CENBG CONTROL SYSTEM AND SPECIFIC INSTRUMENTATION DEVELOPMENTS FOR SPIRAL2-DESIR SETUPS

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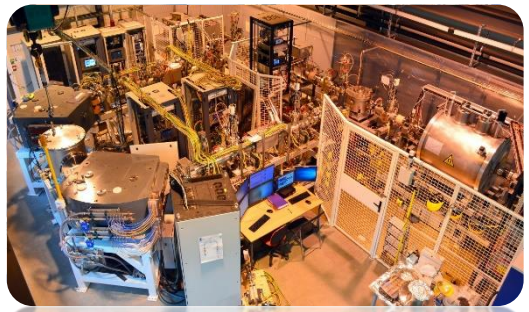
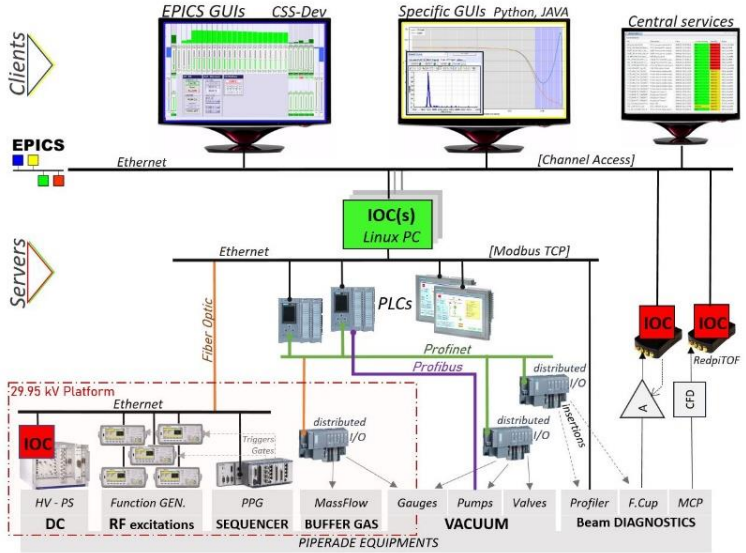
A. The SPIRAL2- **DESIR** FACILITY



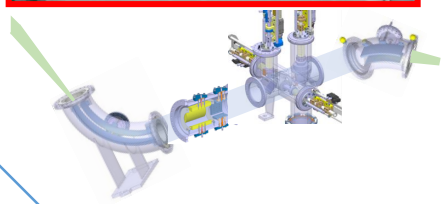
B. DESIR / SPIRAL2 Command Control **context & Rules**



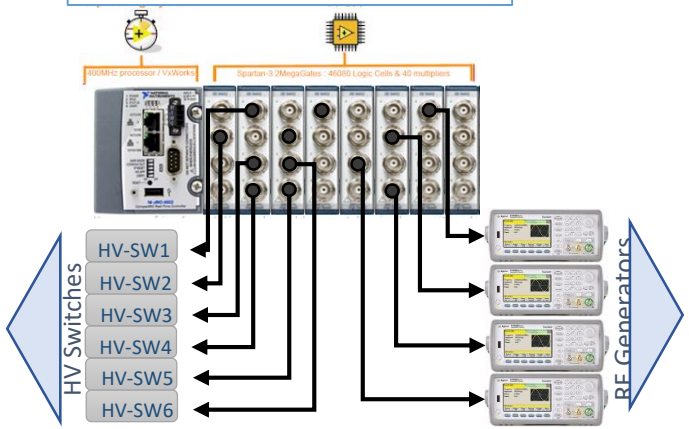
SUMMARY

C. Example of DESIR **Specific solutions**

High Voltage Power Supplies



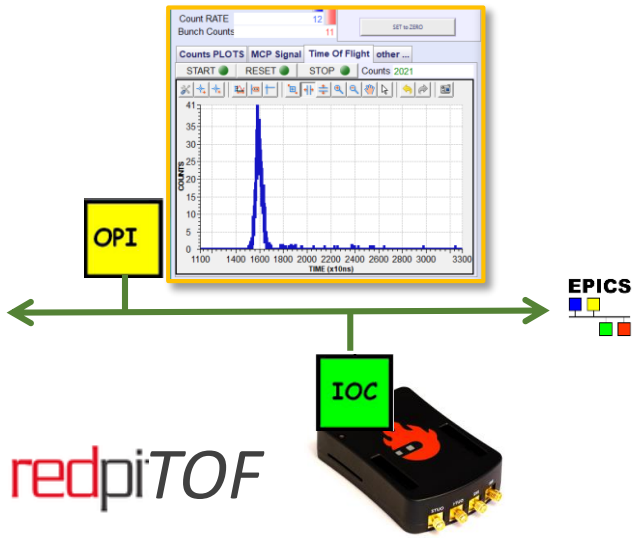
Pulse Pattern Generator



D. **Redpitaya for** Bunched Beam **Diagnostics**

FCup

MCP



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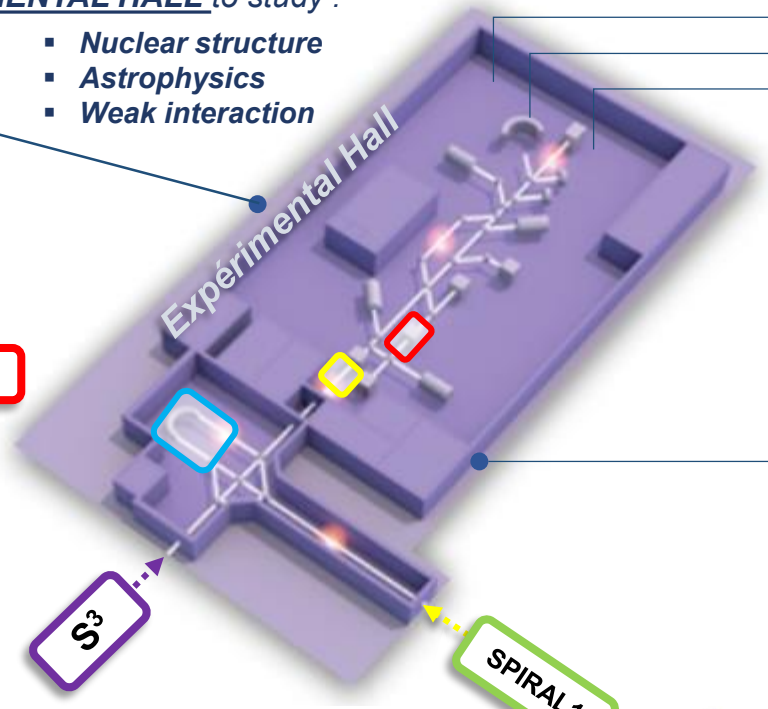
DESIR is the low-energy part of the SPIRAL2 ISOL facility under construction at GANIL.

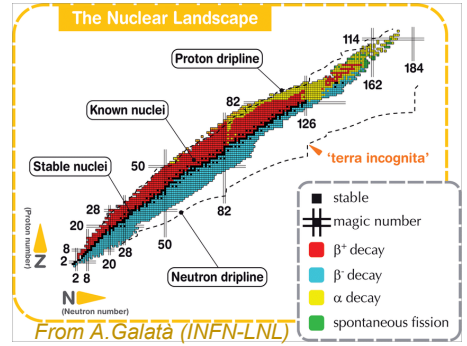
*It consist of an **EXPERIMENTAL HALL** to study :*

- ***Nuclear structure***
- ***Astrophysics***
- ***Weak interaction***



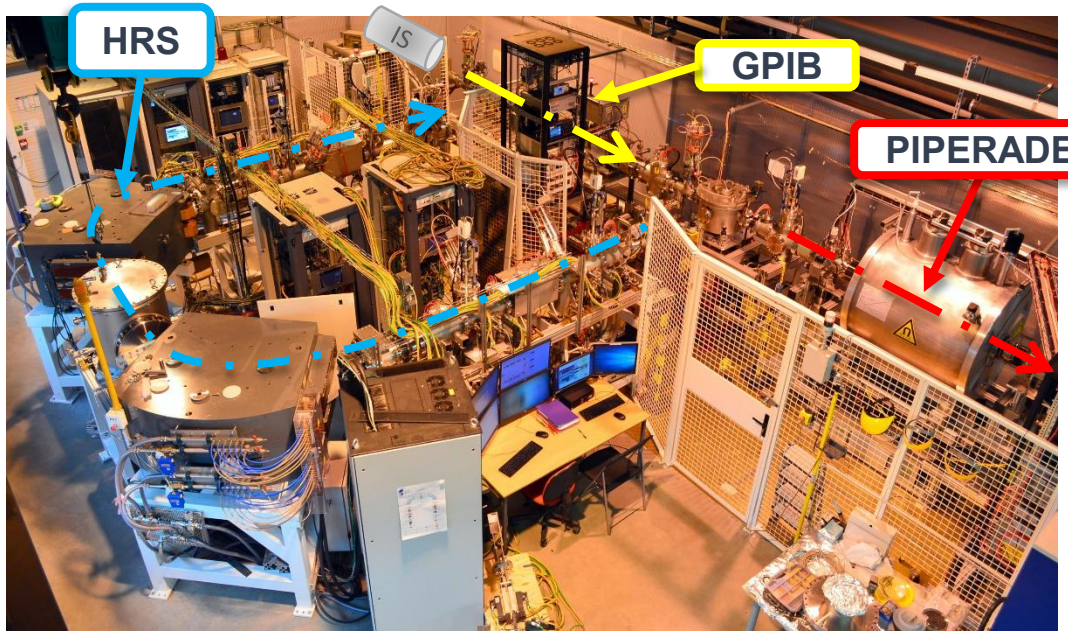
- *Laser spectroscopy*
- *Mass spectrometry*
- *Decay spectroscopy*

to measure exotic nuclei properties at low energy (10..60 keV)



From A.Galata (INFN-LNL)

today @ CENBG *Bordeaux, France*



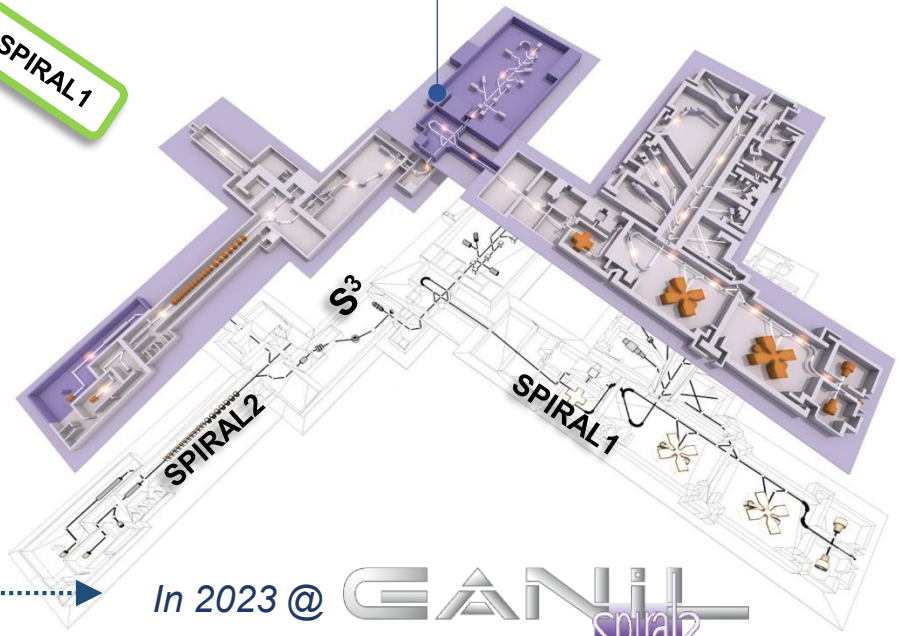
3 main devices are currently developed to guaranty high purity beams needed for high precision measurement @ DESIR

- ❑ *The **High Resolution Separator** **HRS***
- ❑ *The **RFQ - Cooler - Buncher** **GPIB*** (General Purpose Ion Buncher)
- ❑ *The double **Penning TRAP** **PIPERADE***

(PIèges de PEenning pour les ions RAdioactifs de DEsir)

EPICS

Control System (CS) developments performed at CENBG for DESIR are based on **EPICS** architecture, being the basic framework for the **SPIRAL2** control system.



In 2023 @ GANIL *Caen, France*

laboratoire commun CEA/DRF CNRS/IN2P3

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Collaborative Software developments

These CS and Automation developments are done **in collaboration with the GANIL** to be fully compatible with the **SPIRAL2** LINAC, Beamlines and NFS,S3 experimental area.

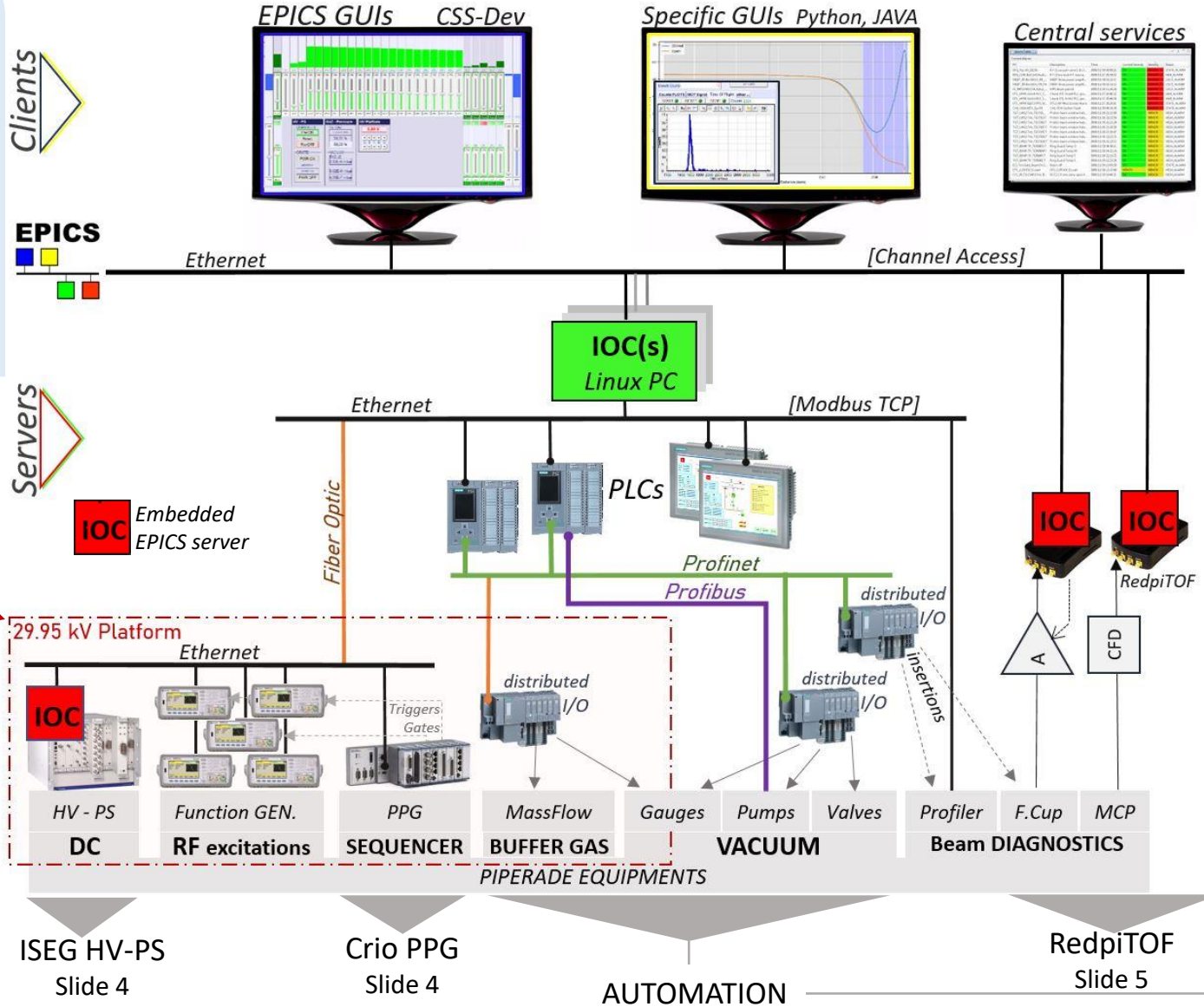
Common base :

- **Naming convention (** for equipment, IOCs …).
- Same **EPICS base** (3.14.9).
- EPICS IOC **"topSP2"** common software platform.
- Ganil **SVN server** used : soon **GitLab** .
- SPIRAL2 JAVA applications .

Shared software development tools :

- **SPIRAL2 CSS/BOY** (CSS-Dev / ECLIPSE IDE) to build most of GUIs : **Phoebus** soon .
- SPIRAL2 databases and IOC generation tools (GenIOC).

DESIR CC Architecture : PIPERADE *example*



Most of the PIPERADE electronics is embedded on a high-voltage platform. Fiber optics coupled to Ethernet switches ensure TCP communication with galvanic insulation of equipment.

Main options followed

- **Modbus TCP** protocol when possible.
- IOCs on **Linux CentOS** machines.
- No more VME Crates … replaced by **PLC** or **Redpitaya** to cover some diagnostics needs (see Slide 5).

Specific Clients

Python programs are under development **to operate PIPERADE traps** (A. Husson, M. Flayol). The main application is inspired from PyMassScanner program and done in **collaboration** with **JYFLTRAP** (*).

"**CorrAb**" is another tuning application under development @ CENBG (A. Balana) for the **HRS optimization** starting from emittance measurements . It will be used to to **correct** as much as possible the separator **aberrations** to reach a resolution of 20000 for isobaric separation.

Automation

SPIRAL2 vacuum systems and interlocks controlled with Siemens **PLCs** (A. Alfaurt, M. Corne).

- **Profibus Fieldbus** to communicate with turbo-molecular pumps
- **Profinet** deployed to manage **Input-Ouput** terminal modules (ET 200S).
- **local HMI** on a dedicated **Touch Panel**.

DESIR Interlock PLCs are also used to :

- Drive **brushless motors** (HRS slits).
- Answer **Fcup needs** (control & measure).
- Control all beamline insertions.

(*) T. Eronen, et al., JYFLTRAP: a Penning trap for precision mass spectrometry and isobaric purification, Eur. Phys. J. A 48 (2012)

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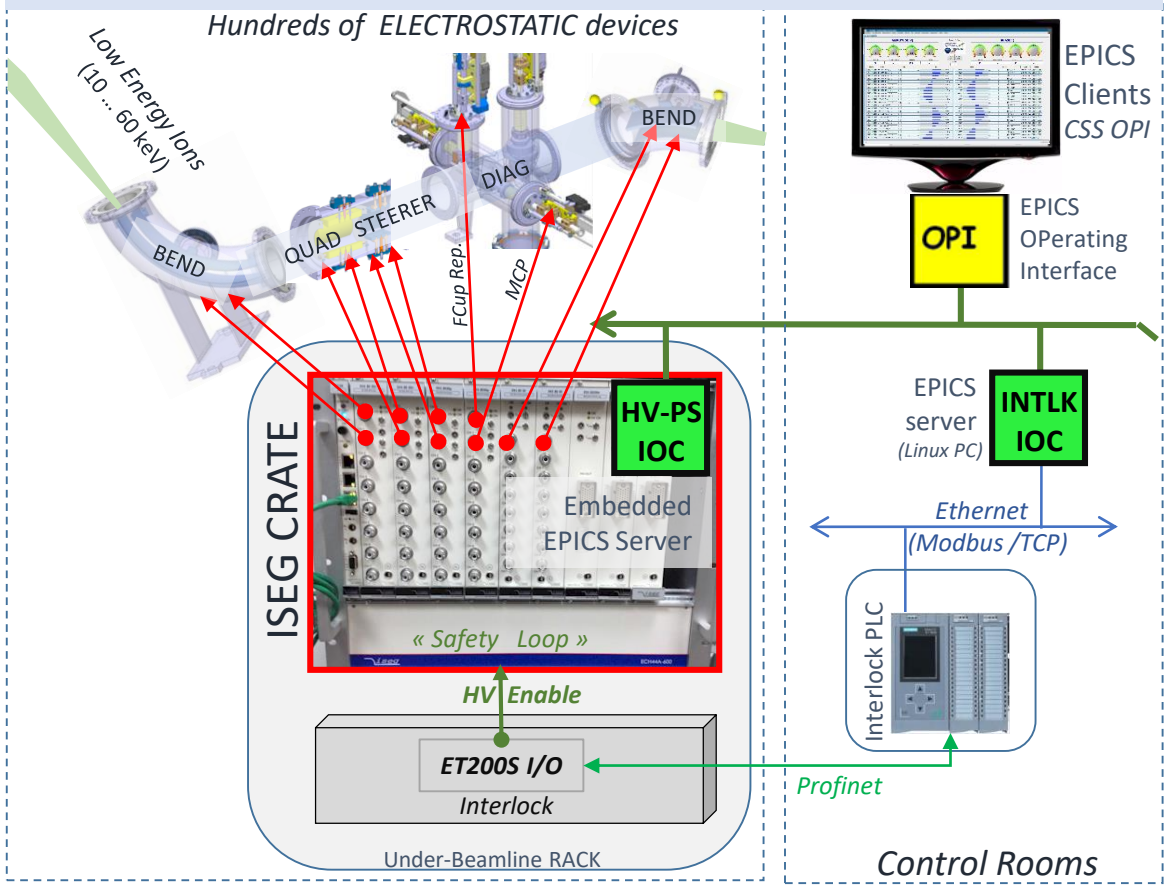
HIGH VOLTAGE POWER SUPPLIES (HV-PS)

Most of DESIR beamlines and setups equipment are electrostatic devices : Quadrupoles, Hexapoles, Benders, Steerers, Diagnostics polarisation.
In order to meet the High Voltage-Power Supplies (HV-PS) requirements, ISEG multichannel crates are used for providing all DC voltages.

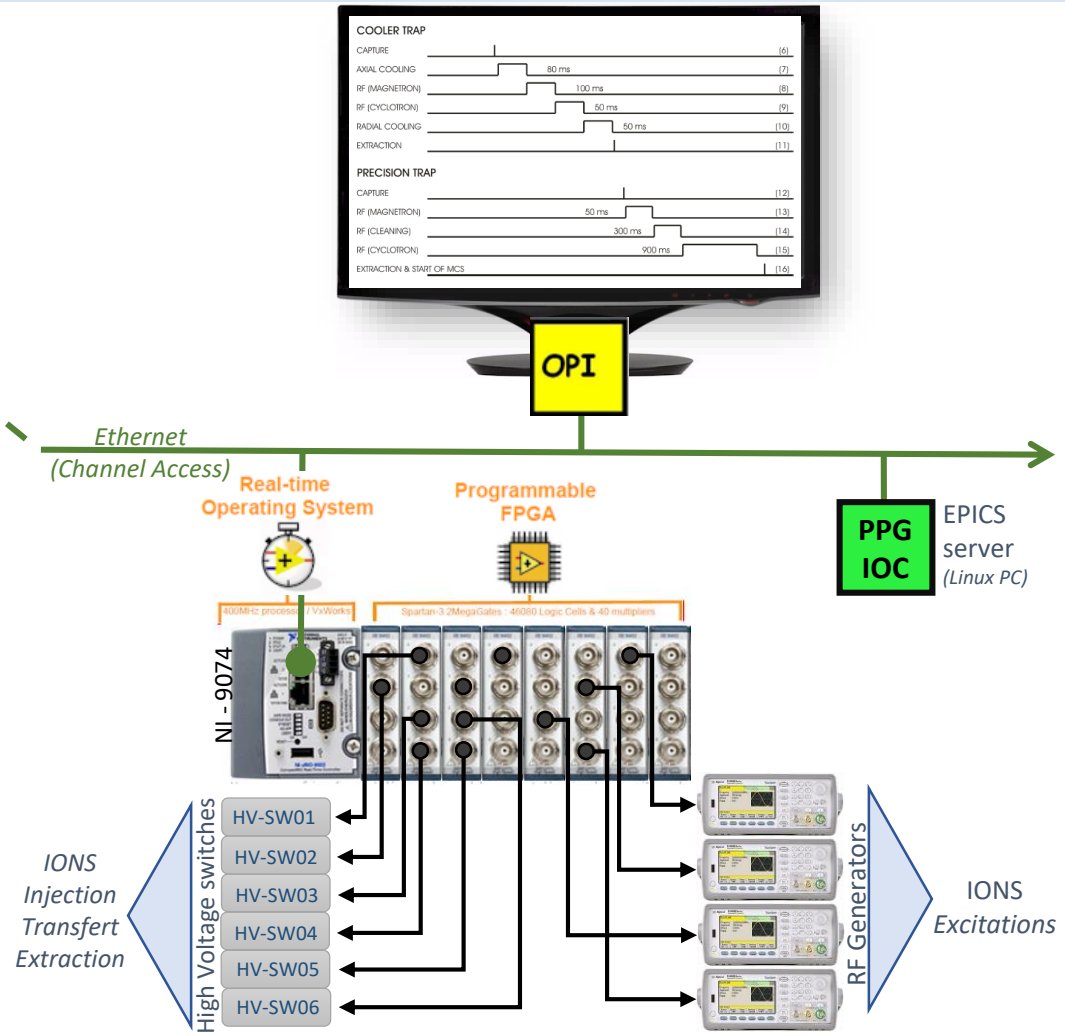


Why this solution adapted :

- Large variety of low-noise, precise and stable HV-PS modules proposed.
- Ability to concentrate a large number of HV channels in a single crate
- Built-in configurable EPICS Server deploying our own record database (SPIRAL2 Like)
- WEB server to remotely configure, test, manage the crate controller (CC24) and all embedded HV-PS.

PULSE PATTERN GENERATOR (PPG)

Ion traps such as PIPERADE need a configurable real-time "conductor". The PPG FPGA and Real-time software is based on SHIPTRAP and ISOLTRAP RIO PPG software (*) deployed for PIPERADE on a CompactRIO (NI-7410) to generate time sequences over 32 digital outputs with 10 ns time resolution. The same device is used to control the GPIB Buncher electrodes time sequence.



(*] « A new PPG based on Labview FPGA » - F. Ziegler et al. / NIM A 679 (2012) 1–6 3

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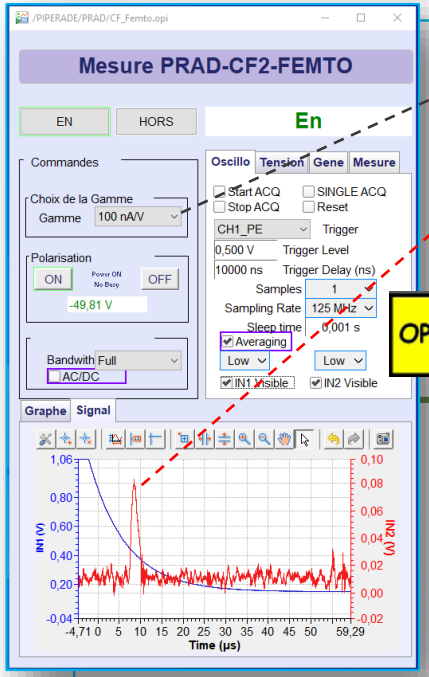


10^7 V/A = 100 nA/V
@ BW 1,8 MHz

0,07 V @ 2,5 µs

Beam Intensity
about **10^5 ions**
in a **2,5 µs bunch**

OPI

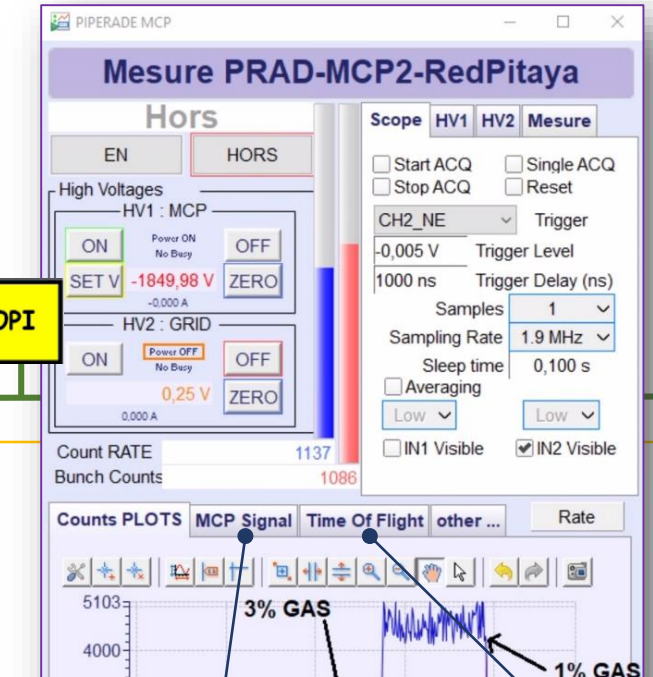
What is the redpitaya board ?

STEMLab 125-14

- *Dual core ARM + **FPGA** Xilinx*
- *OS : **Linux** Debian*
- ***Dual channel Scope** _ 125 MS/s _ ADC 14bits (+/- 1 V)*
- ***WEB server** : Scope & function generator ….*

EPICS Server installed & customised
https://github.com/AustralianSynchrotron/redpitaya-epics

Ethernet Network
(Channel Access Protocol)



OPI

A 50 MHz COUNTER
with on-line
TOF HISTOGRAM redpiTOF

IOC
SCOPE

trigger

Range
Status
Filter

DIO

voltage

FEMTO DHPCA
amplifier

Bunch intensity

30 keV Ions bunch

BUNCH GATE

Discri.
CFD

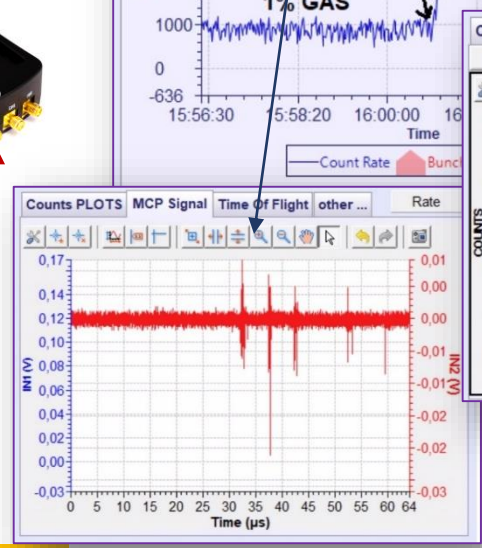
Counts
[STOP]

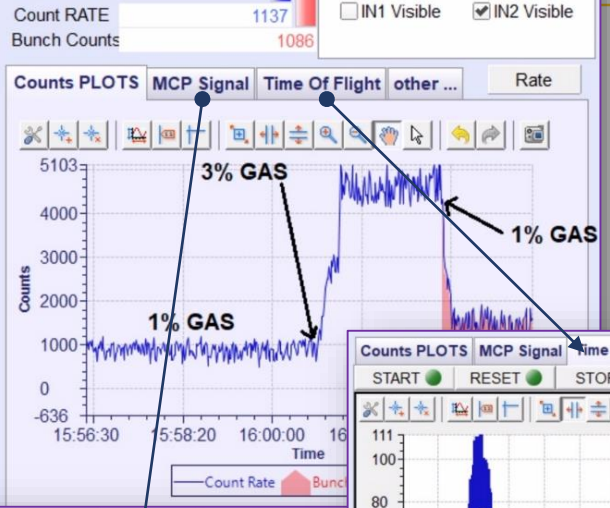
[START]

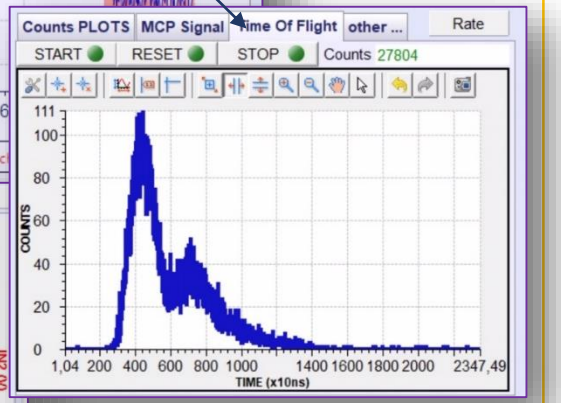
IOC
DI0
DI1
AI2
AI1

MCP Signal

30 keV Ions bunch







BUNCH on Faraday-CUP

BUNCH on MCP : Counting and Time Of Flight