BET-C: THE NEW PORTABLE BEAM EVALUATION TOOL FROM CNES.

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CONTEXT

- When performing a radiation characterization under beam, we need to be confident in the beam characteristics.
- Beam calibration data are delivered by facilities.
- Each facility uses its own dosimetry and calibration technique and also its own calibration data format.

⇒ These calibration data are sometimes difficult to check by the customer (they depend on the dosimetry system)

⇒ Comparison between facilities is not easy

In the last 10 years, we have faced various beam quality events (doubts, confirmed or not, on the beam characteristics) that have convinced us that an autonomous solution for Beam Characterization was necessary.

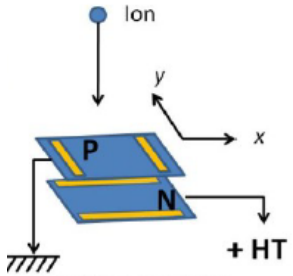
CONTEXT

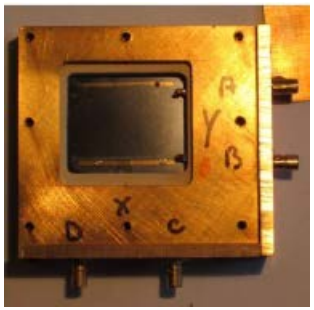
- In the 90’s, CNES was using the Tandem Van de Graff accelerator at IPN (institut de Physique Nucleaire, Orsay, France) as main heavy ion facility.

- A full beam calibration and beam monitoring chain has been implemented by IPN on the line 320 (dedicated to SEE tests) under CNES funding.

CONTEXT

- This solution was made of:
  - XY silicon diode specifically developped and manufactured by IPN
  - Diode biasing control unit
  - Acquisition chain (amplification, filtering, counting,…)
  - A user interface on a UNIX station





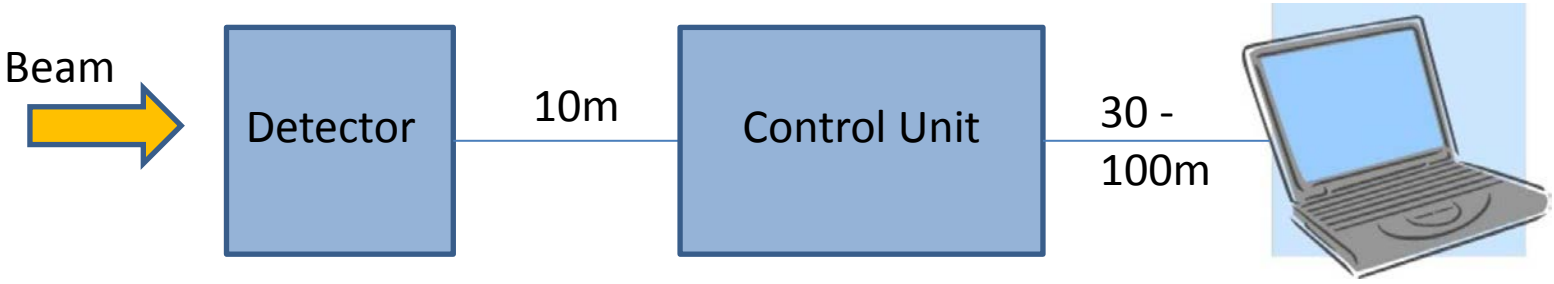
- It was able to deliver a continuous monitoring of the beam:
  - XY distribution: Beam area and count
  - Energy: Mono energetic distribution or beam pollution by isotopes

⇒ This solution is fully adapted to the actual need excepted its size and weight!

BEAM MONITOR SPECIFICATION

The need has been established as following:

- Same characteristics as the previous IPN Line 320 monitoring system (XY distribution and energy monitoring)
- Compatible either with vacuum and air
- Able to monitor proton beams (10-230MeV) and heavy ions beams (10MeV/amu guaranteed, 30MeV/amu TBC).
- Distance between detector and electronic control unit: 10m
- Distance between control unit and user PC: 30-100m



SCHEDULE AND FUNDING OF THE PROJECT

- 2013: Feasibility study

⇒ Diode + Preamp calibration

« Etudes métier »
Beam procurement

- 2014: Monitor development & manufacturing and Control Unit definition:

PI HSI 2014

- Control Unit development & manufacturing:

PI HSI 2014 - 2015

Current Status:

⇒ Monitor has been successfully delivered after calibration.

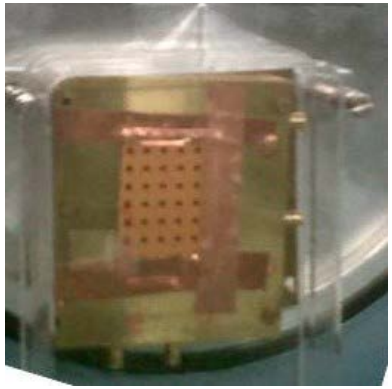
⇒ Control Unit has been integrated with the monitor but is still under validation.

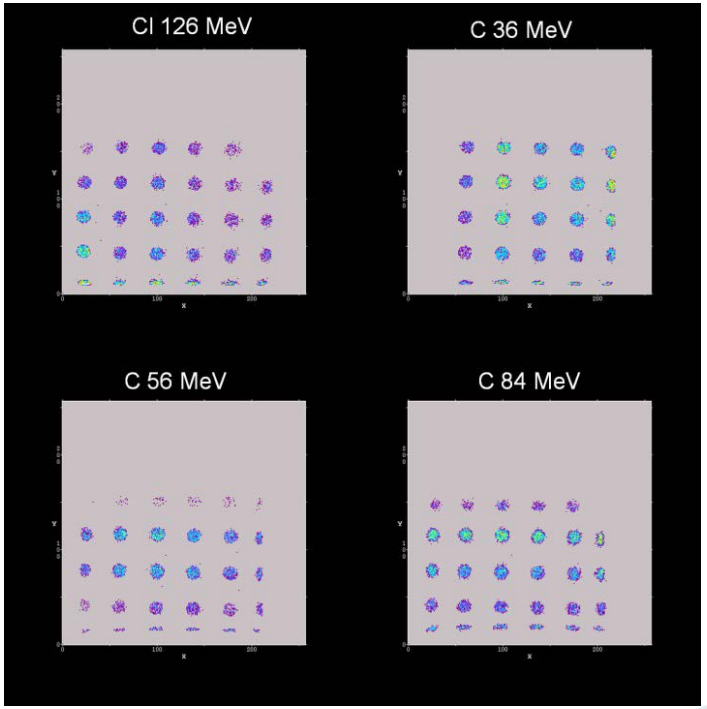
⇒ Complete validation and calibration expected T2-2015.

BEAM DETECTOR

First calibration tests have been performed at IPN on Diode + pre-amps with a non integrated acquisition chain with:

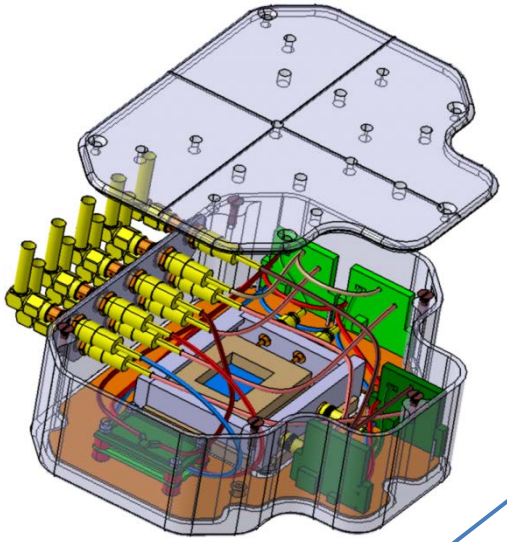
- C 85MeV, 59MeV, 34MeV
- Cl 126MeV, 102MeV,
- Ni 90MeV
- p+ 7MeV, 9MeV,





BEAM DETECTOR

Diode + pre-amps have been assembled in a compact detection system compatible with vacuum and air.



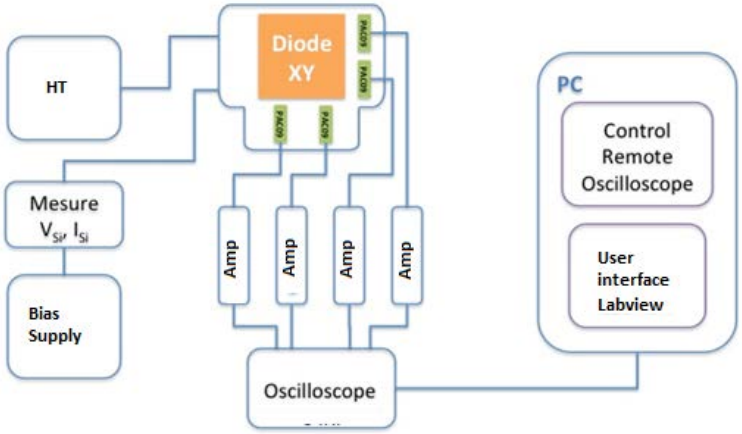
Warning:

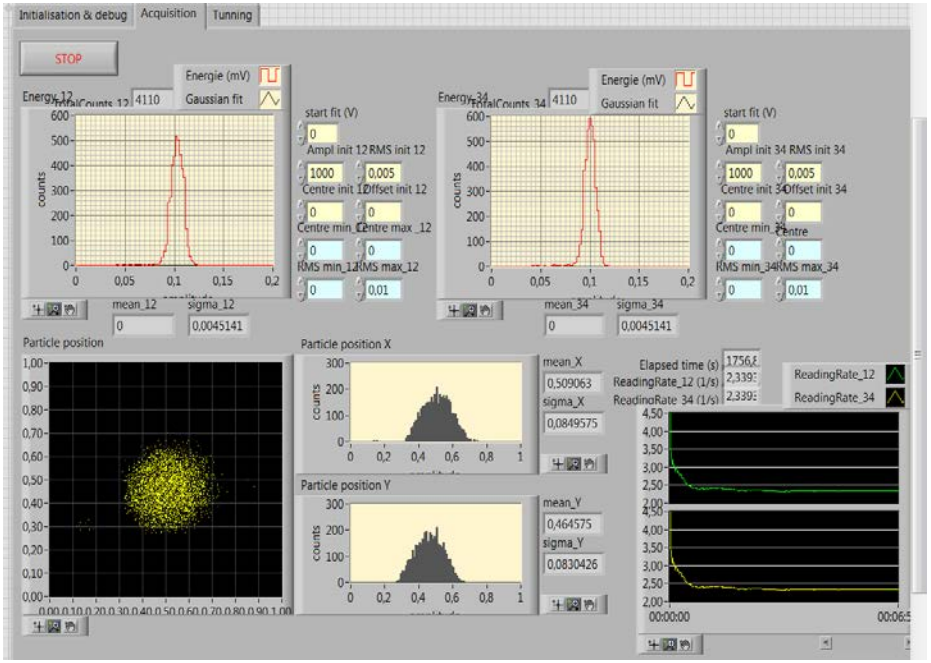
Do not bias under light and during vacuum pumping!

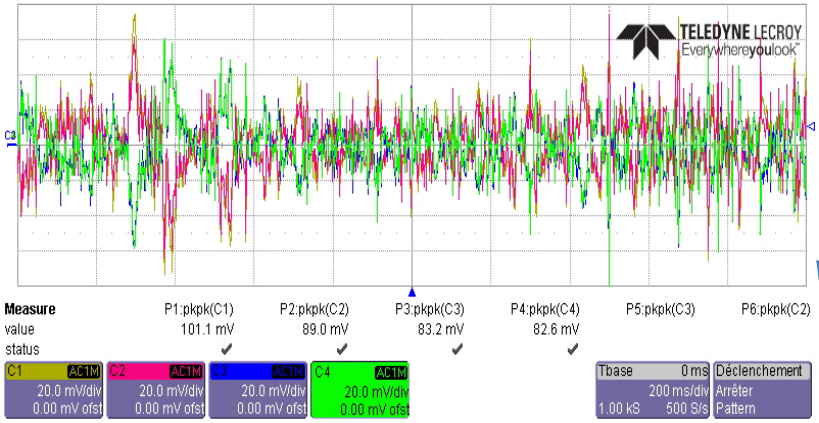
Various masks thicknesses and hole grids are available to avoid saturation and limit energy when necessary.

BEAM DETECTOR

The electrical response of this portable monitor (Diode + pre-amps) has been characterized in vacuum with an Am241 source.

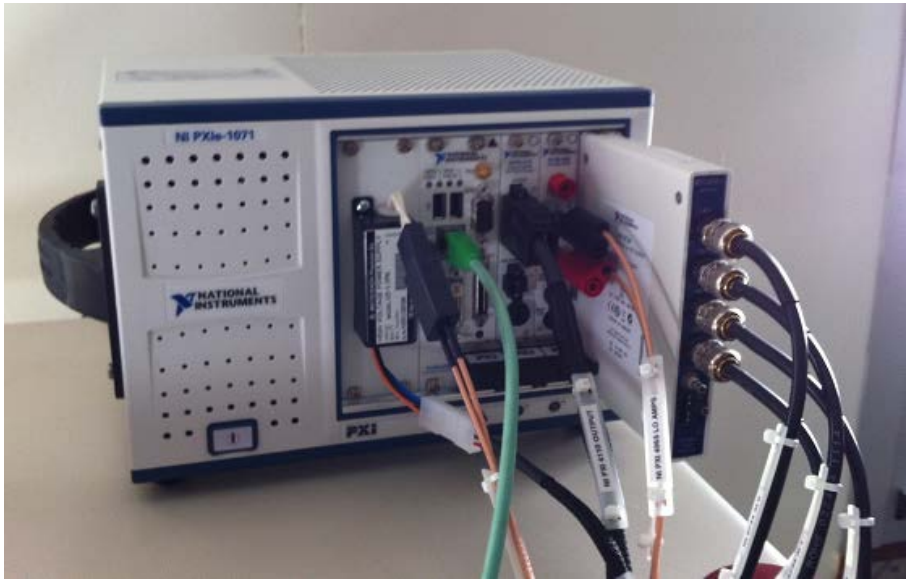






Output noise level for Vdiode=200V

CONTROL UNIT



NI PXI Rack including:

- HV Bias for the Diode
- Bias for pre-amps
- Acquisition chain
- DMM (Numeric Multimeter)
- FPGA for data processing
- Control Unit (windows 7, user interface) with Ethernet link and USB port.
- 10m long harness for connection to the IPN Detector.

⇒ Fully tested with emulation of the IPN detector.

BET-C SYSTEM

Beam Evaluation Tool CNES

Assembly of the 2 elements has been tested in February 2015.

- HV and preamp Bias OK
- Data processing OK
- User interface OK
- Remote control by PC OK

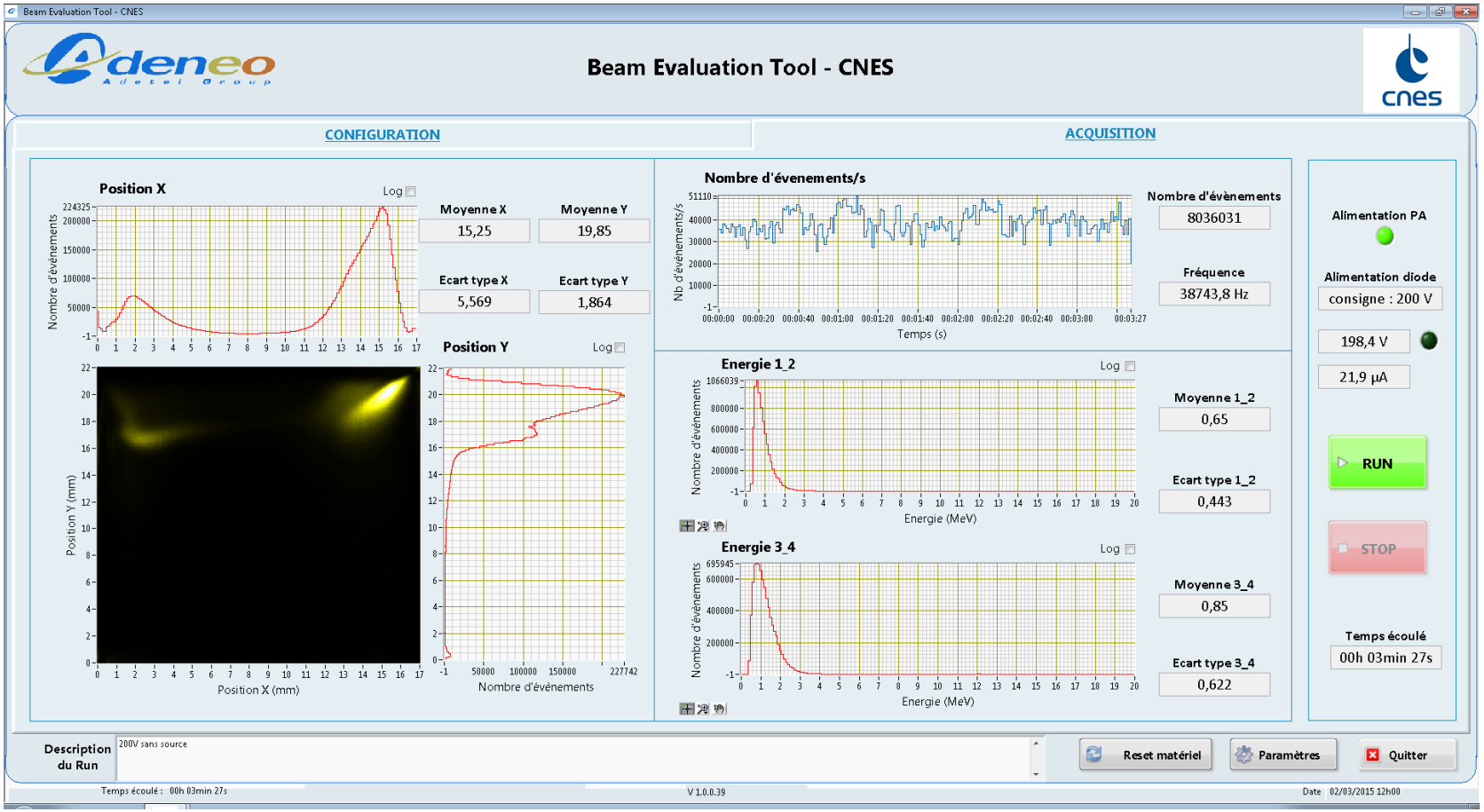
BUT

- Problem of noise level at the acquisition module input.

⇒ Still under investigation.

BET-C SYSTEM

User Interface:



+ Data files in tdms format (compatible Excel via csv)

CONCLUSION & PERSPECTIVES

BET-C, Beam Evaluation Tool CNES, a compact solution for beam diagnostic has been developed by IPN + ADENEO under CNES funding.

There is still a problem of noise, currently under investigation.

The system should be operational by June 2015.

Full validation under beam scheduled this summer at IPN first.

CNES plans to use it as soon as possible at UCL, RADEF and KVI.

Thank you for your attention