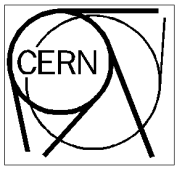
Radiation tests @PSI 4-5 December 2005

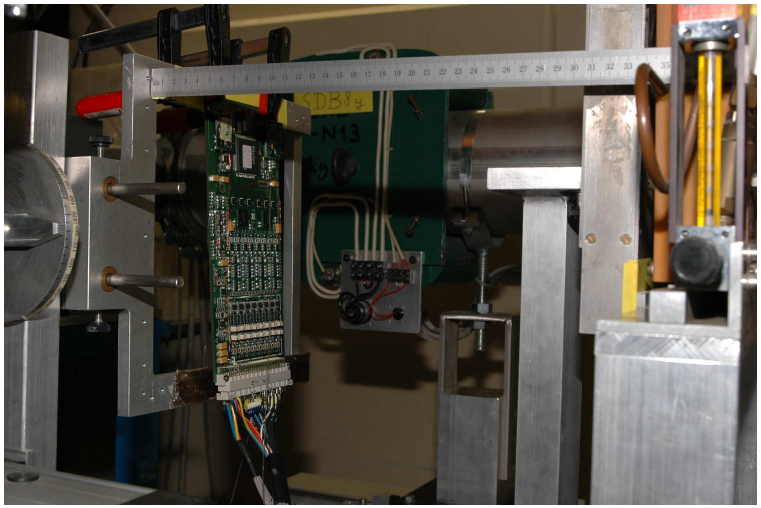
AB/BDI/BL



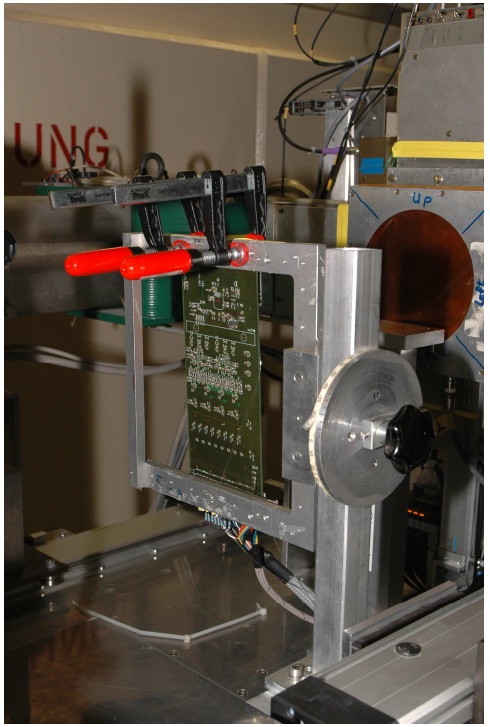
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Laboratoire Européen pour la Physique des Particules
European Laboratory for Particle Physics

Irradiation setup for the CFC board at PSI



Front view



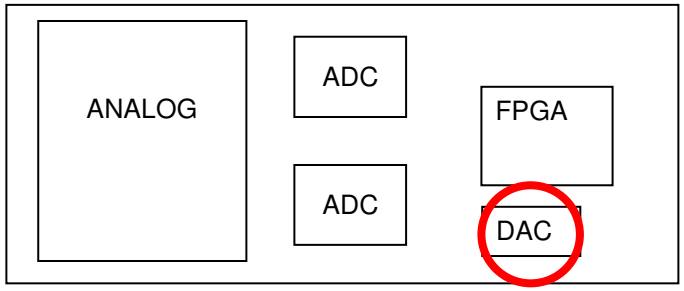
Rear view

Measurements goals

1. Digital to analog converter
   Check the functionality of the DAC after 500 Gray irradiation.
2. Gigabit Optical Link
   Check the optical margin and the eye diagram of the GOH (GOL + Laser) during irradiation until 500 Gray.
3. FPGA
   Check the SEU and functionality of the FPGA during irradiation until 500 Gray.

DAC measurements

Beam position



Measure DAC 1

Energy : 251.63 [MeV]
Run time : 4576 [sec]
Fluence : 9.711e+11 [p/cm2]
Dose : 4.913e+04 [rad]

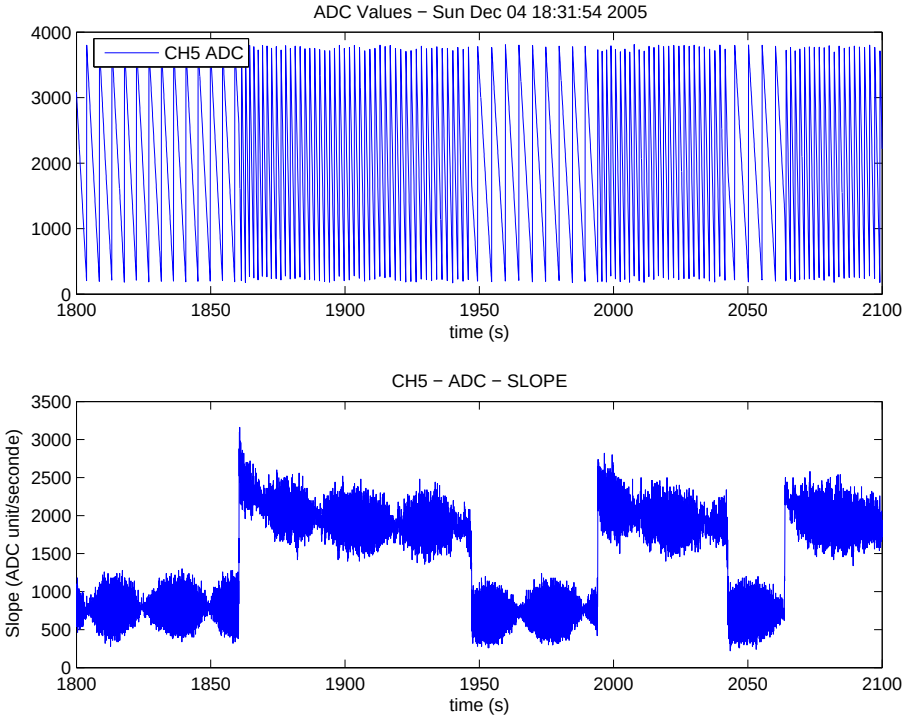
Flux : 2.122e+08 [p/cm2/sec]
Doserate : 1.074e+01 [rad/sec]

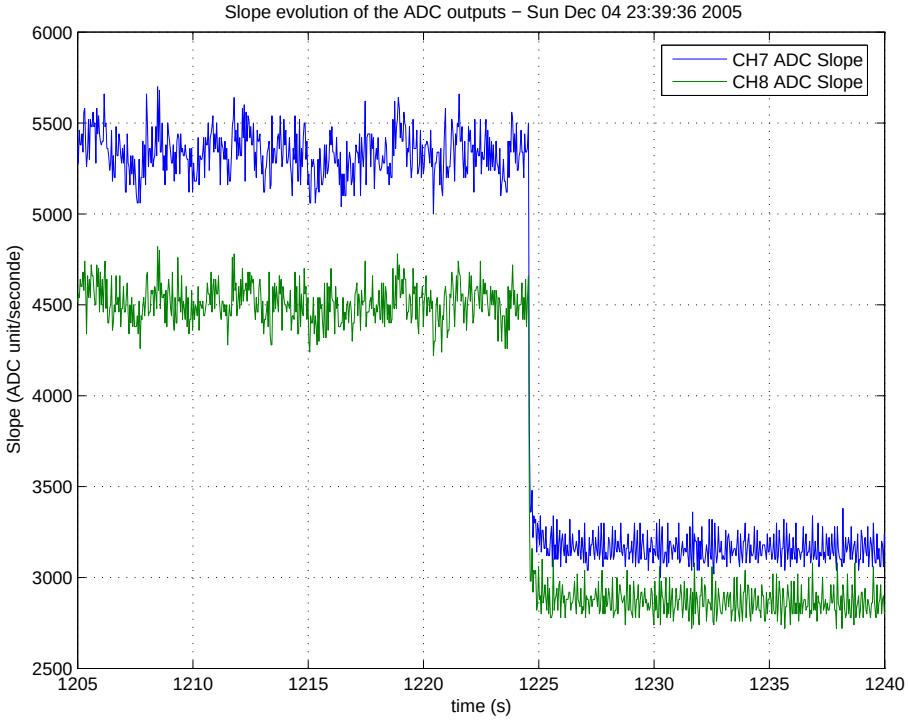
Measure DAC 2

Energy : 251.63 [MeV]
Run time : 4376 [sec]
Fluence : 9.713e+11 [p/cm2]
Dose : 4.914e+04 [rad]

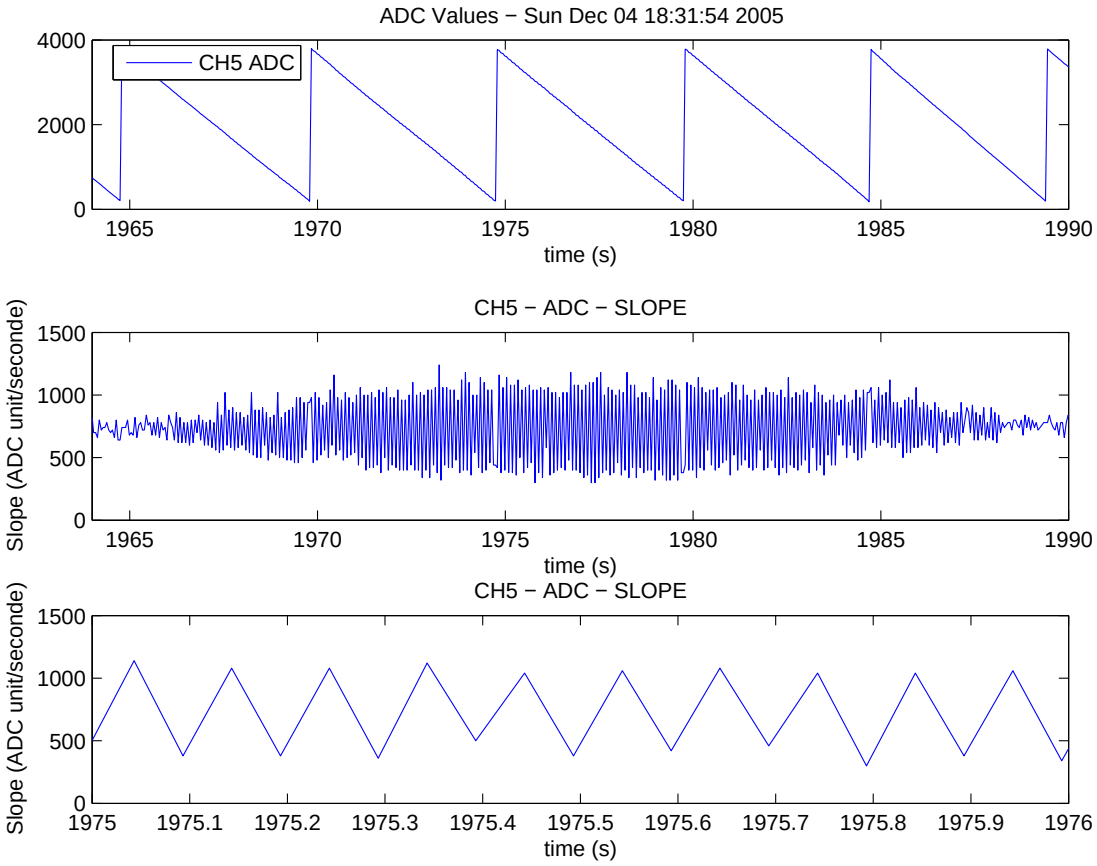
Flux : 2.220e+08 [p/cm2/sec]
Doserate : 1.123e+01 [rad/sec]

DAC measurements





DAC measurements



Measure 1

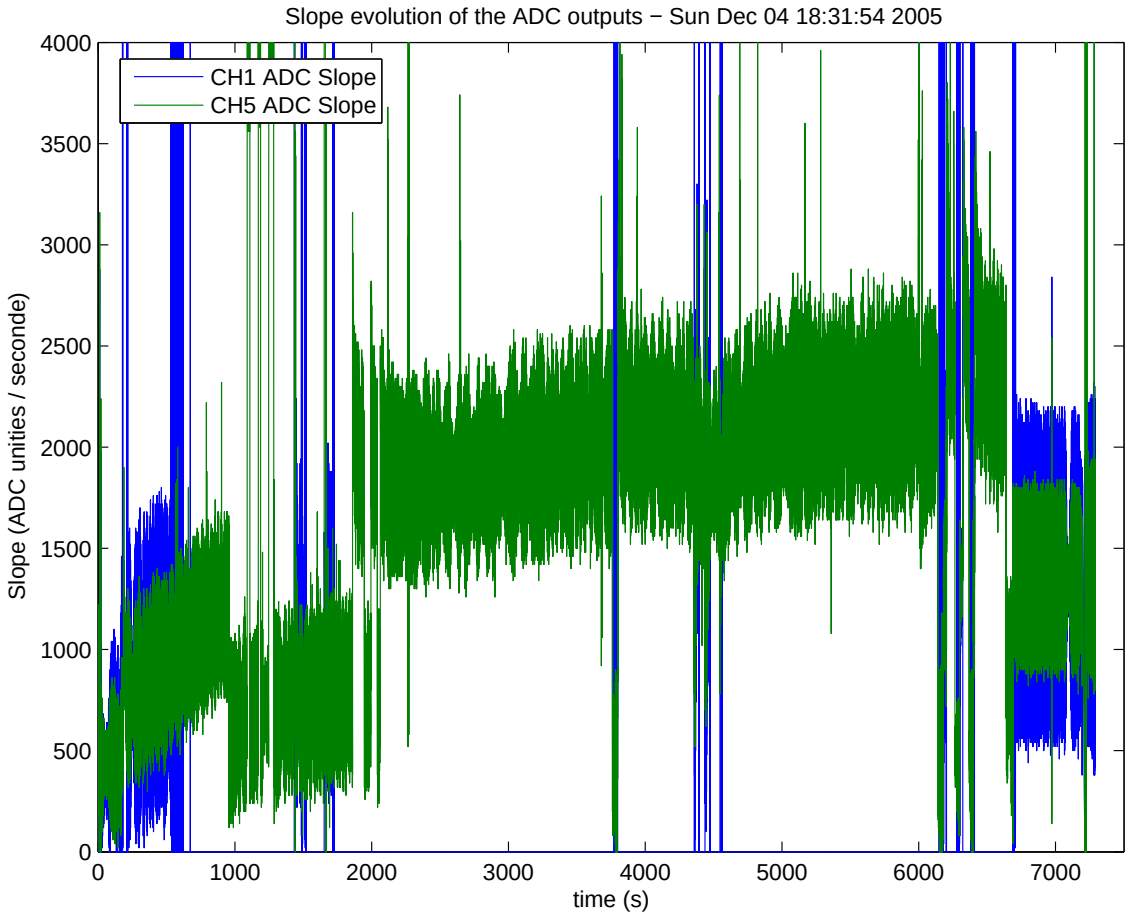
Beam on the Digital to Analog (DAC) converter of the Board 2

Display of the ADC slope for the CH1 & CH5. Indirect way of looking at the DAC output.
The DAC give additional current to the inputs.

Slow shift of the input current (the slope increase, what the sign of the current)

CH1-4 : Work only when beam is off
CH5 : Work correctly

The DAC was not working after the 500 Gray irradiation.
Try to estimate the time when the component died.



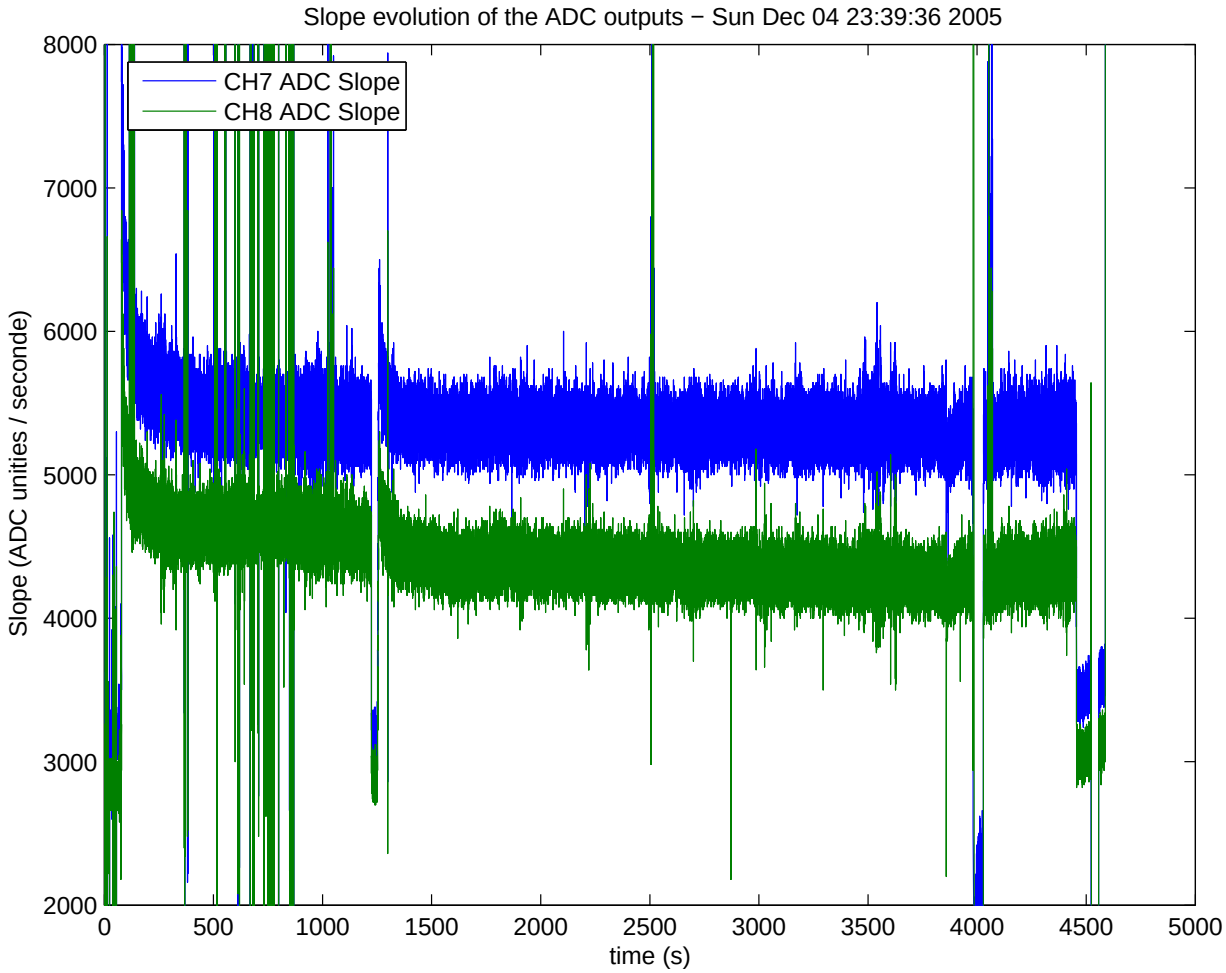
Measure 3

Beam on the Digital to Analog (DAC) converter of the Board 3

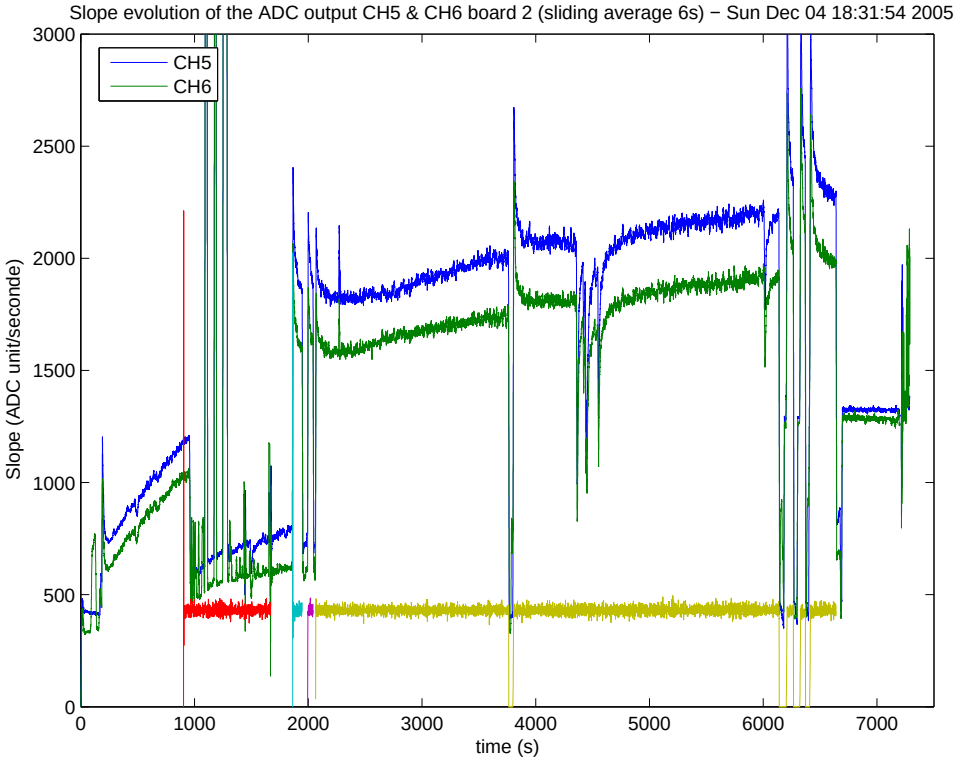
Display of the ADC slope for the CH7 & CH8. Indirect way of looking at the DAC output. The DAC give additional current to the inputs.

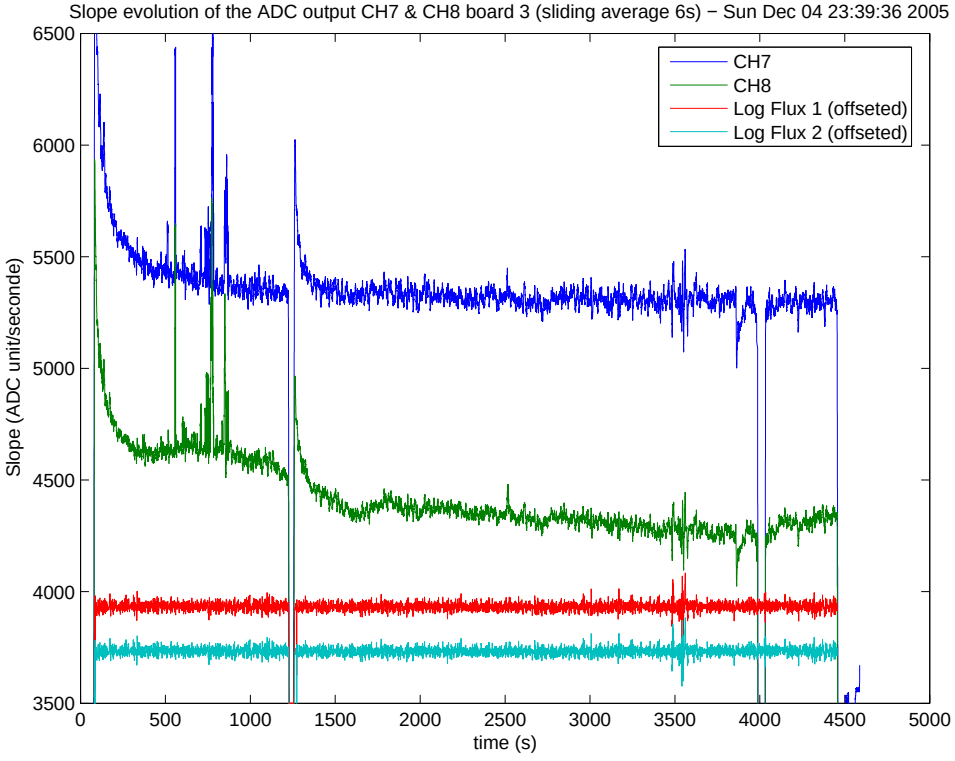
Slow shift of the input current due to irradiation?

The DAC was working after the 500 Gray irradiation.

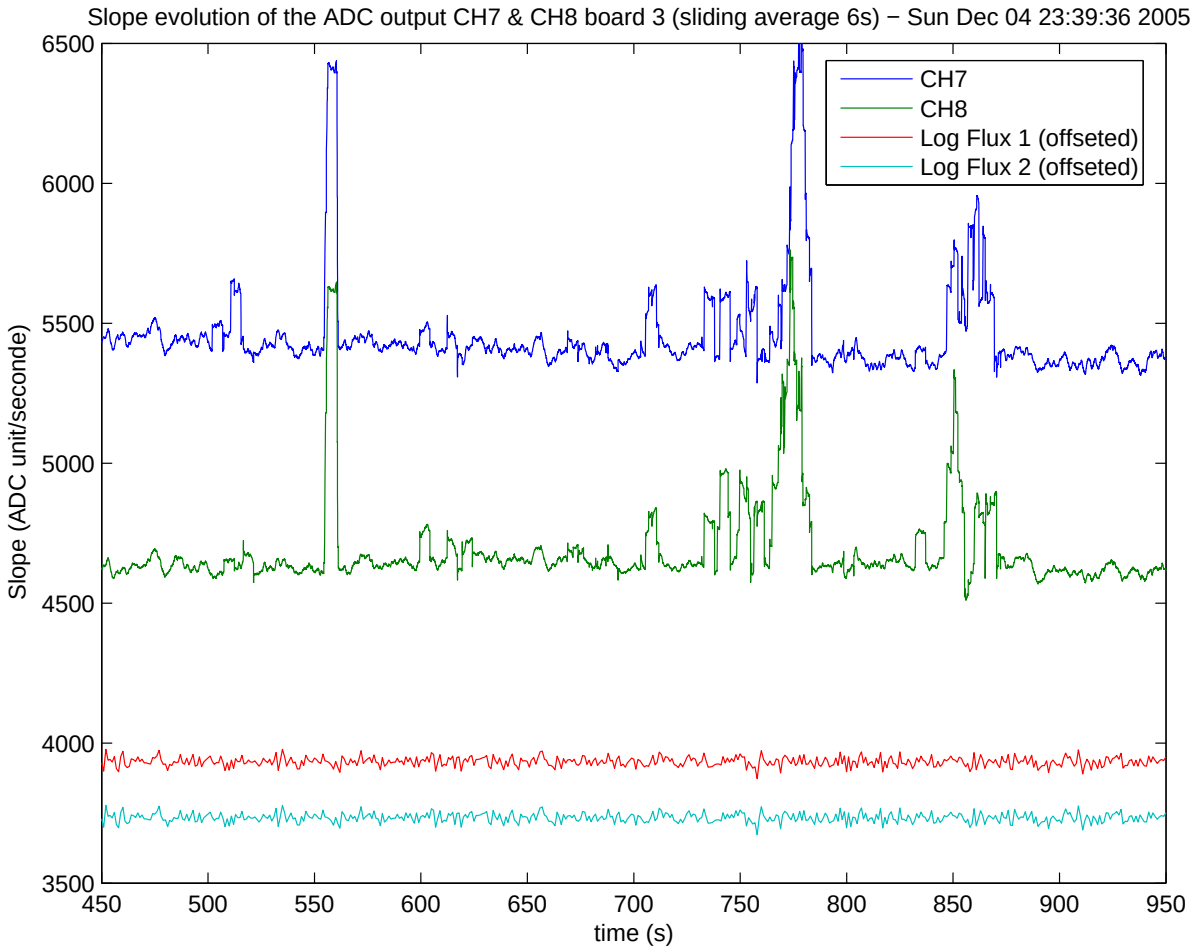


Comparison DAC Measure1 & Measure 3



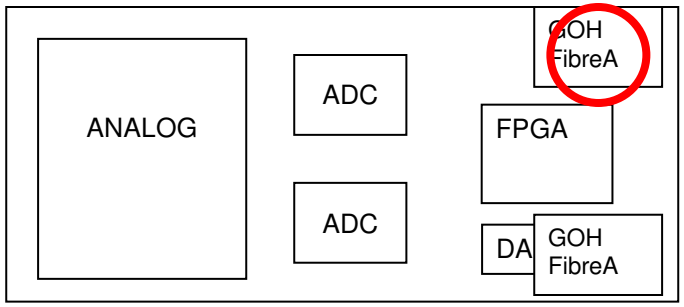


Comparison DAC Measure1 & Measure 3



Measure 2
Beam on the optical transmitter module (GOH) on the Board 3

Beam position

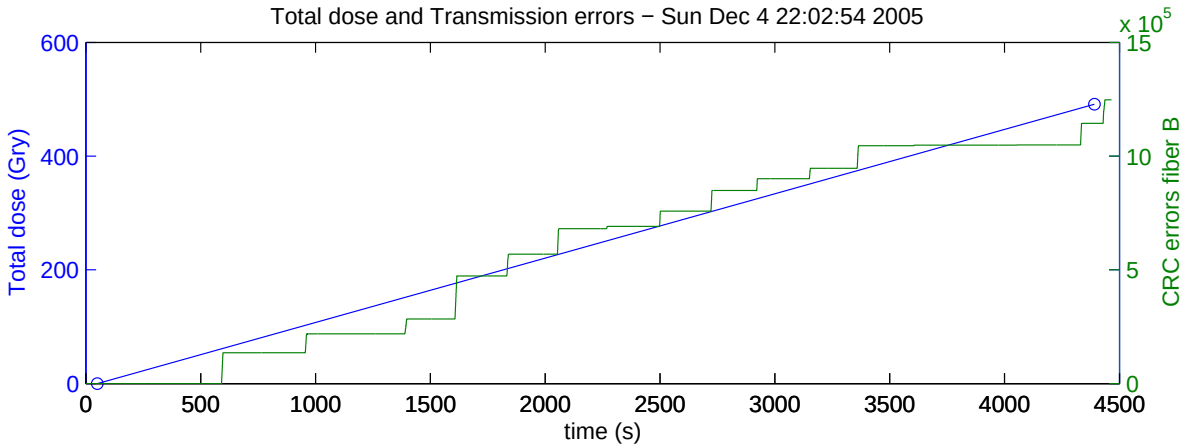


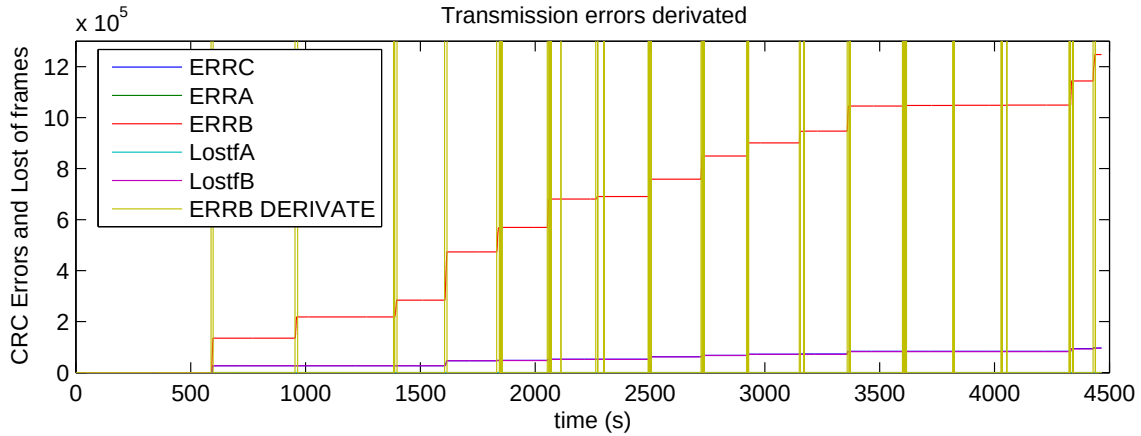
Energy : 251.63 [MeV]
Run time : 4341 [sec]
Fluence : 9.712e+11 [p/cm2]
Dose : 4.914e+04 [rad]

Flux : 2.237e+08 [p/cm2/sec]
Doserate : 1.132e+01 [rad/sec]

Measure 2

Beam on the optical transmitter module (GOH) on the Board 3





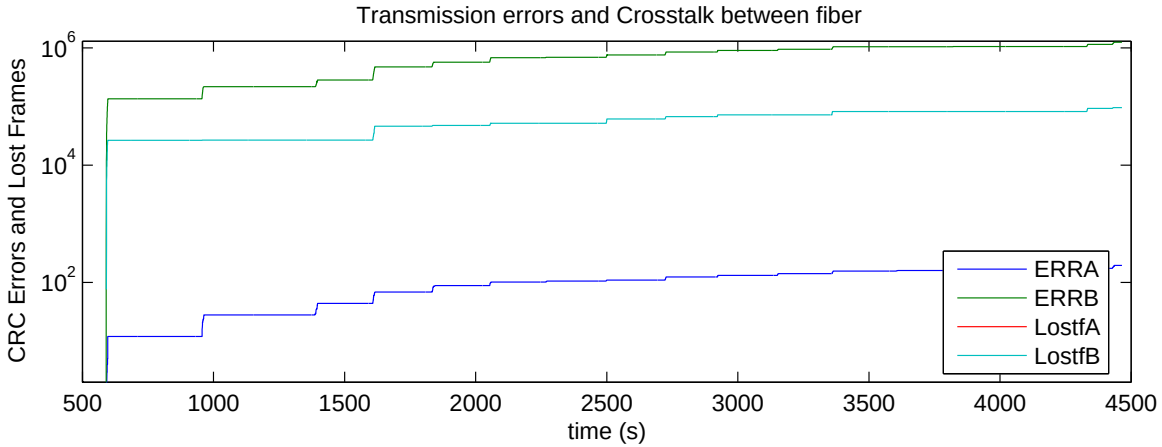
Measure 2

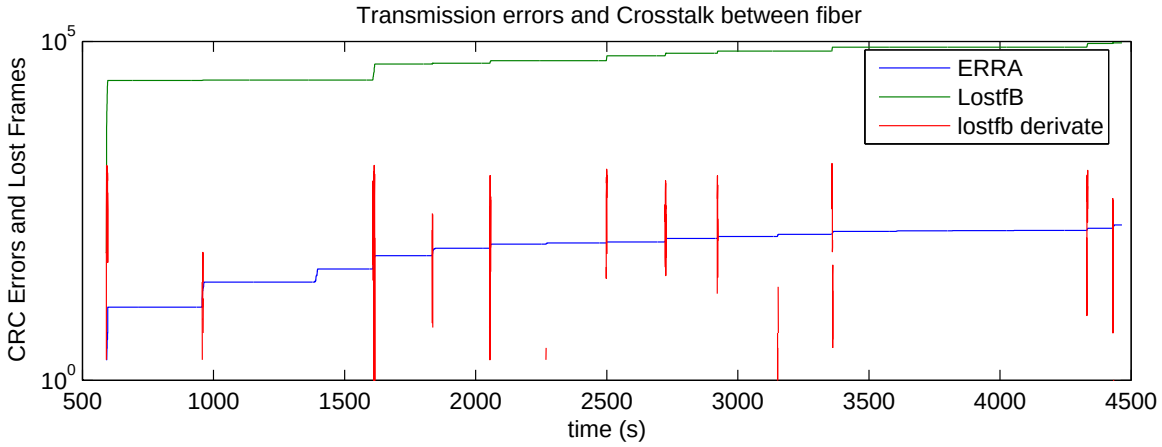
Beam on the optical transmitter module (GOH) on the Board 3

The fiber B has been attenuated in order to check the optical margin.

The fiber A gave some CRC when the fiber B was loosing signal.

Link between ERRA and ERRB but not between LostFrameB and ERRA

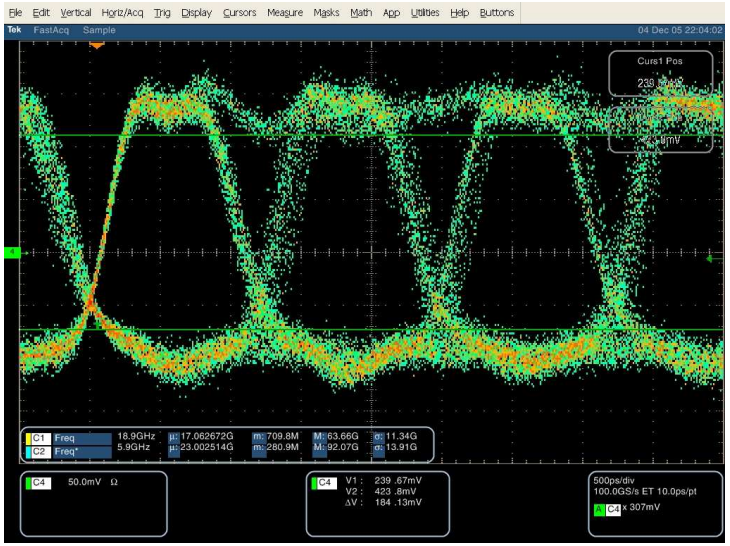


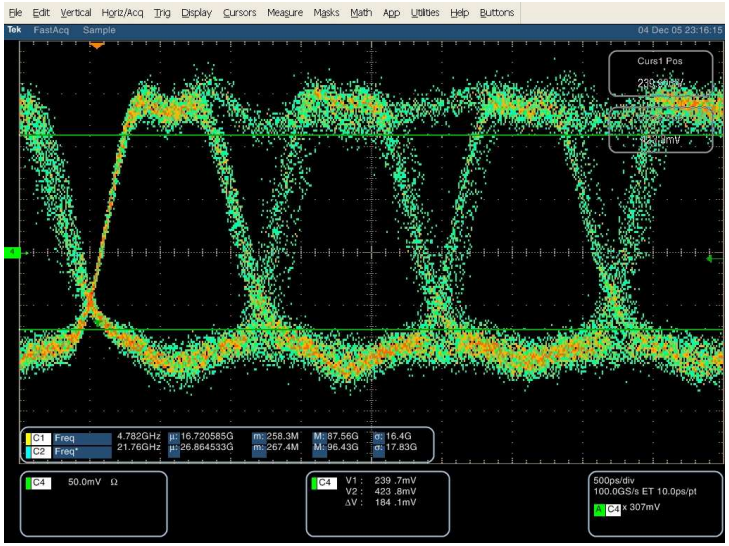


Measure 2

Beam on the optical transmitter module (GOH) on the Board 3

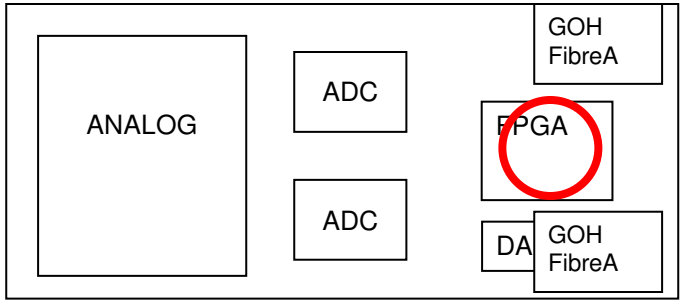
Eye diagram before and after radiation





Measure 4
Beam on the FPGA of the Board 3

Beam position

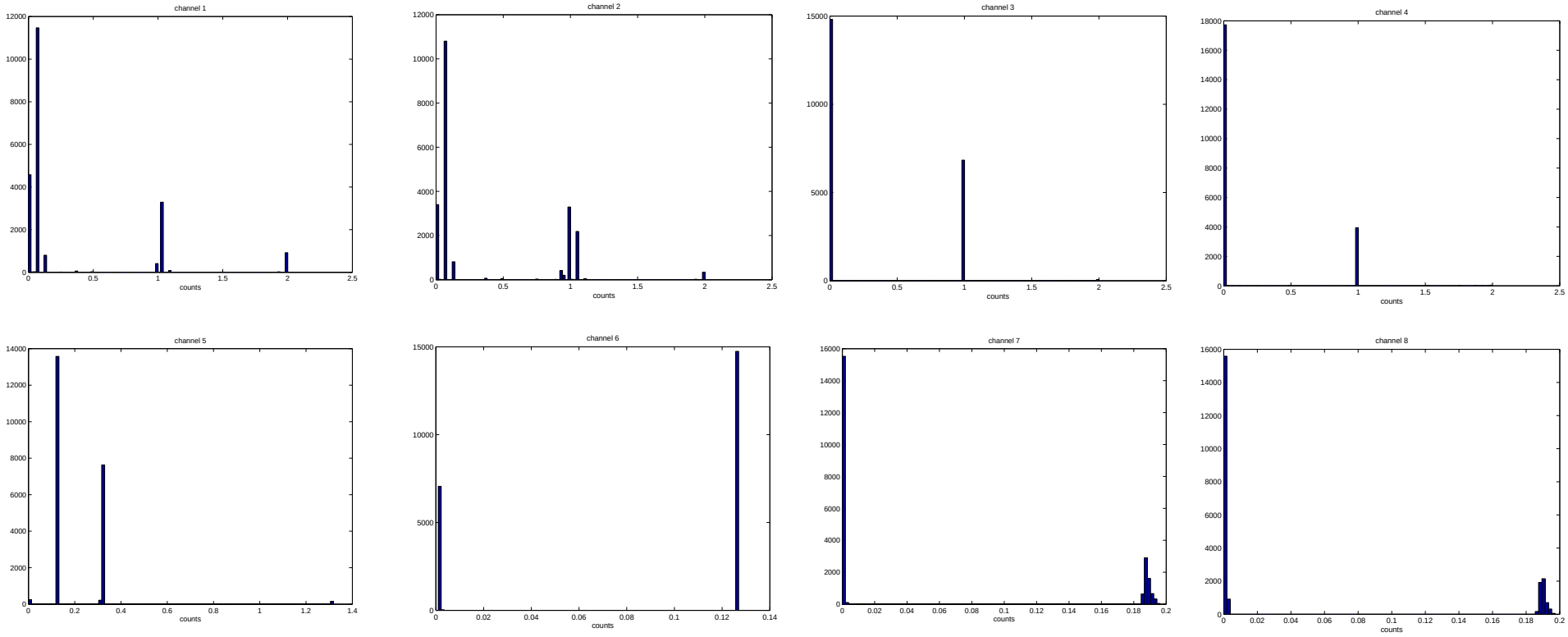


Energy : 251.63 [MeV]
Run time : 4488 [sec]
Fluence : 9.712e+11 [p/cm2]
Dose : 4.914e+04 [rad]

Flux : 2.164e+08 [p/cm2/sec]
Doserate : 1.095e+01 [rad/sec]

Measure 4
Beam on the FPGA of the Board 3

Histogram of the 8 outputs of the “maximum of the running sums”, 40µs.



In case of SEU, the results would show a dispersion in the whole range (0 to 200 counts).

Measure 4
Beam on the FPGA of the Board 3

The card didn't send any corrupted frame until the end of the irradiation (491 Gray)