



Elettra
Sincrotrone
Trieste

Milan Prica

Scientific data lifecycle at Elettra-Sincrotrone Trieste



NOBUGS 2016, Copenhagen

Milan Prica, 17/10/2016





Elettra
Sincrotrone
Trieste

Introduction to the facilities

ELETTRA SRF



FERMI FEL



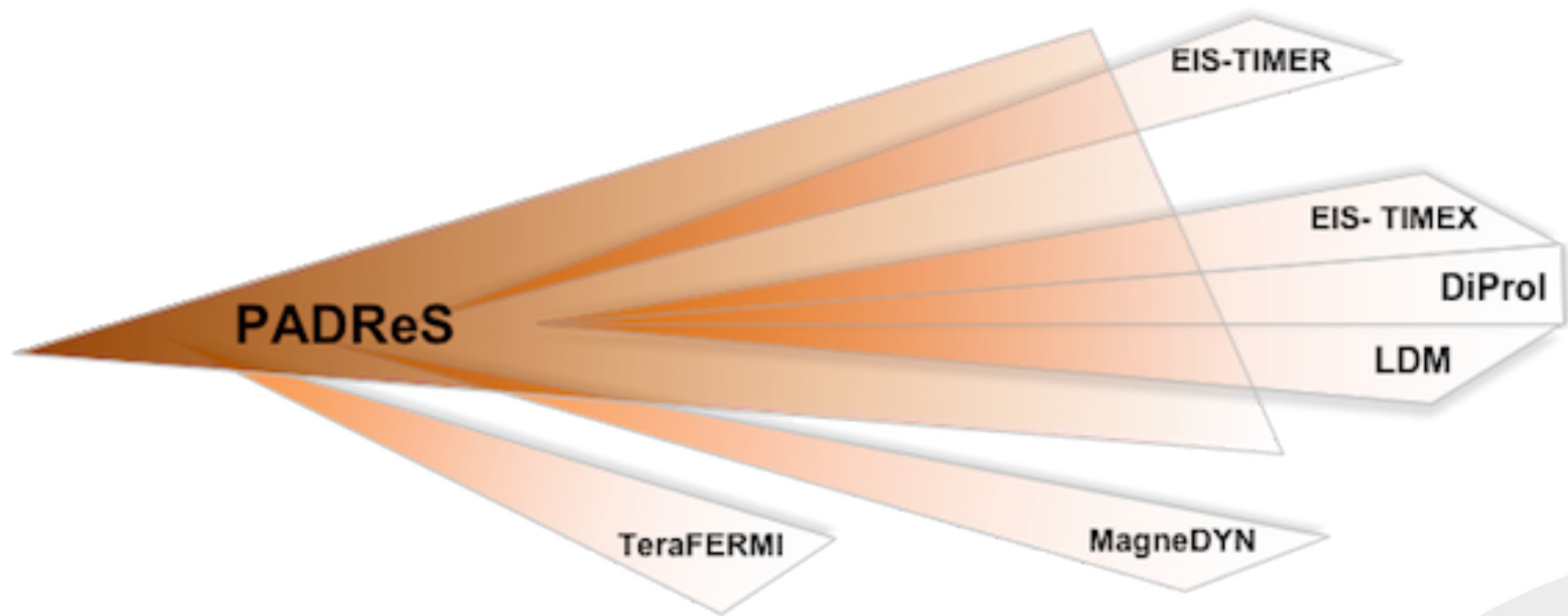
NOBUGS 2016, Copenhagen

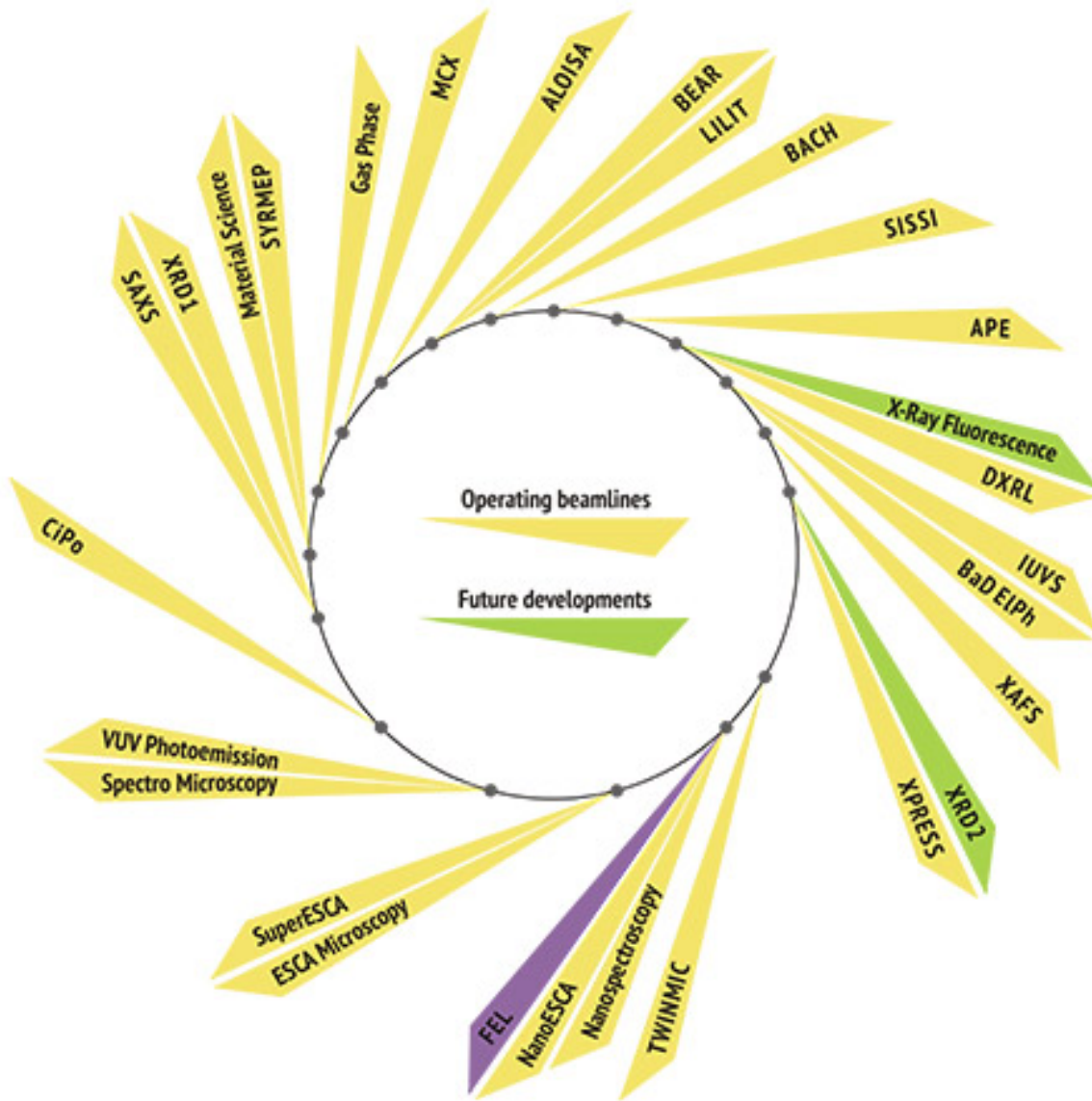
Milan Prica, 17/10/2016



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

- Operational since 2012
- 6 beamlines





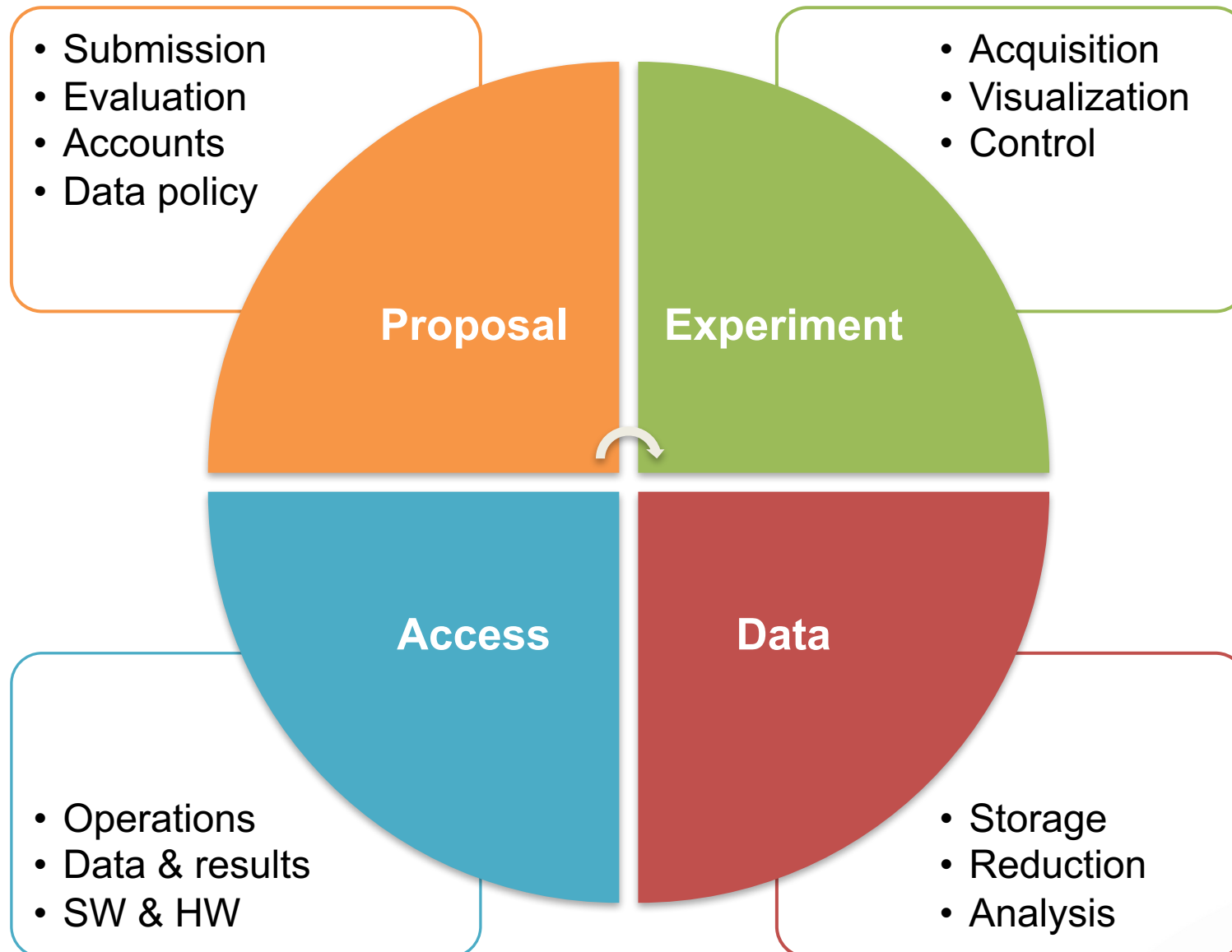
A 3rd generation synchrotron radiation facility

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

Combined, the two facilities have approximately 1400 users/year



Data lifecycle



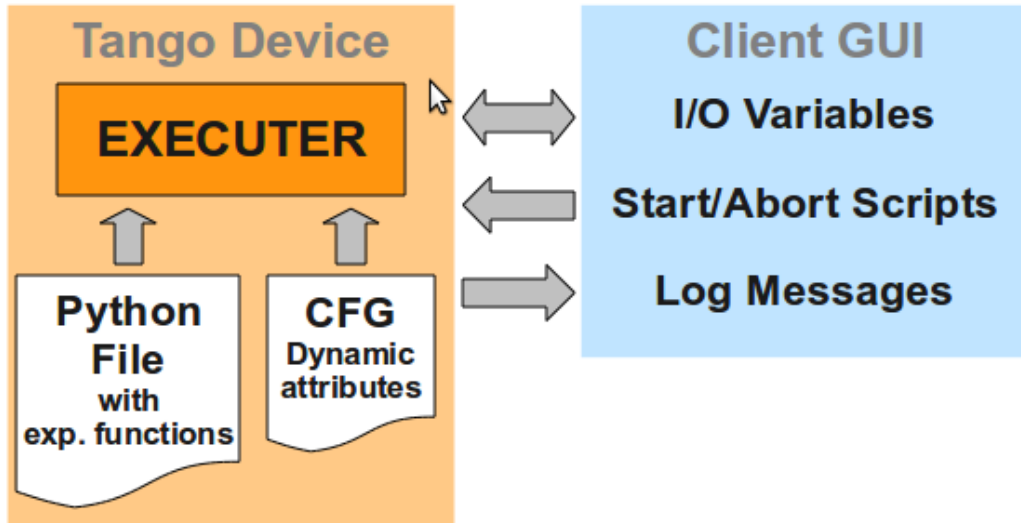
- Main users' web interface to the facilities since 1997
 - User registration: login credentials valid for the web portal, data acquisition, storage devices, computational cluster for data analysis, remote operation tools and Wi-Fi access
 - Proposal submission and evaluation
 - Beam-time scheduling 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

- 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

- 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)

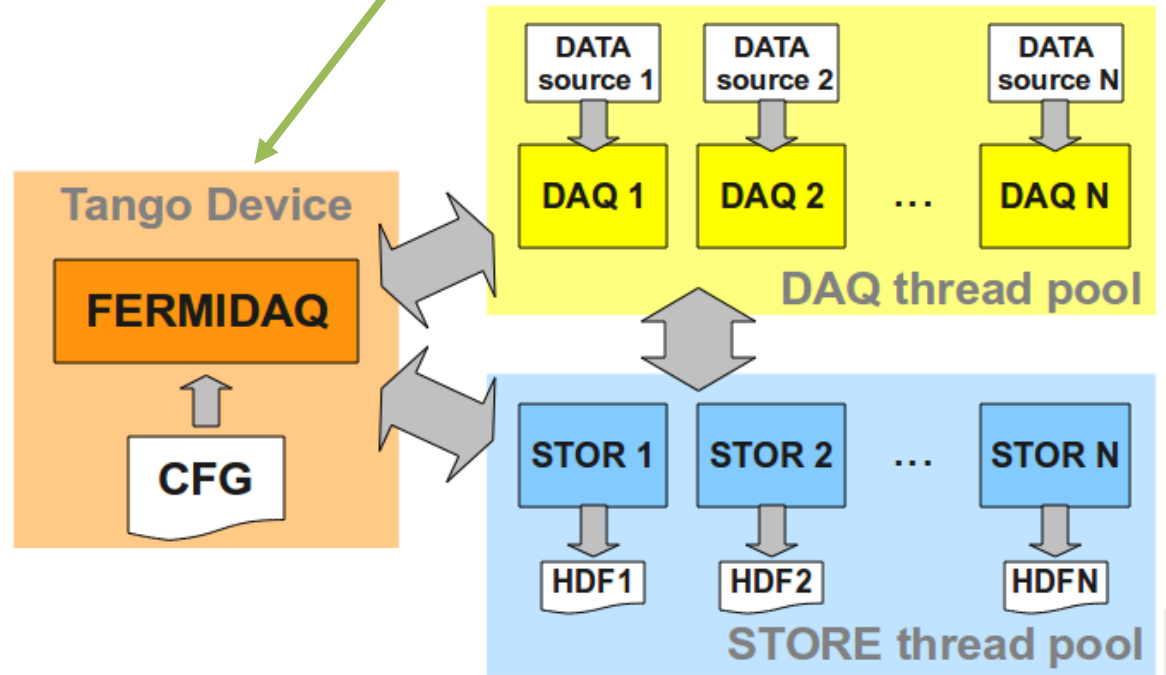


DAQ main components



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.





The screenshot shows a web application window titled "User Login". It features the Elettra Sincrotrone Trieste logo and a yellow header with the text "User Login". Below the header, there are two input fields: "Username" containing "emiliano.principi" and "Password" containing "*****". A "LOGOUT" button is positioned to the right of the password field. Below the login fields, the text "Logged In" is displayed. On the left, there is a table titled "Investigations" with a scrollable list of entries. On the right, there is a section titled "Active Investigation" with a dropdown menu showing "20139031" and two buttons: "New" and "Start".

	Investigations
3	20129014
4	20129024
5	20129030
6	20134039
7	20139025
8	20139031

Active Investigation: 20139031


Buttons: New, Start

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

EIS-TIMEX CONTINUOUS DAQ

Continuous Mode | Pump-Probe Mode | Raster P-P Mode


FermiDaq Status
STANDBY

Project: 20139031 Experiment: CuGeO3 DataSet: 39

START ● **STOP**

The device is in OFF state.

Data log message:

```

10:12:56 Data acquired
10:13:47 Data acquired
10:14:40 Data acquired
10:15:32 Data acquired
10:16:25 Data acquired
10:17:19 Data acquired
10:18:14 Data acquired
10:18:21 Aborting Script...
10:18:21 Aborted
          
```

Shots/File: 500 Acq. N files: 500

Background Shots: 0

Close Shutter On End

File sequence threshold: 5

Enable Fermi Decimation

Fermi Shots: 1

Fermi Blanks: 49

Fermi decimation status: OFF

Variable Scan Mode

Wavelength Scan Begin: 21.4000

Wavelength Scan End: 20.7500

Wavelength Scan Step: 0.0700

Graphical views

Spectrometer_hor_profile

BunchNumber: 725085775

Seed Laser Sync: False

UseFelShutter

Simulation

PADRES_SHUTTER

OPENED OPEN CLOSE

PADRES_VALVE2

OPENED OPEN CLOSE

TIMEX FEL SHUTTER

UNKNOWN OPEN CLOSE

TIMEX SLU SHUTTER

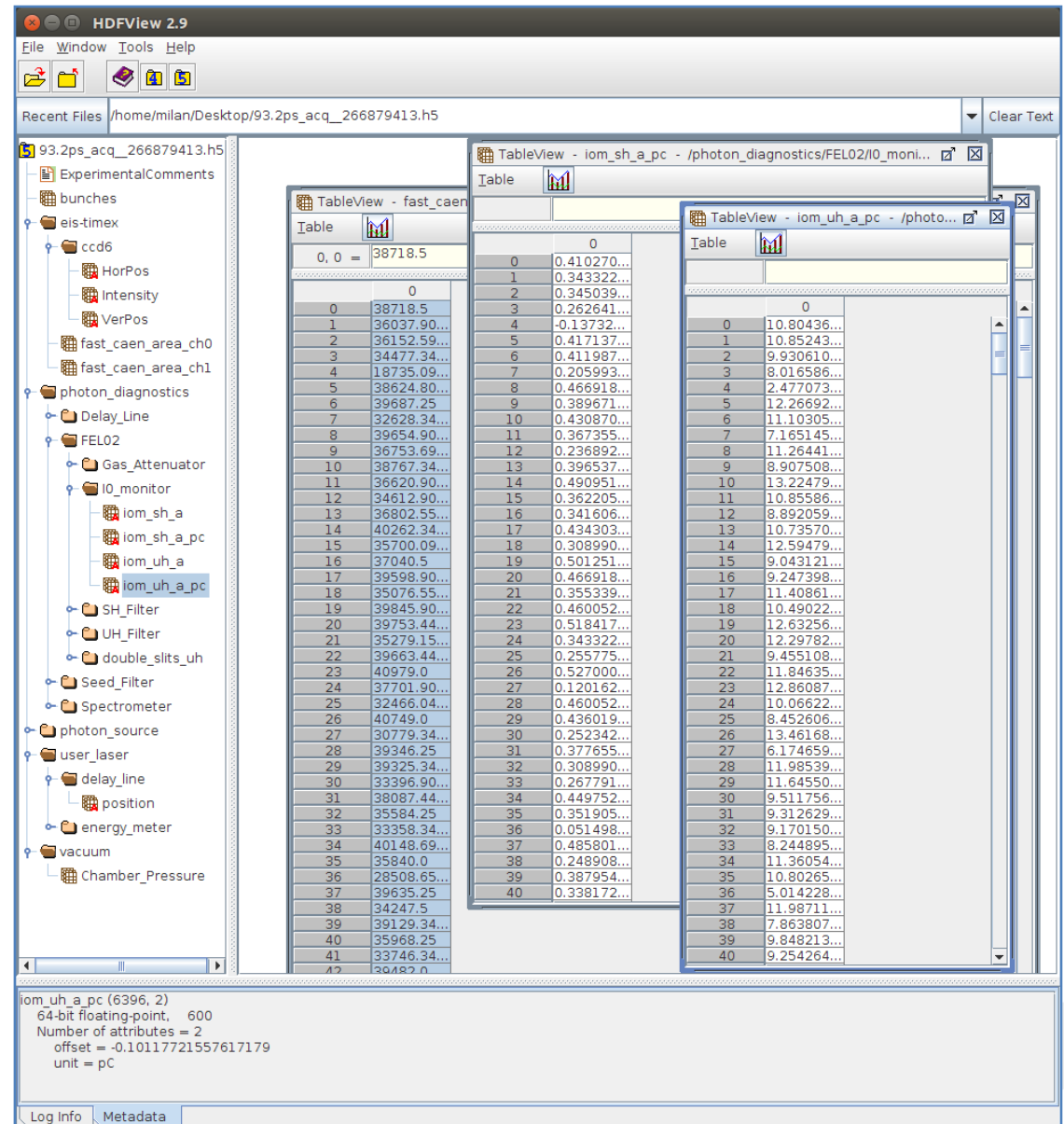
OPENED OPEN CLOSE

EndStation	user_laser	photon_diagnostics	Status
<input type="checkbox"/> eis-timex/caen_area_ch0			OFF
<input checked="" type="checkbox"/> eis-timex/caen_area_ch1			OFF
<input type="checkbox"/> eis-timex/caen_area_ch2			OFF
<input type="checkbox"/> eis-timex/caen_area_ch3			OFF
<input type="checkbox"/> eis-timex/caen_area_ch4			OFF
<input type="checkbox"/> eis-timex/caen_area_ch5			OFF
<input type="checkbox"/> eis-timex/caen_area_ch6			OFF
<input type="checkbox"/> eis-timex/caen_area_ch7			OFF
<input type="checkbox"/> eis-timex/caen_ch0			OFF
<input checked="" type="checkbox"/> eis-timex/caen_ch1			OFF
<input type="checkbox"/> eis-timex/caen_ch2			OFF
<input type="checkbox"/> eis-timex/caen_ch3			OFF
<input type="checkbox"/> eis-timex/caen_ch4			OFF
<input type="checkbox"/> eis-timex/caen_ch5			OFF
<input type="checkbox"/> eis-timex/caen_ch6			OFF
<input type="checkbox"/> eis-timex/caen_ch7			OFF
<input type="checkbox"/> eis-timex/ccd3/HorPos			FAULT
<input type="checkbox"/> eis-timex/ccd3/image8			FAULT
<input type="checkbox"/> eis-timex/ccd3/Intensity			FAULT
<input type="checkbox"/> eis-timex/ccd3/VerPos			FAULT
<input type="checkbox"/> eis-timex/ccd6/HorPos			OFF
<input type="checkbox"/> eis-timex/ccd6/image8			OFF
<input type="checkbox"/> eis-timex/ccd6/Intensity			OFF
<input type="checkbox"/> eis-timex/ccd6/VerPos			OFF
<input type="checkbox"/> eis-timex/fast_caen_area_ch0			OFF
<input type="checkbox"/> eis-timex/fast_caen_area_ch1			OFF
<input type="checkbox"/> eis-timex/fast_caen_ch0			OFF
<input type="checkbox"/> eis-timex/fast_caen_ch1			OFF

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

HDF5 structure is custom at each beamline

Configuration is XML based



The screenshot shows the HDFView 2.9 interface. On the left is a tree view of the HDF5 file structure. The main area displays three 'Table' windows, each showing a list of numerical values. The bottom status bar shows metadata for the selected 'iom_uh_a_pc' group.

TableView - fast_caen

0	38718.5
1	36037.90...
2	36152.59...
3	34477.34...
4	18735.09...
5	38624.80...
6	39687.25
7	32628.34...
8	39654.90...
9	36753.69...
10	38767.34...
11	36620.90...
12	34612.90...
13	36802.55...
14	40262.34...
15	35700.09...
16	37040.5
17	39598.90...
18	35076.55...
19	39845.90...
20	39753.44...
21	35279.15...
22	39663.44...
23	40979.0
24	37701.90...
25	32466.04...
26	40749.0
27	30779.34...
28	39346.25
29	39325.34...
30	33396.90...
31	38087.44...
32	35584.25
33	33358.34...
34	40148.69...
35	35840.0
36	28508.65...
37	39635.25
38	34247.5
39	39129.34...
40	35968.25
41	33746.34...
42	30482.0

TableView - iom_sh_a_pc - /photon_diagnostics/FEL02/I0_moni...

0	0
1	0.410270...
2	0.343322...
3	0.345039...
4	-0.13732...
5	0.417137...
6	0.411987...
7	0.205993...
8	0.466918...
9	0.389671...
10	0.430870...
11	0.367355...
12	0.236892...
13	0.396537...
14	0.490951...
15	0.362205...
16	0.341606...
17	0.434303...
18	0.308990...
19	0.501251...
20	0.466918...
21	0.355339...
22	0.460052...
23	0.518417...
24	0.343322...
25	0.255775...
26	0.527000...
27	0.120162...
28	0.460052...
29	0.436019...
30	0.252342...
31	0.377655...
32	0.308990...
33	0.267791...
34	0.449752...
35	0.351905...
36	0.051498...
37	0.485801...
38	0.248908...
39	0.387954...
40	0.338172...

TableView - iom_uh_a_pc - /photo...

0	10.80436...
1	10.85243...
2	9.930610...
3	8.016586...
4	2.477073...
5	12.26692...
6	11.10305...
7	7.165145...
8	11.26441...
9	8.907508...
10	13.22479...
11	10.85586...
12	8.892059...
13	10.73570...
14	12.59479...
15	9.043121...
16	9.247398...
17	11.40861...
18	10.49022...
19	12.63256...
20	12.29782...
21	9.455108...
22	11.84635...
23	12.86087...
24	10.06622...
25	8.452606...
26	13.46168...
27	6.174659...
28	11.98539...
29	11.64550...
30	9.511756...
31	9.312629...
32	9.170150...
33	8.244895...
34	11.36054...
35	10.80265...
36	5.014228...
37	11.98711...
38	7.863807...
39	9.848213...
40	9.254264...

iom_uh_a_pc (6396, 2)
64-bit floating-point, 600
Number of attributes = 2
offset = -0.10117721557617179
unit = pC

- 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

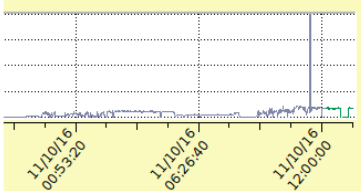
LogBook - LogBook_2016_10_11-12_11.html

File Edit Format Plugins About

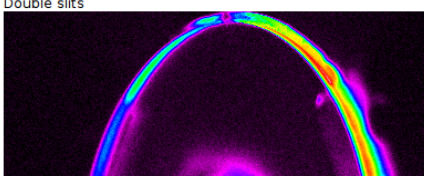
Esperimento Dell'Angela Ottobre 2016 --- proposal 20139031

Fermi Machine Status

RF plants		Seed laser	
status	<input type="text" value="On"/>	status	<input type="text" value="OPEN"/>
recovery time	<input type="text" value="0:00:00"/>	Lock status	<input type="text" value="Locked on Cross Correlator Signal"/>
E-beam Energy	<input type="text" value="1.37"/> GeV	Pulse energy	<input type="text" value="30.62"/> μ J
BC-1 / Energy	<input type="text" value="ON"/> <input type="text" value="0.28"/> GeV	Pulse length	<input type="text" value="130_fs"/>
BC-2 / Energy	<input type="text" value="OFF"/> <input type="text" value="0.70"/> GeV	Wave length	<input type="text" value="251.60"/> nm
Bunch Charge	<input type="text" value="706.46"/> pC	FEL-1	
		Harmonic	<input type="text" value="14.00"/>
		Wavelength[nm]	<input type="text" value="17.97"/>
		Polarization	<input type="text" value="Linear vertical"/>
		FEL-1 I₀ monitor	

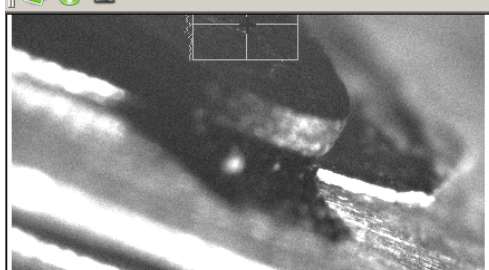


Double slits



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
```



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_HeEn](#)

Investigation details	
Name:	20124009
Description:	20124009
<i>Max 400 characters</i>	
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

Browser, WebDAV, GridFTP

VUO - Experiment

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

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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_HeEn](#) / [Xe](#) / [test](#)



Experiment details	
Name:	He_10_bar_1s5p
Description:	He_10_bar_1s5p
<i>Max 400 characters</i>	

[\[Edit\]](#)

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

- 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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