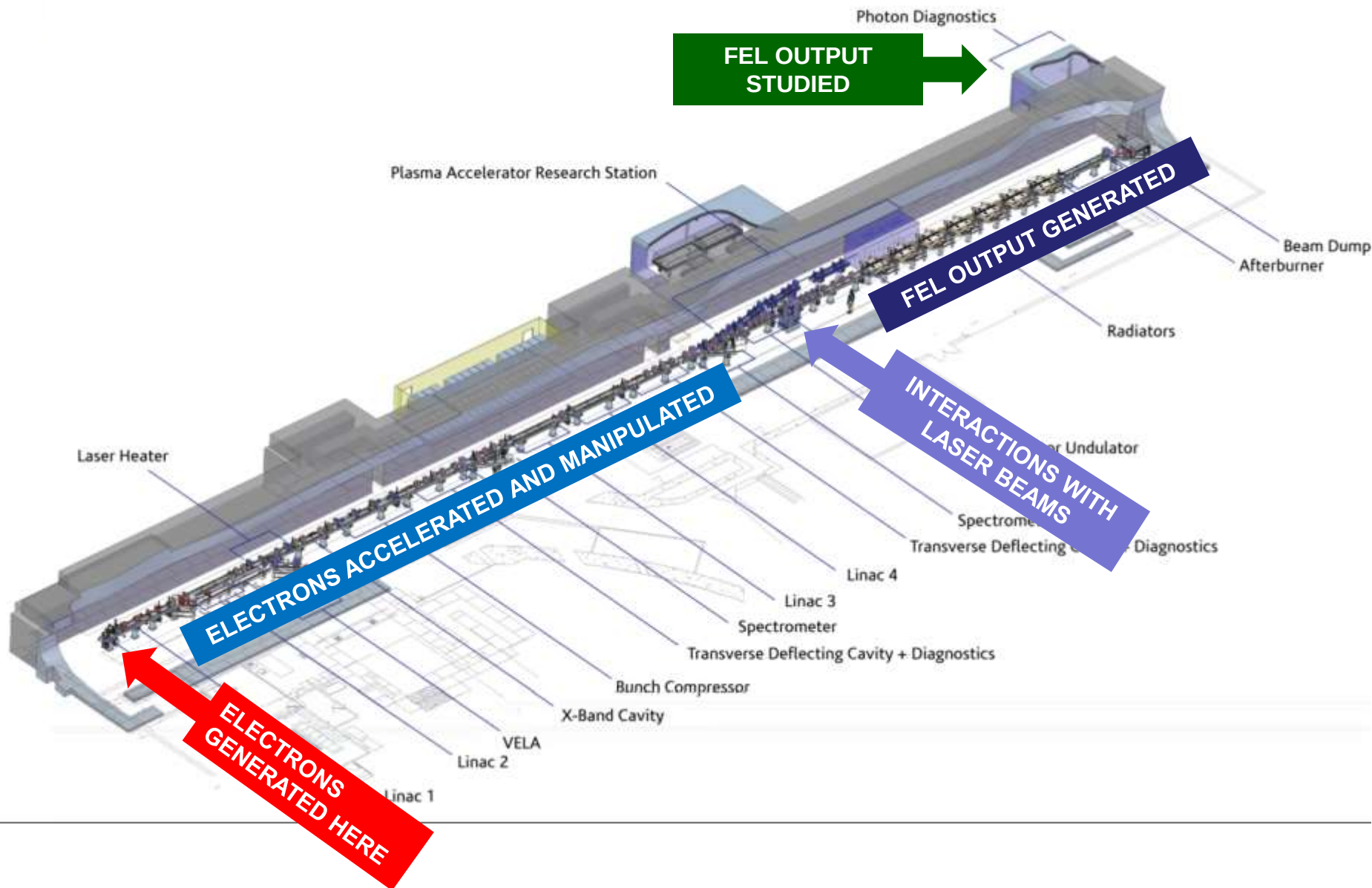




Controlling Multiple RGAs for the CLARA Vacuum System

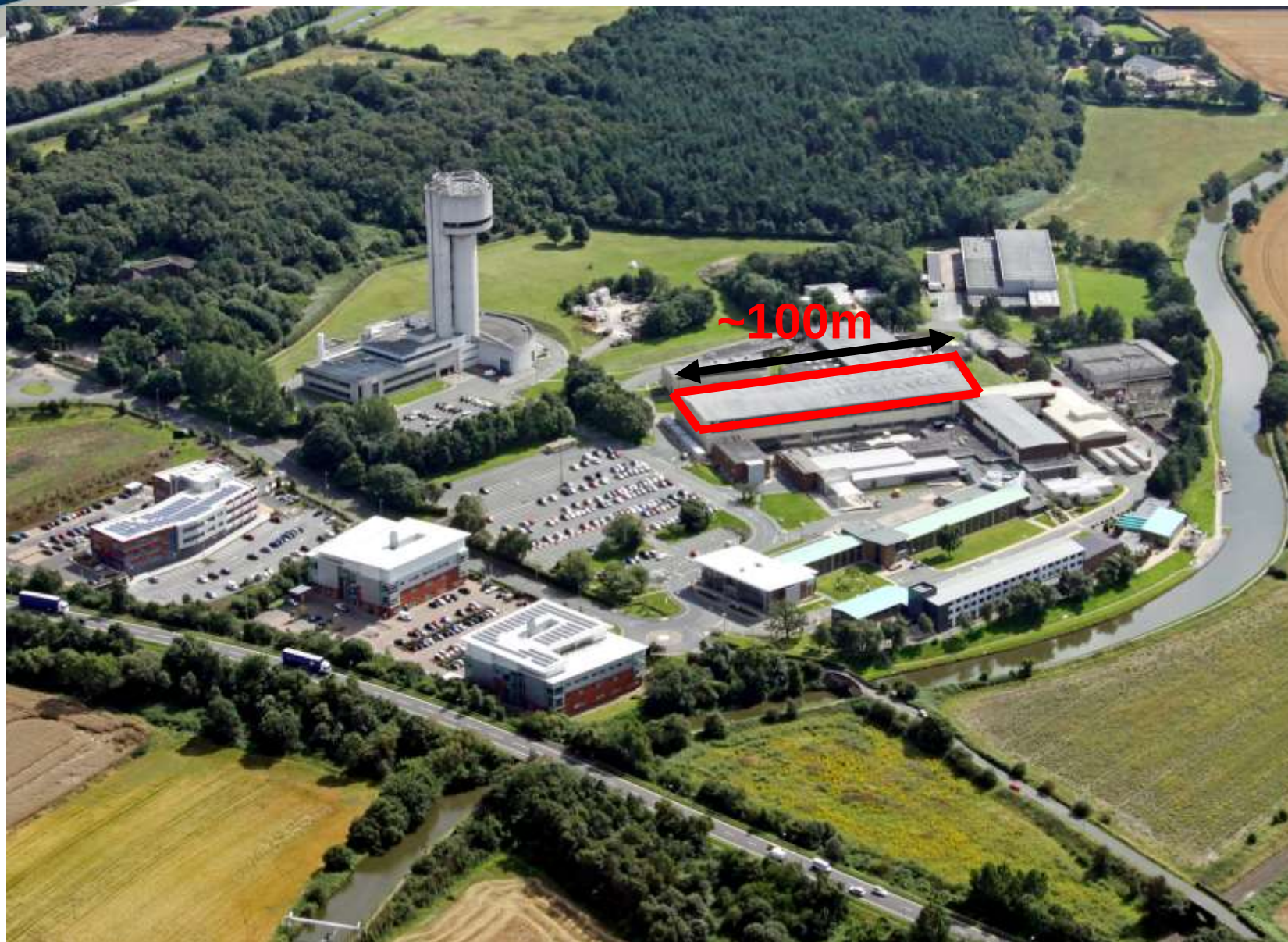
Keith Middleman
STFC Daresbury Laboratory

- CLARA is a ***dedicated FEL test facility*** for ***testing new FEL schemes*** and ***developing new technology***.
- STFC has identified an X-ray FEL as the highest priority for future accelerator based facilities
- CLARA will provide a stepping stone for the implementation of any new scheme or technology on a future UK FEL facility
- Many of the CLARA FEL research topics are in two main areas which are intended to demonstrate improvement of FEL output beyond that available from SASE
 - ***The generation of ultra-short pulses***
 - ***Improvement of temporal coherence.***





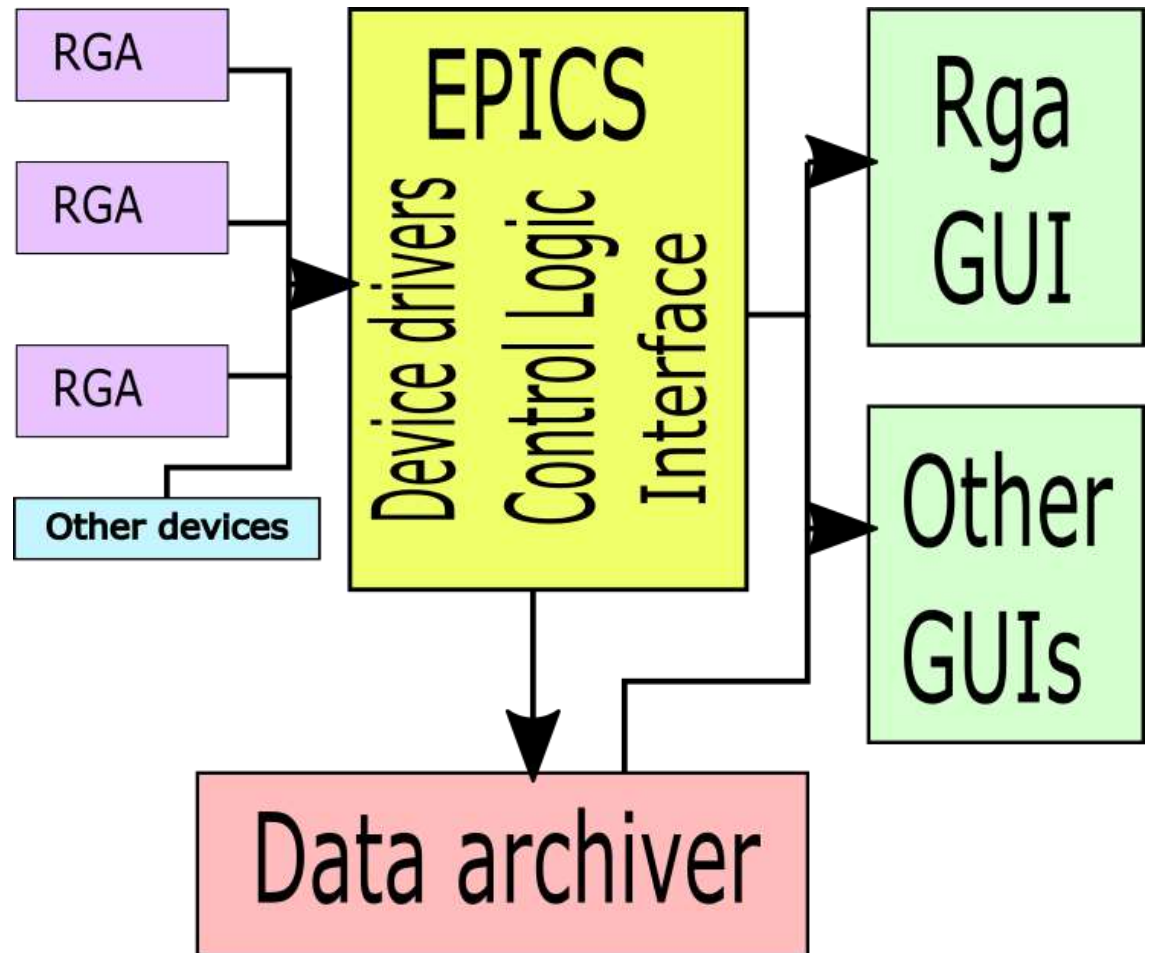
CLARA Location



What is EPICS?

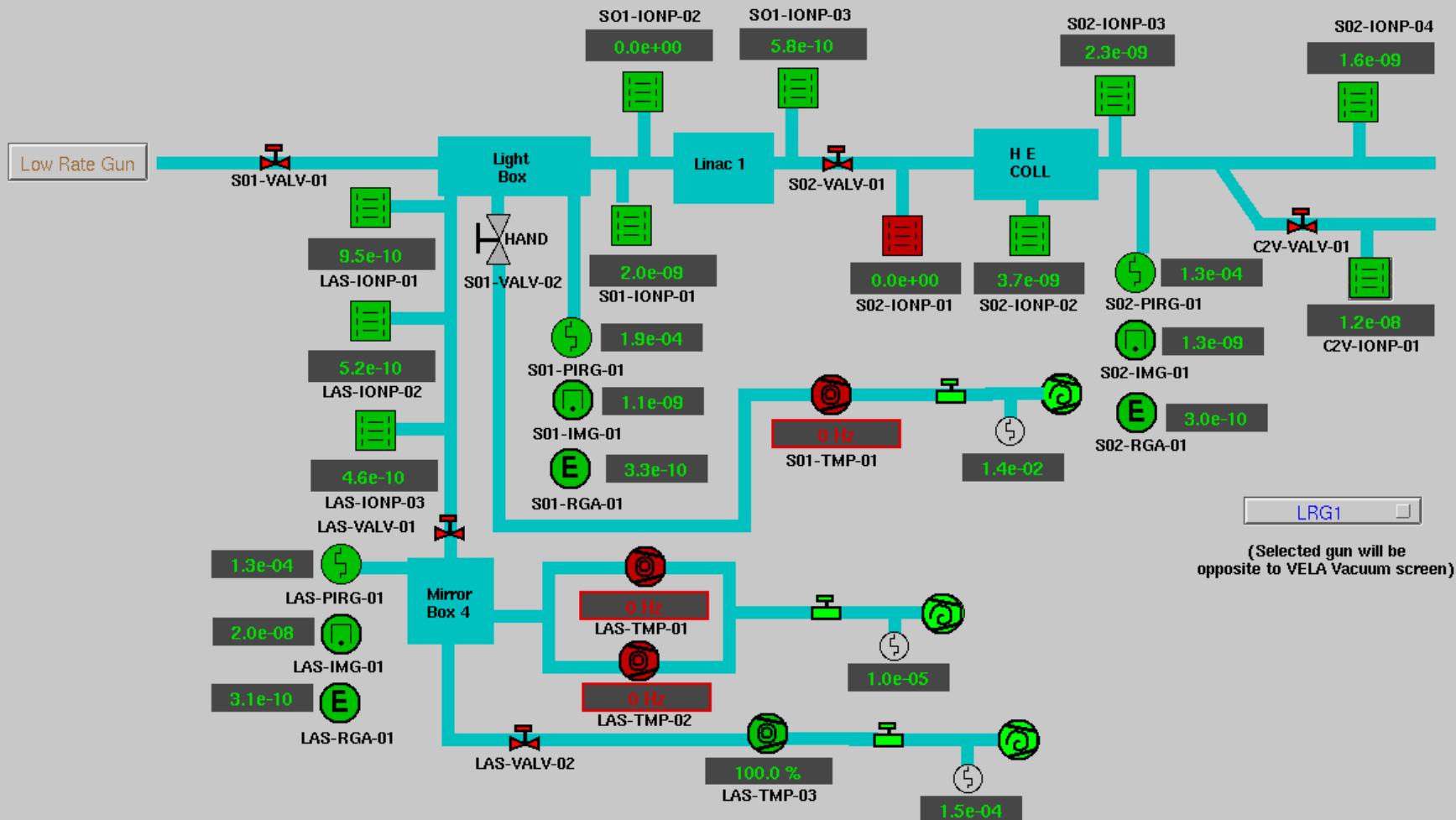
Experimental Physics Industrial Control System

- Every device on an accelerator has differing communication and controls protocols
- EPICS takes all the device protocol interfaces and presents to the user a common interface in the form of process variables
- These process variables are set up with a naming convention and presented to the users in the form of a General User Interface
- The RGAs needed to be integrated into the EPICS framework for CLARA



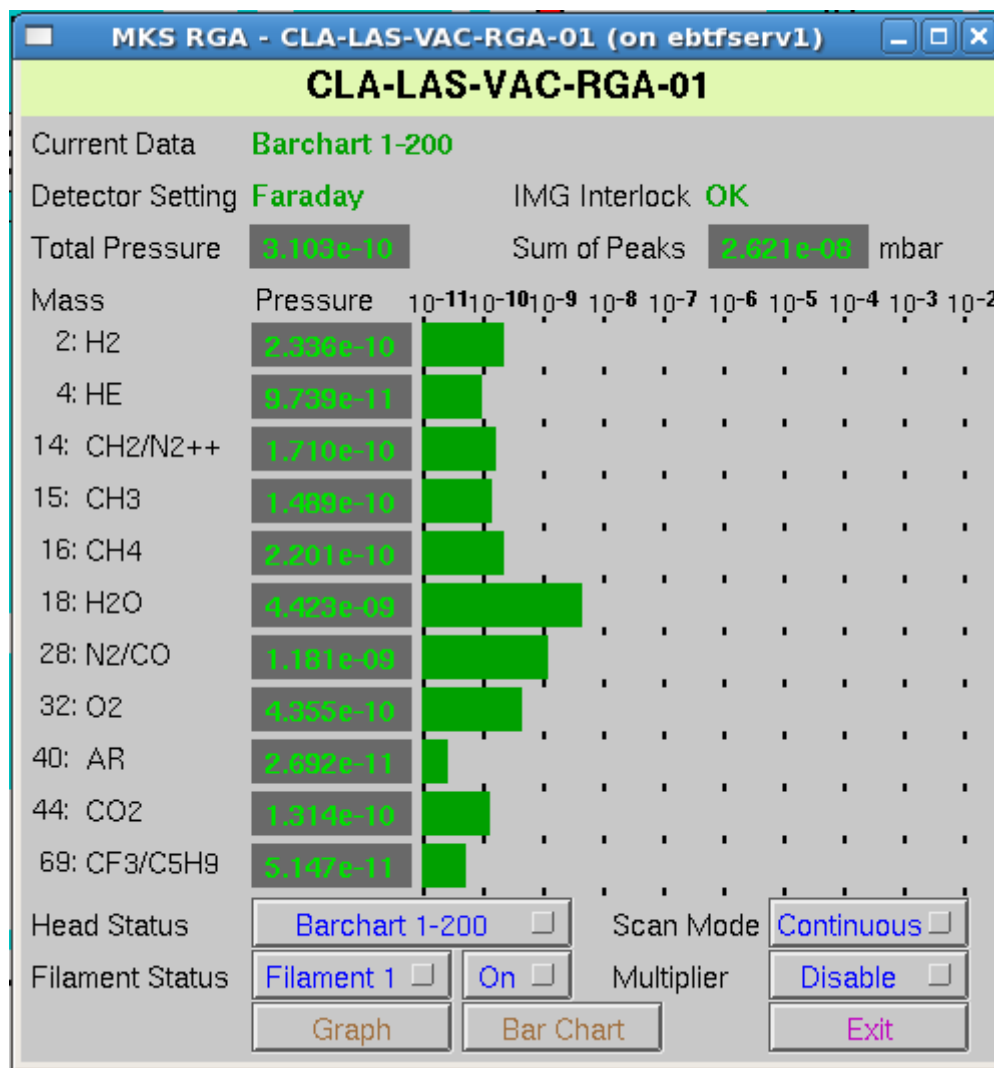


User Interface



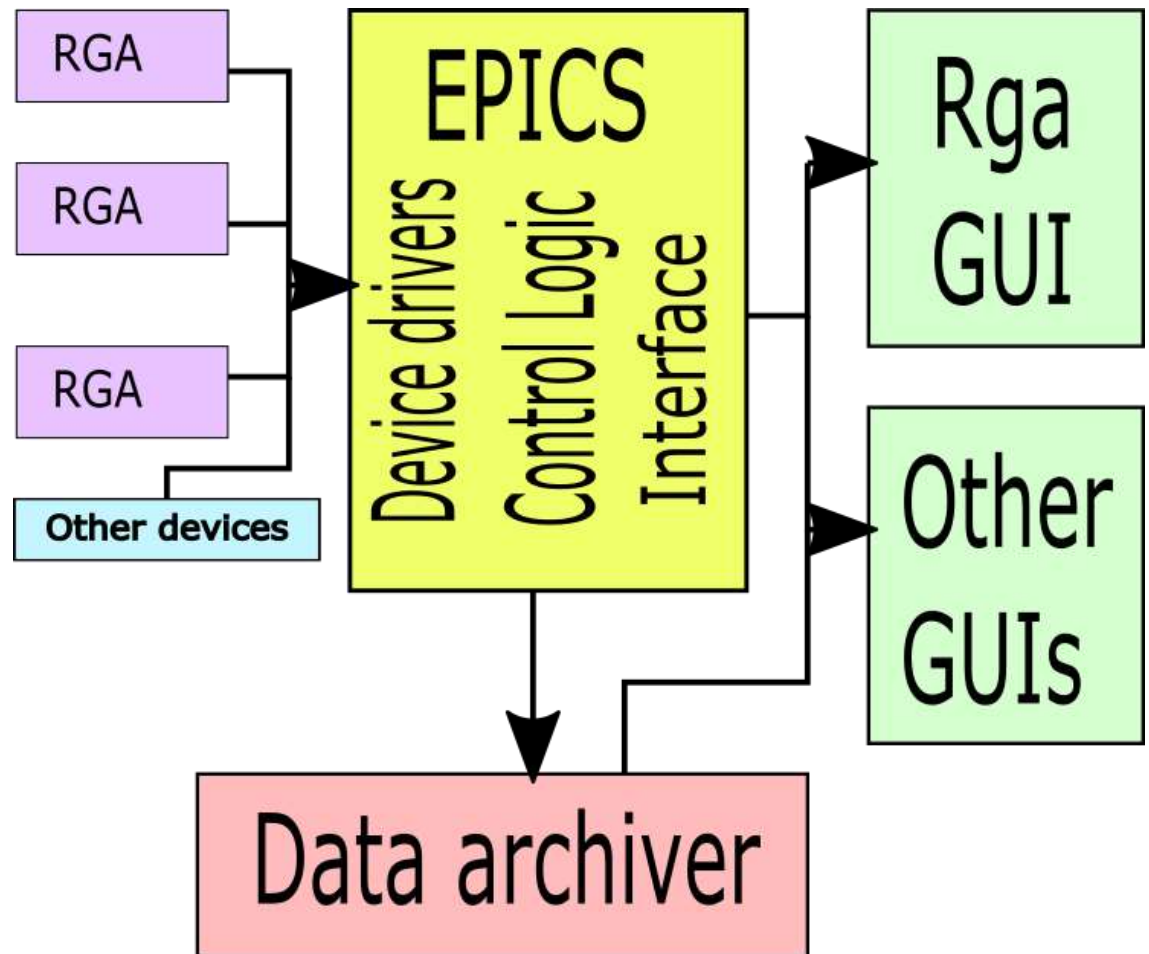


RGA User Interface



EPICS & RGA's

- Proprietary RGA software did not interface with EPICS easily and required extra resources for each RGA. It was not possible to integrate the proprietary RGA software with our data archiver
- Device drivers from Diamond Light Source were modified to connect the RGAs directly to EPICS via their ASCII protocol interface
- This allowed much better control over the RGAs and allowed archiving of data as desired



RGA individual control

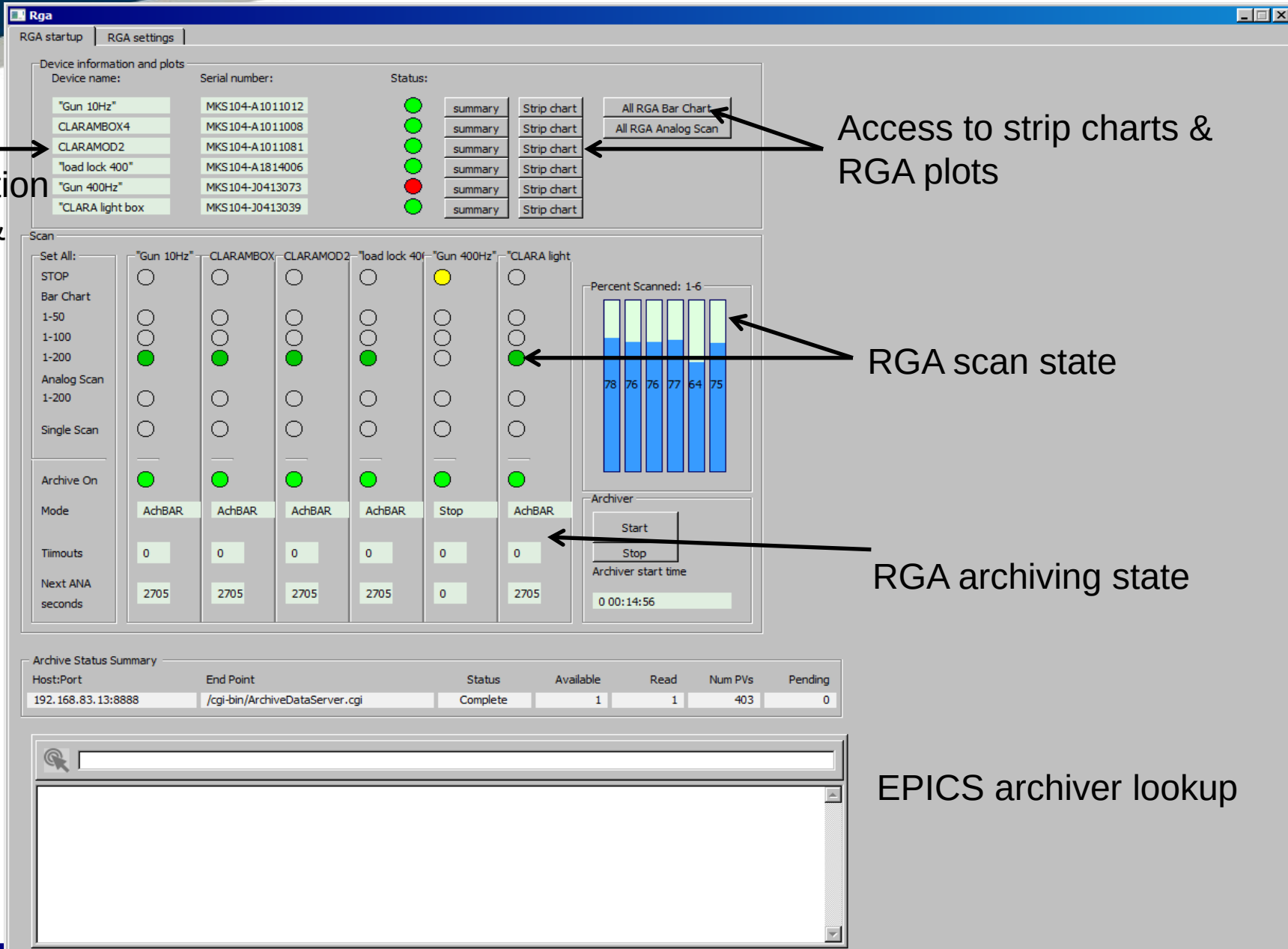
RGA
 connection
 status &
 device
 names

Access to strip charts &
 RGA plots

RGA scan state

RGA archiving state

EPICS archiver lookup



The screenshot shows the RGA control software interface with the following components and annotations:

- Device information and plots:** A table listing device names, serial numbers, and status indicators.

Device name:	Serial number:	Status:
"Gun 10Hz"	MKS104-A1011012	Green circle
CLARAMBOX4	MKS104-A1011008	Green circle
CLARAMOD2	MKS104-A1011081	Green circle
"load lock 400"	MKS104-A1814006	Green circle
"Gun 400Hz"	MKS104-J0413073	Red circle
"CLARA light box"	MKS104-J0413039	Green circle
- Buttons:** "summary" and "Strip chart" buttons are present for each device. "All RGA Bar Chart" and "All RGA Analog Scan" buttons are at the top right.
- Scan section:**
 - Set All:** Radio buttons for STOP, Bar Chart, 1-50, 1-100, 1-200, Analog Scan, 1-200, and Single Scan.
 - Archive On:** Green circle indicator.
 - Mode:** AchBAR, AchBAR, AchBAR, AchBAR, Stop, AchBAR.
 - Timeouts:** 0, 0, 0, 0, 0, 0.
 - Next ANA seconds:** 2705, 2705, 2705, 2705, 0, 2705.
- Percent Scanned: 1-6:** A bar chart showing scan progress for six channels: 78, 76, 76, 77, 64, 75.
- Archiver:** Start, Stop buttons and Archiver start time (0 00:14:56).
- Archive Status Summary:**

Host:Port	End Point	Status	Available	Read	Num PVs	Pending
192.168.83.13:8888	/cgi-bin/ArchiveDataServer.cgi	Complete	1	1	403	0
- EPICS archiver lookup:** A search bar and a large empty box for results.

Annotations with arrows point to the following elements:

- "RGA connection status & device names" points to the device information table.
- "Access to strip charts & RGA plots" points to the "Strip chart" buttons.
- "RGA scan state" points to the "Percent Scanned" bar chart.
- "RGA archiving state" points to the "Archiver" section.
- "EPICS archiver lookup" points to the search bar and results box.

RGA individual control

Rga

RGa startup | RGa settings

RGa Status:

"Gun 10Hz"

Filament Status

On Off ☒ Cool/Warm Fail

Filament select Filament 1

Mode

Stop Bar Chart Ana

1-50 1-100 1-200 Single S. On Off

RGa Status

IMG Interlock Control ☒ Barchart 1-200

Faraday/Mult: status and calibration

Calibration

Sensitivity: A/mBar Voltage

Faraday ☒ 0.00015 A/mBar 0 volts

M1 ☐ 0.00450 A/mBar -650 volts

M2 ☐ 0.04500 A/mBar -750 volts

M3 ☐ 0.45000 A/mBar -900 volts

"load lock 400"

Filament Status

On Off ☒ Cool/Warm Fail

Filament select Filament 1

Mode

Stop Bar Chart Ana

1-50 1-100 1-200 Single S. On Off

RGa Status

IMG Interlock Control ☒ Barchart 1-200

Faraday/Mult: status and calibration

Calibration

Sensitivity: A/mBar Voltage

Faraday ☒ 0.00015 A/mBar 0 volts

M1 ☐ 0.00450 A/mBar -650 volts

M2 ☐ 0.04500 A/mBar -750 volts

M3 ☐ 0.45000 A/mBar -900 volts

CLARAMBOX4

Filament Status

On Off ☒ Cool/Warm Fail

Filament select Filament 1

Mode

Stop Bar Chart Ana

1-50 1-100 1-200 Single S. On Off

RGa Status

IMG Interlock Control ☒ Barchart 1-200

Faraday/Mult: status and calibration

Calibration

Sensitivity: A/mBar Voltage

Faraday ☒ 0.00015 A/mBar 0 volts

M1 ☐ 0.00450 A/mBar -650 volts

M2 ☐ 0.04500 A/mBar -750 volts

M3 ☐ 0.45000 A/mBar -900 volts

"Gun 400Hz"

Filament Status

On Off ☒ Cool/Warm Fail

Filament select Filament 2

Mode

Stop Bar Chart Ana

1-50 1-100 1-200 Single S. On Off

RGa Status

IMG Interlock Control ☒ Barchart 1-200

Faraday/Mult: status and calibration

Calibration

Sensitivity: A/mBar Voltage

Faraday ☒ 0.00015 A/mBar 0 volts

M1 ☐ 0.00450 A/mBar -650 volts

M2 ☐ 0.04500 A/mBar -750 volts

M3 ☐ 0.45000 A/mBar -900 volts

CLARAMOD2

Filament Status

On Off ☒ Cool/Warm Fail

Filament select Filament 1

Mode

Stop Bar Chart Ana

1-50 1-100 1-200 Single S. On Off

RGa Status

IMG Interlock Control ☒ Barchart 1-200

Faraday/Mult: status and calibration

Calibration

Sensitivity: A/mBar Voltage

Faraday ☒ 0.00015 A/mBar 0 volts

M1 ☐ 0.00450 A/mBar -650 volts

M2 ☐ 0.04500 A/mBar -750 volts

M3 ☐ 0.45000 A/mBar -900 volts

"CLARA light box"

Filament Status

On Off ☒ Cool/Warm Fail

Filament select Filament 1

Mode

Stop Bar Chart Ana

1-50 1-100 1-200 Single S. On Off

RGa Status

IMG Interlock Control ☒ Barchart 1-200

Faraday/Mult: status and calibration

Calibration

Sensitivity: A/mBar Voltage

Faraday ☒ 0.00015 A/mBar 0 volts

M1 ☐ 0.00450 A/mBar -650 volts

M2 ☐ 0.04500 A/mBar -750 volts

M3 ☐ 0.45000 A/mBar -900 volts

- On separate tabbed pages the control panels for individual RGAs can be accessed
- As more RGAs are added to CLARA in the future, more tabbed RGA panel pages are added
- This example is one of six RGA panels on a page

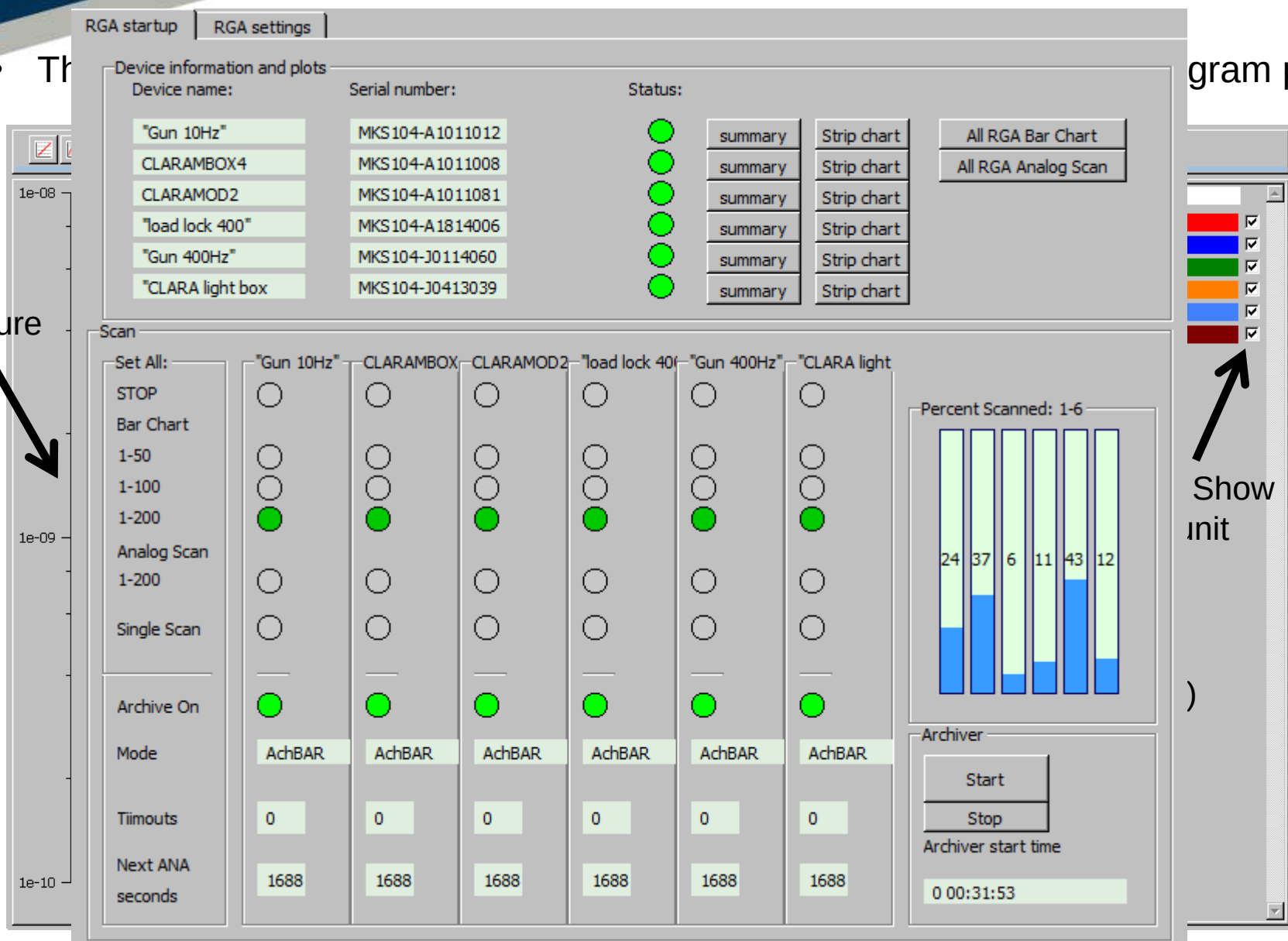
Bar Chart & Analogue scan

• The

gram plot

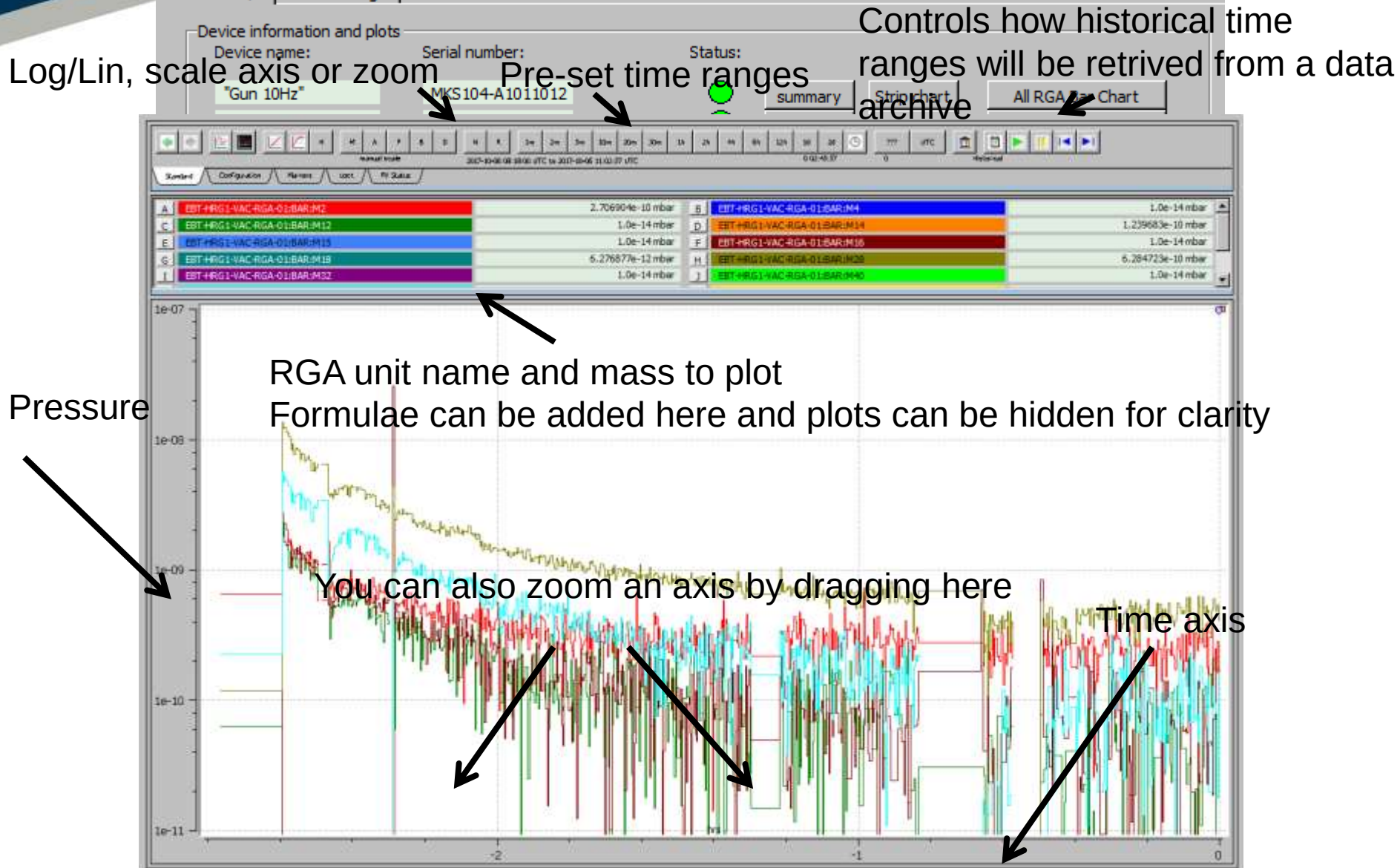
Pressure

Show
init





Striptool: selected masses vs. time





EPICS archiver control of RGAs

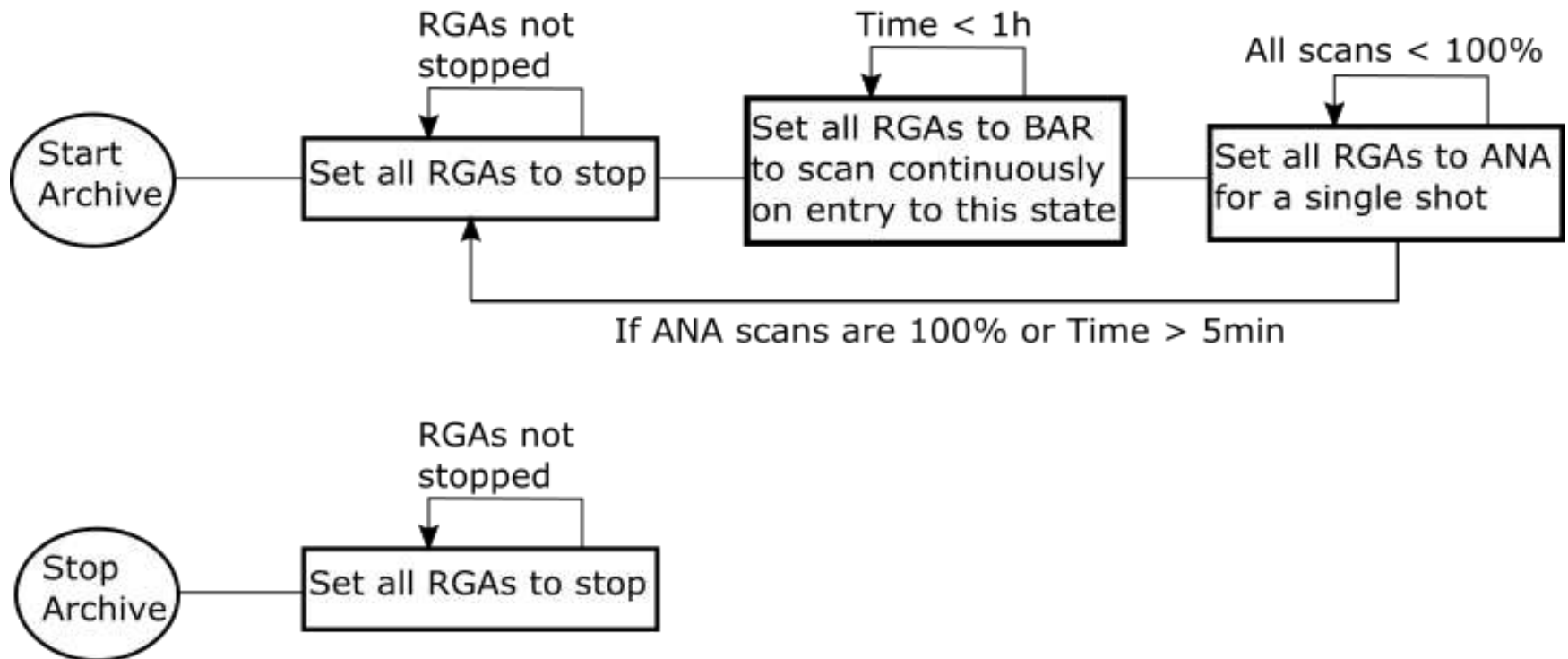
- Using EPICS, a state machine was developed to control the archiving
- The requirement was to archive in two different modes over an hour:

BAR MODE continually:

- Continually scan mass ranges 1-200 in unit steps

ANA MODE done just once per hour:

- Once per hour do a **single**, detailed analog scan:
- mass range 1-200 with 3200 steps



Data extracted from the archiver

RGA startup
RGA settings

Device information and plots

Device name:
Serial number:
Status:

"Gun 10Hz"	MKS 104-A1011012		summary	Strip chart	All RGA Bar Chart All RGA Analog Scan
CLARAMBOX4	MKS 104-A1011008		summary	Strip chart	
CLARAMOD2	MKS 104-A1011081		summary	Strip chart	
"load lock 400"	MKS 104-A1814006		summary	Strip chart	
"Gun 400Hz"	MKS 104-J0114060		summary	Strip chart	
"CLARA light box"	MKS 104-J0413039		summary	Strip chart	

Scan

Set All:
STOP
Bar Chart
1-50
1-100
1-200
Analog Scan
1-200
Single Scan

	"Gun 10Hz"	CLARAMBOX	CLARAMOD2	"load lock 400"	"Gun 400Hz"	"CLARA light"
STOP	☐	☐	☐	☐	☐	☐
Bar Chart	☐	☐	☐	☐	☐	☐
1-50	☐	☐	☐	☐	☐	☐
1-100	☐	☐	☐	☐	☐	☐
1-200	☒	☒	☒	☒	☒	☒
Analog Scan	☐	☐	☐	☐	☐	☐
1-200	☐	☐	☐	☐	☐	☐
Single Scan	☐	☐	☐	☐	☐	☐
Archive On	☒	☒	☒	☒	☒	☒
Mode	AchBAR	AchBAR	AchBAR	AchBAR	AchBAR	AchBAR
Timeouts	0	0	0	0	0	0
Next ANA seconds	1688	1688	1688	1688	1688	1688

Percent Scanned: 1-6

24	37	6	11	43	12
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Archiver

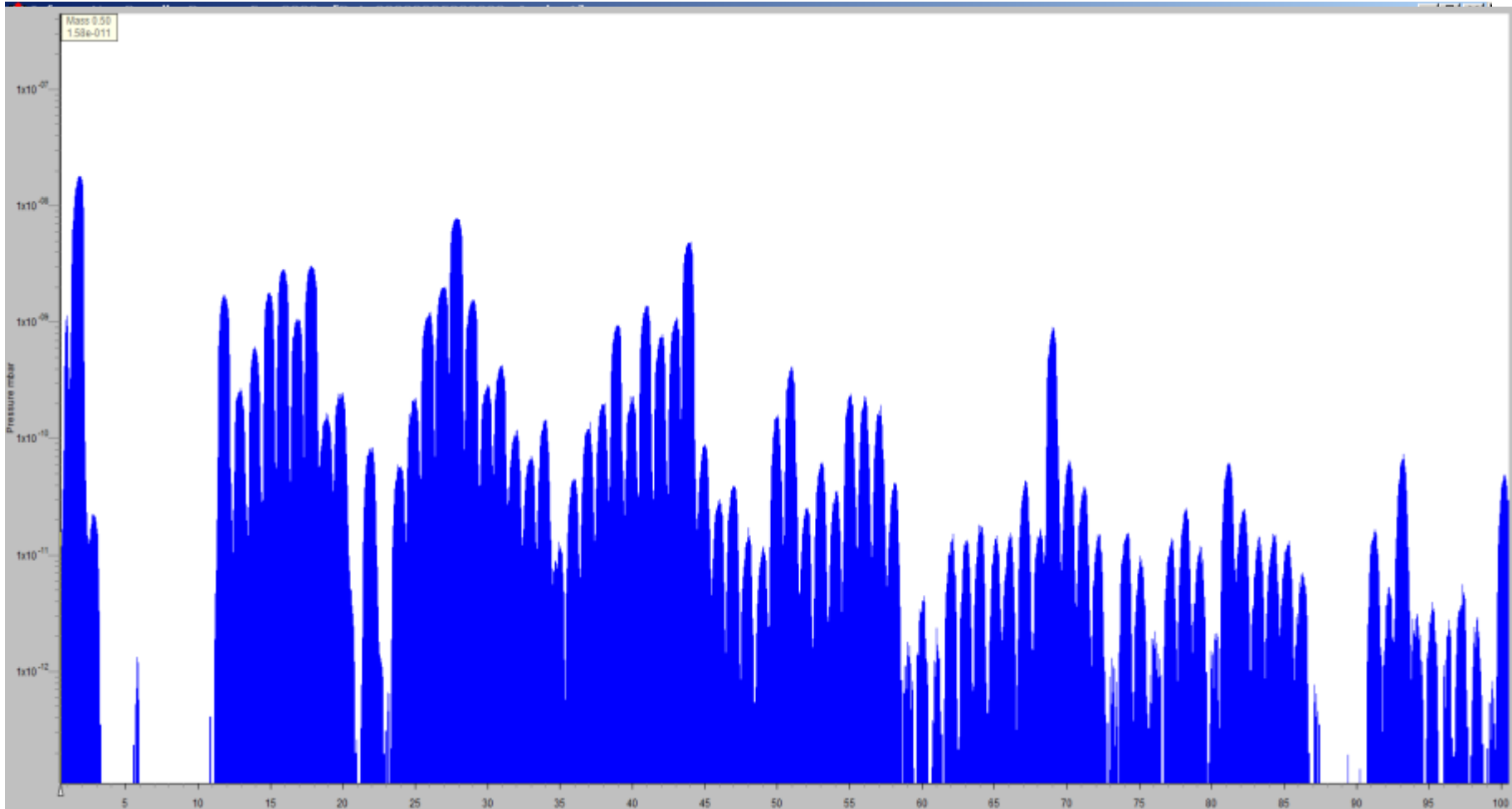
Start
Stop

Archiver start time
0 00:31:53



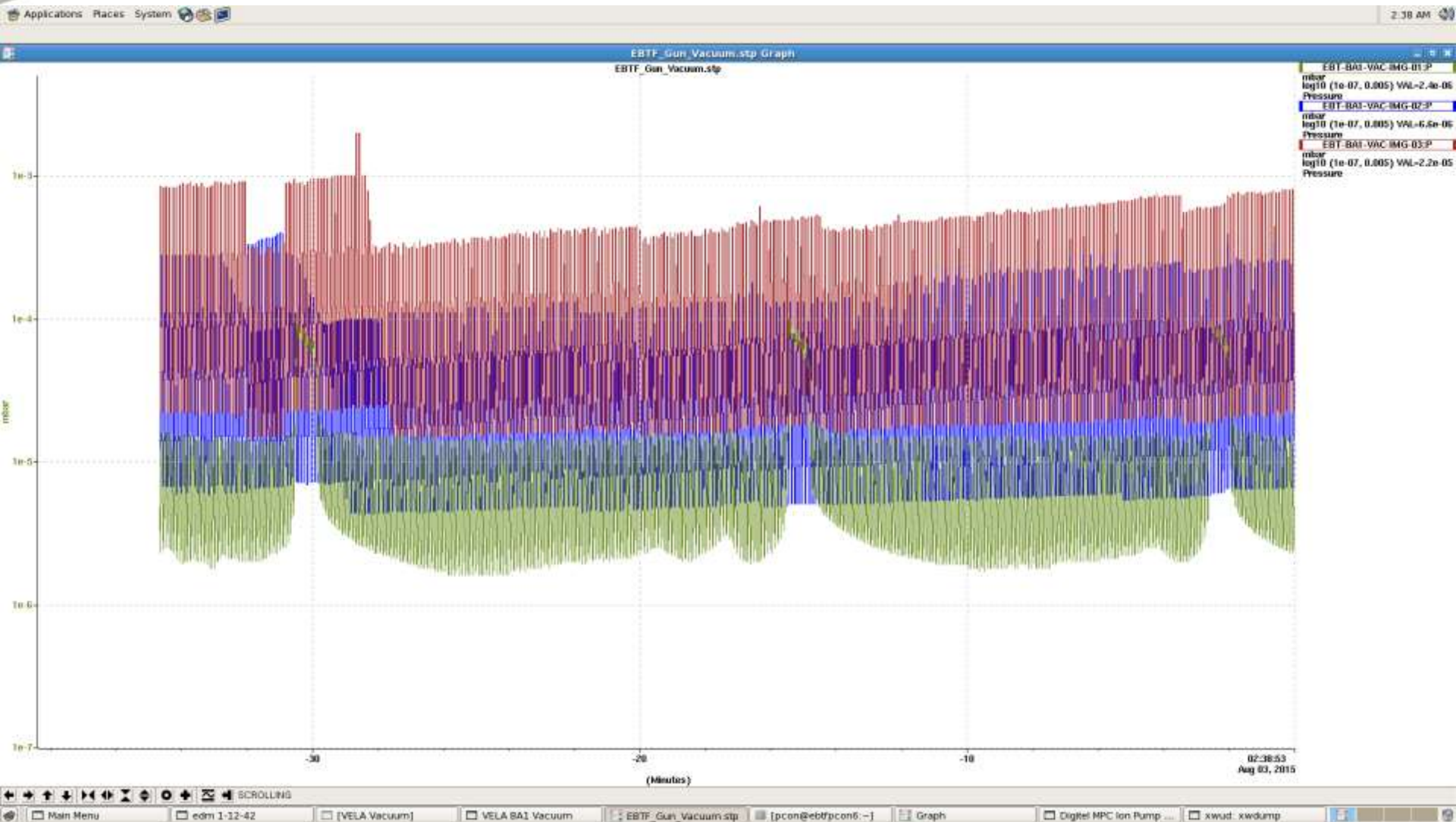
What importance does RGA data bring?

- RGA scan from a good HV system





Ion pump instability





Thank You

- Rory Clarke (DL Controls Group)
- Tom Weston (DL Vacuum Support Group)