Use of XAL at Spiral 2

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- What we had to do :
  - design java applications
    - ✓ to tune accelerators with different beams.
    - ✓ To control the accelerator devices.
  - with
    - ✓ a very small team of developpers.
    - ✓ No background of java and Epics.

- We need a magic wand => XAL

- What we are doing :
  - => definition of the accelerator tree.
  - => definition of the accelerator components.
  - => definition of the management of the values sets for tuning.
  - => writing first applications for supervising devices.

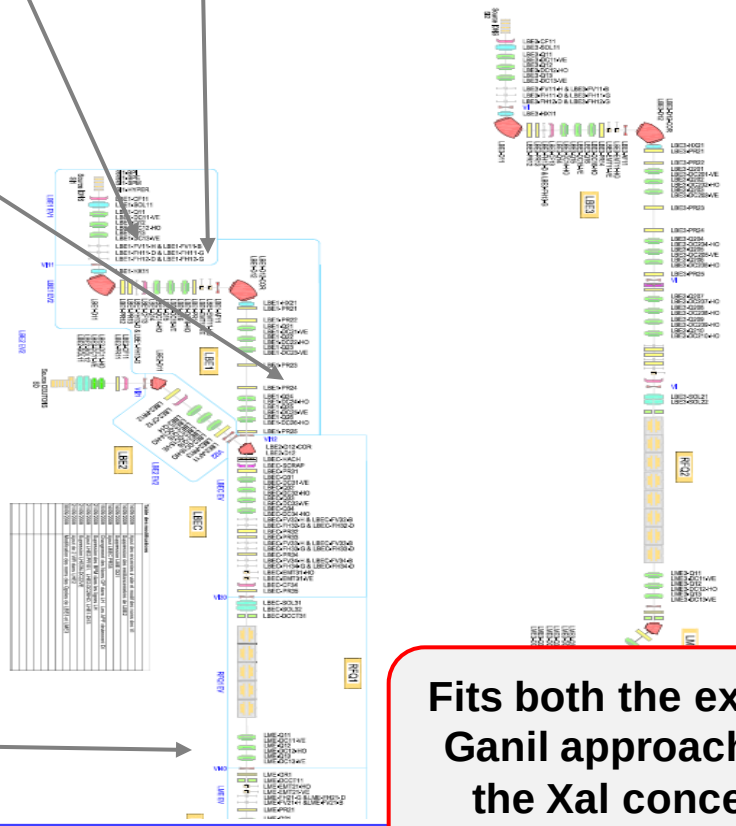
Accelerator tree

- Definition of the accelerator and the beam paths.
  - ✓ Injector
    - ❑ LBE1 => Ions 1/3.
    - ❑ LBE2 => d,p
    - ❑ LBE3 => Ions 1/6

    } could be tuned « off line »
  - ✓ Linac
    - ❑ LME
    - ❑ LINAC A
    - ❑ LINAC B
  - ✓ LHE
    - ❑ NFS
    - ❑ S3
      - o S3 N
      - o S3 S
    - ❑ Beam Dump
    - ❑ Production
- Insertion in a database INGRES

Accelerator hierarchy within the database

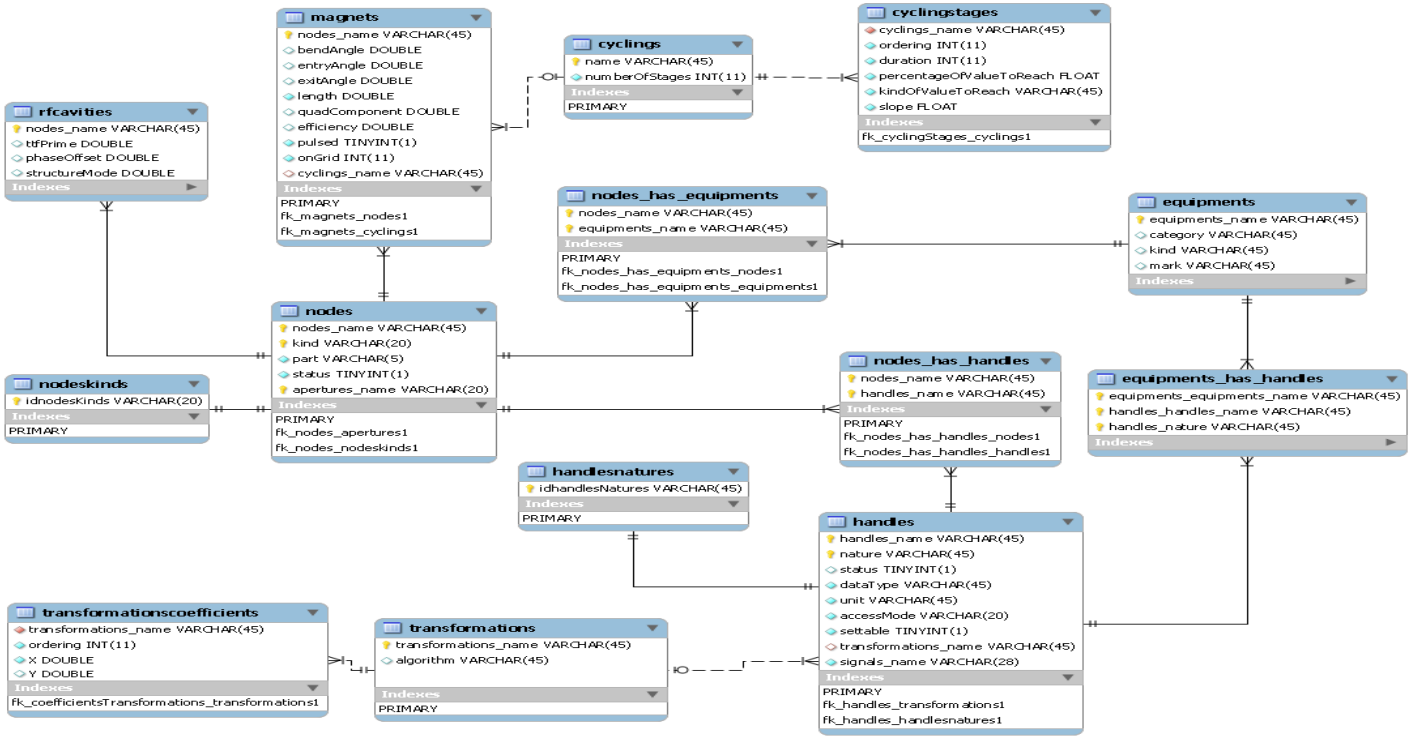
LEVEL	PATH	SEQUENCES	PARTS	NODES	HANDLES
1/3	LBE1	LBE1 SOURCE	LBE1S	LBE1_SI	
		LBE1_PREPARATION	LBE1P	LBE1_Q11	LBE1_Q11_I_RB LBE1_Q11_FIELD_SET
				LBE1_CF11	LBE1_CF11_IMES
				LBE1_FH11	LBE1_FH11_L_SET LBE1_FH11_CDG_SET LBE1_FH11_TEMP_MES
		LBE1_ANALYSE			
DEUTONS	LBE2	LBE2_SOURCE LBE2_PREPARATION LBE2_ACHROMATISME			
INJECTEUR	LBE1_LME	LBE1 SOURCE LBE1_PREPARATION LBE1_ANALYSE LBE1_TRANSPORT LBEC RFQ1			
	LBE2_LME	LBE2 SOURCE LBE2_PREPARATION LBE2_ACHROMATISME LBEC RFQ1			
	LBE3_LME	LBE3_SOURCE LBE3_PREPARATION LBE3_ANALYSE RFQ2			
LINAC		LME LINAC_A LINAC_B			



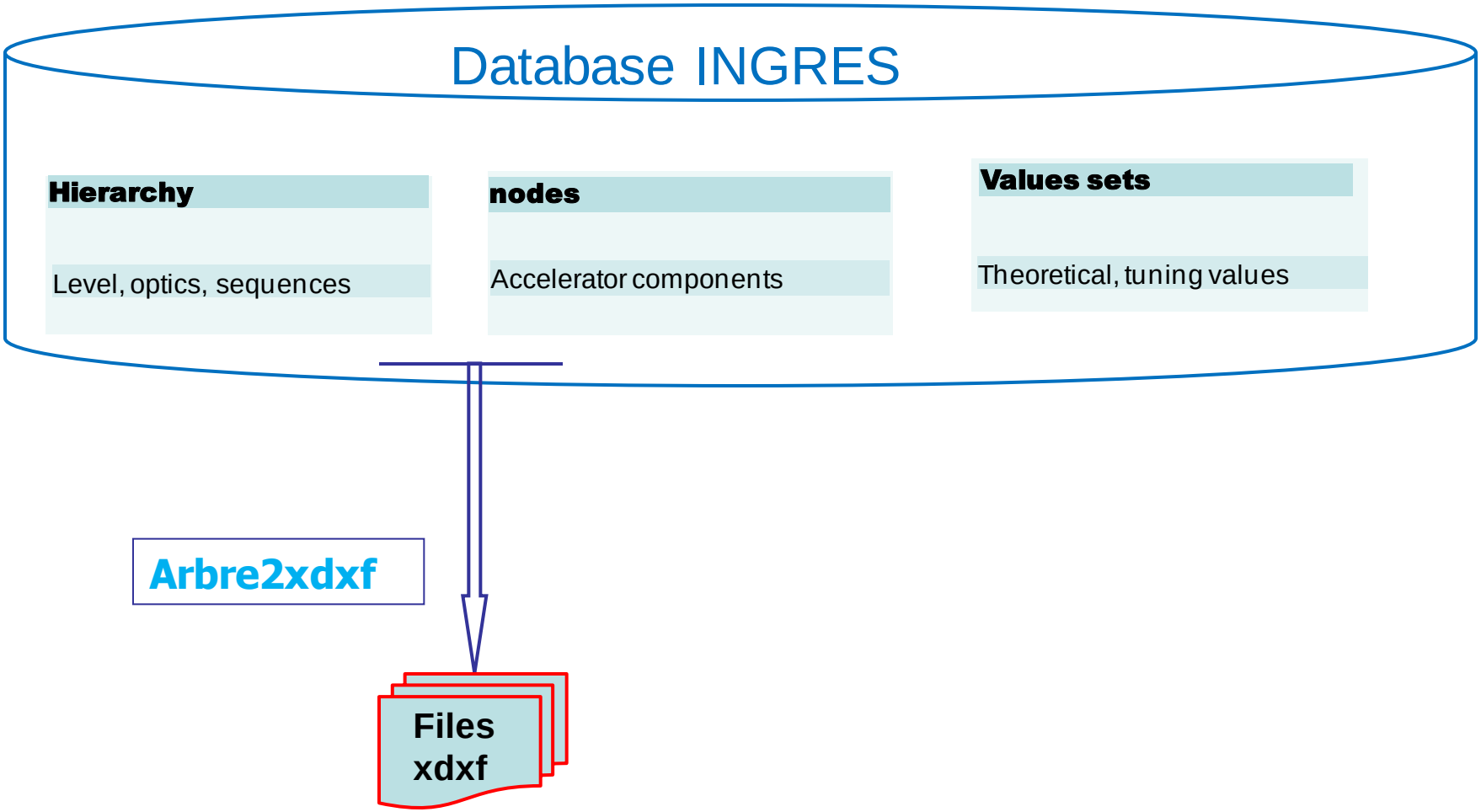
Fits both the existing Ganil approach and the Xal concepts

Definition of the nodes in the database

- Geometry.
- Handles.
- Specifical values magnetic data, Hf ….
- Equipments(power supplies…).



Generation of the optics files



Bd2xdxf

- Arbre2xdxf : software for automatic generation of XDXF files from database
  - Creates a new empty accelerator.
  - Reads the nodes ordered by sequences in the DB.
  - Populates the accelerator with the nodes created by **Spiral2AcceleratorNodeFactory** which from db
    - ✓ reads the alignement values.
    - ✓ reads the component values. (magnetBucket,rfBucket).
    - ✓ reads the handles and their transformations.
    - ✓ reads the equipments used by the node. (ps,…)
  - . Populates the accelerator with the equipements by bd2Eqpts (powersupplies)
  - Writes the accelerator to a file.

LBE1 .xdxf

```
<?xml version = '1.0' encoding = 'UTF-8'?>
<!DOCTYPE xdxf SYSTEM "xdxf.dtd">
<xdxf date="08.21.2009" id="LBE1"  ver="Beta">
  <sequence id="LBE1_ANALYSE" len="07.298" pos= " 2.7505" status="true" type="sequence">
 <attributes>
     <sequence predecessors = 'LBE1_PREPARATION » />
</attributes>
  <node id=" LBE1_D11" len="0.942478" pos="3.5205" status="true" type="DH">
        <attributes>
           <aperture shape="2" x="0.22" y="0.09"/>
           <align pitch="0.0" roll="0.0 "    yaw="0.0" x="3.5205" y="0.0" z="0.0" />
           <magnet bendAngle="-90.0" dfltMagFld="0.101824" dipoleEntrRotAngle="26.565"
              dipoleExitRotAngle="26.565" len="0.942478" polarity="1.0"/>
         </attributes>


         < ps main="LBE1-D11" trim="LBE1-D11-COR "/>


        <channelsuite magnetsuite>
           <channel handle=« fieldRB" settable="false" signal="LBE1-D11-B:Champ" transform="LBE1-D11-B"
           <!- gauge field measurement / bend axis field-->
           <transform name="LBE1-D11-B" nbcouples=  " 2" type=" doubleNevilleInterpolation "
           " x0= " 500" x1="1000" y1= " 505.2" y2="1146.8" ,/>
        </channelsuite>
      </node>
```

Transformations

Used to convert

- Field to current.
- Field measurement to field on axis of magnet.

```
<transform name="LBE1-D11"
  nbcouples="6"
  type="doubleNevilleInterpolation"
   x0="0" x1="80" x2="90" x3="150" x4="200" x5="250"
   y0="0" y1="1019" y2="1146.8" y3="1909" y4="2541.5" y5="3168.7"/>
```

- => modification
  - Signalsuite.java
  - TransformFactory
  - DataTransformFactory

Nodes & Devices

- Xal Nodes
  - Qpoles,bends,Rfcavities, …
- Specific nodes
  - Slits.
  - TrimmedBend.
  - Deflectors (high voltage supply).
  - Bunchers.
  - Diagnostics …
- Access to hardware devices of the accelerator.
  - Power supplies (current and high voltage).
  - Field probes (hall probes, mnr probes).
  - Motors .
  - Temperature probes.
  - Actuators.
- Common handles for accessing devices used by nodes
    - cmd
    - State
    - defaults

Beam diagnostics interface

Name	Interface	Progress
Faraday cup slow acq.	VME ICV150	To be validated
Faraday cup fast acq.	VME ICV178 & 108	First tests to be done
DCCT	VME ICV …	Same as Faraday cups
ACCT	?	Under discussion
Profilers	Modbus / RTU	Prototype mid-2010
BLM Beam Losses Monitors	(↳ NIPNE) ?	To be defined
BPM Beam Position Monitors	(↳ BARC) Specific VME board	To be integrated
Time Of Flight (TOF)	Modbus / TCP	Under discussion
Packet length & FCT	Oscilloscope	Under discussion
Packet length (Linac)	?	?

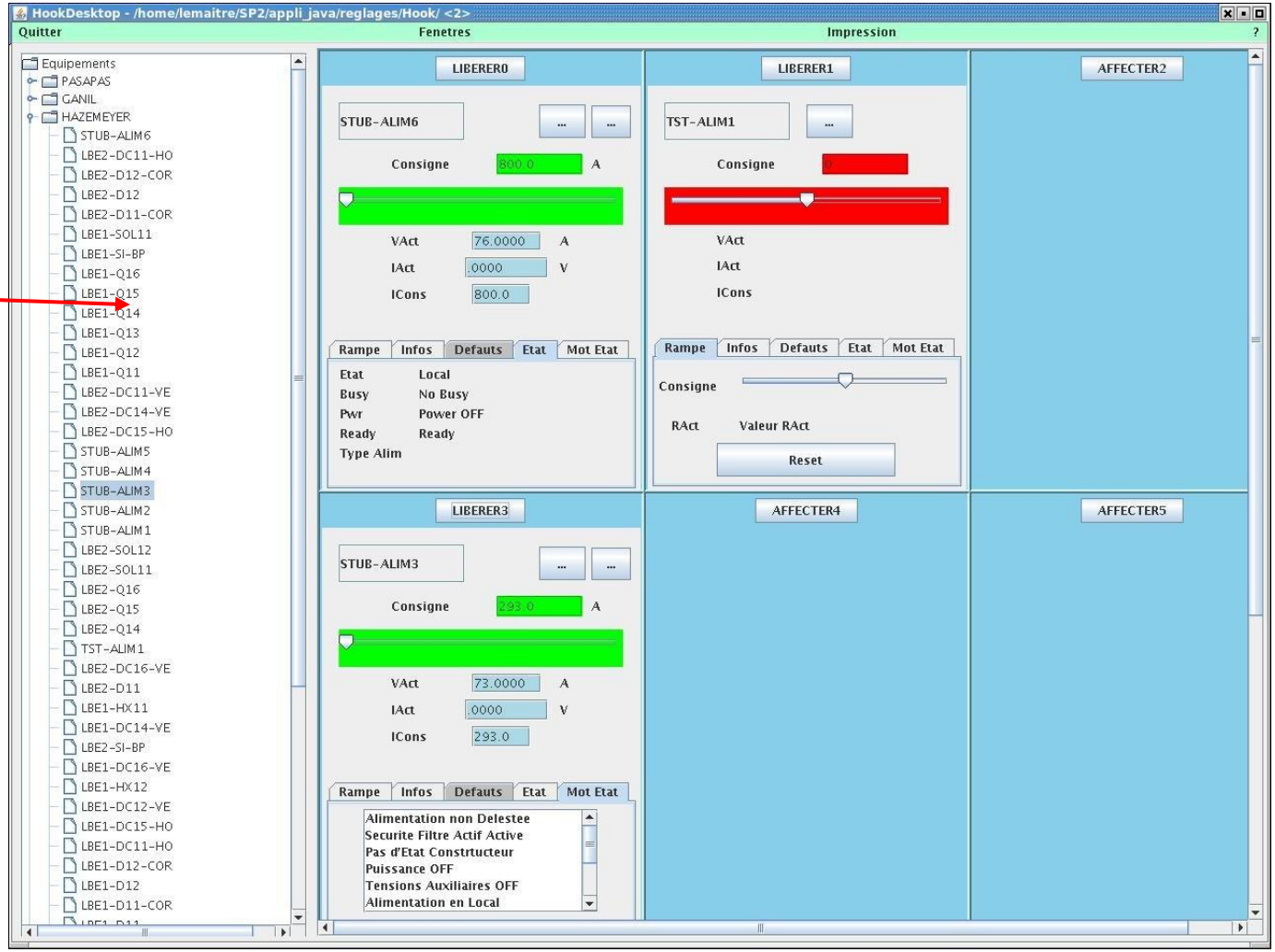
Magnet Power supply Channels

```
<PS>
  <main genre="HAZEMEYER" id="LBE1-D12"  type="main">
 <channelsuite name=« pssuite »>

          <channel handle="I" settable="false" signal="LBE1-D12:IAct"/>
          <channel handle="ISet" settable="true" signal="LBE1-D12:ICons"/>
         <channel handle=« fieldSet" settable="false" signal="LBE1-D12:ICons"  transform="LBE1-D11"/>
          <channel handle=« psFieldRB" settable="false" signal="LBE1-D12:IAct " transform="LBE1-D11"/>

         <channel handle="RampeLocale" settable="false" signal="LBE1-D12:IRampLocal"/>
          <channel handle="Ready" settable="false" signal="LBE1-D12:Rdy"/>
          <channel handle="RampeStart" settable="true" signal="LBE1-D12:IRampStart"/>
          <channel handle="ButeeMax" settable="false" signal="LBE1-D12:IButeeMax"/>
            <channel handle="VMax" settable="false" signal="LBE1-D12:VMax"/>
           <channel handle="VMes" settable="false" signal="LBE1-D12:VMes"/>
           <channel handle="OnOff" settable="false" signal="LBE1-D12:OnOff"/>
           <channel handle="TypeAlim" settable="false" signal="LBE1-D12:TypeAlim"/>
           <channel handle="IMax" settable="false" signal="LBE1-D12:IMax"/>
           <channel handle="Ctrl" settable="false" signal="LBE1-D12:Ctrl"/>
            <channel handle="NoBusy" settable="false" signal="LBE1-D12:NoBusy"/>
             <channel handle="SlopeRb" settable="false" signal="LBE1-D12:IRampAct"/>
              <channel handle="SlopeSet" settable="true" signal="LBE1-D12:IRampCons"/>
            <channel handle="ButeeMin" settable="false" signal="LBE1-D12:IButeeMin"/>
             <channel handle="Pwr" settable="false" signal="LBE1-D12:Pwr"/>

          <channel handle="Cmd" settable="true" signal="LBE1-D12:Cmd"/>
          <channel handle="CmdsList" settable="false" signal="LBE1-D12:ProcessDynamicModbusTable.VALS"/>
          <channel handle="State" settable="false" signal="LBE1-D12:ProcessDynamicModbusTable.VALJ"/>
          <channel handle="StateDescOn" settable="false" signal="LBE1-D12:ProcessDynamicModbusTable.VALT"/>
          <channel handle="StateDescOff" settable="false" signal="LBE1-D12:ProcessDynamicModbusTable.VALU"/>
            <channel handle="DefaultsList" settable="false" signal="LBE1-D12:Defects.VALB"/>
            <channel handle="Defaults" settable="false" signal="LBE1-D12:Defects.VALA"/>
          <channel handle="DefaultsProcess" settable="true" signal="LBE1-D12:Defects.PROC"/>

          <transform name="LBE1-D11" nbcouples="6" type="doubleNevilleInterpolation" x0="0" x1="80" x2="90" x3="150" x4="200" x5="250" y0="0" y1="1019" y2="1146.8"
         y3="1909" y4="2541.5" y5="3168.7"/>
    </channelsuite>
</main>
</PS>
```

equipment handles

Application Hook

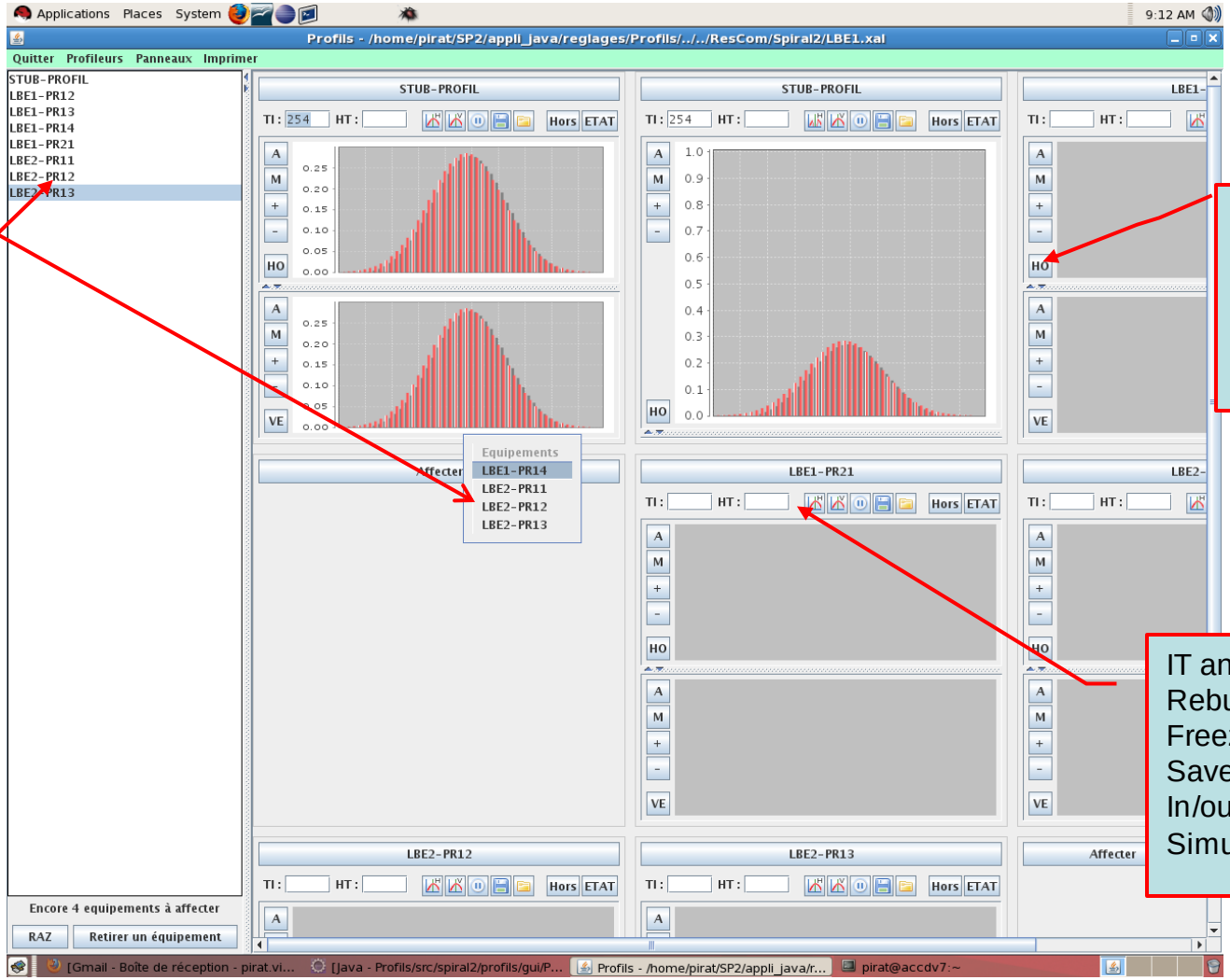
Choice of ps



low level access to devices : power supply control

Profils viewer

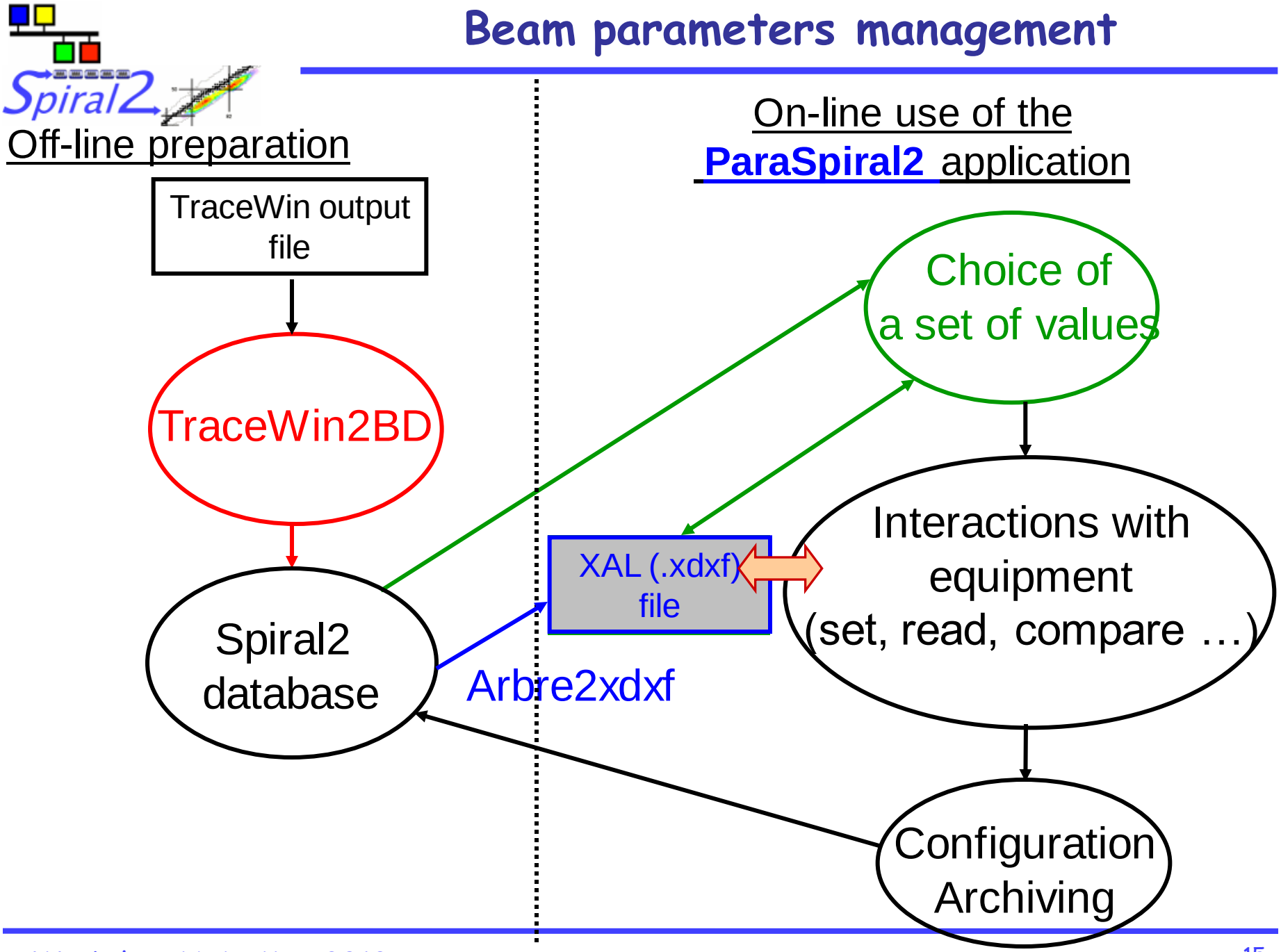
Choice of beam profil



Scaling features
A : automatic
M : maxima
+ : increase
- : decrease

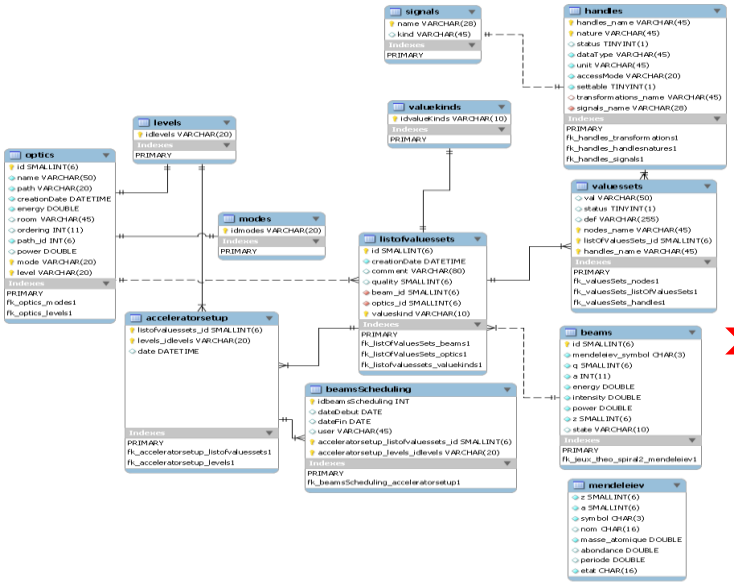
IT and Ht values
Rebuild Mode
Freeze,
Save/restore
In/out state and cmd
Simulation , Test Modes

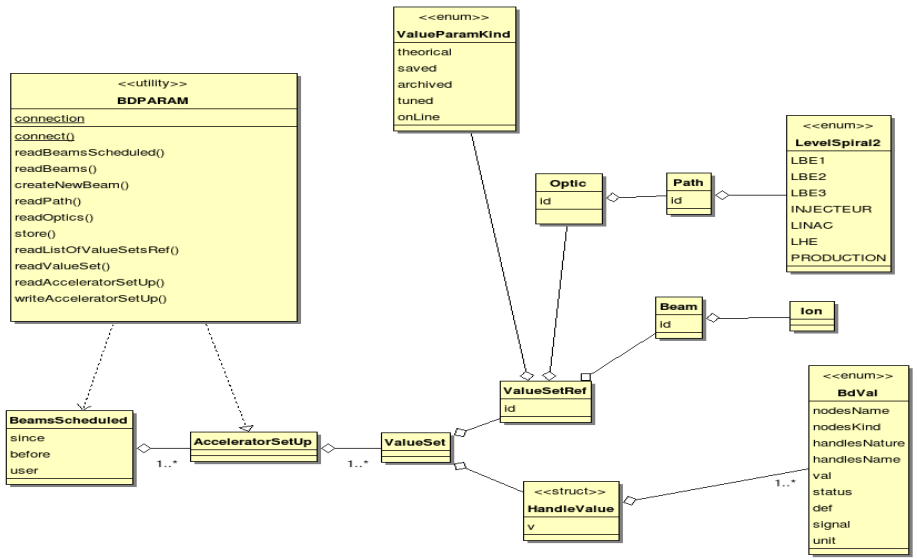
Beam parameters management



Values sets

Tracewin2Bd program reads theoreticals data created by the tracewin application and insert those into database tables





Data base tables

Java classes

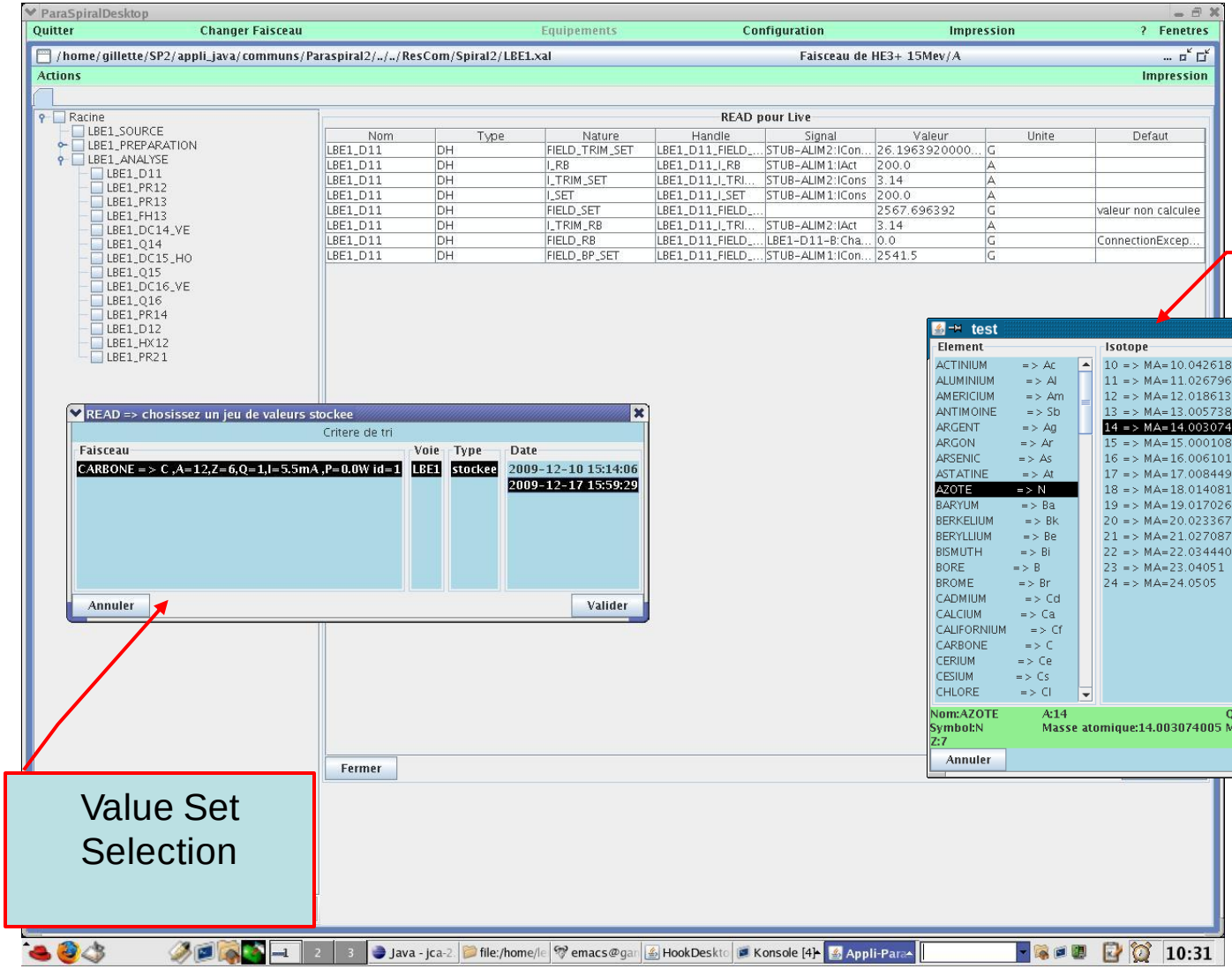
Paraspiral2 application

The user can

- Choose
  - the ion beam.
  - the beam path, the beam optic from DB.
- Read theoritical, saved, archived or live values.
- Save values
  - For short term storage, selection by sequence.
  - For long term archiving, selection by beam path.
- Set values and restore them from DB
- Compare theoritical, saved, archived or live values..

- Change magnetic rigidity of the lines from theoretical, saved, archived or live values.

Paraspiral2



Conclusion

- Xal is mainly used, up to now, as a tool Box.
  - => we don't use modelisation.
  - => we dont' have used bricks for building applications.

- Next steps
  - test the applications already written on the injection line LBE2 in Saclay
  - Write new applications or adapt existing ones
    - ✓ service applications
      - ❑ Launcher
      - ❑ Logging survey
      - ❑ Alarms
      - ❑ Elog
    - ✓ Tuning
      - ❑ general use applications. (scanning,knobs …)
      - ❑ emittance limitation.
      - ❑ modelisation ?
      - ❑ tuning rf cavities
      - ❑ Energy management

- Xal is really what we were looking for and it will be a pleasure to share our code and applications.

Congratulations to the XALteam
for the great work accomplished.

Thank you for your attention.