

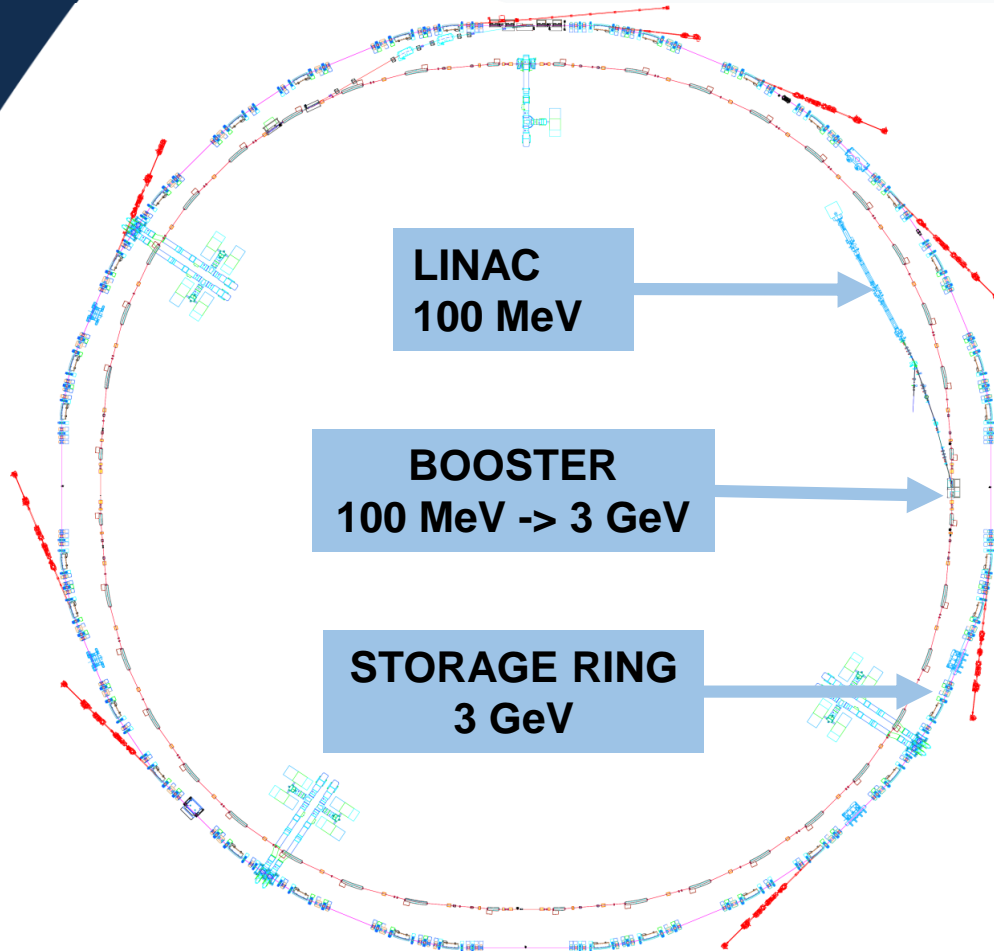


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J.Rio, M.Rodriguez, O.Serres, M.Sos and D.Yépez

# **Control tools developed by the ALBA Synchrotron Operators**

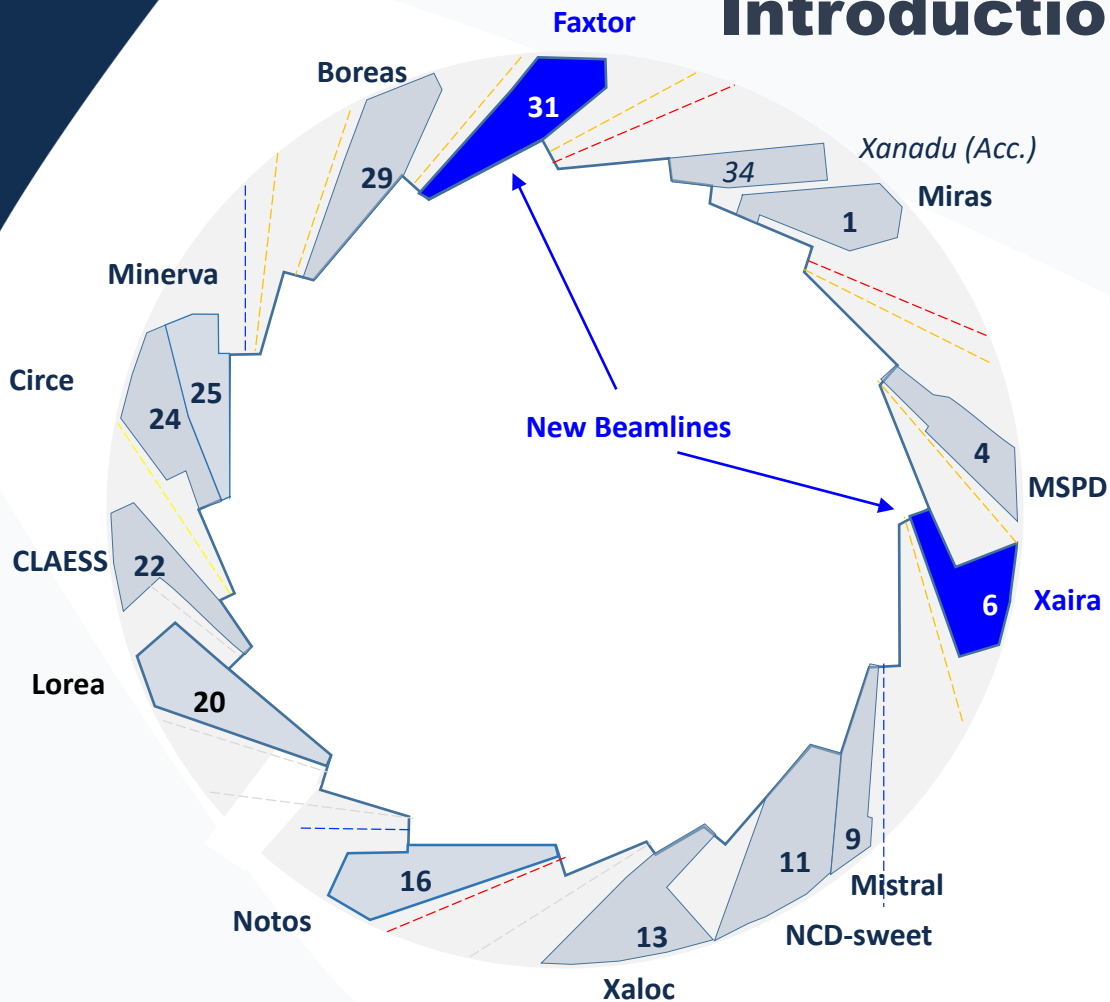
WAO2023

# Introduction



Parameter	Value
Energy	3 GeV
Circumference	268.8 m
Emittance	4.5 nm·rad
Current	250 mA
Rf frequency	500 MHz
# cavities	6
Long straights	4 (8 m)
Medium straights	12 (4 m)

# Introduction

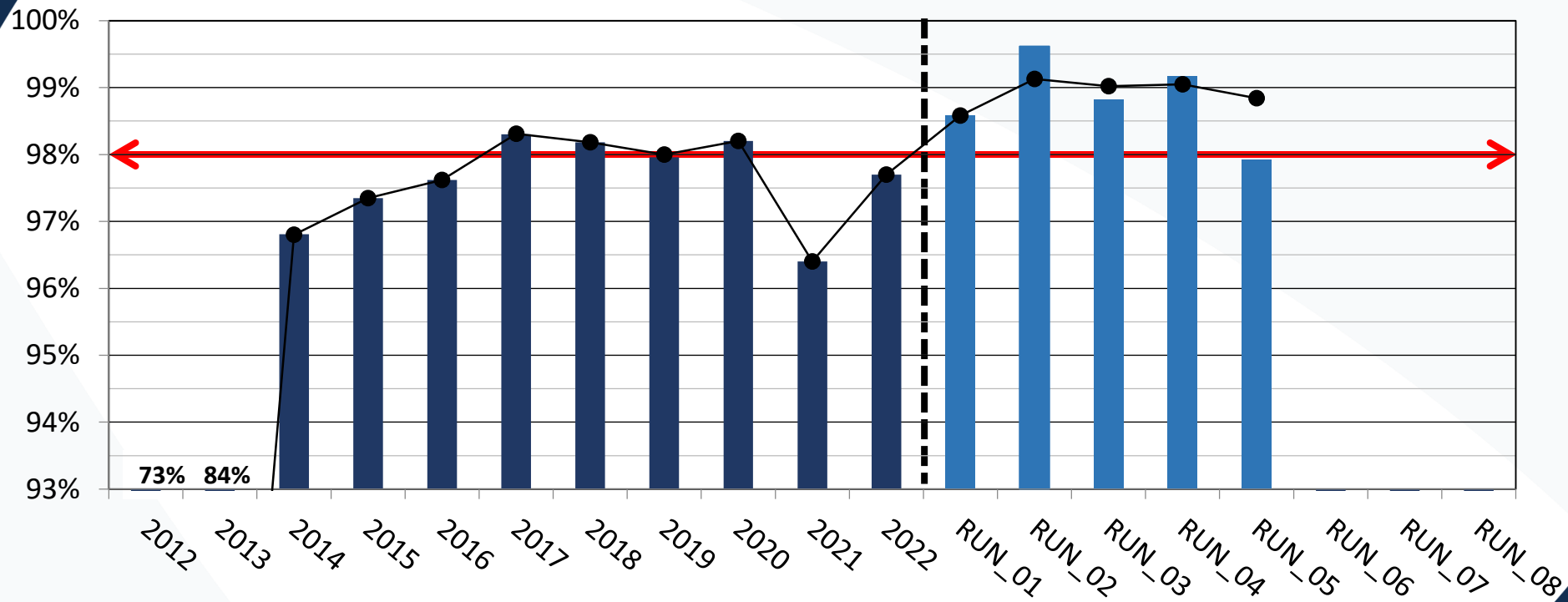


- Operating for users since 2012
- 5650h/year
  - 4500h for users
  - 1150h for machine
- Operating 11 beamlines
- Building/commissioning 2 new ones

# Introduction

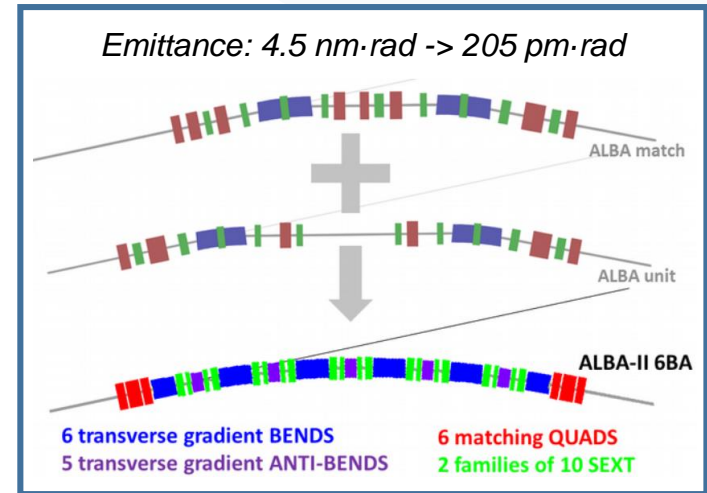
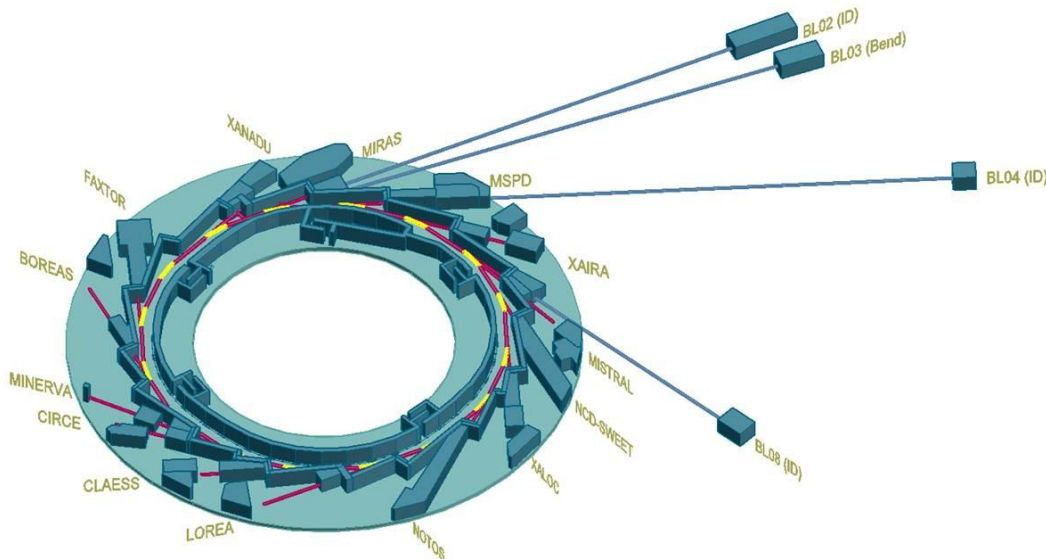


Beam availability\_2023 : 98.84%



# Introduction

- **ALBA II project:** Storage Ring upgrade + Long Beamlines + Data acq. + ...
  - Same injector and present Beamlines position
- Authorities commitment (New land plot + 7.5M€ for prototypes)
- Installation 2030 -> Commissioning 2031



# Introduction



- The ALBA Accelerator Operators
  - 8 operators (1 operator/shift)
  - 50% On Shift // 50% “office”
  - 20% Machine days // 80% Beamlines days



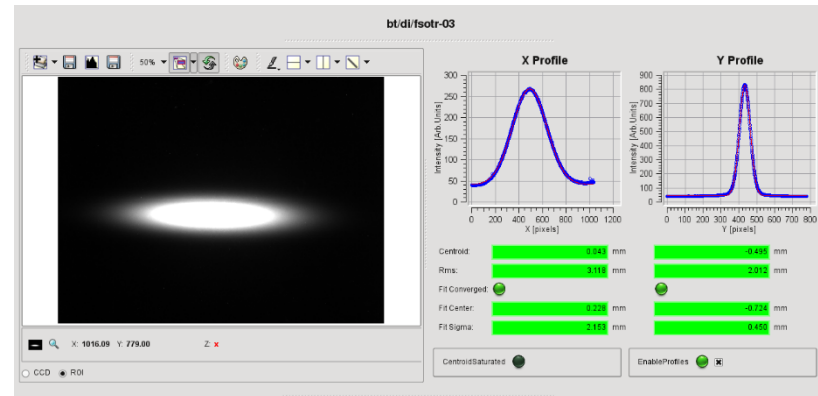
Time for other duties



- Projects related with Operation
- Each operator is assigned to a subsystem:
  1. Linac
  2. Pulsed elements
  3. Radiofrequency
  4. Diagnostics
  5. Controls
  6. PLCs
  7. Front Ends, Magnets & Insertion Devices
  8. Mechanical Designs

# Operators Control Tools

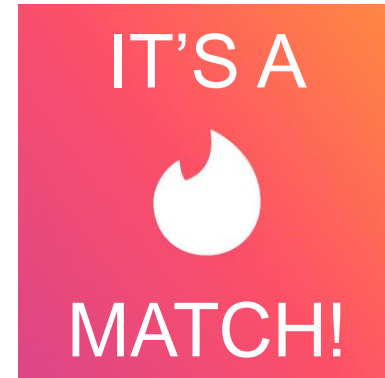
- ALBA is operating with users since 2012 (Commissioning in 2011)
- Controls group provided Control System (based on Tango) and Guided User Interfaces (GUIs) to operate the different subsystems, as well as the protection systems: Equipment Protection System (EPS) and Personal Safety System (PSS)



- Beam Dynamics took care of the Matlab Middle Layer; for commissioning tools and machine setup (LOCO, chromaticity, orbit correction,...)

# Operators Control Tools

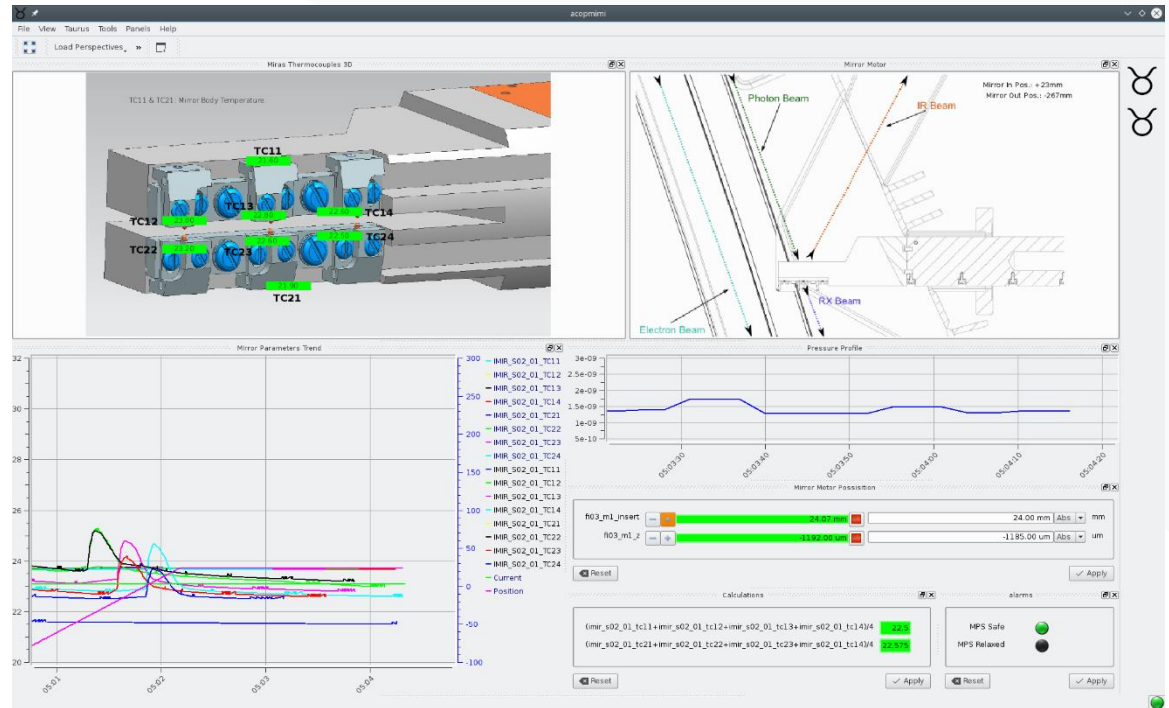
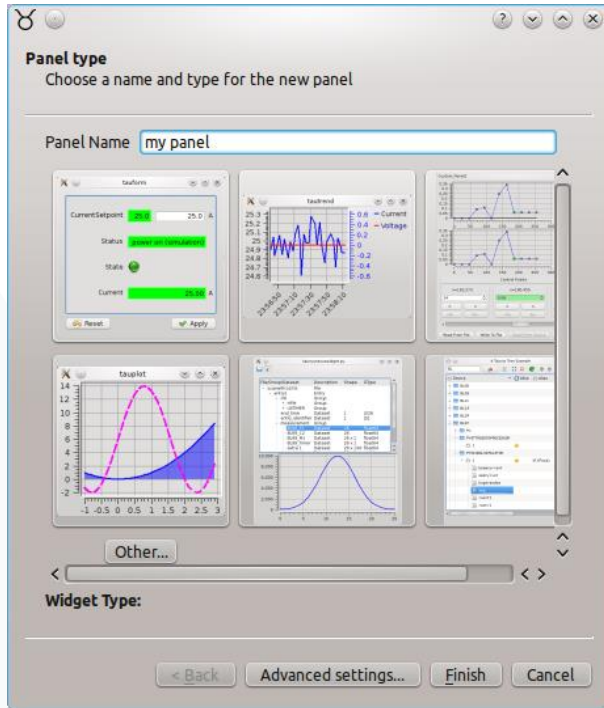
- As soon as the operation stabilized, Operators started asking for:
  1. “Simple” scripts for repetitive tasks/checks
  2. GUIs designed from our point of view
  
- But:
  1. Low priority requests
  2. Controls already at 100% workload
  3. Operators started to have time for projects





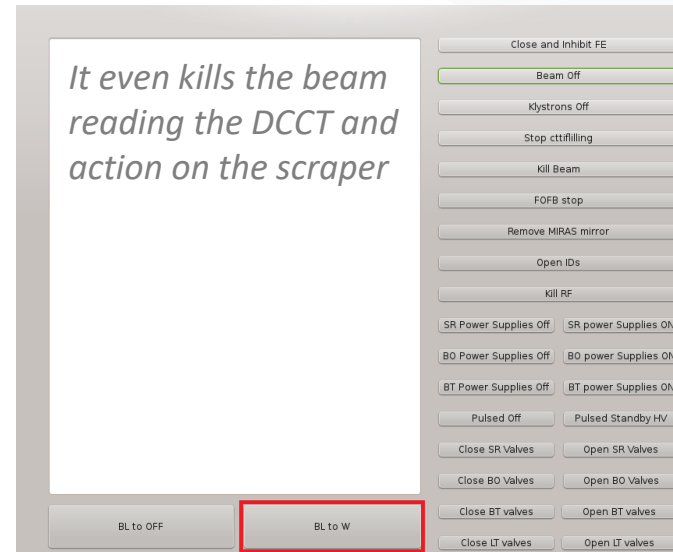
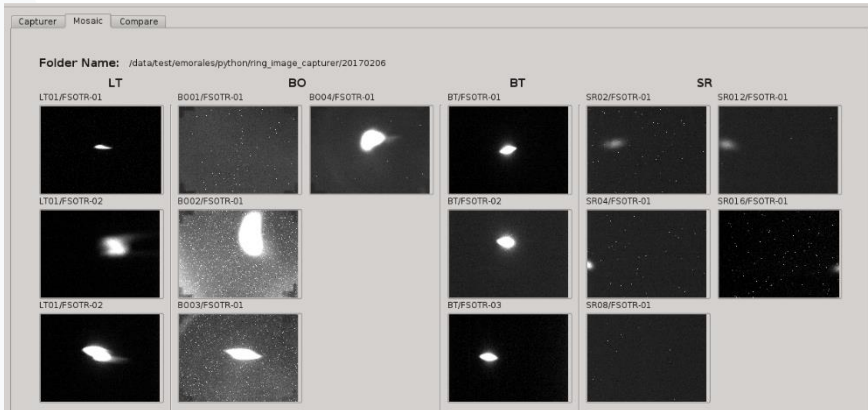
# Operators Control Tools

- Start writing scripts & creating GUIs with TaurusGui



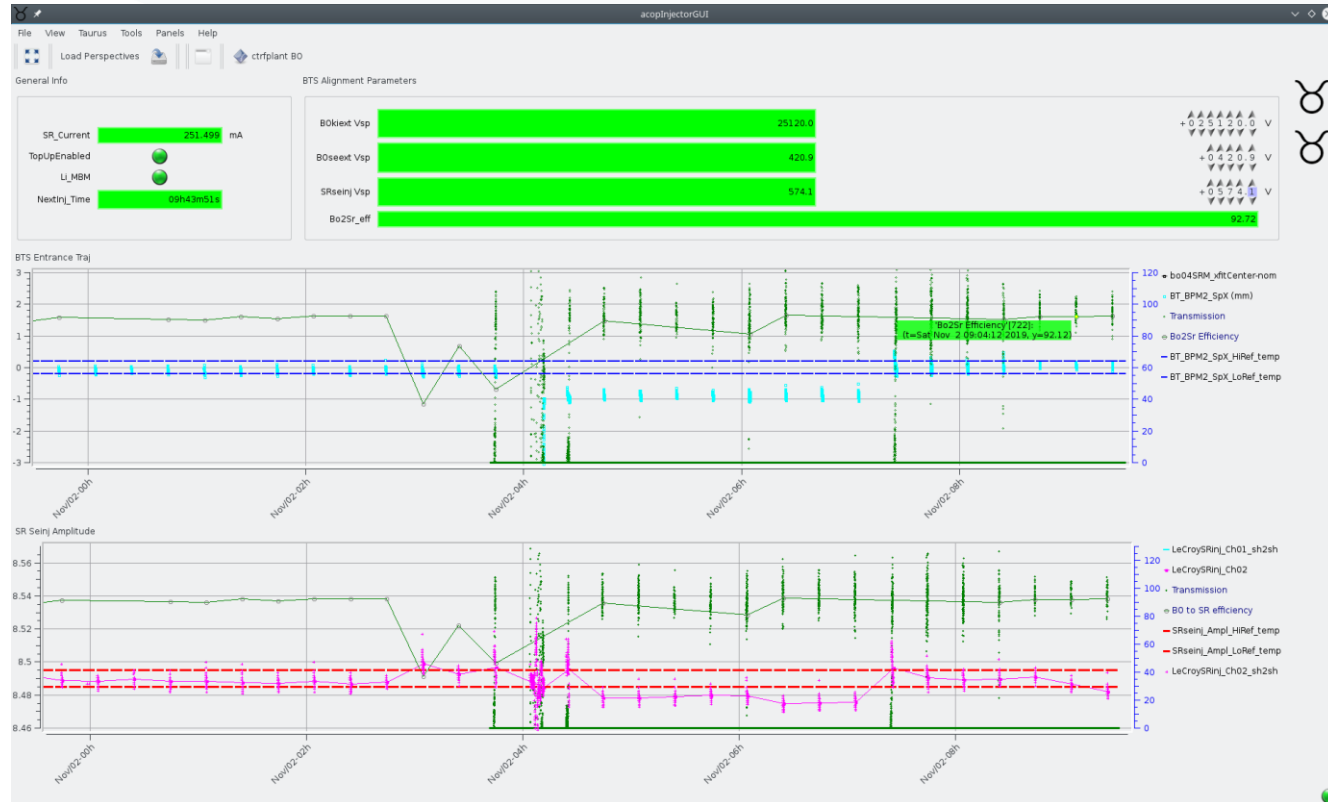
# GUIs for Operation

- Startup/Shutdown procedures checks & automatization
  - CheckFSS.py → Moves IN/OUT all Screens and Scrapers
  - RFcheck.py → Checks all LLRF parameters and suggests working pase
  - IDopen & IDclose
  - RingImageCapturer.py
- Shutdown GUI



# GUIs for Operation

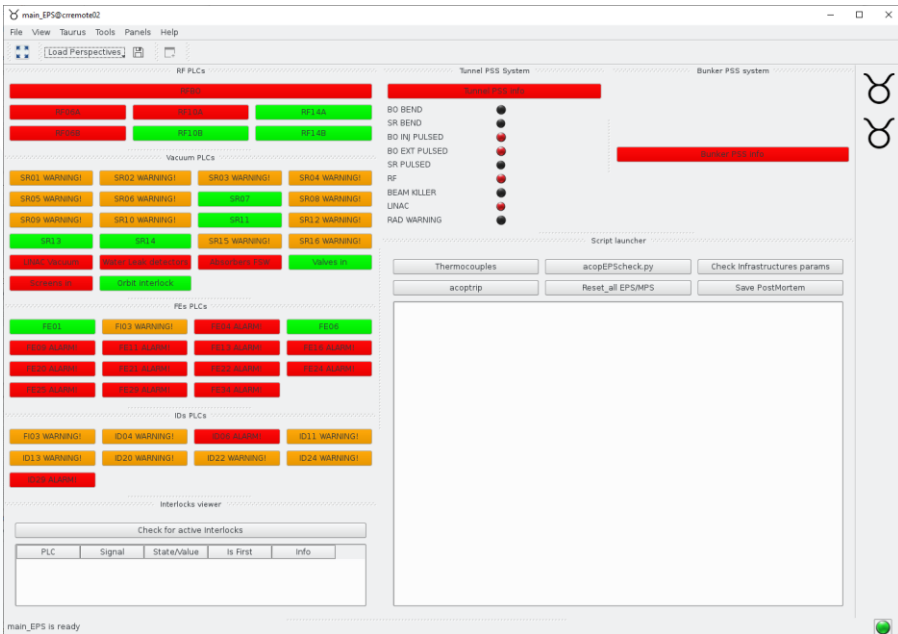
- TopUp stability related GUIs
- ✓ SR BPMs, temperatures, pressure,...
- ✓ Injection: efficiency, pulsed amplitude meas., transfer line BPMs,



# GUIs for Operation - Subsystems

- Equipment Protection System (EPS)

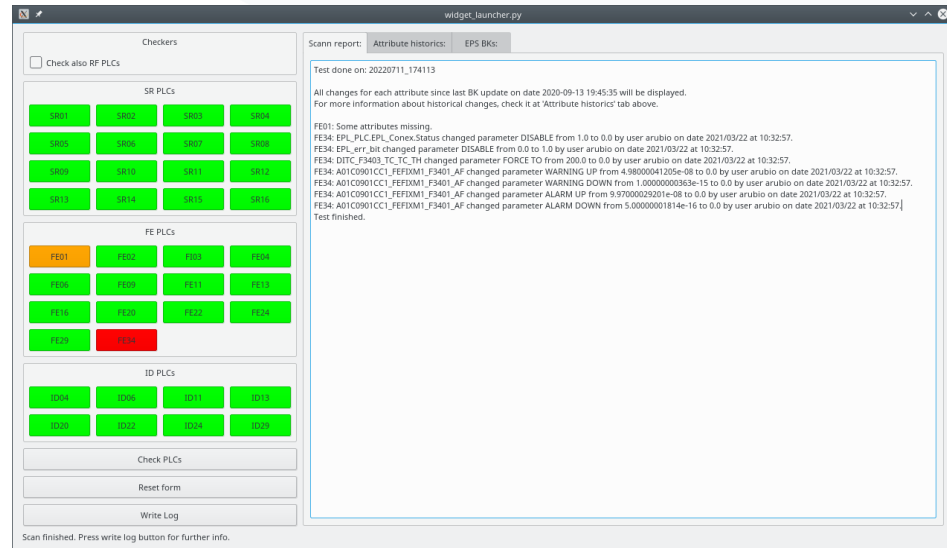
## EPS user GUI



The screenshot shows the main interface of the Equipment Protection System (EPS) user GUI. The window title is 'main\_EPS@cremate02'. The interface is divided into several sections:

- RF PLCs:** A grid of status indicators for RF PLCs, with some showing 'WARNING!' and others 'OK'.
- Vacuum PLCs:** A grid of status indicators for Vacuum PLCs, with some showing 'WARNING!' and others 'OK'.
- FE PLCs:** A grid of status indicators for FE PLCs, with some showing 'ALARM!' and others 'OK'.
- IDe PLCs:** A grid of status indicators for IDe PLCs, with some showing 'WARNING!' and others 'OK'.
- Interlocks viewer:** A section for checking active interlocks, with a table showing columns for PLC, Signal, State/Value, Is First, and Info.
- Tunnel PSS System:** A section showing system parameters and status indicators, including 'RF Beam Protection', 'RF', 'BEAM KILLER', 'LINAC', and 'RAD WARNING'.
- Bunker PSS system:** A section showing system parameters and status indicators, including 'Bunker PSS PLCs'.
- Script launcher:** A section with buttons for 'Thermocouples', 'acopEPsCheck.py', 'Check Infrastructures params', 'acoptrip', 'Reset\_all EPSPMS', and 'Save Postmortem'.

## EPS PLCs configuration check GUI



The screenshot shows the configuration check GUI for the EPS PLCs. The window title is 'widget\_launcher.py'. The interface is divided into several sections:

- Checkers:** A section with a checkbox for 'Check also RF PLCs'.
- SR PLCs:** A grid of status indicators for SR PLCs, with some showing 'WARNING!' and others 'OK'.
- FE PLCs:** A grid of status indicators for FE PLCs, with some showing 'ALARM!' and others 'OK'.
- ID PLCs:** A grid of status indicators for ID PLCs, with some showing 'WARNING!' and others 'OK'.
- Check PLCs:** A button to check PLCs.
- Reset form:** A button to reset the form.
- Write Log:** A button to write the log.
- Scan report:** A section showing the scan report, including the date and time of the scan, and a list of changes for each attribute since the last BK update.

# GUIs for Operation - Subsystems



- Power Converters

## PC checker

Verify Power Supplies LT-BO-BT-PULS      Status All Power Supplies

Power Supplies LT      Comparisons NO OK : 1

	Nombre	Jive	File
1	ro1jpc/bend-01	44.8	44.8
2	ro1jpc/bend-02	7.79	7.79
3	ro1jpc/corh-01	-0.35	-0.35
4	ro1jpc/corh-02	0.0	0.0
5	ro1jpc/corh-03	-0.1	-0.1
6	ro1jpc/corh-04	-0.1	-0.1
7	ro1jpc/corv-01	-0.15	-0.15
8	ro1jpc/corv-02	-0.15	-0.15
9	ro1jpc/corv-03	0.15	0.15
10	ro1jpc/corv-04	-0.07	-0.06
11	ro1jpc/q-01	-1.3	-1.3
12	ro1jpc/q-02	-0.77	-0.77
13	ro1jpc/q-03	1.32	1.32

Verify LT

Power Supplies BOMAIN      Comparisons NO OK : 3

	Nombre	Jive	File
1	bojpc/bend-1	-0.75	-0.905
2	bojpc/bend-2	-0.75	-0.9
3	bojpc/qh01	-0.08	-0.08
4	bojpc/qh02	-0.295	-0.291
5	bojpc/qv01	0.02	0.02
6	bojpc/qv02	-0.259	-0.259

Verify BOMAIN

Power Supplies SRMAIN      Comparisons NO OK : 8

	Nombre	Jive	File
1	srjpc/bend	516.1	516.1
2	srjpc/sh01	69.571	68.663
3	srjpc/sh02	125.134	124.437
4	srjpc/sh03	141.497	140.899
5	srjpc/sh04	102.723	102.001
6	srjpc/sv01	121.747	120.59
7	srjpc/sv02	110.183	108.371
8	srjpc/sv03	141.214	139.082
9	srjpc/sv04	137.625	134.72
10	srjpc/sv05	184.779	174.682
11	sr01jpc/qh01	128.625	128.625
12	sr01jpc/qh02	151.584	151.584
13	sr01jpc/qh03	132.921	132.921
14	sr01jpc/qh04	115.898	115.898
15	sr01jpc/qh05	146.373	146.373
16	sr01jpc/qh06	173.01	173.01
17	sr01jpc/qv01	146.326	146.326
18	sr01jpc/qv02	162.733	162.733
19	sr02jpc/qh07	168.716	168.716
20	sr02jpc/qh08	165.316	165.316
21	sr02jpc/qh09	165.668	165.668
22	sr02jpc/qh10	168.714	168.714
23	sr02jpc/qv03	159.791	159.791
24	sr02jpc/qv04	159.402	159.402
25	sr03jpc/qh07	168.343	168.343
26	sr03jpc/qh08	166.29	166.29
27	sr03jpc/qh09	166.237	166.237
28	sr03jpc/qh10	168.488	168.488
29	sr03jpc/qv03	157.821	157.821
30	sr03jpc/qv04	157.907	157.907
31	sr04jpc/qh01	129.093	129.093

Verify SRMAIN

Power Supplies BT      Comparisons NO OK : 1

	Nombre	Jive	File
1	btjpc/bend-01	160.0	160.0
2	btjpc/bend-02	160.0	160.0
3	btjpc/corh-01	0.6	0.6
4	btjpc/corh-02	-1.6	-1.6
5	btjpc/corh-03	-0.5	-0.5
6	btjpc/corh-04	-0.2	-0.2
7	btjpc/corv-01	1.0	1.0
8	btjpc/corv-02	-0.1	-0.1
9	btjpc/corv-03	0.4	0.4
10	btjpc/corv-04	0.5	0.7
11	btjpc/q-01	105.0	105.0
12	btjpc/q-02	150.61	150.61
13	btjpc/q-03	97.01	97.01

Verify BT

Power Supplies BOCOR      No differences

	Nombre	Jive	File
1	bo01jpc/corh-01	0.0	0.0
2	bo01jpc/corh-02	-0.07	-0.07
3	bo01jpc/corh-03	-0.16	-0.16
4	bo01jpc/corh-04	0.053	0.053
5	bo01jpc/corh-05	-0.035	-0.035
6	bo01jpc/corh-06	0.024	0.024
7	bo01jpc/corh-07	0.004	0.004
8	bo01jpc/corh-08	0.087	0.087
9	bo01jpc/corh-09	0.009	0.009
10	bo01jpc/corh-10	0.038	0.038
11	bo01jpc/corh-11	0.0	0.0
12	bo01jpc/corv-01	0.09	0.09
13	bo01jpc/corv-03	0.084	0.084

Verify BOCOR

Decimals Precision      Precision Compared (%)

3      0.5

Verify ALL (Power Supplies Saved with ctlauncher)

## PC cycler

acopCyclerGUI.py      TaurusTrend

LT BT SR main

Magnets

SR BEND      3      35      600

SR QUAD A      3      20      200

SR QUAD B      3      20      225

SR SEXT      3      25      215

None ALL      Load default

Start

Cycling status: Cycling finished OK

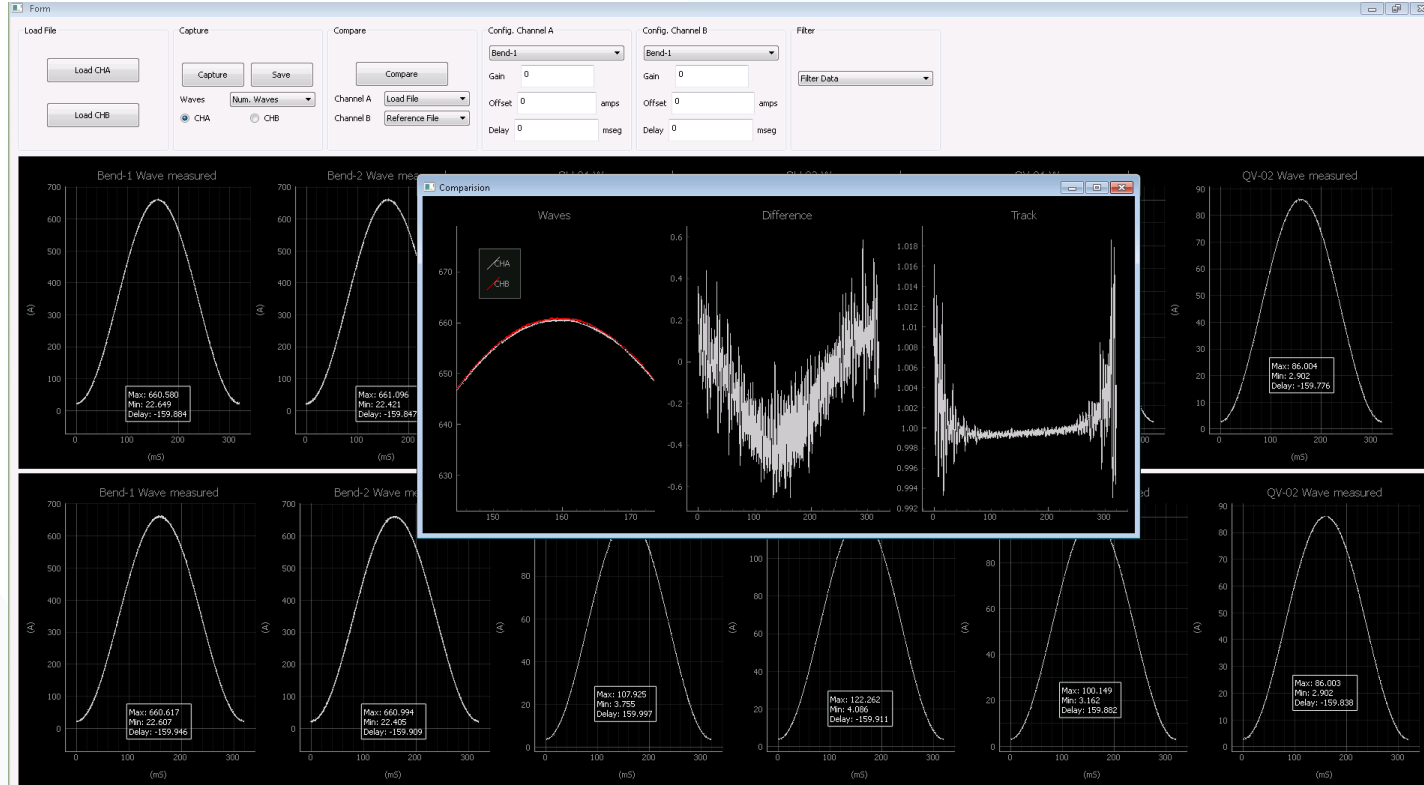
Show log       Show plot       Test mode

```

21h24:20 - Test mode disabled
21h24:20 - ***** START *****
21h24:20 - Starting time: 2020-01-20 21:24:20
21h26:13 - SR SEXT enabled
21h26:39 - All devices are ON
21h26:39 - Start to cycle the SR SEXT.
Cycling ongoing... (check terminal for more details)
21h28:17 - CYCLING FINISHED
21h28:17 - ***** CYCLING ERRORS *****
21h28:17 - No errors during cycling
    
```

# GUIs for Operation - Subsystems

- Power Converters – Measure and compare Booster PC

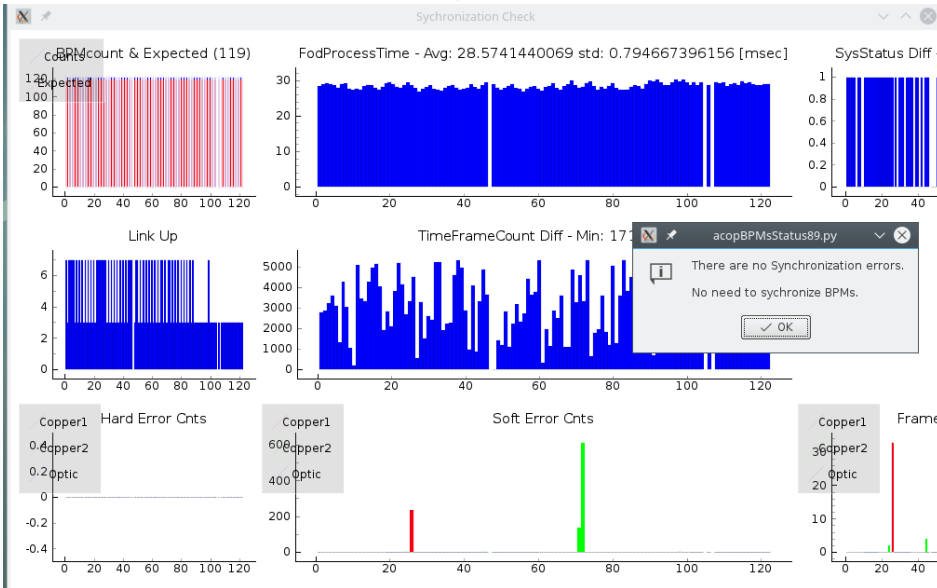


# GUIs for Operation - Subsystems

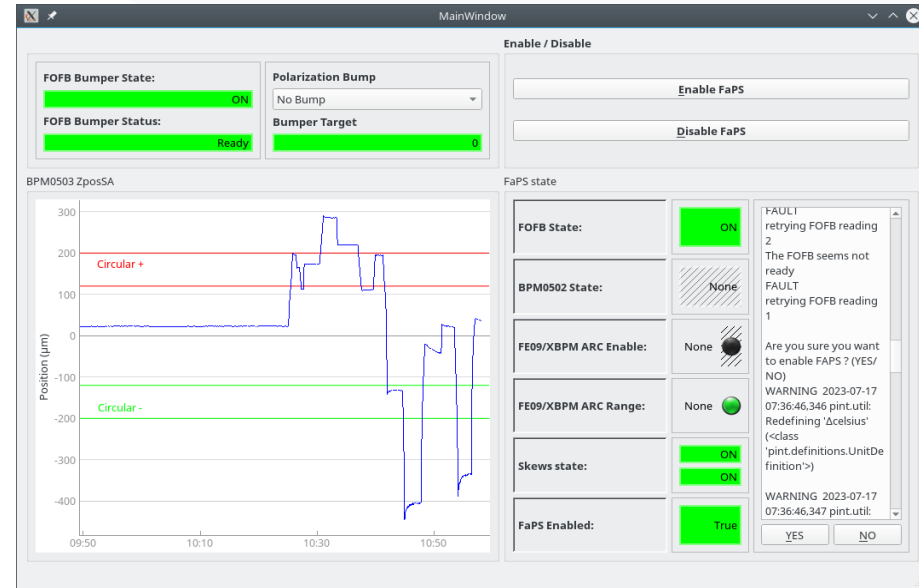


- Beam Position Monitors (BPMs)

## Check and synchronize BPMs



## Fast Polarization Switch (orbit bump)



# GUIs for Operation



- And many other GUIs...
  - **Check FE** → check XBPM position at FE + neighboring SR corr. & compares to other dates
  - **Trip Info** → collects data from timing, RF status as first response after beam trip
  - **Frequency hunter** → takes data from BPMs Fast Archiver, FFTs, follow peaks,...
  - **Save Post Mortem** → Connects and downloads all postmortem data from BPMs
  - **Bump & Tune** → Monitors at every injection the beam distortion (bump closure) and tune
  - **Plot Data** → Access to archived data for plotting with advanced features like filtering
  - **Statistics** → Chron script that computes statistics from DCCT data



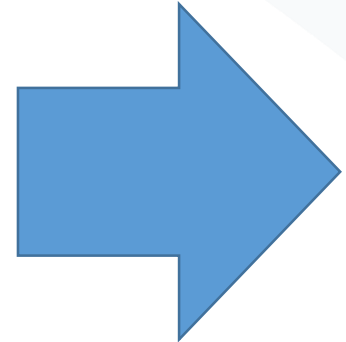
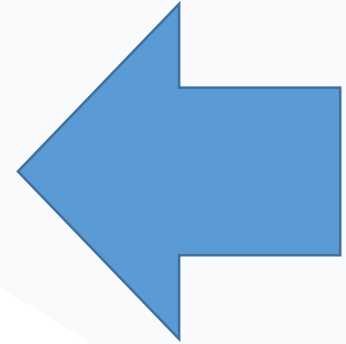
# Other contributions



- We do with limited functioning devices (tango composers and processors)
  - Create our own attributes calculated from other attributes
- We write communication functions with oscilloscopes
- We work with “Sardana macros”; mainly cron scripts that collect data at every injection.
- Support to Accelerators scientists regarding data acquisition and devices control
  
- Two operators are giving support to Controls and PLCs groups
  - Difficult to get involved due to the shiftwork

# Coordination with Controls

- They teach
  - How to create Taurus GUIs
  - How to create/edit PANIC alarms
  - Python course for beginners
- Hotline for doubts on programming or interacting with devices
- Programming skilled operator contributing to Control tools
- Keep track and report failures of the Control System
- *The more we know, the less we call them*



**Thanks on behalf of the  
Accelerator Operations team**