

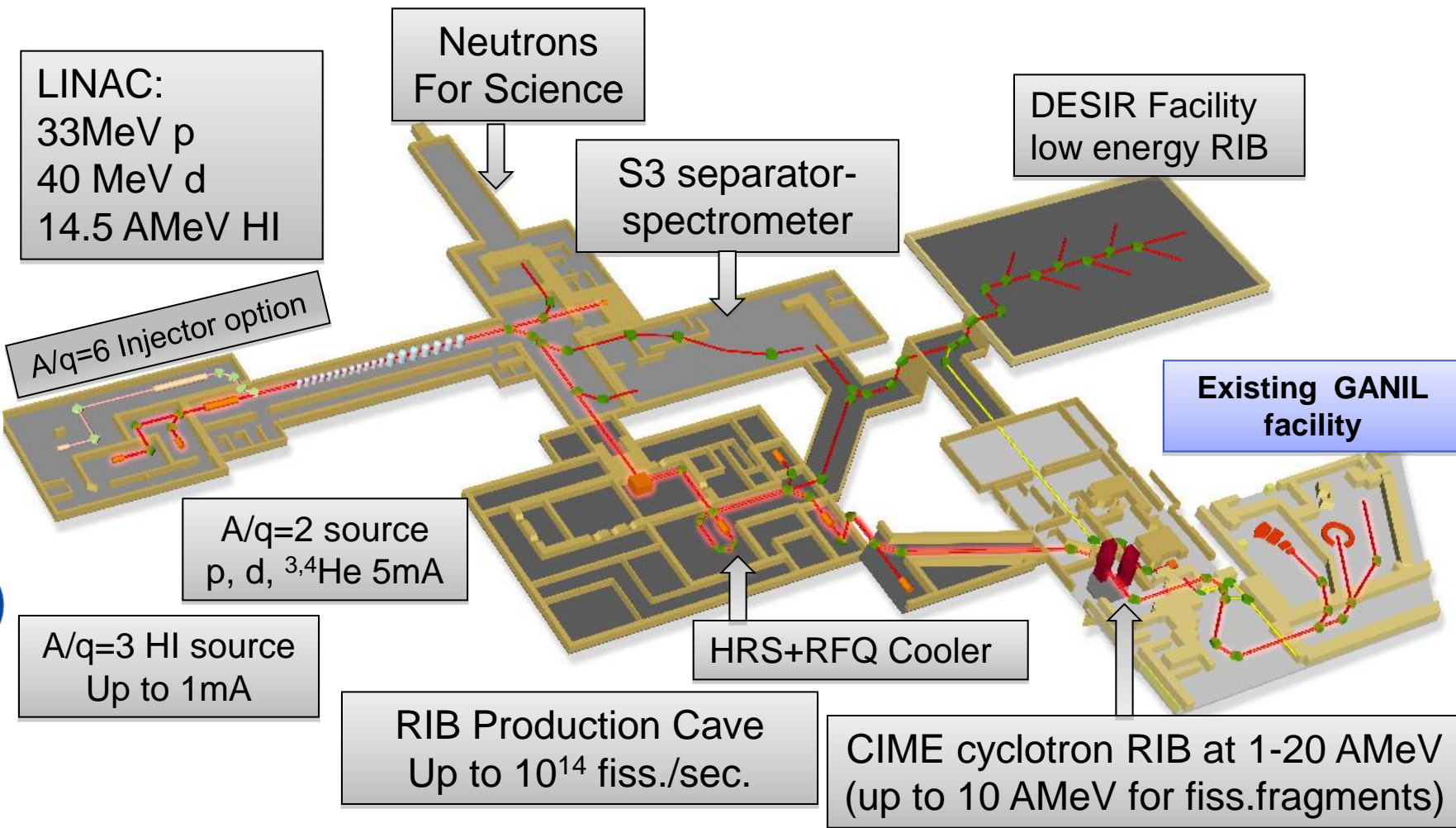
# Spiral2 OPEN XAL applications

WORKSHOP OPEN XAL  
FRIBT/MSU, December 2012

# Summary

- ✓ SPIRAL2 facility.
- ✓ Specificities of spiral2.
- ✓ Environnement for OPEN-XAL.
- ✓ Applications.
- ✓ Tools developped.
- ✓ Changes to the core.
- ✓ Conclusions.





- 1 injector , 2 sources ( $Q/A=1/2$  &  $Q/A=1/3$ ).
  - 1 injector ( $Q/A = 1/6$ ) planned.
- Multiple beams can be accelerated with multiple energy and intensity.

	Q/A	Intensity range mA	Energy range MeV/u	Cw max power kW
Protons	1	0 - 5	2 - 33	165
Deutons	1/2	0 - 5	2 - 20	200
Ions	1/3	0 - 1	2 - 14.5	43.5
Ions	1/6	0 - 1	2 - 8.5	51

→ many different tunings

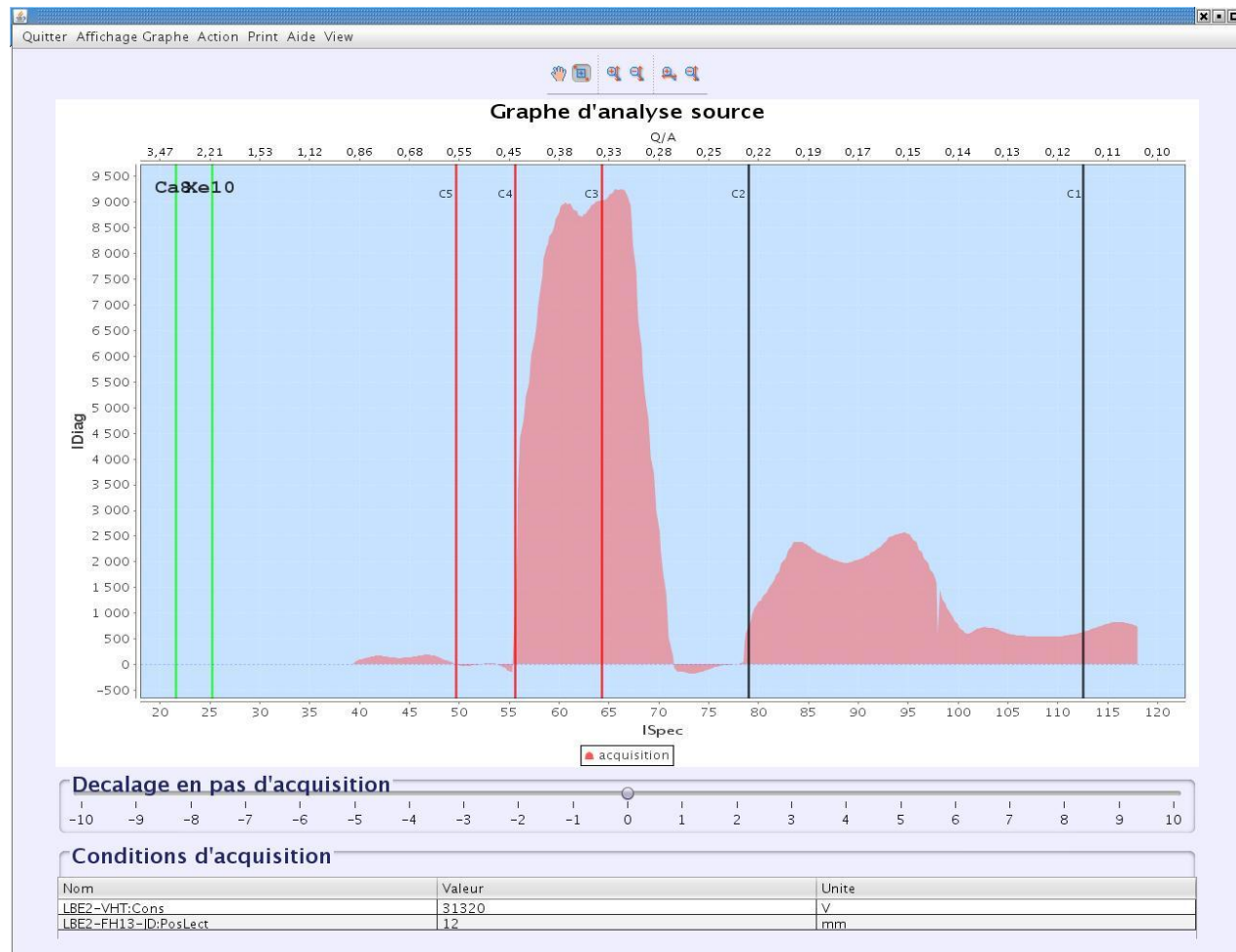
- We have to keep some compliance with the GANIL legacy control system (wrote in Ada/X11 Motif) .
- Implementation of graphical standards in accordance with CSS/EDM applications.
  - not done in all applications, for the moment.
- Tools outside of XAL for creation of parameters set:
  - Tracewin (3D maps. Envelope and multi particles simulations )
  - GenLinWin (for the LINAC cavities)
  - Toutatis (for the RFQ)
- Open-XAL used for control and command of equipments, not only for high-level applications.

- Linux REDHAT ENTREPRISE 5.1.19.
  - Tests for CentOS planned in December 2012
- Java 1.7 JDK-1.7.0\_05.
- CAJ.
- Eclipse Juno.
- Nimbus look and Feel.
- SVN 1.7.4.
- DataBase => INGRES.
- Until 11/2012 : XAL SNS version,  
=> **Almost all applications on OpenXal now.**

Mass Spectroscopy of species at the output from ions sources.

- Peaks identification
- Tagging of species.
- Total efficiency calculation or by peaks.

Firsts steps.



admittance - /home/gillette/SP2/appli\_java/ResCom/accFiles/Ganil/ProfilsD5.xal

Fente	demi largeur init	demi largeur voulue	demi largeur lue	cdg init	cdg voulu	cdg lu	joue	joue init	joue voulu	joue lu	joue	joue init	joue voulu	joue lu
LBEC_FH32	2,828	6,325	4,899	0,000	0,000	0,000	LBEC-FH32-JD	-2,828	-6,325	-4,899	LBEC-FH32-JC	2,828	6,325	4,899
LBEC_FH33	2,000	4,472	3,464	0,000	0,000	0,000	LBEC-FH33-JD	-2,000	-4,472	-3,464	LBEC-FH33-JC	2,000	4,472	3,464
LBEC_FH34	2,828	6,325	4,899	0,000	0,000	0,000	LBEC-FH34-JD	-2,828	-6,325	-4,899	LBEC-FH34-JC	2,828	6,325	4,899
LBEC_FV32	5,000	9,798	4,000	0,000	0,000	0,000	LBEC-FV32-JB	-5,000	-9,798	-4,000	LBEC-FV32-JH	5,000	9,798	4,000
LBEC_FV33	4,224	6,928	2,828	0,000	0,000	0,000	LBEC-FV33-JB	-4,224	-6,928	-2,828	LBEC-FV33-JH	4,224	6,928	2,828
LBEC_FV34	5,000	9,798	4,000	0,000	0,000	0,000	LBEC-FV34-JB	-5,000	-9,798	-4,000	LBEC-FV34-JH	5,000	9,798	4,000

**LBEC HO**

LBEC HO SPIRAL2

Admittance relue : .030  $\text{Pl}^*\text{mm}^*\text{mrad}$

Admittance voulue : .050  $\text{Pl}^*\text{mm}^*\text{mrad}$

facteur forme 1,164

coeff e 1,000

taille profil cental (rms) 1,74 mm

**LBEC VE**

LBEC VE SPIRAL2

Admittance relue : .030  $\text{Pl}^*\text{mm}^*\text{mrad}$

Admittance voulue : .120  $\text{Pl}^*\text{mm}^*\text{mrad}$

facteur forme 1,164

coeff e 1,000

taille profil cental (rms) 2,702 mm

Apply

Adjust the admittance reduction with 3 sets of slits (6 motors).

The user gives the admittance wanted or the FWHM on the control beam profiler.

Successful tests with real beam line in Saclay in the second quarter 2012.



# Applications : Optimisation

Achievement of the minimization of objectives on a set of diagnostics.

Successful tests with real beam line in Saclay in the second quarter 2012 on deuteron beam in injector faraday cup.

The screenshot shows the 'Optimisation' software interface with several panels:

- Choix des elements:** A tree view showing selected elements like LBE2\_SOURCE, LBE2\_ANALYSE, and LBE2\_DC14\_HO.
- Choix des diagnostics:** A tree view showing selected diagnostics like LBE2\_ANALYSE, LBE2\_DC14\_HO, and LBE2\_DC15\_VE.
- Estimation initiale pour les elements et objectifs sur les diagnostics:** A table showing initial values for elements and objectives.
- Resultats de la minimisation:** A table showing the results of the minimization process, including the number of iterations and convergence criteria.
- Convergence vers les consignes:** A graph showing the convergence of the objective function over iterations.

Elements	Valeur Actuelle	Valeur depart	Valeur Min	Valeur Max	Pas	Plage %
LBE2_DC14_HO	-2,011	-2,011	-10	10	0,1	0
LBE2_DC15_VE	2,7	2,7	-10	10	0,1	0
LBE2_DC16_HO	-0,1	-0,1	-10	10	0,1	0

Elements	Valeur Actuelle	Valeur Depart	Ecart A
LBE2_DC14_HO	-4,023	-2,011	-2,013
LBE2_DC15_VE	5,394	2,7	2,694
LBE2_DC16_HO	-1,129	-0,1	-1,029

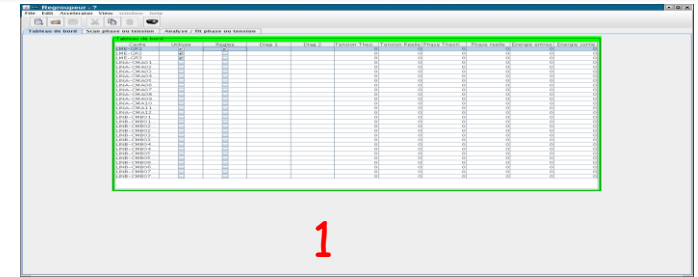
Iteration	Temps de calcul (s)	Critere de convergence
9	25,147	17,956

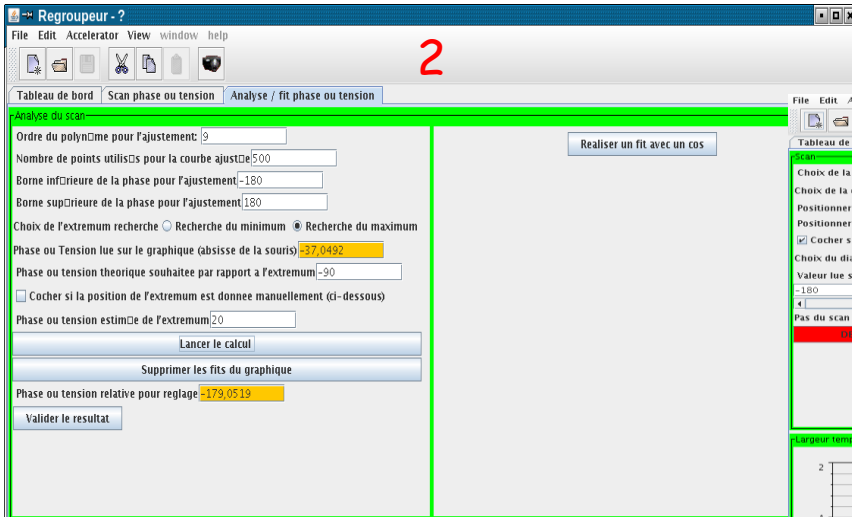
Diagnostics	Grandeur	Valeur Depart	Valeur Actuelle	Objectif	Ecart mm
LBE2_ANALYSE	HOCentroidRB	-4,88	-4,88	-0,547	-0,547

# Applications : Cavities tuning

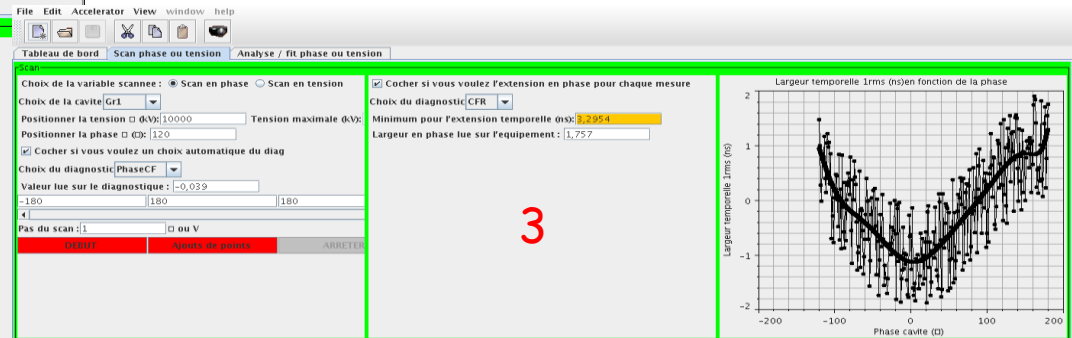
- Firsts steps (simulations) :
- Cavities choice **1**
  - Measure **2**
  - Calculation and Analysis **3**



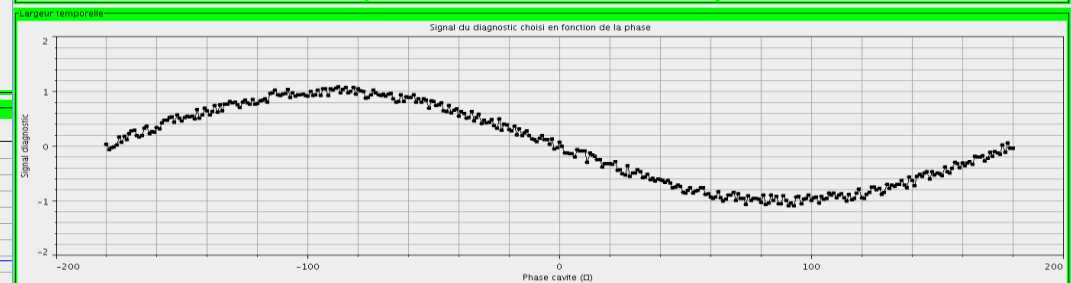
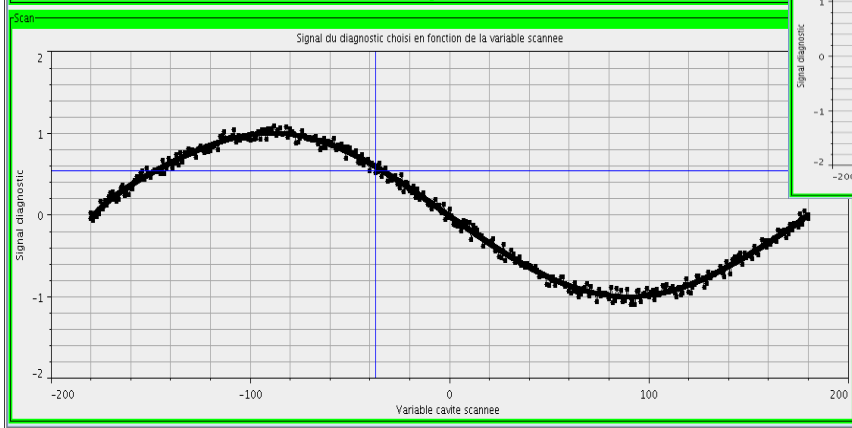
**1**



**2**



**3**



Phase or voltage scan to optimize tuning on extension phase diagnostics.  
Use XAL PLOT and an adaptation of XAL scan

# Applications : Hook

Generic command and control of equipments

Successful tests with real beam line in Saclay in the second quarter 2012:

- Profil 1
- Faraday Cup 2
- Slit + Motors 3
- Buncher 4
- MagnetSupply 5
  - state tab.
  - Info tab
  - Default tab
  - State word tab

# Applications: Profiles

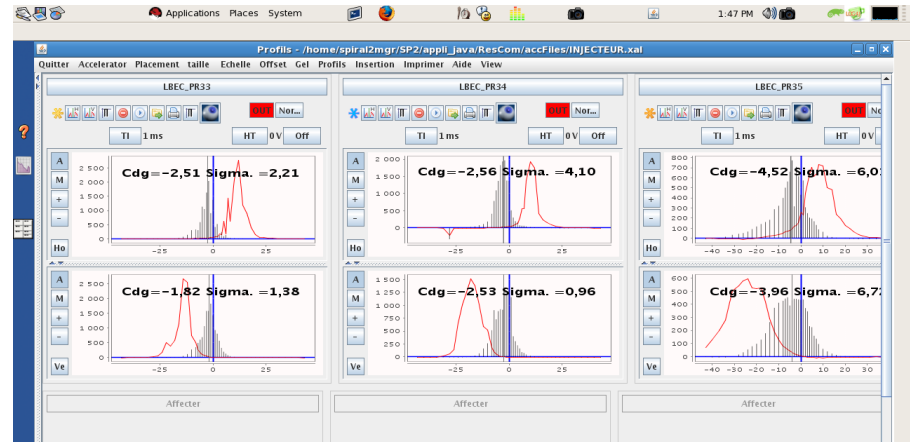
- Beam wire harps display and control **1**

*Successful tests with real beam line in Saclay in the second quarter 2012.*

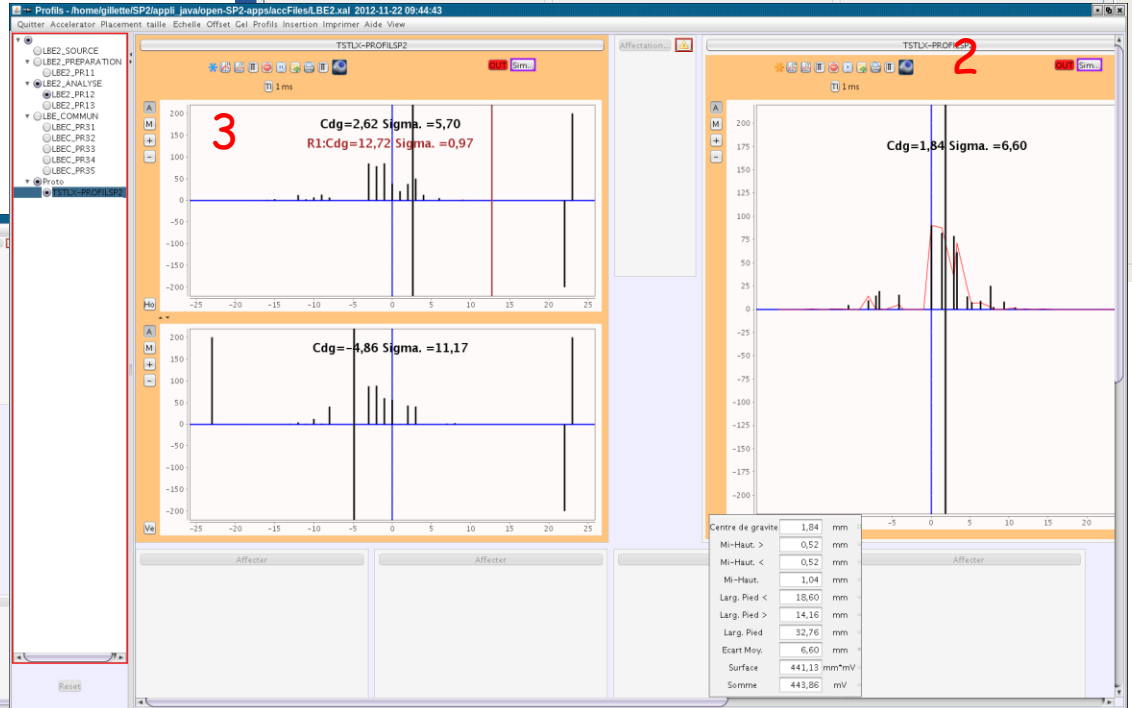
- Simulation and test mode **2**
- Multiple areas calculation **3**
- Broken wires selection. **3**
- Full control on the diagnostic **4**

- Expert panel.
- Integration time, high voltage.

1

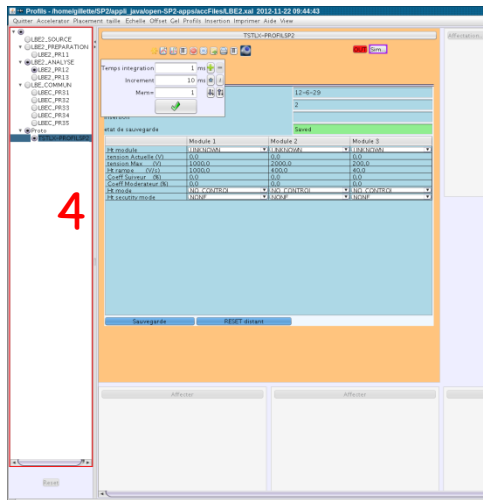


3



2

4





## Beam Parameters Management

- Accelerator Setup.
  - Optics choices.
  - Setup values selection.
- Write/read accelerator values.
- Comparison between
  - Theoretical
  - Live
  - Stored values
- Save and restore functions.
- Magnetic rigidity calculation for the lines.

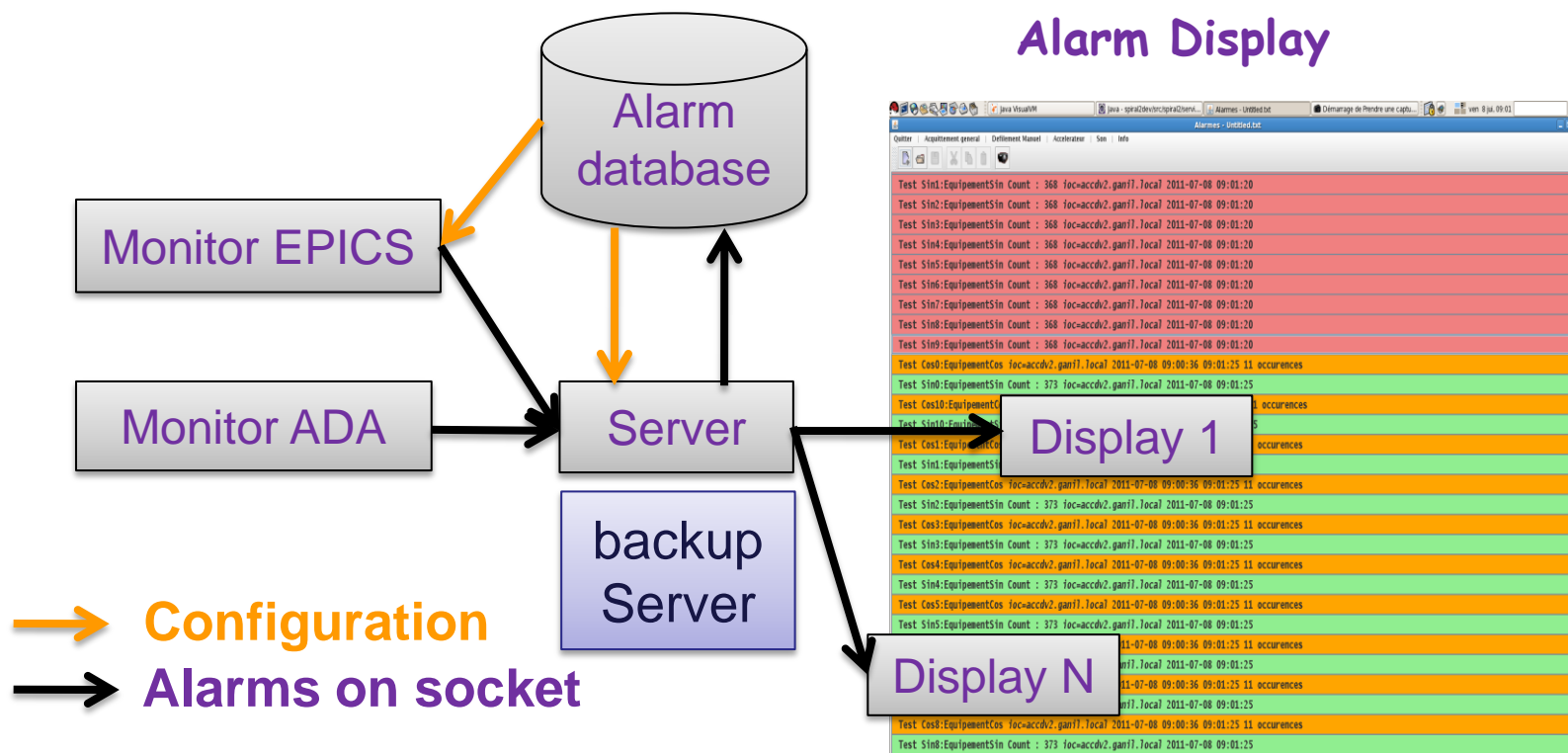
READ pour LIVE						
Nom	Equipement	Nature	Signal	LIVE	Unite	Default
<b>LBE2 PREPARATION</b>						
LBE2_SOL11		fieldRB	LBE2-SOL11:IAct T	0,001	T	
	LBE2-SOL11	I	LBE2-SOL11:IAct	0,05	A	
	LBE2-SOL11	psFieldRB	LBE2-SOL11:IAct T	0,001	T	
	LBE2-SOL11	I_Set	LBE2-SOL11:ICons	0,14	A	
	LBE2-SOL11	fieldSet	LBE2-SOL11:ICons T	0,0024	T	
LBE2_SOL12		fieldRB	LBE2-SOL12:IAct T	0,001	T	
	LBE2-SOL12	I	LBE2-SOL12:IAct	0,05	A	
	LBE2-SOL12	psFieldRB	LBE2-SOL12:IAct T	0,05	T	
	LBE2-SOL12	I_Set	LBE2-SOL12:ICons	0,14	A	
	LBE2-SOL12	fieldSet	LBE2-SOL12:ICons T	0,0024	T	
LBE2_DC11_HO		fieldRB	LBE2-DC11-HO:IAct T	0	T	
	LBE2-DC11-HO	I	LBE2-DC11-HO:IAct	0,05	A	
	LBE2-DC11-HO	psFieldRB	LBE2-DC11-HO:IAct T	0	T	
	LBE2-DC11-HO	I_Set	LBE2-DC11-HO:ICons	0,14	A	
	LBE2-DC11-HO	fieldSet	LBE2-DC11-HO:ICons T	0	T	
LBE2_DC11_VE		fieldRB	LBE2-DC11-VE:IAct T	0	T	
	LBE2-DC11-VE	I	LBE2-DC11-VE:IAct	0,05	A	
	LBE2-DC11-VE	psFieldRB	LBE2-DC11-VE:IAct T	0	T	
	LBE2-DC11-VE	I_Set	LBE2-DC11-VE:ICons	0,14	A	
	LBE2-DC11-VE	fieldSet	LBE2-DC11-VE:ICons T	0	T	
LBE2_PR11		VEArea	LBE2-PR11:VEArea	0,12	?	
		HOArea	LBE2-PR11:HOArea	0,25	?	
LBE2_D11		fieldRB	LBE2-D11:fieldRB	0,02	T	
	LBE2-D11	I	LBE2-D11:IAct	0,05	A	
	LBE2-D11	psFieldRB	LBE2-D11:IAct T	0,0001	T	
	LBE2-D11	I_Set	LBE2-D11:ICons	0,14	A	
	LBE2-D11	fieldSet	LBE2-D11:ICons T	0,0002	T	
<b>LBE2 ANALYSE</b>						
LBE2_PR12		VEArea	LBE2-PR12:VEArea	0,12	?	
		HOArea	LBE2-PR12:HOArea	0,25	?	
LBE2_Q14		fieldRB	LBE2-Q14:IAct T	0,0047	T.m	
	LBE2-Q14	I	LBE2-Q14:IAct	0,05	A	
	LBE2-Q14	psFieldRB	LBE2-Q14:IAct T	0,0047	T.m	
	LBE2-Q14	I_Set	LBE2-Q14:ICons	0,14	A	
	LBE2-Q14	fieldSet	LBE2-Q14:ICons T	0,0082	T.m	
LBE2_DC14_HO		fieldRB	LBE2-DC14-HO:IAct T	0	T	
	LBE2-DC14-HO	I	LBE2-DC14-HO:IAct	0,05	A	
	LBE2-DC14-HO	psFieldRB	LBE2-DC14-HO:IAct T	0	T	
	LBE2-DC14-HO	I_Set	LBE2-DC14-HO:ICons	0,14	A	
	LBE2-DC14-HO	fieldSet	LBE2-DC14-HO:ICons T	0	T	
LBE2_DC15_VE		fieldRB	LBE2-DC15-VE:IAct T	0	T	
	LBE2-DC15-VE	I	LBE2-DC15-VE:IAct	0,05	A	
	LBE2-DC15-VE	psFieldRB	LBE2-DC15-VE:IAct T	0	T	
	LBE2-DC15-VE	I_Set	LBE2-DC15-VE:ICons	0,14	A	
	LBE2-DC15-VE	fieldSet	LBE2-DC15-VE:ICons T	0	T	
LBE2_Q15		fieldRB	LBE2-Q15:IAct T	0,0047	T.m	
	LBE2-Q15	I	LBE2-Q15:IAct	0,05	A	
	LBE2-Q15	psFieldRB	LBE2-Q15:IAct T	0,0047	T.m	
	LBE2-Q15	I_Set	LBE2-Q15:ICons	0,14	A	
	LBE2-Q15	fieldSet	LBE2-Q15:ICons T	0,0082	T.m	
LBE2_Q16		fieldRB	LBE2-Q16:IAct T	0,0047	T.m	
	LBE2-Q16	I	LBE2-Q16:IAct	0,05	A	
	LBE2-Q16	psFieldRB	LBE2-Q16:IAct T	0,0047	T.m	
	LBE2-Q16	I_Set	LBE2-Q16:ICons	0,14	A	
	LBE2-Q16	fieldSet	LBE2-Q16:ICons T	0,0082	T.m	
LBE2_DC16_HO		fieldRB	LBE2-DC16-HO:IAct T	0	T	
	LBE2-DC16-HO	I	LBE2-DC16-HO:IAct	0,05	A	
	LBE2-DC16-HO	psFieldRB	LBE2-DC16-HO:IAct T	0	T	
	LBE2-DC16-HO	I_Set	LBE2-DC16-HO:ICons	0,14	A	
	LBE2-DC16-HO	fieldSet	LBE2-DC16-HO:ICons T	0	T	

- BD2XDXF : Generation of xdx files from data base Ingres using Spiral2AcceleratorNodeFactory.
- TraceWin2BD : insertion of theoretical values in data base Ingres
- GESTPARAM : management of the Spiral2 XAL data base ( value Sets, hierarchy, nodes , optics).

The screenshot displays the GESTPARAM software interface with several windows open:

- Gestion des paramètres**: Shows a tree view of the accelerator hierarchy. A dialog box titled "Modification de la position de LBE2\_D11" is open, showing fields for:
  - Abscisse curviligne absolue: 2.7609
  - Décalage horizontal: 0.0 en mètre
  - Décalage vertical: 0.0 en mètre
  - Décalage longitudinal: 0.0 en mètre
  - Inclinaison en X: 0.0 en degré
  - Déflexion en Y: 0.0 en degré
  - Rotation en Z: 0.0 en degré
  - Plan: H
- Gestion des types / sous-types / natures**: A menu on the left lists various management functions like "Gestion des natures des handles", "Gestion des types des noeuds", etc. A main window titled "Gestion des types des noeuds" contains a table:
 

Identifiant	Nom de la table	Description	Taille horizontale	Taille verticale	Forme	Description
CF	cf_kind	Cage de Faraday				
RF	rfcavities	Cavité RF	0,155	0,155	circule	SOL-B
B	dipoles	Dipoles avec corre...				
SLIT	slits	Fente				
HEX	hexapoles_kind	Hexapole				
HTTIPROFIL	profils_kind	Profilleur avec HT e...				
HTPROFIL	profile_kind	Profilleur avec HT e...				
- Composants de l'accélérateur**: A window titled "Modification du noeud LBE2\_D11" showing details for the selected node:
  - u noeud: LBE2\_D11
  - Type: Dipoles avec correction ...
  - us-type: Dipole de type B
  - Statut:  Activé  Désactivé
  - création: 2011-02-21
  - Partie: LBE2P
  - Position: Détails
- Optiques de faisceau**: A window titled "Modification de l'optique 63 de la voie LBE2\_LBEC" showing:
  - Nom de l'optique: Deutons 6.5mA
  - Date de création: 2011-08-26
  - Voie: LBE2\_LBEC
  - Description:
  - Ordre d'affichage: 0



- Rely on A Ingres database for configuration and storage issues
- Don't use EPICS Alarm Handler
- Supports a throughput of 330 alarms per seconds

# Tools : general use (1/5)

The screenshot displays the spiral2 application interface. On the left, a tree view shows a project structure with folders like 'LBE2\_SOURCE', 'LBE2\_PREPARATION', 'LBE2\_ANALYSE', 'LBE2\_FR11-13', 'LBE2\_COMMUN', 'LBE2\_FR31-35', 'Proto', and 'ESTIMATION'. The main area contains two vertically stacked plots, both showing a distribution of data points centered around zero. The top plot has a y-axis from 0 to 10,000 and an x-axis from -25 to 20. The bottom plot has the same axes. Below the plots are two 'Affecter' buttons. On the right, a help document titled 'Manuel utilisateur Profils' is open, showing a section on 'Grille d'affichage' (display grid) with a red '1' next to it. The document text explains that the selection grid is composed of cells whose size can be adjusted by clicking on the left angle of each cell. A smaller inset window shows a grid with parameters like 'Cdg=5prf=0,00' and 'Cdg=-10,33 Surf=-7,44'. A red '2' is placed near the top of the application window.

- Pdf Viewer
- Can be used with a call to an external application or an internalViewer. 1 (com.acrobat.viewer)
- Added to the help menu in the spiral2ApplicationAdaptor. 2



## Ion selection

- using standalone Mendeleiev XML file
- or
- database Mendeleiev Table.

## Returns

- a single ion
- or
- ions with  $Q_{min} \leq Q \leq Q_{max}$

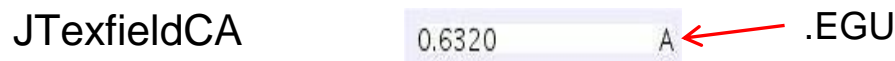
Element	Isotope	C...	C...
ANTIMOINE => Sb	8 => MA=8.038	1	3
ARGENT => Ag	<b>9 =&gt; MA=9.031</b>	<b>2</b>	4
ARGON => Ar	10 => MA=10.017	3	5
ARSENIC => As	11 => MA=11.011	4	<b>6</b>
ASTATINE => At	12 => MA=12.0	5	
AZOTE => N	13 => MA=13.003	6	
BARYUM => Ba	14 => MA=14.003		
BERKELIUM => Bk	15 => MA=15.011		
BERYLLIUM => Be	16 => MA=16.015		
BISMUTH => Bi	17 => MA=17.023		
BORE => B	18 => MA=18.027		
BROME => Br	19 => MA=19.035		
CADMIUM => Cd	20 => MA=20.04		
CALCIUM => Ca	21 => MA=21.049		
CALIFORNIUM => Cf	22 => MA=22.056		
<b>CARBONE =&gt; C</b>			

Nom: CARBONE A:9 Q:2 QMa  
 Symbol: C Masse atomique: 9.031 Masse ionique: 9.029902840178  
 Z: 6

Annuler Valider

- **CA TOOLS:** Swing components associated with a Channel Name

Autonomous, manage PV connection & update, easy to use : creation in 1 line only.



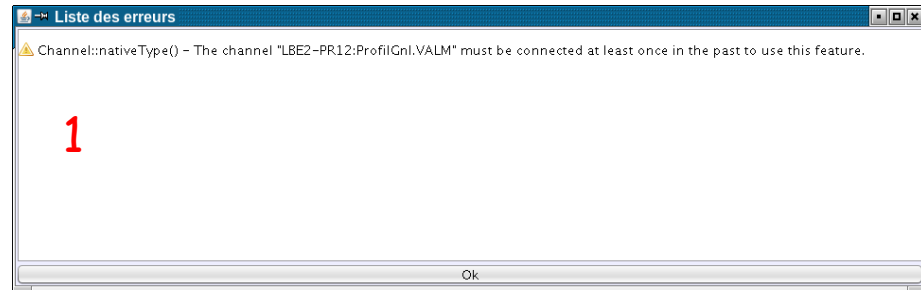
And also JButtonCmdCA, JCheckBoxCA, JTableCA, JSimpleLabelImageCA ...

See Hook application

## ExceptionNotifier 1

Each time an exception occurred the panel can be opened.

The list of exceptions are update in real time.



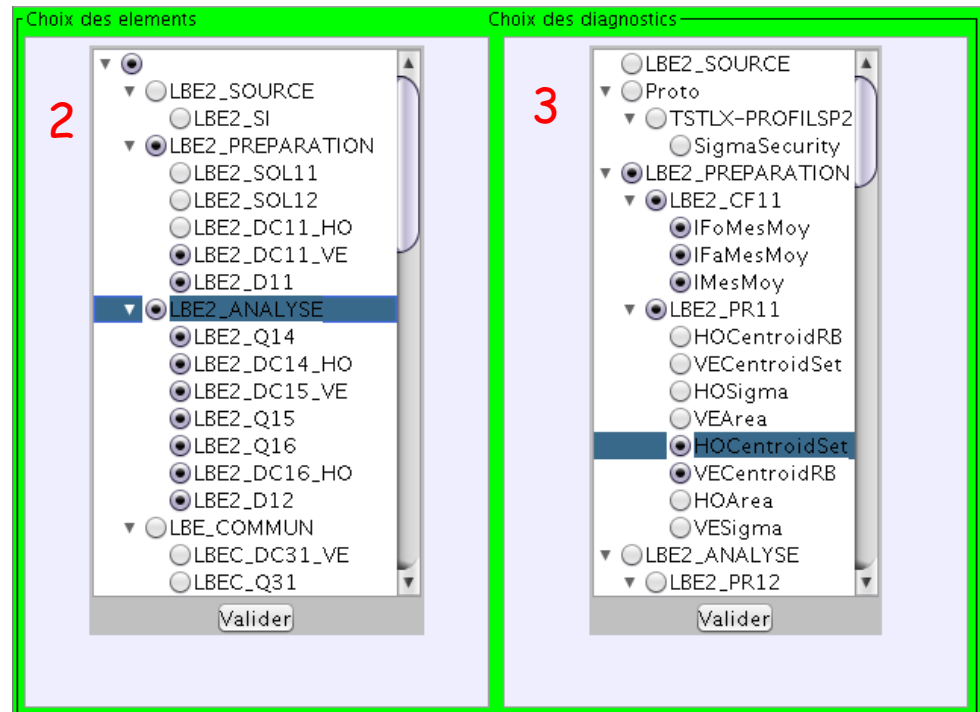
## MultiNodes Selector 2

Based on labbib-checkboxtree

## MultiHandles Selector 3

Based on labbib-checkboxtree

See Optimisation example

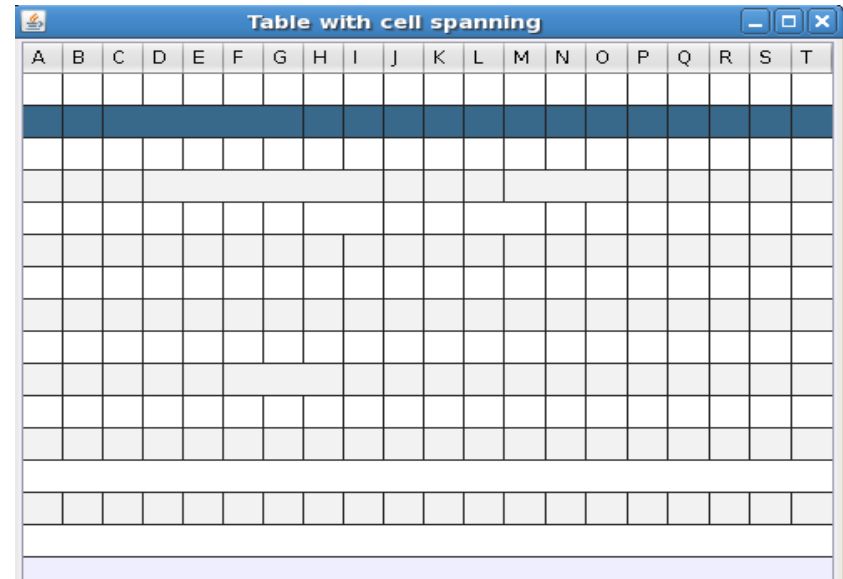


## Swing utilities

### Column Spanning Table.

Add line span support soon.

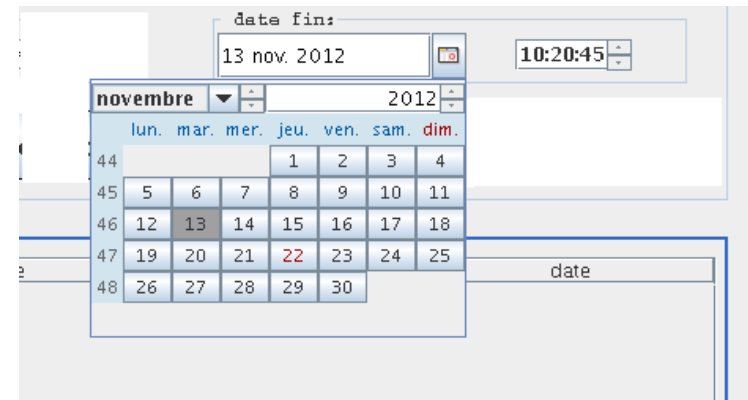
See Paraspiral2 example



### JdateAndTimePicker

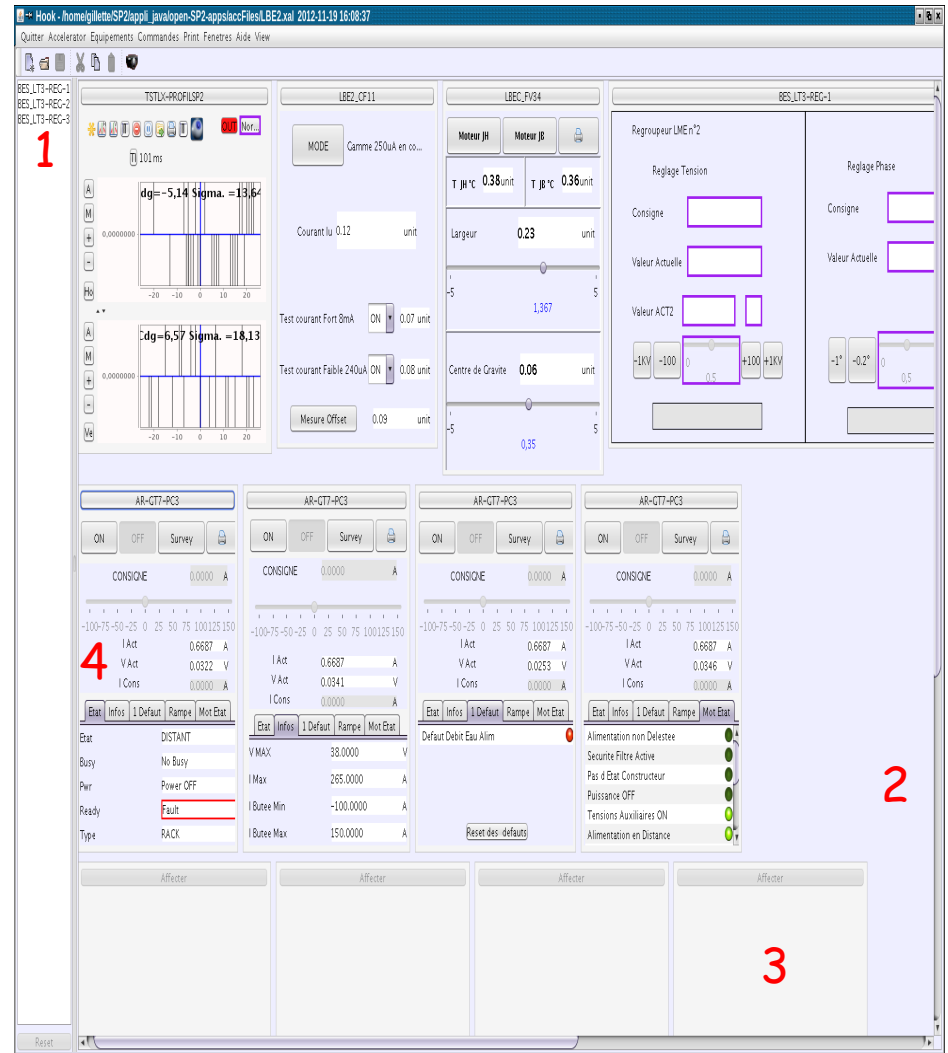
Based on Jcalendar (Kai Toedter)

(<http://www.toedter.com/en/jcalendar/>)





- **QueueAssignment 1:**
  - Choice of the element to assign
- **AssignmentAreaPanel 2:**
  - Control list and size of panels assigned.
- **ElementContainerPanel 3:**
  - Resizable, reassignable.
- **ElementPanelFactory 4:**
  - Profil
  - Magnet Supply
  - Slit + Motor
  - Buncher
  - Faraday Cup



- Loader for SPIRAL2 configuration file
  - Databases information
  - Surcharge locale
  - Log 4J configuration file path
- Initialization of SL4J/LOG4J log system
  - SL4J send XAL logs to LOG4J
- Look & Feel Initialization :
  - Set properties to customize Nimbus L&F
- Spiral2ApplicationAdaptor
  - Specific startup for SPIRAL2
  - Use ApplicationAdaptor

- org.apache.commons
  - \* .configurations+ Jxpath + collections => W/R configuration xml files
  - \* .lang => logging
  - \* .logging. => Database
  - \* .dbutils.
  
- org.jfree => graphic tools.
- com.acrobat.reader.viewer => pdfViewer
- lt.cnr.irmaa.essi.lablib.gui.checkboxtree => tree selection.
- net.sf.jasperreports => report.
- org.sl4j => logging.
- ch.qos.cal10n => internationalisation.
- iijdcb.jar => Ingres Database
- org.hibernate.validator => Bean validation.
- Javax.validation => Bean validation

- Use of a separate equipment file for powerSupplies and motors (extraOptic file).
- Add of an PolynomialTransform in the DataTransformFactory.
- Add functions to access ENUM in CA package
  - function equivalent to caget-d31 to list values
  - ChannelLabelEnumRecord in Channel.java (package CA)
  - Monitor added that return enum value like a string (ex : Ready instead of 1)

- Troubles with synchronous access to epics.
  - numerous pend\_IO errors (CAJ Context).
- DataBase abstraction and Bricks not used.
- Specifics devices used:
  - beam wire profilers,
  - power supplies,
  - faraday cups,
  - slits.
- XAL has proved to be a very efficient tool.
- Evolution from XAL to Open Xal easy to refactor.
  - optimisation is the sole application not fully updated , because of algorithms parts.



**Thank you for your  
attention**