

SIMULATIONS AND TEST RESULTS

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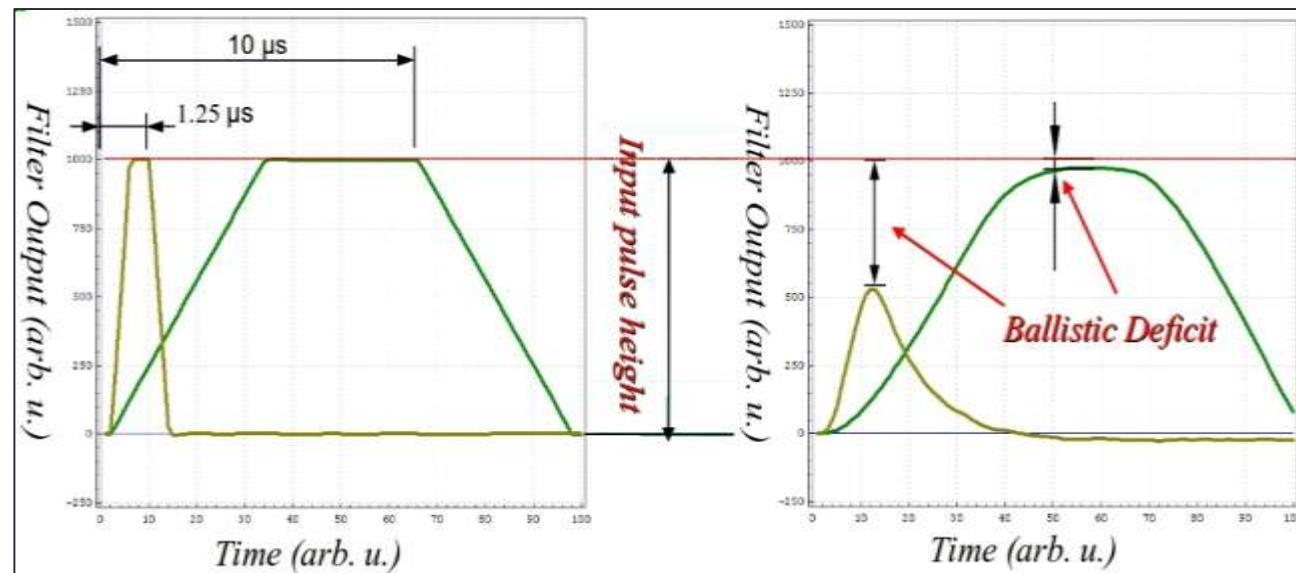
NUMEXO2 Workshop
Debrecen, 2016. november 29-30.

OUTLINE

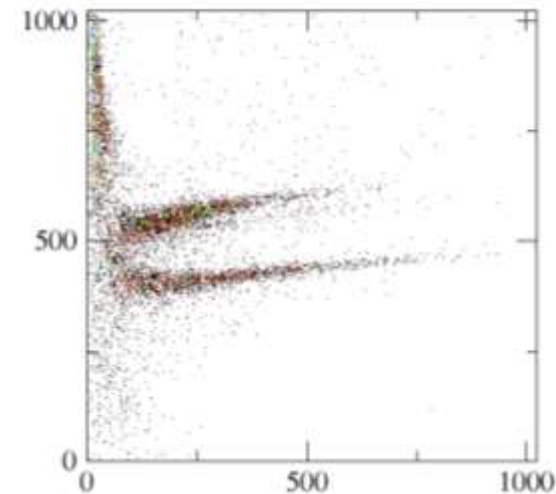
- Preliminary
- Trapez filter parameter optimization on south-african data
- First in-beam test
- Noise investigation
- Offline tests
 - Built-in pulser of old 2nd stage of DIAMANT
 - CAEN DT5800S Detector Emulator
- Second In-Beam test
- Summary

Preliminary

- 2010: BD implementation in C worked on data from iThemba LABS (South-Africa) with two trapezoidal filter



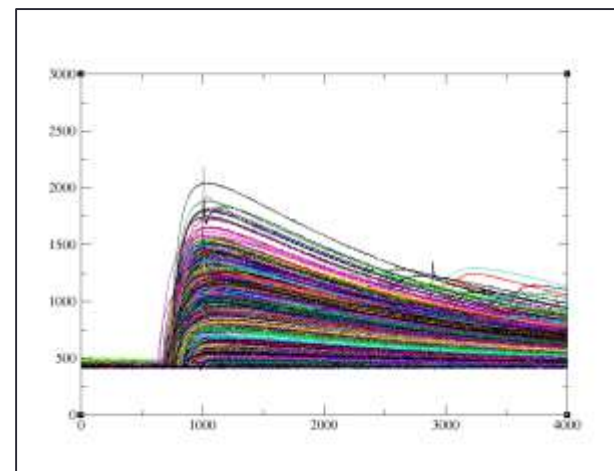
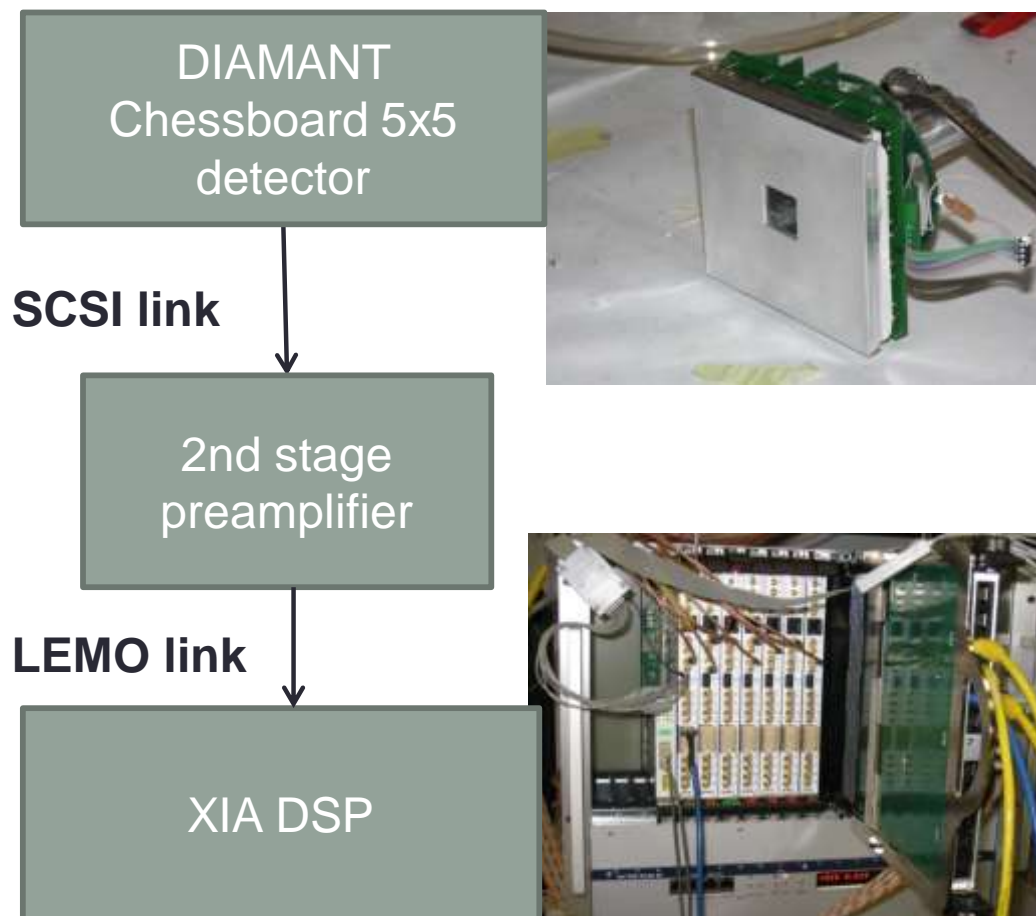
Theory of Ballistic deficit method



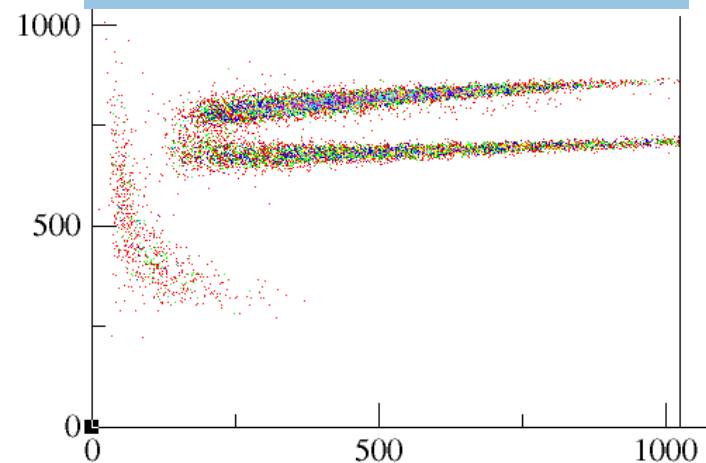
Spectrum from a smaller database

Measure data in South-Africa, 2014

2014: improved BD implementation in C code worked on data measured at iThemba LABS



Traces from data

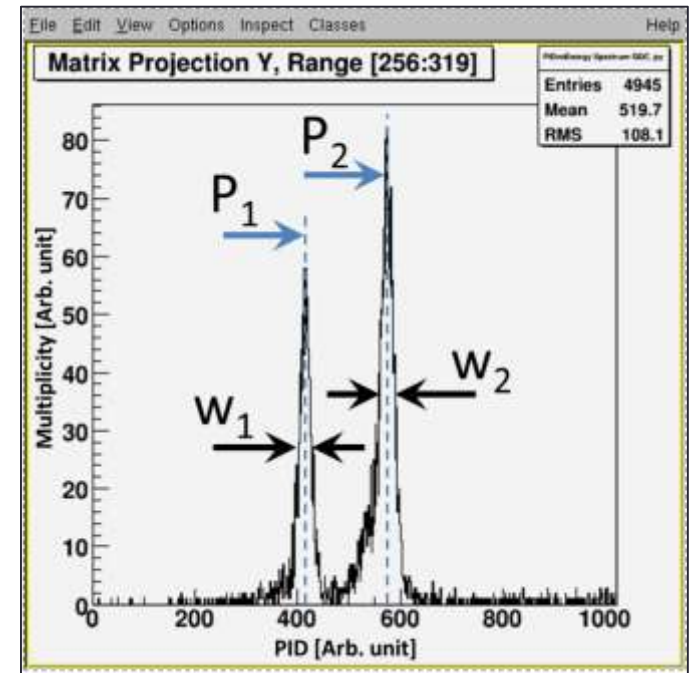
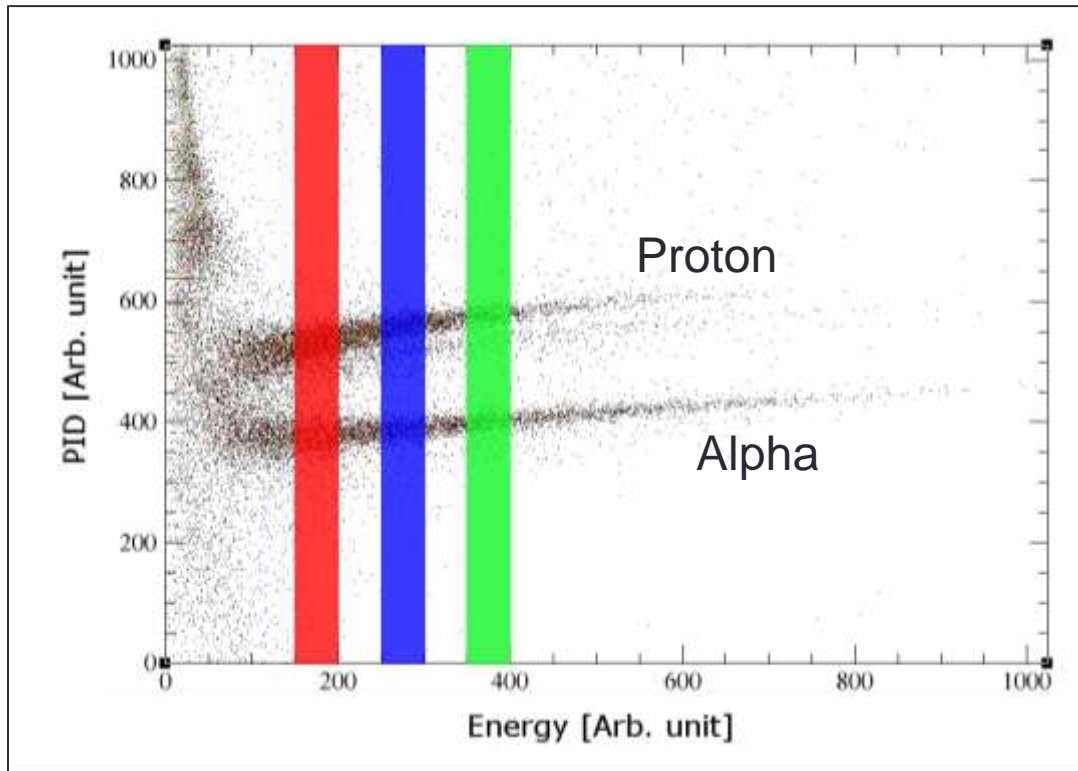


2D spectrum from data

Parameter optimization results

Figure-of-Merit (FoM) analysis

$$FoM_{12} = \frac{|P_1 - P_2|}{W_1 - W_2}$$



Y-Projection intervals and projection in Figure-of-Merit analysis

Parameter optimization results

- Several parameters were tested
- 10 us and 1.25 us seems to be optimal
- Comparison with old VXI electronics

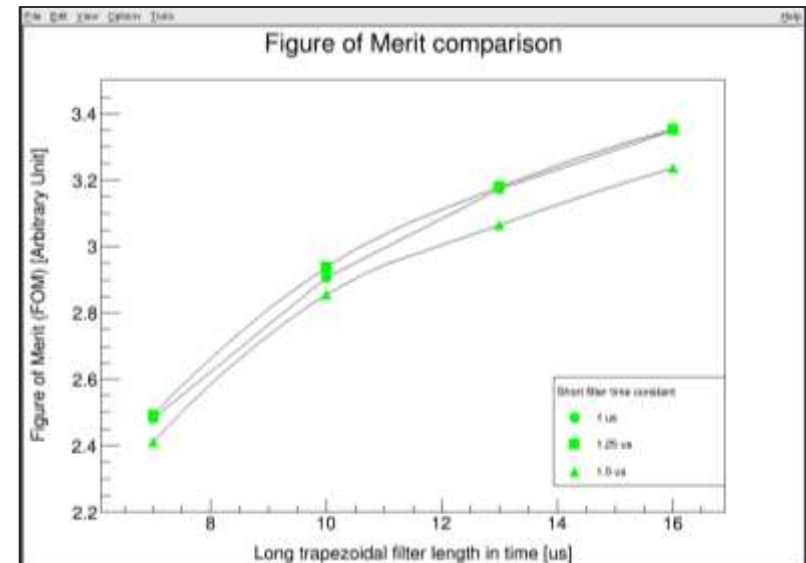
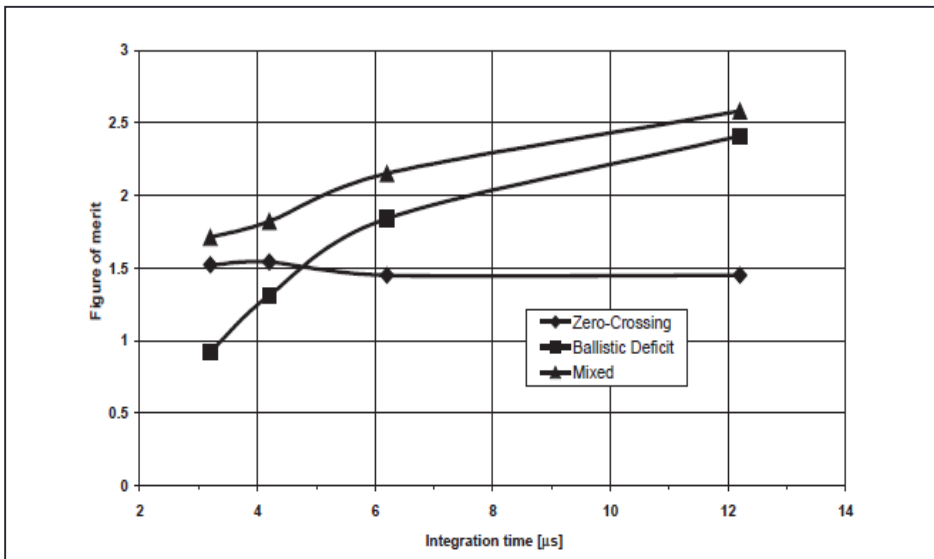
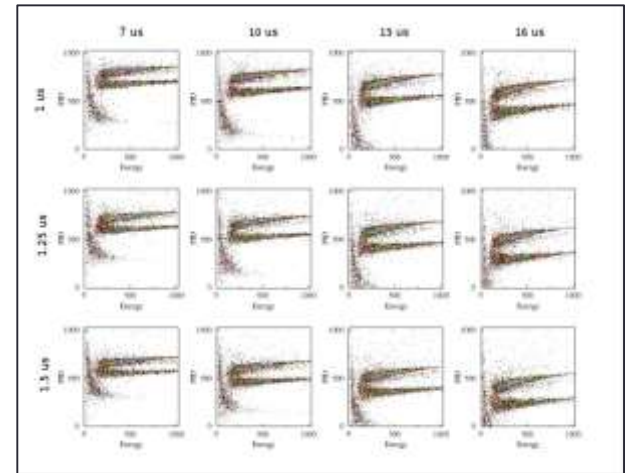
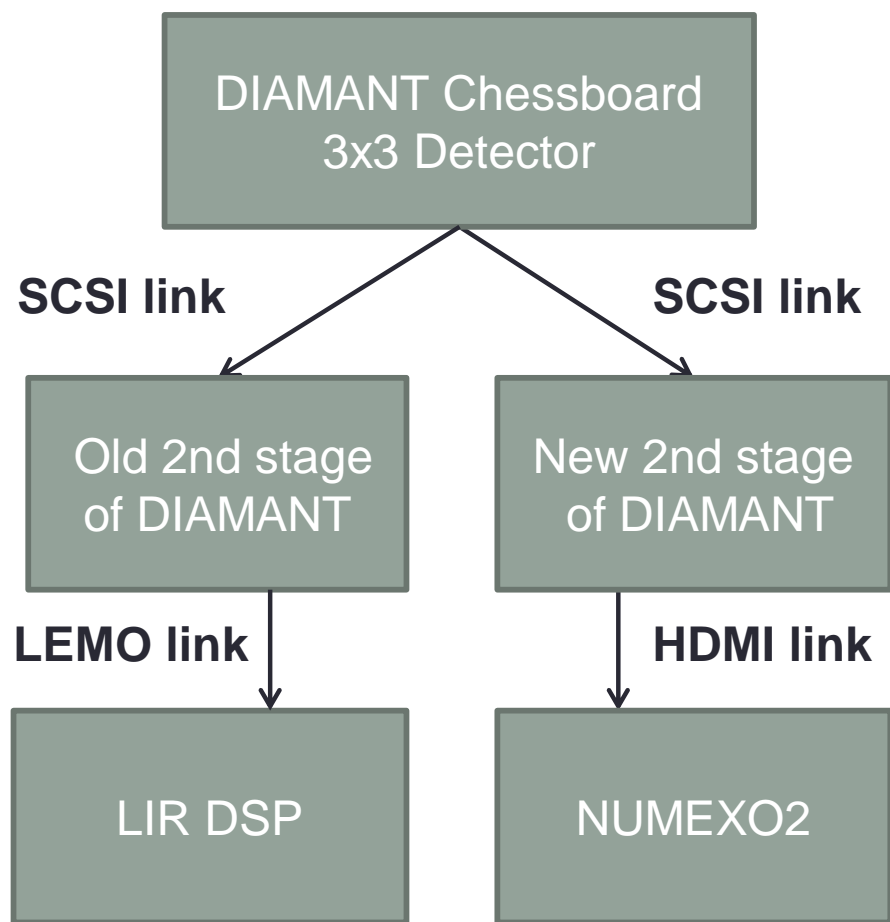
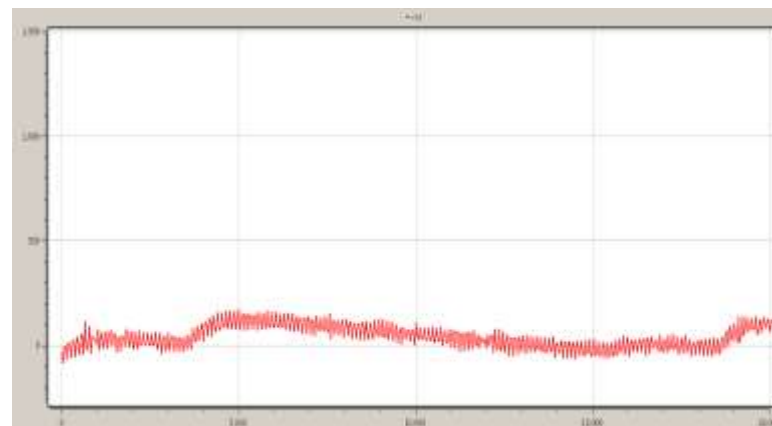


Figure-of-Merit results with VXI analog electronics and BD software implementation

First in-beam test



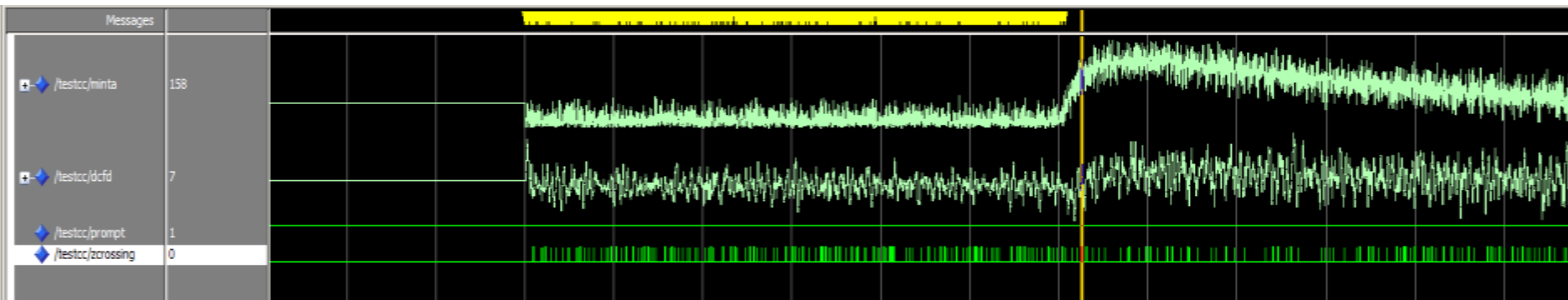
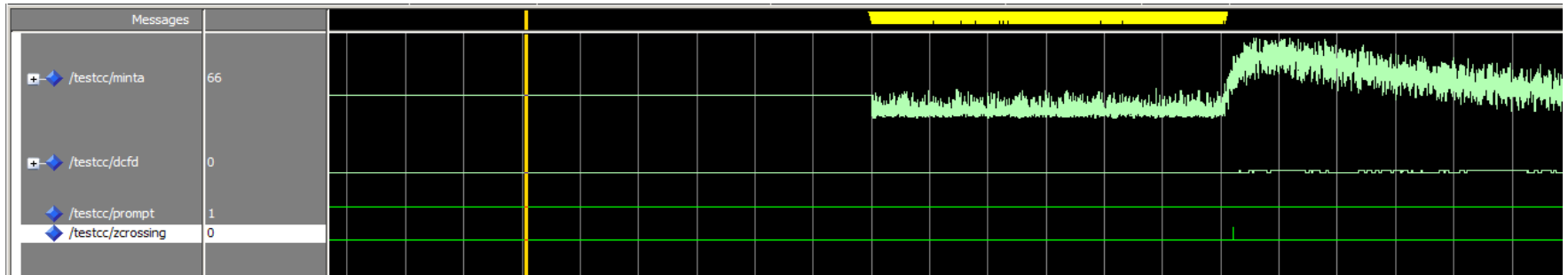
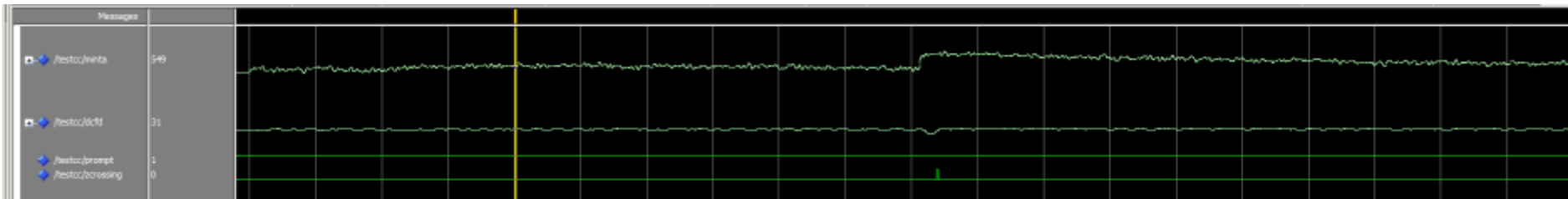
- Speciality: Control branch with tested LIR DSP
- We had hard-to-treat noise



- During the beam-time, we could not parametrize the trigger properly
- On-the-fly development: leading edge trigger

Noise investigation

Noise simulation in C, examining trigger problem in simulation



Offline test with pulser

DIAMANT old 2nd stage
Built-in pulser

SCSI link

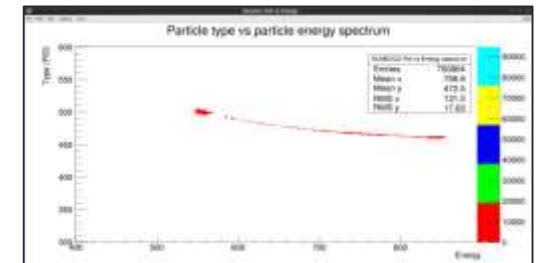
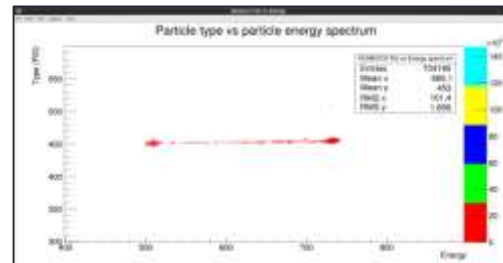
New 2nd stage of
DIAMANT

HDMI link

NUMEXO2



Aim: test discrimination ability of modified firmware with different amplitude and rise-time of signals



Result of firmware with 2 bytes wide and 4 bytes wide energy data

Offline test with detector emulator

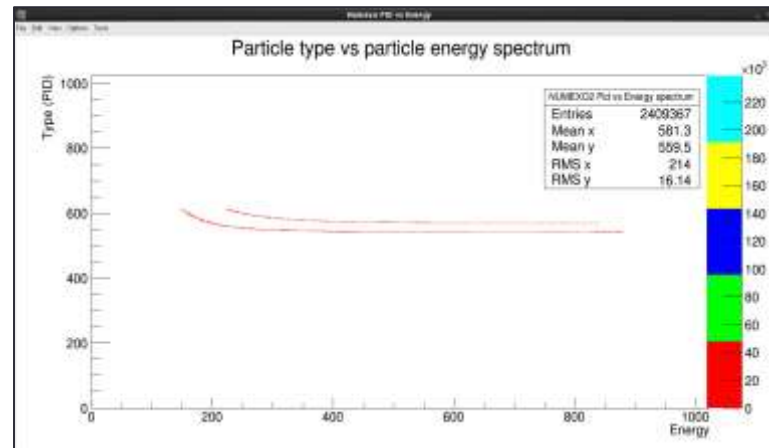
CAEN DT5800S
Detector Emulator

LEMO link

HDMI to 8 LEMO
link converter

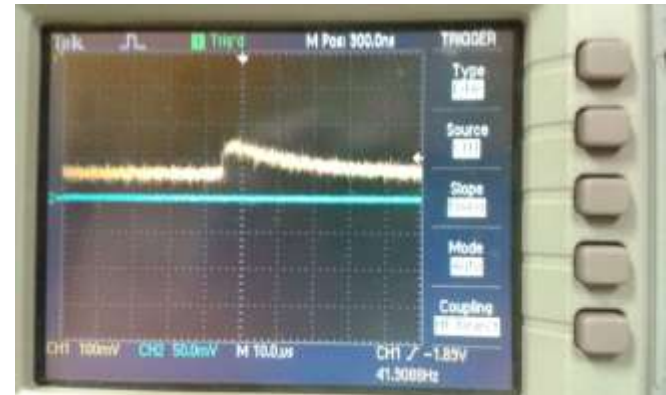
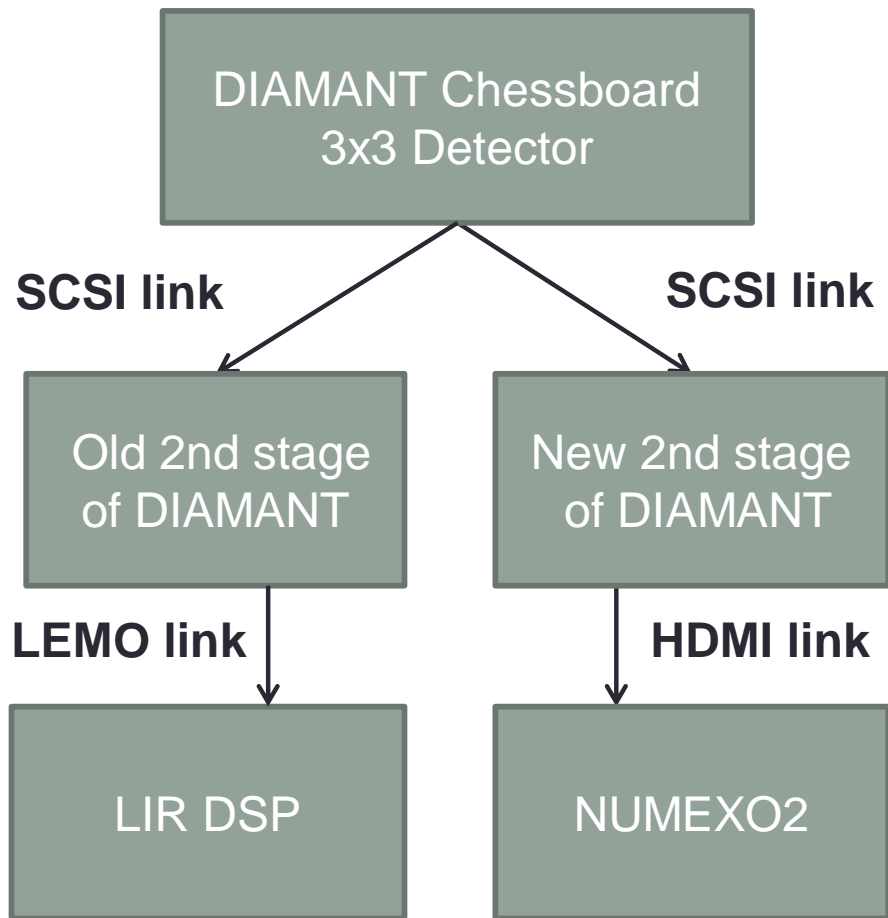
HDMI link

NUMEXO2



- Various quality and quantity of noise on the signals
- Multiple types of particles at the same time.

Second in-beam test



- New shield of SCSI interfaces
- Noise seems to be reduced
- No one expected:
Vacuum problem in Cyclotron

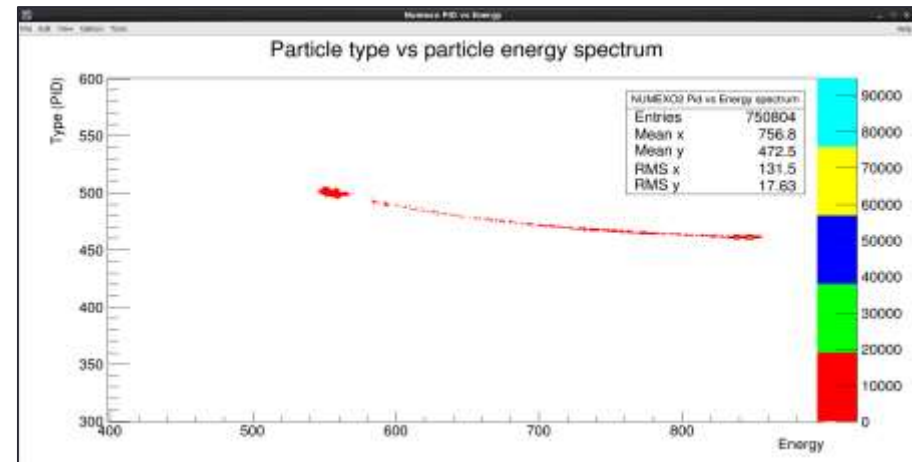
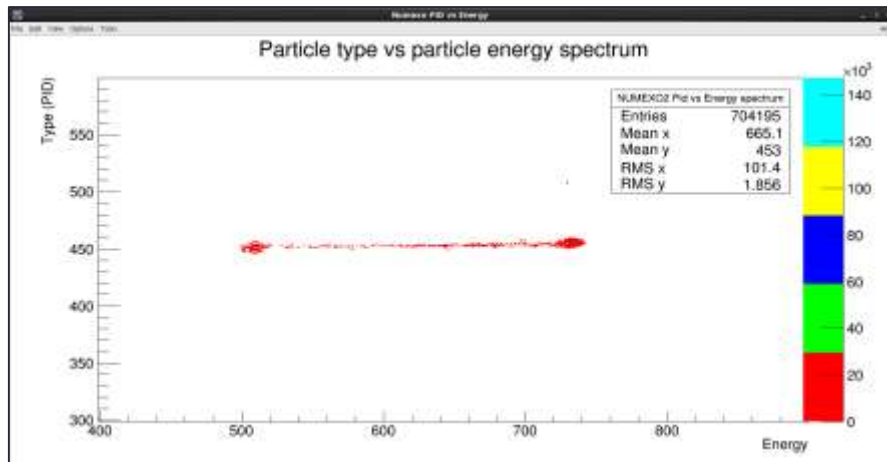
Summary

- We performed several tests with multiple setup
- First in-beam test: trigger problems because of heavy noise
- Offline tests proved our firmware works fine with clean signals
- Second in-beam test: vacuum problems
- Our firmware is under construction, but we are able to
 - discriminate pulser signals, even if it has some noise
 - process any data measured by NUMEXO2 (ROOT macros)
 - represent results of particle discrimination (spectra)
 - compare different parameters goodness (FOM analysis)

THANK YOU FOR YOUR ATTENTION

Offline test with pulser - results

- Tested with different rise time and amplitude particles
- The firmware was proper with clear pulser signals



Result of firmware with elder (2 bytes wide) and newer (4 bytes wide) energy data