

MAXIN

The image shows the word "MAXIN" in a bold, grey, sans-serif font. A bright yellow, curved swoosh underline starts under the 'M', loops under the 'A' and 'X', and ends under the 'N'. The swoosh has a slight curve and a small loop at the top.

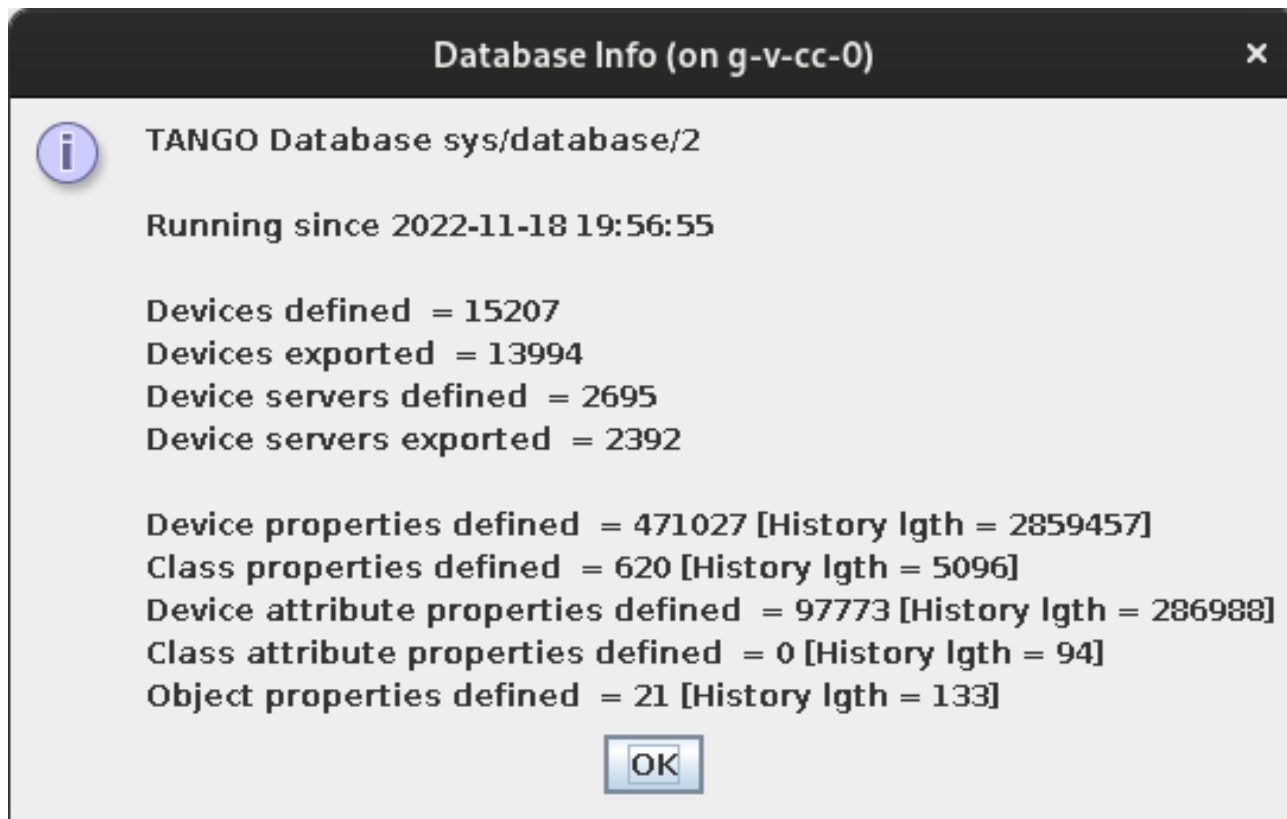


GUI development at MAX IV

Antonio Bartalesi

Overview – control system

- 16 Beamlines (1 TangoDB each) \approx 12500 Tango Devices
- 2 Linac and storage rings (1 TangoDB) \approx 15000 Tango Devices

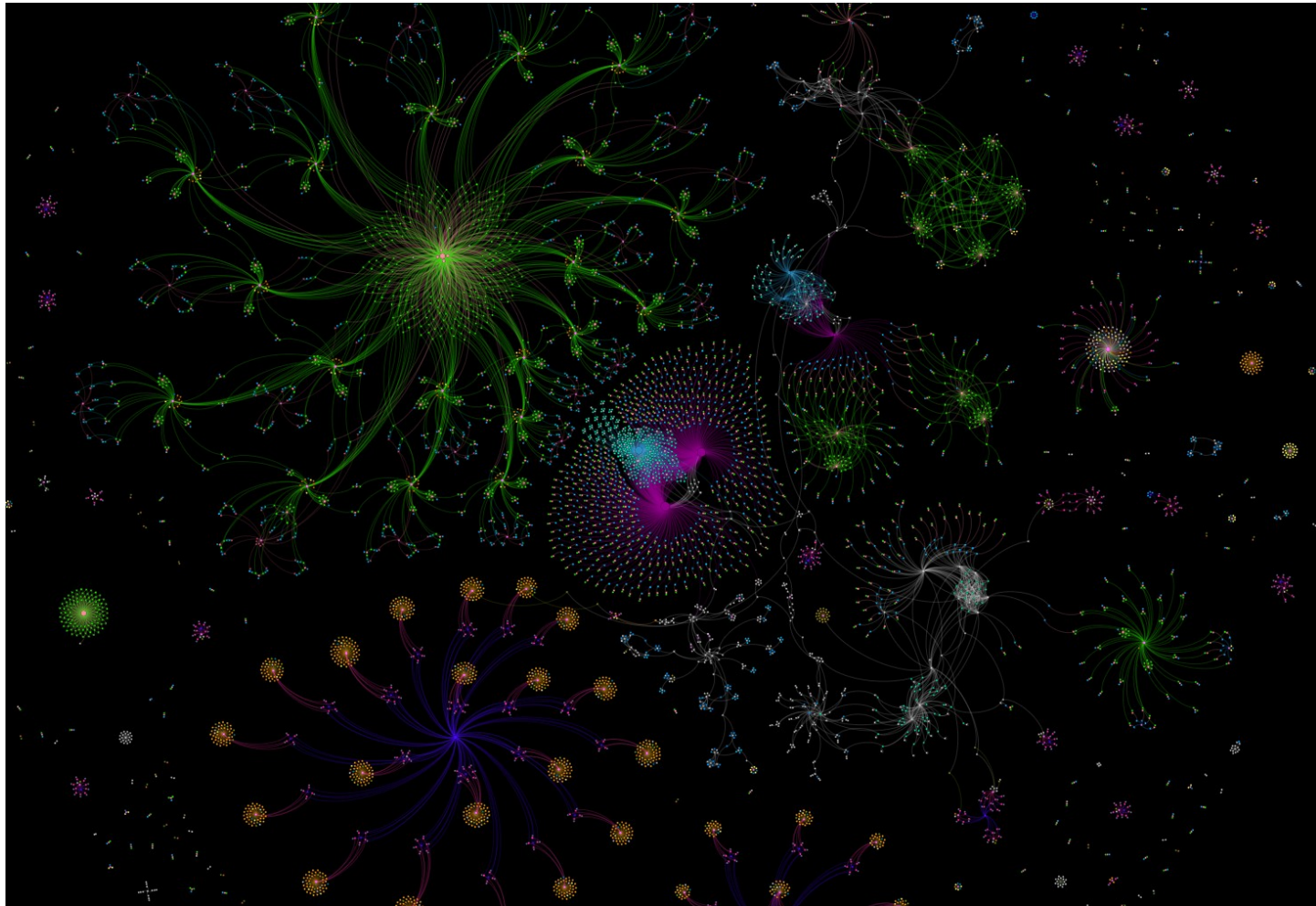


The screenshot shows a window titled "Database Info (on g-v-cc-0)" with a close button (X) in the top right corner. The window contains the following information:

- TANGO Database** sys/database/2
- Running since 2022-11-18 19:56:55
- Devices defined = 15207
- Devices exported = 13994
- Device servers defined = 2695
- Device servers exported = 2392
- Device properties defined = 471027 [History lgth = 2859457]
- Class properties defined = 620 [History lgth = 5096]
- Device attribute properties defined = 97773 [History lgth = 286988]
- Class attribute properties defined = 0 [History lgth = 94]
- Object properties defined = 21 [History lgth = 133]

An "OK" button is located at the bottom center of the window.

A picture of the control system



Courtesy of Johan Forsberg,
repo <http://kits-maxiv.gitlab-pages.maxiv.lu.se/web/tango-graph-maxiv/>

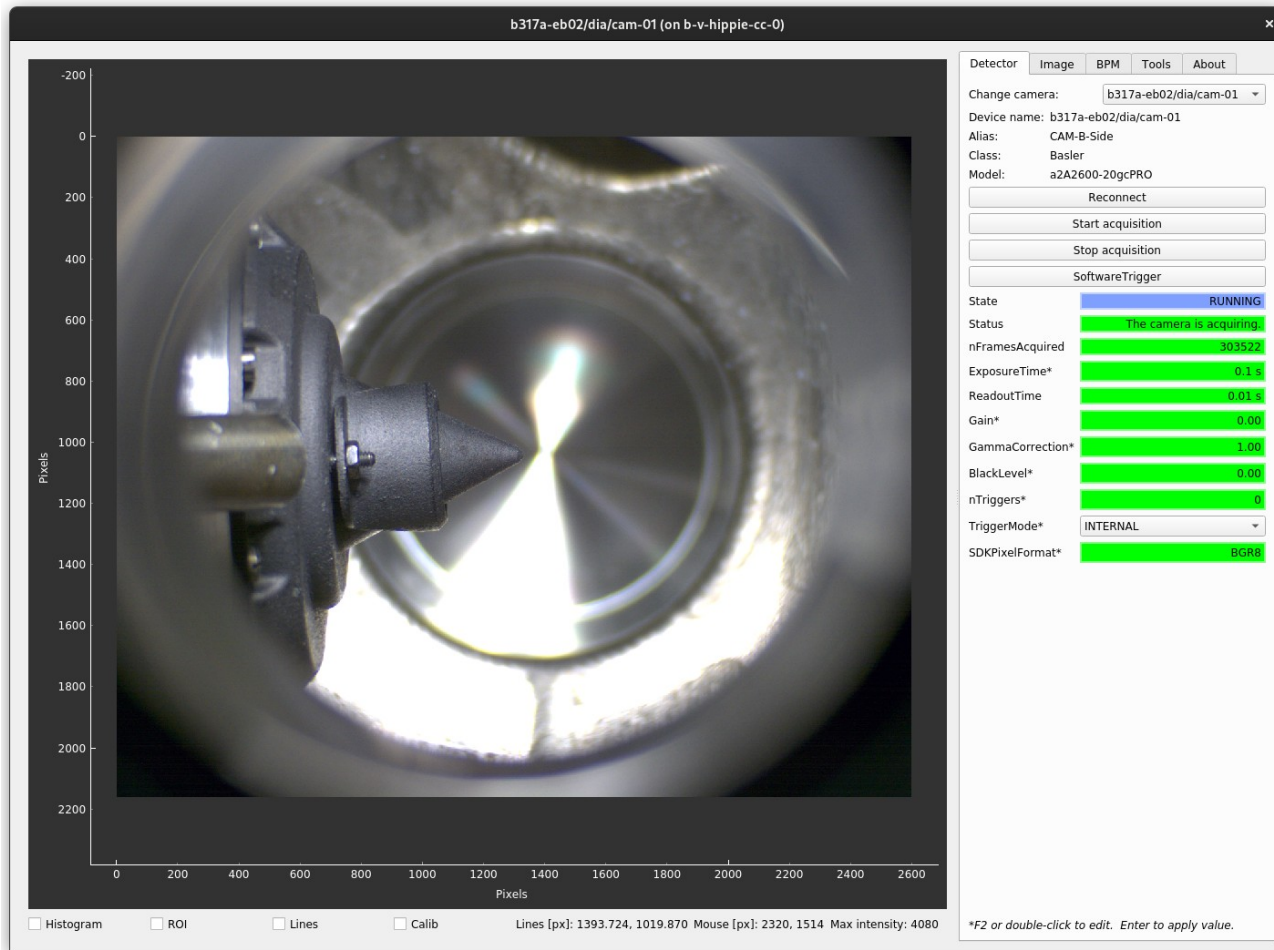
GUI catalogue

- 114 different standalone GUIs (in Ansible catalogue)
- An estimated 25 GUIs maintained by the beamline staff

How to categorize them? An idea:

- Single purpose GUIs (camera, stategrid...)
- Simple but crowded (many simple tags)
- Synoptics

Categorizing GUIs: Specialized



Luxviewer:

- Controls camera
- Basic image processing
- Requires good performance

Categorizing GUIs: Specialized

StateGrid 3 GeV ring (on g-v-cc-0)

| 3 GeV ring | | | | | | | | | | | | | | | | | | |
|------------|-------------|--------------|--------------|----------------|--------|----------|---------|-------|---------|---------|---------|---------|-------------|-----|---------|---------|-------|-----|
| | VAC R Pumps | VAC R Valves | VAC FE Pumps | VAC FE Inserts | VAC FE | VAC VGFA | MAG | RF | TIM | DIA | DIA TCO | DIA BPM | DIA Inserts | CTL | WAT | ID | MPS | PSS |
| 301 | ON | OPEN | | | | | NA | ALARM | ON | NA | ON | ON | ON | OFF | ON | | ALARM | |
| 302 | ON | OPEN | ON | CLOSE | | | ON | | ON | | ON | ON | | OFF | ON | | ALARM | |
| 303 | ON | OPEN | ON | OPEN | CLOSE | OPEN | ON | | ON | | ON | ON | | OFF | ON | RUNNING | ON | |
| 304 | ON | OPEN | ON | OPEN | CLOSE | OPEN | ON | | ON | | ON | ON | | OFF | ON | RUNNING | ON | |
| 305 | ON | OPEN | ON | CLOSE | | | ON | | ON | | ON | ON | | OFF | ON | | ON | |
| 306 | ON | OPEN | ON | CLOSE | | | ON | | ON | | ON | ON | | OFF | ON | | ON | |
| 307 | ON | OPEN | ON | CLOSE | | | ON | | ON | | ON | ON | | OFF | ON | | ON | |
| 308 | ON | OPEN | ON | OPEN | CLOSE | OPEN | ON | | ON | | ON | ON | | OFF | ON | RUNNING | ON | |
| 309 | NA | OPEN | ON | OPEN | | | ON | | ON | | ON | ON | | OFF | ON | | ON | |
| 310 | ON | OPEN | ON | OPEN | CLOSE | OPEN | MOVING | | ON | | ON | ON | | OFF | ON | RUNNING | ALARM | |
| 311 | ON | OPEN | ON | OPEN | CLOSE | OPEN | ON | | ON | | ON | ON | ON | OFF | ON | RUNNING | ON | |
| 312 | NA | OPEN | ON | CLOSE | | | ON | | ON | | ON | ALARM | | OFF | ON | | ON | |
| 313 | FAULT | OPEN | ON | CLOSE | | | ON | | ON | | ON | ON | | OFF | UNKNOWN | | ON | |
| 314 | ON | OPEN | ON | CLOSE | | | ON | | ON | | ON | ON | | OFF | ON | | ON | |
| 315 | ON | OPEN | ON | CLOSE | | | ON | | ON | | ON | ON | | OFF | ON | | ALARM | |
| 316 | ON | OPEN | ON | OPEN | CLOSE | OPEN | ON | ON | ON | | ON | ON | | OFF | ON | RUNNING | ON | |
| 317 | ON | OPEN | ON | OPEN | CLOSE | OPEN | ON | ON | ON | | ON | ON | | OFF | ON | RUNNING | ON | |
| 318 | ON | OPEN | ON | OPEN | CLOSE | OPEN | ON | ON | ON | | ON | ON | | OFF | ON | RUNNING | ON | |
| 319 | ON | OPEN | ON | CLOSE | | | ON | ON | ON | STANDBY | ON | ON | | OFF | ON | | ON | |
| 320 | ON | OPEN | ON | CLOSE | | | ON | ALARM | ON | RUNNING | ON | ON | | OFF | UNKNOWN | | ALARM | |
| PLC | | RUNNING | | | | | RUNNING | | | | | | | | RUNNING | RUNNING | | |
| Alarm | | | | | | | ALARM | | | | | | | | | | ALARM | ON |
| Global | | | | | | | | | UNKNOWN | | | ON | | | ALARM | | | |

Stategrid: unique task, unique look and features



Categorizing GUIs: Simple but Crowded

lrfExpertGUI_R1 (on g-v-cc-0)

File View Taurus Tools Panels Help

Load Perspectives

IqLoopsSettings

| | RF Chain A | | RF Chain B | |
|---------------------------------|-------------|-------------|------------|------------|
| | Write | Read Back | Write | Read Back |
| Amplitude Loop [0,1000] mV | 204.00 mV | 203.99 mV | 193.00 mV | 192.99 mV |
| Phase Loop [0, 360] (°) | -160.00 deg | -160.00 deg | 5.00 deg | 5.00 deg |
| Voltage Increase Rate (mV/s) | 4 | 4 | 4 | 4 |
| Phase Increase Rate (degrees/s) | 6 | 6 | 6 | 6 |
| AmpRefMin [0,1000] mV | 30.00 mV | 30.00 mV | 40.00 mV | 40.00 mV |
| PhaseRefMin (°) | 45.00 deg | 45.00 deg | 45.00 deg | 45.00 deg |
| PLimit [0, 1000] (mV) | 400.00 | 400.01 | 350.00 | 349.98 |
| Slow IQ Loop - Ki [0, 32767] | 20.00 | 20.00 | 20.00 | 20.00 |
| Slow IQ Loop - Kp [0, 8] | 0.00 | 0.00 | 0.00 | 0.00 |
| Quadrant [1st, 2nd, 3rd, 4th] | 1 | 1 | 1 | 1 |
| Look Reference | OFF | False | OFF | False |
| Slow IQ Loops Enable | ON | True | ON | True |
| Slow IQ Loops Input | 0 | 0 | 0 | 0 |
| Gain OL = k * CL [0.5, 2] | 0.88 | 0.88 | 1.02 | 1.02 |
| Phase shift ADCs Enable | ON | True | ON | True |
| Phase shift Cav [0°, 360°] | 47.00 deg | 47.00 deg | -42.00 deg | -42.00 deg |
| Phase shift FwTet1 [0°, 360°] | 0.00 deg | 0.00 deg | 0.00 deg | 0.00 deg |
| Phase shift FwTet2 [0°, 360°] | 0.00 deg | 0.00 deg | 0.00 deg | 0.00 deg |
| Phase shift FwCirc [0°, 360°] | 0.00 deg | 0.00 deg | 0.00 deg | 0.00 deg |
| Phase shift FwCav [0°, 360°] | 0.00 deg | 0.00 deg | 0.00 deg | 0.00 deg |
| Phase shift DACs Enable | ON | True | ON | True |
| Phase shift Tetrode1 [0°, 360°] | 0.00 deg | 0.00 deg | 0.00 deg | 0.00 deg |
| Phase shift Tetrode2 [0°, 360°] | 0.00 deg | 0.00 deg | 0.00 deg | 0.00 deg |
| Gain Tetrode1 [0.01, 2] | 1.00 | 1.00 | 1.00 | 1.00 |
| Gain Tetrode2 [0.01, 2] | 1.00 | 1.00 | 1.00 | 1.00 |
| # filter stages | 0 | 0 | 0 | 0 |
| # samples to average | 0 | 0 | 0 | 0 |

Diagdc

Amp and Phase Loop

| | RF Chain A | | | | RF Chain B | | | |
|----------------------|------------|----------|---------|-------|------------|---------|---------|-------|
| | I | Q | Amp | Phase | I | Q | Amp | Phase |
| Cavity Ref | 66.77 mV | ... | ... | ... | 16.70 mV | ... | ... | ... |
| Cavity Volt Loop | 70.22 mV | ... | ... | ... | 17.18 mV | ... | ... | ... |
| FwTet1 Loop | 0.15 mV | -0.06 mV | 0.48 mV | ... | 0.82 mV | 0.49 mV | 0.26 mV | ... |
| FwTet2 Loop | 0.06 mV | 0.09 mV | 0.13 mV | ... | 0.09 mV | 0.15 mV | 0.23 mV | ... |
| FwCircin Loop | 0.03 mV | 0.12 mV | 0.13 mV | ... | 0.03 mV | 0.09 mV | 0.10 mV | ... |
| FwCav Loop | 58.25 mV | ... | ... | ... | ... | ... | ... | ... |
| Loop Input | 70.01 mV | ... | ... | ... | 16.37 mV | ... | ... | ... |
| Error (Proportional) | 0.43 mV | 0.45 mV | ... | ... | 0.03 mV | 7.72 mV | 7.72 mV | ... |
| Error (Accumulated) | 86.34 mV | ... | ... | ... | 5.13 mV | ... | ... | ... |
| Control Action | 86.34 mV | ... | ... | ... | 5.86 mV | ... | ... | ... |
| Control Action 1 | 0.55 mV | ... | ... | ... | 4.55 mV | ... | ... | ... |
| Control Action 2 | 25.85 mV | ... | ... | ... | 69.52 mV | ... | ... | ... |
| MO | 281.38 mV | ... | ... | ... | ... | ... | ... | ... |
| Fast IQ Loop Ref | 0.03 mV | 0.15 mV | 0.45 mV | ... | 0.43 mV | 0.15 mV | 0.45 mV | ... |
| Fast IQ Loop Input | 0.15 mV | -0.06 mV | 0.16 mV | ... | 0.43 mV | 0.16 mV | 0.46 mV | ... |

InterlockLevel

| | RF Chain A | | RF Chain B | |
|-----------------------|------------|-----------|------------|-----------|
| | Write | Read Back | Write | Read Back |
| RvTet1 [0,1000] mV | 800.00 mV | 800.01 mV | 800.00 mV | 800.01 mV |
| RvTet2 [0,1000] mV | 800.00 mV | 800.01 mV | 800.00 mV | 800.01 mV |
| RvCirc [0,1000] mV | 800.00 mV | 800.01 mV | 800.00 mV | 800.01 mV |
| FwLoad [0,1000] mV | 800.00 mV | 800.01 mV | 800.00 mV | 800.01 mV |
| FwHybLoad [0,1000] mV | 800.00 mV | 800.01 mV | 800.00 mV | 800.01 mV |
| RvCav [0,1000] mV | 350.00 mV | 349.99 mV | 350.00 mV | 349.99 mV |

Interlock: SW Interlock

ItckInDiags

RF Chain A RF Chain B

- RvTet1
- RvTet2
- RvCirc
- FwLoad
- FwHybLoad
- RvCav
- Manual Interlock
- Arcs
- Vacumm
- External ITCK Inp
- End Switch Up
- End Switch Down
- Interlock timestamp (m)

Interlock number: + 1

TuningDiag

| | RF Chain A | | RF Chain B | |
|-----------------------|------------|----------|------------|----------|
| | Readings | Warnings | Readings | Warnings |
| Tuning Dephase | -2.04 deg | ... | 1.79 deg | ... |
| Fw Phase | 10.18 deg | ... | 32.97 deg | ... |
| Cavity Phase | 153.14 deg | ... | 47.11 deg | ... |
| Plunger Position (cm) | None | ... | None | ... |

Landau

Landau Manual Tuning

| | F Chain A | | F Chain B | |
|------------------|-----------|-----------|-----------|-----------|
| | Write | Read Back | Write | Read Back |
| Number of Pulses | 2000 | 2000 | 1000 | 1000 |
| Move Out | OFF | False | ON | True |
| Move End Plate | ON | True | ON | True |

Automatic tuning

| | F Chain A | | F Chain B | |
|------------------------|-----------|-----------|-----------|-----------|
| | Write | Read Back | Write | Read Back |
| Landau Tunig Enable | ON | True | ON | True |
| Landau Tuning Positive | OFF | False | OFF | False |
| Landau Phase offset | 0.00 deg | 0.00 deg | 0.00 deg | 0.00 deg |

Usually just a very long list of attributes

Categorizing GUIs: Simple but Crowded

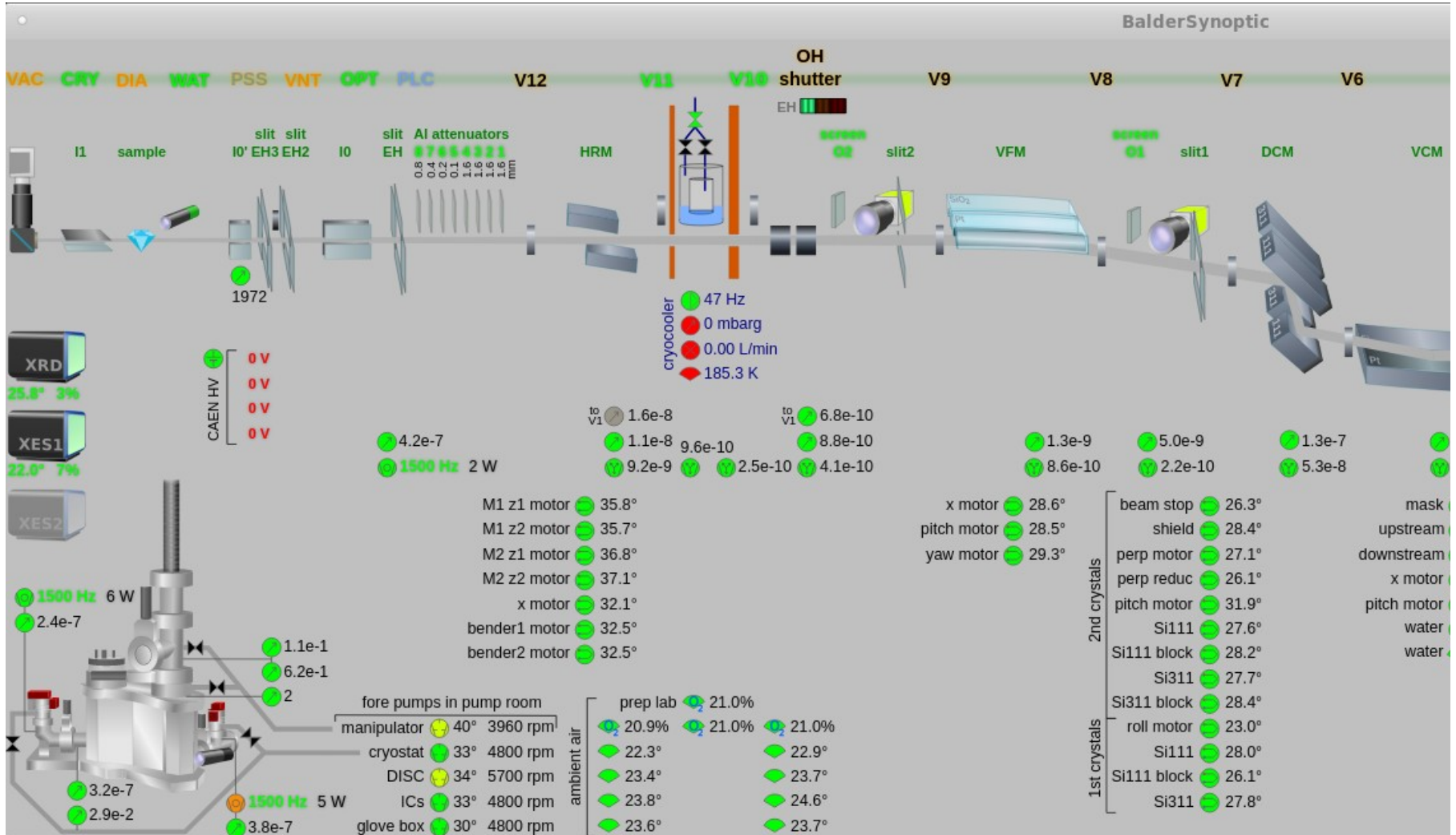
The screenshot displays the VeritasQuickGUI interface, titled "VeritasQuickGUI (on b-v-veritas-cc-0)". The interface is divided into several sections:

- Mainpanel:** Contains control elements for Position, a_slit1_v, EPU_R3_316_GAP, CffDesired, and CffReal. Each parameter has a green bar indicating its current value and a corresponding input field with a "Set" button and units.
- Energy:** A section for energy-related parameters, currently empty.
- Parameter List:** A table of parameters with their current values, target values, and units. Each row includes a "Set" button and navigation arrows.
- Trend Graph:** A line graph showing two data series: "pressure[0]" (red line) and "pressure[0] (2)" (blue line). The y-axis ranges from 0 to 9e-07, and the x-axis shows time from 15:08:10 to 15:08:20.
- Bottom Panel:** A row of tabs for different components: Front end, M1, BDM, PGM, M3baffles, M3a, M3b, Slit, M4a baffles, and M4a.

| Parameter | Current Value | Target Value | Unit |
|----------------|----------------|----------------|------|
| Position | 408.055 eV | 408.050 eV | eV |
| a_slit1_v | 50.065 μm | 50.000 μm | μm |
| EPU_R3_316_GAP | 150.0000 mm | 18.2715 mm | mm |
| CffDesired | 2.25000 | 2.25000 | |
| CffReal | 2.24997 | | |
| a_m4_lateral | 335.9940 μm | 336.4200 μm | μm |
| a_m4_vertical | 1000.2884 μm | 1000.0000 μm | μm |
| a_m4_yaw | -222.5218 μrad | -224.0000 μrad | μrad |
| a_m4_roll | 3.8345 μrad | 0.0000 μrad | μrad |
| a_m4_pitch | 75.1816 μrad | 75.0000 μrad | μrad |
| a_m4_v1 | 976.8433 μm | 975.9554 μm | μm |
| a_m4_v2 | 975.9877 μm | 975.9554 μm | μm |
| a_m4_v3 | 1025.3150 μm | 1025.1799 μm | μm |
| a_m4_h4 | 349.4430 μm | 349.4303 μm | μm |
| a_m4_h5 | 333.3910 μm | 333.4233 μm | μm |

Occasionally tabs, and a taurus trend

Categorizing GUIs: Synoptics

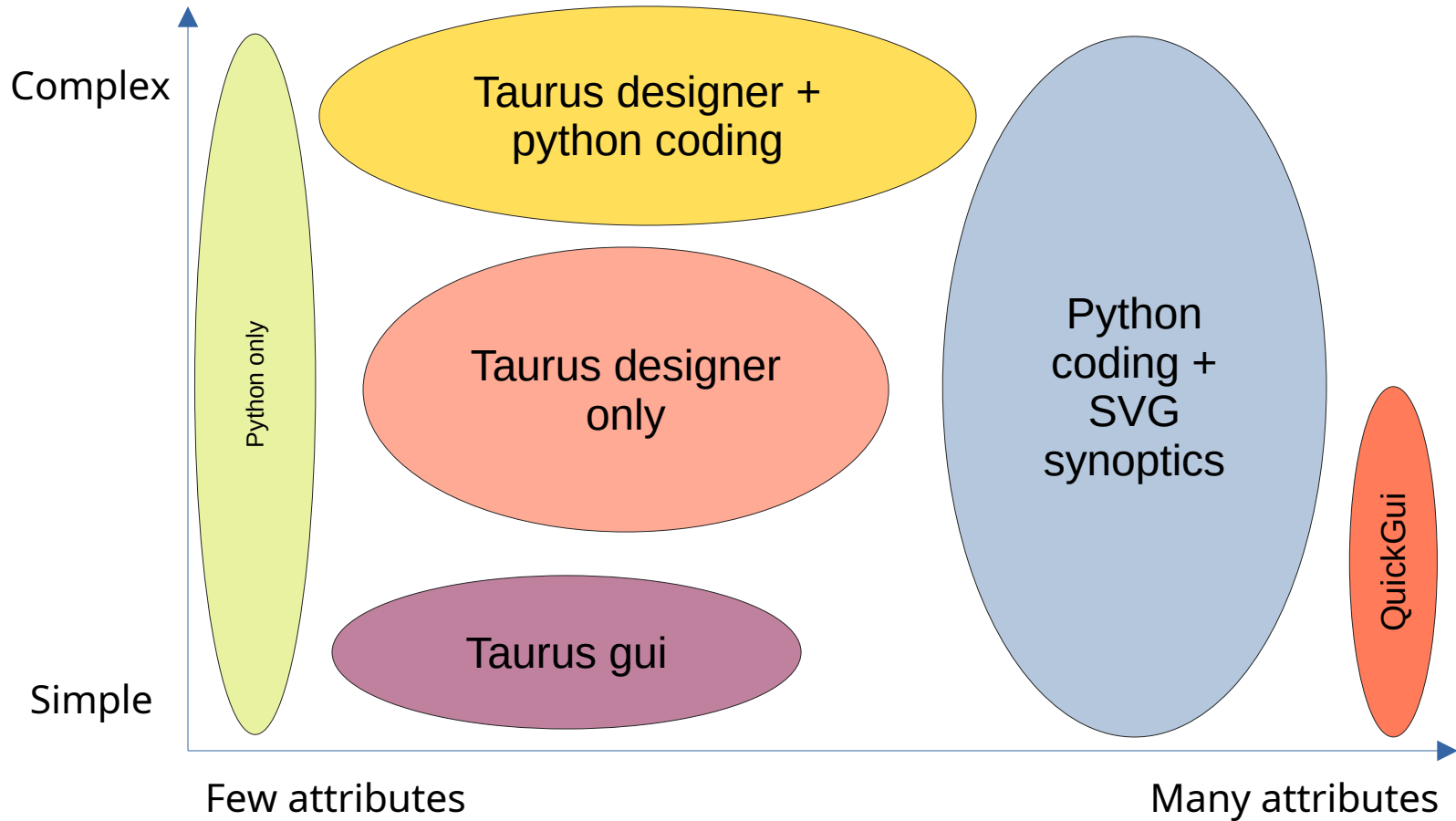


Our famed Balder synoptic has even audio feedback

Which development tools?

- Coding in python only
- Taurus designer + python coding
- Taurus designer only (an idea for now)
- Inkscape + SVGSynoptic MAX IV library
- Taurus gui
- Quickgui (MAX IV tool to create gui from yaml files)

Development tools application



This is an observation of what tool is usually chosen

Responsibilities

We see a strong correlation between tool and responsibility:

- SVG: Almost exclusively done by the beamline staff, with inkscape. Software helps to wrap it into an app
- Taurus designer files: can be both the beamline staff and software team
- Python coding: only few beamlines do code
- QuickGui: mostly software team (adoption problem?)
- Taurus gui: beamline staff only
- We have great external collaborators too!

Collaboration with **s²innovation** Software solutions

3

Developers

Dominika
Wojtek
Jakub

10+

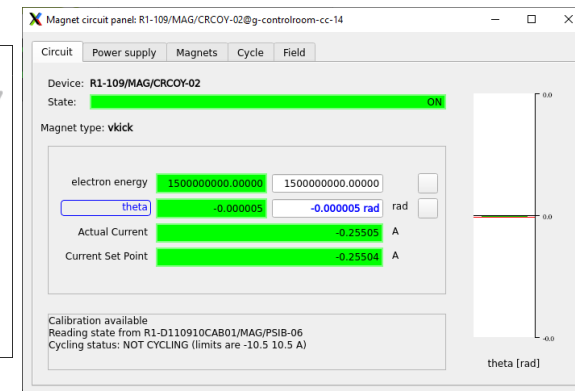
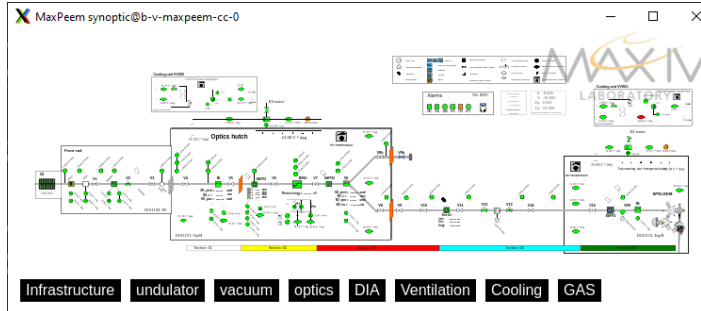
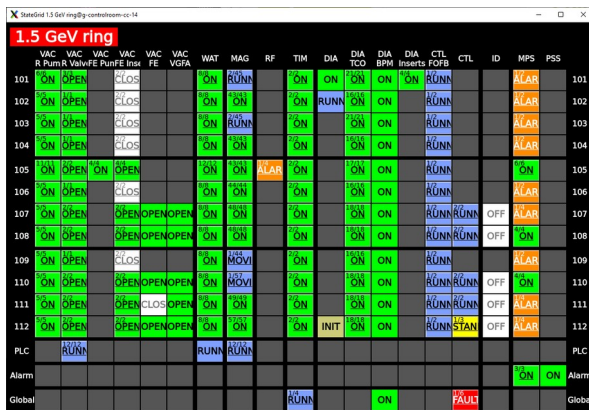
Migrations to Python 3 / PyQt 5

SvgSynoptic
StateGrid
MaxWidgets
...

15+

Improved GUIs

LuxViewer
ScanGUI
QuickGUI
...



Courtesy of Jakub Kowalczyk @ S2Innovation



Feedback

- We have been using taurus for a long time, and it's fully integrated in our workflows
- We aim to provide tools for the least experienced users, such as svgsynoptics and quickgui, as well as training for tools like the designer
- Extensive use of CI/CD, to allow beamline staff to even deploy (especially synoptics)
- Challenging migration from Taurus 4, still not 100% completed (but it got easier with conda)

Taurus feedback

What we like about Taurus:

- Looks good, native, modern
- Easy to get started, still possible to go in advanced features
- Good performance, scalable (better than taranta)
- Plenty of tools to design different applications

What we would like:

- More polished taurus_pyqtgraph
- Better taurus designer plugins (not all the widgets are there yet)
- More development and continued support, maybe a roadmap?

Conclusions

We believe Taurus to be a mature, performant tool, at the moment an irreplaceable part of our control system.

We have good experience working with it, both in house and with collaborators.

We have very little complains from our users, with some even taking GUI developing in their own hands.

Thank you for the attention!