PROGRESS IN THE CONVERSION OF THE IN-HOUSE DEVELOPED CONTROL SYSTEM TO EPICS AND RELATED TECHNOLOGIES AT iTHEMBA LABS

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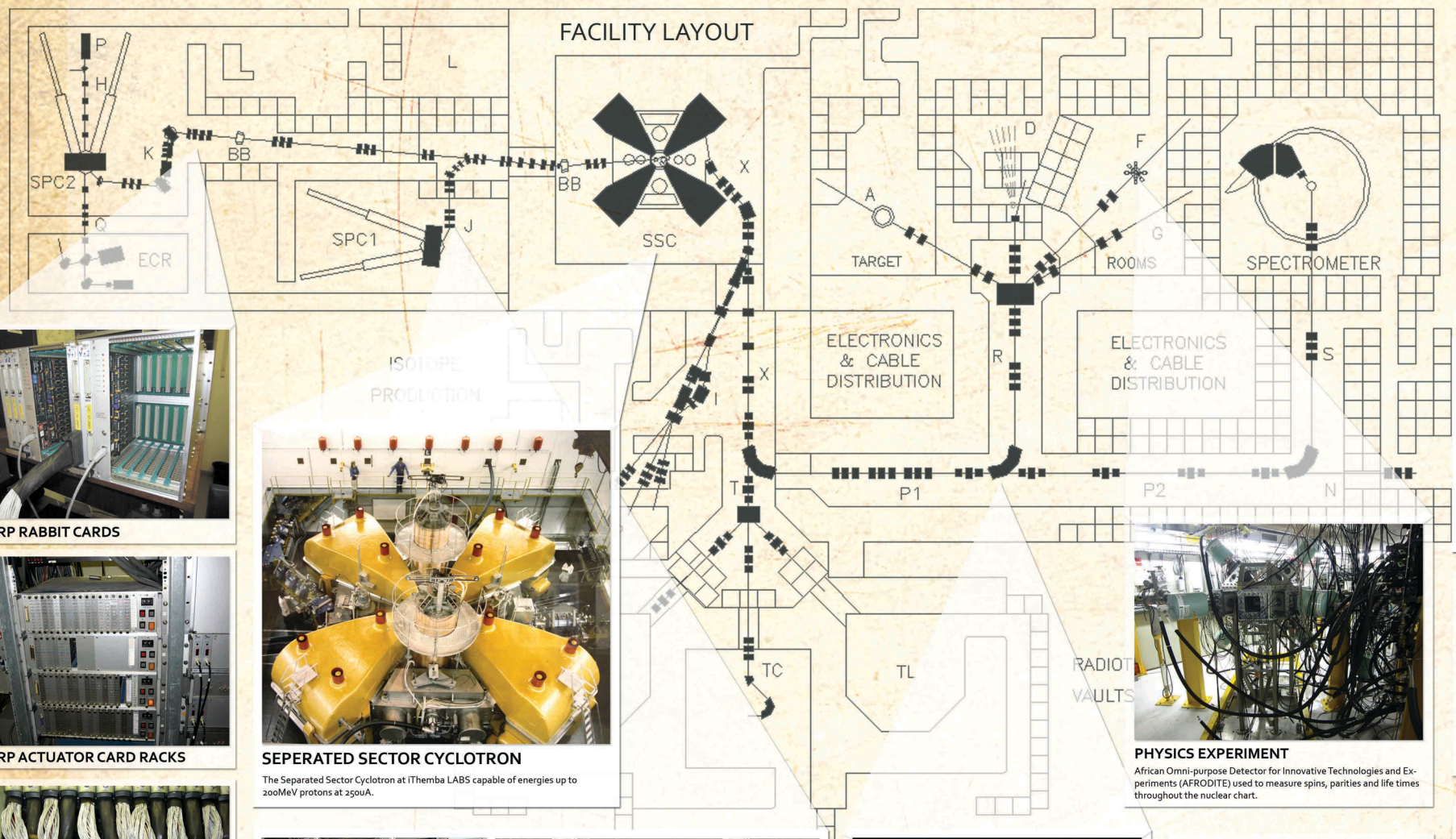
ABSTRACT This poster highlights challenges associated with the upgrading of the iThemba LABS control system. Issues include maintaining an ageing control system[1] which is based on a LAN of PCs running OS/2, using in-house developed C-code, hardware interfacing consisting of elderly CAMAC and locally manufactured SABUS[2] modules. The developments around integrating the local hardware into EPICS, running both systems in parallel during the transition period, and the inclusion of other environments like Labview are discussed.



HARP RABBIT CARDS

HARP ACTUATOR CARD RACKS

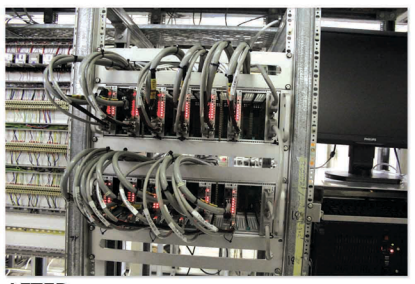
HARP AMPLIFIER CARDS INSTALLED

Harps Electronics

These are crates that can read currents on 7 harps each with 48 X and 48 Y wires. Each crate has 2 Rabbit multiplexer cards (one for X and the other for Y) which interface to the 48 channel amplifier cards and communicate with a PC over an Ethernet TCP/IP socket. The harps, faraday-cups and neutron shutters pneumatic actuators are driven by crates of 16 channels controlled by a specialized SABUS actuator card.

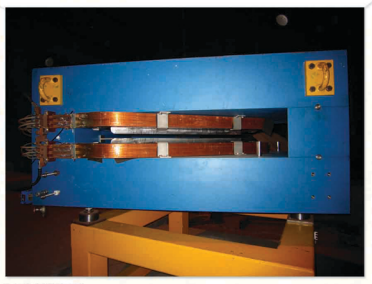
SEPERATED SECTOR CYCLOTRON

The Separated Sector Cyclotron at iThemba LABS capable of energies up to 200MeV protons at 250uA.



JB LINE SLITS BEFORE AFTER

Upgrade of the injection Beam-line slits (before and after). The old system consisted of three CAMAC crates and 8 boxes of electronics, this was reduced to two SABUS crates implementing the control of the injection beam-line slits on EPICS.



MAGNET

Water cooled electro-magnet

PHYSICS EXPERIMENT

African Omni-purpose Detector for Innovative Technologies and Experiments (AFRODITE) used to measure spins, parities and life times throughout the nuclear chart.

CONTROL DESK CABINETS

Moved to a server room with backup air handling and dual redundant power supply.

SABUS INSTALLED

Installed EPICS IOC and SABUS crate

Each EPICS IOC is built on a standard PC, running Ubuntu Linux 10.04 LTS.

I/O expansion is implemented by adding a daisy chain of up to 15 SABUS crates per PCI interface card.

The IOC is customised by running a script that:

- installs Linux drivers for 2 types of PCI and one type of ISA master differential driver card
- installs EPICS base, ASYN, stream device, autosave and MEDM
- adds template files for all SABUS type cards
- runs makebaseapp.pl then converts the IOC application to include our drivers, card templates and substitution file.

SABUS Cards
Dual Channel Power Supply Controller (PSC) with DAC, ADC, status and on/off, positive/negative pulse controls
Stepping motor controller(SMC) with encoder or potentiometer position read-back, limits and brake controls
A 32 way relay card,
each bit individually addressable 24 bit Optically or relay input and output card 80 bit Optically isolated input card Dual specialized actuator crate controller card SABUS IGOR (Input Gate Output Register) card which is a direct replacement of the CAMAC version.

SABUS CARD PRODUCTION

SABUS CARDS

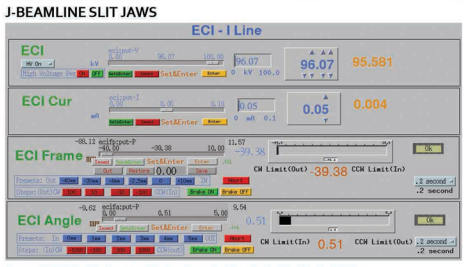
SABUS CRATE

SABUS CRATE BACK PLAIN VISIBLE

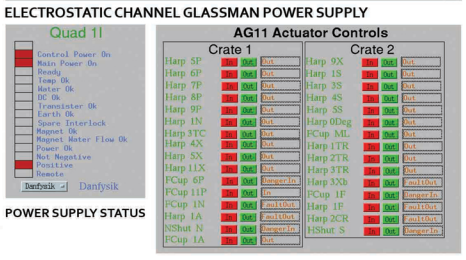
Each card frame has 13 slots, linked to a PC via a 8bit parallel differential bus. Up to 15 crates can be daisy chain connected to each PCI master differential bus driver plugged into the PC motherboard.

SPLITTER MIMIC

J-BEAMLINE SLIT JAWS



ELECTROSTATIC CHANNEL GLASSMAN POWER SUPPLY

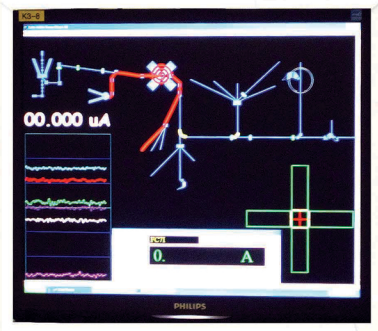


POWER SUPPLY STATUS

EPICS MEDM Screens HIGH ENERGY BEAMLINE ACTUATORS

In the beginning stages of the EPICS implementation it was decided to provide a basic level of control by using simple MEDM pages.

Shown is a mimic diagram of a piece of beam-line where the beam is split for the dual isotope production target stations. Control pages are launched by clicking on the "highlighted" areas.
So far 1034 controllable variables have been implemented on EPICS.

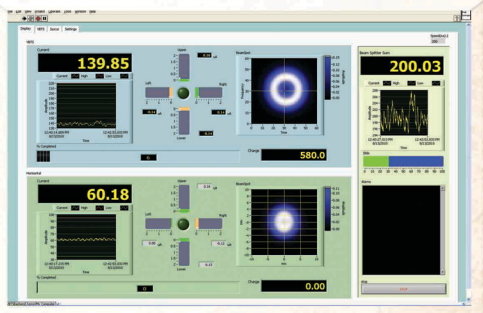


ACTIVE BEAM

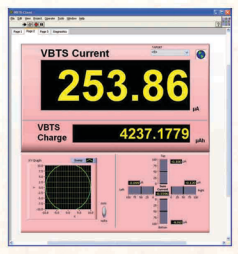
HARPS

Harp Interface

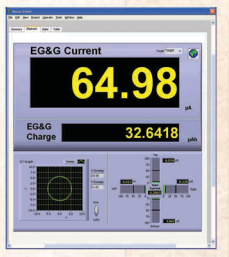
This is a Windows C# .NET application using National Instruments Measurement Studio in VS 2010 for the graphics. Harps, faraday-cups and neutron shutters are placed in the line on mouse clicks.



CHARGE INTEGRATION SYSTEM

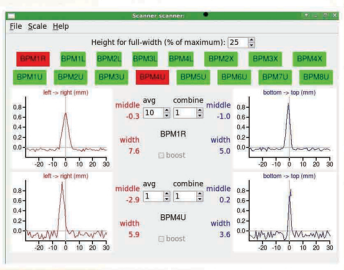


VERTICAL TARGET STATION



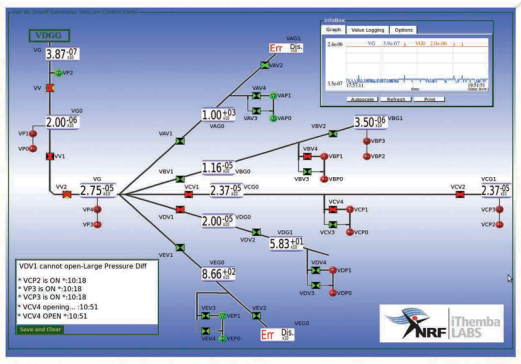
HORIZONTAL TARGET STATION

The Charge Integration system implemented on Labview and National Instrument I/O cards, showing energy distribution on the targets and the effect of splitting the beam with 139.85uA (70%) going to the vertical target station and 60.16uA being sent to the horizontal target station (30%).



SCANNERS

The scanner program provides a display for National Electronics beam profile monitors it uses Qt Open Source Edition version 4.5.0. by Nokia. Up to 16 scanners may be connected to National Instruments cards managed by an EPICS IOC. The IOC must be configured with a custom EPICS ASYN driver, developed at iThemba LABS for this purpose.



VAN DE GRAAFF GUI

Vacuum System

The Vacuum System uses Trolltech's Qt (which subsequently became Nokia's). Customised EPICS-capable plug-in widgets/GUI components were created using Qt Designer, these GUI-objects can be dragged and dropped into a display and those with EPICS functionality have their Process Variable(PV) names entered. Customised Signals and Slots easily link and transfer information between customised components and standard ones.

CONCLUSION The split of implementation is about 90% non-commercial (EPICS and in-house cards) to 10% commercial (Labview, .NET and NI[9] cards). Where there is a large number of I/O cards required (for example about 150 dual power supply controllers) it is cost effective to go in-house. To date about a third of the process variables are running under EPICS on the non-real time operating system Linux (Ubuntu), using off-the-shelf personal computers and in-house interface cards. They are proving to be stable. A consequence of a non-commercial solution is that a fair amount of time has had to be allowed for the development of the software drivers for the I/O cards as well as manufacture and debugging of the I/O cards. This has removed the reliance on commercial suppliers though and the flexibility of the local designs has allowed tailoring of interfacing to match any equipment already installed. Once the design phase is complete the cost per system is low. However on the commercial side when it has been determined that smaller quantities of more specialized interface cards are required Labview in conjunction with these cards has proven to be a very convenient tool with excellent graphics, ready-made drivers and a wide range of I/O cards available. Cognisance also has to be taken of the available skills within the development team. Some developers prefer the Microsoft .NET environment and having experience in this technology allows for rapid development of their assignment , an example being the harp and faraday cup system, successfully deployed.

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