First results of asymmetry with QADC signals of single $PbWO_4$ crystal

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Data set

We have started to study QADC data taken by single $PbWO_4$ crystal at different angles with electrons of 50 GeV both without Pb in front to the crystal and with different mm of Pb in front to the crystal.
The goal is computed: asymmetry versus angle for different shower depths and the fraction of Cerenkov component (as previous year)
This study is related to second paper :"Separation of crystal signals into Cerenkov and scintillation components".

1. Stand-alone measurements of single $PbWO_4$ crystals (room temperature)

(Data relevant for paper #2)

Runs 112 - 135, logbook page 16
Beam: 50 GeV e^-, $\theta = 0°$

- *Angular scan of the crystal response (electrons)*
  Runs 402 - 433, logbook pages 33-34
  Beam: 50 GeV e^-, $\theta = -60°$ to $+60°$

Analysed

- *Angular scan of the crystal response (mips)*
  Runs 497 - 532, logbook pages 38-39
  Beam: 70 GeV π^-, $\theta = -75°$ to $+75°$

To be analysed

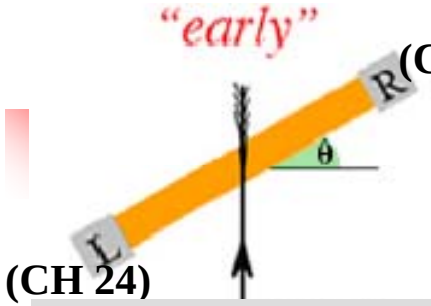
- *Angular scans of the response to developing showers (50 GeV e^- + Pb)*
  10 mm Pb upstream, Runs 256 - 278, $\theta = -35°$ to $+35°$, logbook page 25
  20 mm Pb upstream, Runs 284 - 309, $\theta = -35°$ to $+35°$, logbook page 26
  35 mm Pb upstream, Runs 310 - 336, $\theta = -45°$ to $+45°$, logbook page 28
  4 mm Pb upstream, Runs 434 - 457, $\theta = -35°$ to $+35°$, logbook page 35

Analysed

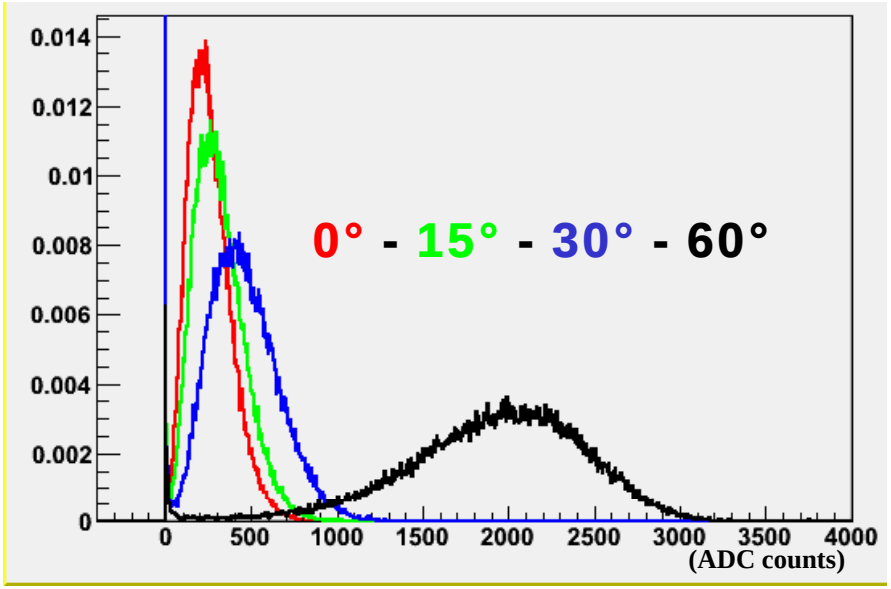
  8 mm Pb upstream, Runs 458 - 460, $\theta = -30°$ to $+30°$, logbook page 35
  14 mm Pb upstream, Runs 461 - 463, $\theta = -30°$ to $+30°$, logbook page 35
  25 mm Pb upstream, Runs 466 - 487, $\theta = -35°$ to $+35°$, logbook p. 35,37

To be analysed

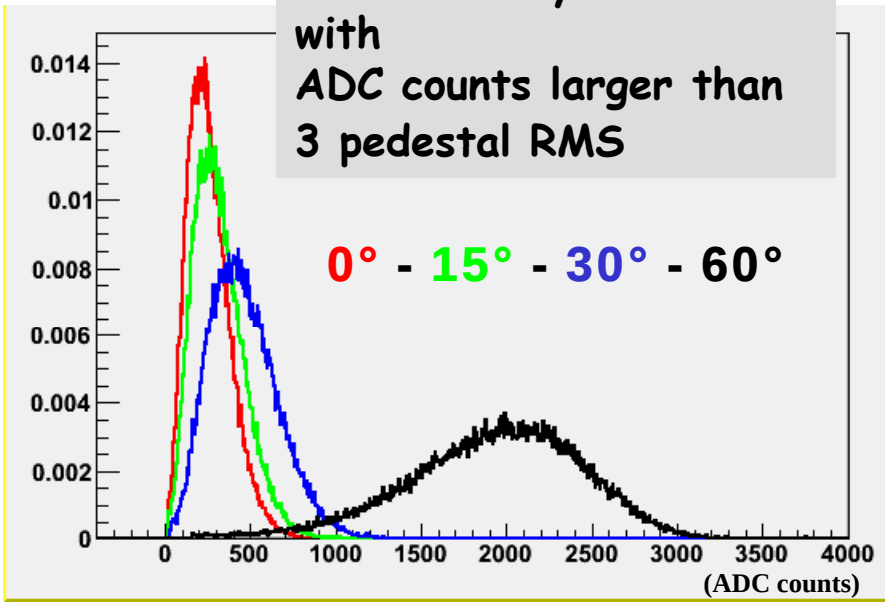
50 GeV electron showers in the early stage



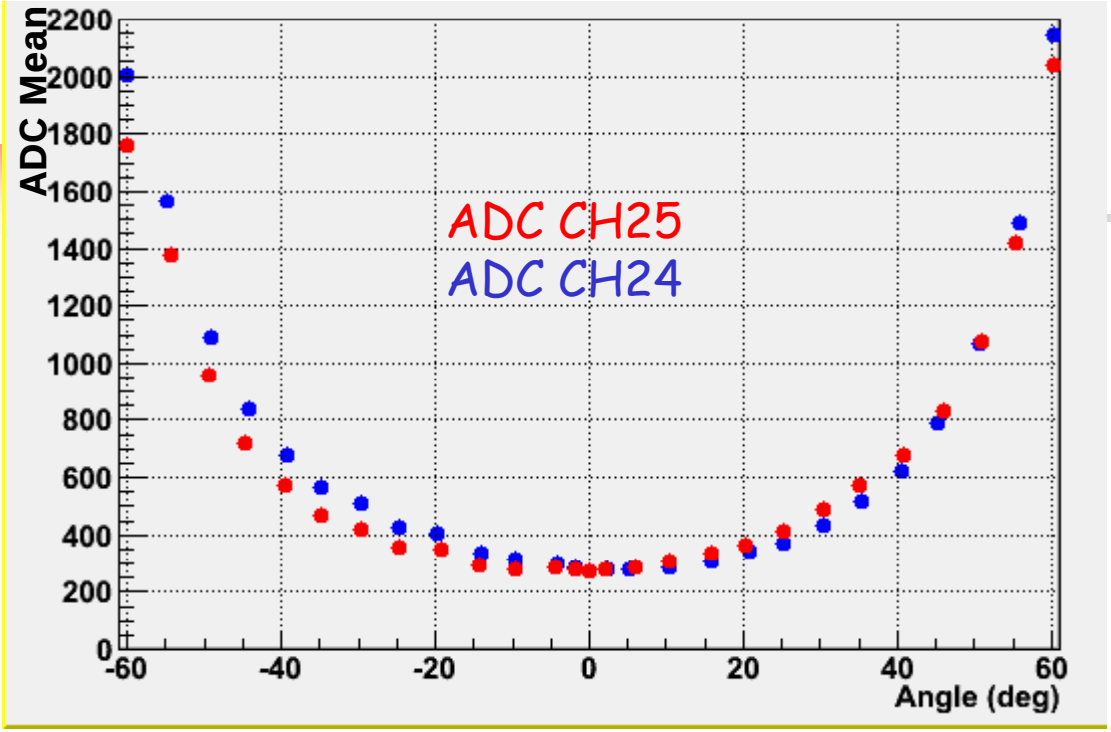
ADC spectra after pedestal subtraction

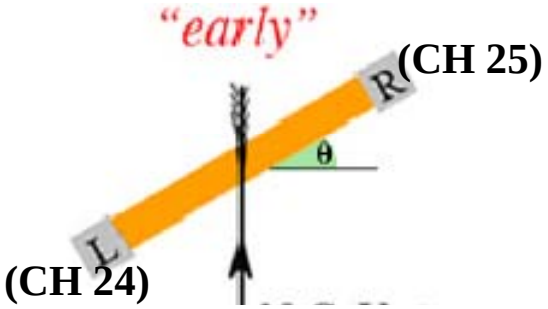


Selected only events with
ADC counts larger than
3 pedestal RMS



We have equalized ADC signals of the two channels at 0^0 degrees





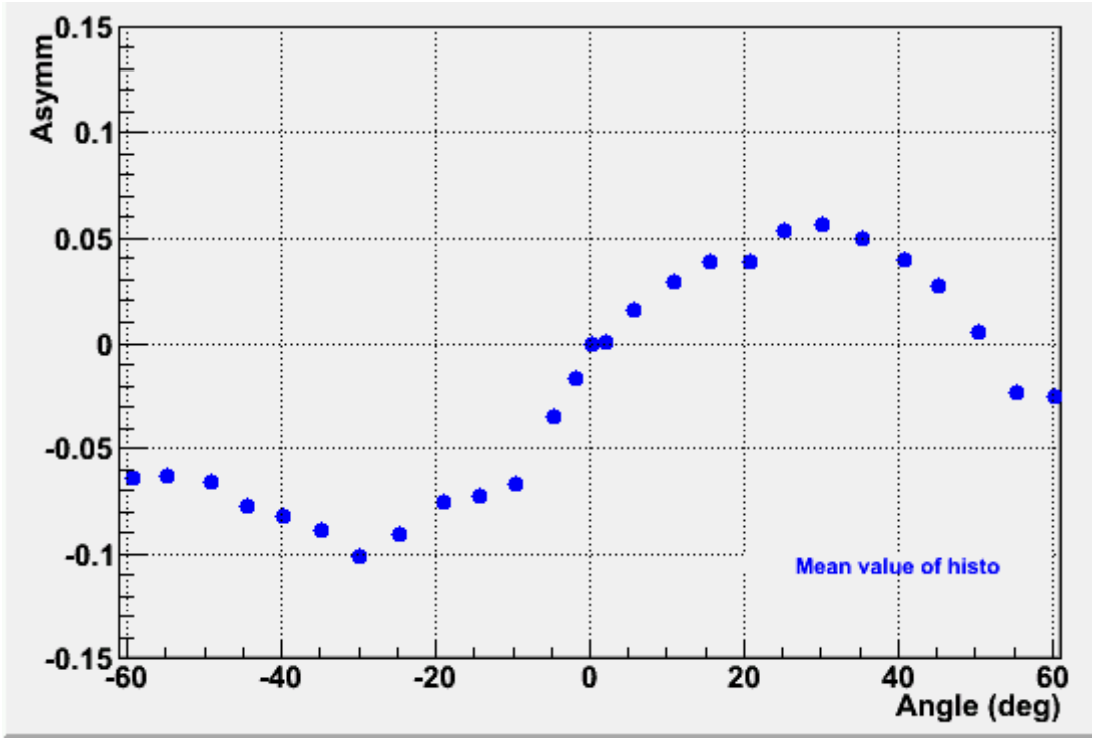
The ADC signal increases with the angle, because increases the track length.

For positive angles the CH25 signal is larger than CH24 one because CH25 collects a larger Cerenkov component (vice versa for negative ones),
except for positive angles 55° and 60°.

But at fixed positive and negative corresponding angles, the difference between the signal of the 2 CHs is not equal, this is evident also in asymmetry slope.

$$\text{Asymmetry} = \frac{ADC_{mean}(CH25) - ADC_{mean}(CH24)}{ADC_{mean}(CH24) + ADC_{mean}(CH25)}$$

ADC_{mean} is the mean of the ADC spectra shown before

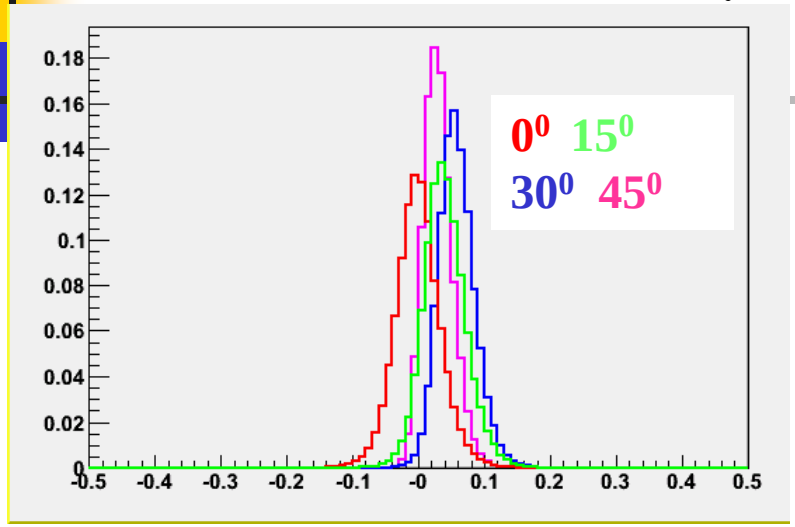


At positive angles the slope is similar to the one observed last year

At negative angles slope quite different to be investigated!

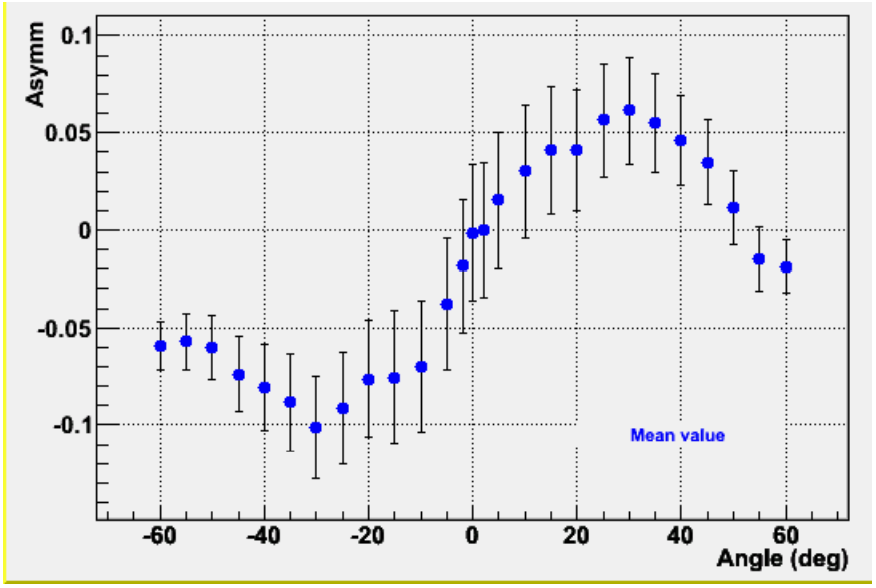
We have computed asymmetry also event by event at a fixed angle

$$\text{Asymmetry} = \frac{ADC_{count}(CH25) - ADC_{count}(CH24)}{ADC_{count}(CH24) + ADC_{count}(CH25)}$$

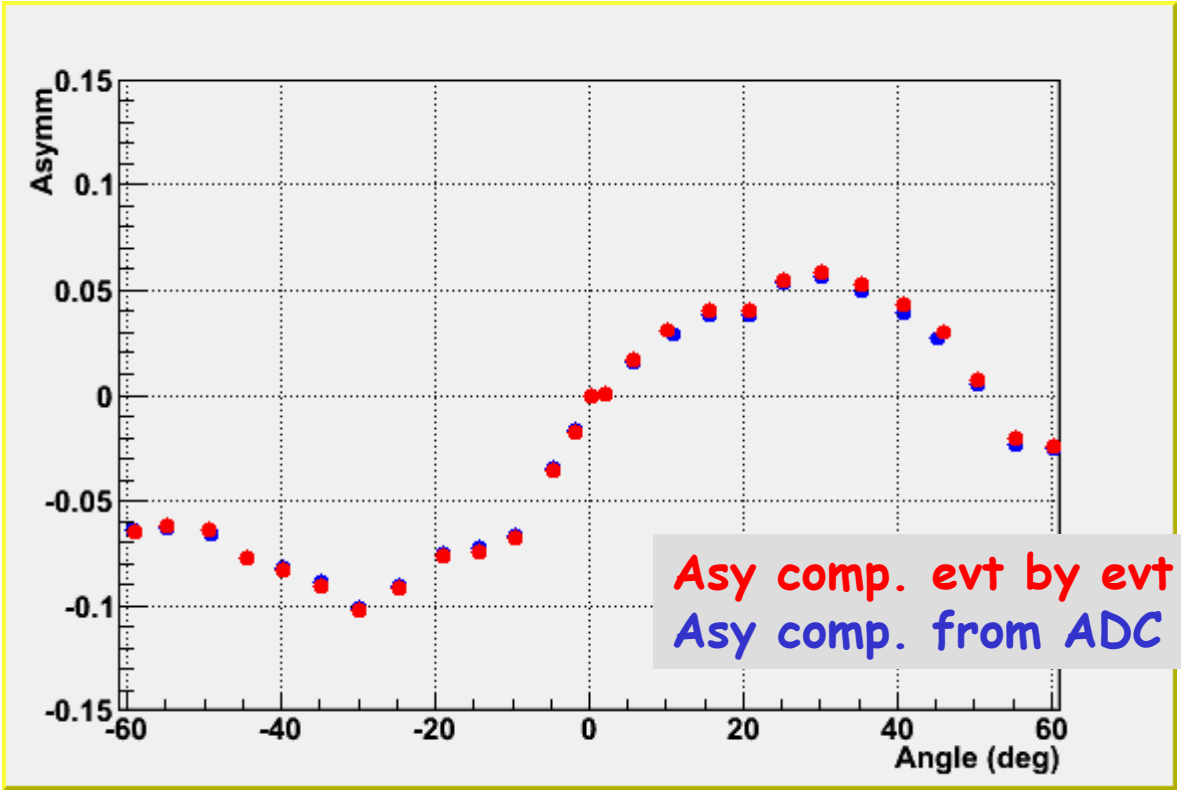


Taken mean value of the asymmetry distribution for each angle

Errors of the plot are RMS of asymmetry distributions

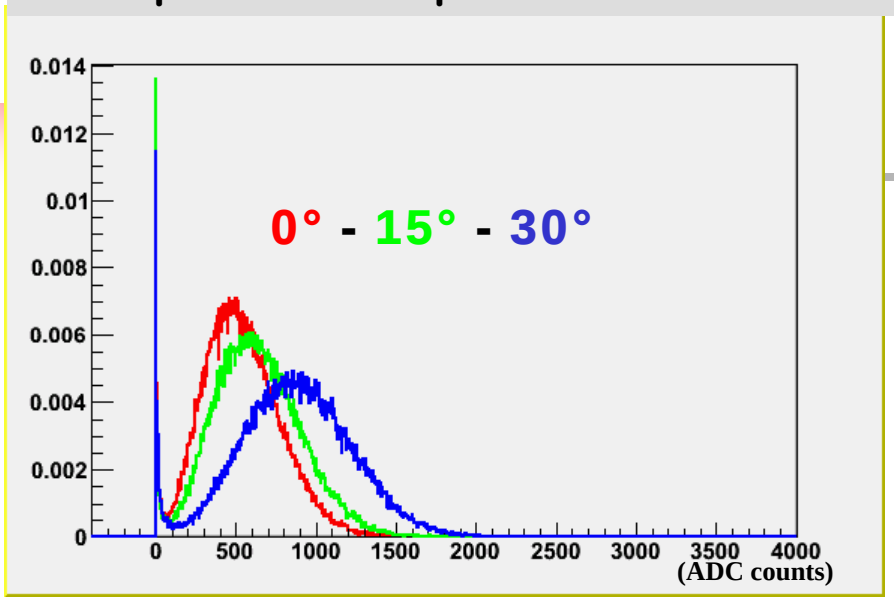


The two methods give the same results

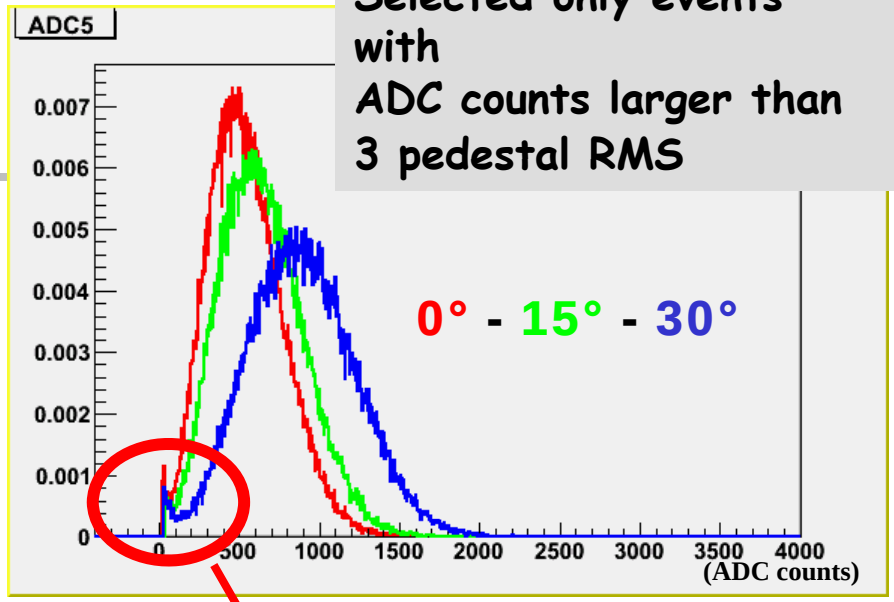


50 GeV electrons shower with 4mm of Pb upstream

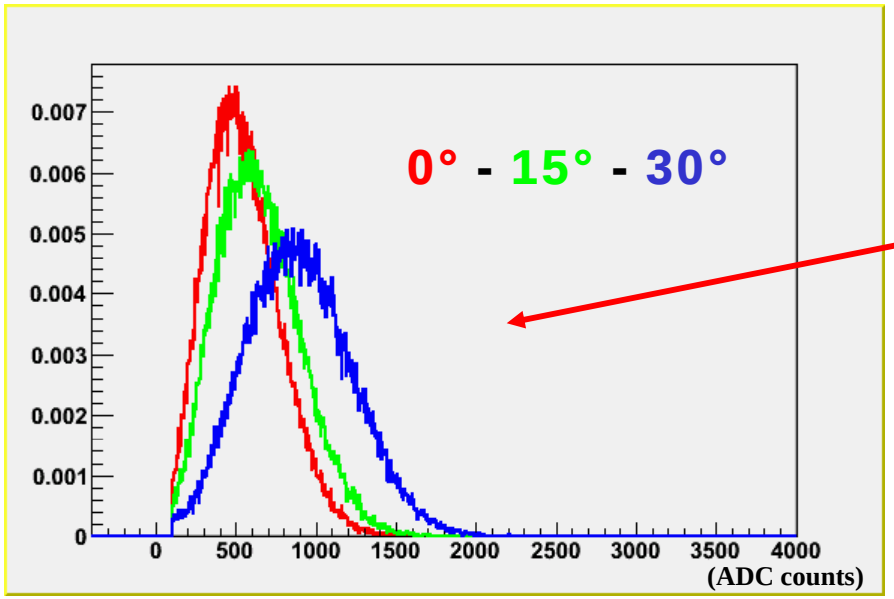
ADC spectra after pedestal subtraction



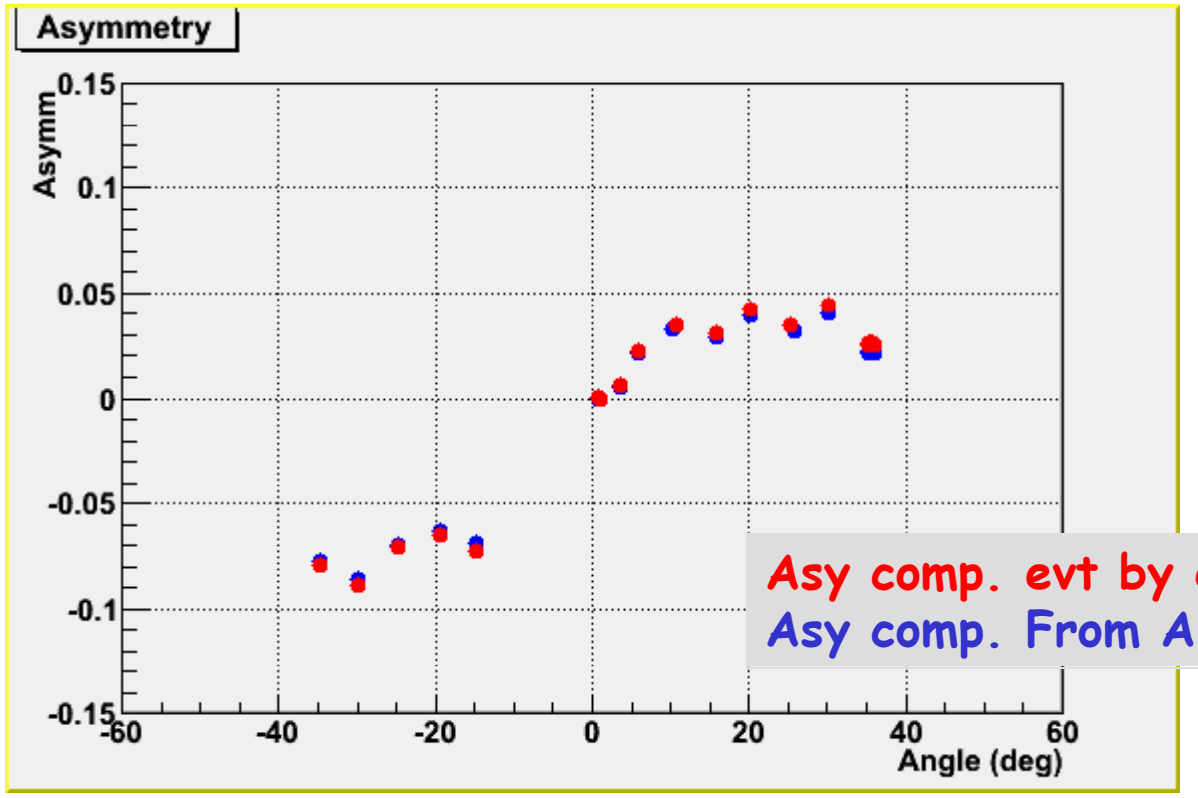
Selected only events with
ADC counts larger than
3 pedestal RMS



This cut seems not optimal.
(see Tommaso's presentation about these tails)
Selected events with
ADC_counts>100



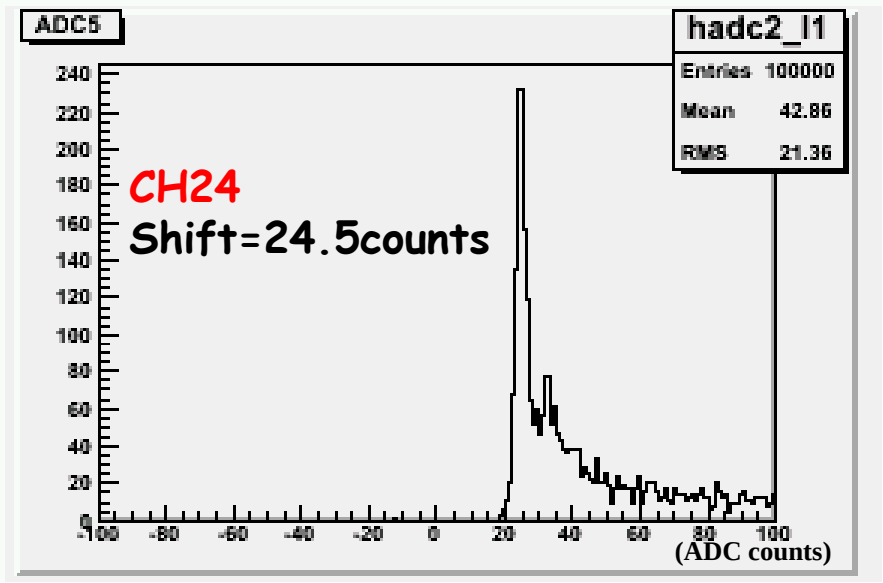
Asymmetry computed as in the previuos case both from ADC spectra distributions and event by events

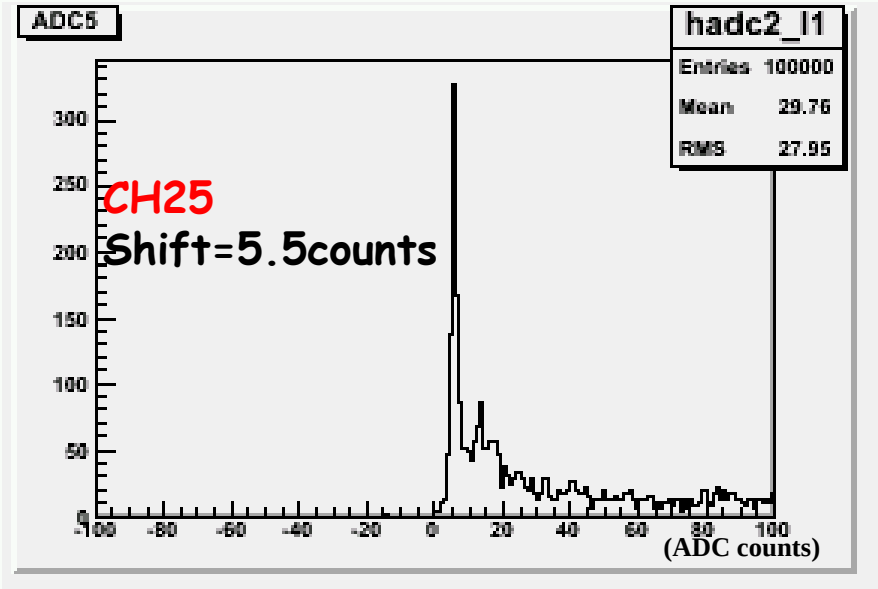


50 GeV electrons shower with 10mm, 20mm, 35mm of Pb upstream

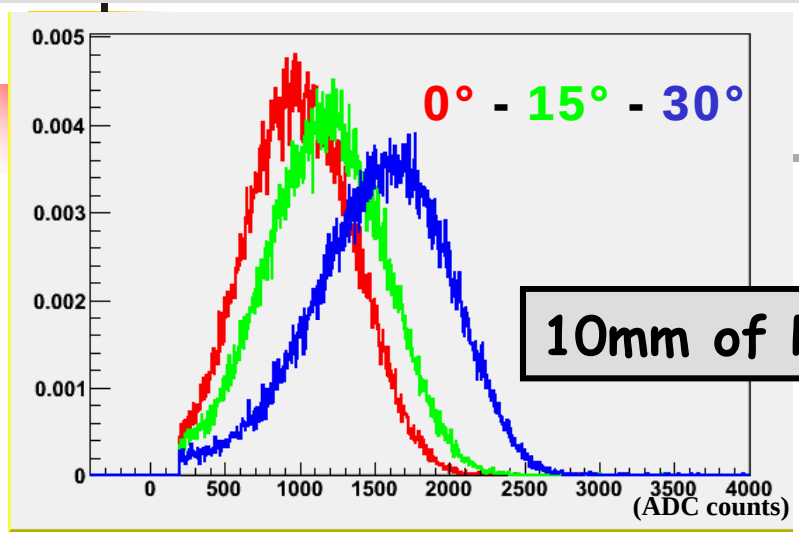
In these runs observed a problem: pedestal values of physics runs are different from pedestal values of pedestal runs.
The differences are for all runs at level of :
24.5-25.5 ADC counts for ch24 and of 5.5 ADC counts for ch25.

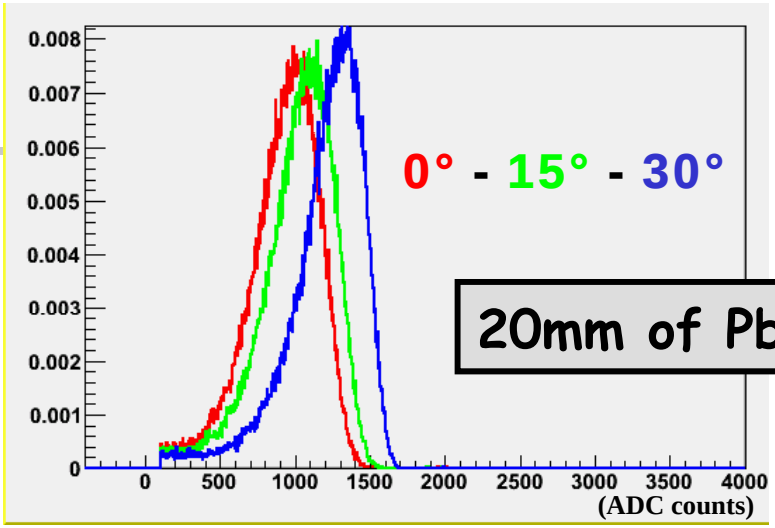
First part of ADC spectrum after pedestal substraction

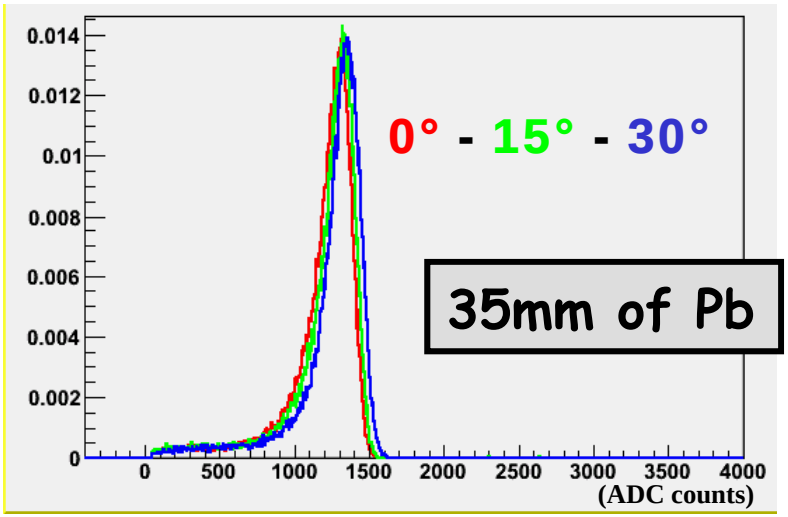




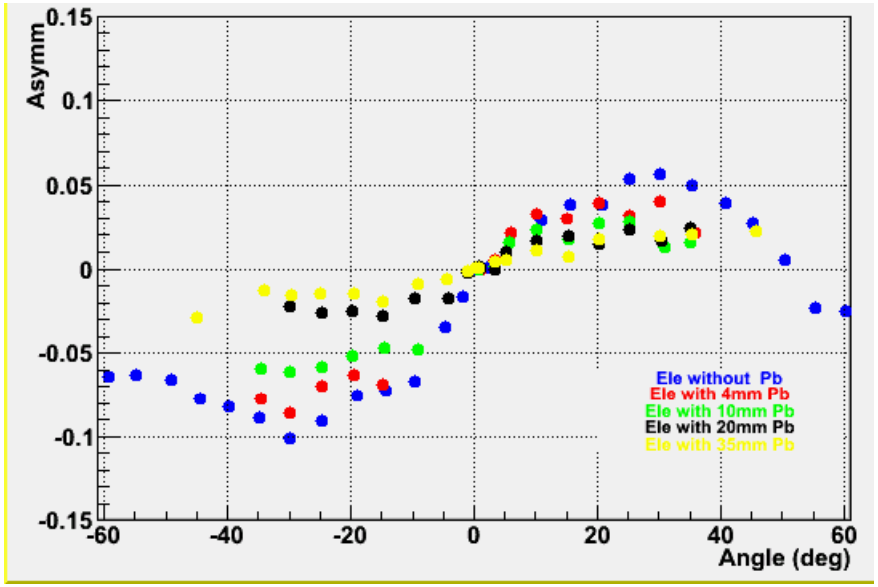
ADC spectra after correct pedestal subtraction



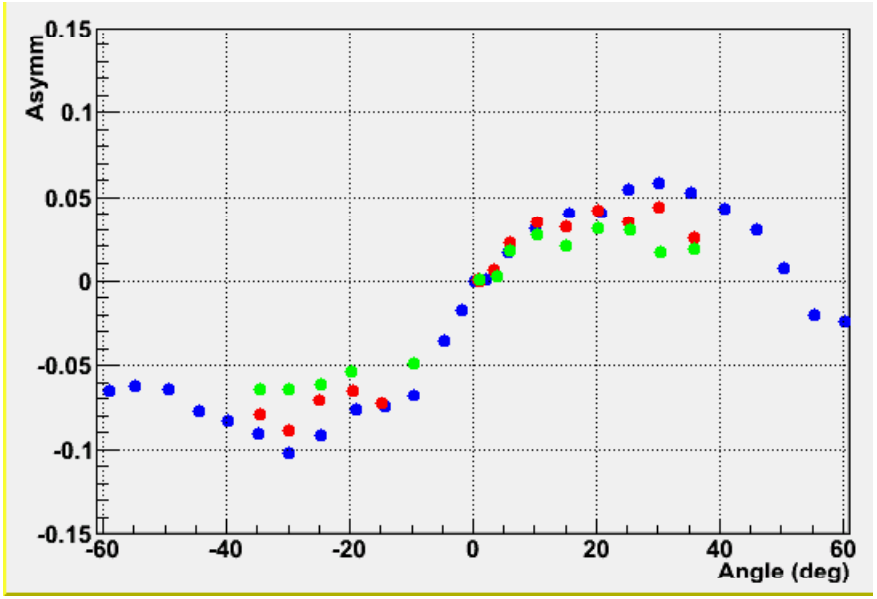


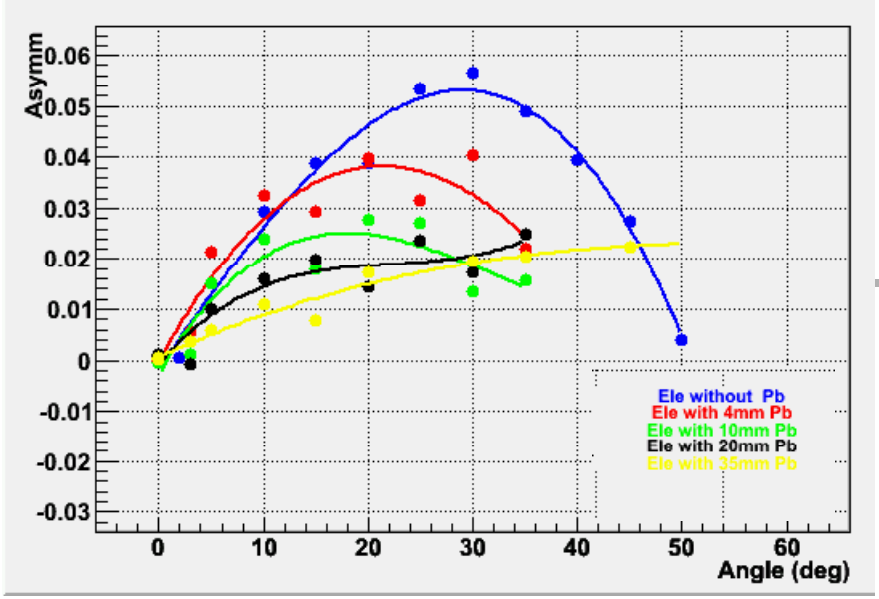


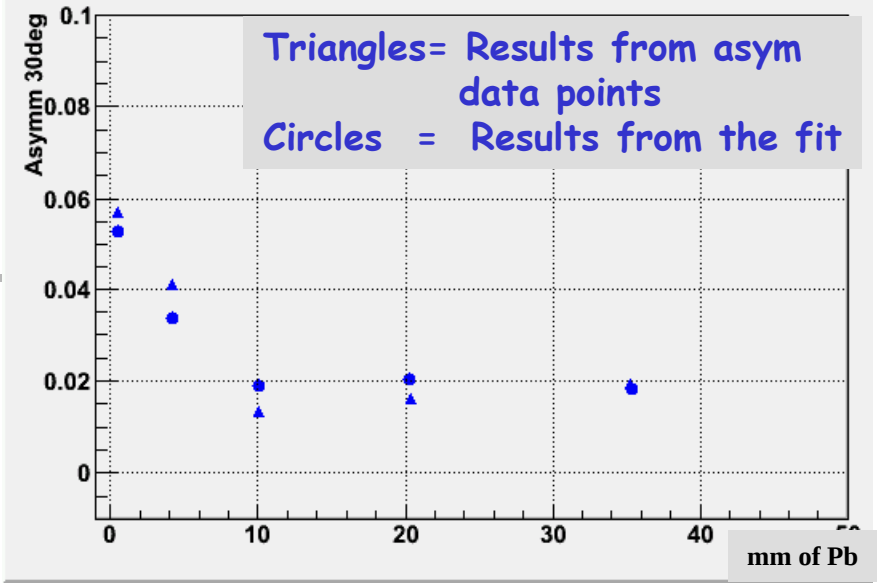
Asymmetry computed from ADC spectra



Asymmetry computed event by event







$$\frac{\text{Cerenkov}}{\text{Signal}}(30°) = \frac{2\text{Asym}}{(1+\text{Asym})}$$

$$\frac{\text{Cerenkov}}{\text{Signal}}(30°) = 10.5\%\,\text{(without Pb)} \quad \text{from positive angles}$$

$$\frac{\text{Cerenkov}}{\text{Signal}}(30°) = 18\%\,\text{(without Pb)} \quad \text{from negative angles}$$

The difference must be investigated!

$$\frac{\text{Cerenkov}}{\text{Signal}}(30°) = 13\%\,\text{(without Pb)}$$ from previous testbeam with ele of 10 GeV

To do

- Understand the difference between negative and positive angles
- Look at the data with 8-14-25 mm of Pb in front to the crystal with electrons of 50 GeV
- Look data with pions of 70 GeV (Davide Pinci has already analysed them looking at oscillope data)