perovskite structure, with volume collapse of ~9.8%. This is the first case of iso-structural phase transition observed in cubic perovskite structures.

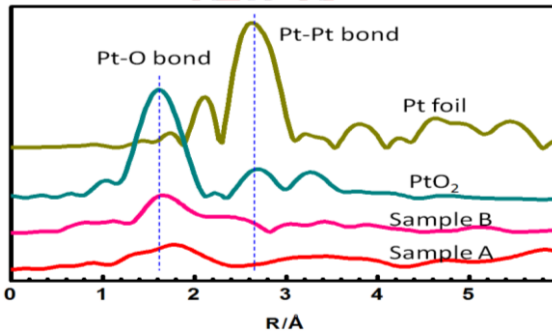


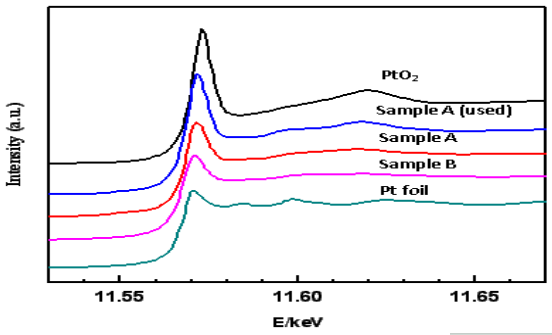
Proc Natl Acad Sci U S A. 2010, 107, 14026

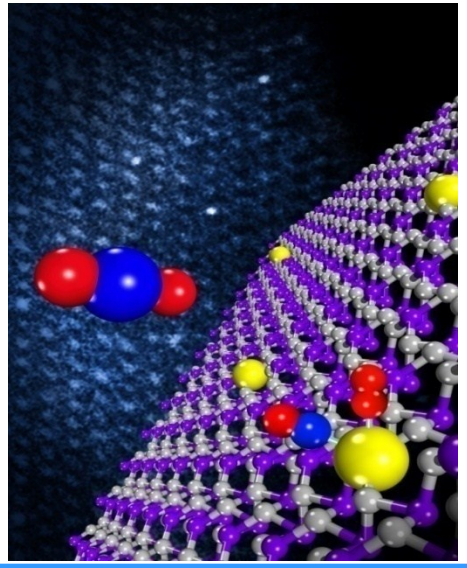
XAFS studies on single-atom catalyst Pt_1/FeO_x



Tao Zhang's team of Dalian Institute of Chemistry and Physics, CAS: single-atom catalyst that consists of only isolated single Pt atoms anchored to the surfaces of iron oxide nanocrystallites. This catalyst has extremely high atom efficiency and shows excellent stability and high activity for both CO oxidation and preferential oxidation of CO in H_2.







Nature Chemistry 2011, 3, 634

C&EN CHEMICAL & ENGINEERING NEWS

SAXS Studies on CO_2/Surfactant System

Buxing Han's team of IC-CAS: Studies on in-situ micro-structure changes of CO_2/surfactant system under pressure.

Angew. Chem. Int. Ed., 2008, 47, 10119-10123
Green Chem., 2010, 12, 452-457
Soft Matter, 2010, 6, 6200-6205
Phys. Chem. Chem. Phys., 2011, 13, 684-689
Langmuir, 2010, 26, 4581-4585
Angew. Chem. Int. Ed., 2011, 50, 636-639
Angew. Chem. Int. Ed., 2011, 50, 9911-9915

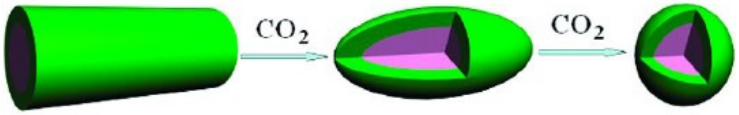


Fig3. The effect of CO_2 on the microstructure of l-α-phosphatidylcholine (lecithin) reverse micelles

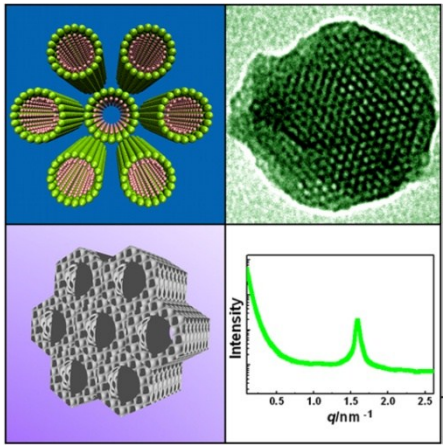


Fig4. synthesis of MOF nanospheres in an IL/SCCO2/surfactant emulsion system

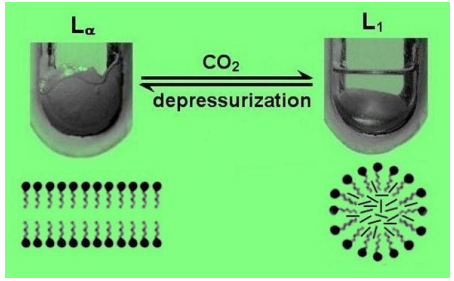


Fig1. Compressed CO_2 can switch the surfactant sodium bis-2-ethylhexylsulfosuccinate/water system between L_α phase and L_1 reversibly at ambient temperature.

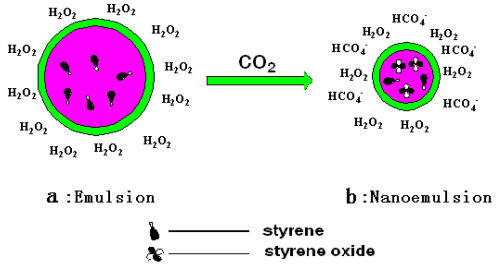


Fig2. "Reactor" with adjustable size——chemical reaction in CO_2/ emulsion system

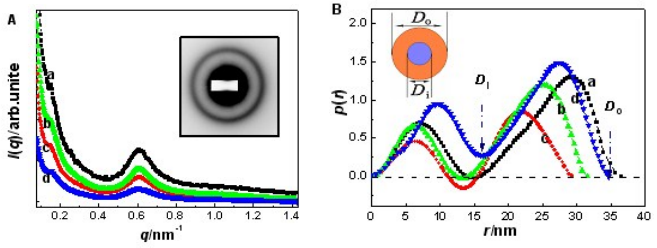
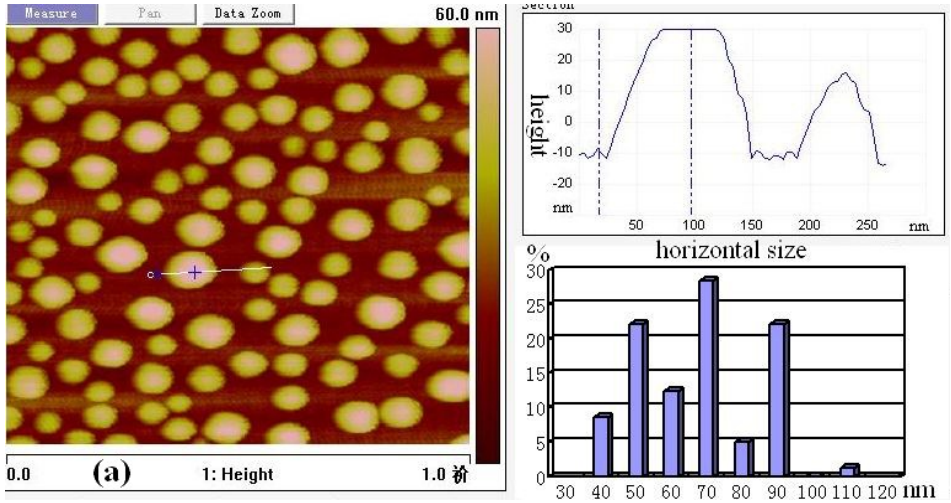
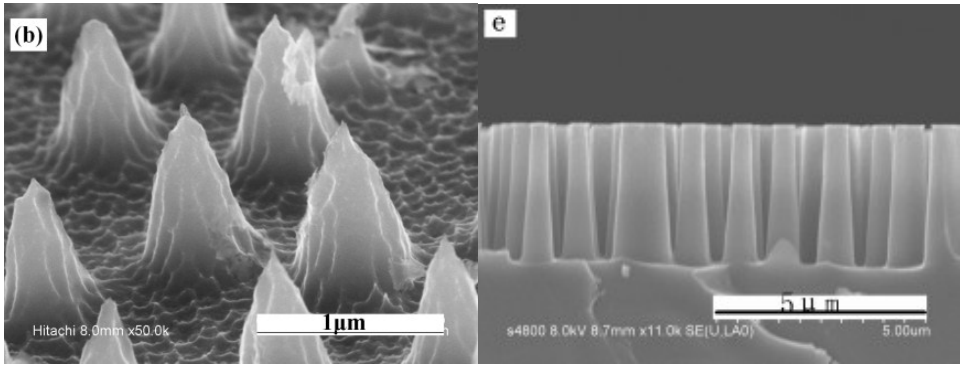


Fig 5. SAXS studies on double nano-emulsion induced by CO_2

Nanopillars by Cesium Chloride Self-Assembly and Dry Etching

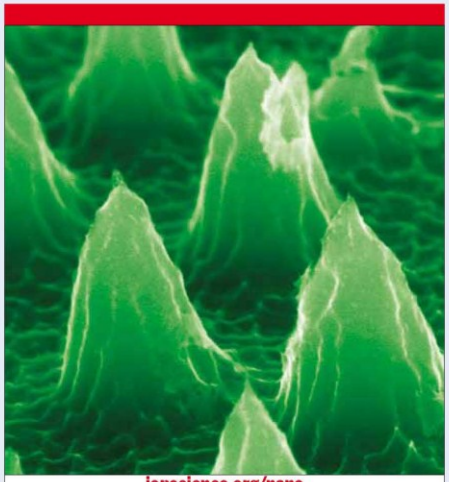


Morphology plots of the nanoislands and histograms of diameter distribution of 70nm CsCl nano-dot



Sharp cones and truncated cones

ISSN 0957-4484
NANOTECHNOLOGY
VOLUME 21 NUMBER 46 19 NOVEMBER 2010

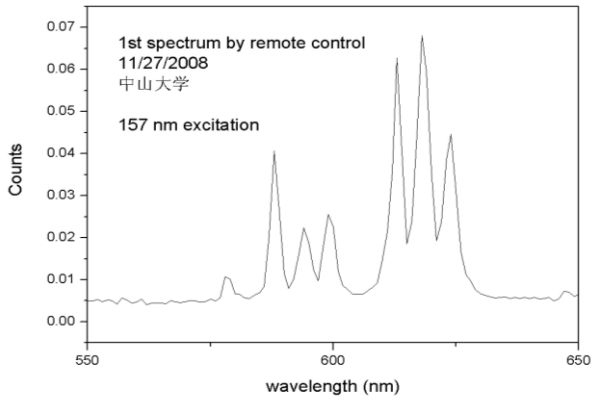


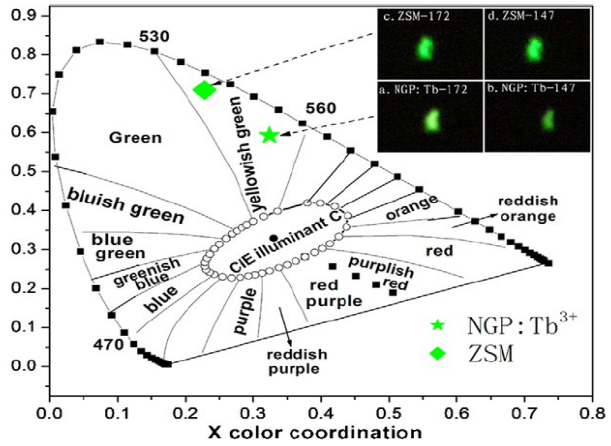
iopscience.org/nano
Featured article
Nanopillars by cesium chloride self-assembly and dry etching
Y-X Liao and F-T Yi

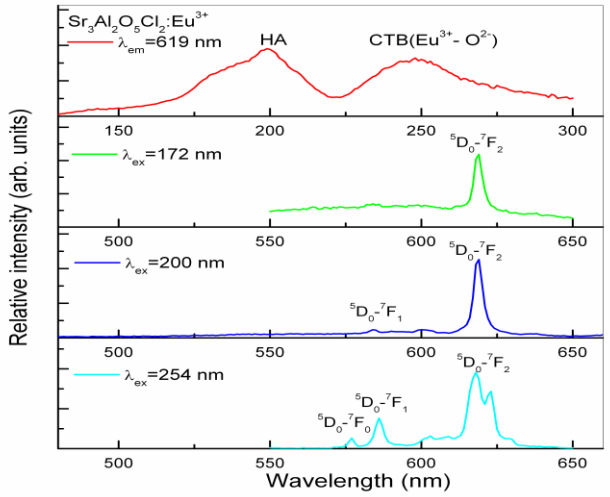
IOP Publishing

Remote control of VUV Exp. Since 2009

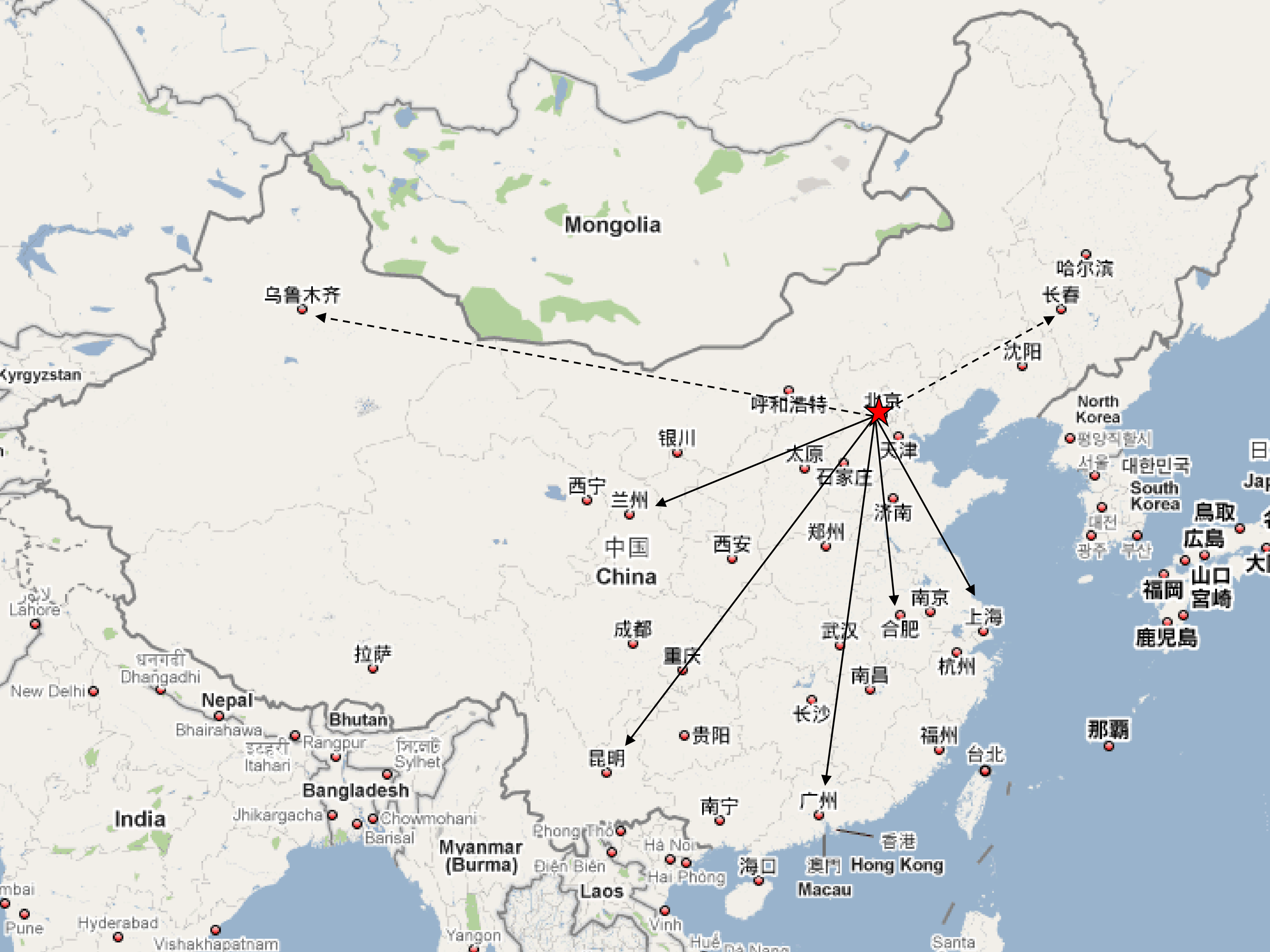
The users in Guangzhou (Zhongshan University) control their experiments in BSRF。







Experimental results



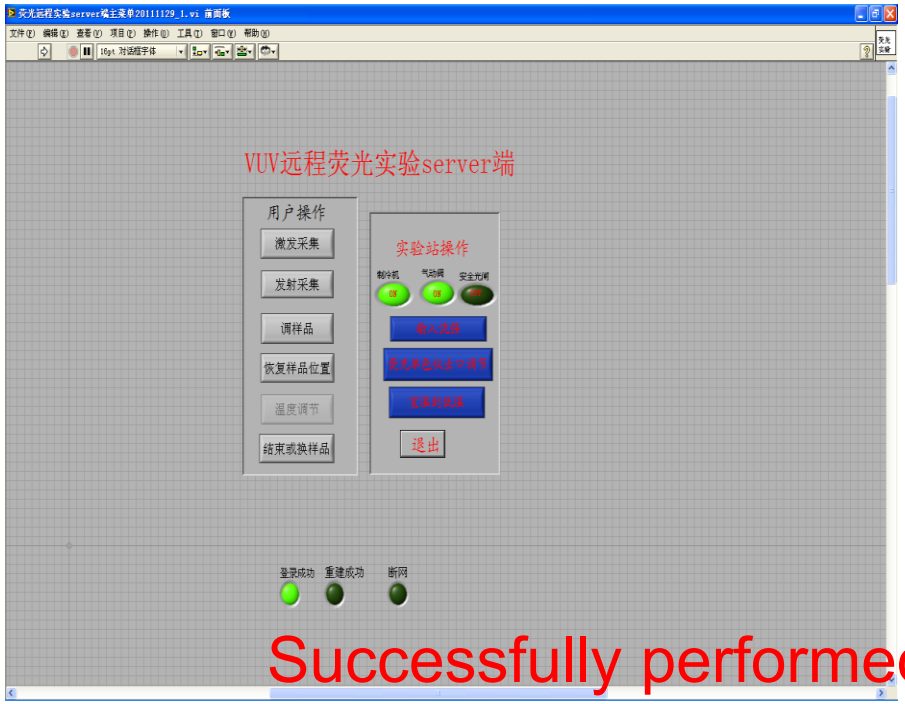
Mongolia
乌鲁木齐
哈尔滨
长春
沈阳
Kyrgyzstan
呼和浩特
北京
天津
银川
太原
石家庄
西宁
兰州
济南
郑州
西安
中国
China
North Korea
South Korea
大韓民国
鳥取
広島
山口
福岡
宮崎
鹿児島
南京
上海
合肥
武汉
杭州
成都
重庆
拉萨
南昌
长沙
福州
台北
那覇
贵阳
昆明
南宁
广州
香港
Hong Kong
澳門
Macau
海口
Lahore
New Delhi
Dhangadhi
Nepal
Bhairahawa
Bhutan
Rangpur
Itahari
Sylhet
Bangladesh
India
Jhikargacha
Chowmohani
Barisal
Myanmar (Burma)
Phong Thổ
Điện Biên
Hà Nội
Hai Phòng
Laos
Vinh
Huế
Pune
Hyderabad
Vishakhapatnam
Yangon
Santa

Progress in remote controlling of experiments

New Mode：Labview TCP/IP

Easy to connect, very-low requirement on network speed, no delay, and high safety.

Mobile phone → Experiments



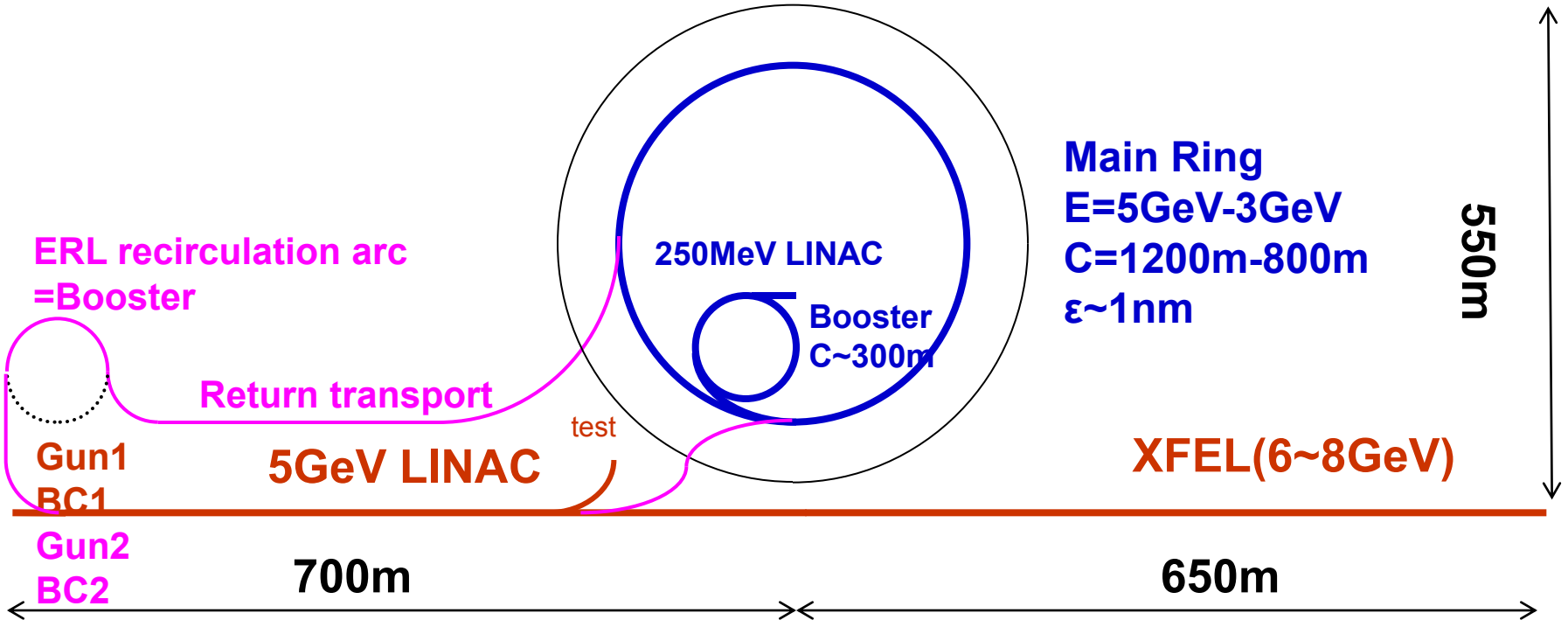
Successfully performed from Kunming, Yunnan

Future plan on photon science

- **Beijing Advanced Photon Source**
  - **Preparing to submit the proposal**
  - **Starting the Concept Design Report**
- **X-ray Free Electron Laser**
  - **EXFEL collaboration: Cryomodule and Undulator prototypes R&D**
  - **9-cell rf cavity**
  - **Photo-cathode electron gun.**
  - **Protein structure characterization by XFEL**
- **X-ray Energy Recovery LINAC**
  - **Preparing a proposal for the test facility at IHEP.**

Schematic of Beijing Advanced Photon Complex

Phase I: Low emittance Synchrotron Radiation source BAPS, 5GeV, 100-200mA, 1nm.rad, 2015-2018 (R&D:2012-2014)
Phase II: X-ray Free Electron Laser BXFEL, 0.15 nm, 6~8 GeV, 2017-2022
Phase III: X-ray Energy Recovery LINAC source, BXERL, 2022-



Main beam parameters of BAPS

Parameter	Unit	Value
Beam energy	GeV	5
circumference	m	1200
Beam current	mA	100~200
emittance（H/V）	nm.rad	1/0.01(κ =1%) 0.5/0.005 damping wiggler
Bunch length	ps/mm	7.2/2.2
Photon critical energy(Ec)	keV	13.4(main bend) 83.1(5T SC Wig.) 166(10T SC Wig.)
Brilliances	Photons /s/mm^2/mrad^2/0.1%BW	~10^{21}

Progress on BAPS R&D project

- In 2010, BAPS R&D project was proposed to the National Development and Reform Committee for the next 5-year Plan. It was approved by Scientific Review Committee. Waiting to be approved by National Council.
- On 18 March, 2011, CAS and Beijing government signed an agreement to establish jointly the Beijing Multi-discipline Research Center, in Huairou.
- BAPS CDR (draft) and BAPS R&D Proposal were finished and reviewed within IHEP.
- In Sept. 2011, a Xiangshan Science Conference has been held on the demands in China for high energy Synchrotron source. Users expressed strong interests in BAPS。
- The geographic survey and vibration measurements have been carried out preliminary.
- Some key technique R&D has been started.

R&D of BAPS

- Conceptual Design of BAPS
- Extreme high(<1μm) precision measurement, control and feedback of beam orbit
- High presicion magnets and power supply
- Design and manufacture of key devices (BPM etc.)
- High performance insertion devices

- Extreme High Performance Monochromators
- High Precision X-Ray Mirror mechanism and Metrology
- X-Ray Nano-focusing Optics and Nano-Probe Positioning and Scanning Technology
- Inelastic X-ray Scatting Spectrometer
- Femtosecond time resolution X-ray pump-probe Technology
- High performance X-ray Detector
- In-suit measurement under extreme condition
- Integration and simulation of Engineering Materials

Future collaborations

- X-ray beamline optics
  - High energy and high resolution crystal monochromators
  - Nano-focusing and moving techniques
  - High resolution surveying on mirrors
- Experimental methods
  - High energy X-ray experimental methods
  - In-elastic scattering technique
  - Extreme environment experiments
- Suggestions
  - Assignment of contact persons.
  - Jointly organizing workshops and meetings

Summary

- As the second generation source, BSRF still played very important roles for Chinese science community.
- Users are very active in SR experiments and get quite fruitful results.
- Beijing Advanced Photon Source got strong support from users, especially from the Beijing region and engineering material community.
- More collaboration with Soleil/ESRF is expected, especially for the BAPS R&D.

Thank you
for your attentions!