The Spiral2 DESIR Facility

under EPICS control

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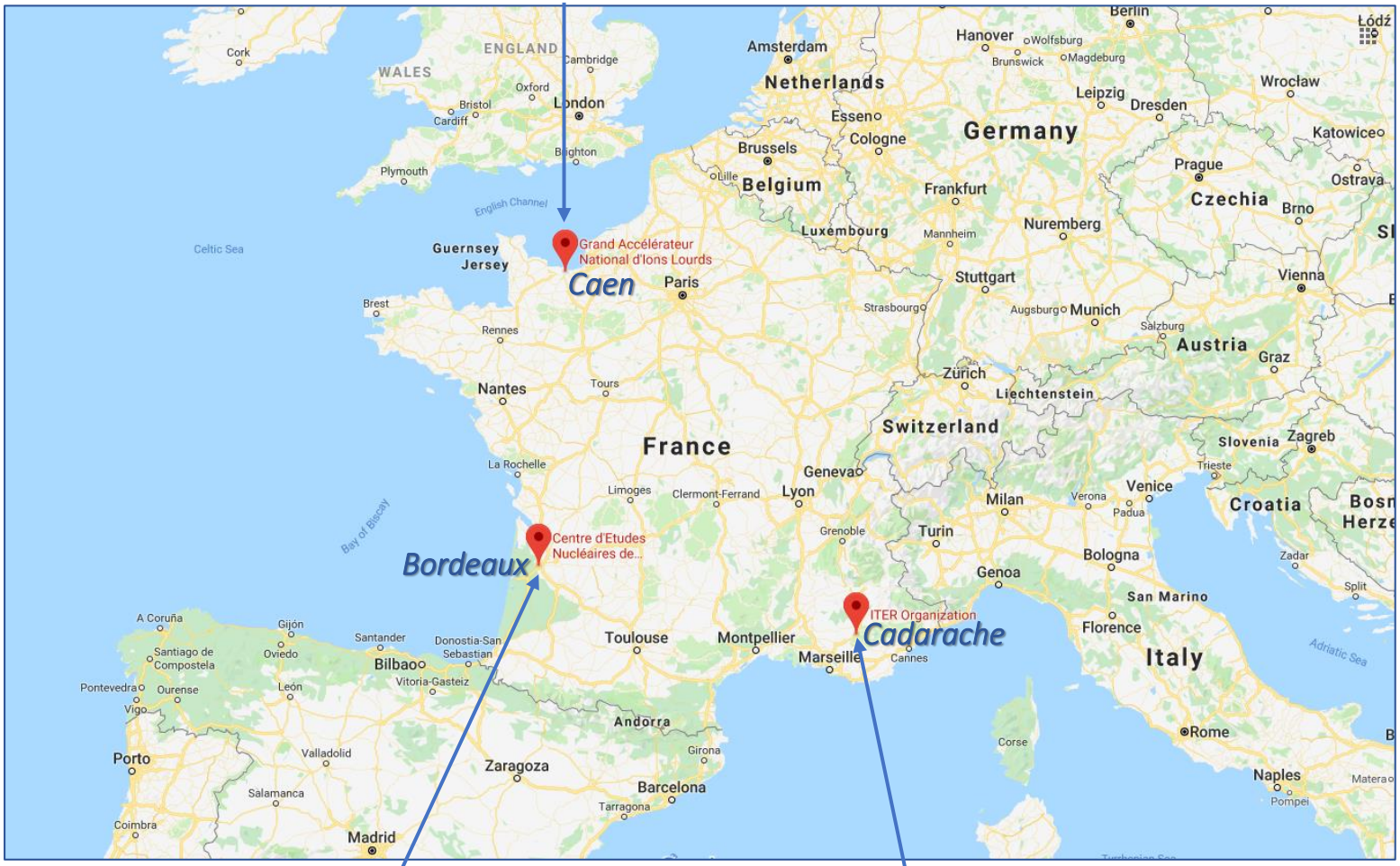


CENBG

Centre d'Etudes Nucléaires de Bordeaux Gradignan

GANIL

« Grand Accélérateur National d'Ions Lourds »

Large National heavy ion Accelerator

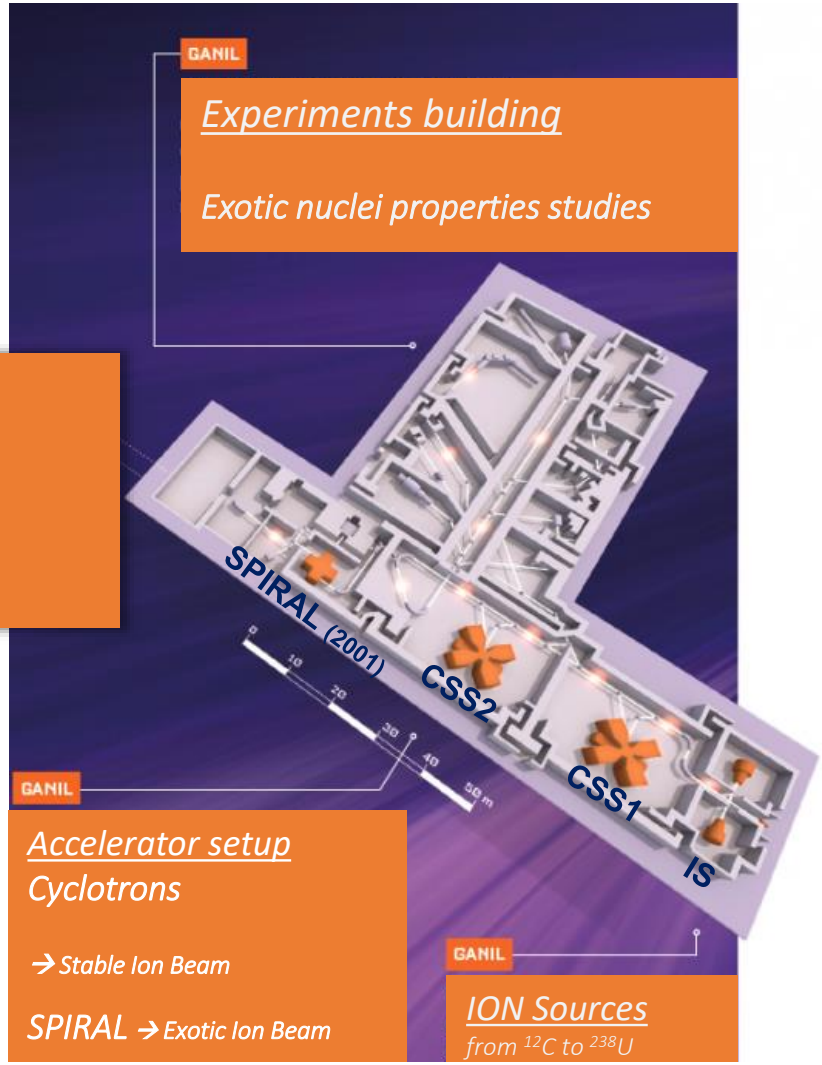
GANIL

- *1983 : First beam delivered to Physicist*
- *2001 : SPIRAL first Radioactive ion Beam*

SPIRAL

Système de Production d'Ions RadioActifs en Ligne

RadioActive Ions on Line Production System



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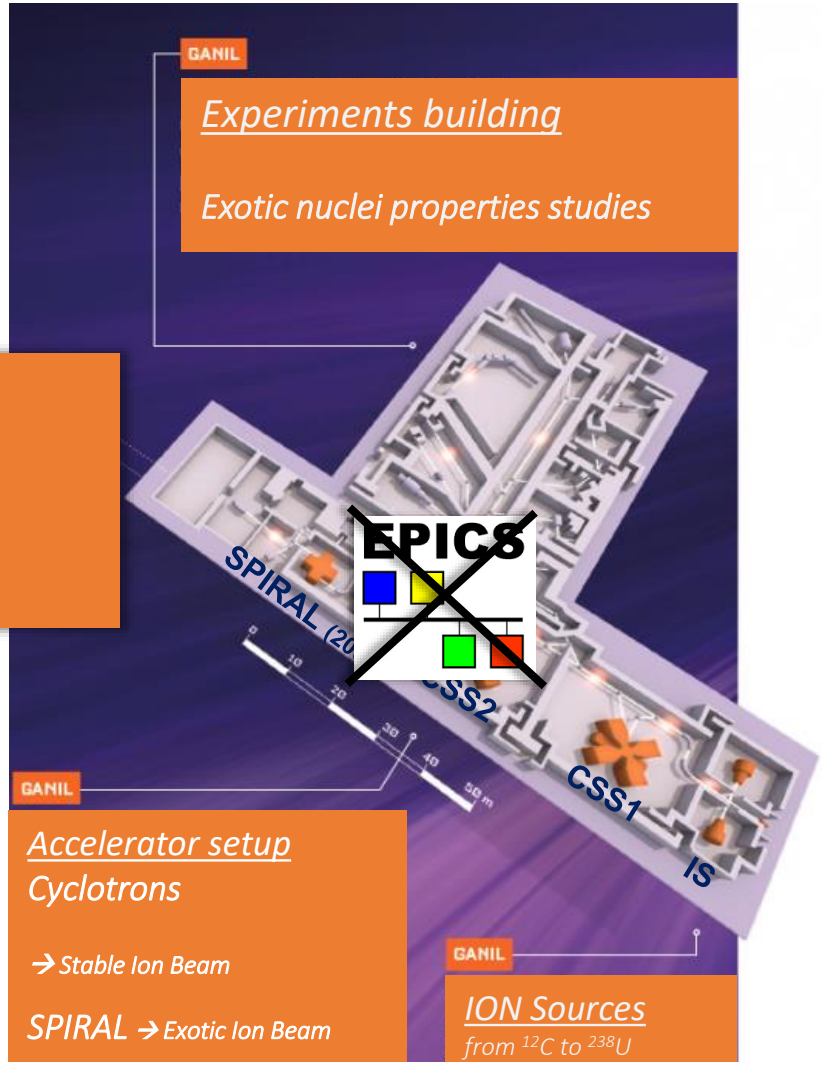
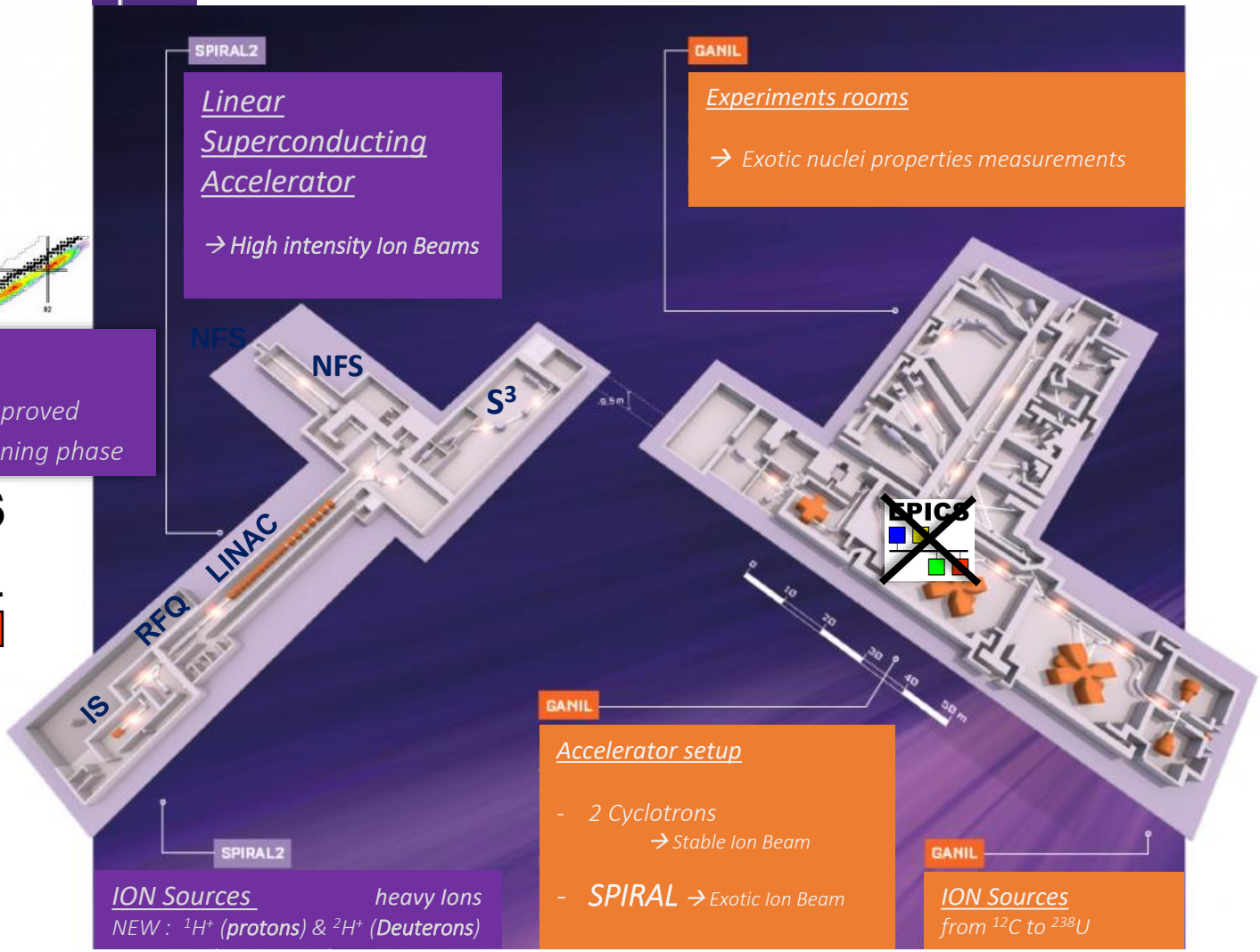


Spiral2

SPIRAL2 *phase 1*

- *2005 : Project approved*
- *2017 : Commissioning phase*

EPICS



SPIRAL2 : *Système de Production d'Ions RadioActifs en Ligne 2ème génération*

Spiral2

SPIRAL2 *phase 1+*

Experimental Hall

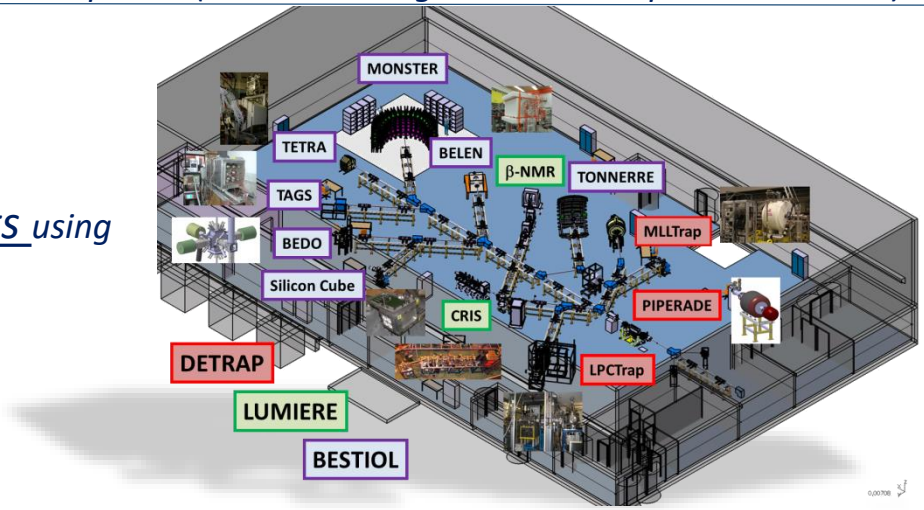
DESIR

EPICS

DESIR Désintégration Excitation et Stockage des Ions Radioactifs

Decay Excitation and Storage of Radioactive Ions

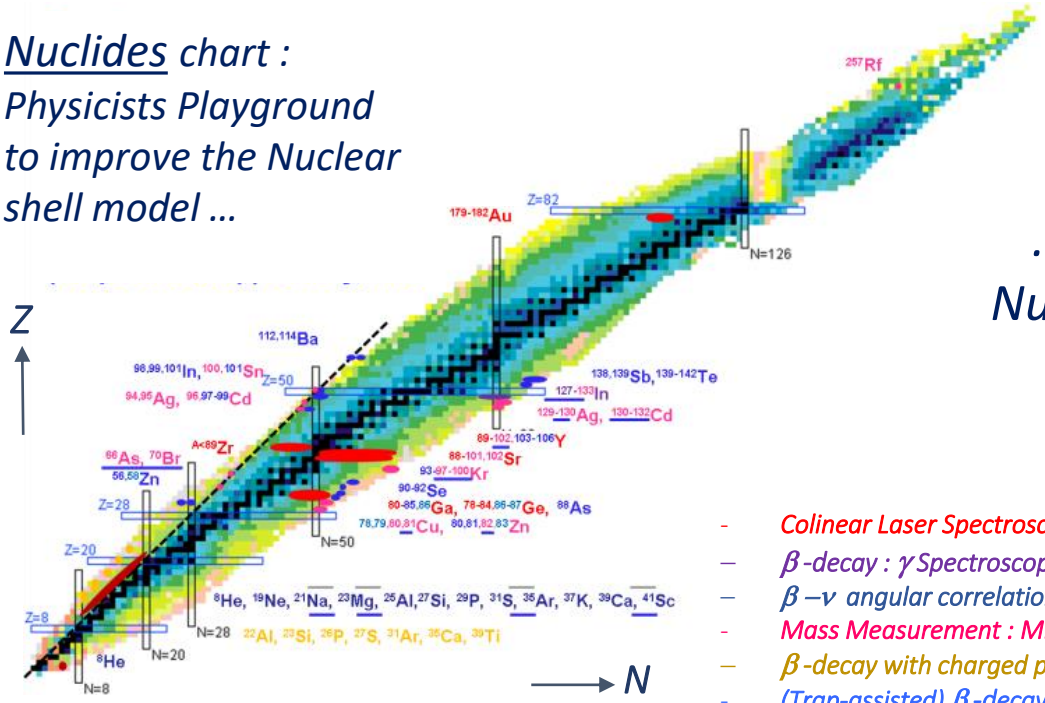
DESIR



Exotic Nuclei Properties measurements using

- *Laser spectroscopy*
- *Mass spectroscopy*
- *Decay spectroscopy*

Nuclides chart :
Physicists Playground to improve the Nuclear shell model …



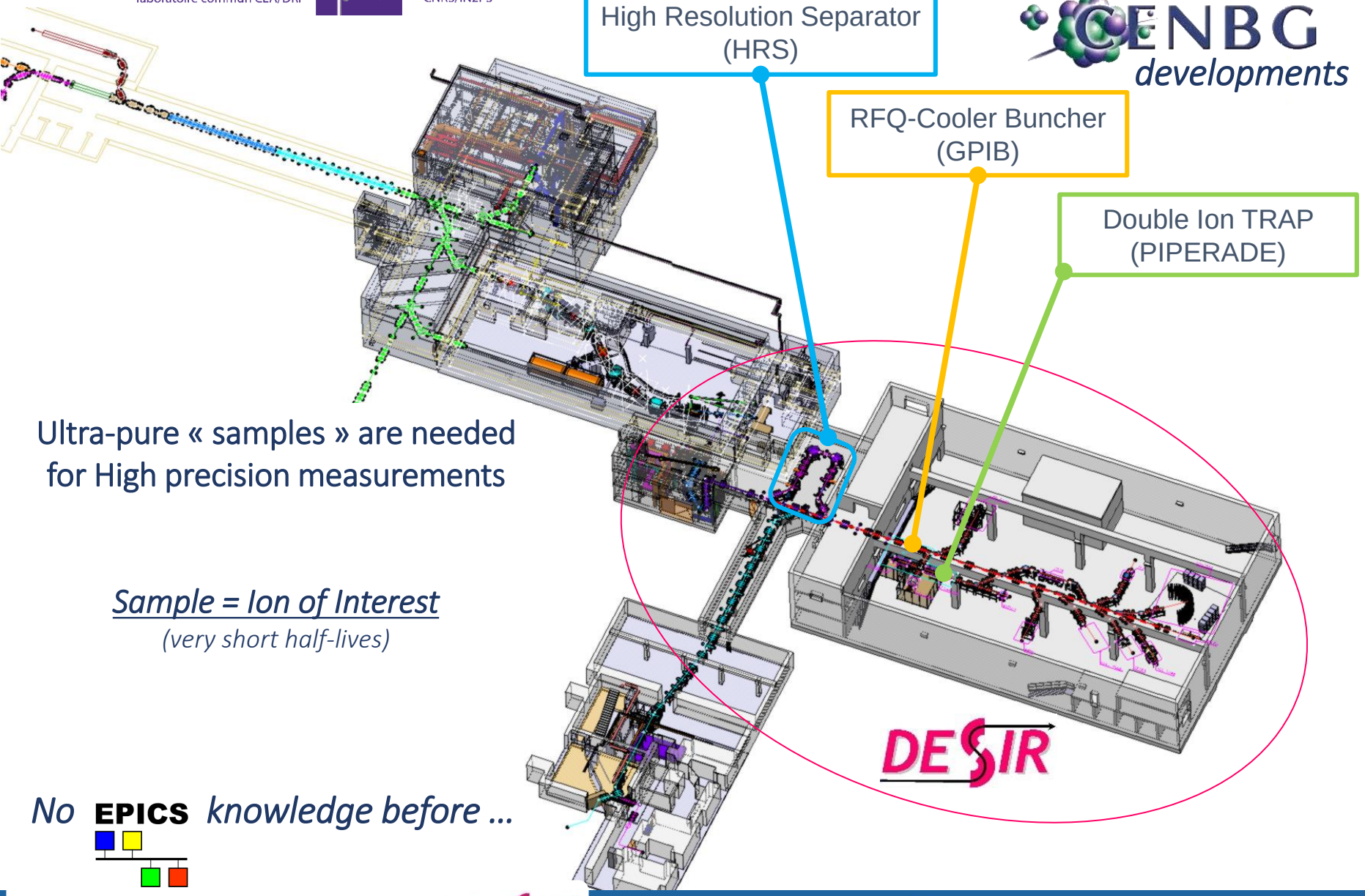
… Fundamental researches on Nuclear Physics Weak Interaction & Astrophysics

- *Colinear Laser Spectroscopy*
- *β-decay : γ Spectroscopy with polarized laser*
- *β –ν angular correlation : LPCtrap*
- *Mass Measurement : MLLTrap*
- *β-decay with charged particle emission*
- *(Trap-assisted) β-decay , TAS*

GANIL spiral2 laboratoire commun CEA/DRF CNRS/IN2P3

Ion of interest Selection & Beam Purification

CENBG developments



Ultra-pure « samples » are needed for High precision measurements

Sample = Ion of Interest

(very short half-lives)

No EPICS *knowledge before …*

SPIRAL2 EPICS Control System : Collaborative Developments

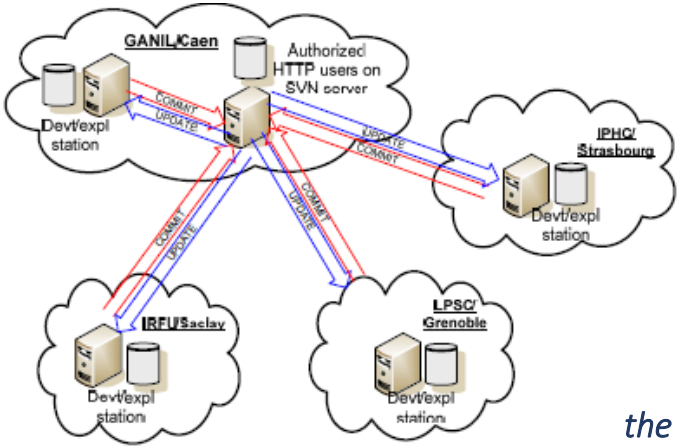
Several french Laboratories

SP2_ Phase1 (Accelerator – NFS - S3)

- *CEA-IRFU (Saclay)*
- *CNRS-IPHC (Strasbourg)*
- *CEA-CNRS Ganil (Caen)*

SP2_Phase1+ (DESIR)

- *CNRS-CENBG (Bordeaux)*
- *LPC Caen (Caen)*

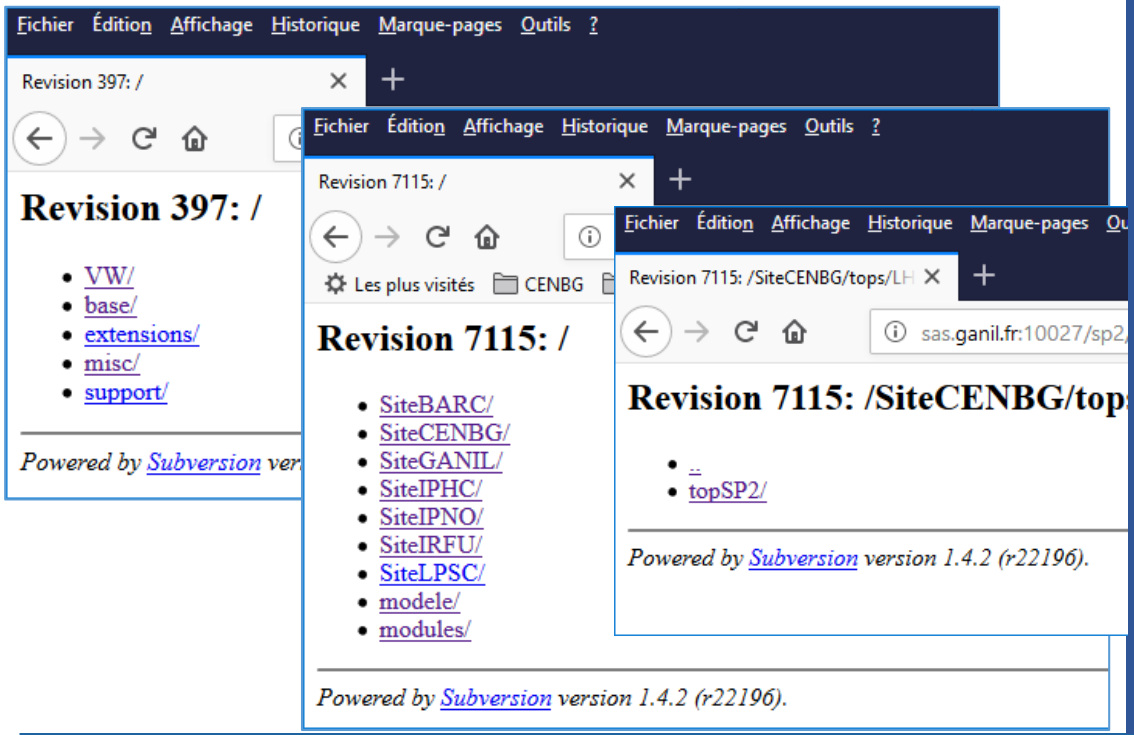


A common Framework

Software developments shared & centralized using the GANIL subversion (SVN) WEB Server

A common environment

- *: Common VxWorks & EPICS Distributions*
- *« topSP2 » repository to integrate the different developments*
- *Naming Conventions*
  - *Files*
  - *Repositories …*



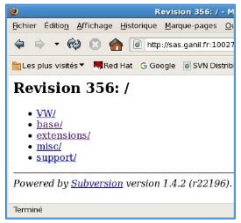
SPIRAL2 EPICS Control System : Collaborative Developments

SP2 Main technical choices presented previously …

[1] D. Touchard & al. "The Spiral2 command control software organisation and management", Icalepcs 2009.
[2] E. Lécorché & al. "Development of the future Spiral2 control system", Icalepcs 2009,
[3] D. Touchard & al. « Status of the future Spiral2 control system », PCaPAC, 2010.
[4] E. Lécorché & al. "Overview of the Spiral2 control system progress", Icalepcs 2011.
[5] E. Lécorché & al. "Overview of the GANIL control system for the different projects around the facility", Icalepcs 2017.
[6] C. Haquin & al. "Development of a safety classified system with Labview and EPICS", Icalepcs 2017.

EPICS IOCs :

- PC (RHEL & CentOS Linux) & **VME (Vx-Works)**
- Common EPICS Distribution with currently EPICS Base 3.14.12
- Common « topSP2 »



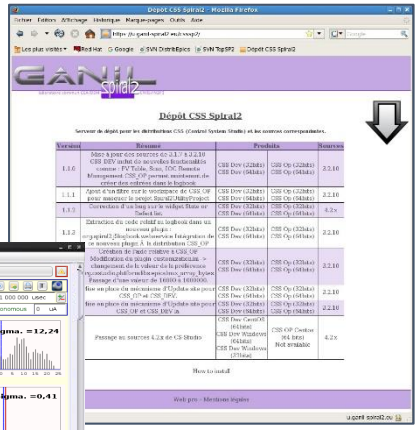
Automation :

- Siemens S7-PLCs used for
  - Vacuum,
  - Interlocks systems
  - Radio-Frequency, Cryogenic, Motor …

→ More details in on following slides …

EPICS Clients developments :

- SPIRAL2 CSS Boy Version : CSS-DEV & CSS-OP
- Graphical convention
- Specific Java Applications within Xal Framework



Naming conventions / codification

Function *Domain-Marker-Component* *(17 character max)*		Signal *(10 character max)*
DDDDD-MMMMM[-CCCCCCC]	:	SssssSssss

General Purpose Applications

Equipment access via standardized EPICS PVs using

- XAL Framework
- Eclipse Integrated Development Environment
- SVN

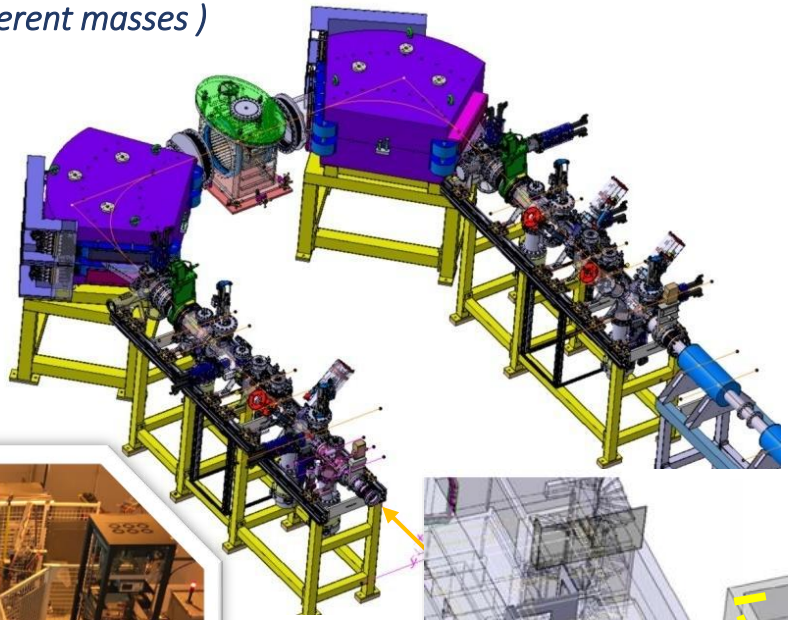
…. Now, let's see a concrete example of development : the DESIR-HRS

The DESIR - High Resolution Separator (HRS) → Ion of interest Selection

INput : Exotic Low energy & continuous Ion beam
(mixture of ions with different masses)

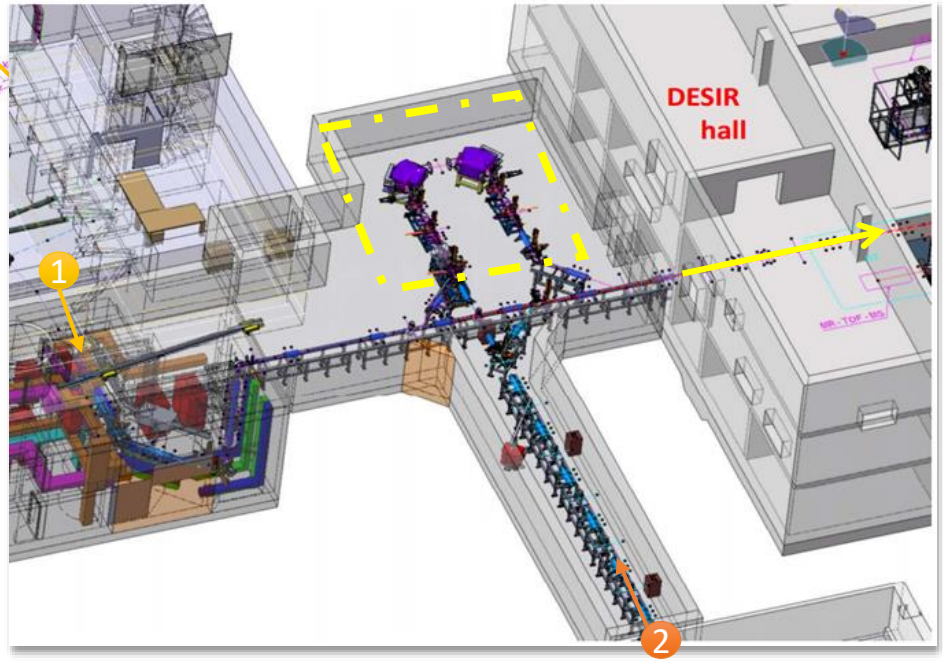
OUTput : Only selected Ions $\left(\frac{m}{\Delta m} \approx 20000\right)$

CENBG development



@ Bordeaux today

@ Caen in a few years



Automation :
VACUUM Control System

EPICS OPI

EPICS IOC

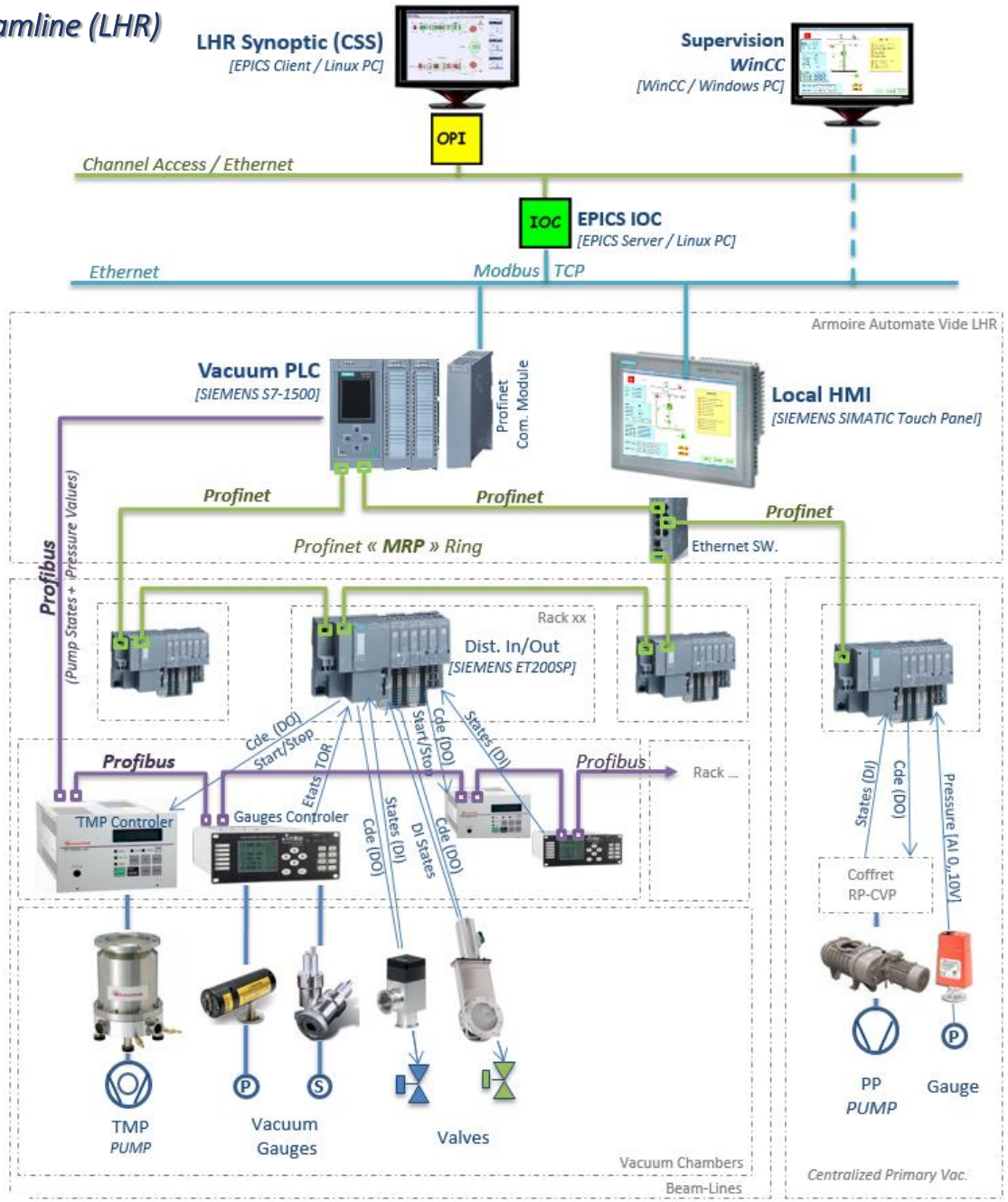
Siemens S7 PLC & HMI

Field Bus
Profinet & Profibus

PLC-Distributed INputs-OUTputs

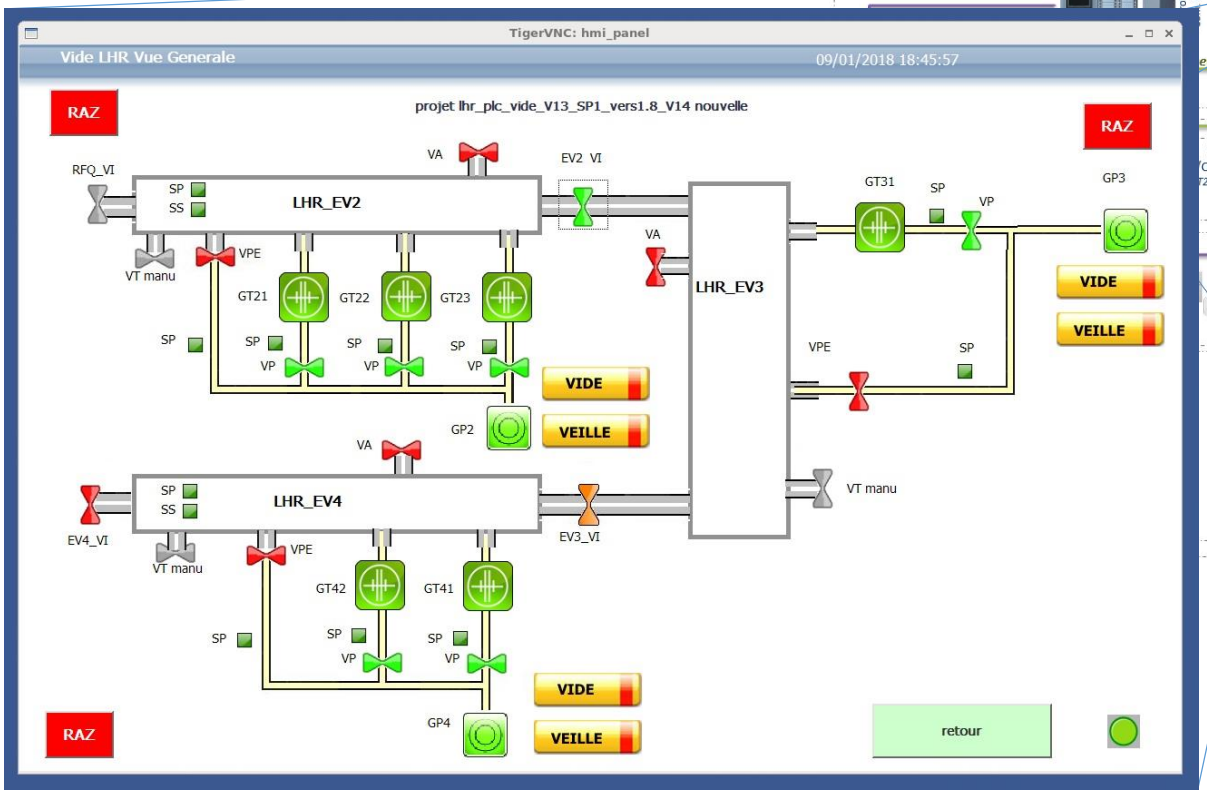
Equipment Controller

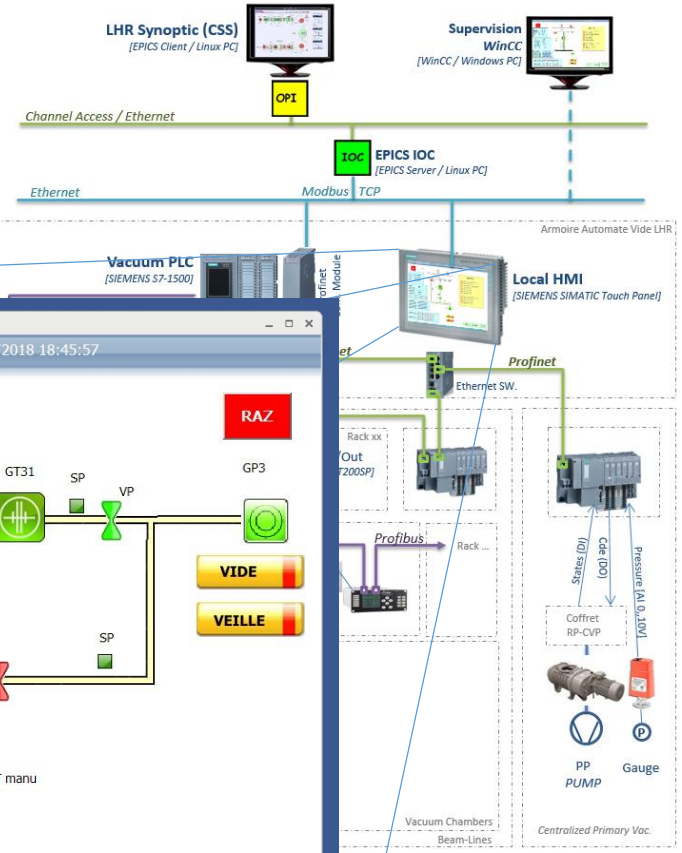
Equipment
Rotary & Turbo Pumps
Vacuum Gauges
Electro-pneumatic Valves



Automation :
VACUUM Control System

SIMATIC HMI
Remote « Touch-Panel » using VNC





Beam-Line Equipments to control

Beam Diagnostics

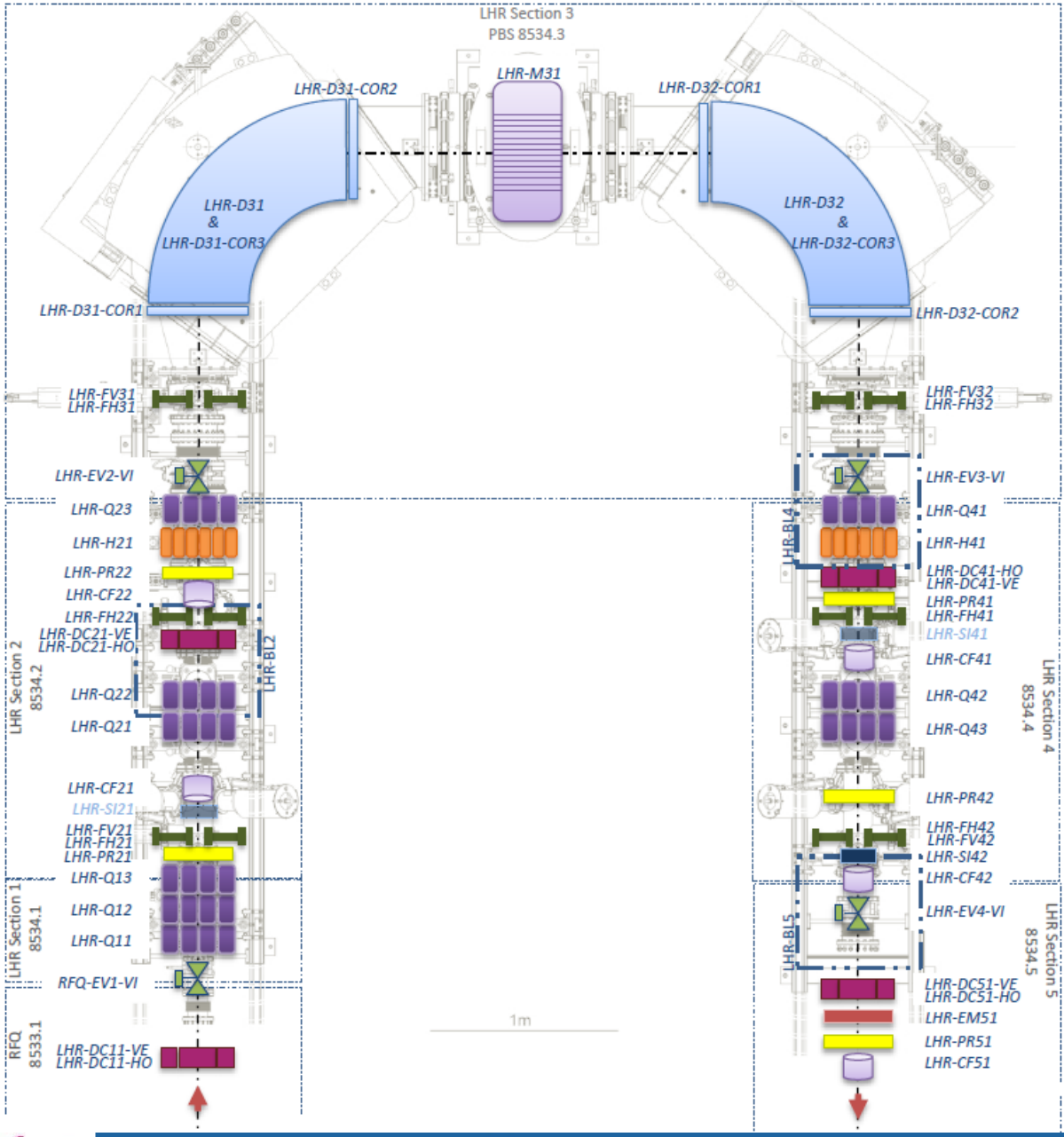
- CF : Faraday Cup
- PR : Profiler

Apertures

- FH : Horizontal Slits

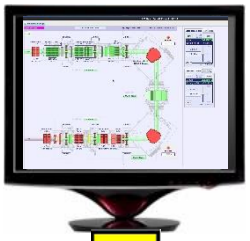
Ion Beam Optics - Transport

- D : Dipole
- DC : Steerer
- Q : Quadripole
- H : Hexapole
- M : Multipole



SLITS Motion System

(specific LHR development)



SLITS control on
LHR Operator Interface
[EPICS Client (CSS) / PC Linux]

OPI

Ethernet (Channel Access)

IOC IOC EPICS IOC *[Linux PC]*

Ethernet (Modbus)

Interlock PLC
LHR-PLCINTLK
[Siemens S7-1500]

Profinet Com. Module
[SIEMENS CM1542-1]

Local HMI (Touch Panel)
« LHR-HMINTLK »

Interlock PLC Rack

Profinet

Motors Rack

DRIVE-CLiQ

Control Unit 1 Axis
[Siemens CU-310]

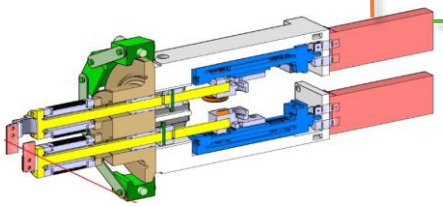
Power Module
[Siemens PM340]

Sensor Module
(Resolver)
[Siemens SMC10]

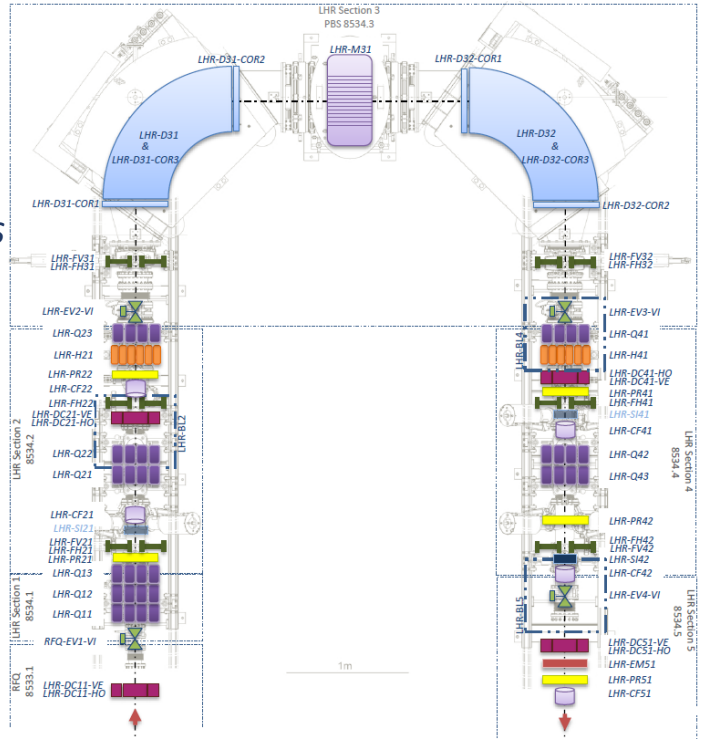
Resolver

SINAMICS S120

Motor

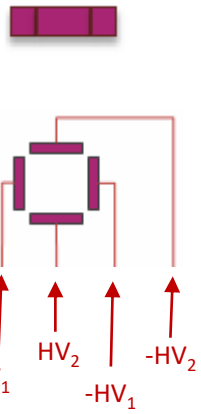


Brushless Motor + Resolver + Brake

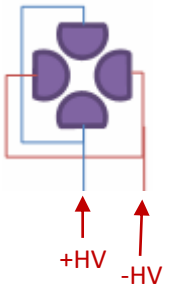


DESIR Beams = Low energy Ions (60keV max) → ***Electrostatic*** *Devices*

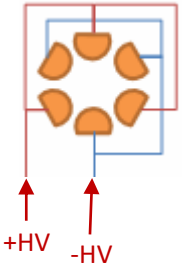
Steerer *(bipolar)*



Quadrupole



Hexapole



Multipole *(48 rods)*

large number of ***High Voltage Power Supplies***

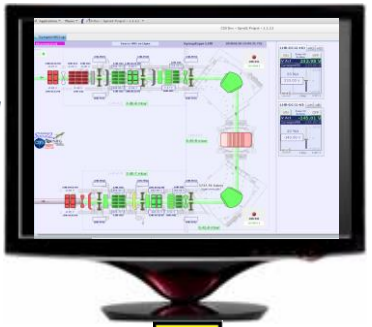
→ *ISEG Crate with ISEG HV Modules*
(first one used in 2015 for LHR)

LHR : 1 Crate = 86 HV Channels

High Voltage Power Supplies … Embedded EPICS IOC

(specific LHR development)

LHR Synoptic OPI
[EPICS Client / Linux PC]



OPI

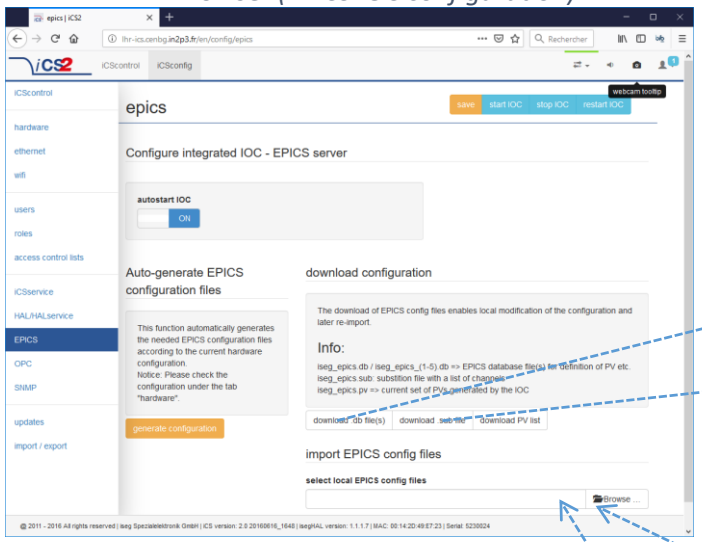
Channel Access / Ethernet

ISEG Crate

ISEG Controller *(CC24)*

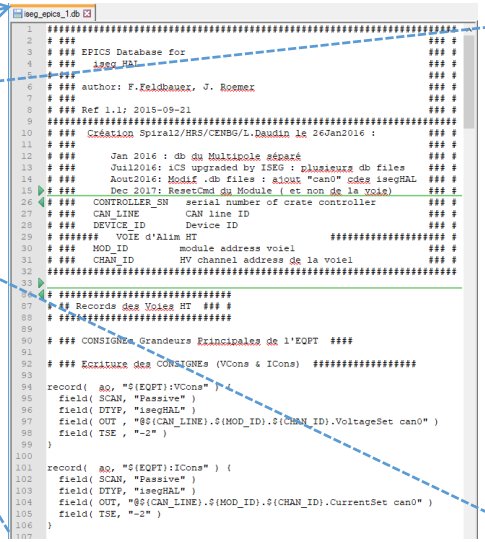
IOC ISEG IOC
[EPICS server / ISEG iCS]

ISEG Communication Server (iCS)
WEB Browser *(EPICS IOC configuration)*

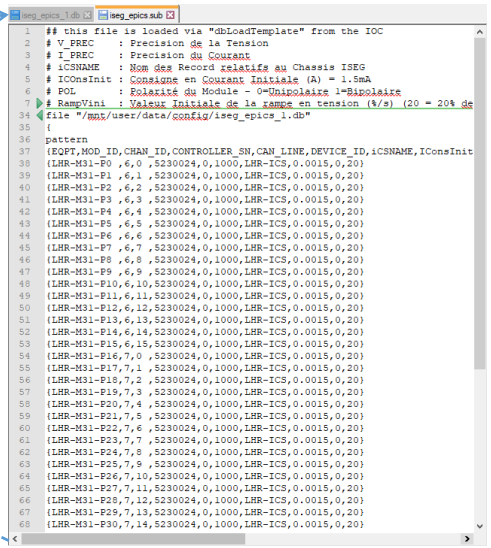


EPICS IOC « SP2 » Database Definition (.db & .sub files)

« .db Files »



« .sub File »



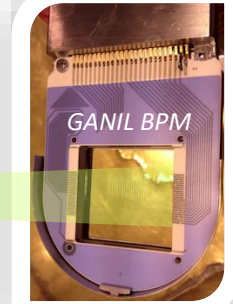
L. Böhm[3], F. Feldbauer[1,2], A. Hartmann[3], J. Pöthig[3], J. Römer[3]

[1]Helmholtz-Institut Mainz
[2]Johannes Gutenberg-Universität Mainz
[3]iseg Spezialelektronik GmbH

some Client Applications …

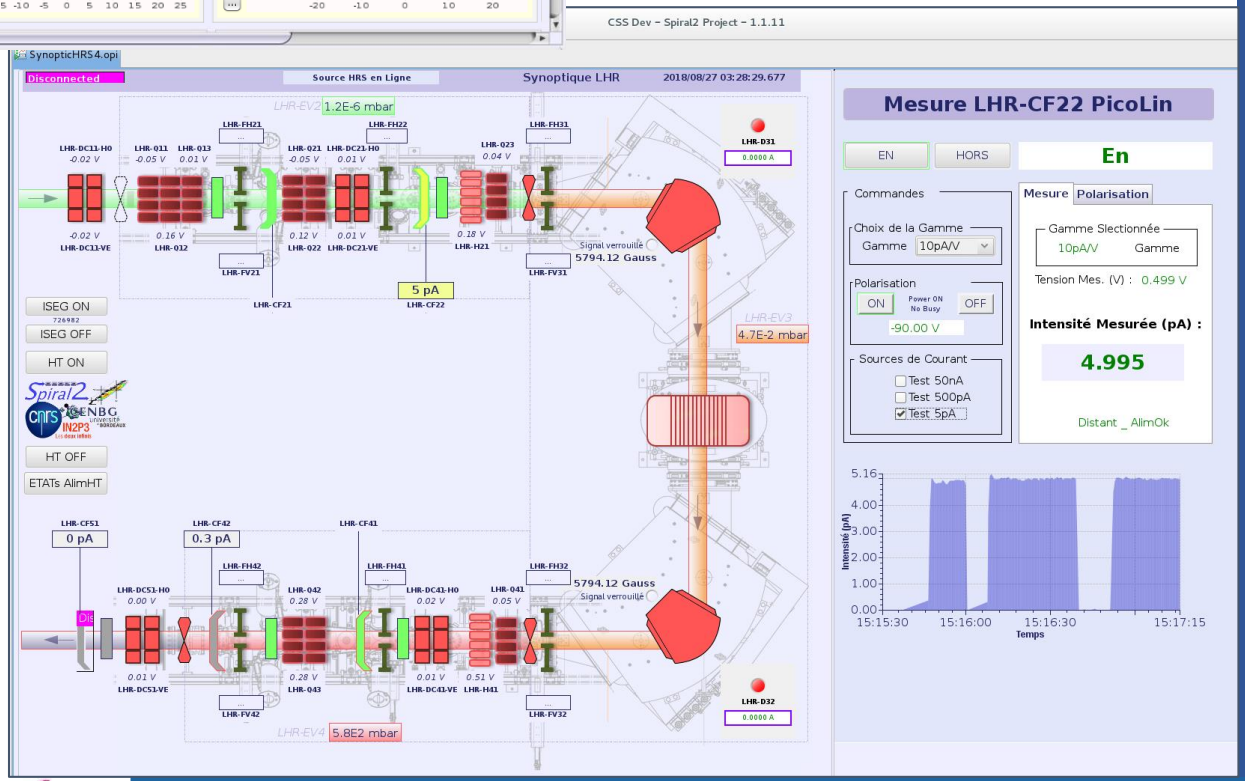
« *Profile* » Application

(Spiral2 Java Application)



Ion beam

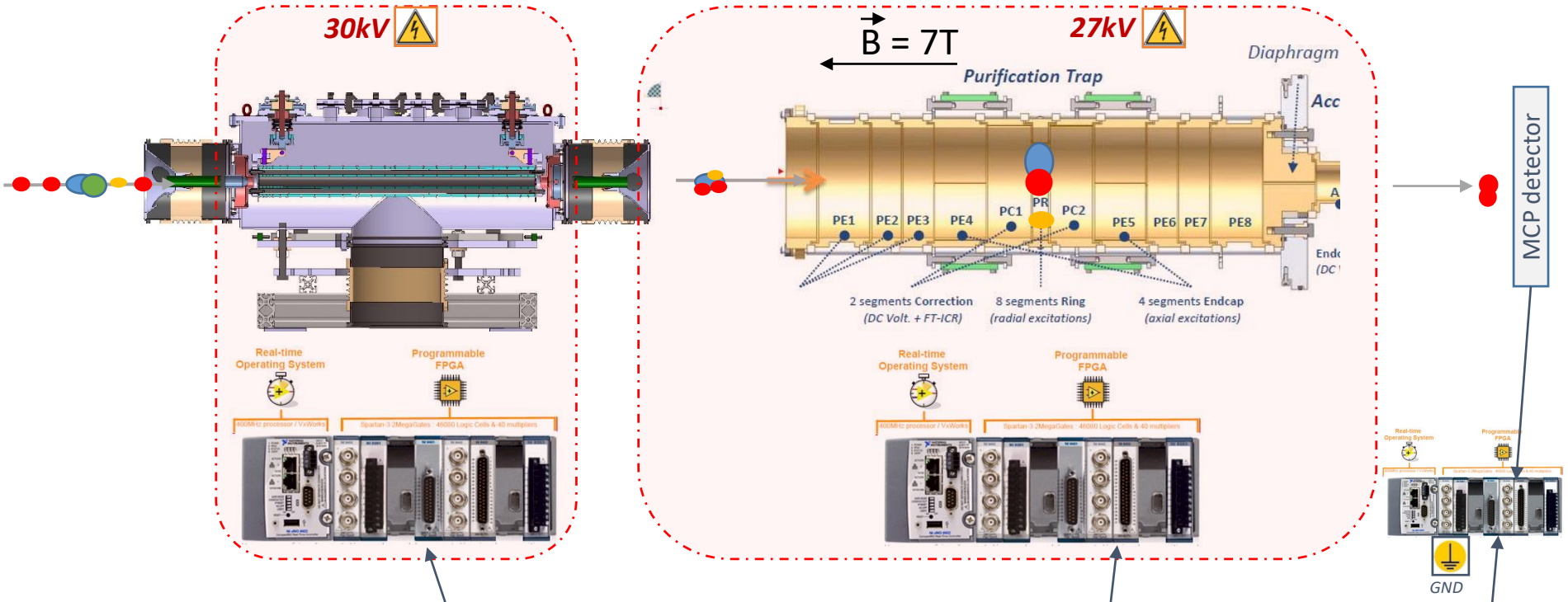
47 wires in Horiz. & Vert. Planes
(70µm W wires / pitch 500µm)



LHR OPerator Interface

(developed with « CSS-DEV »)

RFQ_Cooler_Buncher (GPIB) the Double Penning Traps (PIPERADE)



Programmable Timing Sequence

→Pulse Pattern Generator (PPG)

Optimized Buncher

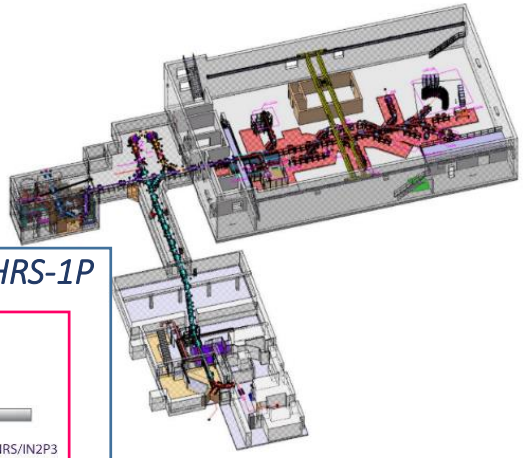
User defined Trapping Sequences

Ions Detection :

Particle Counting

Time **O**f **F**light

Spiral2 DESIR contributions



HRS-1P

DESIR Beam lines

FAIR @ GSI

GANIL laboratoire commun CEA/DRF Spiral2 CNRS/IN2P3

IPN INSTITUT DE PHYSIQUE NUCLÉAIRE ORSAY

CENBG

MAX-PLANCK-INSTITUT FÜR KERNPHYSIK

lpc caen

HRS RFQ-Cooler

CSNSM

UNIVERSITY OF JYVÄSKYLÄ

Beam preparation : GPIB & PIPERADE

cnrs IN2P3 Les deux infinis

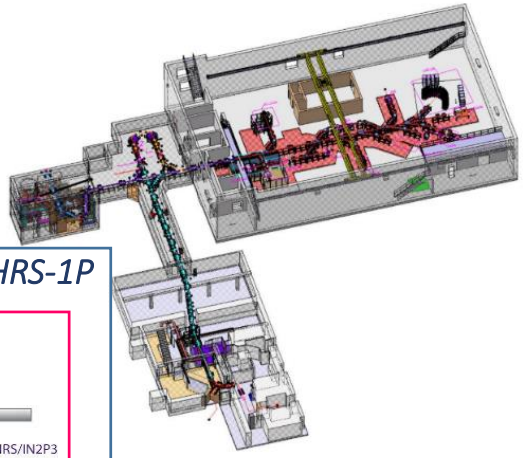
université de BORDEAUX

RÉGION NORMANDIE

INVESTISSEMENTS D'AVENIR

Agence Nationale de la Recherche ANR

Spiral2 DESIR contributions



HRS-1P

DESIR Beam lines

FAIR @ GSI

GANIL laboratoire commun CEA/DRF spiral2 CNRS/IN2P3

IPN INSTITUT DE PHYSIQUE NUCLÉAIRE ORSAY

CENBG

Thank you for your attention !

MAX-PLANCK-INSTITUT FÜR KERNPHYSIK

HRS RFQ-Cooler

CSNSM

UNIVERSITY OF JYVÄSKYLÄ

Beam preparation : GPIB &

PIPERADE Pièges de Penning pour les Radioisotopes à DESIR

cnrs IN2P3 Les deux infinis

université de BORDEAUX

RÉGION NORMANDIE

INVESTISSEMENTS D'AVENIR

Agence Nationale de la Recherche ANR