Prototype detector (surface fully passivated)– PZ0 readout test. June 2008

Test 0: PZ0 mounted on cross in Cu (acting as Faraday Cage) Cdet=33 pF.

Results: FWHM 1.5 keV @ Pulser (~1.4 MeV)

Test 1: PZ0 shielded in Cu box on cross, cold - HV filter (1GΩ,4.6 nF) unshielded on other side of cross.

HV=3000 V, LC ~ 100 pF.

Results: FWHM 3.3 keV @ ^{60}Co, 2.7 @ Pulser (~1.4 MeV).

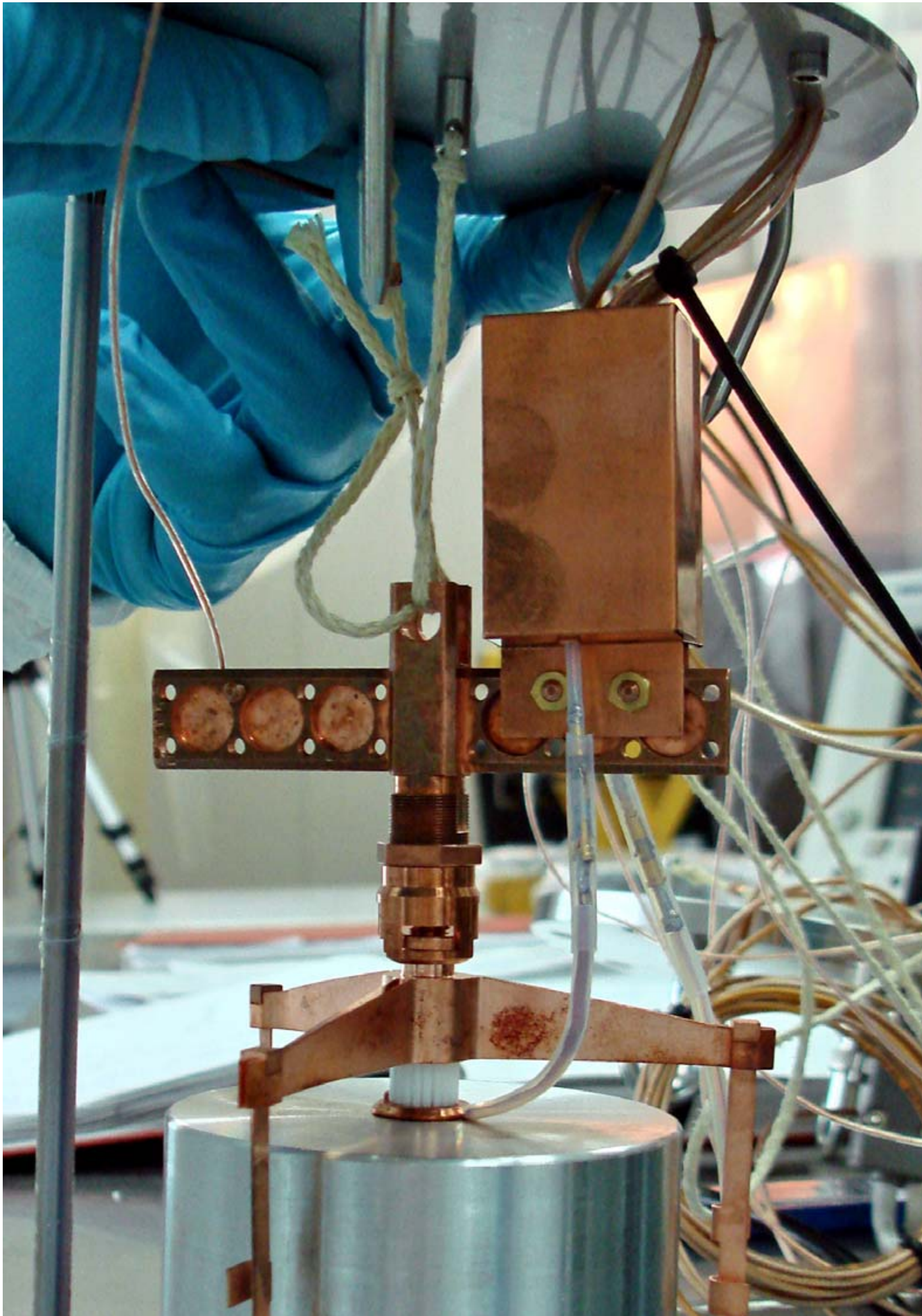
Some instability of resolution depending on external HV cable and filter position.

Test 2: As 1 but cold – HV filter in Cu FC back to back to PZ0). Minimized length of signal and HV cable from detector. Improved anchorage of signal cable at vertical bars of detector Cu holder.

HV=2500 V, LC = 190 pA

Results: FWHM 3.7 keV@ ^{60}Co, 3.2 @ Pulser

R depends heavily from HV cable and filter positioning



Test performed in august 2008.

Test 3: Substitute detector with C=100 pF suited to apply HV.

Result: $FWHM_{pulser}$ (setted@1.4 MeV) = 2.6 keV both HV On and OFF. Consistent with noise slope of ~2 e^- r.m.s/pF as measured at test bench, and consistent with FWHM for C_{det}=33 pF

Purpose: To evaluate the resolution worsening related to pick-up of HF (through HV line and ground),LF (50 Hz, bubbling), preamplifier mounting, cabling etc.

Performed spectroscopy and pulse recording

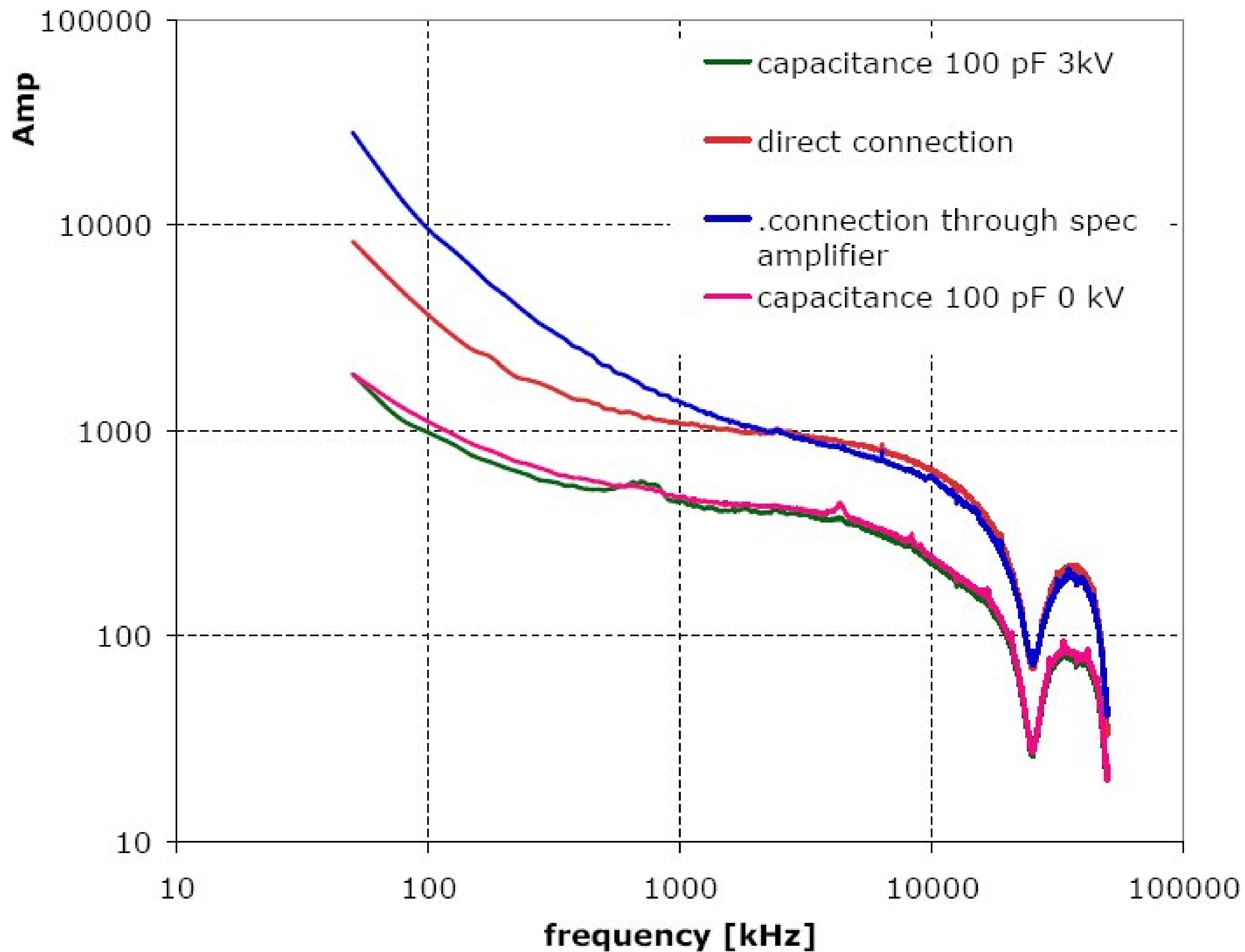
Conclusions: There is no frequency dominating the noise and causing the resolution worsening, but white + some 1/f noise.

Test 4: Connect again detector reprocessed no PL.

HV=3000 V, LC ~ 40 pA

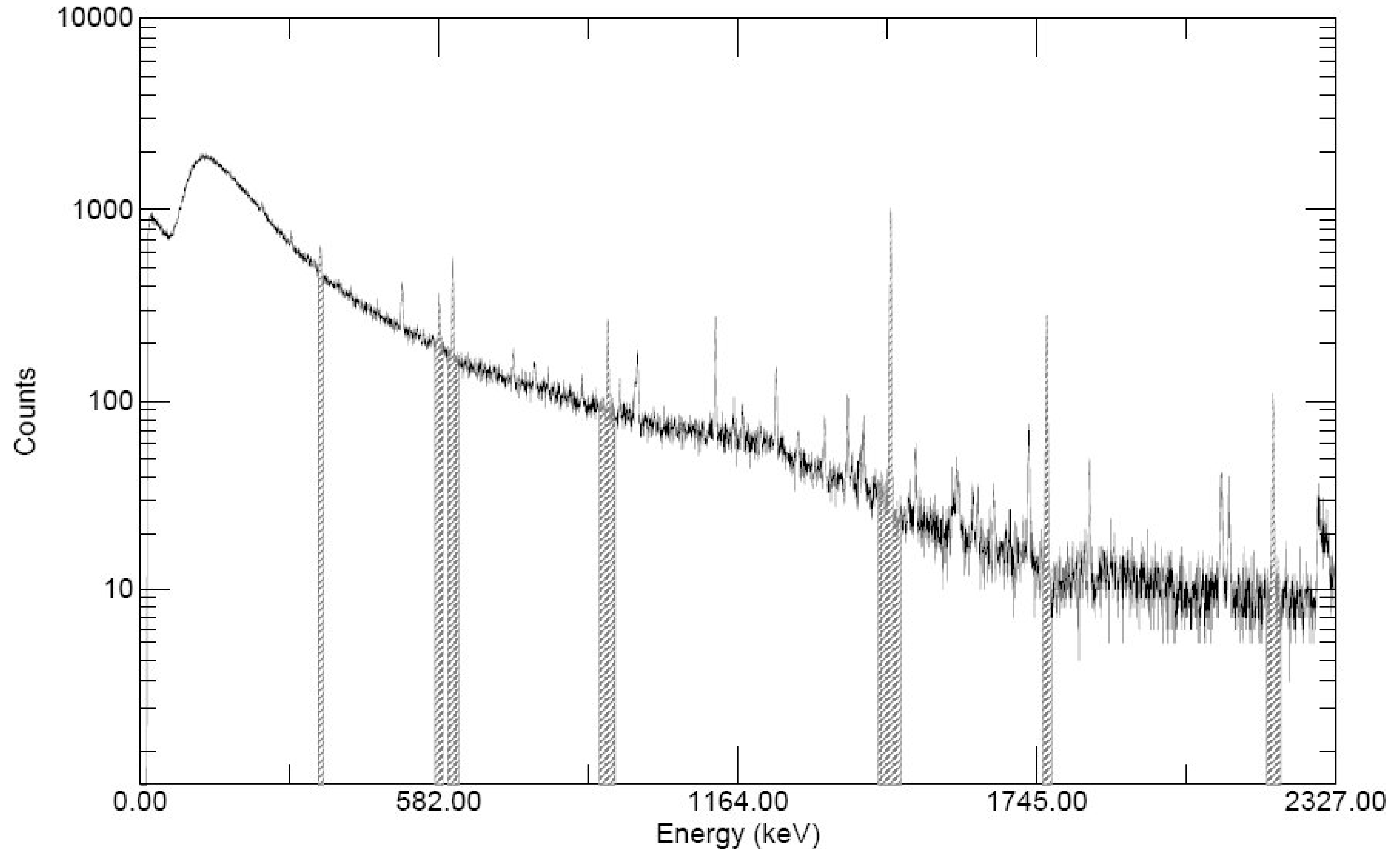
Results: FWHM 3.2 keV@ ^{60}Co, Pulser not available (ground of cable broke).

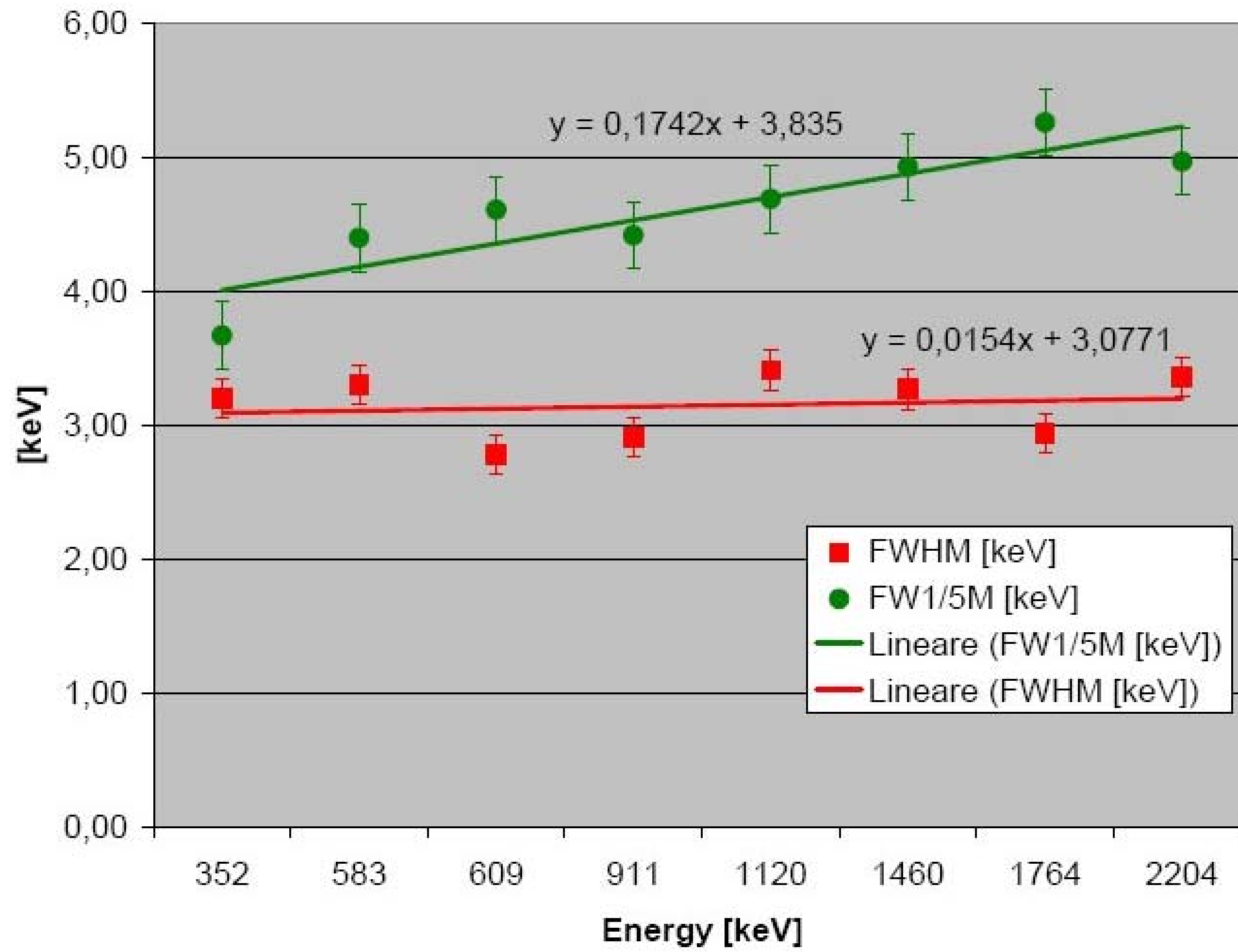
Evaluation of excess noise: $(3.2^2 – 1.5^2 – 1.7^2)$ keV ~ 2.2 keV



100000
10000
1000
100
10
Amp
10
100
1000
10000
100000
frequency [kHz]
capacitance 100 pF 3kV
direct connection
.connection through spec amplifier
capacitance 100 pF 0 kV

Background spectra 7 August 2008.
HV= 3000 V, LC <50 pA, τ = 6 μs




FWHM vs Energy
6,00
5,00
4,00
3,00
2,00
1,00
0,00
[keV]
y = 0,1742x + 3,835
y = 0,0154x + 3,0771
FWHM [keV]
FW1/5M [keV]
Lineare (FW1/5M [keV])
Lineare (FWHM [keV])
352
583
609
911
1120
1460
1764
2204
Energy [keV]

Test of FE and detector string

- Open issues
  - Position/location of FE above the detector string
  - interface with detector (pin/soldered)
  - Interface with detector cable string (pin/soldered)
  - HV filter (RC):
    - is it really needed? If yes location and design
- Program of tests
  - Test bench: 2-3 weeks
  - Encapsulated detector: 1 week
  - Naked detector @ LNGS: 2-3 weeks
    - 1 detector
    - 2 detector
  - Test at Munich with capacitors (33 pF) HV OFF and HV ON to qualify cable chain
  - Test at Munich with real string: 2-3 weeks?
- Working group
  - A. Pullia, C. Cattadori, F. Zocca, A. D'Andragora, S. Riboldi,

Extimate of Activity of 3-ch PCB

- Position and location of FE above the detector string:
  - Depends on radioactivity of final PCB:
    - Extimated mass of 6 x 4 x 0.038 cm3 x 2.15= 2 g
    - From γ-ray screening:
      - Th-232: Ra-228: < 3.0 mBq/kg <==> < 7.3 E-10 g/g
      - Th-228: < 1.9 mBq/kg <==> < 4.6 E-10 g/g
      - U-238: Ra-226 (Pb&Bi) < 0.85 mBq/kg <==> < 6.9 E-11 g/g
      - Pa-234m < 0.13 Bq/kg <==> < 1.1 E-8 g/g
      - U-235: < 3.7 mBq/kg <==> < 6.5 E-9 g/g
      - K-40: (48 +/- 15) mBq/kg <==> (1.5 +/- 0.5) E-6 g/g
      - Cs-137: < 1.6 mBq/kg
      - Co-60: < 3.2 mBq/kg (only for Cu layer)
  - Activity of 1 3-ch PCB → < 10 μBq in Th+U
  - Activity of SMD components ~ 0.5 Bq/kg in Th&U. 1 component ~0.01 g.

  Use 50 components/PCB: 50 x 0.01x 10^{-3} Bq= .25 x 10^{-4} Bq ~ 250 μBq→ important to minimize the number of components on-board

  + Soldering paste

  +Cu ASIC protection

Location of FE

- On the cross or above along Cu rods?
- At which height they must be located?

  Final γ- spectrometry measurement needed on final real 3-ch PCB.

3 ch FE: open issues to proceed with PCB production and ASIC bondings

Need from TG1 and TG5

- OK for overall dimensions
- OK for anchorages holes

Order already placed: 2 different companies

- TVR (VI) for PCB production with electrogalvanic Ni/Au deposition (2-3 days for sampling production from the OK). Cuflon in our hands (available).
- MIPOT (TS) for bonding+ SMD component mounting: 10 days for sampling production (5 ASIC bonded)