IRFU COLLABORATION IN SPIRAL2 & LIPAC CONTROL SYSTEMS

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Brief legacy with some EPICS projects

Our collaboration in Spiral2

Our collaboration in LIPAc
BRIEF LEGACY OF EPICS IN OUR INSTITUTE

Started with EPICS in 1993 on TTF at Desy TTF Injector, LLRF and some diagnostics

1996-1999 ARC energy measurement at Jlab, Hall A

- Controls of wire scanners for the bend angle measurement
- Field integral measurement of the ARC
EPICS BETWEEN 2000-2005

4 EPICS VMEs on COMPASS at CERN
- Micromegas and drift chambers
- Quench data acquisition and slow control for the superconducting magnet

Ground Support equipment of MIRI imager (JWST)
- ESO software for IR detector
- EPICS for slow control
IPHI (High Intensity Proton Injector) started in the 90’s
HPPA : High Power Proton Accelerator

IPHI : AN HPPA PROTOTYPE INSTALLED AT SACLAY

- CW Source SILHI
- 5 MeV RFQ cavity
- MEBT: with diags
A first EPICS control system in 2001

Hardware and Software Renewal in 2012
The Spiral2 facility will be a new Rare Ion Beam facility for nuclear physics and astrophysics at Ganil in Normandy.

Spiral2 control system is under the responsibility of Ganil with E. Lécorché (following presentation).

3 French Labs, Ganil (Caen), IPHC (Strasbourg) and Irfu cooperate for the Spiral2 control system.
- The EPICS platform for the whole project
  - Based on VME/VxWorks and Linux PCs

- Injector (2 sources, 2 LEBTs, RFQ) with CS

- Some diagnostics controls
  - FC, ACCT/DCCT
  - Fast Current Transformers
  - Time of Flight
  - Agilent oscilloscope EPICS interface for the Fast Faraday Cup
    - Chopper

- LLRF
COMMON SPIRAL2 HARDWARE PLATFORM

- Emerson MVME 5500

- VME NEXEYA ADAS boards/EPICS drivers
  - ICV150: 32 ADCs, 16-bit resolution, 30 K samples/s
  - ICV714: 16 DACs, 12-bit resolution
  - ICV196: 96 binary I/O channels
  - ICV108: a controller board with RAM 4 Mbytes, external trigger
  - ICV178: 8 ADCs, 16-bit resolution, 50 K Samples/s up to 1.2 M Samples/s

EPICS driver developed for the synchronised intensity measurement (FC, ACCT, EMU) on Spiral2 and then used on other projects
Homogeneous development was needed between the 3 labs to ease integration:

- **Rules:**
  - for naming files and global functions
  - for naming PVS

- **Development model:**
  - Top directory topSP2
  - makeBaseApp templates for Apps and IOCs
THE COMMON EPICS PLATFORM (2)

- EPICS 3.14.12.4
- VxWorks 6.9 for MVME5500
- CentOs or Scientific Linux CERN on PCs
- Available from SVN server at Ganil
2 Flow controllers: Deuterium/Hydrogen & Nitrogen

Agilent pulse generator
RF generator = magnetron

Automatic Tuning Unit = impedance adapter

SNL program for regulation based on the beam current reading

50 KV PS polarizes pt

30 KV PS, intermediate electrode

3 KV PS repelling electrode
Controls of diagnostics & 20 Power Supplies

Diagnostics:
FC, ACCT & DCCT, SEM-grid harps (Ganil), Allison emittance-meters (IPHC), Slits => VME or Modbus/Tcp used

20 Hazemeyer Power Supplies:
- 2 dipoles
- 2 solenoids
- 7 quadrupoles
- 9 steerers
- Connected to Ethernet fieldbus & accessed via Modbus/TCP
- A common software interface (Ganil)
- The 2 beamlines Saclay and Grenoble tested with only EDM displays
- Migration to CSS BOY started late 2011
- Tests at Saclay and Grenoble stopped in May 2012
- We are waiting for the starting signal from Ganil for the CS installation
IFMIF (International Fusion Materials Irradiation Facility) purpose: provide an accelerator based on a neutron source to produce high-energy neutrons (deuterons) at sufficient intensity and irradiation volume to qualify materials for fusion reactors.

A prototype LIPAc (Linear Ifmif Particle Accelerator) identical to the low energy section of IFMIF is being built to check the validity of the design before launching the IFMIF construction.
LIPAc is developed under the Broader Approach for Fusion agreement between Europe and Japan. 3 European countries are involved: France, Italy and Spain and share the sub-systems.

The control system is split into different LCSs between CIEMAT Madrid, INFN Legnaro and CEA Saclay.
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- in charge of a transverse coordination, standardisation of the development and acceptance tests through European LCSs
EPICS software platform
  - Identical to Spiral2 platforms (hardware & software)
  - With the same templates to use for development

Guidelines for installation

Guidelines for development

Guidelines for naming

Template LCS Acceptance Test
  - To be filled up and followed step by step during the acceptance
LCS ACCEPTANCE TESTS

- Checking of the manuals
  - User manual
  - Maintenance manuals (one per device)
    - Design of software development
    - Hardware configuration
    - Scenarios to test controls

- Checking software installation
  - Start from scratch
  - The complete LCS software has to be reinstalled automatically if possible
  - Checking of the topIFMIF tree
  - Checking of the database records naming

Scripts in collaboration with INFN/Legnaro
LCS ACCEPTANCE TESTS (2)

- Application module acceptance test
  - Checking scenarios adapted by the person/developers in charge of the LCS

- Release acceptance test
  - This phase concerns the test of the full system from the LCS user interface to the I/Os.

- Global acceptance test
  - All LCSs connected to the Rokkasho network and Central Control system

- CEA diagnostics European LCS Acceptance tests took place May 2014
Injector disassembly at Saclay
November 2012

Linux PC / EPICS supervision: BOY displays and archiving

Siemens microbox/OPC server & EPICS OPC client

Ethernet

MVME5500/VxWorks 6.8

EMU, ACCT, FC, FGA

EMU source (HV PS, RF generator, ATU, coils, electrode)
LEBT (coils, solenoids)

Vacuum

Water cooling

OF + Spectrometer
Control system tested October 1-9th
- CEA Diagnostic controls of IFMIF-Eveda prototype accelerator: LIPAc
  Jean-François Denis (CEA)

- LIPAc LLRF control system development based on EPICS
  Julio Calvo (Ciemat)

- LIPAc status: EPICS integration and commissioning
  Alvaro Marqueta (Project Team at Rokkasho)
CONCLUSION

- Our collaboration in Spiral2 and then LIPAc was, and still is, very rewarding
  - Fruitful exchanges
  - 2 different projects enabled us to study different technologies
  - Improvement of our methods of work between the 2 projects

- Many thanks to the EPICS community for all their help since 1993.
IRFU EPICS TEAM

EPICS platform & tools: Y. Lussignol & P. Mattei

Spiral2 EPICS team
sources: J-F. Denis
LEBTs: J-F. Denis, F. Gougnaud, Y. Lussignol
LLRF: Y. Lussignol

LIPAc EPICS team:
Injector: D. Bogard, P. Mattei & A. Gomes
Diagnostics: J-F. Denis
Transverse Coordination: F. Gougnaud, J-F. Gournay (now retired)

2 EPICS beginners: T. Joannem & N. Senaud