AIDA first annual Report
28-30 of March 2012

WP7.2: Status at UCL, Belgium

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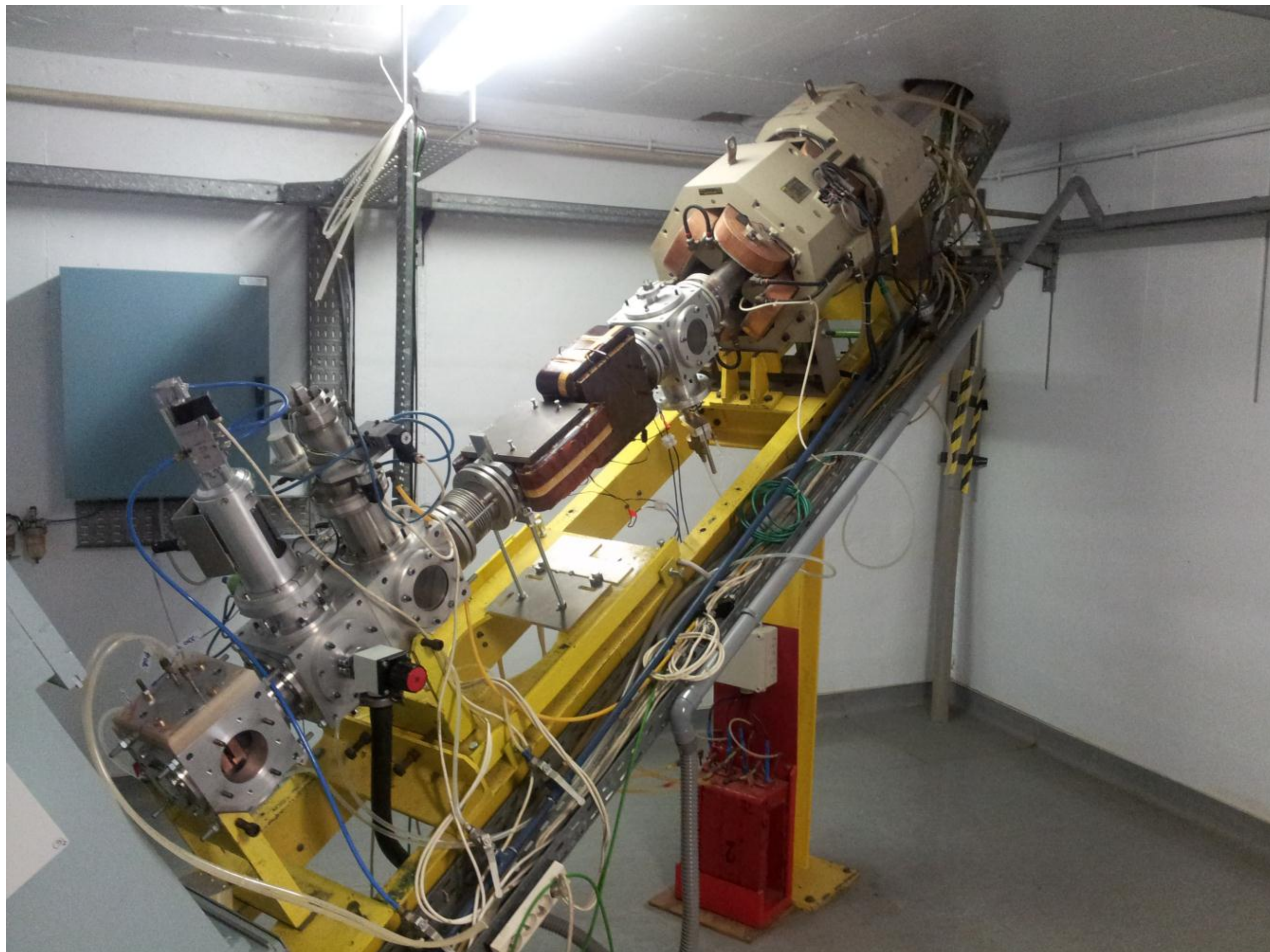
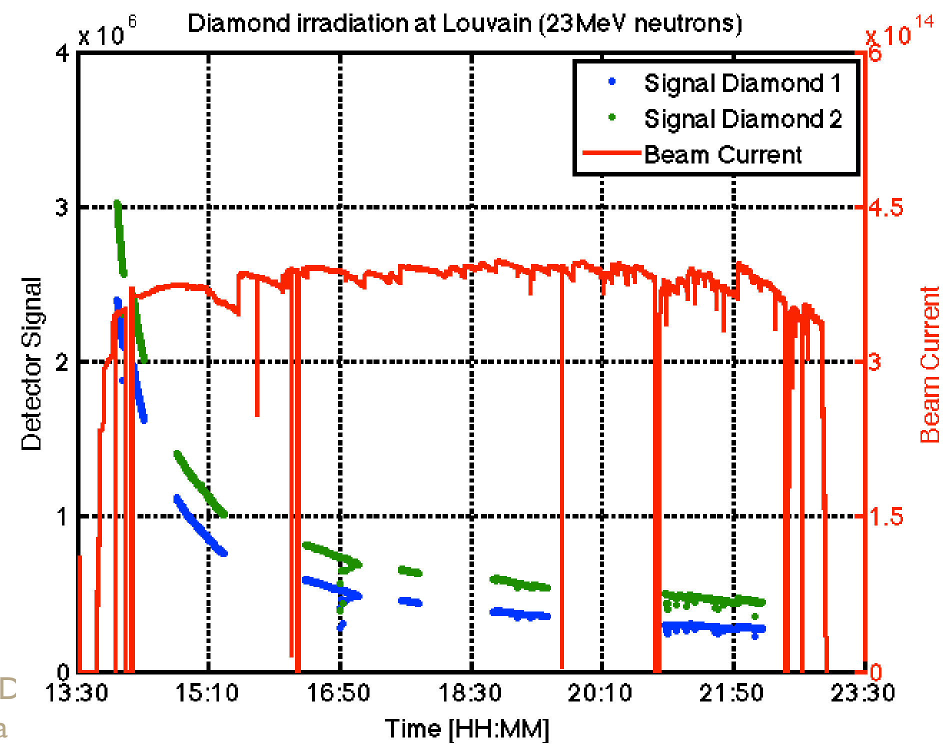
Same Cyclotron extension -T2- used for both neutron and the proton irradiations



2011:

During the first year of AIDA, one project has been submitted to our task for neutron irradiation (15 hours)

Karlsruhe: Irradiation of two sCVD diamonds to quantify radiation damage of energetic neutrons to diamond detectors. - Measurement of leakage current during irradiation with a readout system similar to the used system in CMS Beam Condition Monitor.



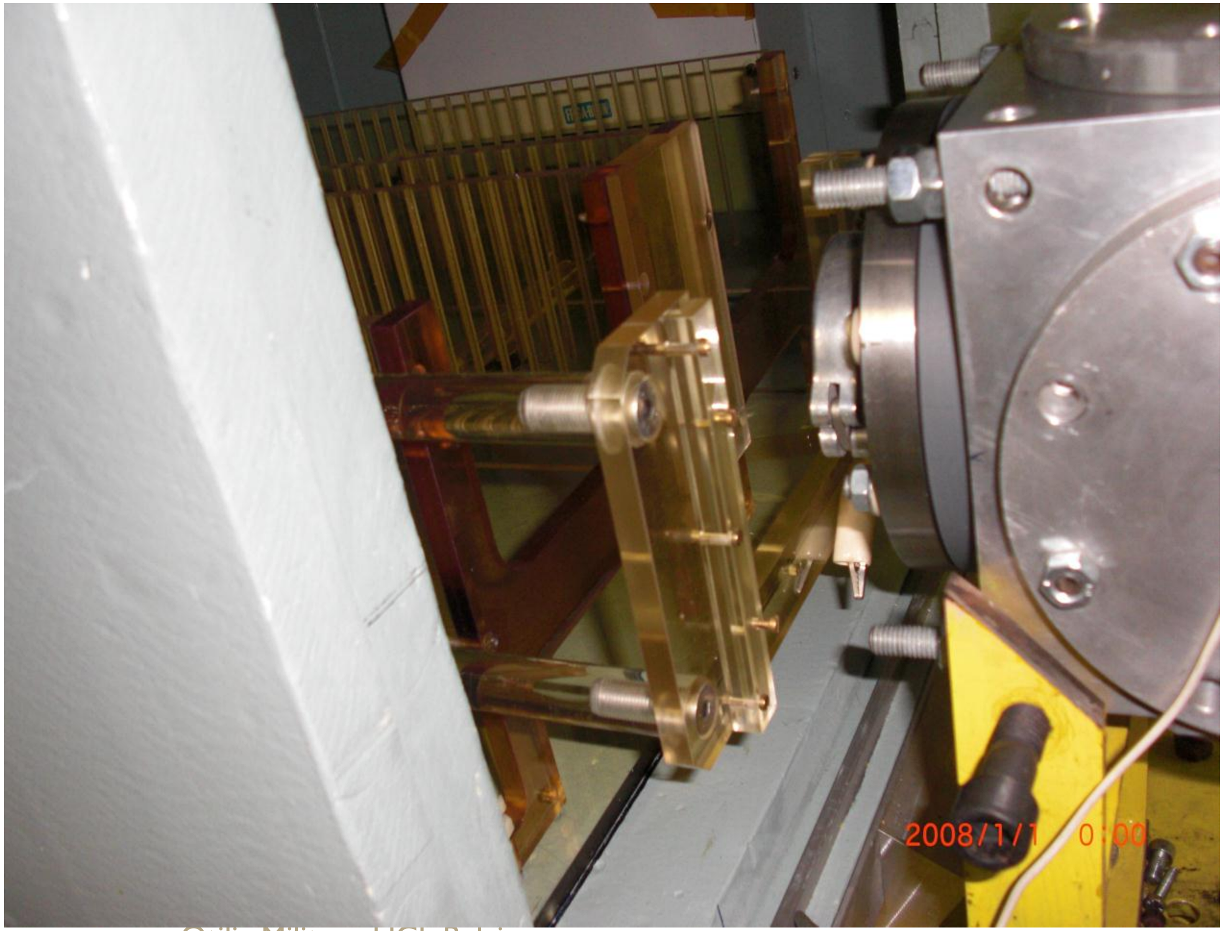
2011:

We are not troubled yet, because the beams we provide are more suitable, both in flux and size, to test radiation hardness of complex systems (online device monitoring with additional read-out electronics) that will be produced in a later phase of the project.

High Flux Neutron beam line (HF-NIF)

For example : the support was extended outside the box, to reach very high fluences, at 5 cm from the Be target and the devices (diamond detectors) were monitored for 15 hours

Total fluence:
$8x10^{15}$ n/cm^2



High Flux Neutron beam line (HF-NIF)

silicon samples: (inside the cold box)
the hardness factor is 1.95.
Current ~ 12 µA

For samples like small diodes, or small detectors (~ surface 6 cm diameter) … the customary distance is 23-25 cm from the Be target. Time to reach $4x10^{14}$ 1MeV eq. is 12 hours

For larger samples like detectors (~ surface 10 cm diameter) … the customary distance is 40 cm from the Be target.
Time to reach $2x10^{14}$ 1MeV eq. is 24 hours

(But had in the past also 2-3 days of neutron irradiations (at cold) to reach much higher fluences.)

For samples at room T: at 5 cm from the target

10^{16} n/cm^2 in < 5 h

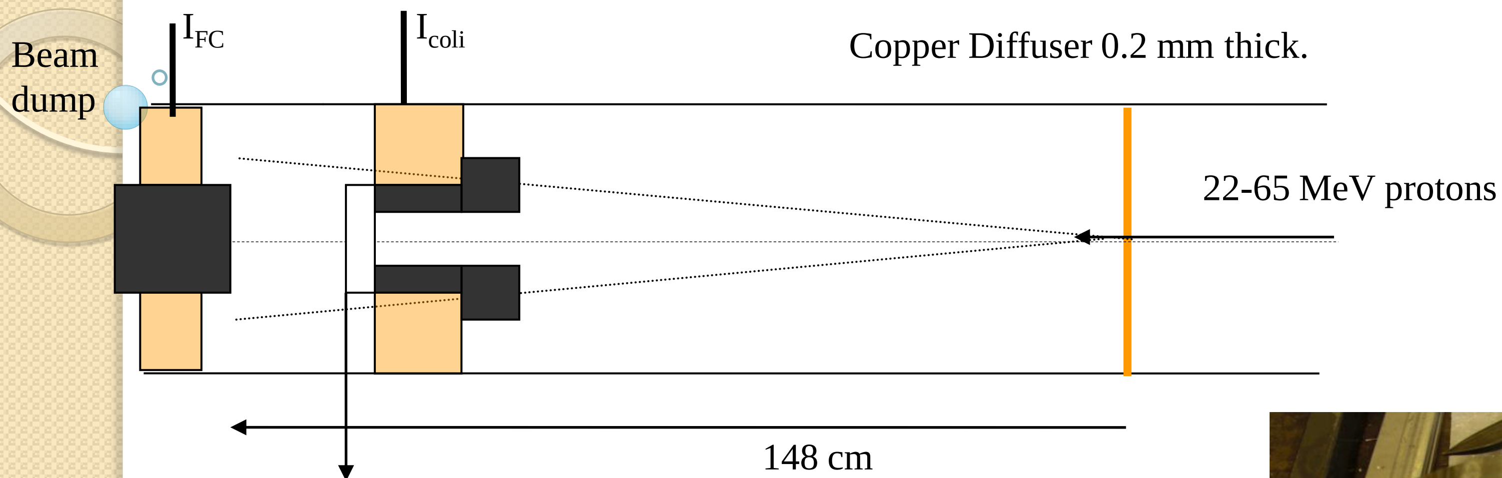
2012:

A new high flux proton setup was developed, on the same extension of the Cyclotron, and the first AIDA irradiation was done in **March 2012** for 7 hours (for NA62 experiment).

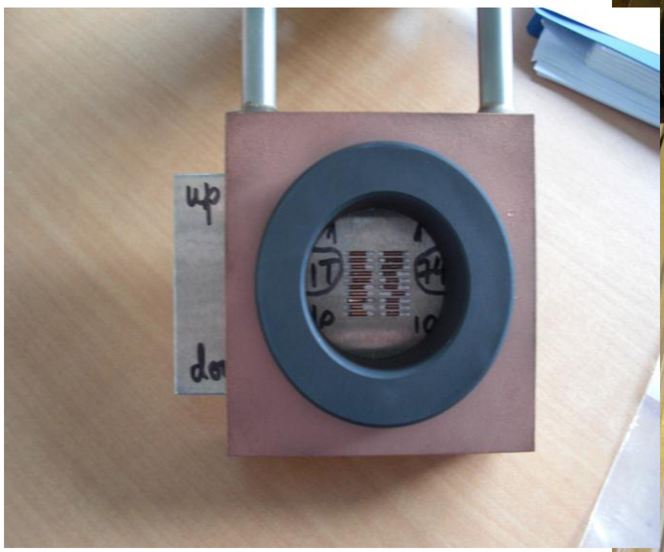
Plans for 2012:

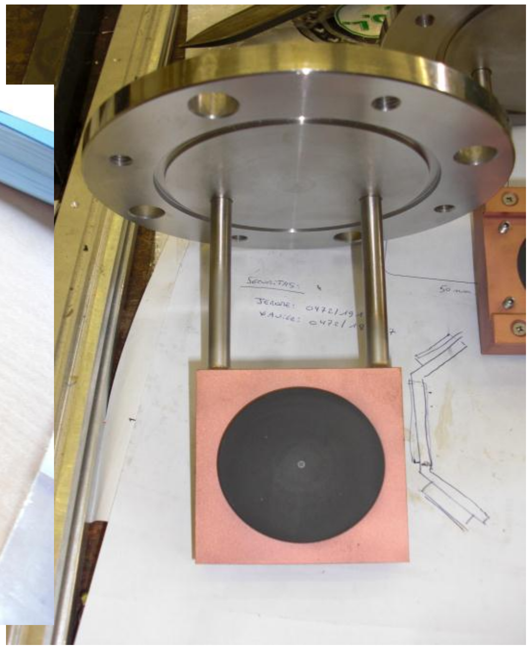
- September 2012: Prof. Pawel Kaminski, Institute of Electronic Materials Technology Poland (samples of standard FZ Si and samples of Si:N with the nitrogen concentration of ~$1x10^{15}$ cm^{-3}. The fluences could be $1x10^{14}$, $1x10^{15}$ and 10^{16} n/cm^2).

High Flux Proton beam line (HF-PIF)



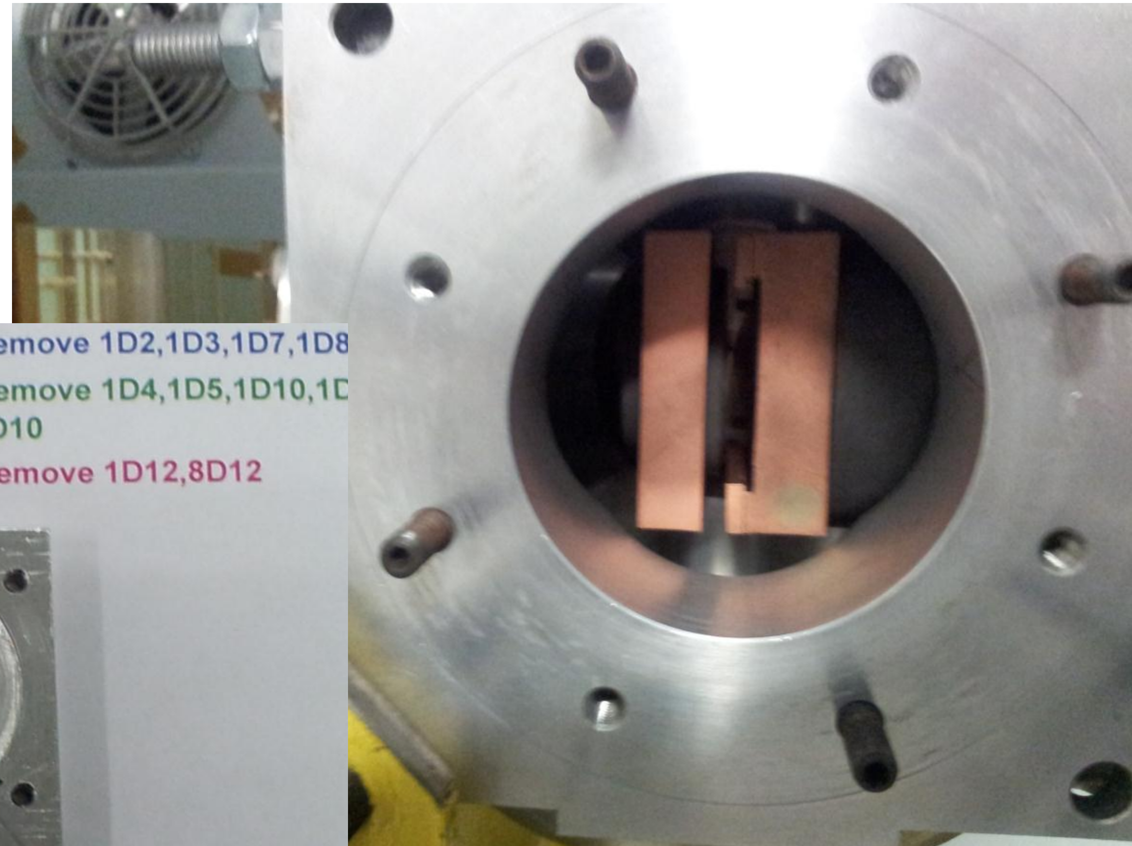
Both the beam dump (FC) and the collimator are cooled with room T water

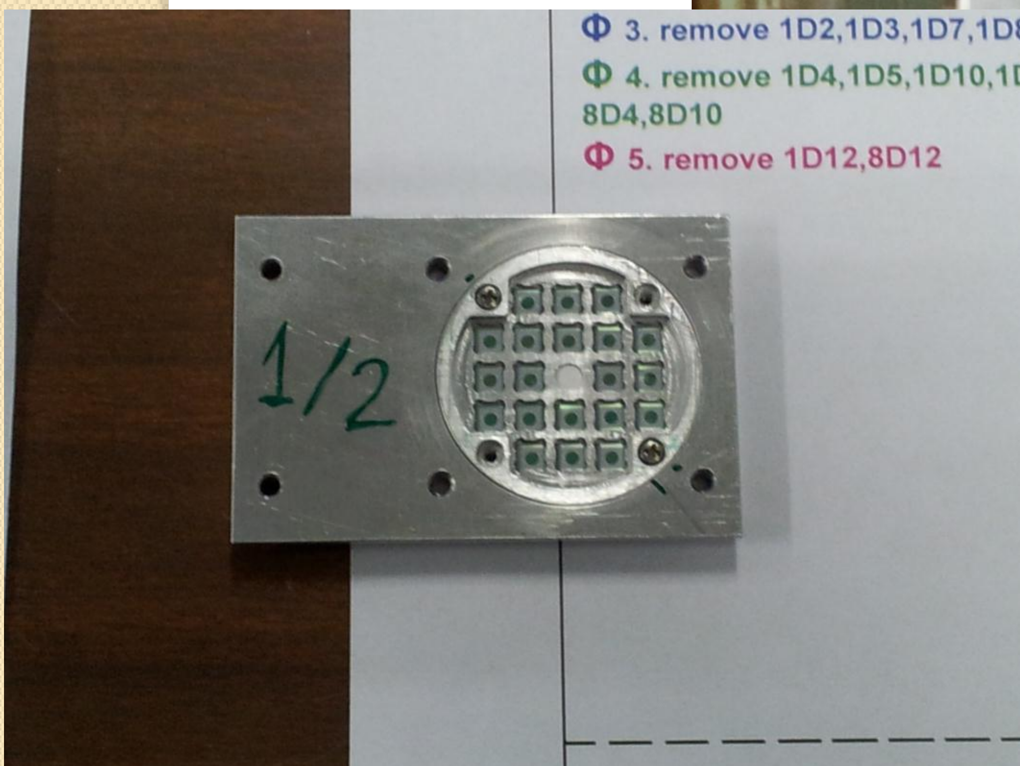




High Flux Proton beam line (HF-PIF)

NA62 samples
March 2012





The samples are fixed on supports and fixed on the collimator, with a common cooling system

High Flux Proton beam line (HF-PIF)

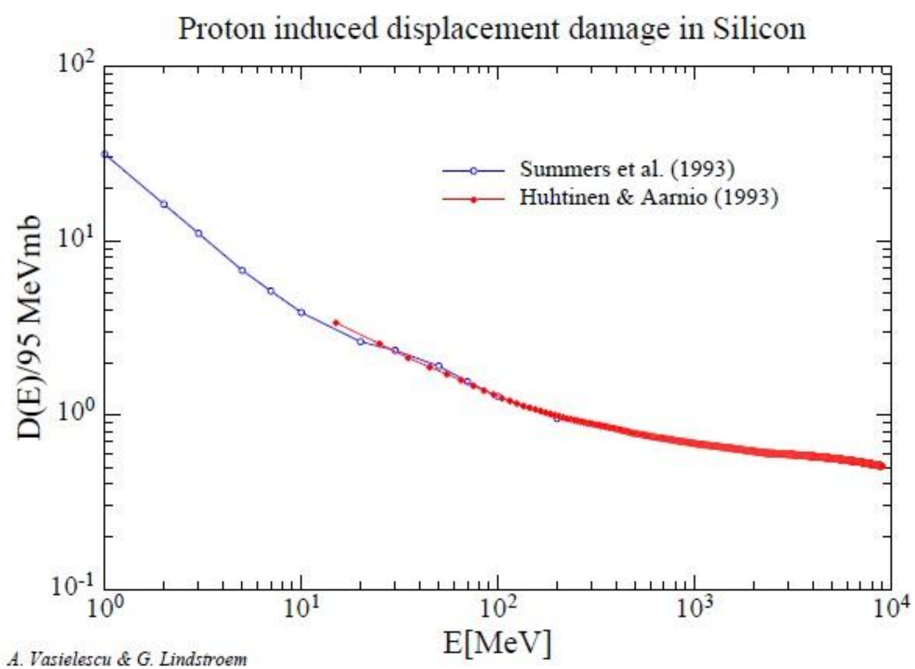
Dosimetry:

On-line monitoring of the current on both beam dump and collimator;
For a maximum current of 5 μA measured on the beam dump:

$$\Phi = \frac{5 \times 6.24 \times 10^{12}\ p/cm^2}{\pi \times R^2} = 3.5 \times 10^{12}\ p/cm^2 s$$

To reach 10^{17} p/cm^2 ~ 8 hours

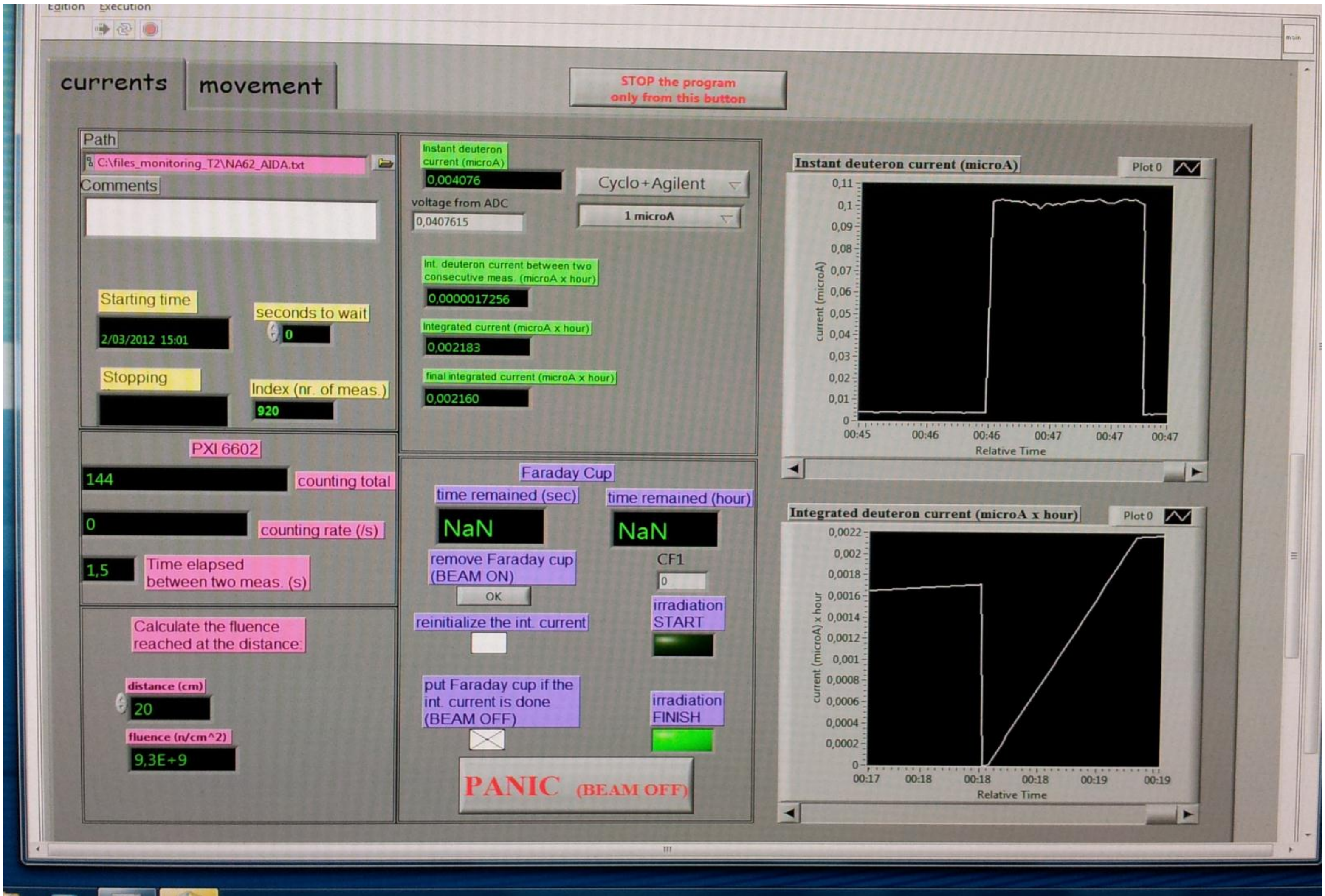
For silicon samples we use the proton induced displacement damage coefficient to evaluate the fluence in 1 MeV eq. n/cm^2



A. Vasielescu & G. Lindstroem

High Flux Proton beam line (HF-PIF)

The integrated current on the beam dump is permanently calculated and the beam is stopped (Faraday cup released) when the target fluence is reached.

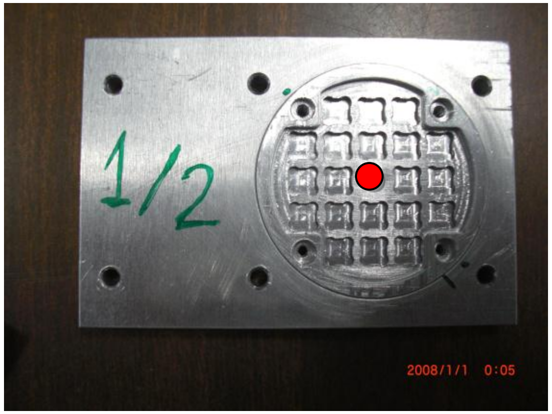


High Flux Proton beam line (HF-PIF)

Dosimetry:

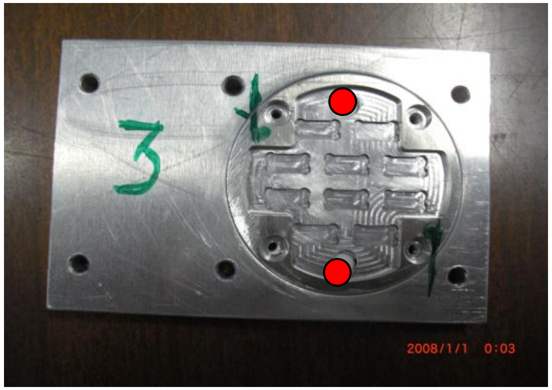
Ref: Radioprotection handbook (Radioactivity and radiation protection, pag 163)

$$\Phi(cm^{-2}) \approx D(Gy)\frac{6.24\times10^{9}}{\frac{dE}{dx}}$$



where dE/dx (MeV cm^2/g) the energy loss per unit length.

For the fluence of 5.4×10^{12} p/cm^2 for example, the difference between the measured dose and calculated dose is less than 10%.



Placing the alanine dosimeters in the center and border of the active region, the uniformity down to 80% could be verified.

SUMMARY:

High flux Neutron Irradiation Facility (NIF)

-current up to 12 μA
-for samples that need cooling (Si), a fluence of $4x10^{14}$ 1MeV eq. can be reached 12 hours.
-for other samples, 10^{16} n/cm^2 in < 5 h

new High Flux Proton Irradiation Facility (PIF);

-monoenergetic proton beam 26-63 MeV
-current up to 5 μA
-samples on supports of 3.4 cm diameter, 10^{17} p/cm^2 ~ 8 hours
for HL-LHC fluences ~ several minutes

We can fully offer assistance for irradiation, no need the user to come to Louvain (only if she/he is willing to ..).

PLANS for the next months:

Develop the cooling for the proton irradiation, adapt it for silicon samples and very high fluences;

Make available more universal supports for proton irradiations (a lot of work involved in adapting the support for different samples)