

Performance of LYSO Crystal Readout with SiPMs for Beam Radiation Monitor

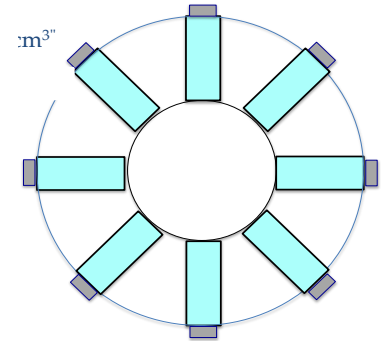
UiB

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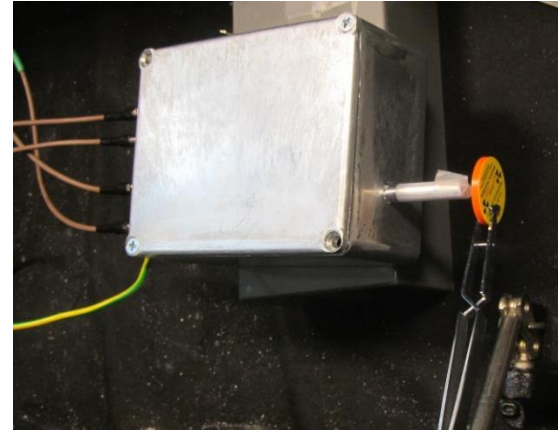
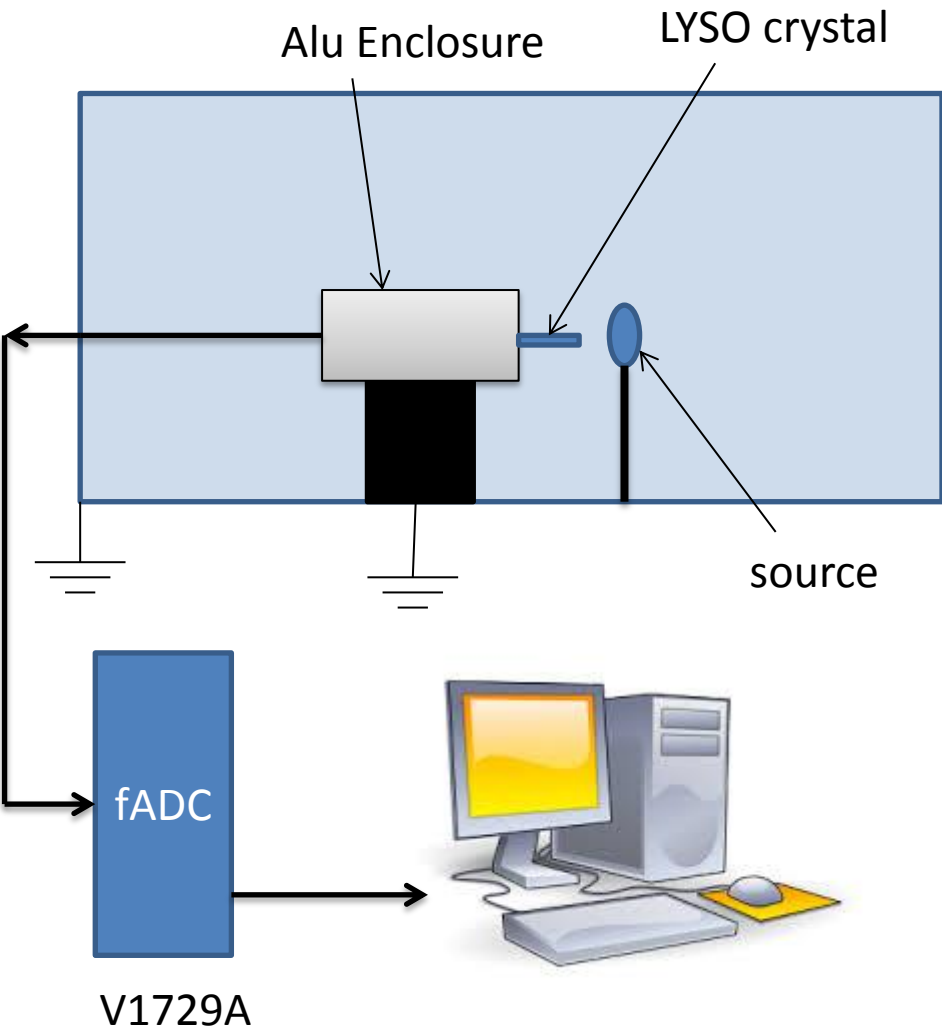
Beam Radiation Monitor

- Our task is to build a beam radiation monitor for KLOE at the DaΦne experiment in Frascati
- Detector consists of an array of 8 LYSO crystals arranged in a ring around the beam pipe to record beam radiation photons in 100 keV energy range
- Each crystal (dimension: $0.5 \times 0.5 \times 4 \text{ cm}^3$) is wrapped in ESR film and is read out with a KETEK SiPM having an active area of $3 \times 3 \text{ mm}^2$ with **12100** $20 \times 20 \text{ }\mu\text{m}^2$ pixels (SiPM is not on the market)
- We have tested 6 of 8 crystals with different wrappings and 8 novel KETEK SiPMS using ^{133}Ba , ^{57}Co , ^{22}Na , ^{137}Cs and ^{60}Co sources
 - Attach crystals to SiPMs with optical grease (use glue later)
 - Amplify signal with charge-sensitive preamp AD8000 (gain: 8.5)
 - Record Signal with 14-bit Caen ADC read out with Labview
- Design of the mechanical support structure requires a visit to Frascati to inspect beam area, as many cables are tied to the beam pipe 30th of June

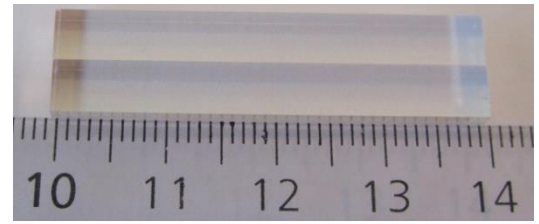




Test Setup at Bergen University



Picture of the setup



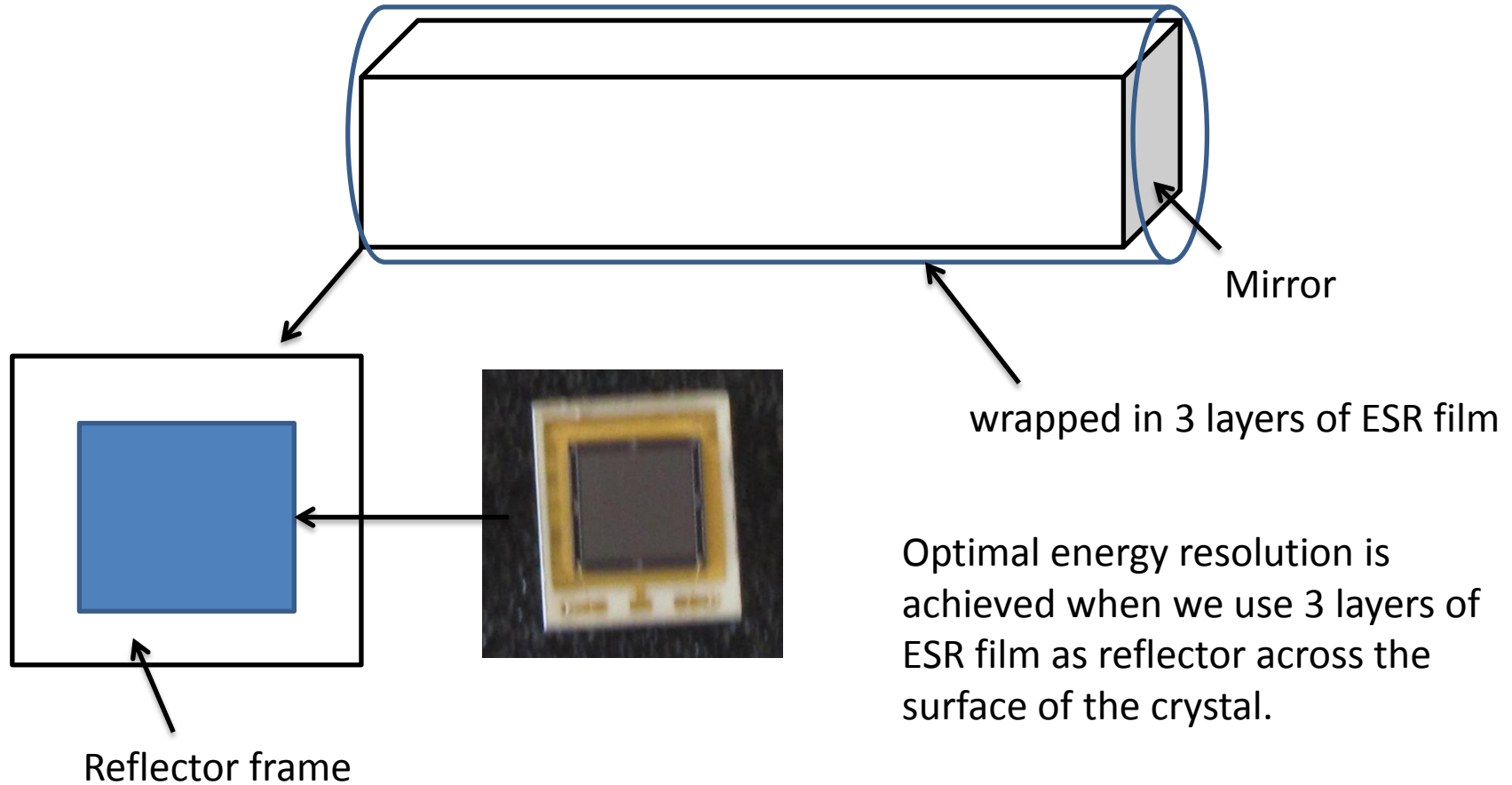
LYSO crystal
5x5x40 mm



KETEK SiPM



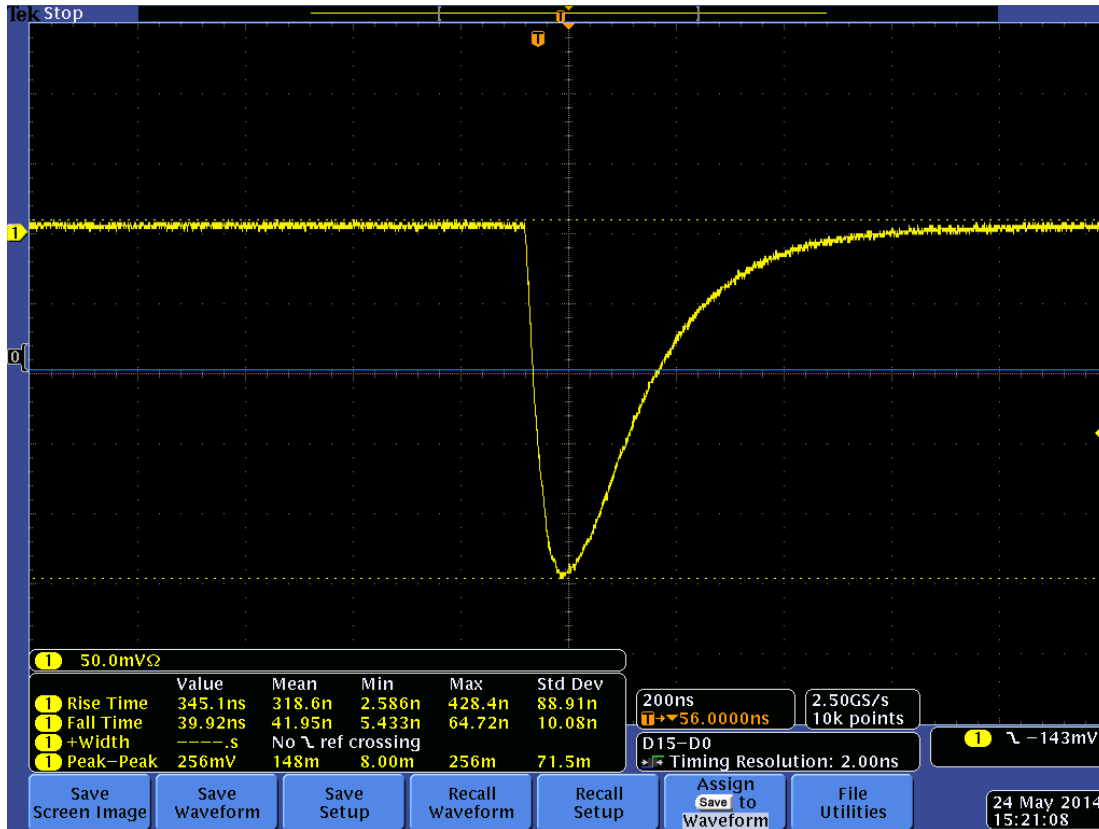
LYSO crystal wrapping



Results are shown on next slides



Improving the Noise/Signal ratio

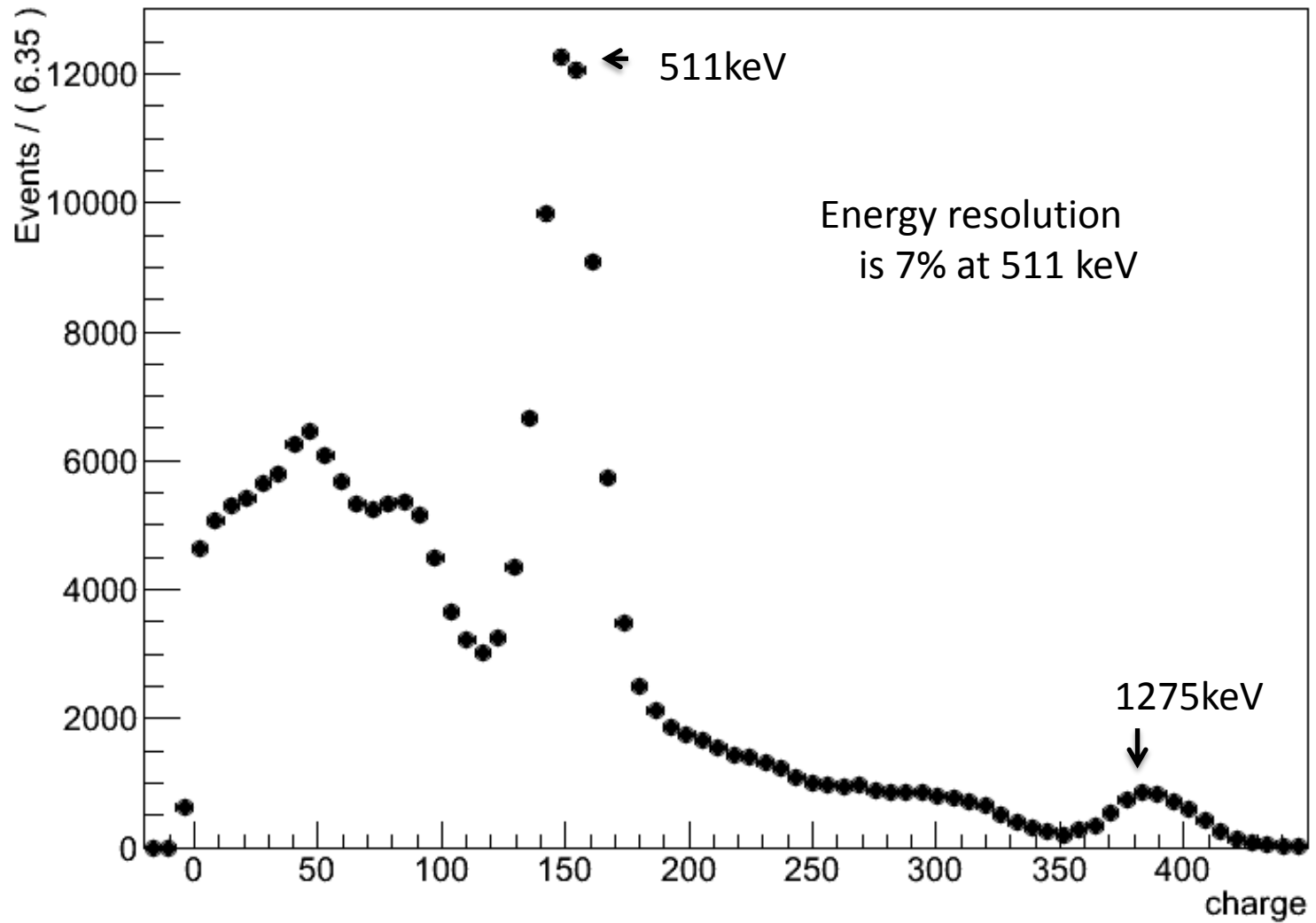


- Important step before the data taking
- Noise reduced when we use double shielding of the AD8000 amplifier and SiPM.
- Using a start point grounding avoid ground loops

The output signal from the AD8000 using a Ketek MP204va W8 SiPM.
Pulse amplitude is 256mV, Pulse length ~ 200 ns, Noise level practically is 0

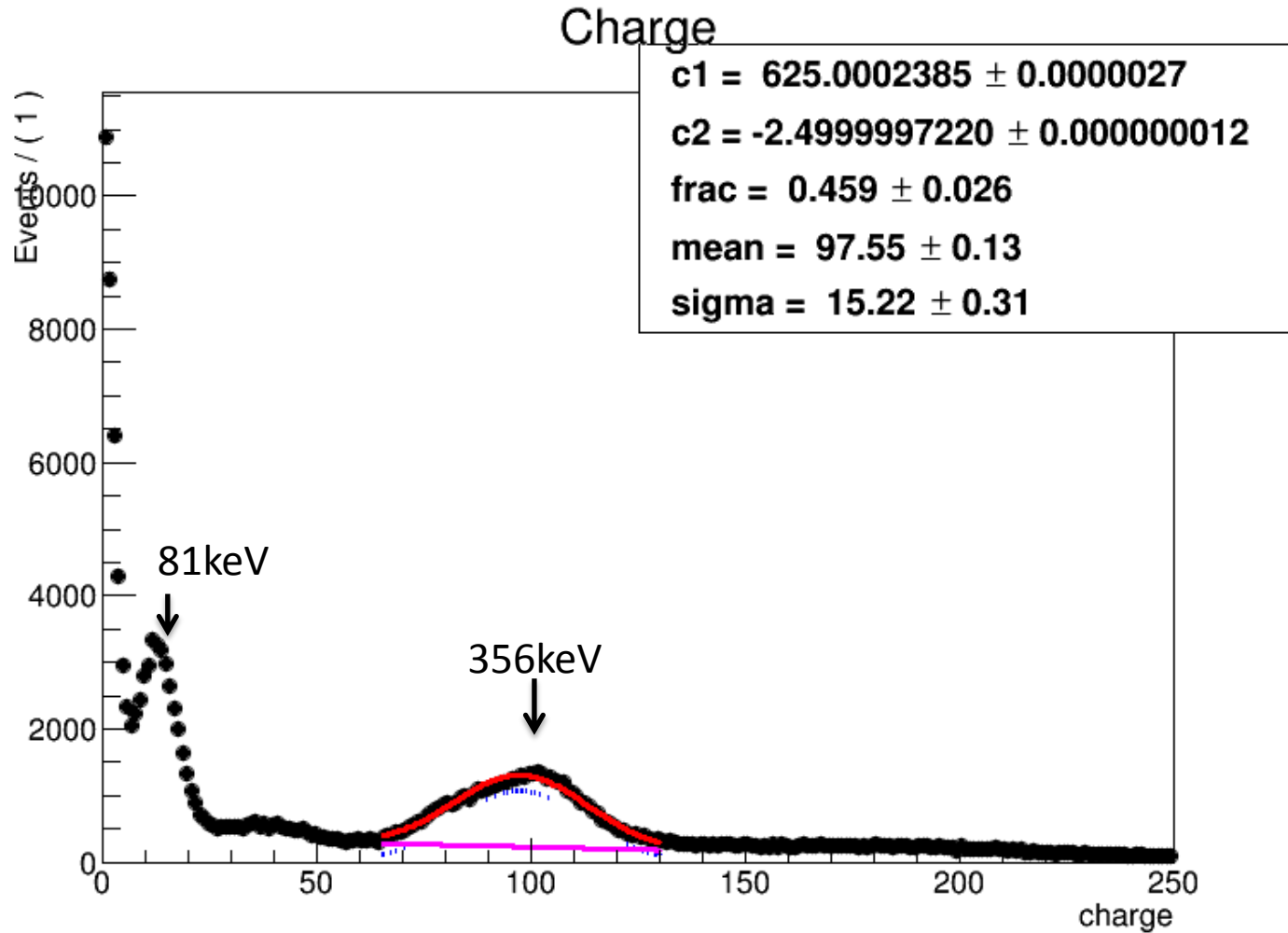


Spectrum Na22



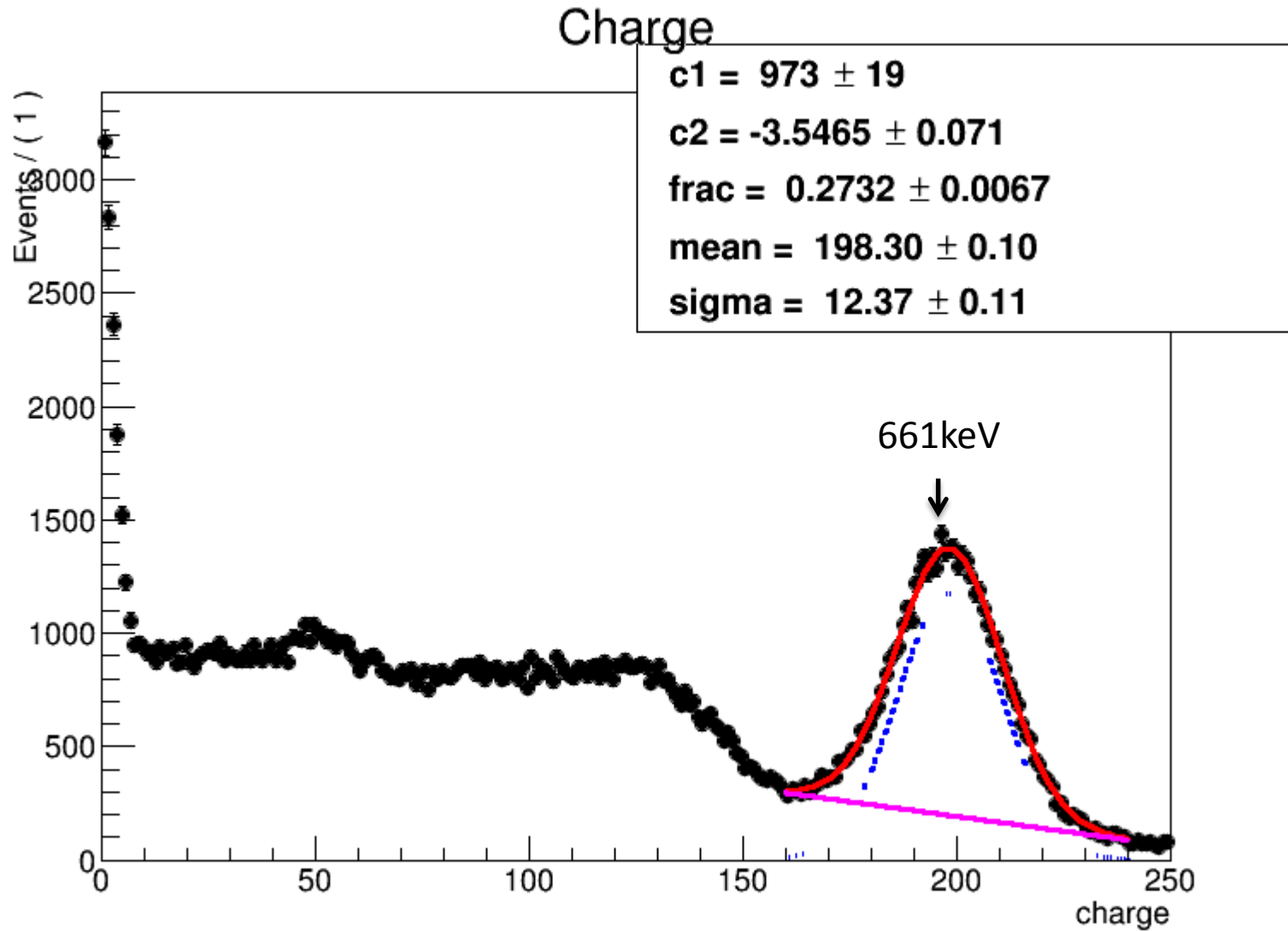


Spectrum Ba133



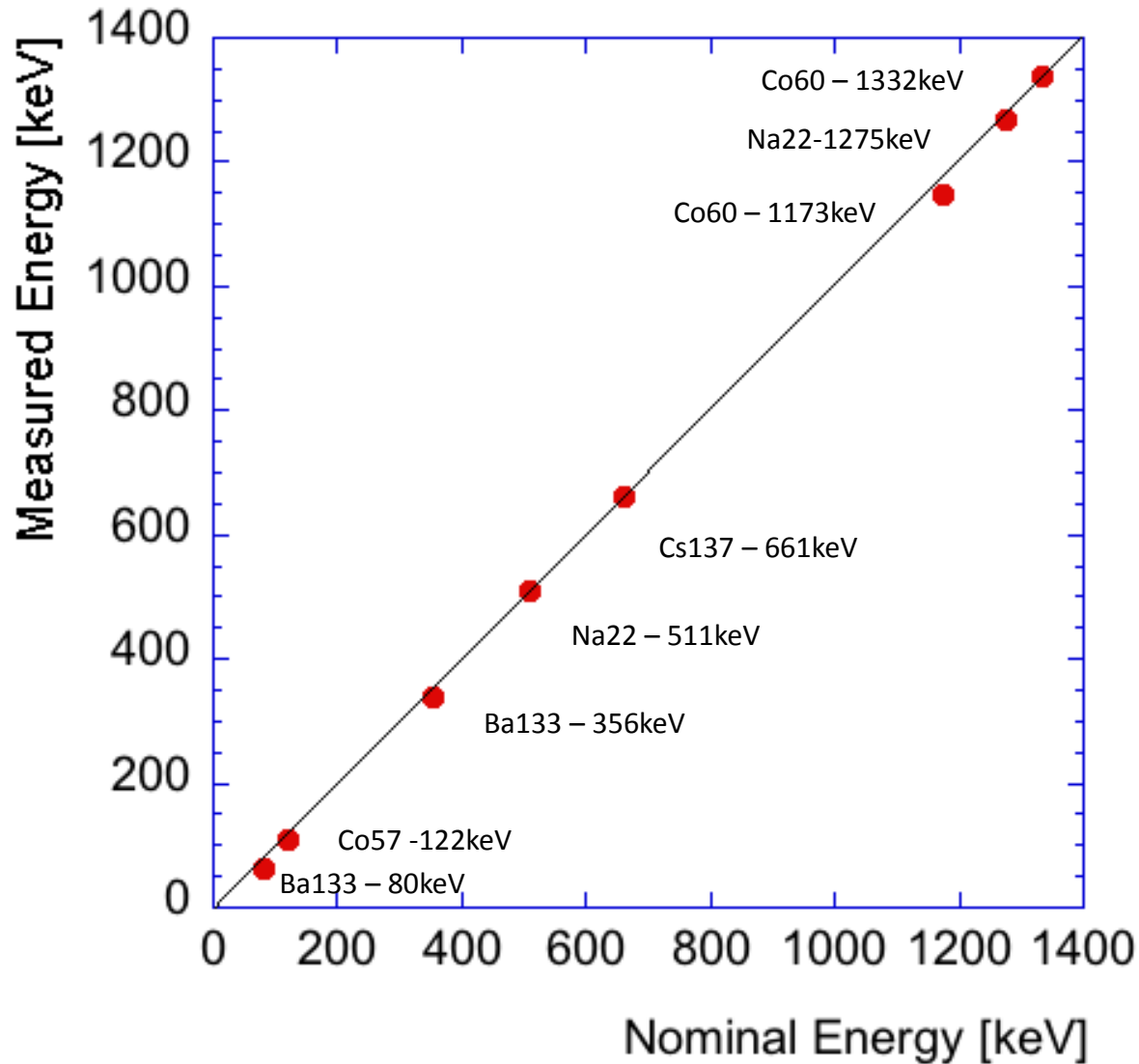


Spectrum Cs137





Energy scale is linear at least up to 1.33 MeV



Measured energies of the follow sources

- Co57
- Co60
- Ba133
- Na22
- Cs137



Beam Radiation Monitor Time Line

- We have optimized the light collection and tested all SiPMs and 6 crystals → all perform well
- Apply final wrapping to 8 LYSO crystals and glue them to a SiPM → test performance including time resolution
- Design mechanical support structure after visit to Frascati- July
- After completion of mechanical support structure at UiB, we install detector at DaΦne and test it with beam- fall 2014
- Write report and publication – End of 2014



Thank you