LabVIEW universal control interface for residual gas analysers

TE-VSC-SEMINAR

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15/03/19

SUMMARY

- Context and motivations
- What is the LabVIEW Universal control Interface for residual gas Analysis ?
  - Design and development
  - What does the application offer ?
  - Important information regarding the application
- Live Demo

CONTEXT

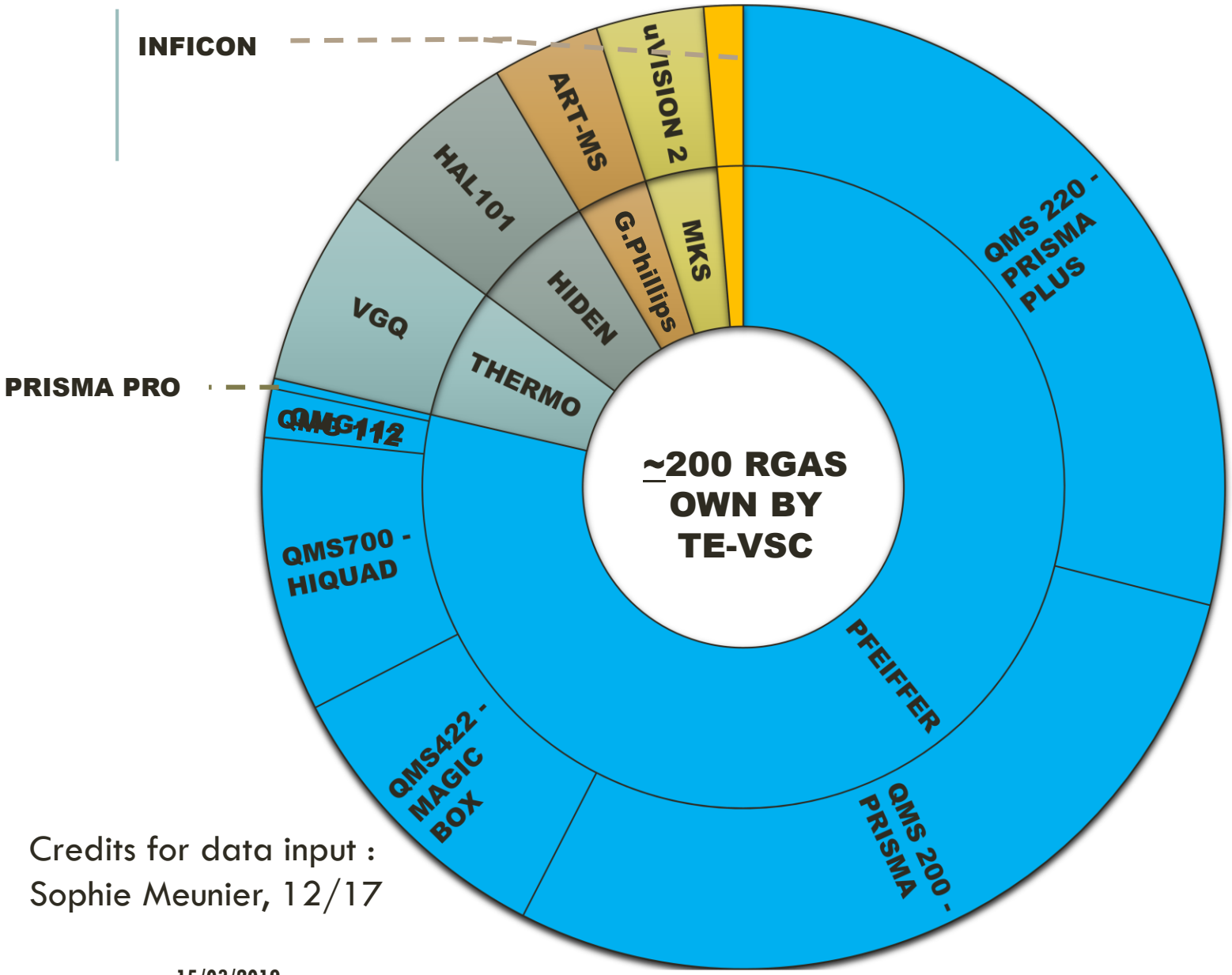
≈ 200 mass spectrometers belonging to the Vacuum group are used to perform residual gas analysis.

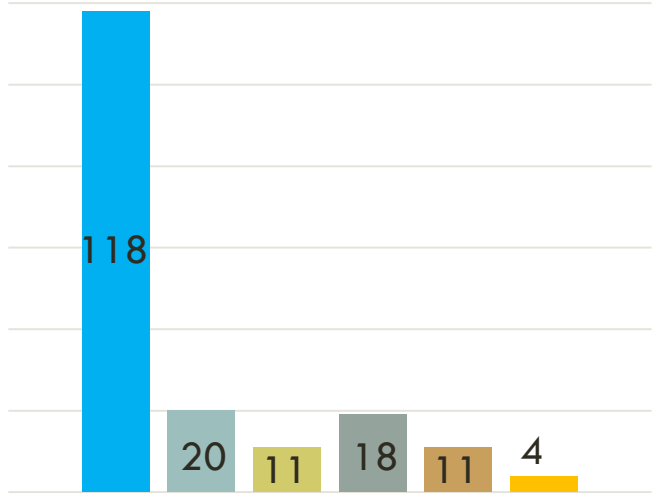
The mass spectrometers panel is represented by several models of RGAs, from different manufacturers.

The more represented models are :

- Pfeiffer PRISMA PLUS (QMS 220) and PRISMA (QMS 200)
- Pfeiffer HiQUAD (QMS 700) and MAGIC BOX (QMS 422)
- HIDEN HAL 101

CONTEXT : TE-VSC RGAs MODELS DISTRIBUTION





Credits for data input :
Sophie Meunier, 12/17

CONTEXT

Each RGA is different.
This implies different:

- communication protocol
- commands used
- manufacturer software
- outputs files formats

Not really convenient for users who have to deal with different RGA models

Hardware side

Software side

RGA

analyzer

Control unit

Communication protocol

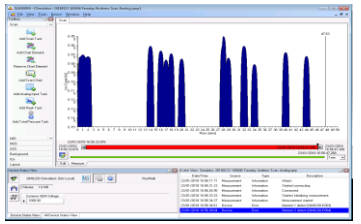
COMPUTER

Control interface

Pfeiffer Prisma plus

Ethernet (OPCDA)

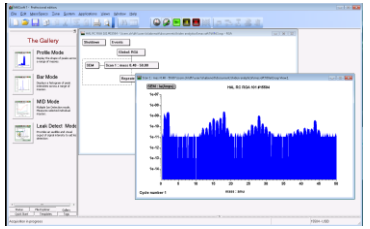
QUADERA



Hiden HAL 7

USB

massoft



CONTEXT : TE-VSC RGAs PANEL DESCRIPTION

MANUFACTURER	An. HEAD	Electronics / control units	Communication	Software	#RGAS
PFEIFFER	QMA 125	QMG 112	DIGITAL/ANALOG	Custom LabVIEW	5
	QMA 125	QGM422 – MAGIC BOX	SERIAL - RS232	QUADSTAR	30
	QMA 125	QMG700 - HIQUAD	ETHERNET (OPC DA)	QUADERA	28
	QMA 200	QMG 200 –PRISMA	Serial - RS 232	QUADSTAR	27
	QMA 200	QMG 220 -PRISMA PLUS	ETHERNET (OPC DA)	QUADERA	28
HIDEN	HAL 101 RC	HAL MSIU	ETHERNET / USB	MASSOFT 7	19
THERMO	Masstor VGQ	MASSTOR	SERIAL - RS 232	GASWORKS	20
MKS	Microvision 2	Microvision 2	ETHERNET	-	11
GRANVILLE PHILIPS	ART-MS	ART-MS			11

Credits for data input : Sophie Meunier, 12/17

CONTEXT

- Consolidation program of Pfeiffer electronics
  - QMS 112
  - QMS 422 – magic box
  - Prisma 200

The electronics of QMS 112 and 422 are getting replaced by HiQuad and the Prisma electronics by Prisma Plus.

MOTIVATIONS : GOALS

"Build a universal driver for all RGAs, easy to use, easy to maintain to offer an alternative to the manufacturer applications"

MOTIVATION : BENEFITS AND DRAWBACKS

Benefits

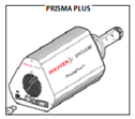
- A friendly interface, common for each model of RGA, defined based on expert users requirements.
- One software able to control several RGAs
- A common output file format for all scans. Results are presented in the same format no matter the RGA used.
- Possibility to implement new custom functionalities on the users requests.

Drawbacks

- Home development : “It’s our responsibility to maintain the application”
- If the manufacturers decides to change firmware or communication protocol, the drivers will have to be modified for the application

WHAT IS THE LABVIEW FOR RGA APPLICATION?

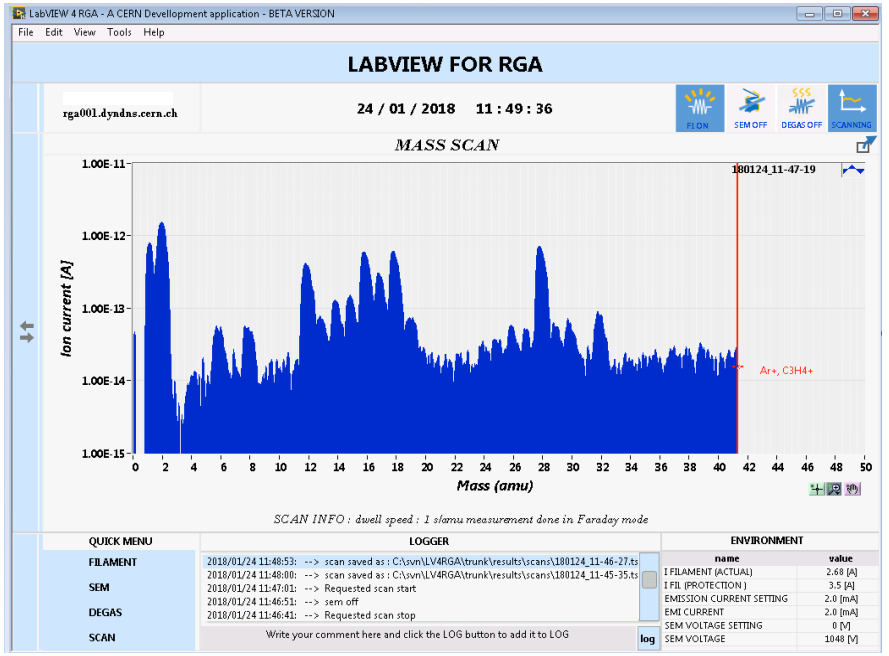
- Unique tool for the control of different RGA models through the same software
- Easy and user friendly interface
- Simple to perform your measurements and to export data
- Alternative tool to the manufacturer application, developed to make your life easier.
- Offers control for



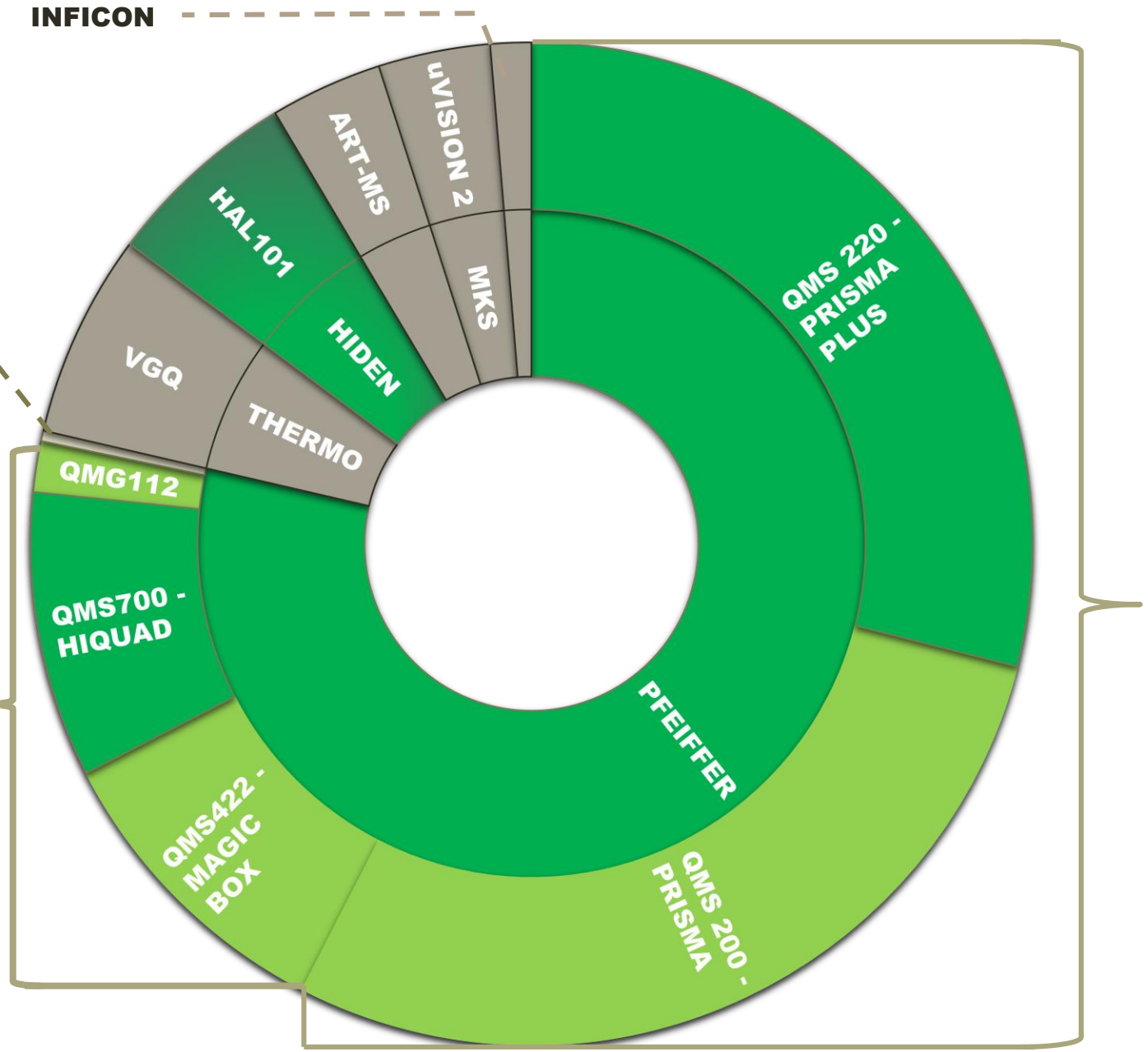
QMS 220/ Prisma plus from Pfeiffer

QMS 700 / Hiquad from Pfeiffer

HAL 101 from Hiden Analytical



RGA MODELS DISTRIBUTION BY CONTROL FROM LabVIEW FOR RGA



Control covered by LabVIEW for RGA application today

Control covered by LabVIEW for RGA at the end of the consolidation Program

Not covered

QMG 112 and QMS422 converted to QMS700 at the end of the consolidation program

PRISMA becomes PRISMA PLUS at the end of the consolidation program

~ 50% of RGA panel controllable today

~ 80% of RGA panel controllable after consolidation program

DEVELOPMENT USING LABVIEW

Why LabVIEW ?

- **LabVIEW** is a powerful programming language when dealing with **devices** and **Graphical User Interfaces.**
- LabVIEW is already widely used in TE-VSC labs
- CERN as a great experience with LabVIEW development.
- The “CERN LabVIEW team” will offer support and serenity for the project over time.
- **Object Oriented Programming** in LabVIEW offers the flexibility of development needed for this project and is a common way of programming among the LabVIEW experts

LABVIEW DESIGN : OOP CONCEPTS

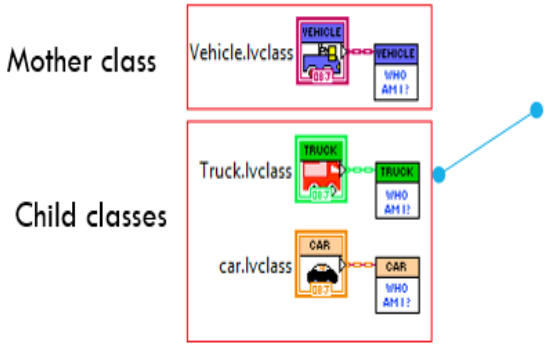
Application is based on Object Oriented Programming in LabVIEW

OOP offers modularity at runtime. Using "classes", the function or "method" to be executed can change depending on the class Object currently used. This is what we call dynamically dispatched code

Some OOP concepts :

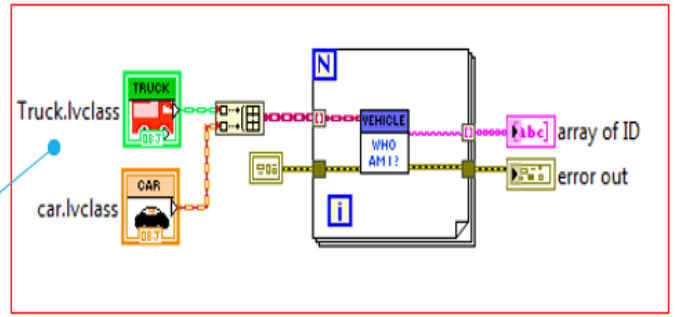
"class" = implementation of a data cluster and "methods" related to it.
"Parent class" = A parent implementation of a class from which child classes will **inherit** from.
"Child classes" = specific implementation that can be define as a kind of "the mother class".
"Inheritance" = A child inherits from a mother, he can do what the mother can do in addition to what only he can do.
"Dynamic dispatch" = Depending on the class provided, child classes can execute their own version of the methods to execute

EXAMPLE :
Vehicle is a "mother implementation. Truck and car are child implementations of a vehicle.

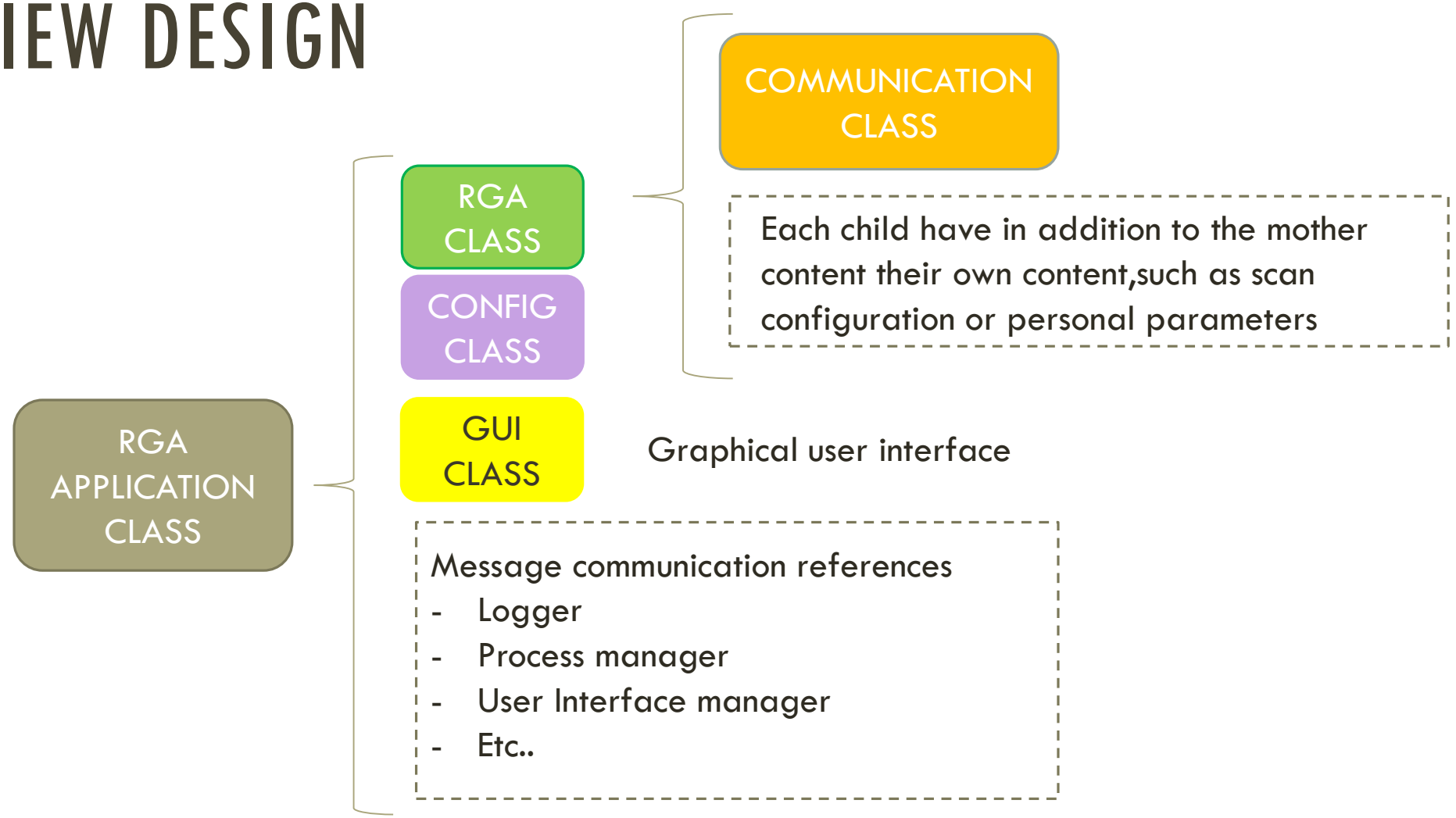


Truck and car have their own implementation of the "who am I vi"

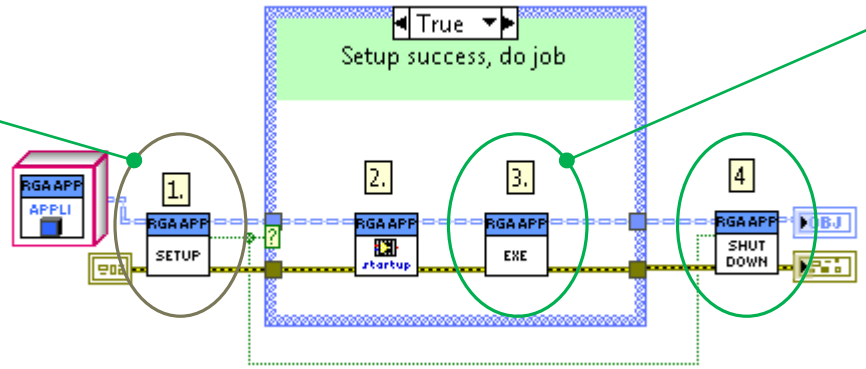
At run time the executed version of the "who am I?" vi will depend on the object provided.

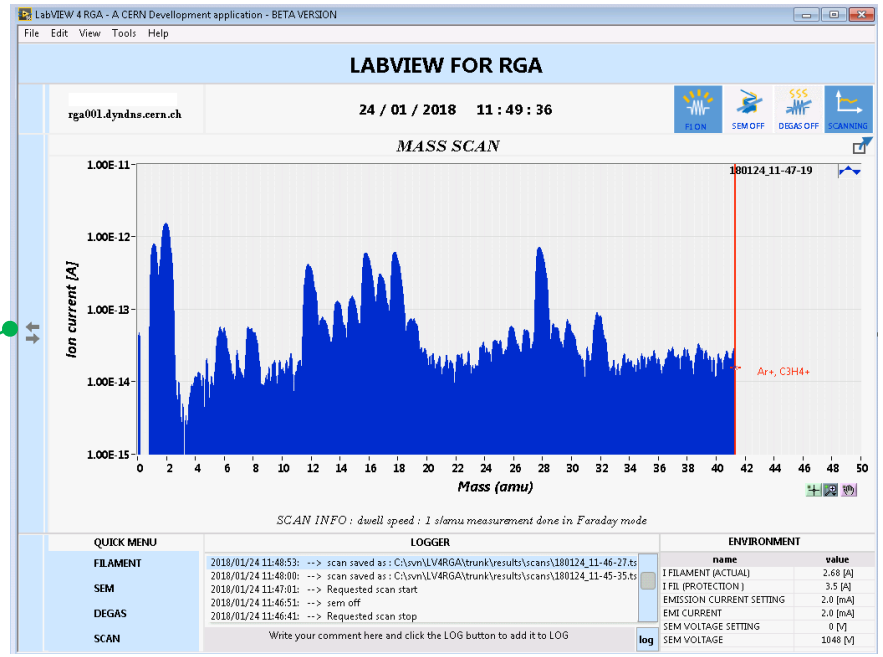


LABVIEW DESIGN



LABVIEW DESIGN

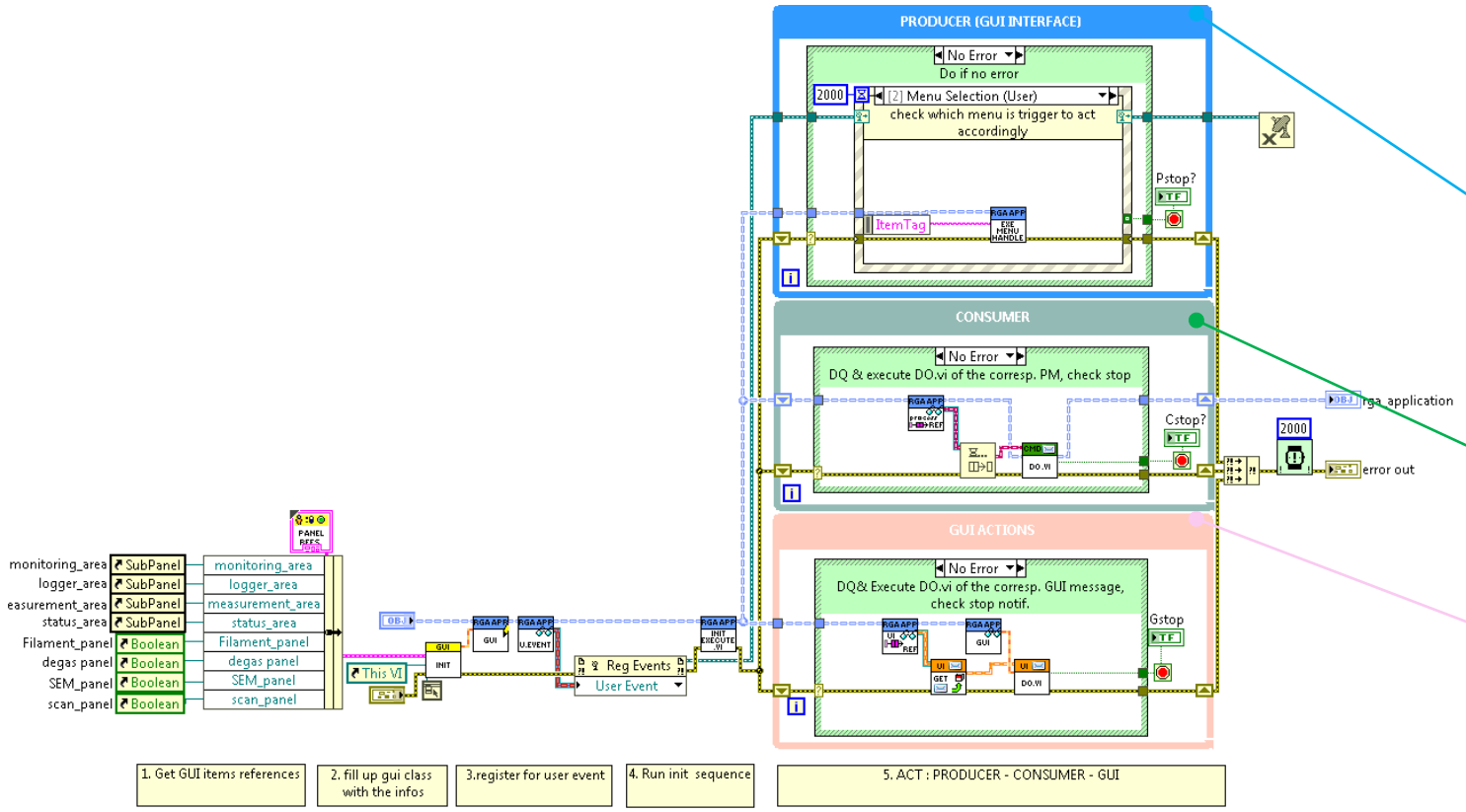




1.Setup : Selection of the RGA, configuration, and communication tests
2. Startup : Launch of specific additional processes that may be requiered
3. Execute : This is the core code, with the user interface
4. Shudown : Handle the shutdown of the application

LABVIEW DESIGN

CORE Code Architecture is based on **OOP** **Plugin Architecture template**



CORE CODE IMPLEMENTATION

CORE CODE BASED ON MESSAGING TEMPLATE.

3 CORE PROCESSES

PRODUCER

Handles users interaction and other requests

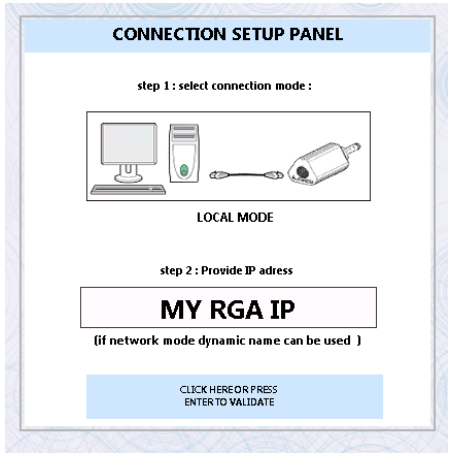
CONSUMER

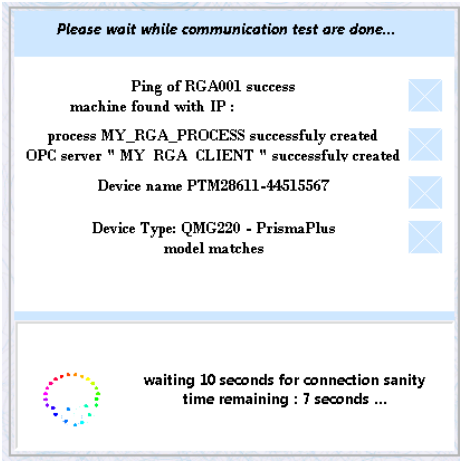
Perform actions related to core code.

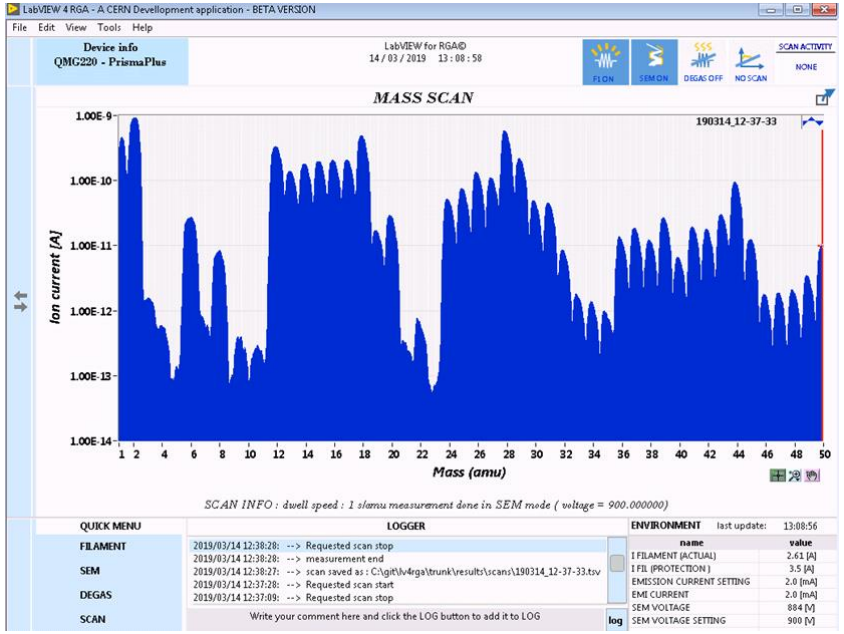
GUI LOOP

Handles the actions Related to the GUI

LABVIEW DESIGN : APPLICATION WORKFLOW







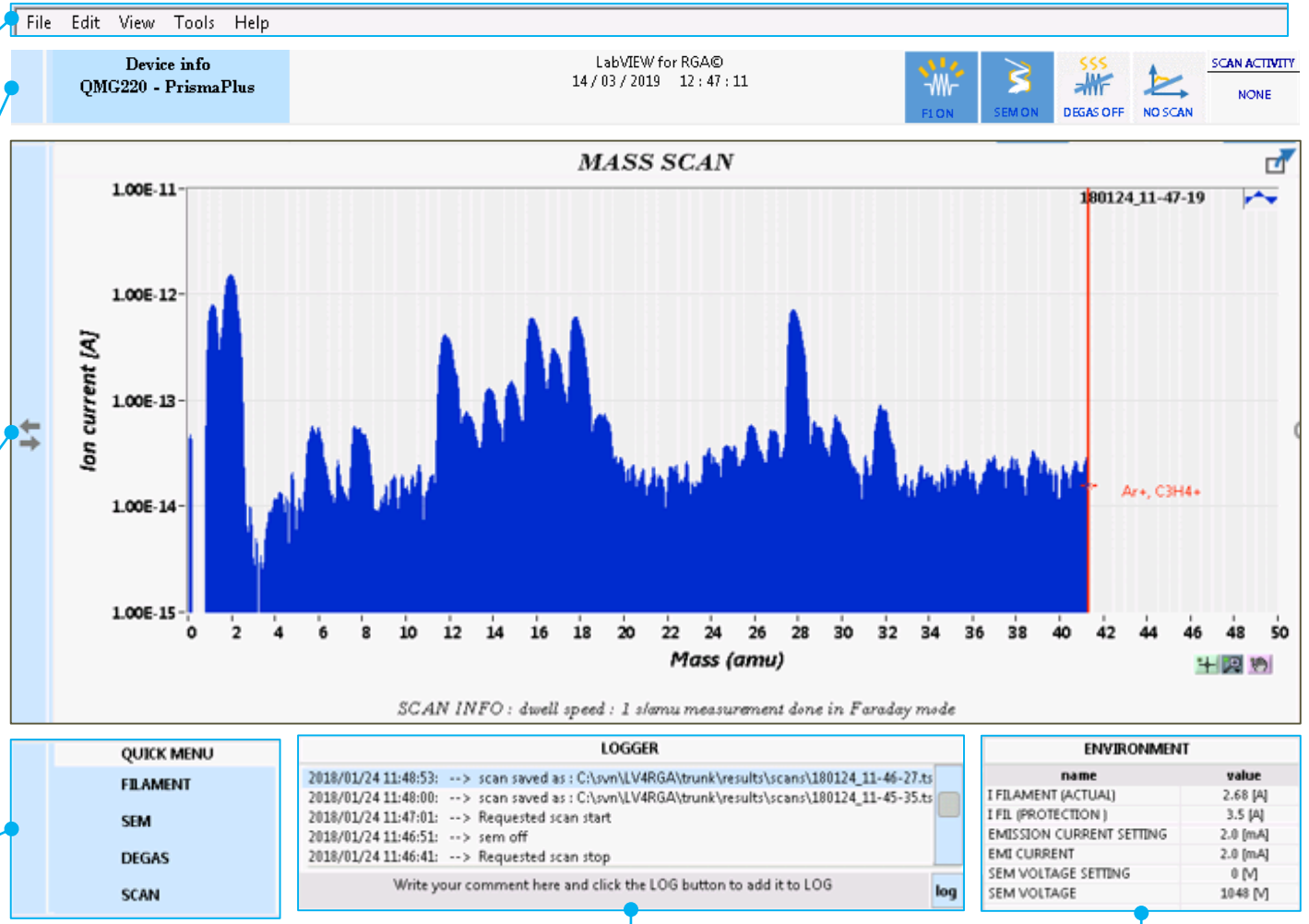
USER INTERFACE

Specific menus, populated at start for each RGA :
- Data export
- Display switch
- Access to RGA specific Options such as Ion source parameters for Prisma plus or Environment Parameters for Hiden

RGA Status and information

Graphical area :
Display of Mass scan, MID scan , scan history, scan overlays

Quick menus access:
Filament options
SEM options
Degas operations
Scan Operations



Application log

RGA Environment data

IMPORTANT INFORMATION

- This tool can be used by **anyone** from CERN.
- It is available **today** and can be found here : **\\cern.ch\dfs\Services\PMA\Vacuum\RGA\lv4rga installer**
- A user guide is available with it and describes all the software and the installation procedure.
- You must have manufacturer softwares previously installed before using the application.
- For RGA using Ethernet protocols : You have to use the manufacturer tools to get the IP. There is no IP detection tool included in the LabVIEW software
- All questions, requests, feedbacks can be addressed to Bernard HENRIST (TE-VSC-VSM)

IMPORTANT INFORMATION

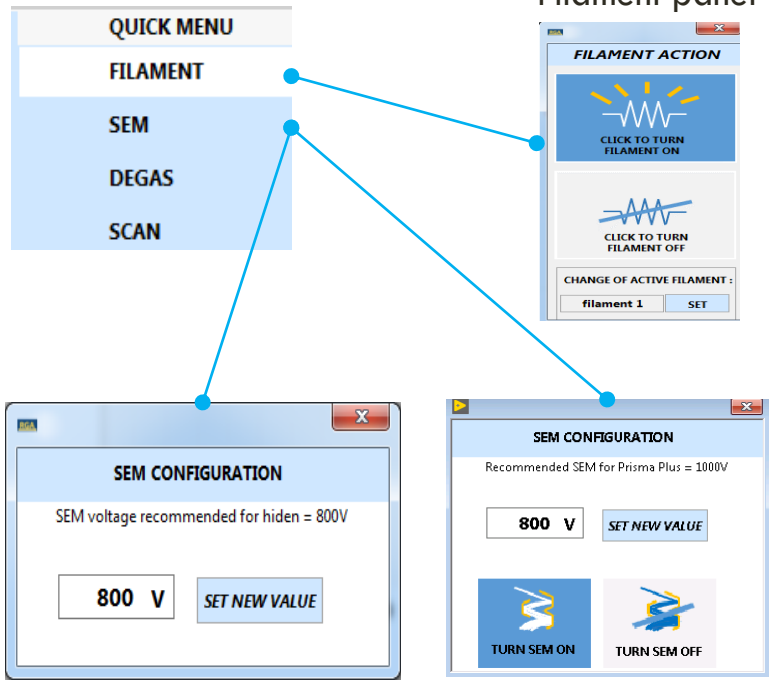
Original development done by :	**Antoine BENOIT**	TE/VSC/VSM
under supervision of :	Adriaan RIJLLART	EN-SMM-MTA
	Odd Oyvind Andreassen	EN-SMM-MTA
	Berthold JENNINGER	TE-VSC-VSM
And special Support of :	Sophie MEUNIER	TE-VSC-VSM
	Bernard HENRIST	TE-VSC-VSM
	Vincent BAGLIN	TE-VSC-VSM
	The LabVIEW TEAM	EN-SMM-MTA

- Contact persons for the application

DEMO

THANKS YOU FOR YOUR ATTENTION !

FUNCTIONALITIES : STATUS VIEW, FILAMENT CONTROL, SEM CONTROL AND DEGASSING



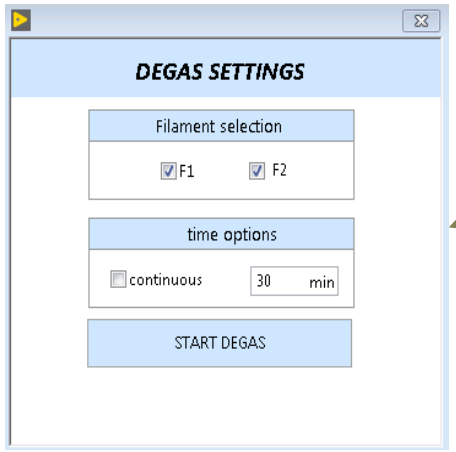
Filament panel

Hiden SEM panel

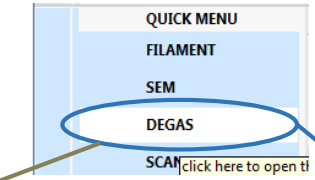
Prisma plus and Hiquad SEM panel

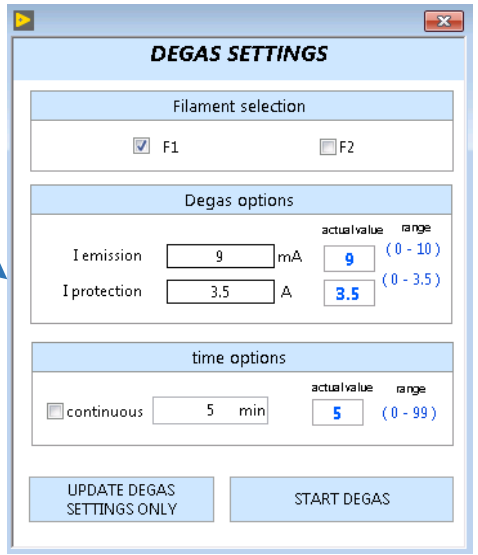
Hiden Status bar

Prisma and Hiquad Status bar



HIDEN panel for filament degassing

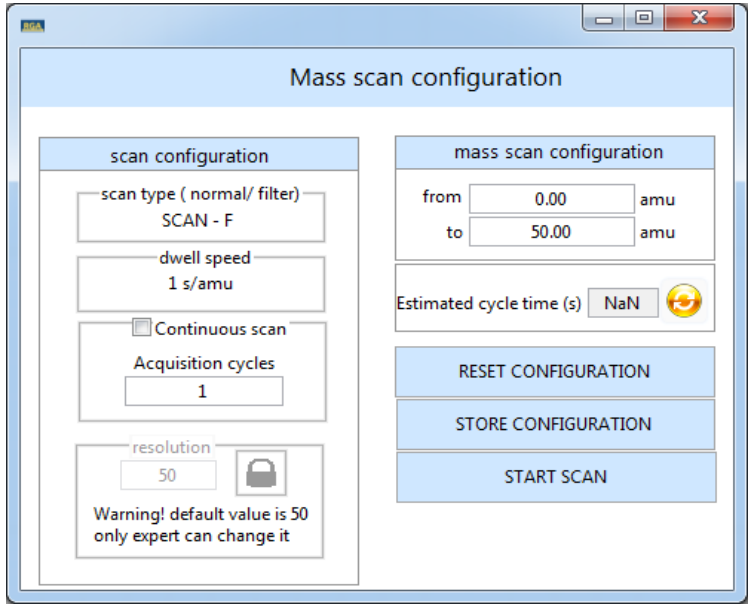




PFEIFFER panel for filament degassing

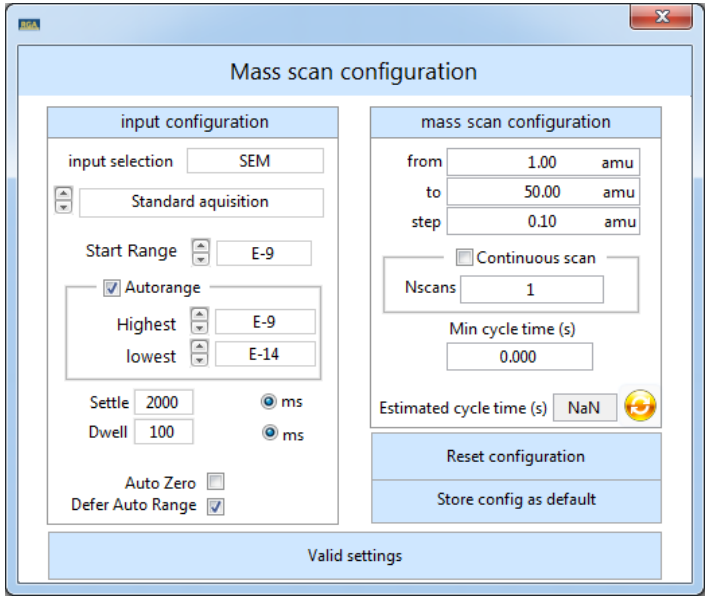
FUNCTIONALITIES : MASS SCANS CONFIGURATION

Mass scan configuration panel for Prisma plus and Hiquad

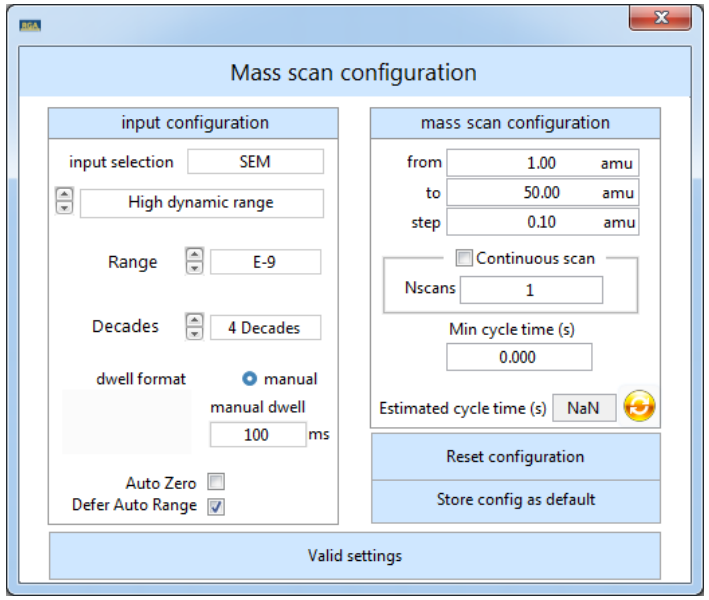


Mass scan configuration panel for Hiden

Standard mode

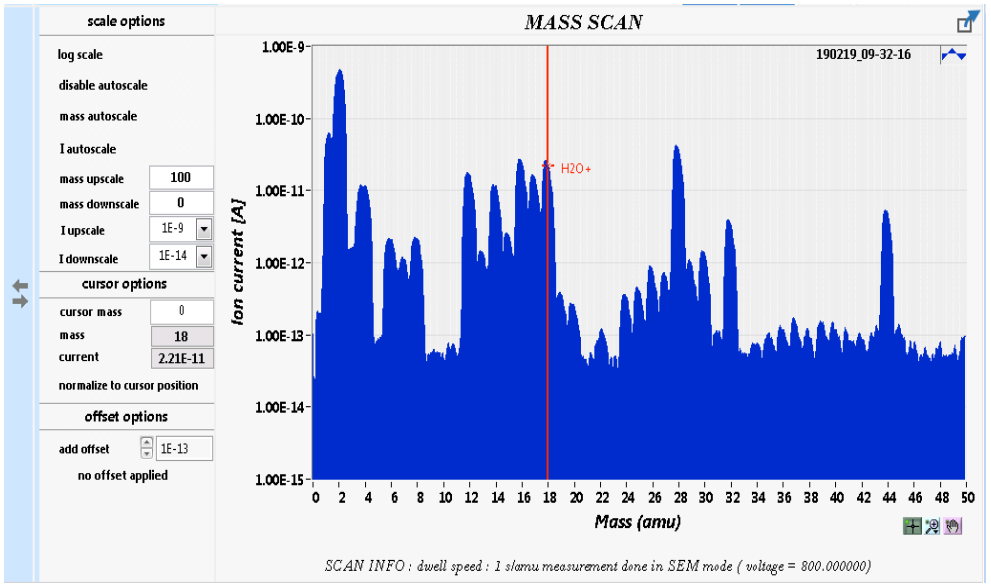


High dynamic range mode



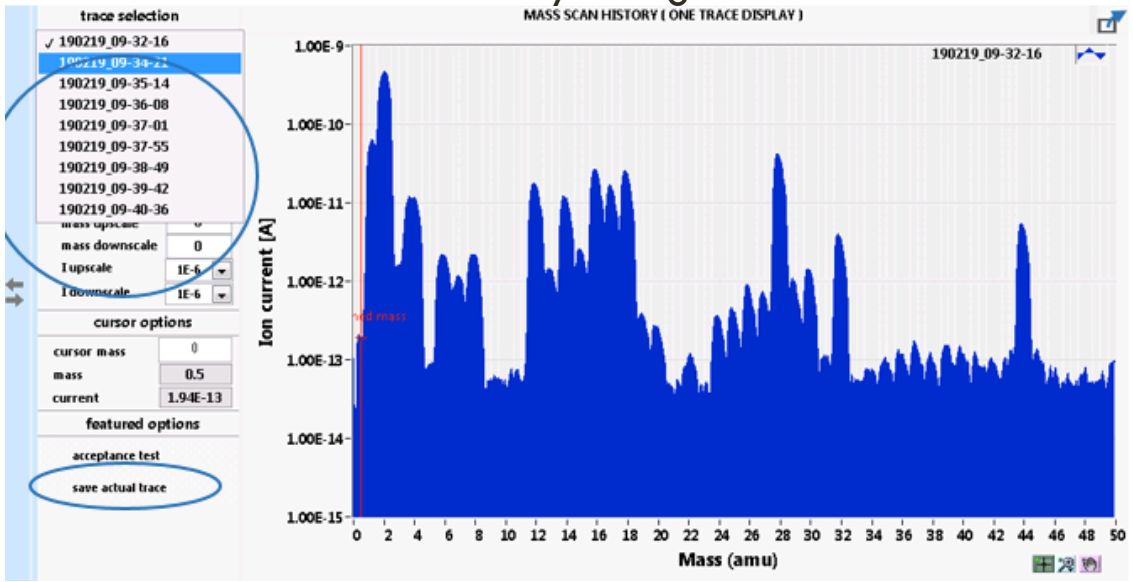
FUNCTIONALITIES : MASS SCANS VISUALIZATION

actual scan view



View actual scan
Scan automatically saved when
Can be manually export to destination of choice from the file menu

Scan history navigation view



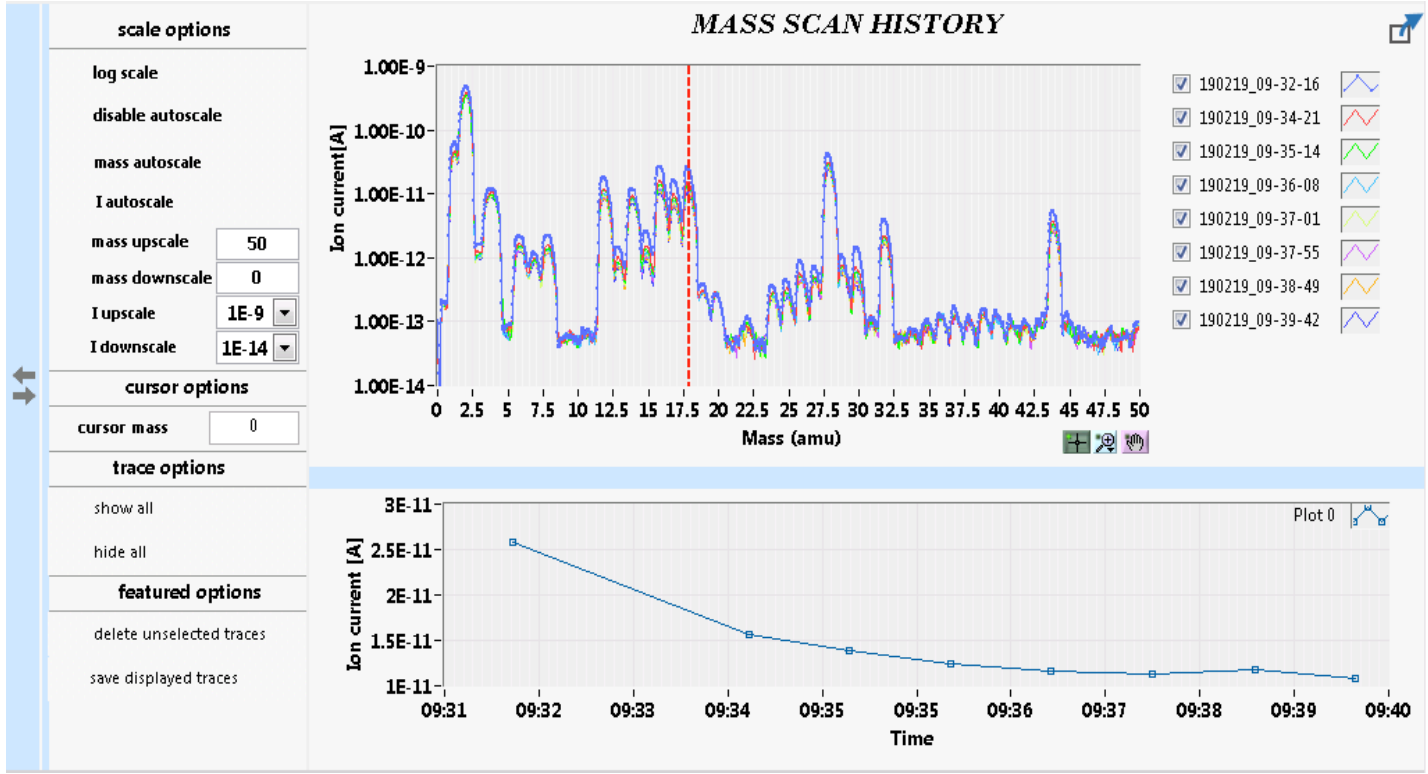
View previous scan
Export of selected scan
Select scan to perform acceptance test

FUNCTIONALITIES : MASS SCAN OVERLAY

Visualize all scan Overlayed

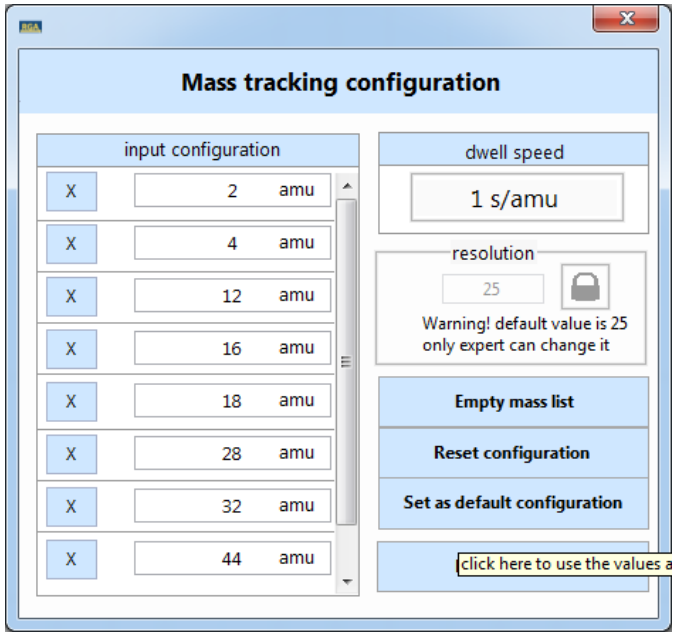
Get MID over mass scans view using the cursor

Export selected traces all together in the same file.

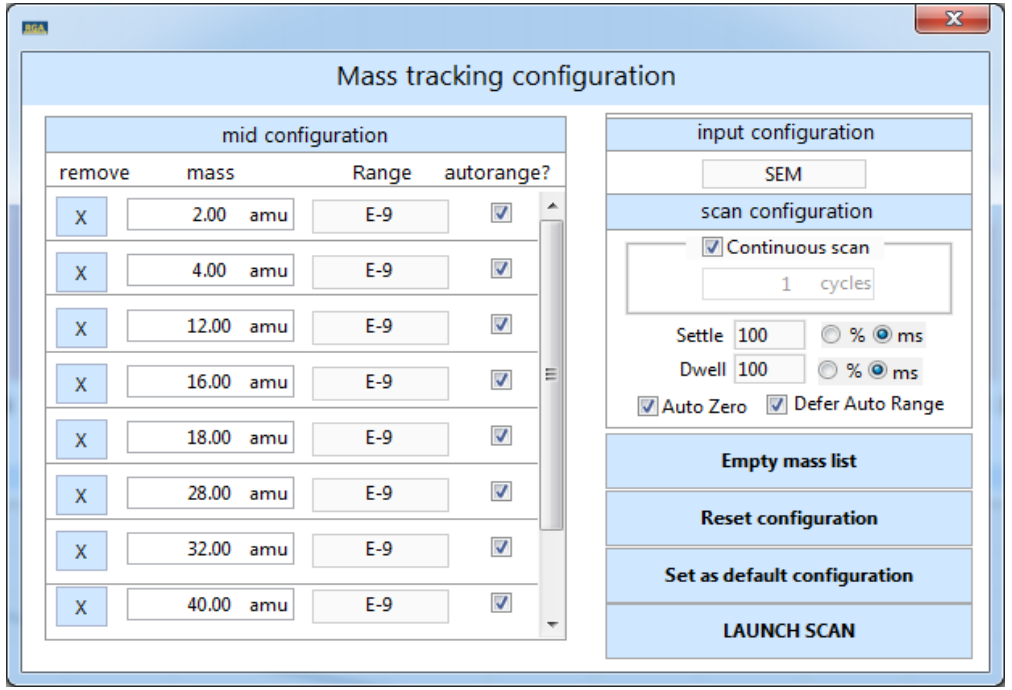


FUNCTIONALITIES : MID SCAN

MID scan configuration panel for Prisma plus and Hiquad



MID scan configuration panel for Hiden



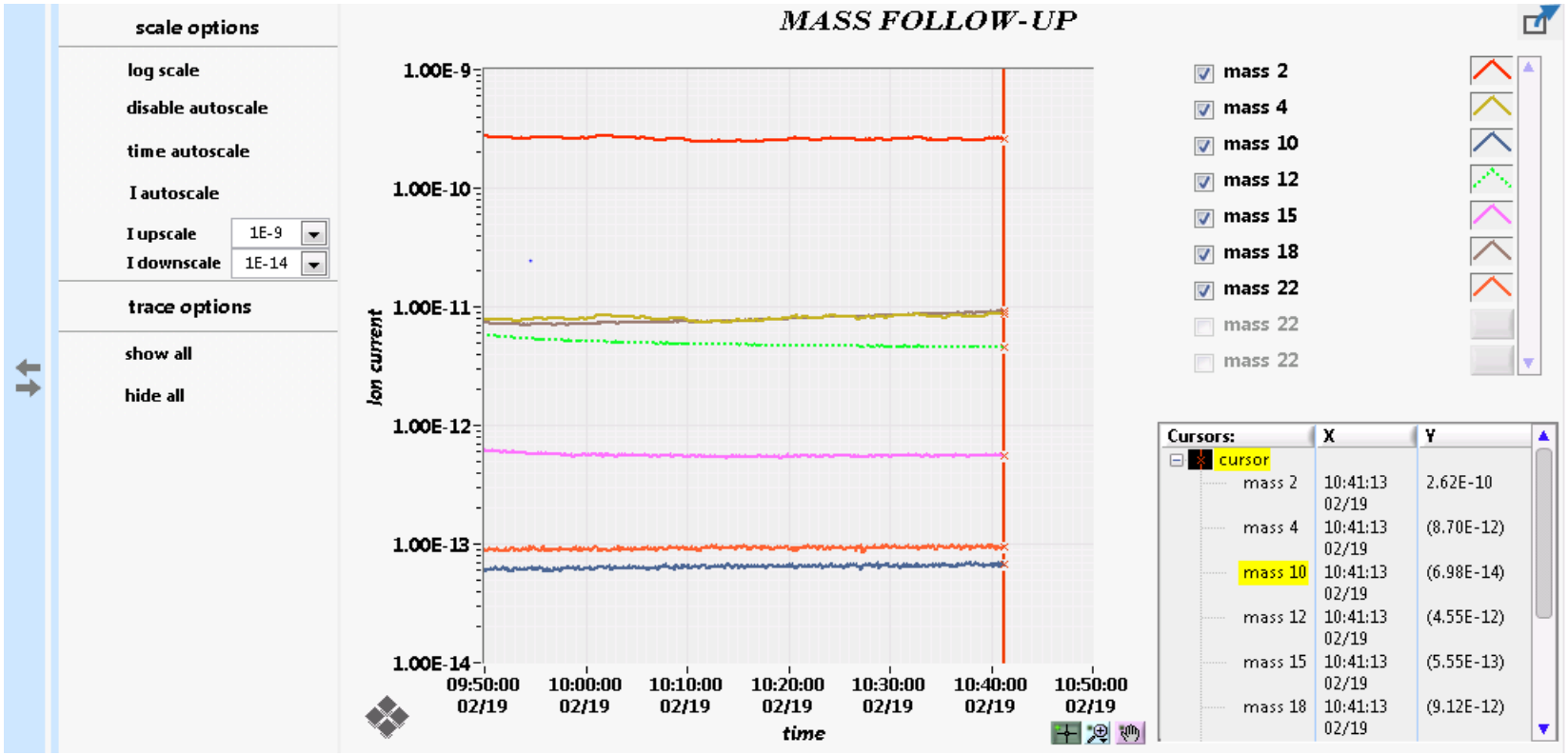
MID SCAN VISUALIZATION

Visualize MID scan

Use cursor to get value at specified time

Show hide traces for comfort

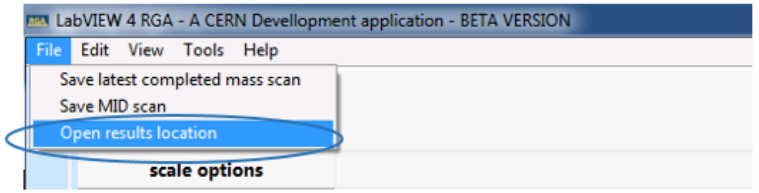
Automatically saved. But can be exported to destination of choice from file menu.



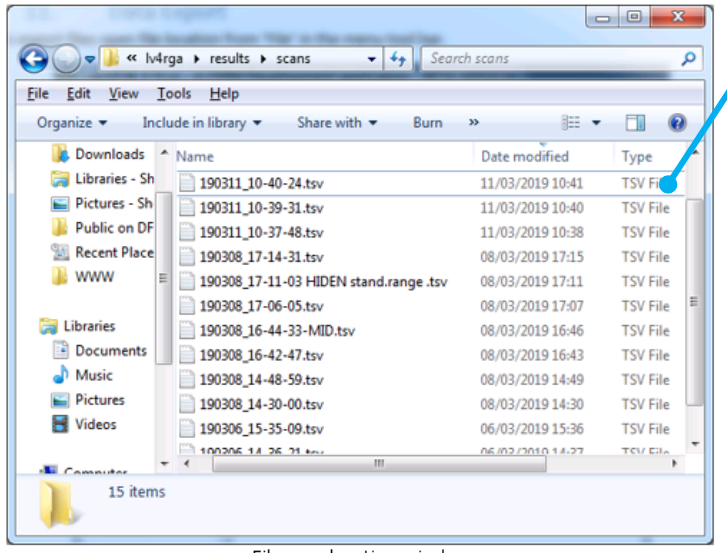
SCAN FILES

Scan are automatically saved in the result folder of the rga application.

All scan files are text format *.tsv to be easily processed with excel, matlab, python, labview, or whatever tool you like.



Tool Bar Menu - File Access

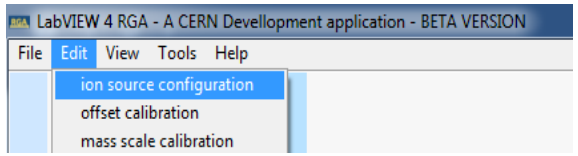


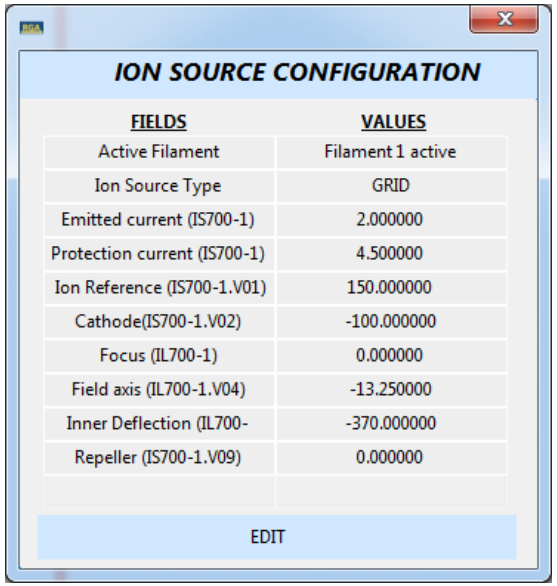
File save location window

	A	B
1	user name	antoine BENOIT
2	information	test session
3	COMMENT	this is an autosaved scan
4	Partial pressure	not specified
5	SCAN NAME	190314_12-37-33
6	RGA info	QMG220 - 64-D2-41-01-20-80
7	Active Filament	Filament 1 active
8	Ion Source Type	HIGH SENSITIVITY
9	Emission Current (IS220-1)	2
10	Protection current (IS220-1)	3.5
11	RF Polarity	NEGATIVE
12	Ion reference (IS220-1.V01)	150
13	Cathode (IS220-1.V02)	-65
14	Focus (IS220-1)	-8.5
15	Field axis (IS220-1.V04)	-7
16	Extraction (IS220-1.V05)	-40
17	mass resolution	50
18	EP1 OFFSET E-05	-6.10426E-10
19	EP1 OFFSET E-06	-3.96777E-10
20	EP1 OFFSET E-07	-6.10426E-12
21	EP1 OFFSET E-08	-3.96777E-12
22	EP1 OFFSET E-09	6.10426E-14
23	EP1 OFFSET E-10	3.96777E-14
24	EP1 OFFSET E-11	4.24246E-14
25	EP1 OFFSET E-12	3.61677E-14
26	FIRST MASS	0
27	LAST MASS	50
28	DWELL SPEED	1 s/amu
29	MEAS UNIT	Ampere
30		
31		
32	SEM STATE	ON
33	SEM VOLTAGE	900
34	Mass	Current
35	0	1.08758E-12
36	0.03125	4.98739E-13
37	0.0625	1.665E-13
38	0.09375	4.47692E-14
39	0.125	4.19696E-14
40	0.15625	1.53666E-13
41	0.1875	4.66102E-13
42	0.21875	1.03289E-12
43	0.25	1.73096E-12
44	0.28125	2.3195E-12
45	0.3125	2.66603E-12
46	0.34375	2.8161E-12

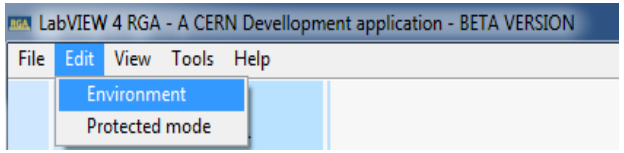
ION SOURCE AND ENVIRONMENT DATA

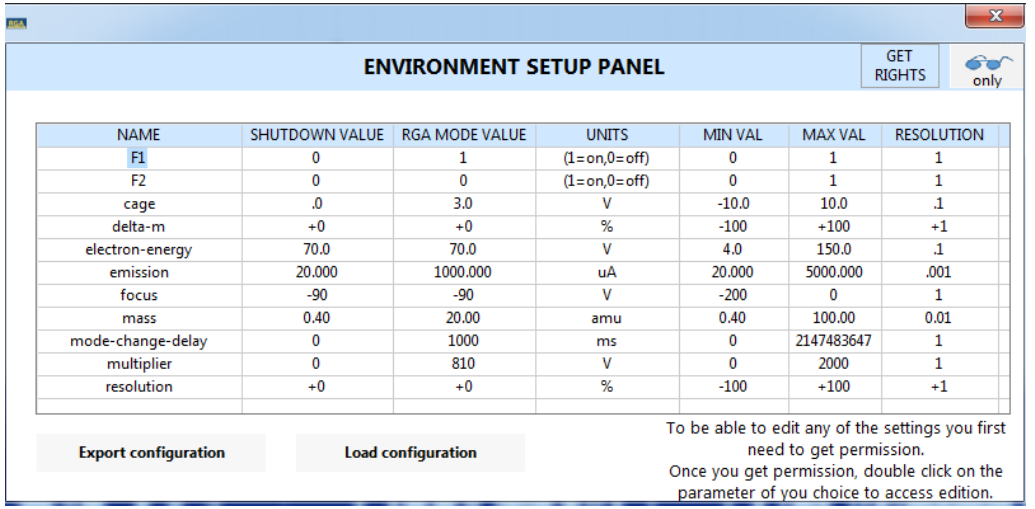
Ion source configuration for Prisma and Hiquad





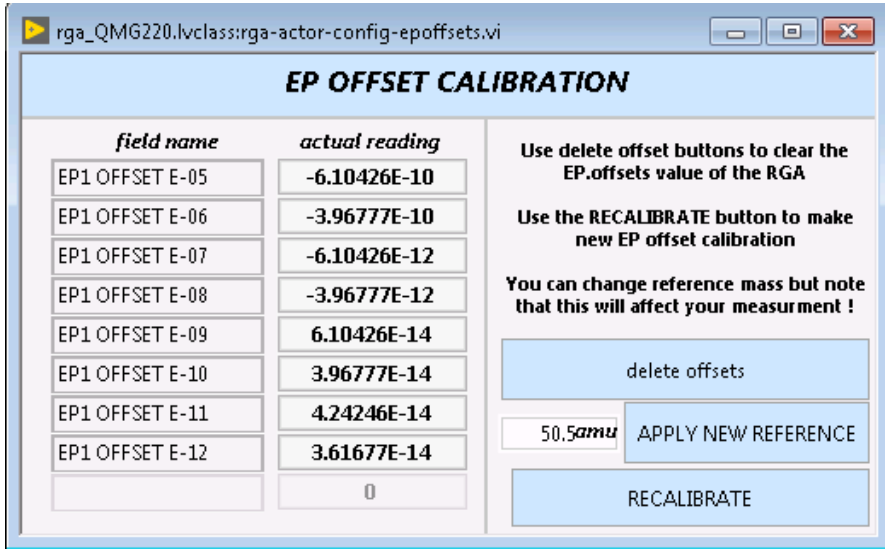
Environment configuration for Hiden





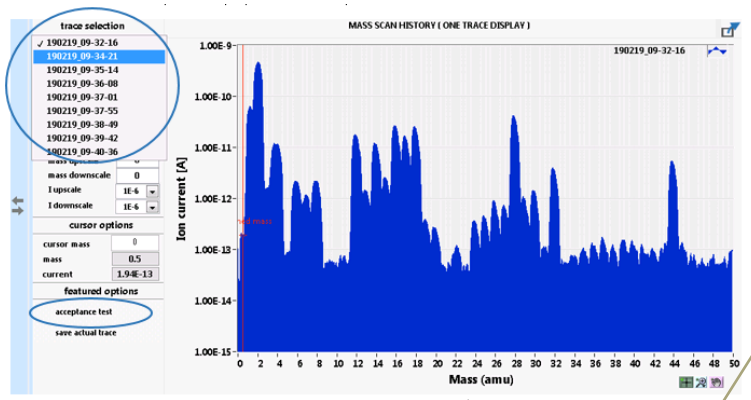
FUNCTIONALITIES : EP OFFSETS FOR PFEIFFER RGAS

For Hiquad and Prisma plus,
Standard users can access the EP Offset panel and visualize the values.
Experts can perform and EP Offset calibration

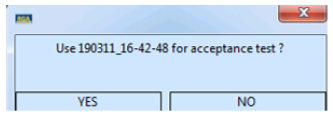


ACCEPTANCE TEST

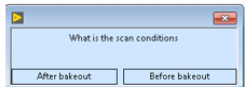
From the scan navigator window, user can select a scan to perform an acceptance test.
He can select condition of scans as before or after bakeout to apply the corresponding acceptance test limits

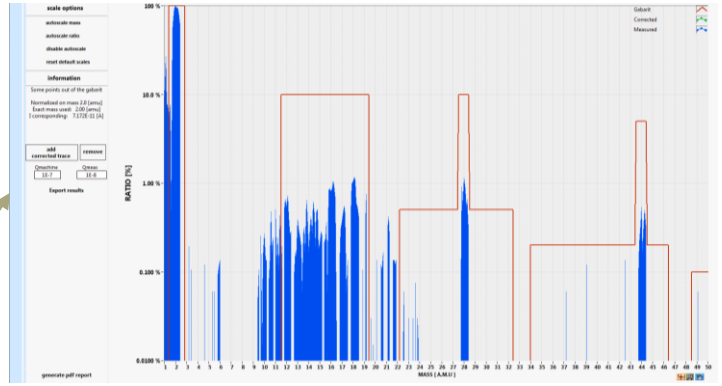


RGA View Mass Scan History Window

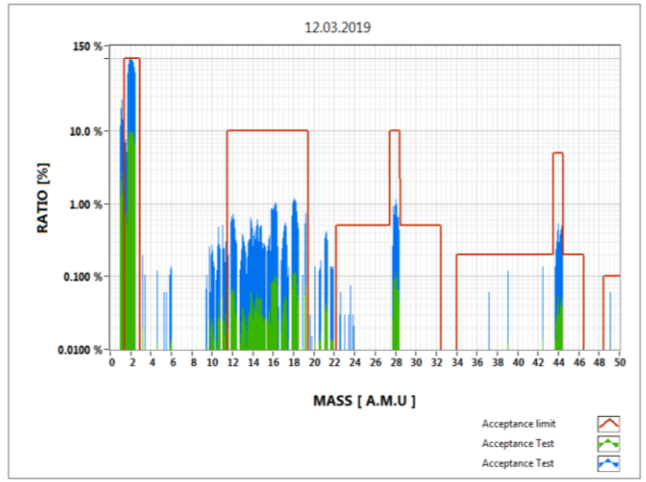


Select YES to confirm cycle for acceptance test.





The acceptance can be exported as pdf image or as text file.



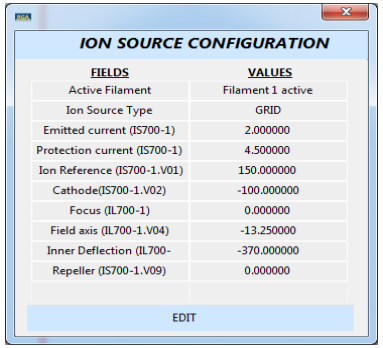
Acceptance test results as pdf

EXPERT VS STANDARD USER INTERFACE

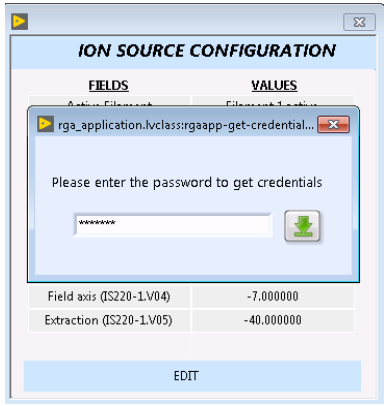
The interface is the same.

Only difference is that expert can access extra functions via the expert password.

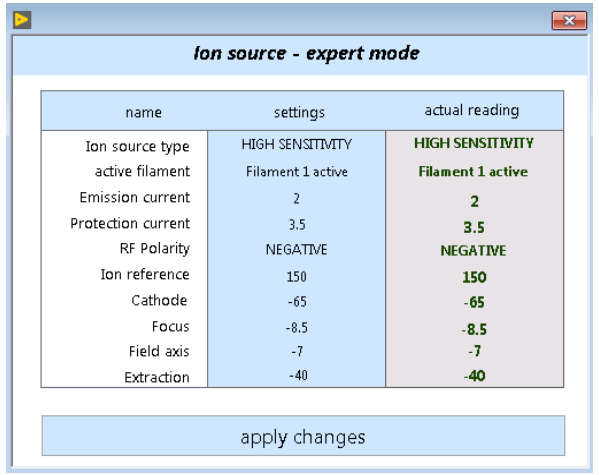
This strategy is to prevent basic users from editing parameters they should not need to touch.



Standard user panel
Cannot edit values



Enter expert password



Expert panel : can edit parameters

LABVIEW DESIGN