



# **Current Status of SSRF & EPICS archive database at SSRF**

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**NOBUGS 2010,  
Oct. 11, 2010**



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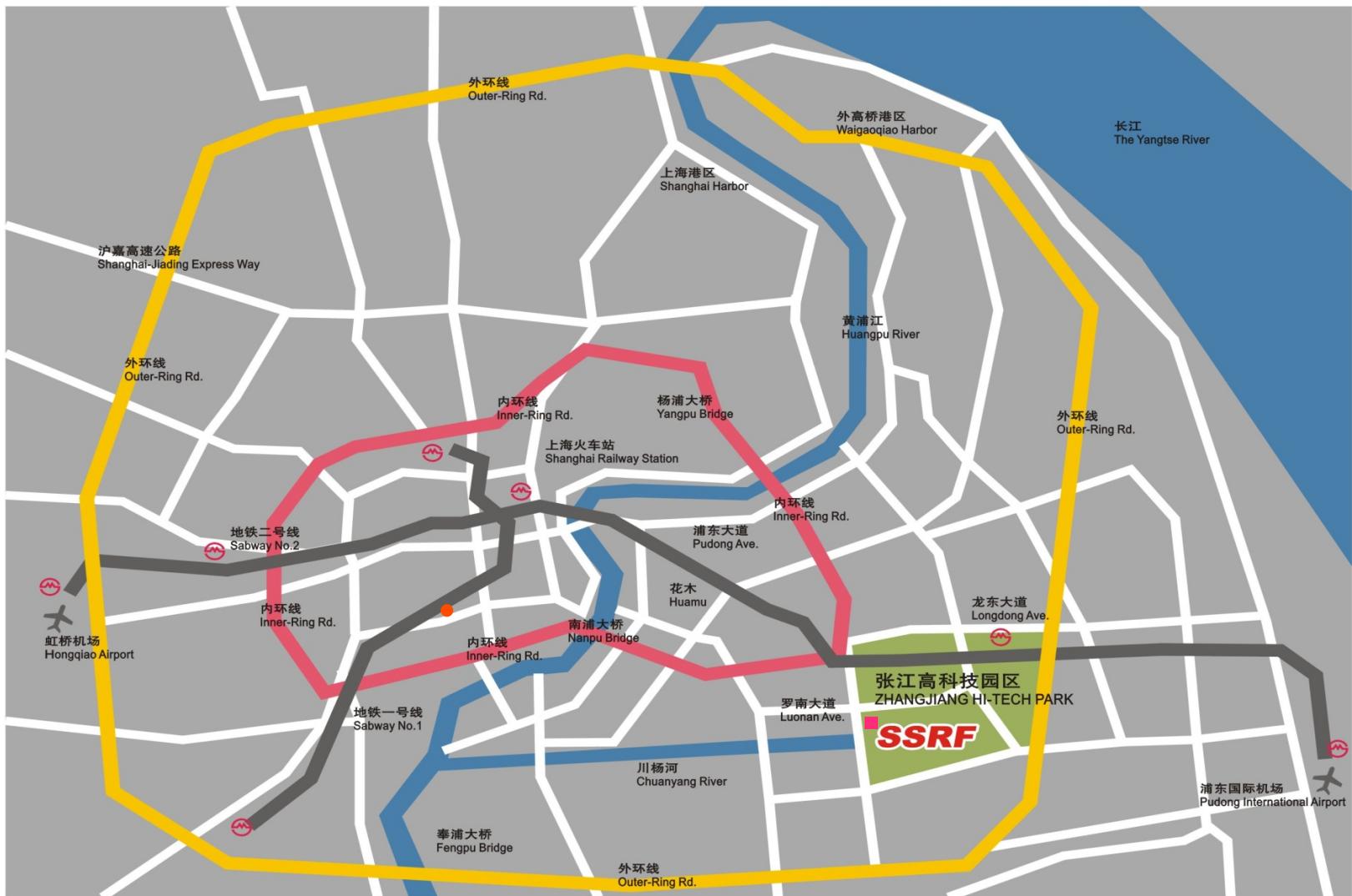
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- Overview of SSRF Construction
- SSRF Phase I Beamlines
- User Operation and Experiments
- Future Beamline Programs
- EPICS archive database at SSRF



SSRF

# The SSRF Site Location



# Shanghai Synchrotron Radiation Facility

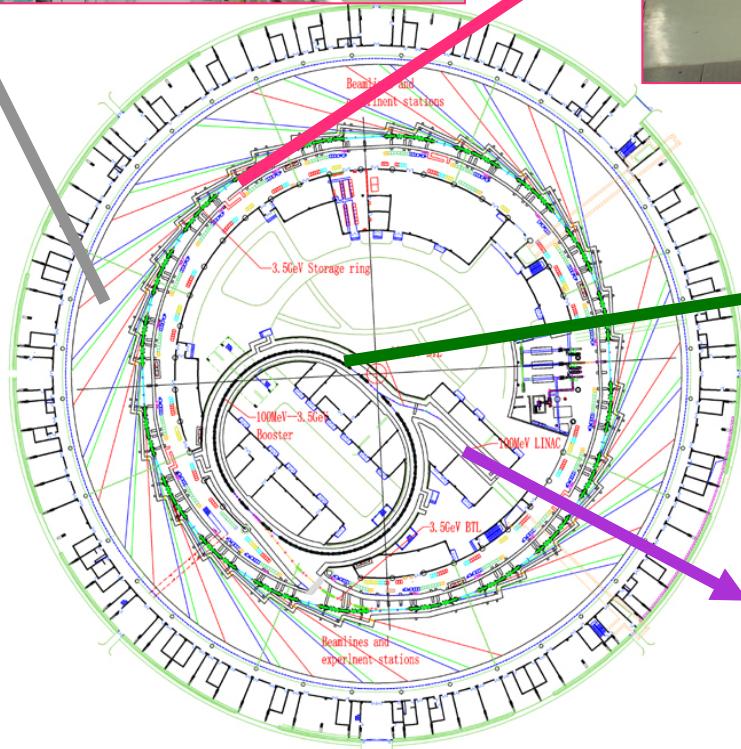
- SSRF is an intermediate energy 3rd generation light source funded by Chinese Academy of Sciences (CAS), Shanghai local government and central government of China;
- Major scientific fields of SSRF( at present)
  - Biological Sciences
  - Physical and Materials Sciences
  - Earth and Environmental Sciences
  - BioMedical, Chemical and Industrial Applications

## Beamlines



# The SSRF Complex

**Storage Ring  
3.5GeV,C=432m**



**Booster  
3.5GeV,C=180m**



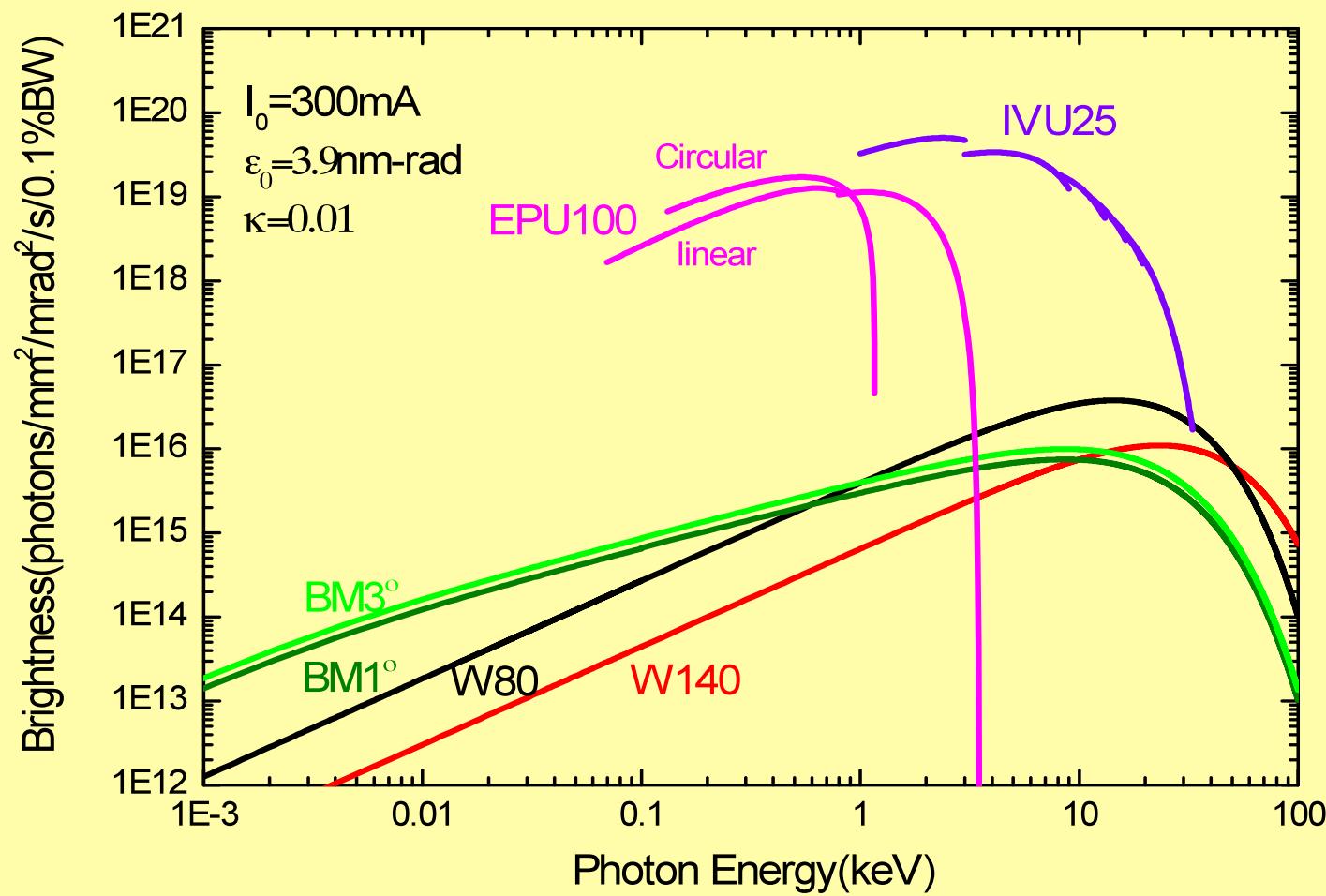
**Electron Linac  
150MeV**

## Main parameters of Storage Ring

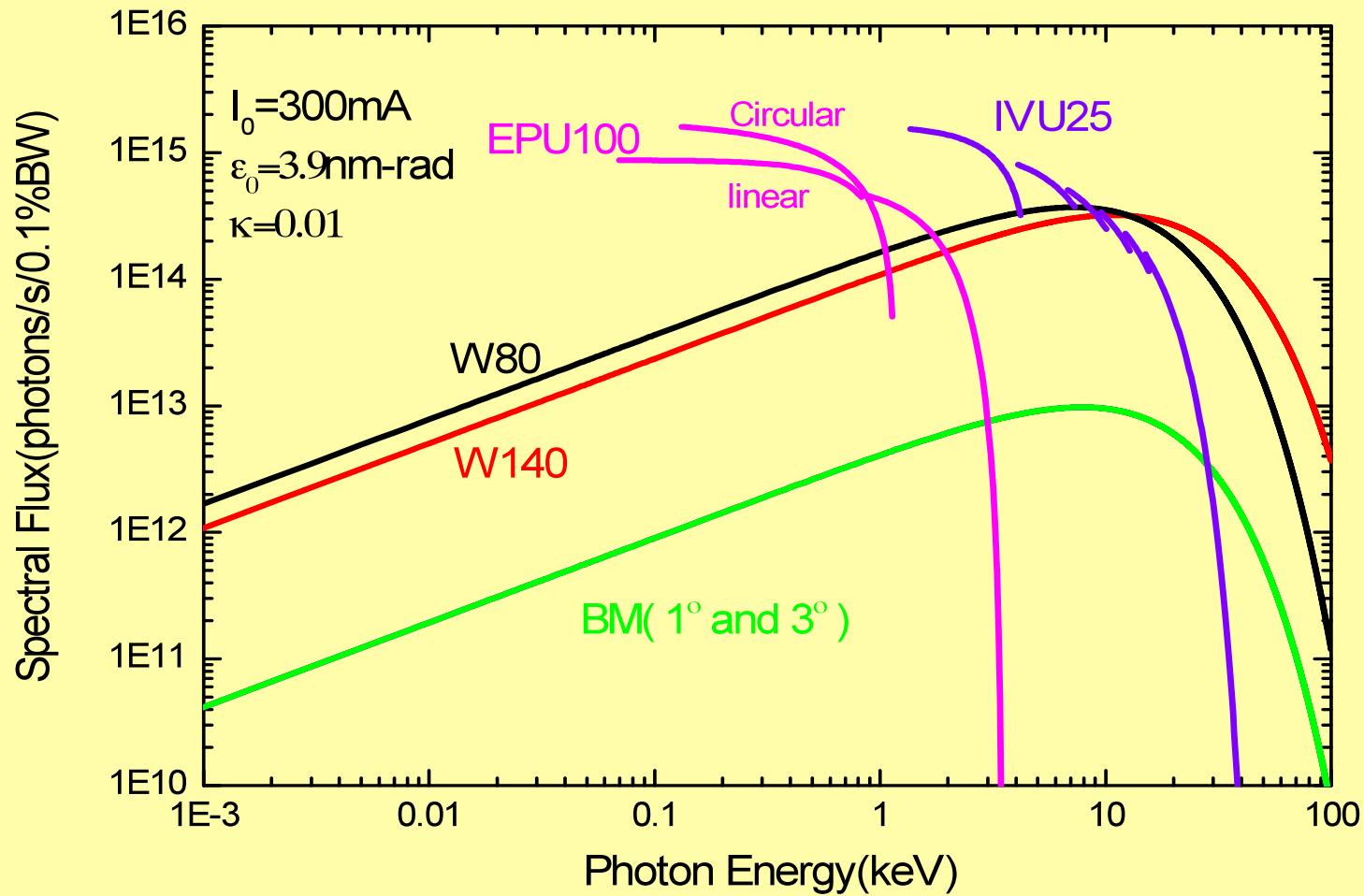
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■ Energy	3.5GeV
■ Circumference	432m
■ Lattice	DBA (Combined)
■ Number of Cells	20
■ Straight Sections	$4 \times 12\text{m}$
16×6.5m	
■ Current	200~300mA
■ Emittance	3.9 nm-rad
■ Life time	> 15hrs (top-up injection later)
■ Beam position stability	<10% beam size

## SSRF provides very bright photon beams from 0.1-20keV



## SSRF provides high flux photon beams from 0.1-40keV



## SSRF Construction Schedule and Milestones

- Dec. 25, 2004 Ground Breaking
- Dec. 2004 ~ May 2007: Building construction
- Jun. 2005 ~ Jun. 2008: Accelerator equipment and components manufacture and assembly
- Dec. 2005 ~ Dec. 2008: Beamline construction and assembly
- May. 2007 ~ Jul. 2007: Linac commissioning
- Oct. 2007 ~ Dec. 2007: Booster commissioning
- Dec. 2007 ~ Dec. 2008: Storage ring commissioning
- Dec. 24, 2007, First SR Light Achieved
- May 2008 ~ Apr. 2009: Commissioning of beamlines
- May 2009: The user operation began



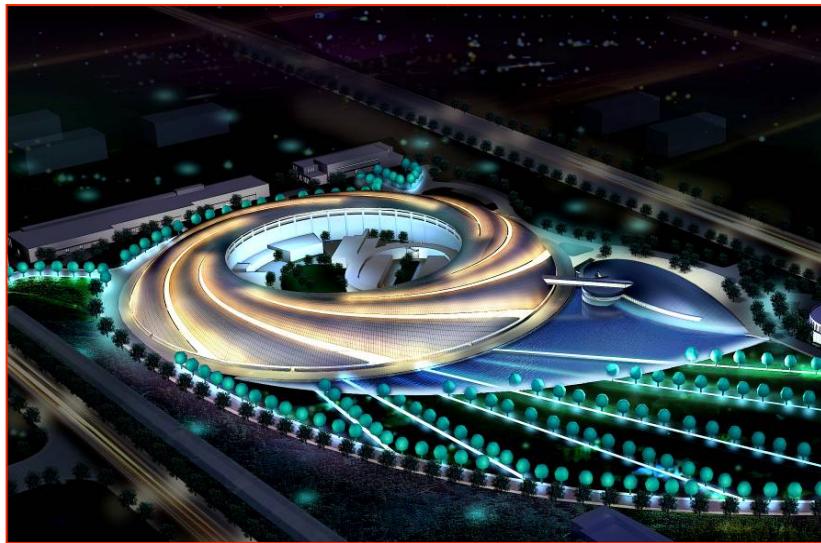
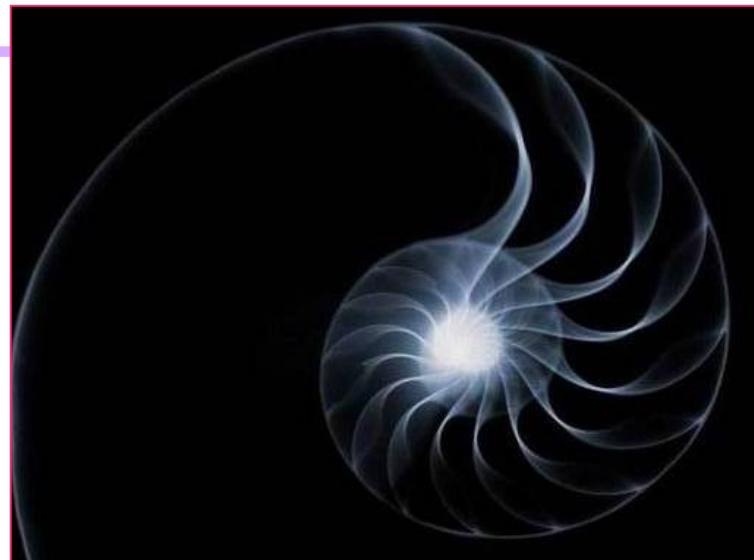
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Shanghai Institute of Applied Physics, Chinese Academy of Sciences



SSRF Campus (Design)



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**Linac**



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**Booster**

## Storage Ring and IVU25B





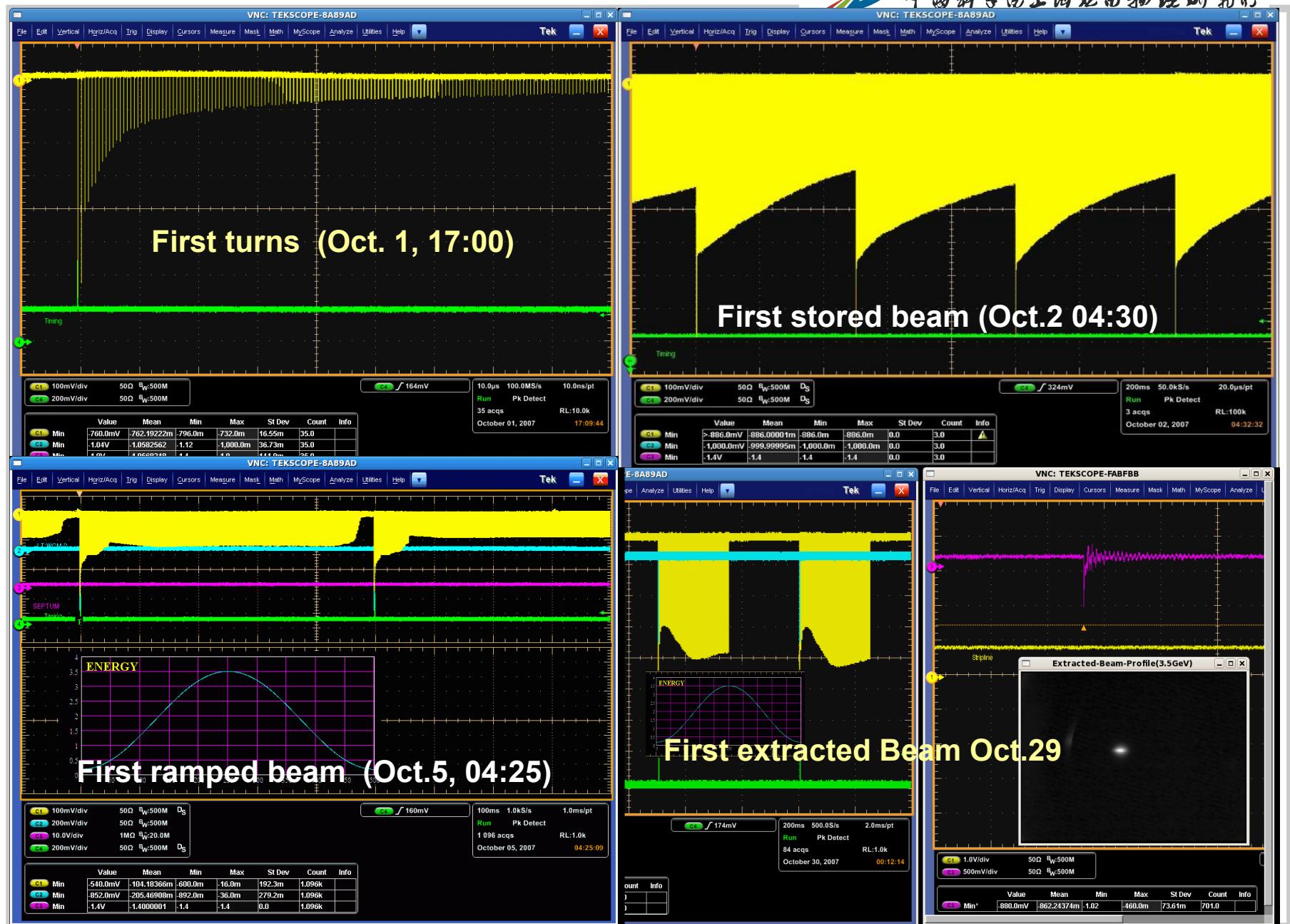
EPU

# SSRF Experimental Hall

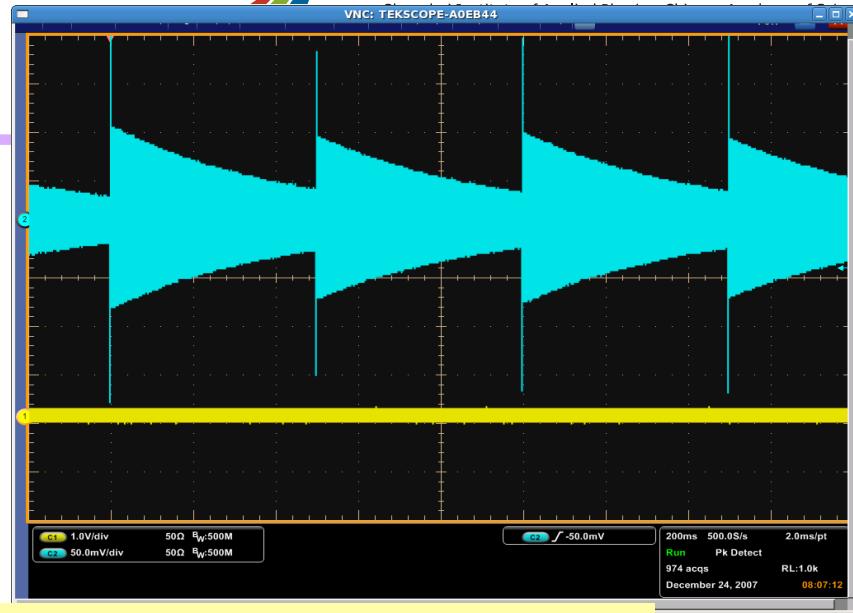
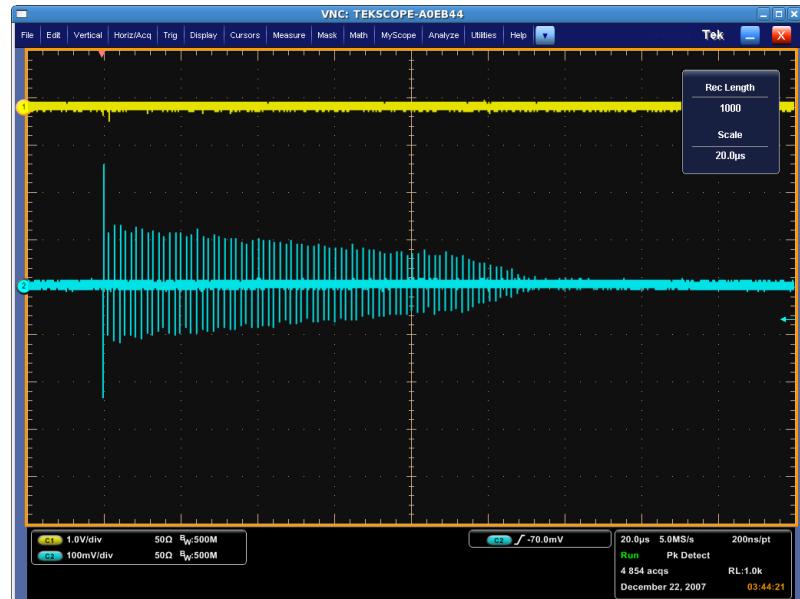


# First beam from Linac on May 15, 2007



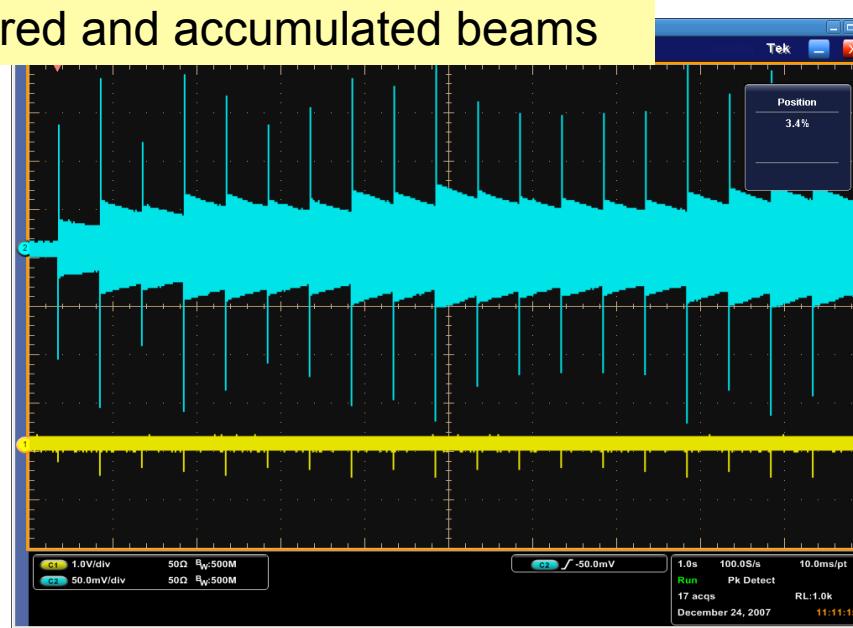
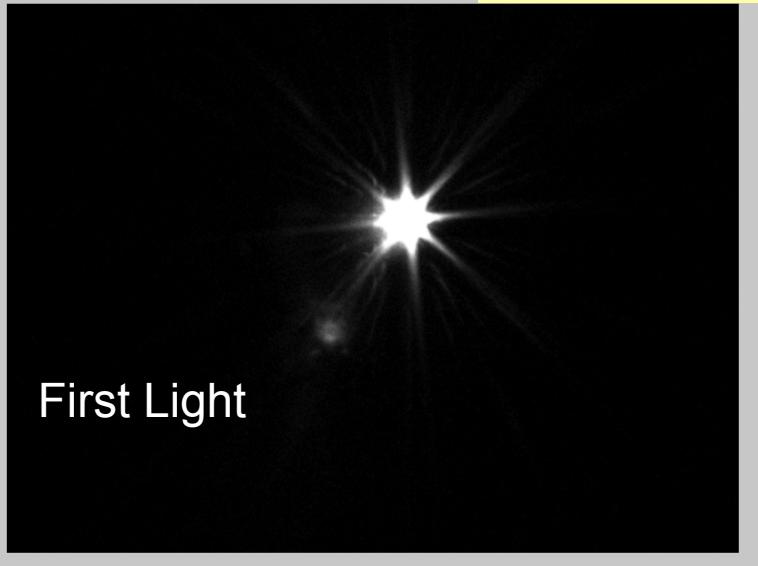


## Booster Commissioning

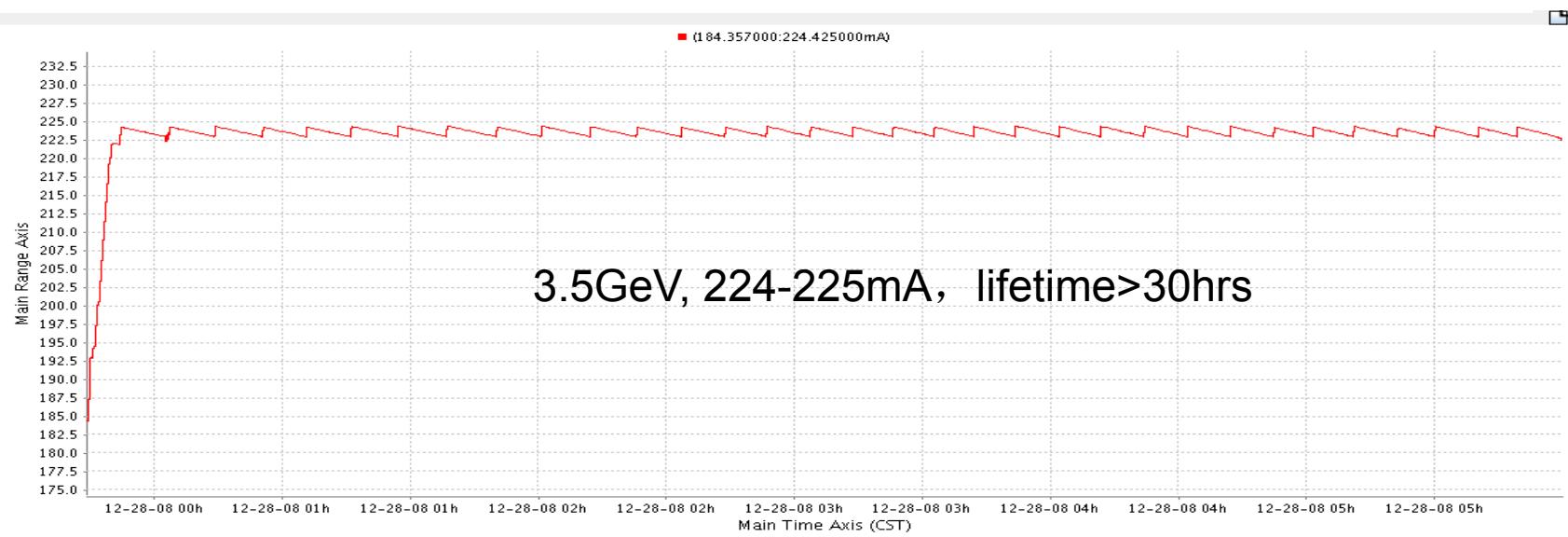
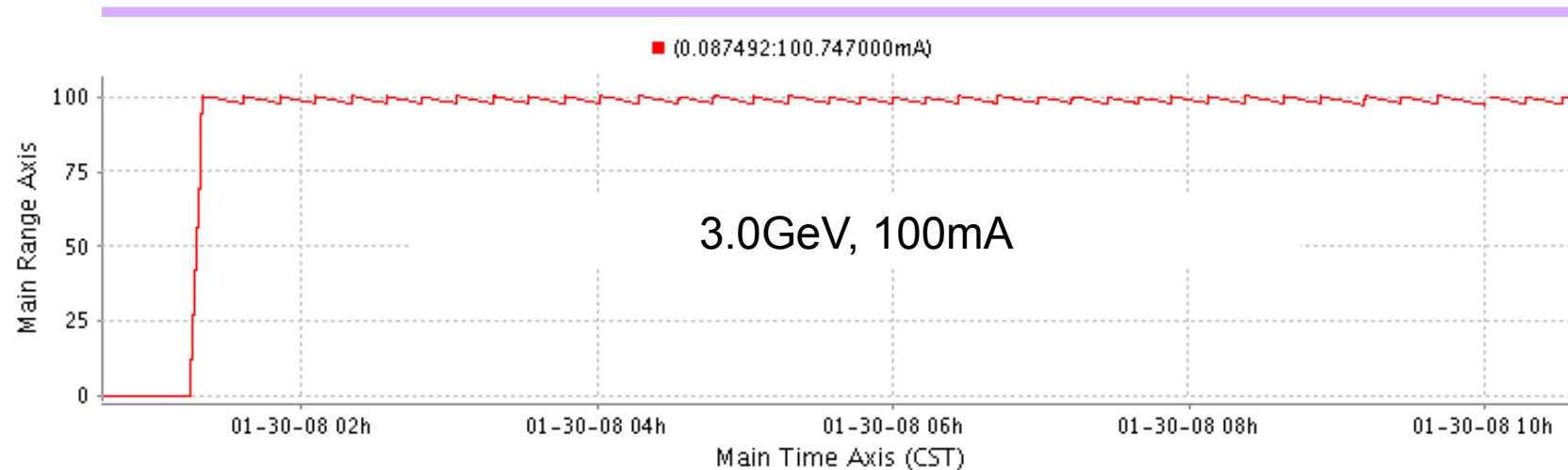


SR-SRM-image

Circulated, Stored and accumulated beams



the first Stored Beam 06:54, Dec.24, 2007



# Storage ring commissioning

# **SSRF Phase I Beamlines**

# SSRF Phase I Beamlines

- ◆ **Macromolecular Crystallography Beamline (IVU)**
- ◆ **Diffraction Beamline (BM)**
- ◆ **XAFS Beamline (Wiggler)**
- ◆ **Hard X-ray Microfocusing Beamline(IVU)**
- ◆ **X-ray Imaging Beamline (wiggler)**
- ◆ **Small Angle X-ray Scattering Beamline (BM)**
- ◆ **Soft X-ray Spectromicroscopy Beamline (EPU)**

## Beamline Commissioning

- The first beamline (SAXS) started commissioning in May 2008 and the last beamline (MX) of phase-I started commissioning in March 2009.
- Systematic measurements of beamline parameters have been made during the commissioning period from May 2008 to April 2009 with the conclusion of “design requirements have been met”;
- Test user operation began on May 6, 2009

# **SSRF**

## **User Operation and Experiments**

# SSRF User proposals for 2009 (up to 2009-3-31 )

Beamline	Proposals	Beamtime request (shift/8hr)
BL08U1	30	246
BL13W1	40	297
BL14B1	40	245
BL14W1 (XAFS)	65	545
BL15U1	43	352
BL16B1	32	265
BL17U1 (MX)	51	906
Total	301	2868 (~23000hr)

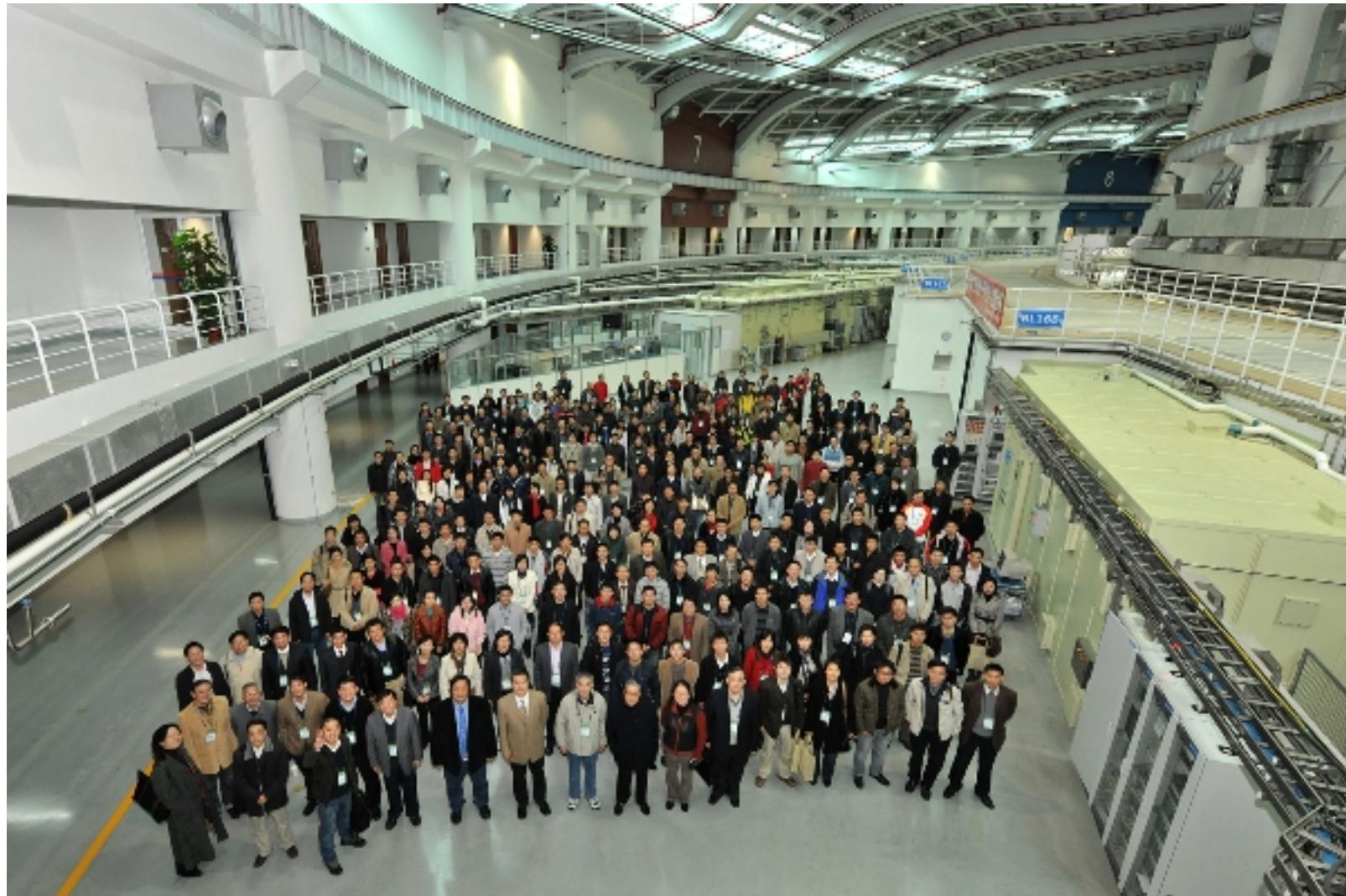
# SSRF User proposals: Second Run (up to 2009-9-30 )

Beamline	Proposals	Beamtime request (shift/8hr)
BL08U1	33	300
BL13W1	46	587
BL14B1	35	241
BL14W1 (XAFS)	67	670
BL15U1	35	280
BL16B1	40	266
BL17U1 (MX)	69	758
<b>Total</b>	325	3102

- **User operation started from May 6, 2009;**
- Since then, ~2500 hours beamtime has been provided to users(up to Feb. 2010);
- ~240 groups in 108 institutions and companies have carried out experiments at SSRF;
- 1064 users ( 1900 user visits) for experiments.
- Beamtime assigned/requested 2165/5970, 36%  
MX beamline: 1/4, 90% proposals were approved with reduced beamtime.



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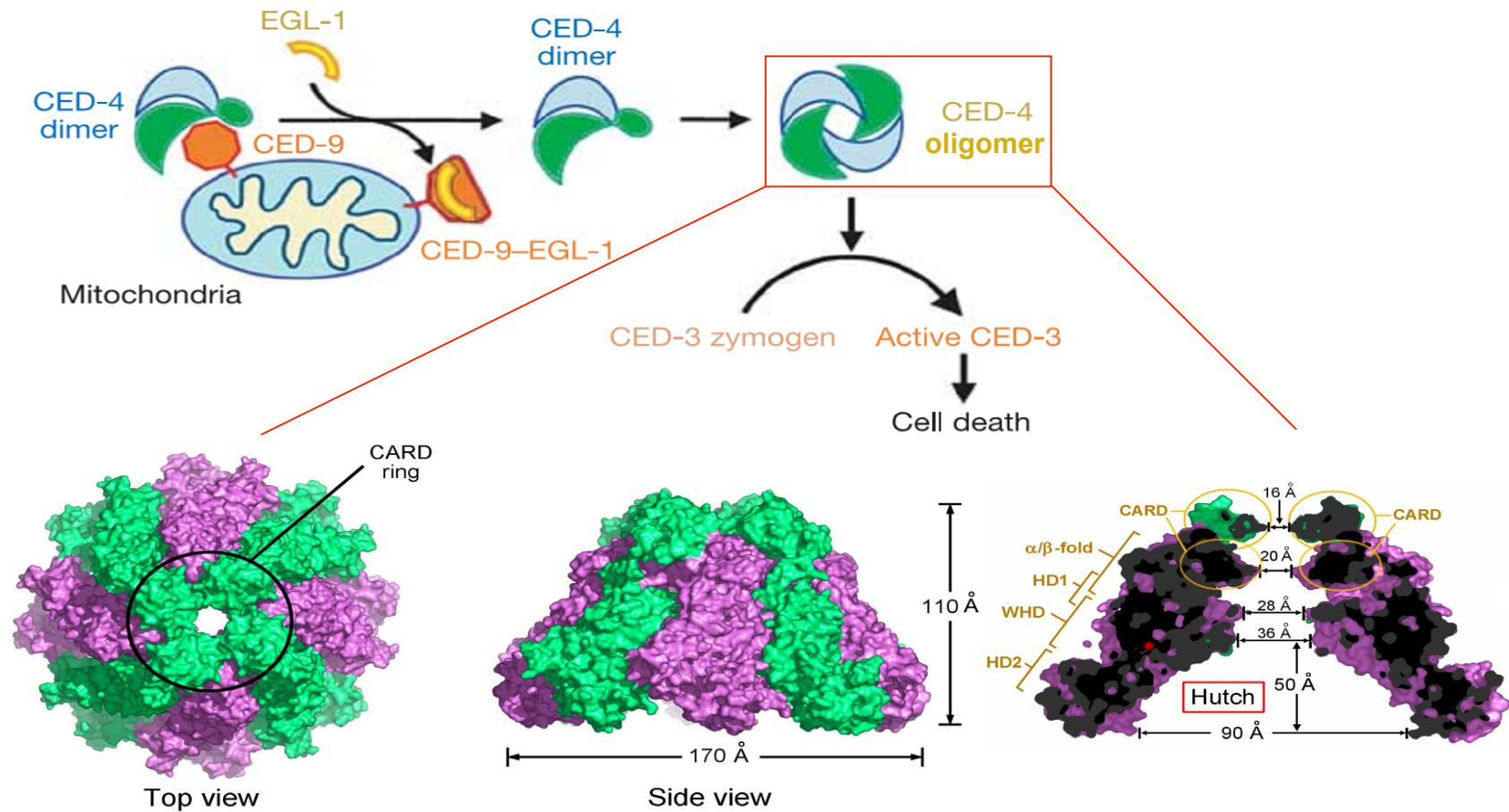


**1<sup>st</sup> SSRF User Meeting , Nov.28-29, 2009**

**~350 participants**

# Structure of the CED-4 Apoptosome:

*Giving insights into its assembly and function*



Shiqian Qi et al., Nieng Yan, and Yigong Shi, *Structure of the CED-4 Apoptosome: Insights into Its Assembly and Function*. **Cell** (2010)

# **SSRF**

## **Future Beamline Programs**

# Capacity of Beamlines on SSRF

## ➤ 18 Straight sections for IDs

- In vacuum undulators will be employed to produce brilliant x-ray beams and a standard straight section can accommodate two IV-undulators.
- A long straight can accommodate two or more standard undulators
- More than 26 ID beamlines have been scheduled

## ➤ 20 BMs

Two beamlines can be extracted from each BM at  $1^\circ$  and  $3^\circ$ ,  
Up to 38 BM ports (including 4 IR ports) available

**SSRF has a capacity of accommodating more than 60 beamlines**

# Future Beamline programs

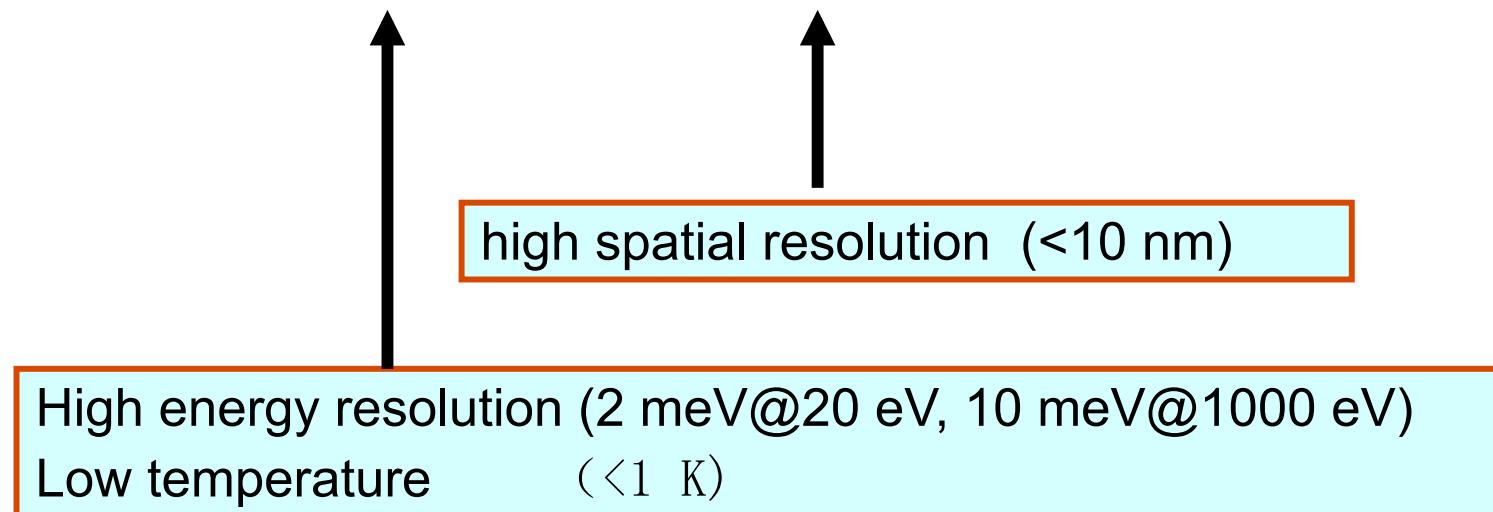
## ◆ Five Beamlines for “National Facility for Protein Science” ——The project has been approved

- Three Protein crystallography beamlines
  - Protein micro-crystals: membrane proteins etc.
  - Crystals with large unit cell: macromolecular complexes and assemblies
  - High throughput crystal screening and structural determination
- Small angle X-ray scattering beamline(Bio-SAXS)
  - High performance(very small angle X-ray scattering) beamline for the studies of protein dynamics and interaction
- IR Beamline with two end-stations
  - Time-resolved spectroscopy for protein dynamics and interaction
  - Micro-spectroscopy and imaging for structural and functional studies of cell, tissue and organisms

## ◆ One Soft X-ray Beamline with Extremely High Resolution for ARPES and PEEM :

### *Dreamline*

ARPES + PEEM



- Proposed by Institute of Physics, CAS, has been funded

## ◆ SSRF Phase II beamlines: A proposal to CAS

- 24 beamlines have been proposed as the preliminary program, by making full use of the brilliant beam and the partial coherence to achieve higher spatial resolution and energy resolution, faster time resolution;
- Detailed program is under discussion and is open for modification.



## Acknowledgements:

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- Profs. X.J. Xu and Z.T. Zhao( SSRF Directors)
- Principal beamline scientists for SSRF Phase I beamlines:  

Drs. J. He, Z. Li, Y.Y. Huang, T.Q. Xiao, X.H. Yu,  
R.Z. Tai, J. Wang,
- *SSRF Project Team*

# EPICS archive database at SSRF

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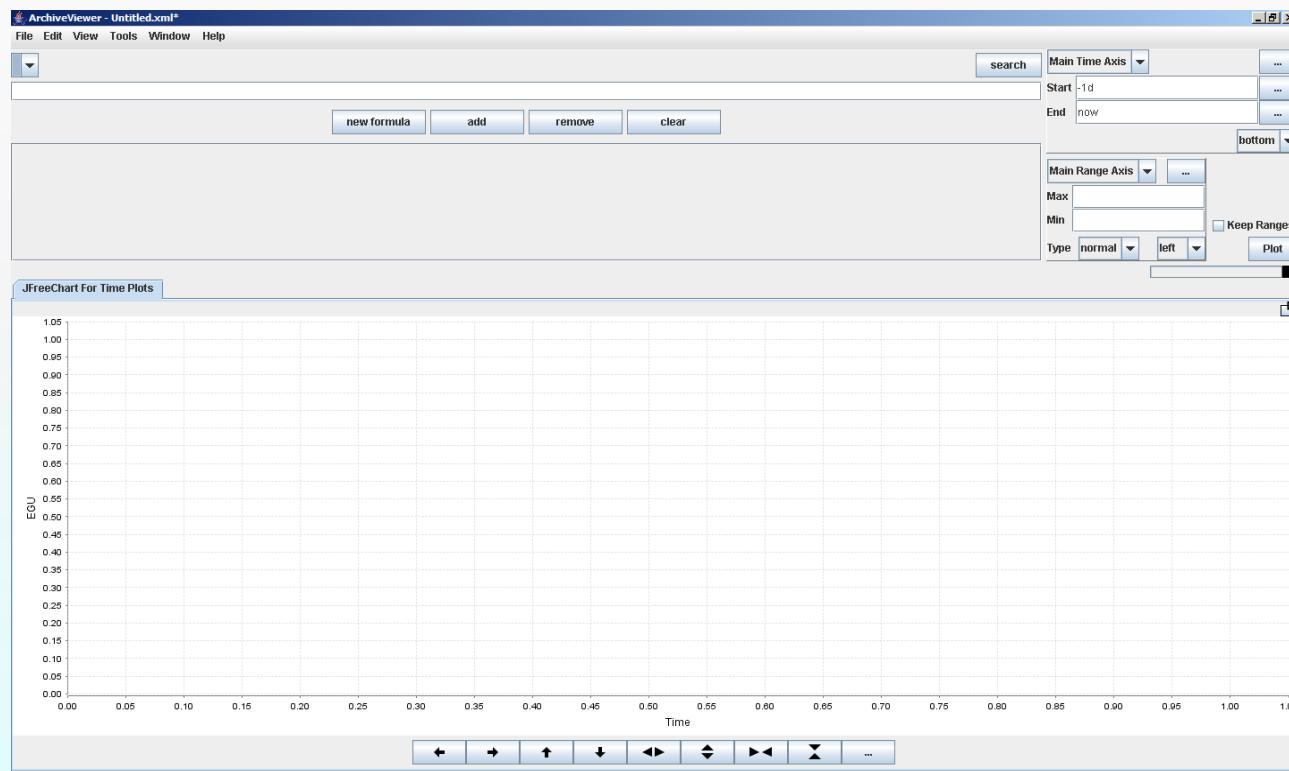
# Backgrounds

- ❖ Currently, 7 beamlines (phase I) in SSRF;
- ❖ Over 1000 PVs;
- ❖ Scan Frequency 1 second;



# Previous Solution

## ❖ ArchiveViewer



# User Requirement

- ❖ View the historical physical variable
- ❖ Recording their interesting data using image format or text format
- ❖ View the data not showing using CA command



# New Solution

- ❖ Web2.0 Technology enabled better user experience
- ❖ Restful Architecture
- ❖ Model-Viewer-Controller Design Pattern



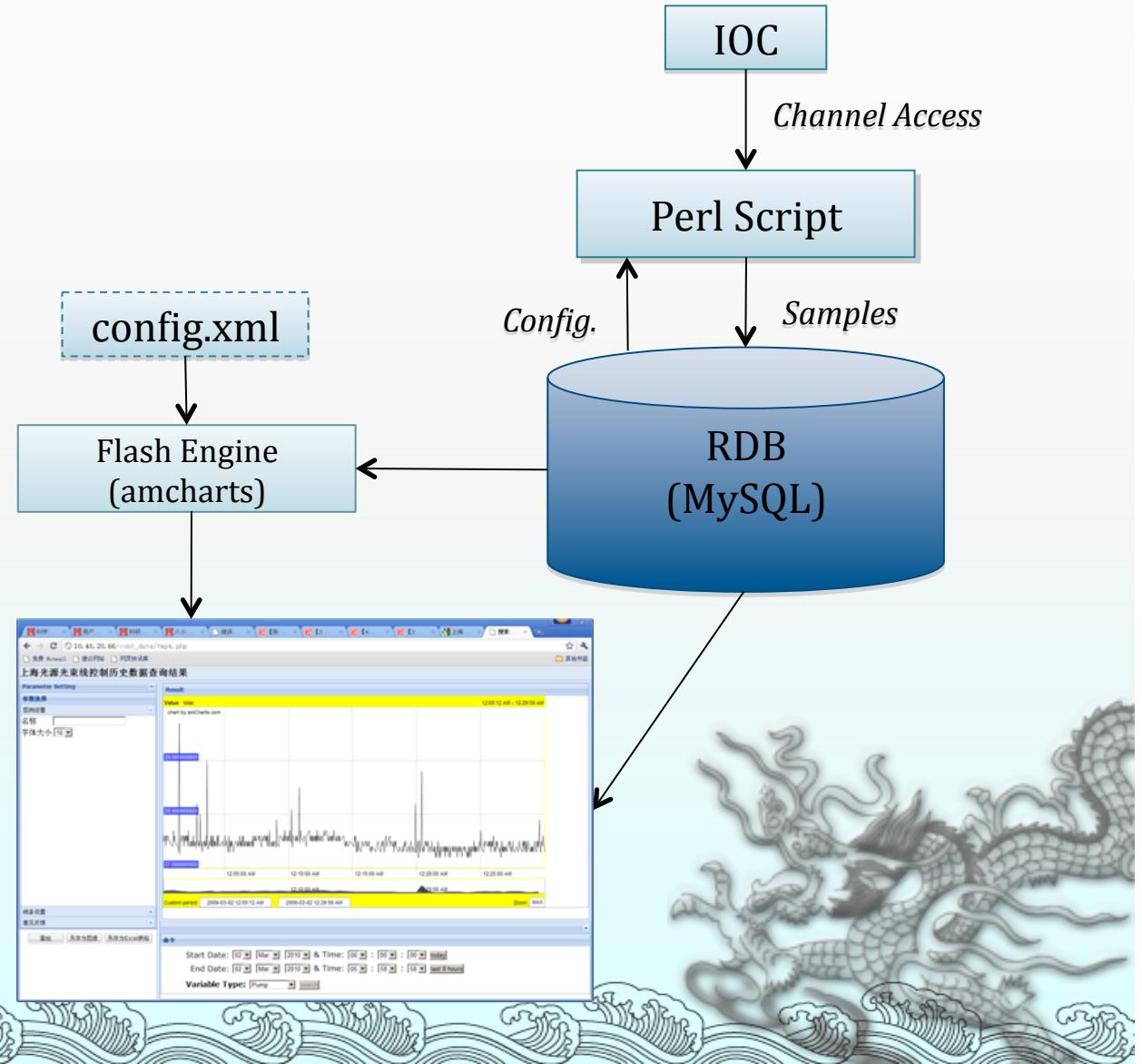
# Design Principles 1

## ◆ Software Chain

- ◆ Perl : getting data using CA protocol, and writing to database table
- ◆ PHP : Controller
- ◆ MySQL : Database engine
- ◆ Apache : Web Server
- ◆ Flash : Presentation
- ◆ Javascript : User Interface



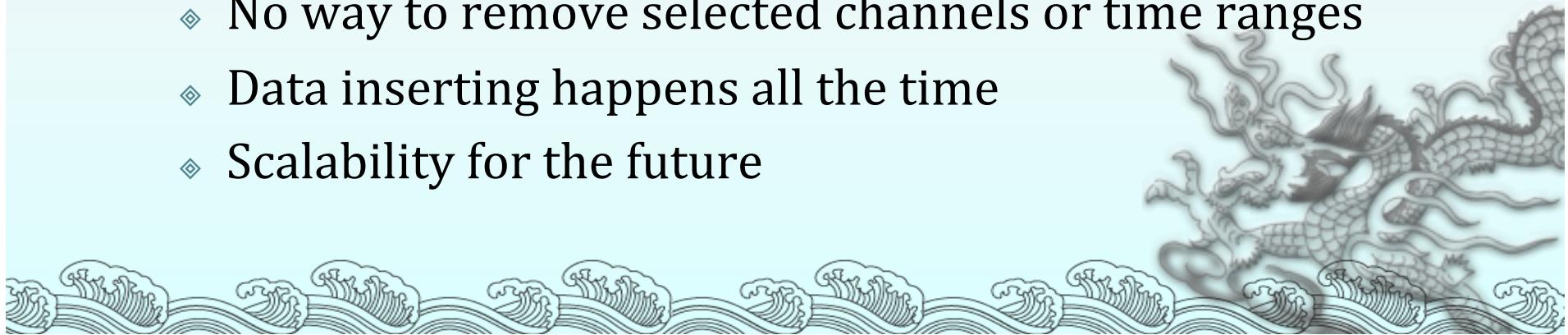
# Design Principles 2



# Database Design

## ◆ Problems

- ◆ Index time grows with data
- ◆ Stuck when index files reach 2GB
- ◆ SSRF Users faced with seven sub-archives
- ◆ No clue what needs fixing after network/power problems
- ◆ No idea who contributes how many samples
- ◆ No way to remove selected channels or time ranges
- ◆ Data inserting happens all the time
- ◆ Scalability for the future



# Database Design

- ❖ Solutions
  - ❖ Design with time division tables
  - ❖ Index with bi-tree algorithm
  - ❖ Incorporation with sharding



# Controller

- ❖ PHP 5.3 with Zend Engine
  - ❖ User controlling and input tracking;
  - ❖ Multiple Searching simultaneously with dynamically-generated template;
  - ❖ Optimized with memcached;



# Presentation

- ❖ Flash-based presentation
  - ❖ Using from amcharts.com;
  - ❖ Supporting user preference on graph;
  - ❖ Supporting image archive interesting graph;
  - ❖ Supporting excel text format archive of interesting graph
  - ❖ Supporting dragging operation on data time interval



# Presentation II



Data view panel



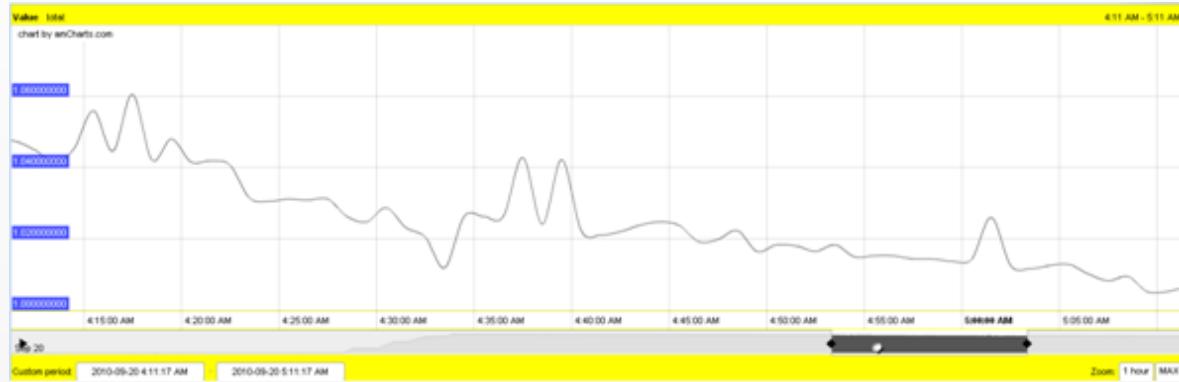
View properties setting panels

# User Interface

- ❖ Javascript generated interface
  - ❖ Using extjs javascript Framework;
  - ❖ Building interaction with amcharts flash template;
  - ❖ Designing a bootstrapping way of finding related PV;



# User interface ii



draggable time axis

Start Date: 02 Mar 2010 & Time: 00 : 00 : 00 today  
End Date: 02 Mar 2010 & Time: 05 : 58 : 58 last 8 hours  
Variable Type: Pump search

Start Date: 02 Mar 2010 & Time: 00 : 00 : 00 today  
End Date: 02 Mar 2010 & Time: 05 : 58 : 58 last 8 hours  
Variable Type: Temperature Beamline: BL08U1 Position: FE search

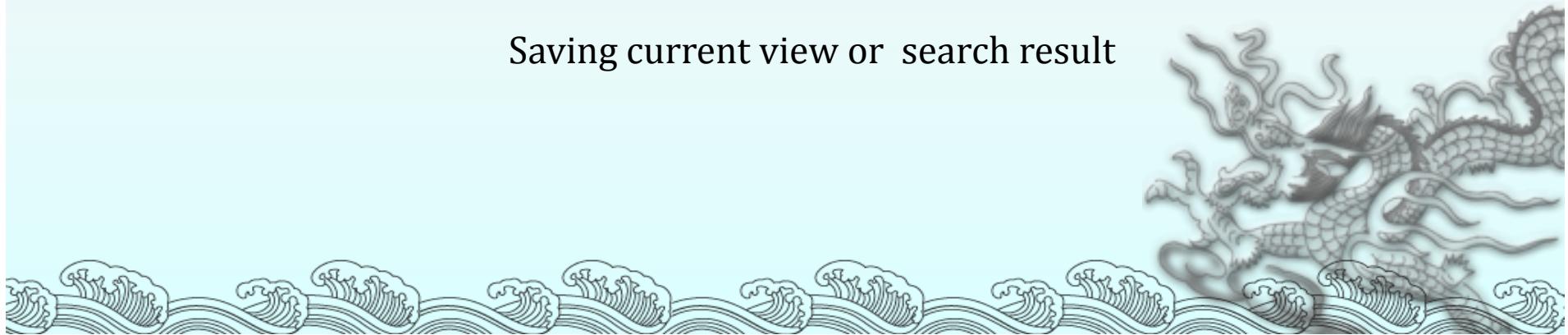
Start Date: 02 Mar 2010 & Time: 00 : 00 : 00 today  
End Date: 02 Mar 2010 & Time: 05 : 58 : 58 last 8 hours  
Variable Type: Temperature Beamline: BL08U1 Position: OP Component: SLIT1 PV: TC1:AI search

Clickable searching box

# User interface iii



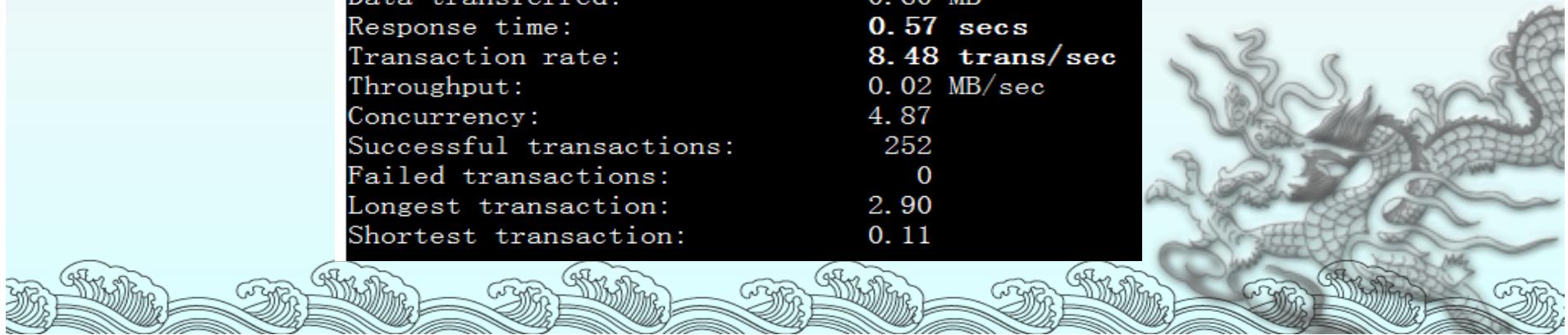
Saving current view or search result



# Run-time performance

- ❖ Siege: <http://www.joedog.org/JoeDog/Siege>
- ❖ Baseline Benchmark Drupal 7 PHP-5.3.3 PHP Apache 2.2.3
- ❖ *siege -c -b -t30s http://10.30.50.16/cont\_data/*

```
**SIEGE 2.67
**Preparing 5 concurrent users for battle.
The server is now under siege...
Lifting the server siege...      done.
Transactions:                  252 hits
Availability:                 100.00 %
Elapsed time:                  29.73 secs
Data transferred:              0.60 MB
Response time:                 0.57 secs
Transaction rate:              8.48 trans/sec
Throughput:                     0.02 MB/sec
Concurrency:                   4.87
Successful transactions:       252
Failed transactions:           0
Longest transaction:          2.90
Shortest transaction:          0.11
```



# Conclusion

- ❖ Reach wider usability;
- ❖ No learning curve;
- ❖ Fast Response time (webpage response time 100,000 item/sec);



# Thank you for your attention!

