Services for Synchrotron deployment and operations

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Synchrotron 'Solaris'

Synchrotron is a universal research device used in many fields of science.

Synchrotron is used to accelerate electrons which produce light, that is electromagnetic radiation in a wide spectral range from infrared to X-ray radiation.

Synchrotron radiation is used to study matter and this kind of research can be applied in such fields of science as physics, chemistry, biology, materials science, medicine, pharmacology, geology and crystallography.
The Machine

Injector:
- 550MeV linear accelerator

Storage Ring:
- Energy: 1.5GeV
- Current: 500mA
- Emittance: 6nmrad
- Circumference: 96m
- 12 straight sections

Replica of MaX IV 1.5 ring with Adaptation to our environment
Synchrotron construction

Timeline
- Building overtake: 12.2013 (previously 09.2013)
- Tests of subsystems: 03.2014
- First run of liniac: 08.2014
- First electrons in ring: 12.2014
- Synchrotron light at experimental stations: 02.2015
- End of Phase 1: 30.04.2015
- Phase 2: Accelerator tuning and extension of experimental lines

News
Additional funding – second experimental line (UARPES)

Recent activities
- Liniac tests in MAX-IV, Lund
- Development of Solaris specific software
Experimental lines

• Photoelectron Emission Spectroscopy (PEEM) – IKiFP PAN and AGH - project
  ● Source: Bending magnet
  ● Energy range: 200 – 1600 eV
• Ultra Angle Resolved Photoelectron Spectroscopy (UARPES) – JU
  ● Source: Apple type undulator – variable polarization
  ● Energy range: 8 – 100 eV
• X-ray Photoemission Spectroscopy (XPS) – Silesian University – app. submitted
  ● Source: undulator
  ● Energy range: 40-1500 eV
• **Hard X-ray** beamline – Poznan University – app. in writing
  ● Source: SC 3-3.5T Wiggler
  ● Energy range: x -15keV
Services proposed for Synchrotron users

**Elegant service**
Access to Elegant software („ELEctron Generation ANd Tracking”)
Matlab configuration for usage of Self Describing Data Sets (SDDS)
Preparation of modules facilitating usage for users
Additional scripts facilitating job submission locally (UI) and grid-wise (URC)
**Status:** Integration with PL-Grid infrastructure completed

**Virtual accelerator service**
Requires:
- Elegant service on site (working nodes)
- TANGO (The TAco Next Generation Objects) installed – control system used in Synchrotron domain
- Access to virtual machine from Cloud (UI for simulation of Virtual Accelerator control system environment and job submission to worker nodes via Unicore middleware (UCC)
**Status:** Prototype tested by users. Integration with PL-Grid infrastructure in progress

**Tracy service**
Set of libraries and tools for synchrotron calculations
Requires Numerical Recipies

**User oriented generic services** (within PL-Grid PLUS project) – for data storage and managing
- VeilFS unified data access to data stored in heterogenous and distributed systems
- **Data backup** (with cooperation with PLATON U4 service - under evaluation)
Support for Elegant job submission
Elegant service output visualisation

Storage ring requires a sufficiently large dynamic aperture in order to achieve high injection efficiency and long Touschek lifetime. In order to predict the performance of the storage ring different simulations are done, e.g. to calculate the dynamic aperture in the 6D space: the frequency map analysis and diffusion maps analysis are made. Figures show the diffusion map and frequency map for the electron bunch circulating in the storage ring. The diffusion is low for a blue color and for light blue where you see such circles it is a bit higher.
Virtual accelerator 1/2

**applications**
(.operator interface)

**integration layer**
(Tango)

**machine**

BPMs
Magnets

BPM hardware
Power supplies

Orbit correction, Measurements
Settings
(Tracy, Elegant, Matlab, ...)

Magets
Virtual accelerator 2/2

- **applications (operator interface)**
  - Orbit correction, Measurements
  - Settings
    - (Tracy, Elegant, Matlab, ...)

- **integration layer (Tango)**
  - BPMs
  - Magnets

- **model**
  - Input/output
Beam position corrections
Beam position correction
Summary

IT Services in preparation
- Elegant service ready and used for machine operation design
- Virtual accelerator ready in December 2013

Timeline:
- 04.2015 (end of construction phase)
- 06.2015 (available for users)

More information: Solaris and PL-Grid PLUS webpages

http://www.synchrotron.uj.edu.pl/

http://www.plgrid.pl/en