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Sincrotrone
Trieste

Milan Prica

Scientific data lifecycle at Elettra-Sincrotrone Trieste

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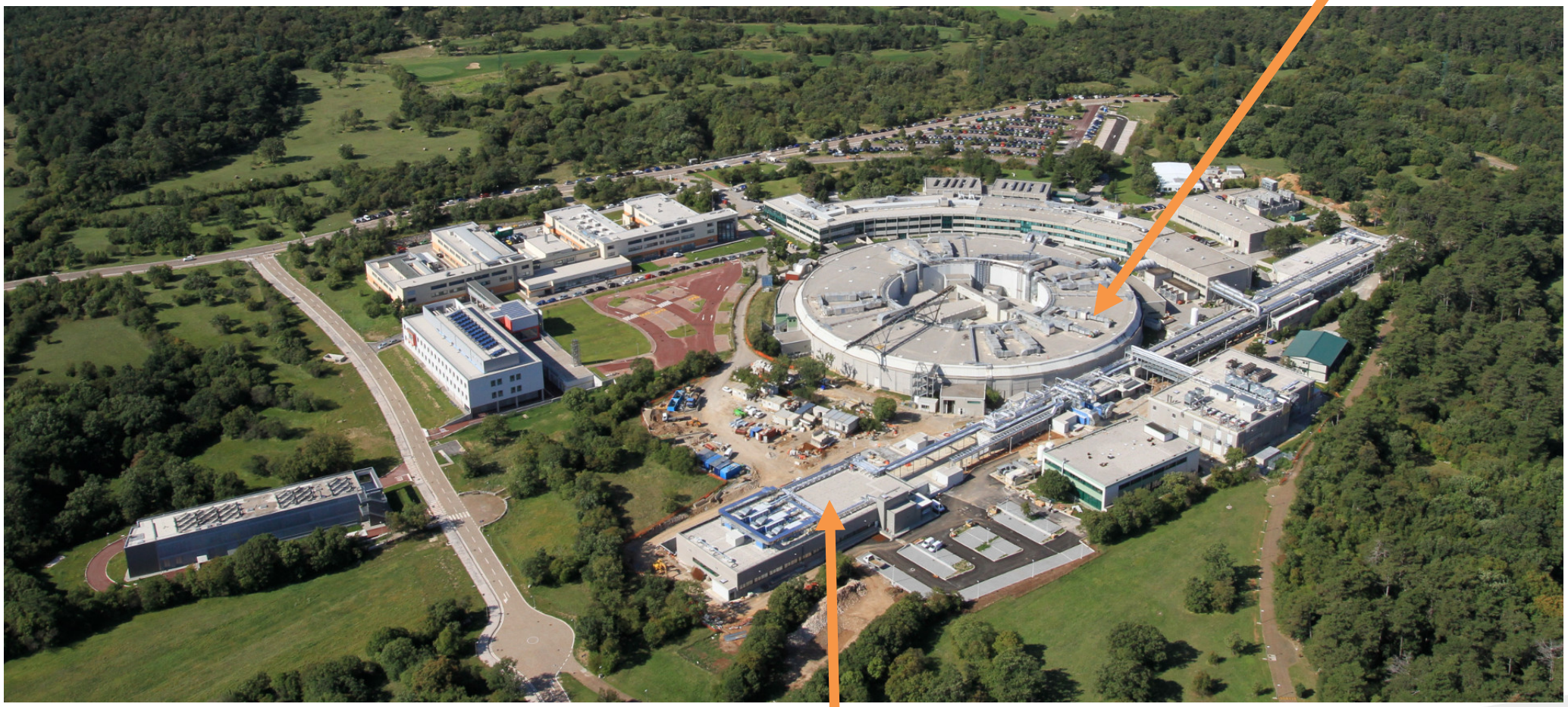
Introduction to the facilities



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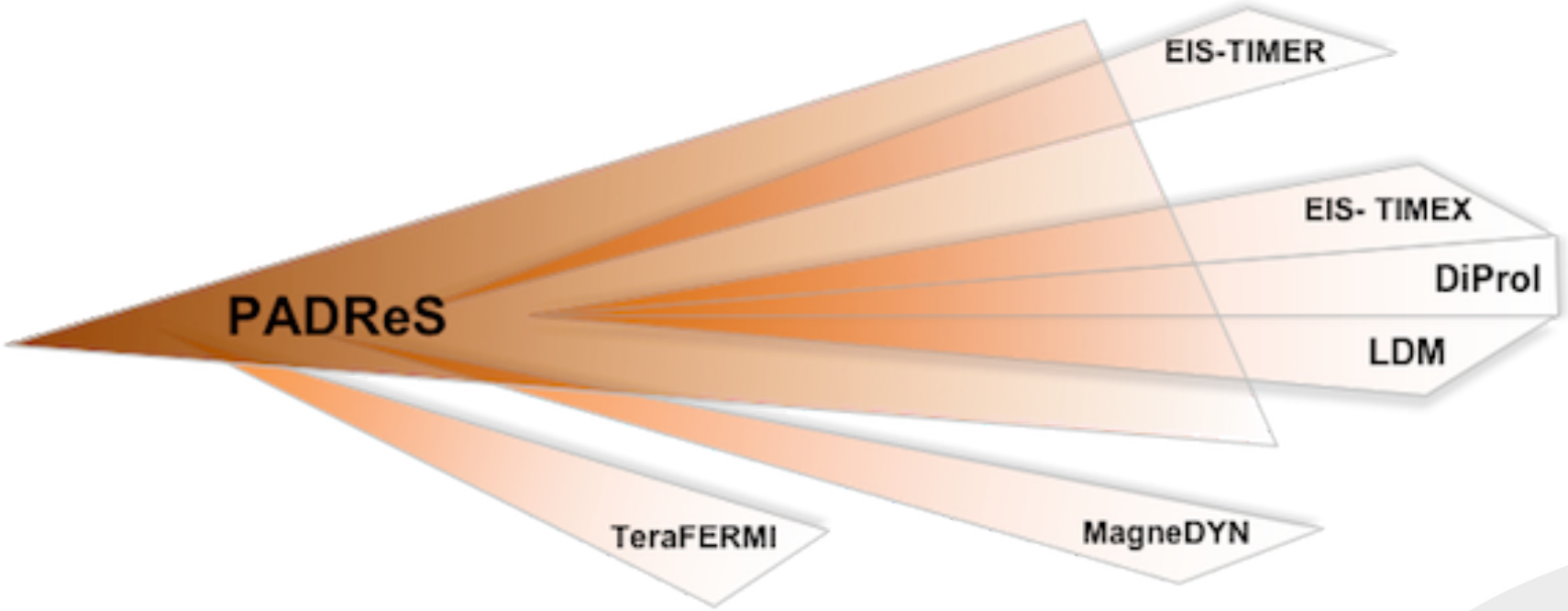
FERMI@ELETTRA

A 4th generation light source is a linac-based, single pass Free Electron Laser with an external seeding scheme

- Operational since 2012
- 6 beamlines



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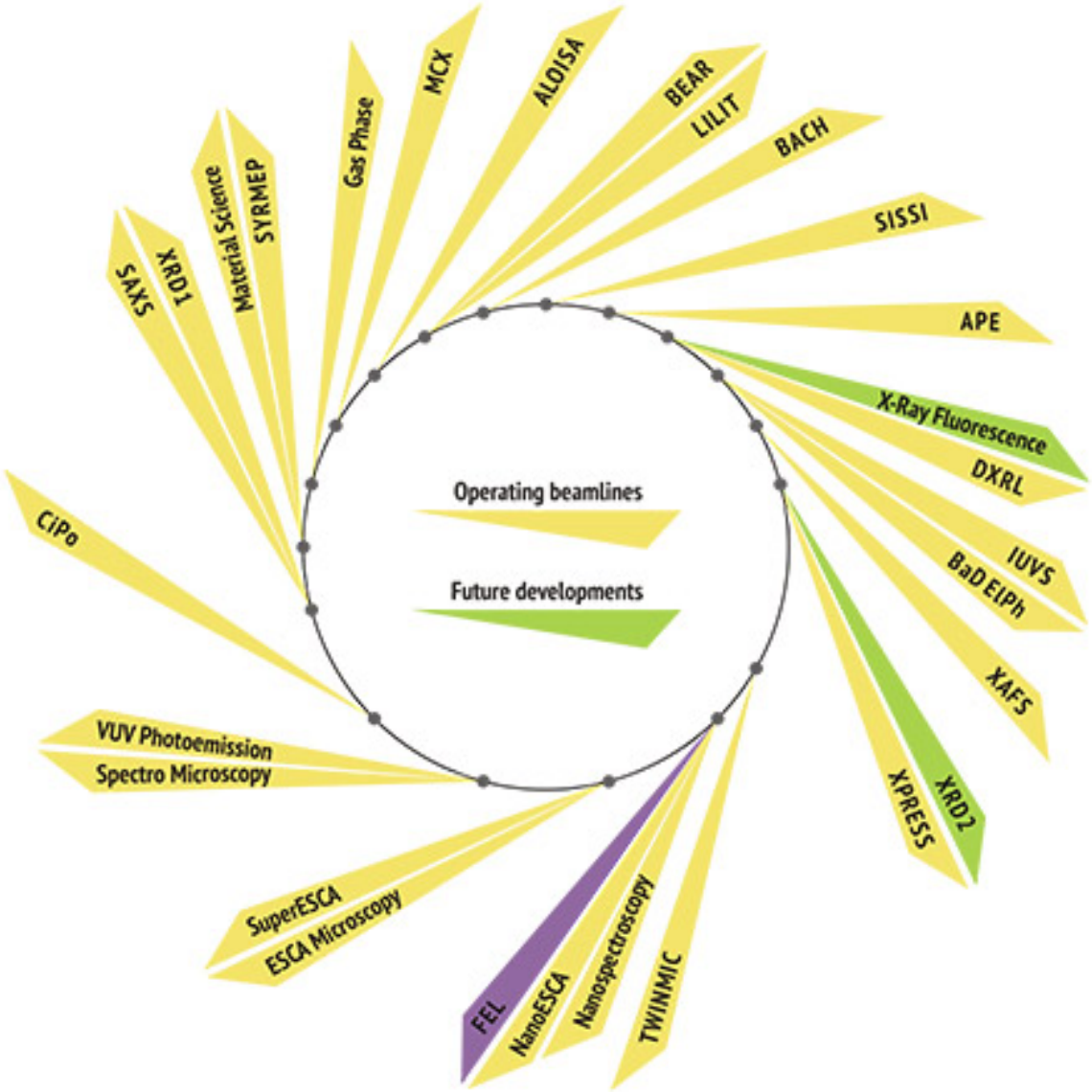
ELETTRA



A 3rd generation synchrotron radiation facility

- Operational since 1993
- Major upgrade in 2010
- 28 beamlines

Combined, the two facilities have approximately 1400 users/year

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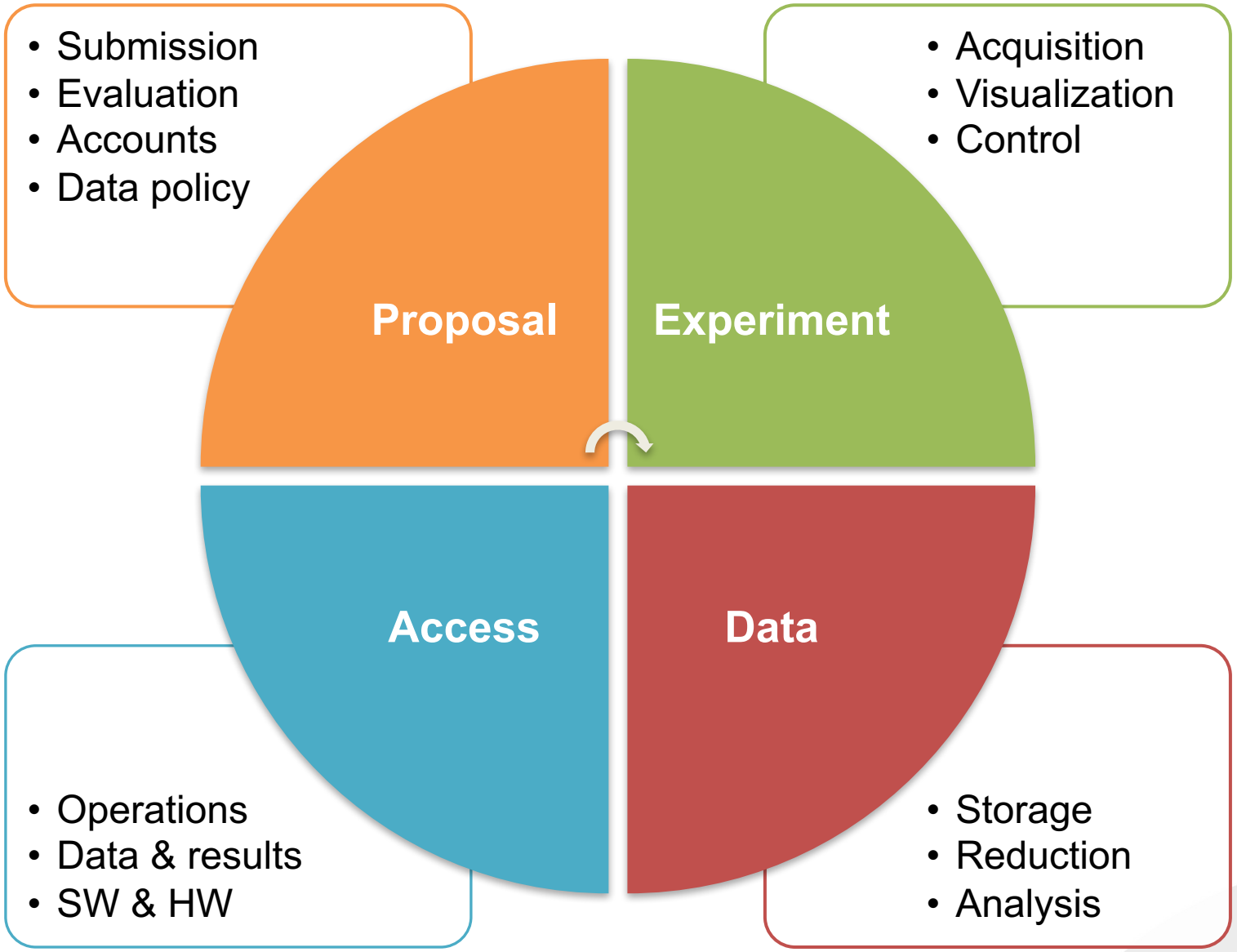
Data lifecycle



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Virtual Unified Office (VUO)

- Main users' web interface to the facilities since 1997
  - User registration: login credentials valid for the web portal, data acquisition, storage devices, computational cluster for data analysis, remote operation tools and Wi-Fi access
  - Proposal submission and evaluation
  - Beam-time scheduling in the portal calendar
  - Access to storage
  - Remote safe access to resources (Java-based tunneling tool with authentication and authorization in support of RDP, NX, VNC)
  - Users' feedback: machine functionality, achievements, complete experimental report
  - Integrated with the company's ERP
  - Umbrella ID login supported on the portal

Scientific data policy

- Users must accept the data policy before the beamtime
- All the data obtained as a result of publically funded access to the research facility will become open access after a reasonable embargo period (3 years, extendable)
- Raw data are kept for 10 years, accessible as read-only
- Implementing the data policy:
  - Data are saved in experiment/dataset/datafile tree.
  - 3 level storage: scratch, online, offline
  - Main (online) storage is currently being upgraded
  - Offline storage is at CINECA computing center (iRODS)
  - DOIs on datasets are not issued (yet)
  - Future upgrade to ICAT is likely

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Data acquisition system

- Each beamline end-station is a complex, dynamic instrument consisting of a large number of interconnected components
- Each experiment requires a long sequence of operations on most of end-station components
- End-station controls and acquisition system must be flexible, extensible and easily adaptable
- Key elements:
  - Automatization of experimental sequences
  - Fast acquisition system
  - Based on TANGO distributed control system
  - QTango based GUIs (+ PyQt, Taurus)

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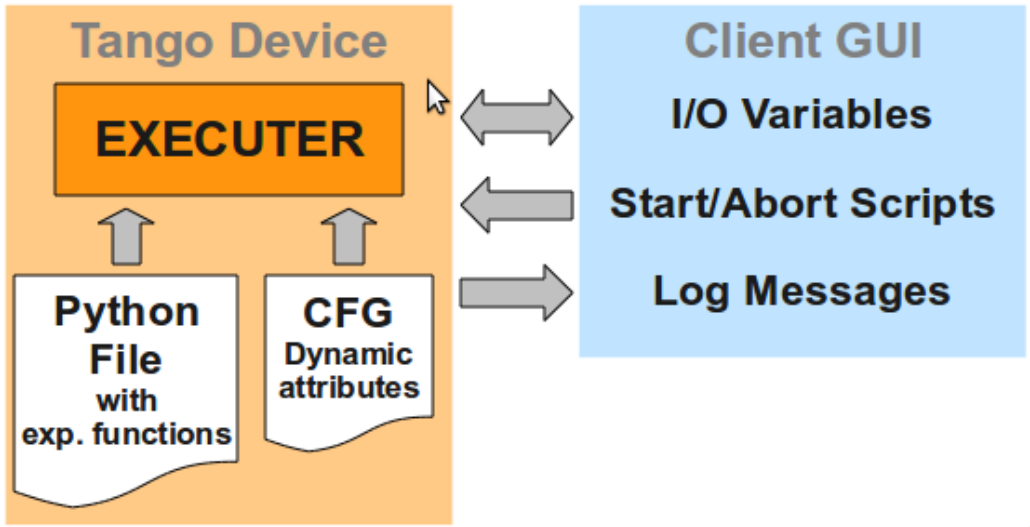
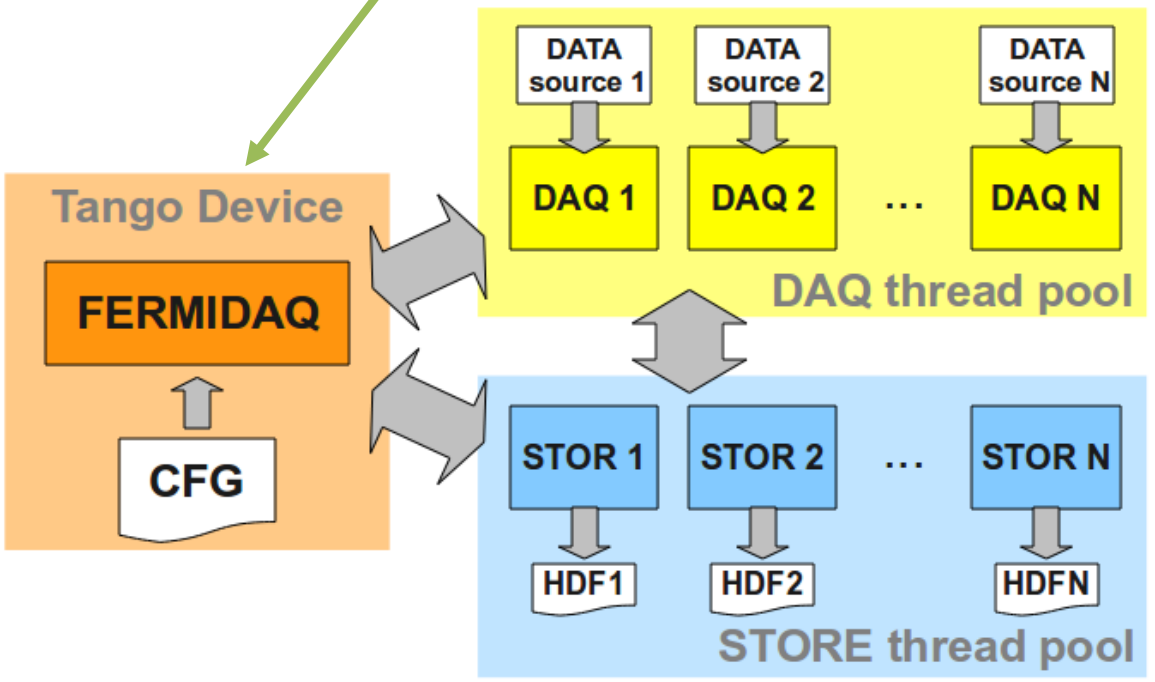
DAQ main components



Multithreaded PyTango device that collects and stores shot-to-shot data and related metadata from a large number of Tango sources. Configurable via XML. FERMI specific (Pulsed source).



PyTango device that executes generic Python functions from scripts located in external files. In/out variables are handled as dynamic Tango attributes. Configurable via XML.

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DAQ access

User logs in with his/her VUO credentials (username/password)

A logged-in user is presented with a list of his/her proposals and must select one for data acquisition

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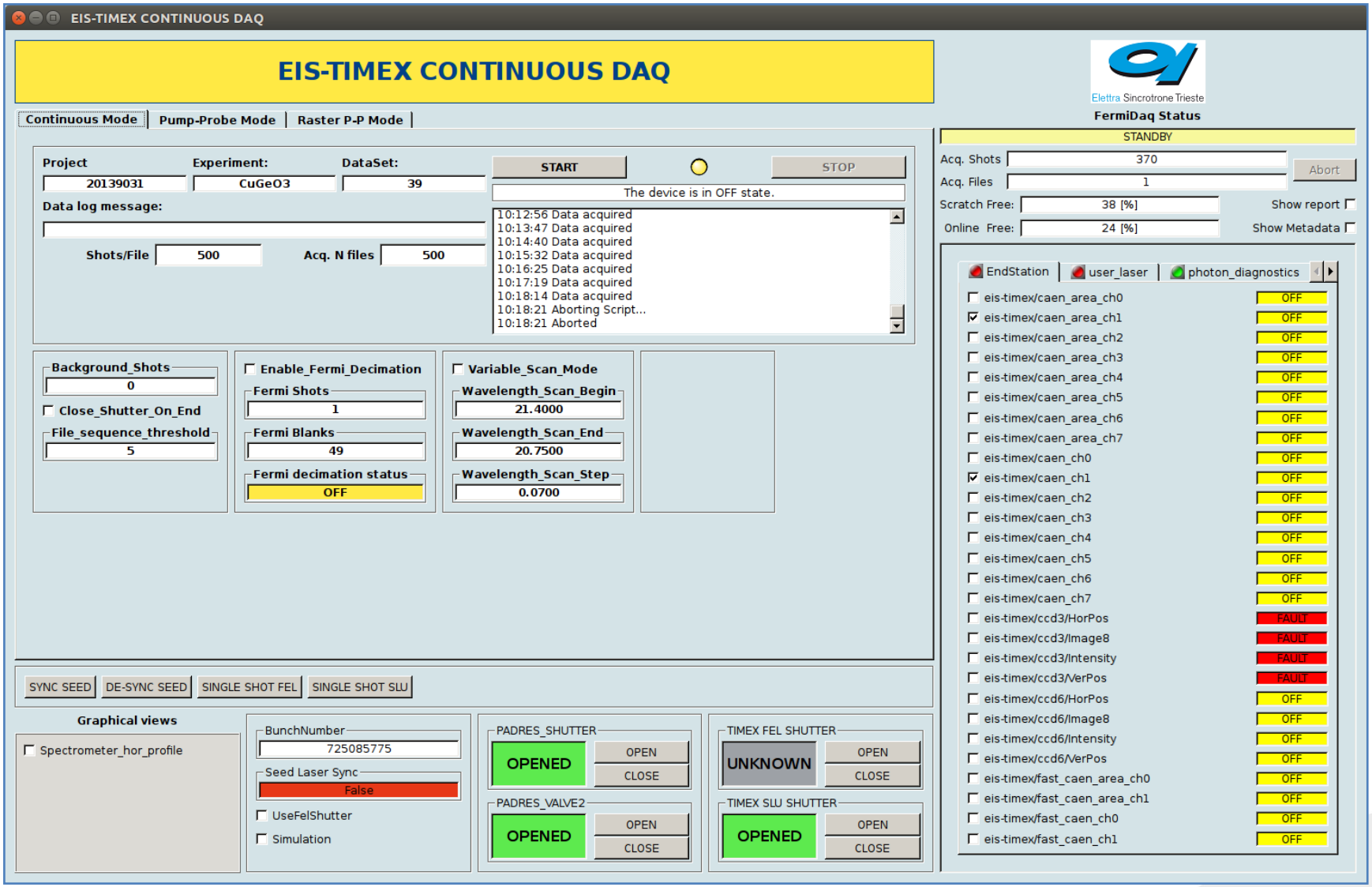
DAQ main panel



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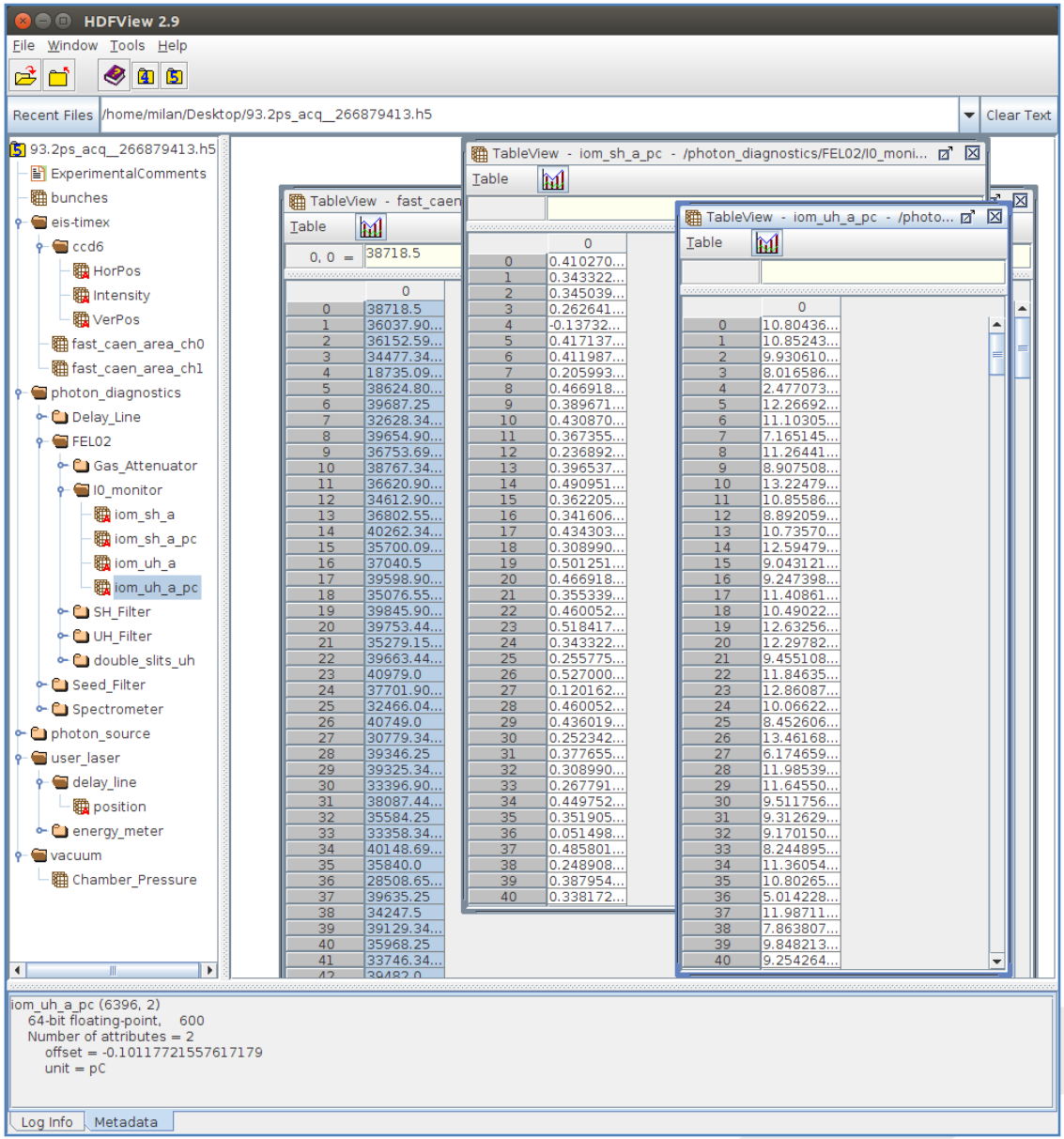
Data format

HDF5 is used as a container for meta-data rich structures

HDF5 structure is custom at each beamline

Configuration is XML based



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End-station user-oriented tools

- Plug-in based architecture allows for constant evolution and customization
- Python based, GUI development in PyQt
- E-logbook for experiments with automated metadata reporting
  - HTML-based, WYSIWYG editor, screenshots, data server, remote client, exportable to PDF
- Visualizer of scientific images integrated with BL controls
  - CBF, TIFF, MAR345 support, ROI zooming, line profiles, background subtraction
- Tool for rapid prototyping of data collection sequences and analysis scripts
- 0MQ-based system for data collection and experiment managing - see DonkiOrchestra talk by R. Borghes tomorrow

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E-Logbook

LogBook - LogBook_2016_10_11-12_11.html

File Edit Format Plugins About

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Esperimento Dell'Angela Ottobre 2016 --- proposal 20139031

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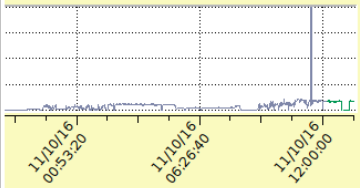
Fermi Machine Status

RF plants

status	On
recovery time	0:00:00

E-beam Energy	1.37	GeV
BC-1 / Energy	ON 0.28	GeV
BC-2 / Energy	OFF 0.70	GeV
Bunch Charge	706.46	pC



Seed laser

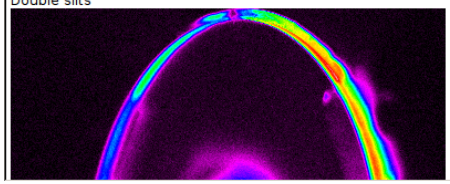
status	OPEN
Lock status	Locked on Cross Correlator Signal
Pulse energy	30.62 μJ
Pulse length	130_fs
Wave length	251.60 nm

FEL-1

Harmonic	14.00
Wavelength [nm]	17.97
Polarization	Linear vertical

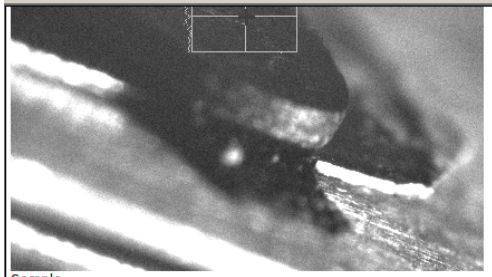
FEL-1 I_0 monitor

Double slits



LogBook - LogBook_2016_10_11-12_11.html

File Edit Format Plugins About



Sample
tetha: 25
y: 8.3
x: 12.25

SMARACT
A1: -9
B1: 6.98
C1:-3

Filtro Zr 100 nm, diminuzione dell'intensita di 1/3

Spettrometro
X: 46.32
Y: 14.097
DET: 12.67
armonica 14

Slitta .75

prime misure del picco elastico su CuGeO3:

```
>>> Tue Oct 11 19:05:21 2016 - Data acquisition started - Continuous mode with optional background shots
>>> FEL_Source = FEL1; Wavelength = 17.97 nm; Harmonic number = 14.0; Polarization = Linear vertical;
>>> Seed Laser Pulse Energy = 29.80 uJ; Seed Laser Wavelength = Unknown; Seed Laser Pulse Length = Unknown;
>>> GasAttenuatorPress = 2.13e-06 mbar;GasAttenuatorHighPress = -0.0002 mbar;Padres SeedFilter in UH = OffBeam;Padres Al_Filter = OffBeam
>>> TIMEX Filters Holder = NO_FILTERS;TIMEX Filters Wheel = Unknown;
>>> Manipulator [ X_pos = 0.798 mm; Y_pos = -6.060 mm; Z_pos = 86.706 mm; PHI_pos = 0.03 deg; THETA_pos = 0.20 deg ]
>>> Data Saved to: 20139031/RUN_01/001
>>> Acquired 10 files
>>> From: /scratchtimex/investigations/20139031/RUN_01/001/001_acq__717809660.h5
>>> To: /scratchtimex/investigations/20139031/RUN_01/001/001_acq__717814160.h5
>>> Tue Oct 11 19:07:02 2016 - Data acquisition done
```

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Data access

Browser, WebDAV, GridFTP

VUO - Investigation

Logged as: **Roberto PUGLIESE** (738) [Sudo] - [Logout] Create Help

Home/ My investigations/ All investigations/ My tags/ All tags/ My tunnels/ All tunnels/ My applications/ All applications/ Unix users/

LDM

20124009

He_10_bar_1s5p / He_10_bar_50-76 / He_Meta_and_Fluo / He_VMI / TEST / VMI_and_Meta_HEn

Investigation details	
Name:	20124009
Description: *Max 400 characters*	20124009
Principal investigator:	(14637) ZITNIK Matjaz [JSI - Jozef Stefan In
Proposal:	20124009

[Edit]

Other investigators	Name
[Delete]	AVALDI Lorenzo
[Delete]	BUCAR Klemen
[Delete]	CORENO Marcello
[Delete]	JOURNEL Loic
[Delete]	MARCHENKO Tatiana
[Delete]	MIHELIC Andrej
[Delete]	O KEEFFE Patrick
[Delete]	PIANCASTELLI Maria Novella
[Delete]	PLEKAN Oksana Kudelich
[Delete]	PRINCE Kevin Charles
[Delete]	RICHTER Robert
[Delete]	RUBENSSON Jan Erik
[Delete]	SODERSTROM Johan

[Add a new investigator]

Experiments	Code
[View]	He_10_bar_1s5p
[View]	He_10_bar_50-76
[View]	He_Meta_and_Fluo
[View]	He_VMI

VUO - Experiment

Logged as: **Roberto PUGLIESE** (738) [Sudo] - [Logout] Create Help

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LDM

20124009

He_10_bar_1s5p / He_10_bar_50-76 / He_Meta_and_Fluo / He_VMI / TEST / VMI_and_Meta_HEn / Xe / test

↓

Experiment details	
Name:	He_10_bar_1s5p
Description: *Max 400 characters*	He_10_bar_1s5p

[Edit]

Datasets	Code	Status
[View]	He_003	Filled
[View]	He_004	Filled
[View]	He_005	Filled
[View]	He_006	Filled
[View]	He_007	Filled
[View]	He_008	Filled
[View]	He_009	Filled
[View]	He_010	Filled
[View]	He_011	Filled
[View]	He_012	Filled
[View]	He_013	Filled
[View]	He_014	Filled
[View]	He_015	Filled
[View]	He_016	Filled
[View]	He_017	Filled
[View]	He_018	Filled
[View]	He_019	Filled
[View]	He_020	Filled

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Conclusions

- Implementing a complete data lifecycle in a large physics experimental facility is a very complex and expensive task
- A large number of heterogeneous systems have to work in concert in a very dynamic environment
- All the main components developed to support the experimental data acquisition and handling must be highly configurable
- International collaborations have provided many solutions that address common problems of the proton and neutron facilities (and many more still need to be addressed)

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Thank you!

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