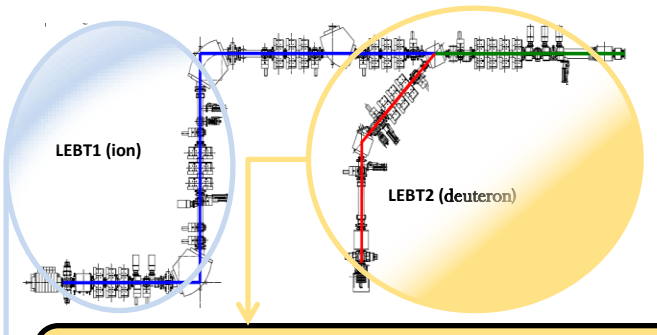
THE IMPLEMENTATION OF THE SPIRAL2 INJECTOR CONTROL SYSTEM

J-F.Denis, *F.Gougnaud, J-F.Gournay, Y.Lussignol, P.Mattei, R.Touzery (CEA-IRFU-SIS/Saclay, France)
P.Gilette, C.Haquin (Ganil/Caen, France)
J.Hosselet, C.Maazouzi (CNRS-IPHC/Strasbourg, France)

MOPMU025

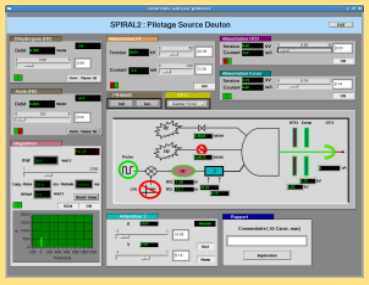


The EPICS framework was chosen for the Spiral2 project control system [1] in 2007. Four institutes are involved in the command control: Ganil (Caen), IPHC (Strasbourg) and IRFU (Saclay) and LPSC (Grenoble), the IRFU institute being in charge of the Injector controls. This injector includes two ECR sources (one for deuterons and one for A/q= 3 ions) with their associated low-energy beam transport lines (LEBTs). The deuteron source is developed at Saclay and the A/q=3 Ion source at Grenoble. Both lines will merge before injecting beam in a RFQ cavity for pre acceleration. This paper presents the control system for both injector beamlines with their diagnostics (Faraday cups, ACCT/DCCT, profilers, emittance-meters) and slits. This control relies on COTS VME boards and an EPICS software platform. Modbus/TCP protocol is also used with industrial devices like power supplies and Siemens PLCs. The Injector graphical user interface is based on EDM while the port to CSS BOY is under evaluation; also high level applications are developed in Java. This paper also emphasizes the EPICS development for new industrial VME boards ADAS ICV108/178 with a sampling rate ranging from 100 K Samples/s to 1.2 M Samples/s. This new software is used for the beam intensity measurement by diagnostics and the acquisition of sources.

*contact : francoise.gougnaud@cea.fr

LEBT2 at Saclay

Deuteron source



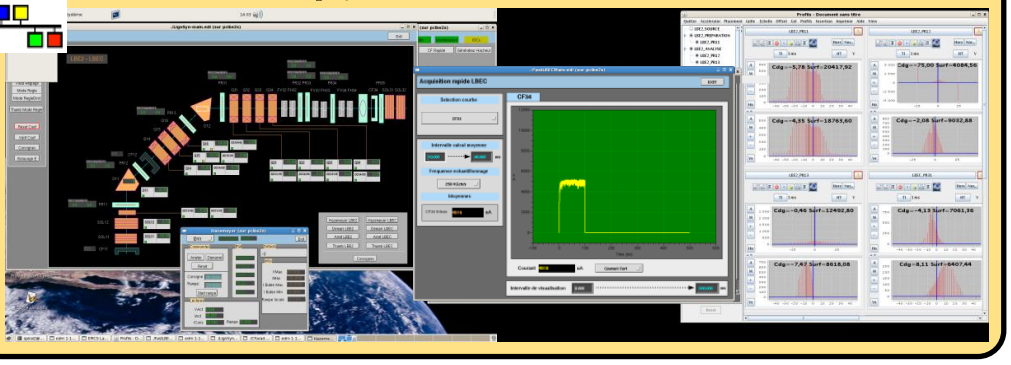
The Saclay proton/deuteron source control system has been done in Epics. It controls several pieces of equipement : a magnetron, a pulse generator, an impedance adaptor, an extracting beam High Voltage power supply, a gas injector controller and a repelling eclectrode power supply.

COTS VME Boards

The Spiral2 Injector Standard VME is composed of an Emerson Motorola MVME5500 and NEXEYA ADAS VME boards:

- ICV 150 (32 ADCs, 16 bits, and 30 K Samples/s)
- ICV714 (16 DACs, 12bits)
- ICV196 (96 binary I/O channels)
- ICV108 (Controller board with 4 M bytes of RAM)
- ICV178 (8 ∑Δ ADCs, 16 bits, 1,2 M Samples/s)

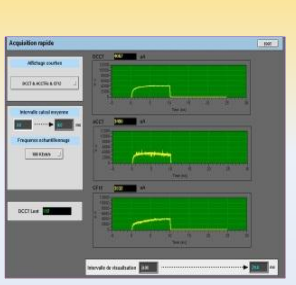
EDM display of LEBT2 : the beam at the end of the line



"Fast acquisition" EPICS Driver for ACCT/DCCT & Faraday Cups

ACCT/DCCT

Faraday Cup



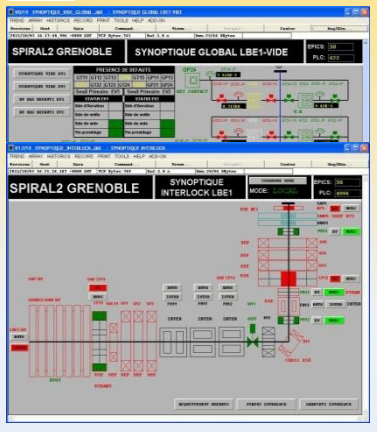
This driver is used for Faraday Cups, ACCTs and DCCTs.
The principle for this synchronised acquisition is to start acquisition at the beam pulse start, to buffer the digitalised data, to display the pulse shape and intensity average value for each pulse.

The solution relies on :

- VME ADAS ICV108, a controller board which includes an external trigger and a RAM buffer of 4 M bytes (Flip/Flop Mode)
- VME ADAS ICV178, an 8 ∑Δ ADC board with a 16bit resolution, Sampling from 100 K Samples/s up to 1 M Samples/s

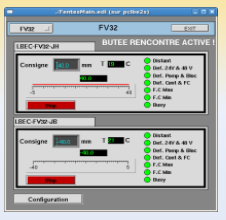
To optimize the running with regard the 4 M bytes RAM and the sampling frequency, this driver only samples the channels corresponding to the equipment used for the intensity measurement. The EPICS driver compressed (averaged) data to speed up the visualization of graphs.

PLCs (Muscade) µSCADaEmbedded



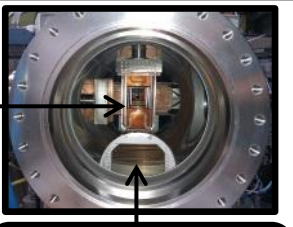
Siemens S7 PLCs were chosen. Interlock PLCs provide safety of the equipement on the beam line. There is a another PLC to control the vacuum. It is connected to Ethernet and supervised by a Muscade station and with EPICS EDM HMIs. Protocol Modbus/TCP is used for the communication between EPICS IOCs and PLCs.

Slits

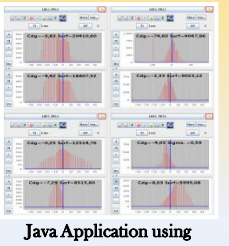


The objective of the slits is to remove a part of the halo surrounding the heart of the beam. A pair of thermocouples is integrated into each slit to monitor the temperature that is controlled by an Epics IOC through the ICV150 ADC board. The control of the motor driver is based on Modbus/TCP in the same way as the power supplies.

EDM display of the LEBT1



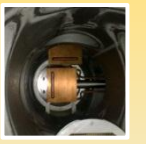
Profiler

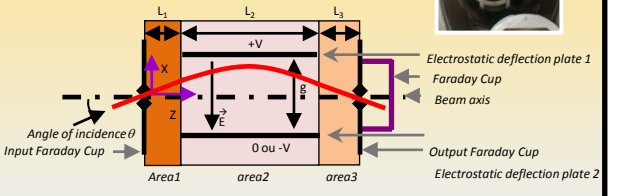


Java Application using XAL framework

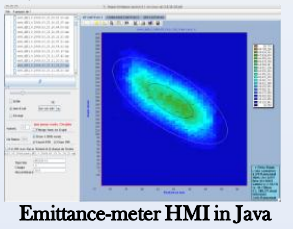
An IOC application computes average and offset subtraction. Then a server task provides supplementary calculations like surface, signals sum, gravity center, standard deviations, widths,... for client and graphical applications.

Emittance-meters





The transversal emittance is a cartography of the transverse angles of the particules of the beam.



Emittance-meter HMI in Java

First, the maximal voltages are applied on the plates. Then, the process is made of 3 sequences: positioning, voltage ramp setting and current reading. For each position during the move, the voltages of the plates are decreased until an electrical field equal to zero is reached. Then, the field is inversed and the same sequences restart.

LEBT1 at Grenoble