Status of FE and Signals Chain Tests

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Pre - Isola Meeting June 2009

•Kapton Flat Cable assembled with signal-gnd tracks reversed has been replaced.

•Mapping Pogo Pin Matrix contacts: correspondence found between Signals, HV and LV with PPM and KFC.

•LV and Signals Panel Connectors decoupled from the flange: electronic gnd dedicated.

•Signal transmission and PreAmplifier Signal Out trasmission through cable system (KFC + 10m Habia + 10m Lemo).

•Preliminar HV test: no HV gnd on KFC → pick up noise @ 10-100kHz modulated in radio-frequency contribution.

Post – Isola Meeting
Outline

- Status and description of gnd system, HV branch, and Test Bench.

- PZO Preamplifier Tests:
  - -Uncompensated Circuit (with C_{DET})
  - -Compensated Circuit (with C_{DET} and Detector)

- Commercial CMOS (CC) Preamlifiers Tests (with C_{DET})

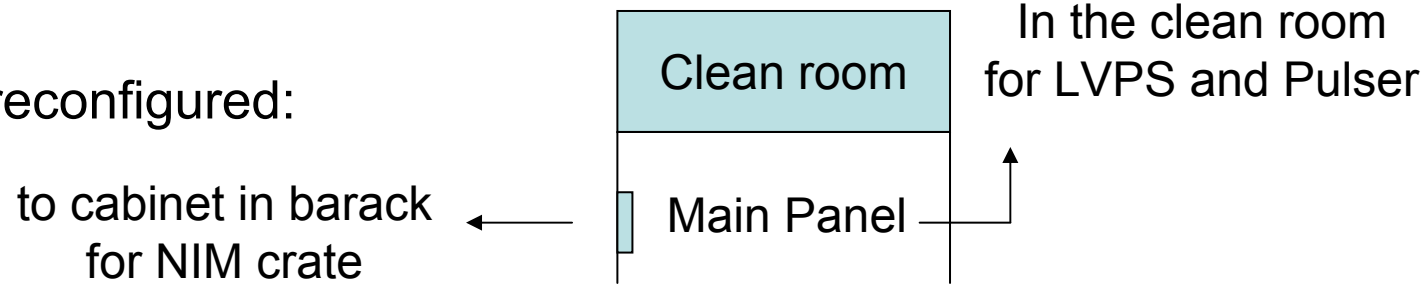
Description of gnd system, HV branch and Test Bench

HV gnd has been placed on KFC: ~20 cm above PPM HV cable has a break in the sock and the inner wire has a crimp contact: with a short wire soldered on HV sock the gnd continuity has been replaced down to PPM → this part soldered MUST be in LAr

HV and LC test (in LN2):
2 HV lines with HV gnd on KFC: (HV2 and HV4; num on SHV connectors)
HV2 = 4500 V, HV4 = 4500 V => LC(HV2) = 21-25 pA; LC(HV4) = 27-32 pA;
HV2 = 5000 V, HV4 = 5000 V => LC(HV2) = 37-41 pA; LC(HV4) = 41-46 pA.

At the beginning two separated gnd had been used in order to dedicate a clean gnd for the electronics. As soon as we started to test the Preamplifier with long leg input capacitor (to simulate the real distance between Detector-FE) we needed to go to a single gnd solution to be able to shield the long leg input using the dewar.

Power Supply Line reconfigured:

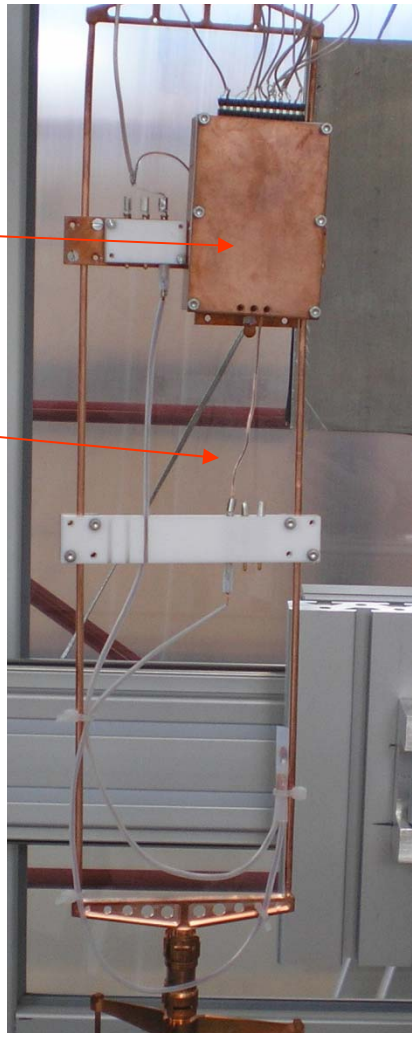


Uncompensated PZ0 Preamplifier test

The same used for underground tests with the Prototype, 2 chns working

Chn 1: $C_{detector}$=33 pF on board

Chn 2: $C_{detector}$=33 pF long leg



Warm tests

Double gnd results

Resolution

$C_{detector}$=33 pF on board

1.4 keV FWHM at 1 MeV

(55 mV Test Pulse on 1 pF Test Capacitor)

$C_{detector}$=33 pF long leg

1.9 keV FWHM → long leg input shielded with cupper foil

It's difficult to shield the detector

inside the dewar with a separate gnd.

Use only one gnd and the dewar (and the lock) as shield

$C_{detector}$=33 pF long leg

2 keV FWHM at 1 MeV → long leg input shielded inside the dewar

or the vertical tube

Cold tests: no good results

Chn 1: bad resolution (~ 4 keV)

Chn 2: Preamplifier Signal Out saturated at the beginning, then arisen but bad resolution (~ 5 keV)

Signals out disappeared (after warming up signals re-appeared again).

An other attempt (cooling-warming cycle) gave the same results.

Before an other attemp has been realized that the top and the bottom part of the PPM were not so tight as the beginnig: the same problem has been found in Munich, some kapton tape has been added inside bottom part of PPM (between cupper plate and PTFE part). In this way the PPM looked tighter in warm condition.

In an other attemp signals out alive for several minutes, then disappeared.

Problem in PPM contacts

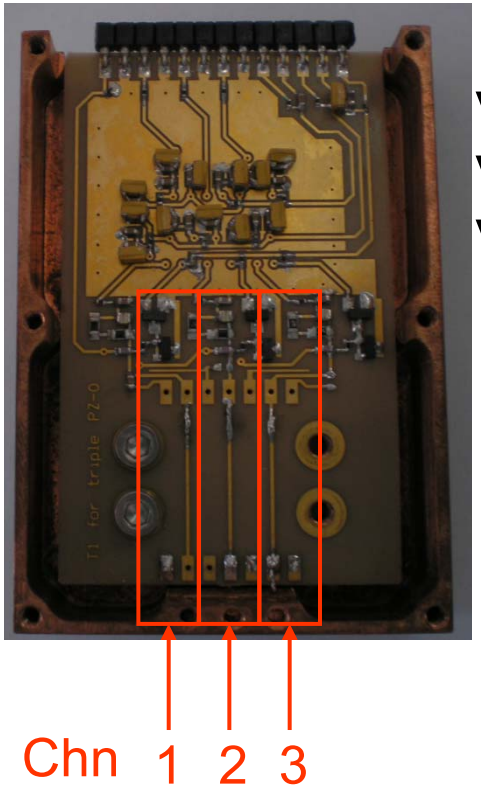
A special strip of pins has been realized to short circuit all signals to verify the cold PPM working

Test input contact not working → replaced with a spare cable.

After an other cooling cicle, Signal Out 1 sometimes disappeared.

Compensated PZ0 Preamplifier test (1.4 pF compensation, C_F=0.3pF)

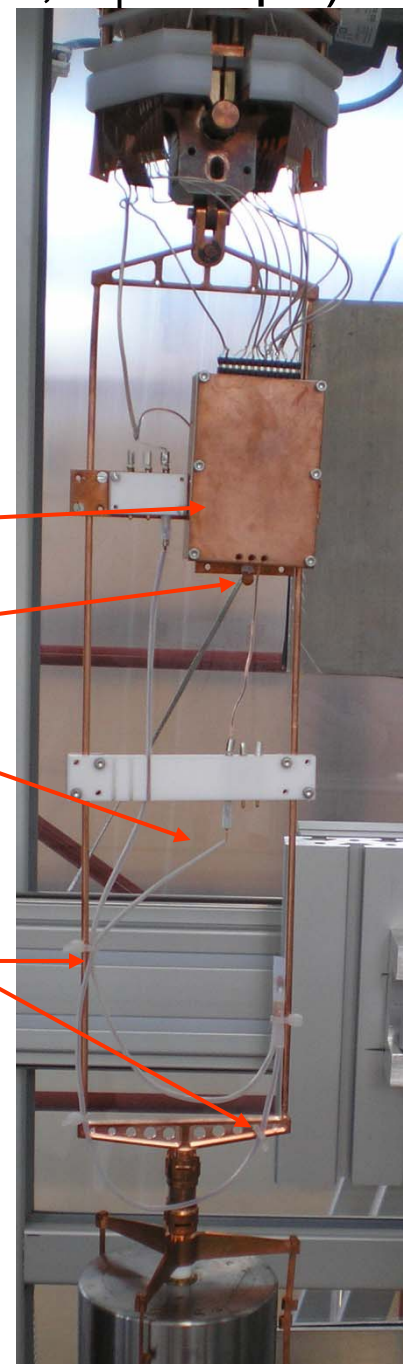
The same used for tests with the SUB detector in MiB



LVPS

V_{FET} = 14.5, V_{CC} = 3.3, V_{EE} = -2.5 V; warm
V_{FET} = 3.7, V_{CC} = 3.1, V_{EE} = -2/-2.4 V; cold
V_{CC} and V_{EE} 3 cables in parallel

Chn 1: C_{DET}=33 pF on board
Chn 2: C_{DET}=33 pF short leg
Chn 3: C_{DET}=33 pF long leg



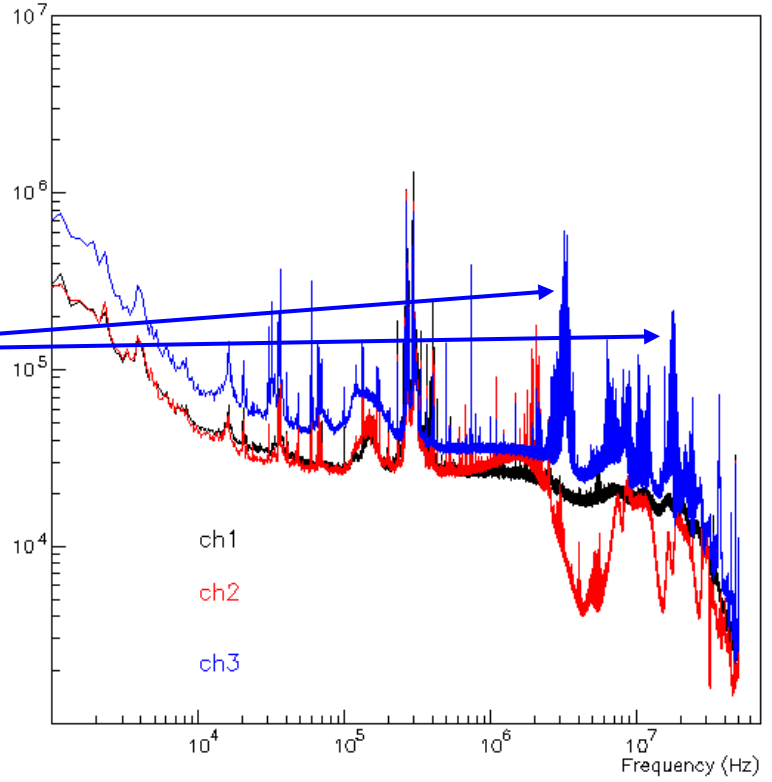
It's very important to fix cables to avoid microphonism

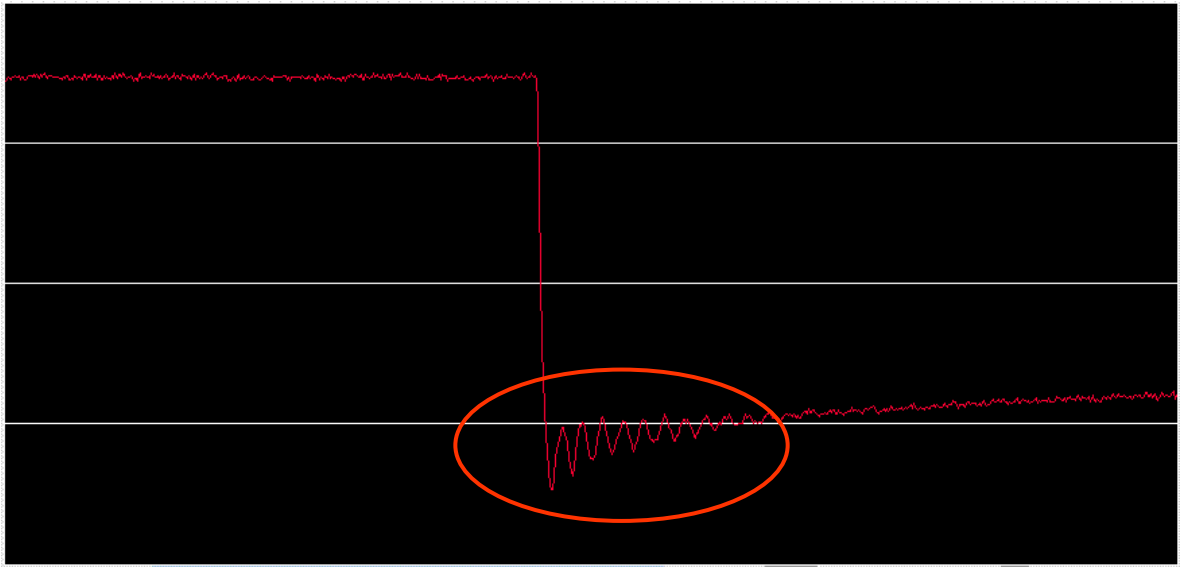
Resolution Cold (1kΩ Shaper Termination)

Chn1: 1.1 – 1.2 keV FWHM @ 1 MeV
Chn2: 1.1 – 1.2 keV FWHM @ 1 MeV
Chn3: 1.8 – 1.9 keV FWHM @ 1 MeV

When we acquired the baselines to perform a frequency analysis
4-40 MHz noise appeared

FFT of Chn1, 2, 3:
Chn 3 (l.l.) shows 4-40 MHz peaks which are consistent and comparable with a ringing in the waveform acquired

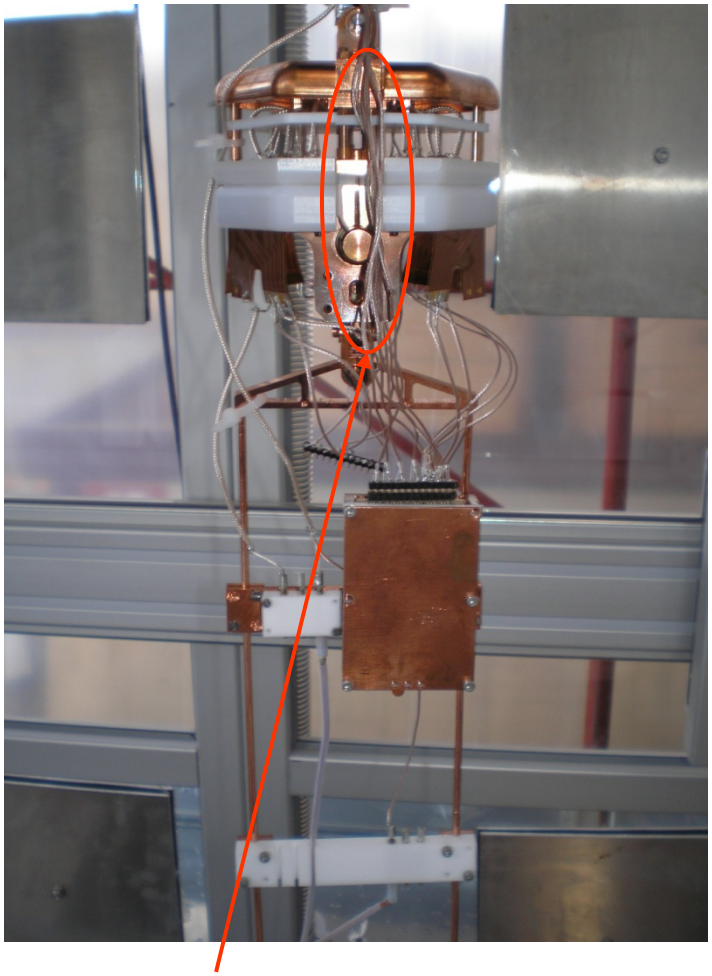


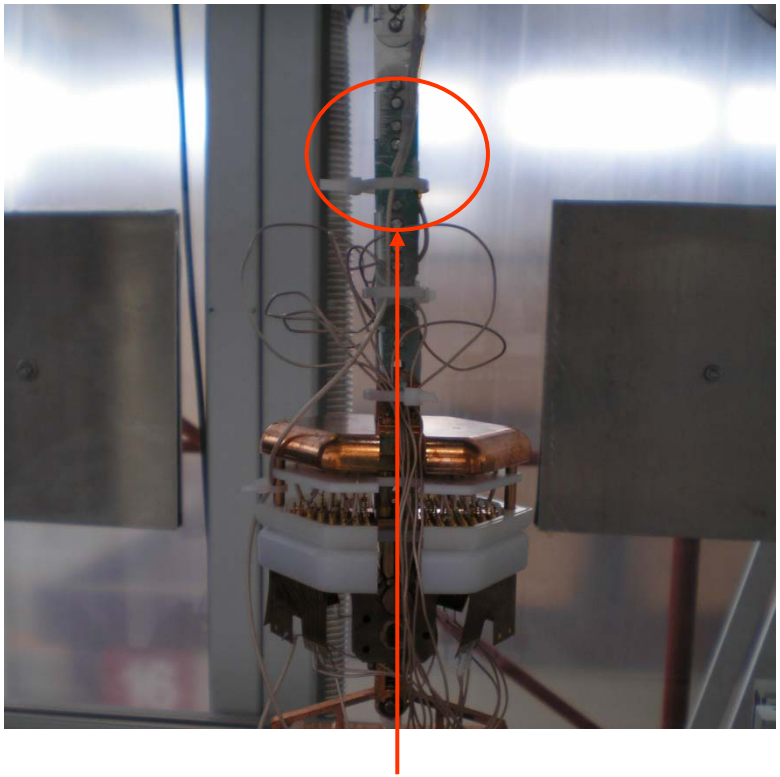


This noise makes the resolution ~10% worse

Waveform acquired without termination

Since we have seen from the tests with uncompensated circuit that several PogoPins cold had a bad contact, we decided to by-pass the PPM, for the Signal Out, Test Input, LV, HV to be sure that all signals and their gnd (particularly HV gnd) have good cold contacts



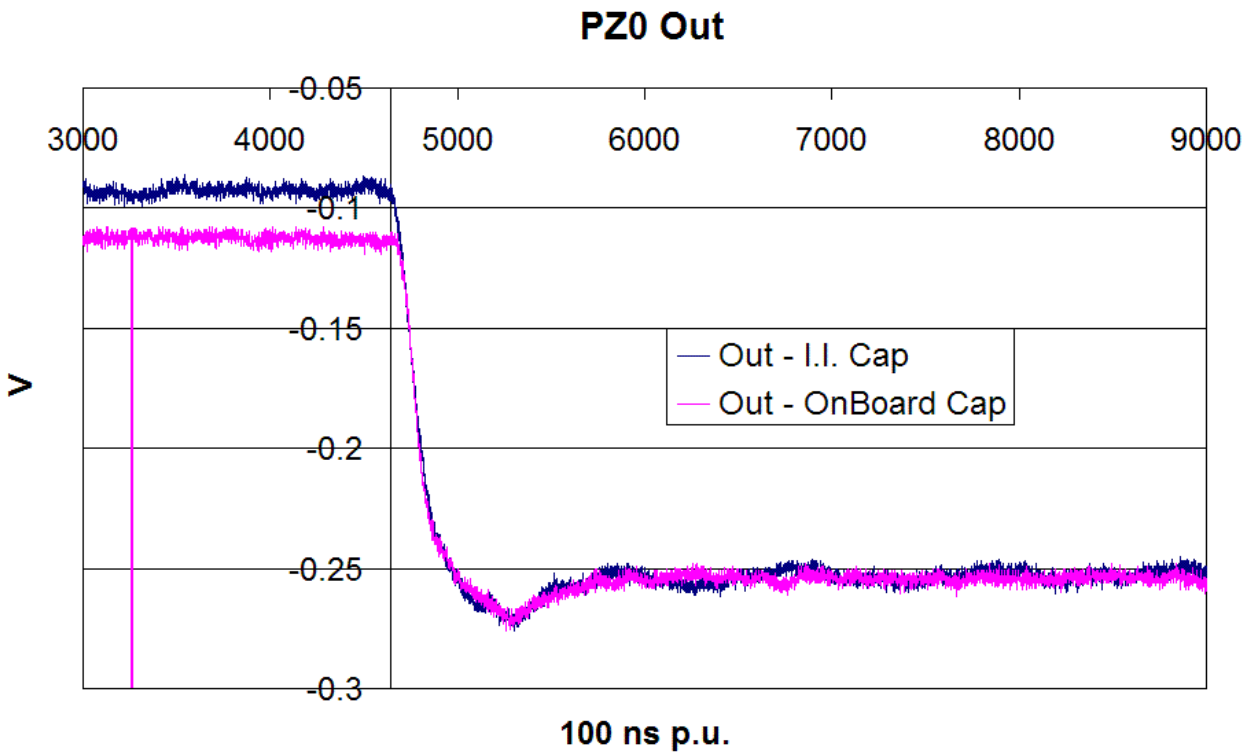


One of 4 HV cables has been cut and elongated: this part MUST be in LAr

Spare cables used to by-pass the PPM:
LV are taken by 4 cables in parallel (1 spare outside PPM, 3 inside PPM)

Compensated PZ0 Preamplifier test results by-passing the PPM

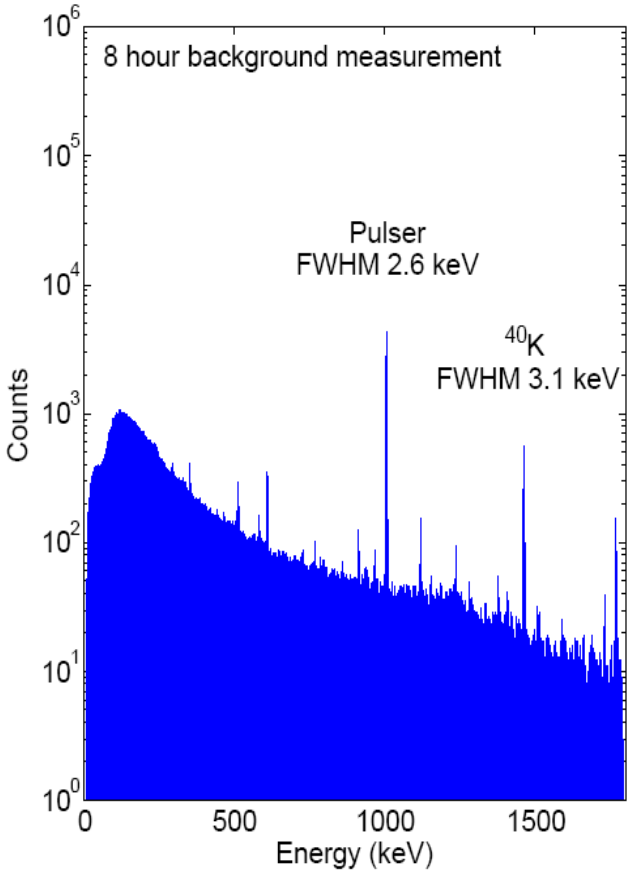
	Chn 1 (C on board)	Chn2 (C s.l.)	Chn3 (C l.l.)
Resolution (@ 1MeV)	1.1 keV	1.1 keV	1.9 - 2 keV
τ_{rise} (10m Lemocable)	76 ns	73 ns	72 ns
τ_{rise} (1m Lemo cable)	41 ns	41 ns	38 ns

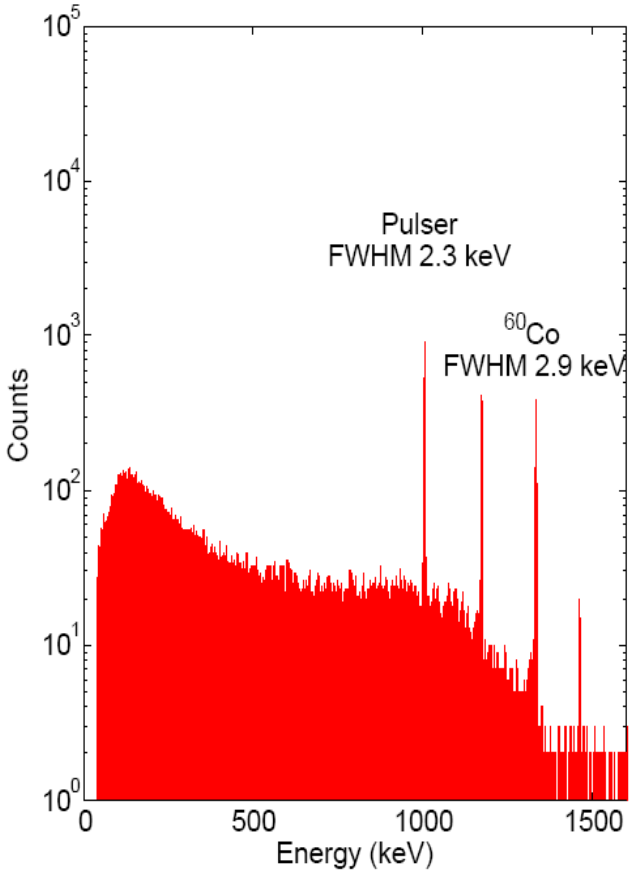


Preamplifier Signal Out (Chn1, 3; 1m Lemo Cable; 1 MΩ Osc. Term.):
a small effect of reflection due to not-termination of cables

Compensated PZ0 Preamplifier test results with Prototype Detector

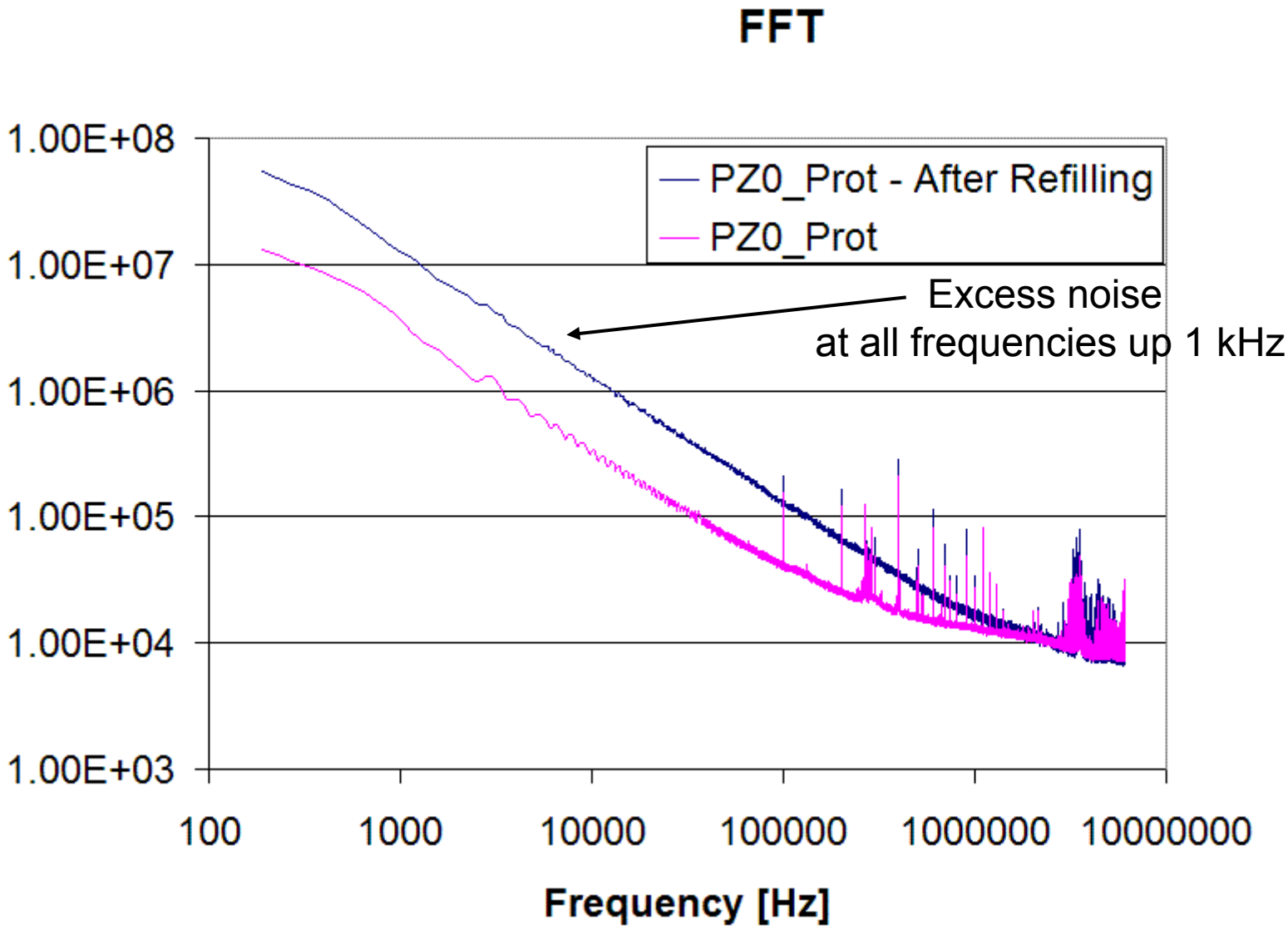
	Chn 1 On Board 33 pF Cap.	Chn 2 Short Leg 33 pF Cap.	Chn 3 Detector
Resolution	1.2 – 1.3 keV @ 1 MeV Pulser line	1.2 – 1.3 keV @ 1 MeV Pulser line	2.9 – 3 keV @ 1332.5 keV ^{60}Co 3 – 3.1 keV @ 1460.5 keV ^{40}K 2.4 – 2.5 keV @ 1 MeV Pulser line





Plot resolution

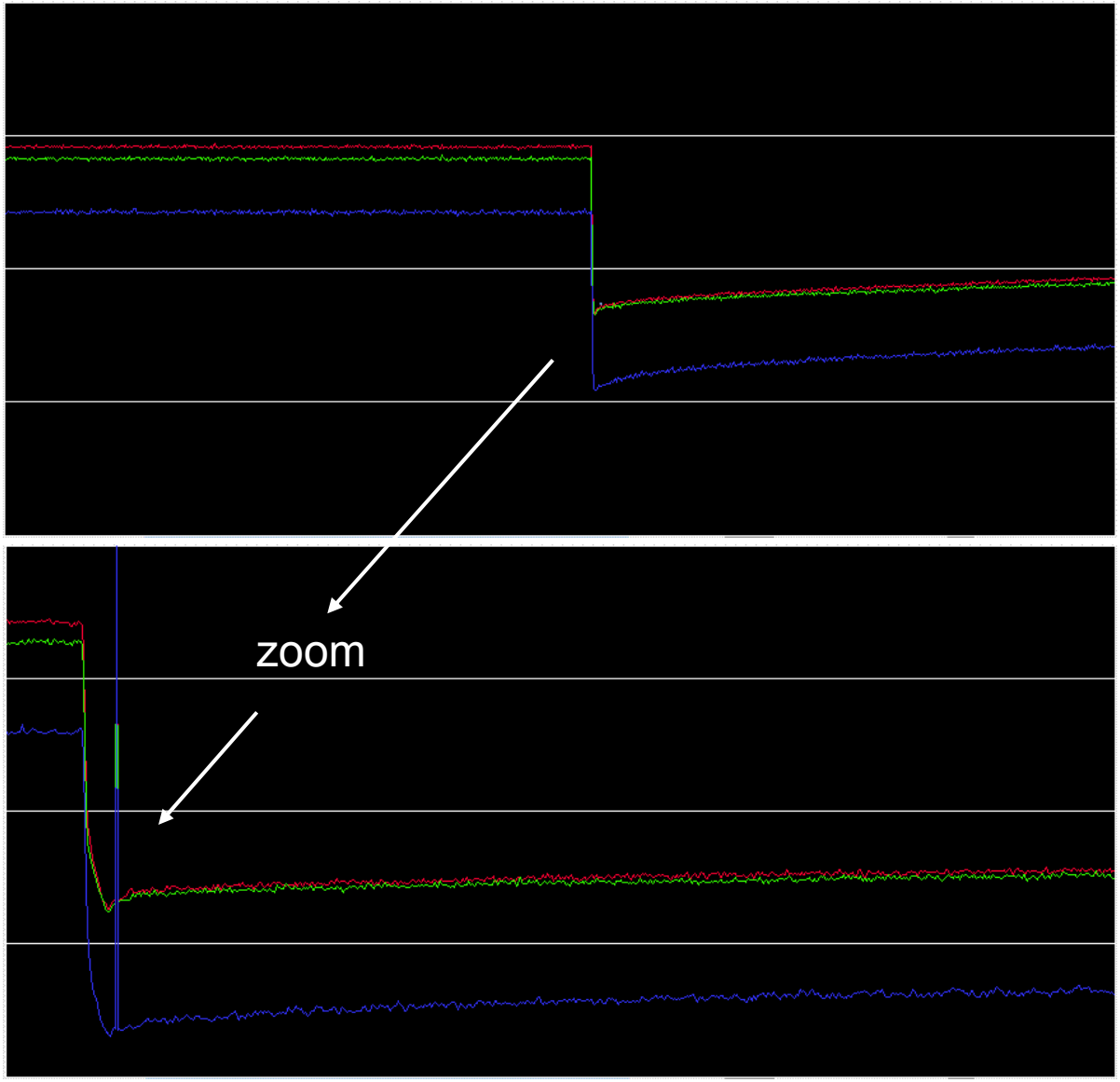
Good resolution was achieved with 97 kg of LAr: after refilling increase of microphonics because of high filling level and boiling, resolution around 5 keV. After problems with BL movements solved, returned to 2.9 keV.



FFT Baseline Signal Out obtained in good and bad conditions

Compensated PZ0 Preamplifier test results with Prototype Detector

Preamplifier Signal Out (Test Pulser Input)



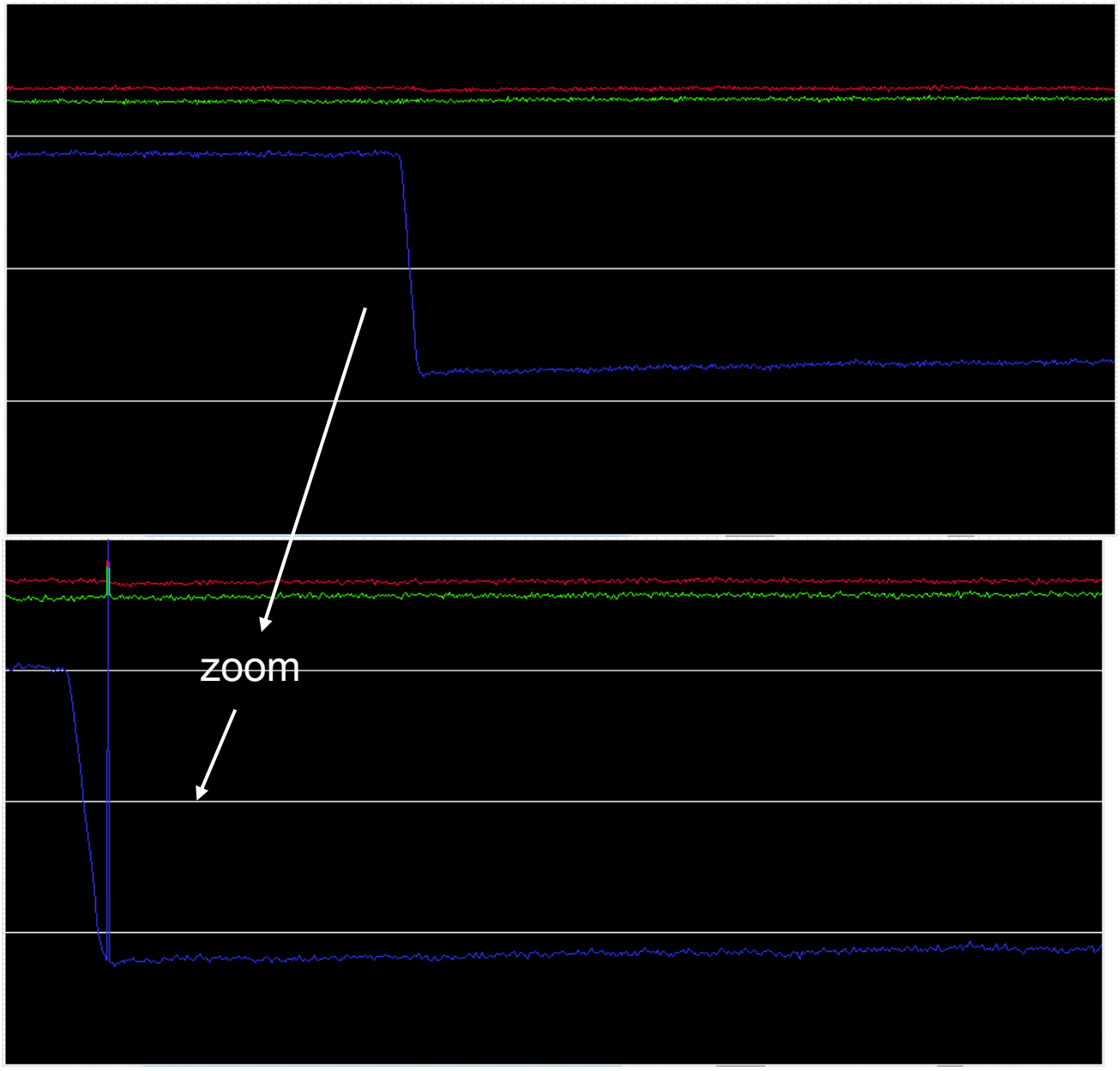
'b': detector
'r': C_{DET} on board
'g': C_{DET} s.l.

Waveforms acquired without termination (50Ω removed)

Small effect of reflection due to not-termination of cables

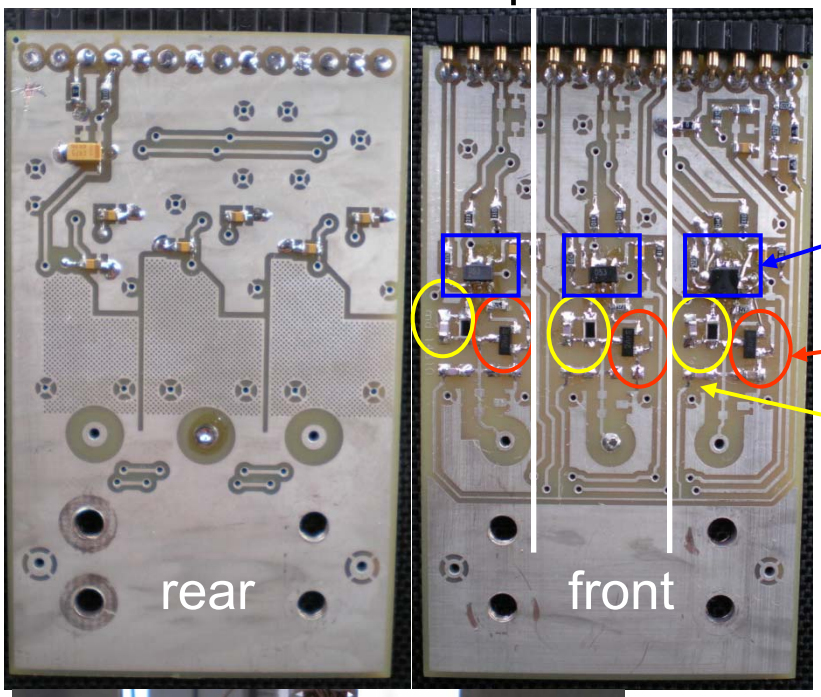
Compensated PZ0 Preamplifier test results with Prototype Detector

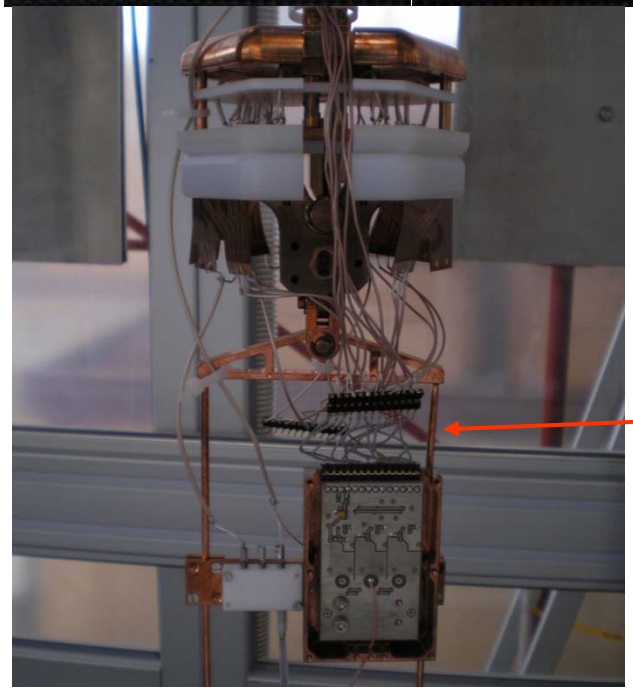
Preamplifier Signal Out (Detector Signal)



when the signal is slower, the effect of non-termination of the cable is less evident

3 Chn Preamplifier





Commercial CMOS (CC) Preamplifier tests

Designed by UniMi & Mi INFN

Texas Instrument
CMOS Opertional Amplifier

External jFET BF862

Feedback components

LVPS (warm and cold)
V_{FET}=12V, V_{CC}=2.5V, V_{EE}=-2.5V
Not needed 3 cables in parallel

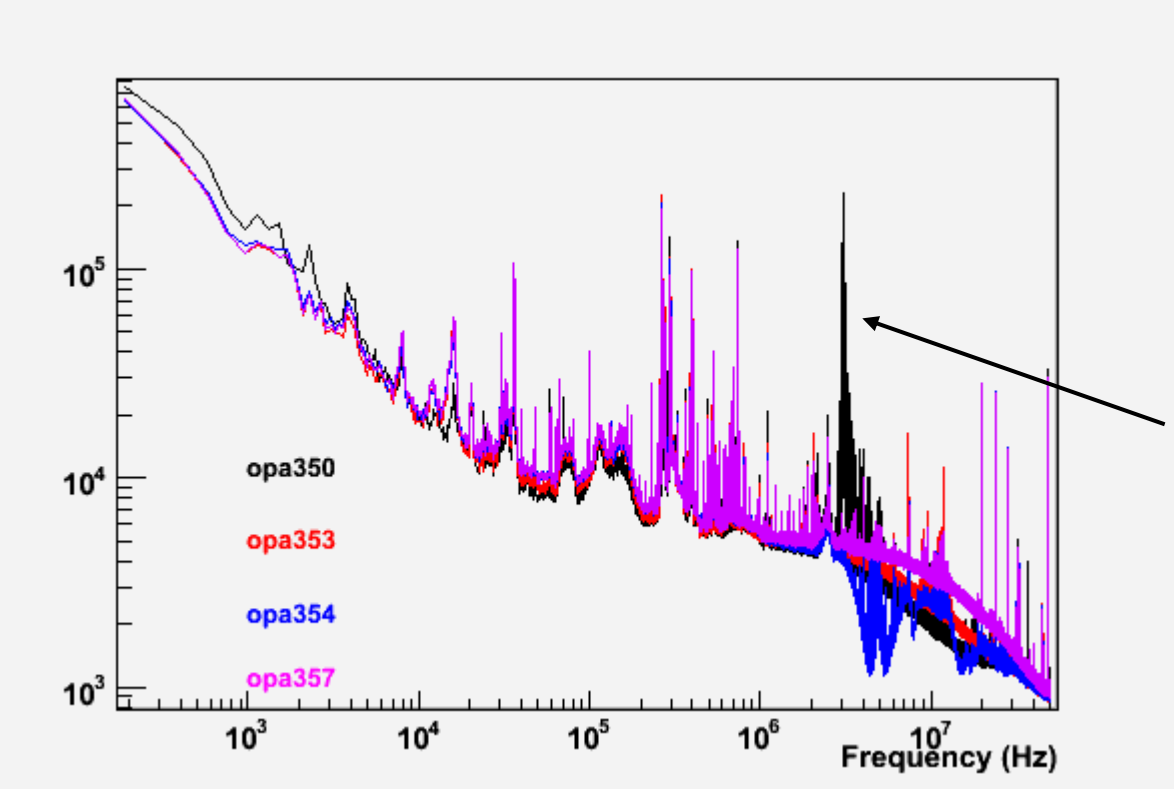
Test performed by-passing PPM

Strip of pins to adapt PZ0 pins to CC

OPA 354 – 353 – 357 – 350 – 355 – 356
have been tested
with a C_{DET}=33pF and compared.

Commercial CMOS (CC) Preamplifier test

	Chn 1 OPA 353 C l.l.	Chn2 OPA 350 C on board	Chn3 OPA 353 C on board
Resolution (@ 1 MeV)	1.9 – 2 keV	1.1 keV	1.1 keV
τ_{rise} (10m Lemo cable)	83 ns	98 ns	84 ns
τ_{rise} (1m Lemo cable)	77 ns	94 ns	80 ns



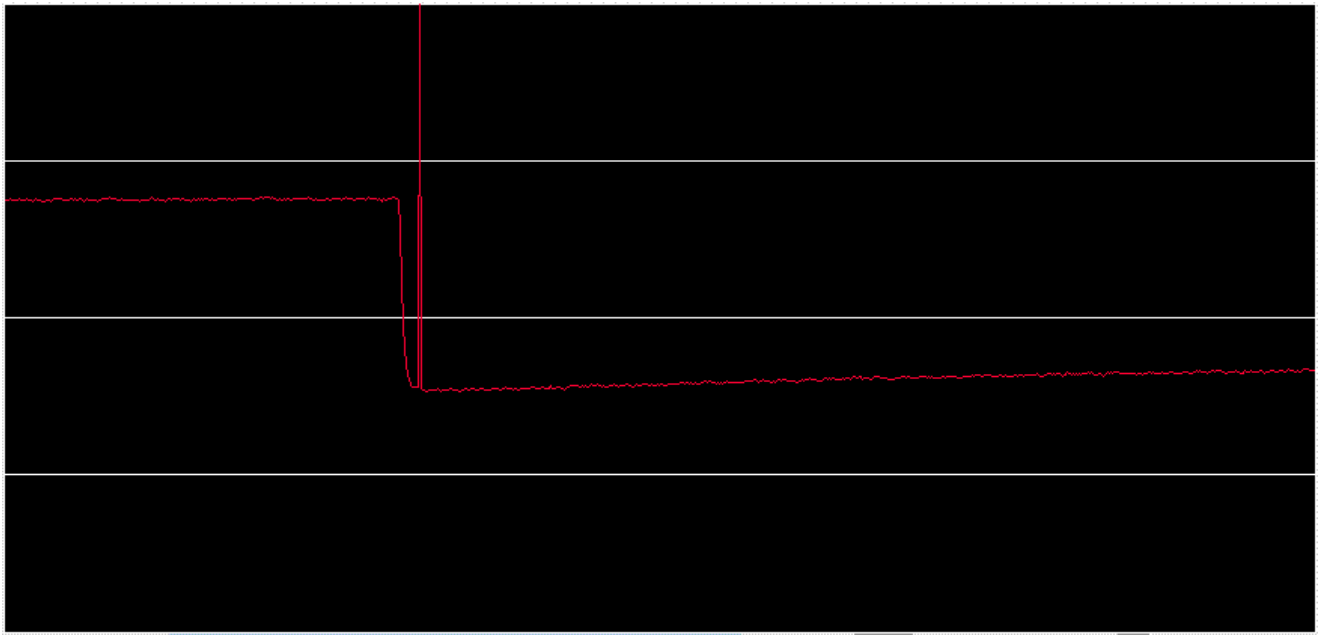
CC Preamp FFT

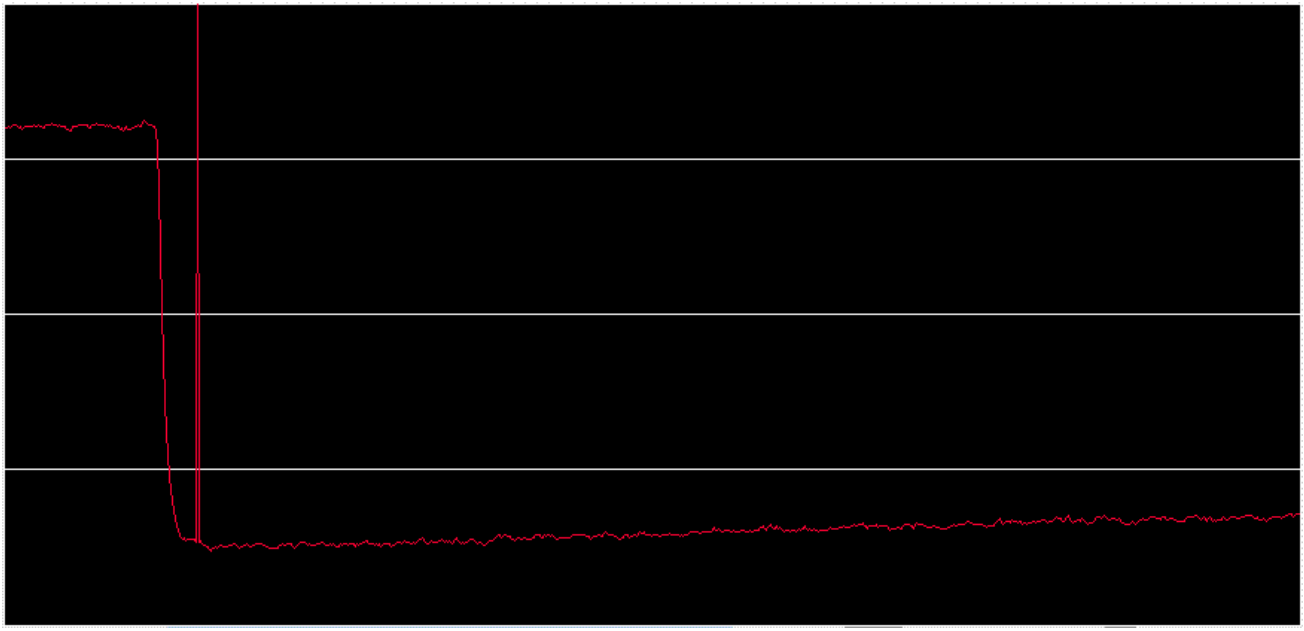
Need to be investigated:
may be related to a bad
(or missing) contact of HV gnd

OPA 354 – 357 have been tested before and presented Resolution=1.3–1.4keV but only with low LVPS (1.1 – 1.5 V) and not reliable.

Preamplifier Signal Out (Test Pulser Input)

Chn 1: OPA 353 C_{DET}=33 pF I.I.





50 Ω termination:
no effect of reflection

Conclusion:

- Improvement of set up and gng scheme

- Test performed:
  - PZ0 Preamplifiers with C_{DET} and Detector
  - CC Preamplifiers with C_{DET}

- Next measurements:
  - Cross Talk analysis
  - Spectroscopy Analysis with digital system (FADC and adhocalgorithms)
  - Preparing Bench for 2 detectors string