Sim & Reco of Pure CsI in basf2

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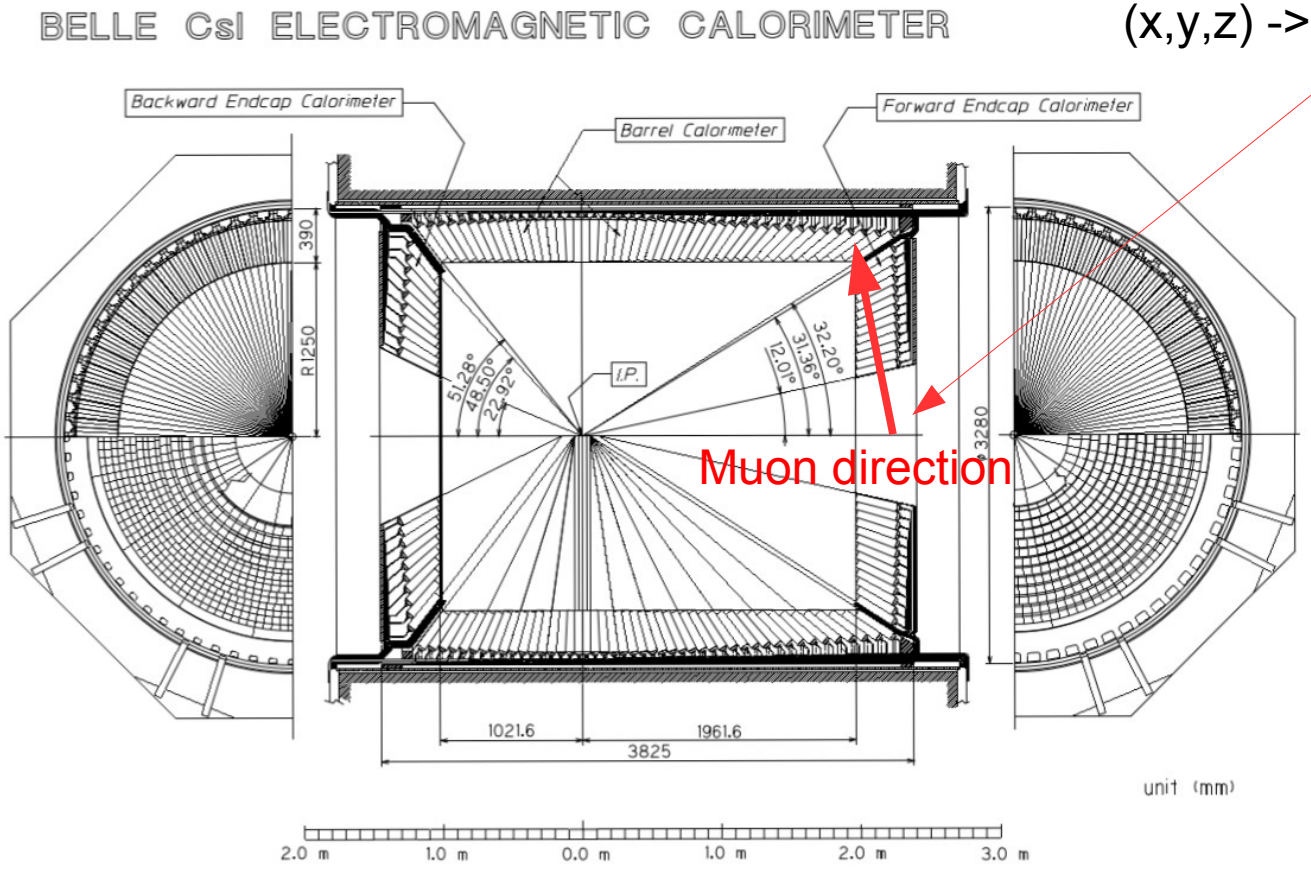
The beginning: "Cosmic Test"

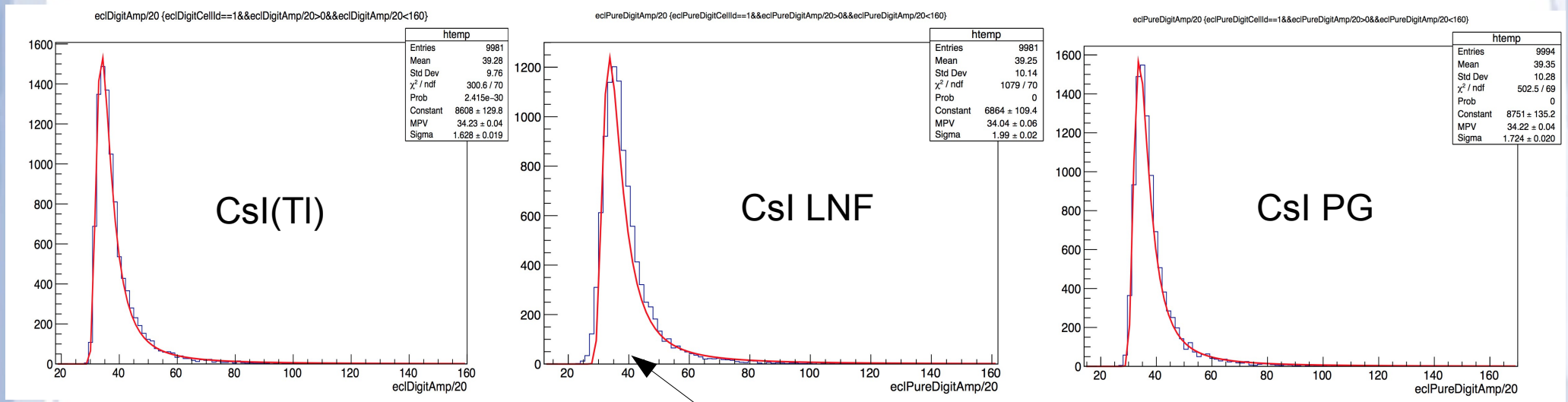
- Goal is to compare simulation and lab results
- We start shooting MIP muons from beam-axis on face of crystal #1 of 1st ring (middle point)
- Code revision r24746, geometry: ECL only

p=10 GeV
(theta, phi) -> (102.4,3.5)
(x,y,z) -> (0,0,221.55)



Cosmic Test (2)

- 3 configurations studied:
  - Baseline (CsI(Tl))
  - Pure CsI LNF version (ENE=1.3, PS=0.40)
  - Pure CsI PG version (ENE=0.7, PS=0.20)



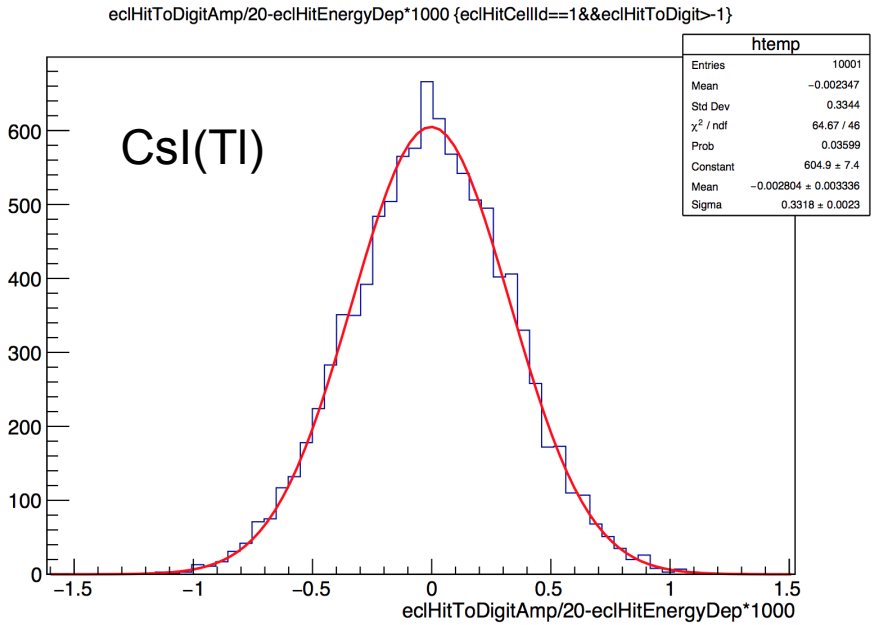
Crystal #1

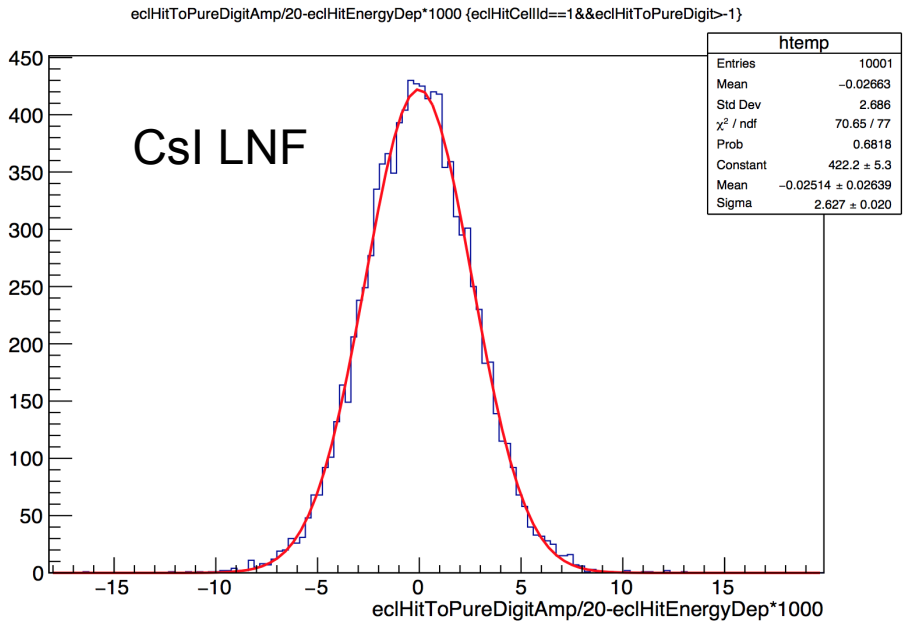
Not well described by Landau f

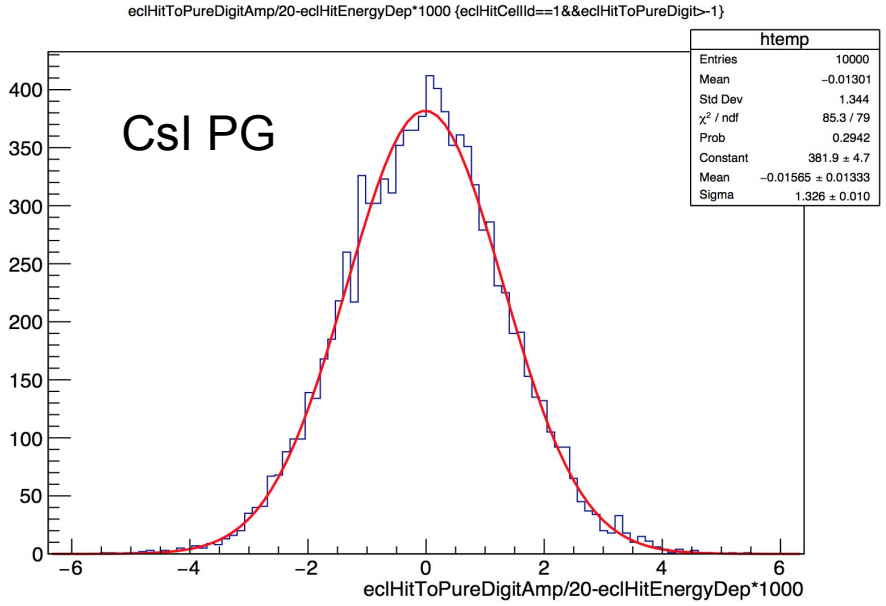
Resolution w/o bkg (Crystal 1, ring1)

- Ereco – Edep hit level
- CsI(Tl) : 0.97%
- CsI LNF : 7.72%
- CsI PG : 3.87%

sigma(gaus)/MPV(landau)



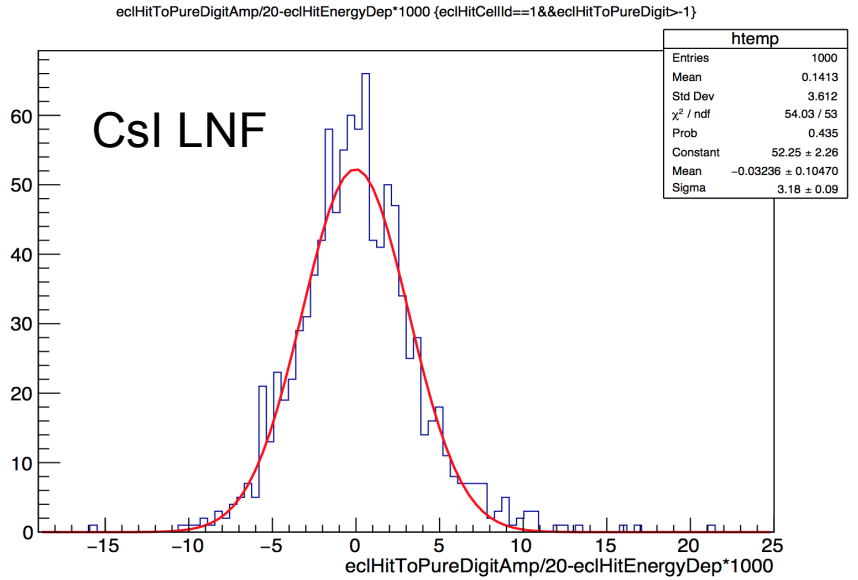


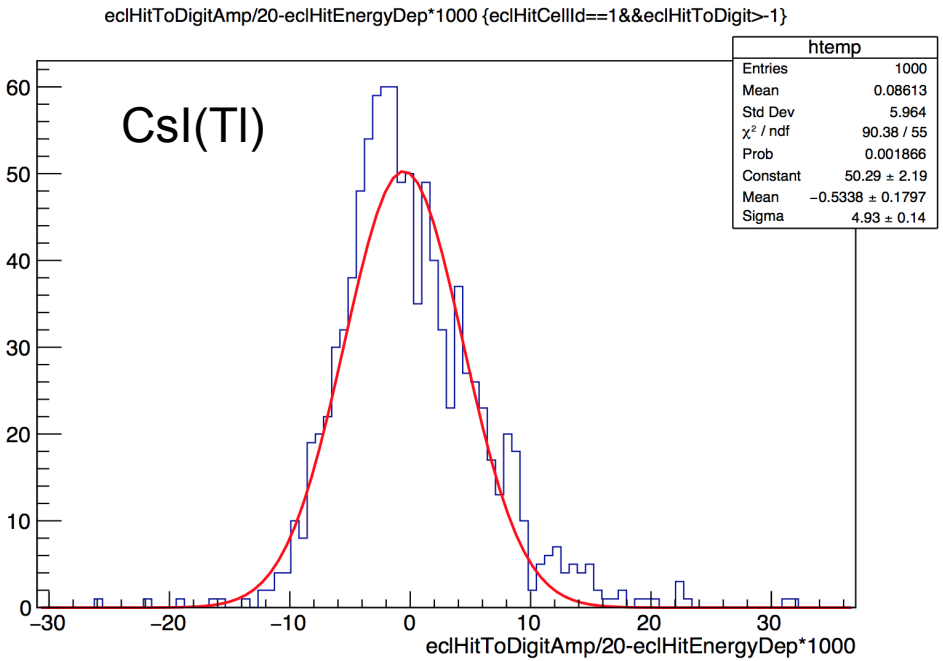


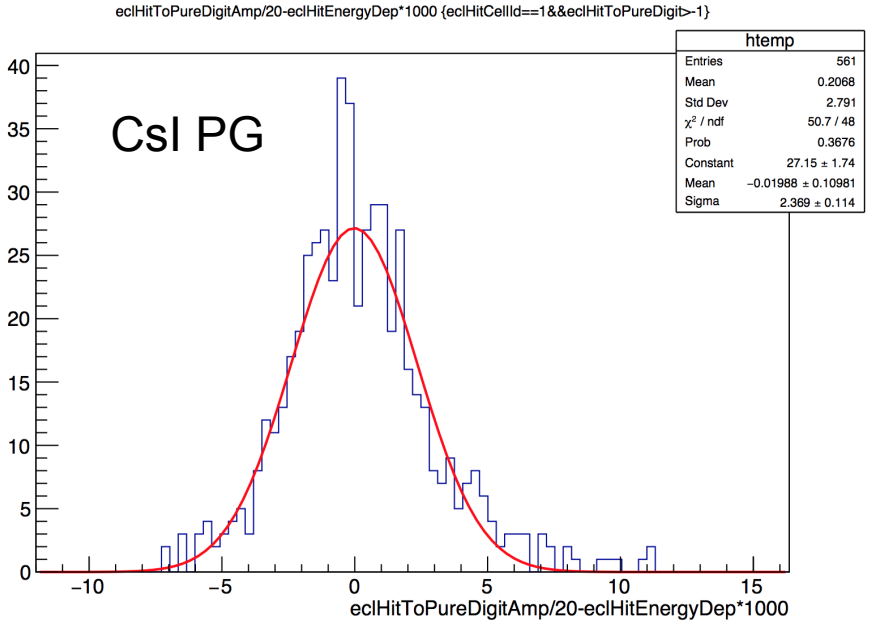
Resolution w bkg Crystal 1

- Crystal #1
- CsI(Tl) : 14.6 %
- CsI LNF : 9.2 %
- CsI PG : 6.94 %

sigma(gaus)/MPV(landau)



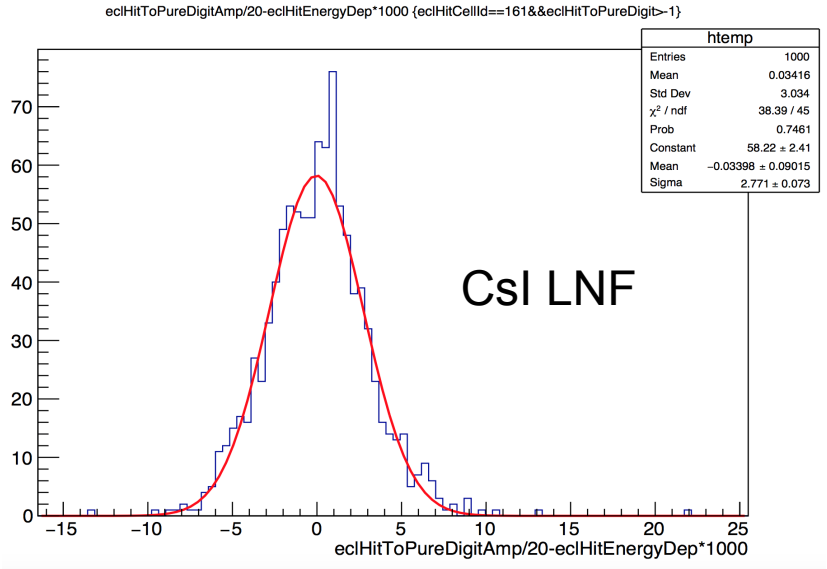


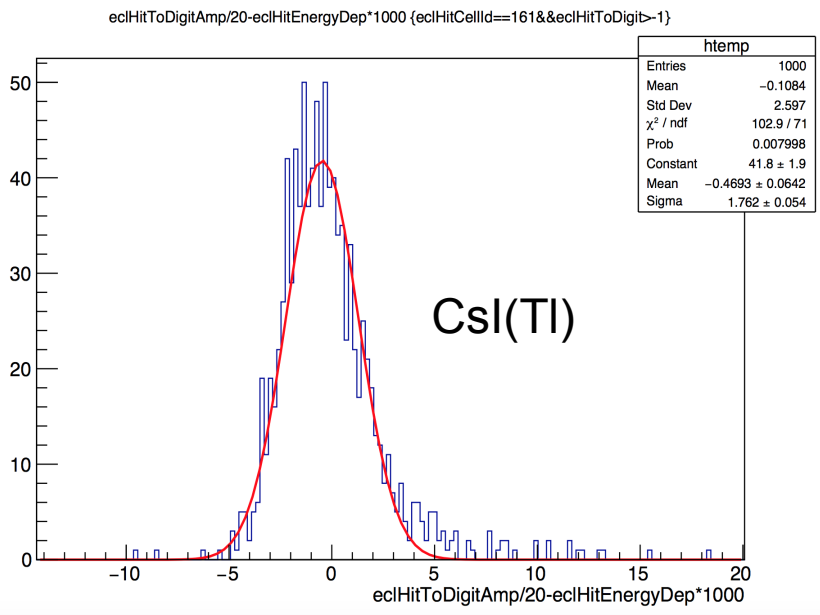


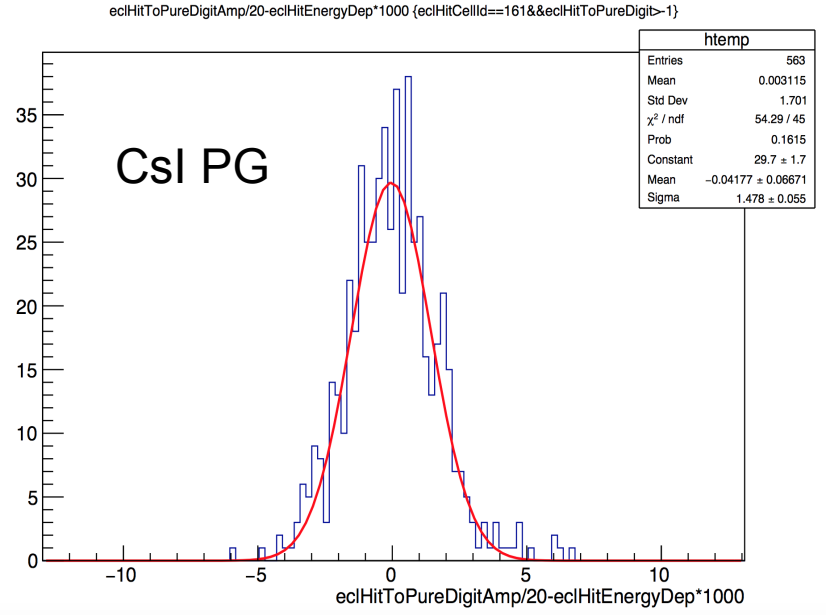
Resolution w bkg Crystal 161 (ring 4)

- Crystal #161
- CsI(Tl) : 5.15 %
- CsI LNF : 8.07 %
- CsI PG : 4.36 %

sigma(gaus)/MPV(landau)

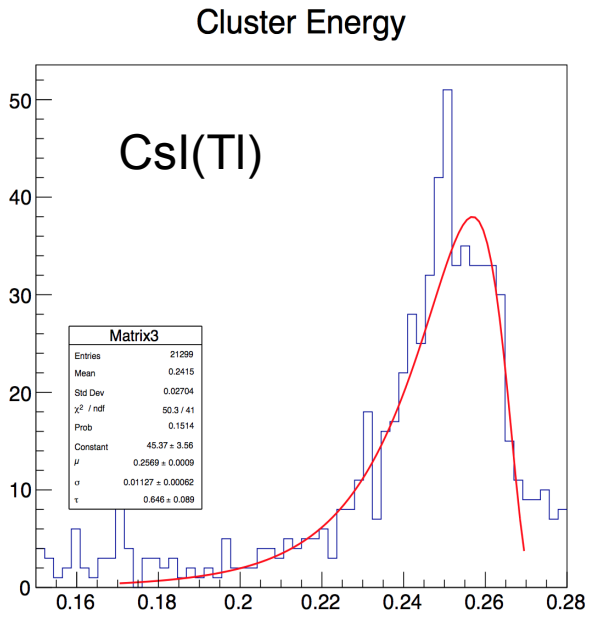


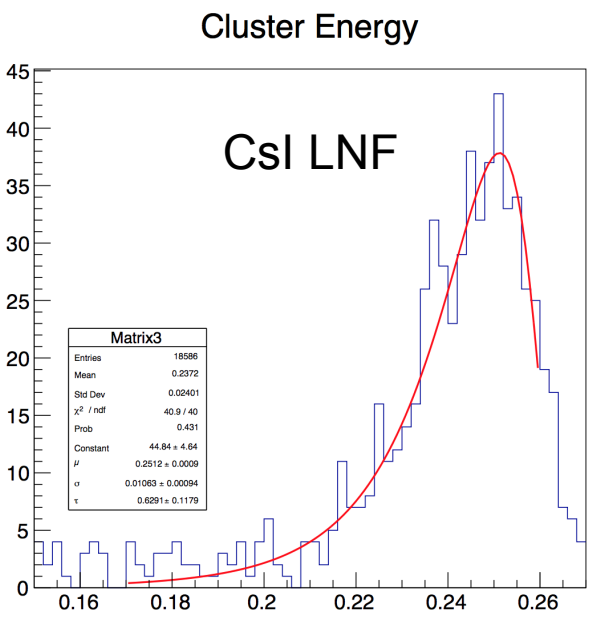


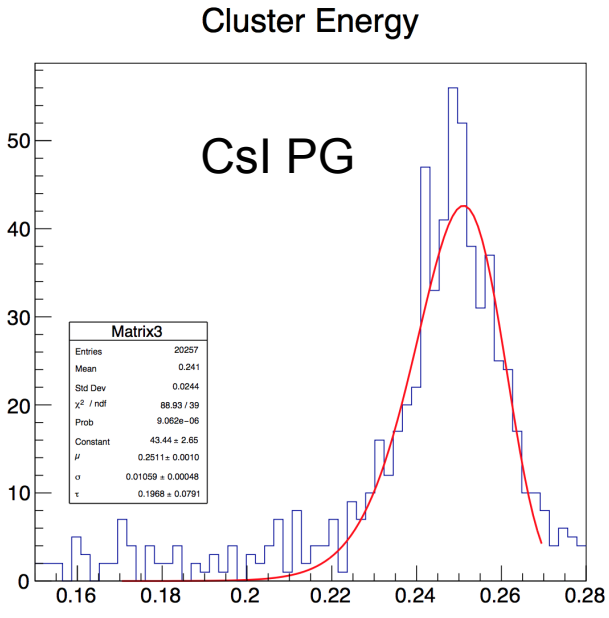


Energy resolution for photons w bkg

- Elisa had shown at last B2GM resolution as f(E) with ECL only w and w/o bkg
- Using similar approach (i.e. Novosibirsk fit) we studied:
  - the effect of material
  - different settings for pure CsI



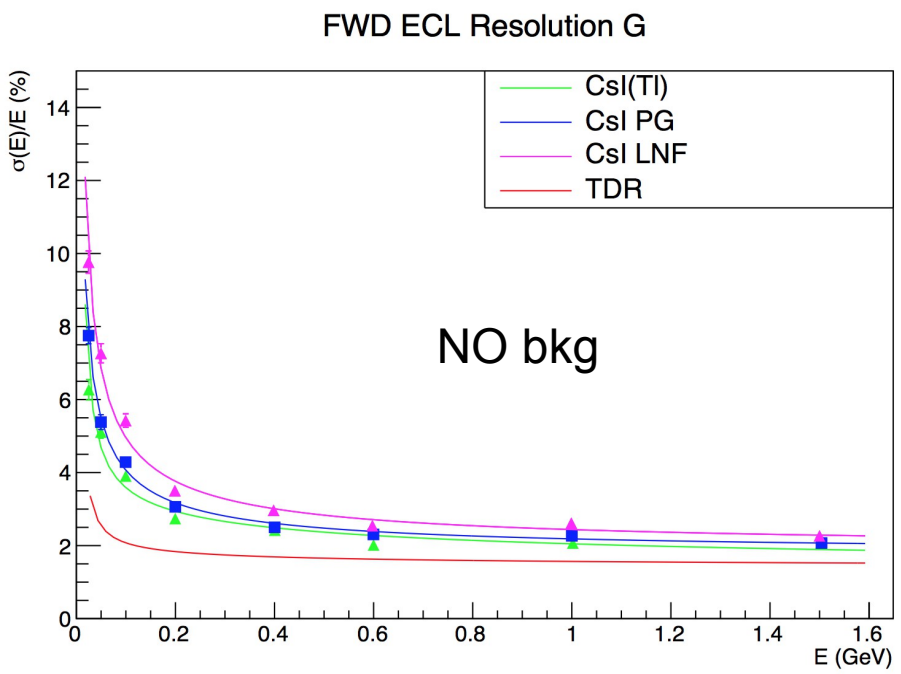


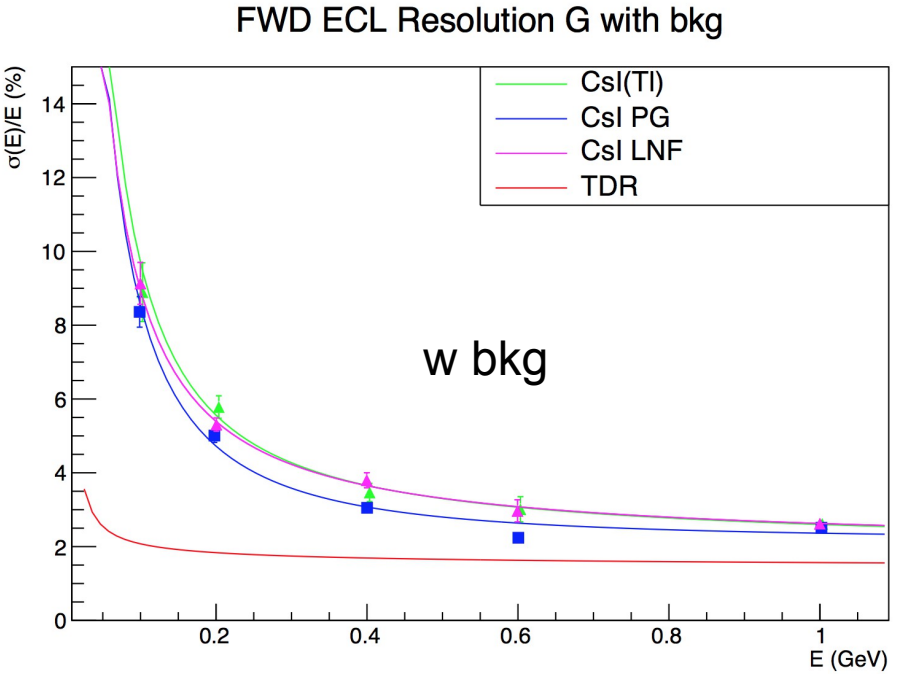


(note that for Novosibirsk f sigma=FWHM/2.36)

Energy resolution for photons w bkg

- Single photon 13<theta<25, energy scan, no material in front of ECL
- Shown on 4th March -> discrepancy with Elisa's results w bkg shown at B2GM
- Error found, my simulation was made with a 5 layer pure CsI configuration instead of 13 layer used by Elisa

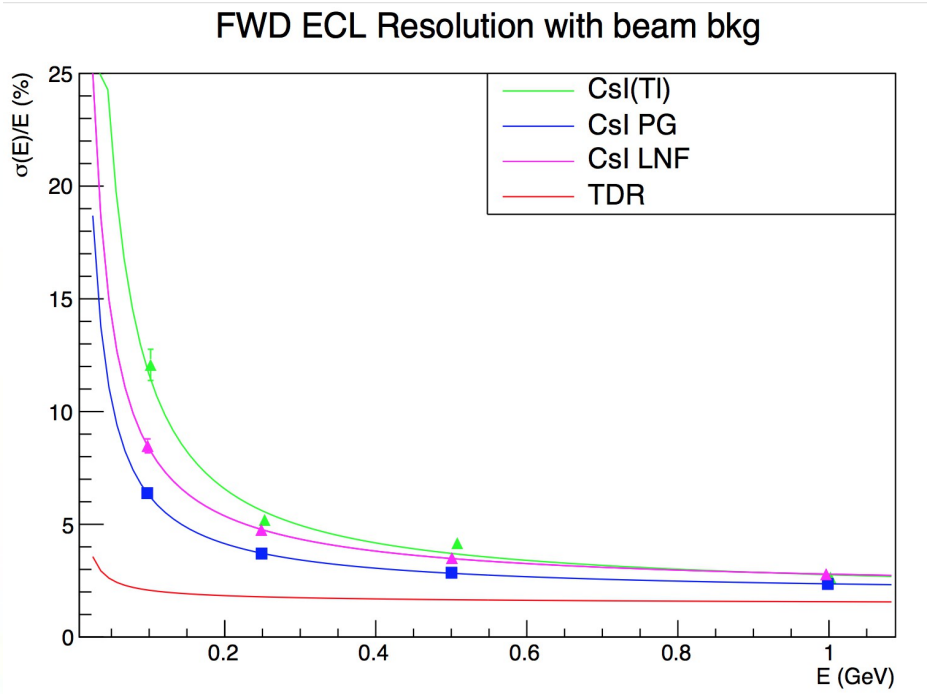


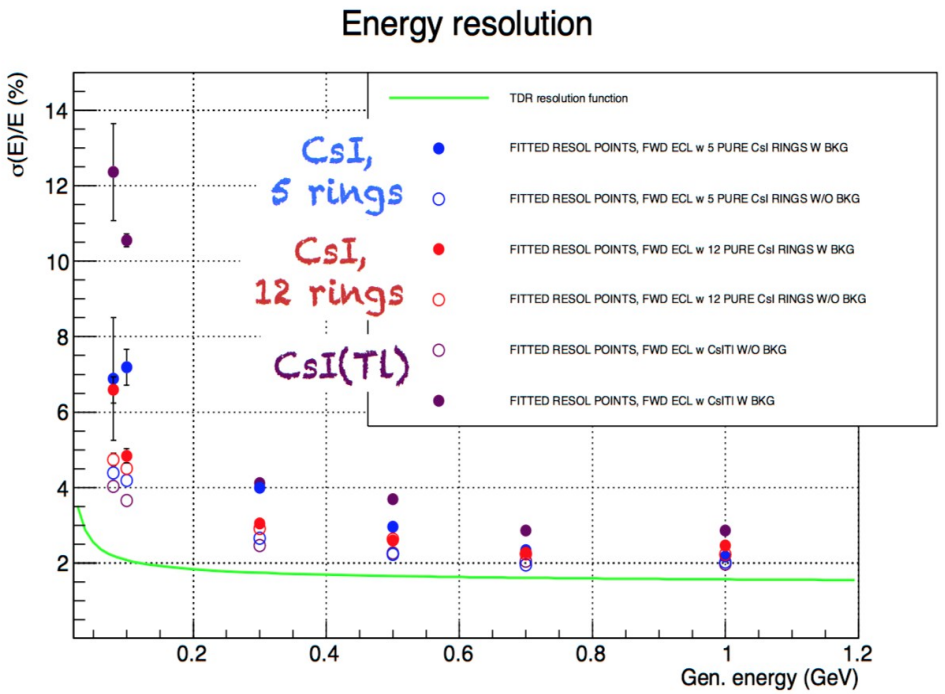


r24746 and latest bkg files, i.e. 12th campaign

Photons w bkg with correct layout

- Single photon 13<theta<25, energy scan, no material in front of ECL
- Results seems to be in agreement with Elisa's simulation

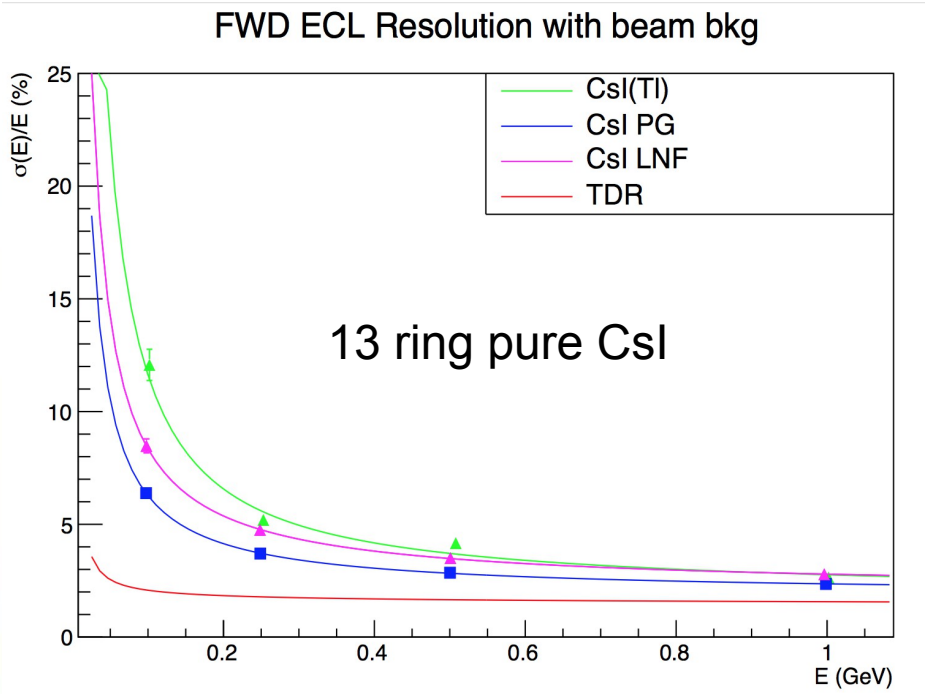


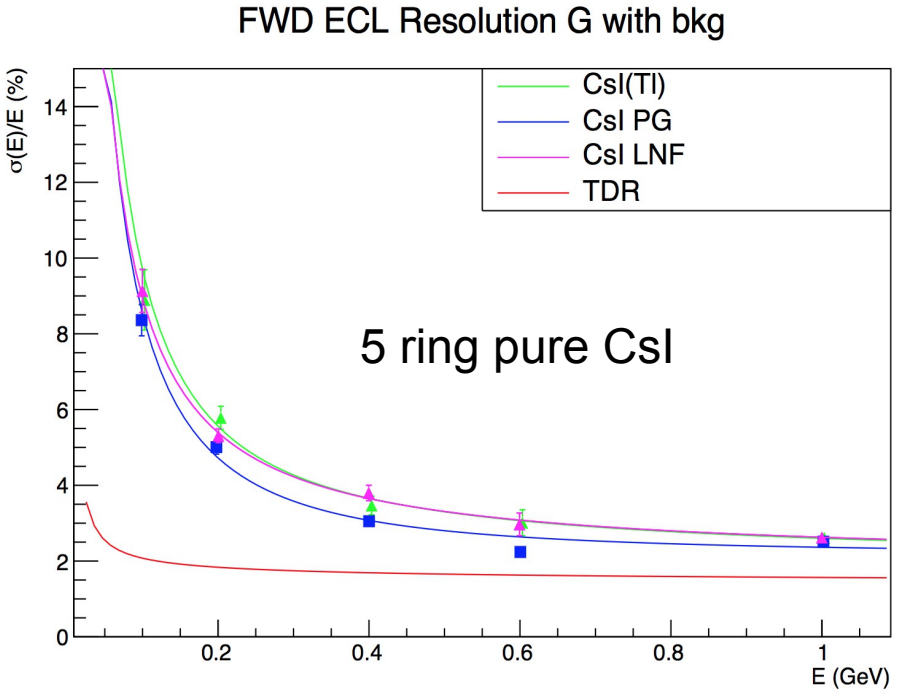


r24746 and latest bkg files, i.e. 12th campaign

5 vs 13 layer pure CsI FWD

- Efficiency is seen to be better for a pure CsI FWD rather than a partial one
- Is this reasonable?

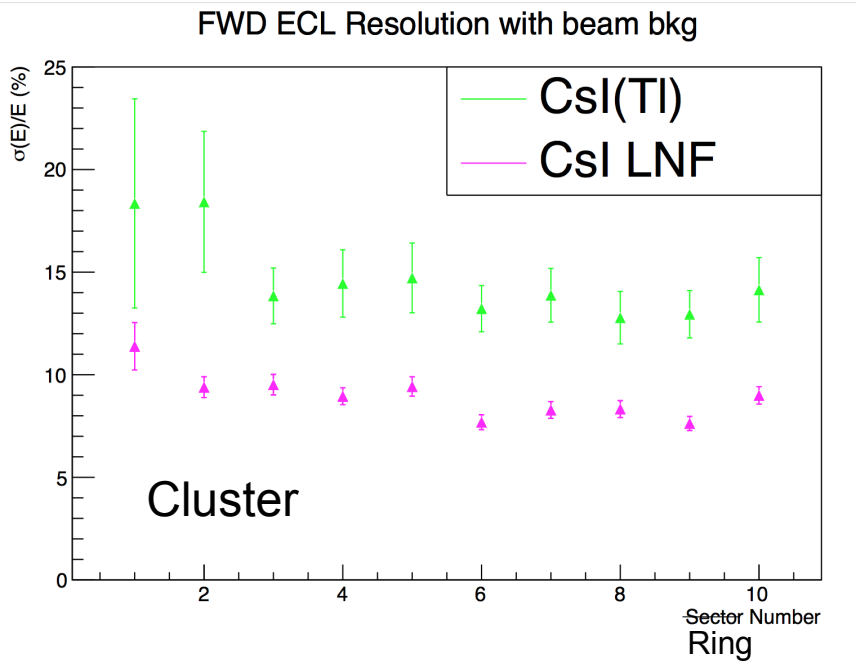


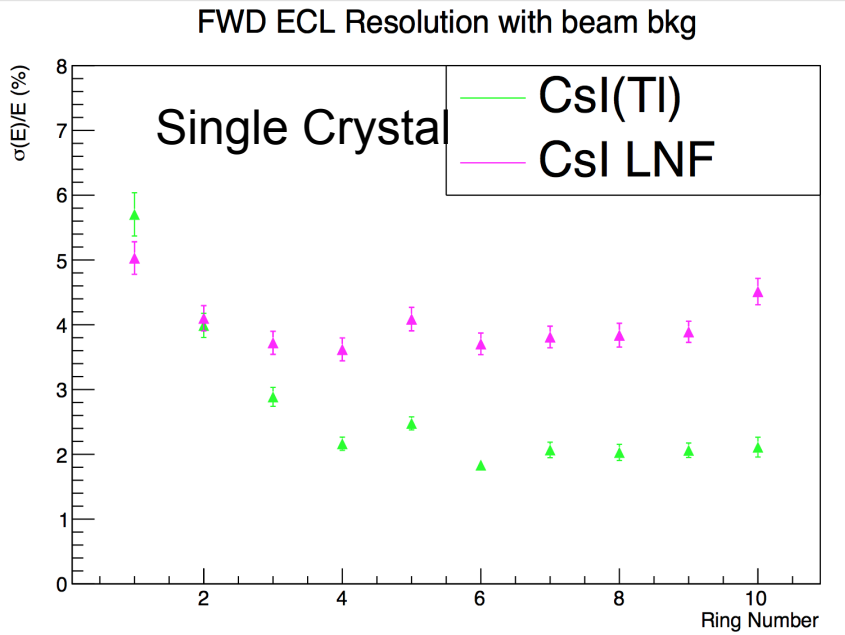


r24746 and latest bkg files, i.e. 12th campaign

Single crystal studies

- From previous result one could argue that even on the outer rings where the bkg is lower pure CsI performs better than CsI(Tl)
- We perform a ring by ring scan to study this dependency -> issue seems to be in clustering process

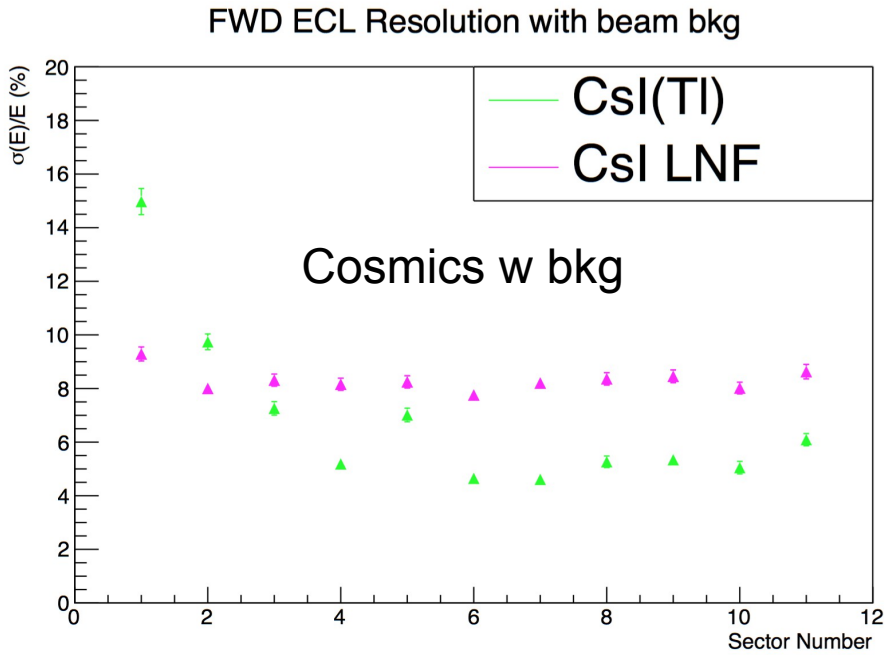




r24746 and latest bkg files, i.e. 12th campaign

Single crystal results w cosmics

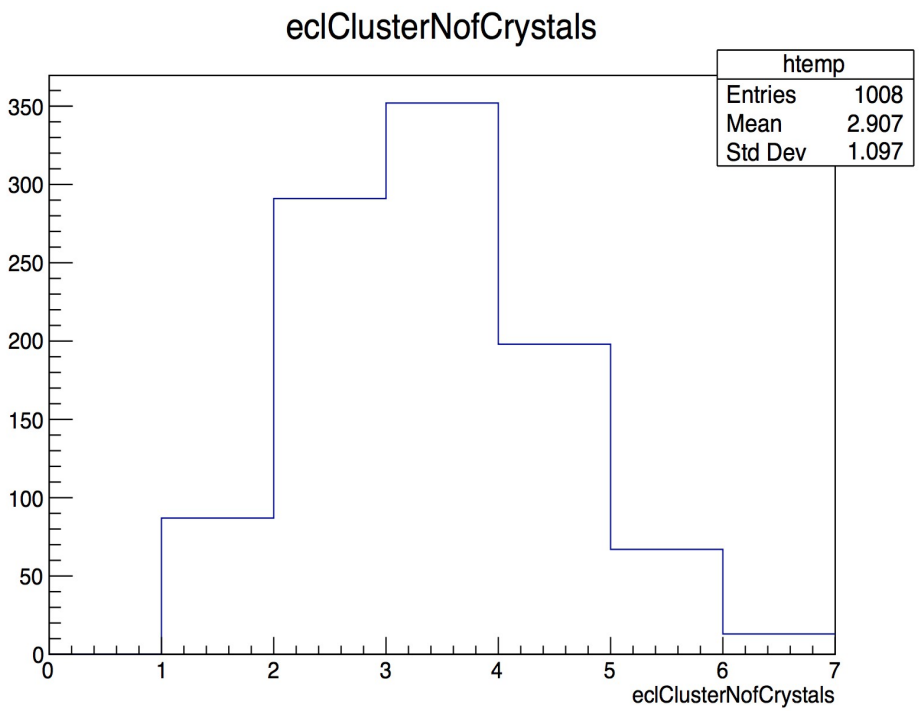
- We compare single crystal results for photons with those from cosmic test -> same behavior
- We do not compare the resolution in terms of clusters due to the way the cosmics are generated
- Strange behavior for ring 5 observed in both cases

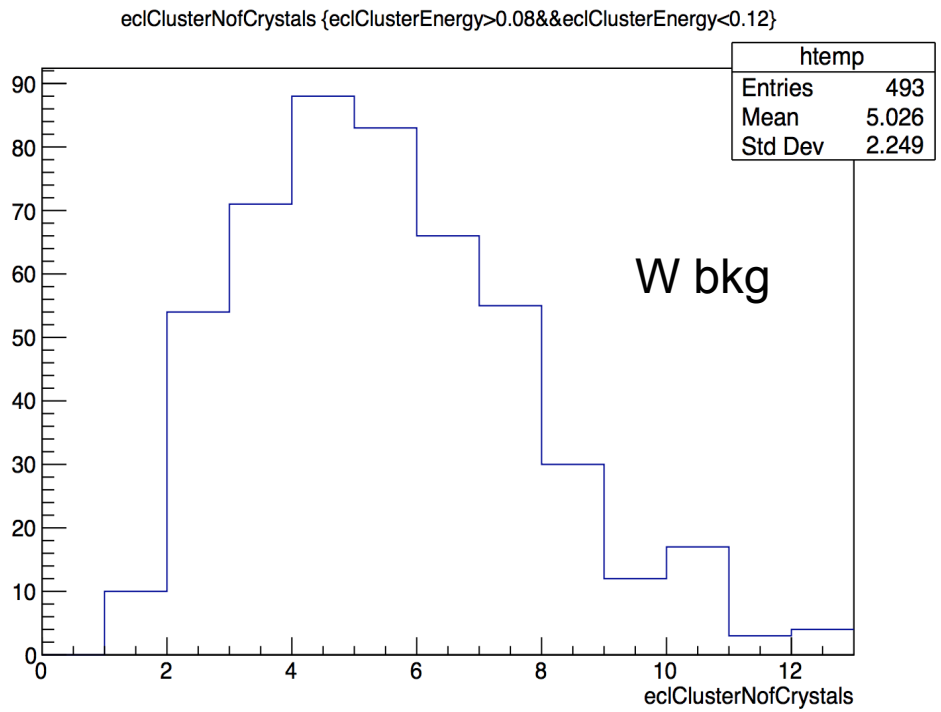


r24746 and latest bkg files, i.e. 12th campaign

NofCrystals in clusters (CsI(Tl))

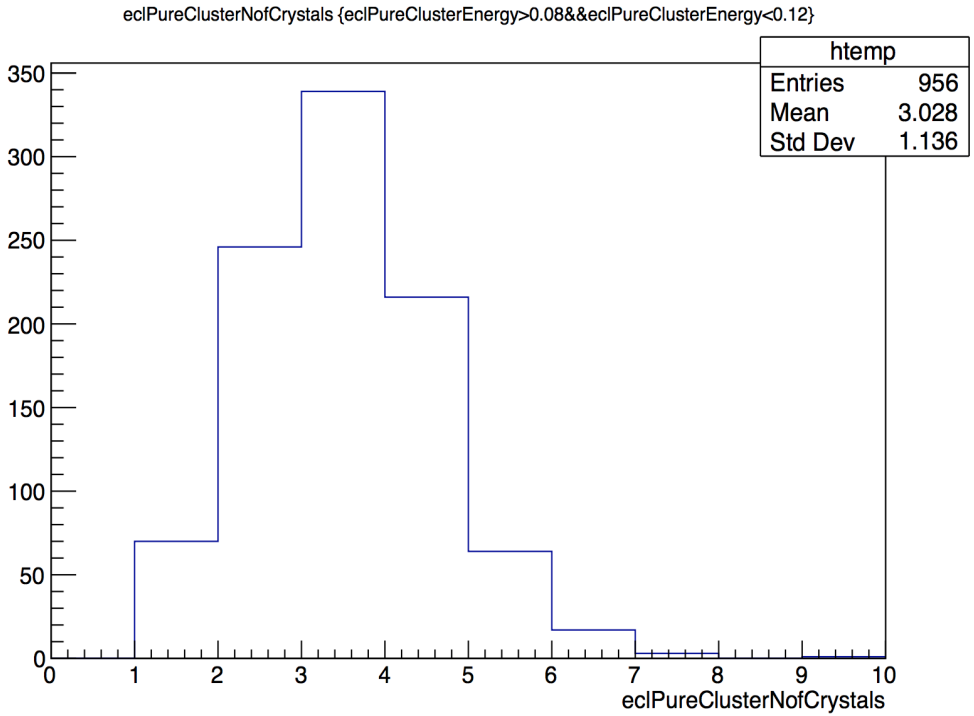
- When shooting single 100 MeV photons, even w bkg, we observe that the multiplicity of crystals is low and, in any case, much lower than the number of Digits above 1MeV

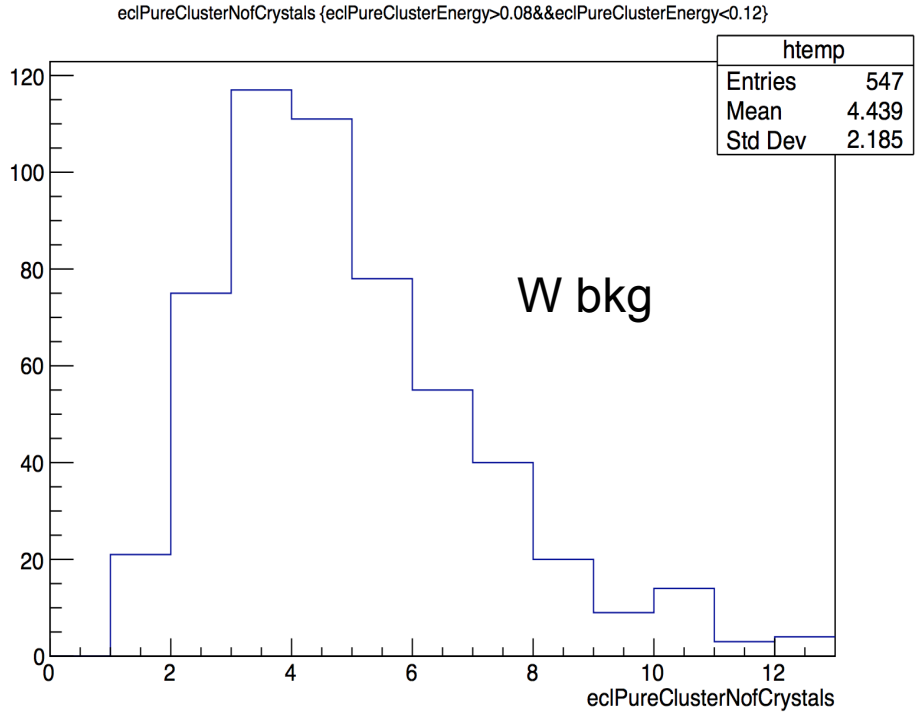




r24746 and latest bkg files, i.e. 12th campaign

NofCrystals in clusters, pure CsI





r24746 and latest bkg files, i.e. 12th campaign

Single crystal studies continued

- To understand the origin of the different behavior among single crystals and clusters we studied the clustering algorithm
- We found that a theta dependent minimum energy is required for crystals to be included to form a cluster
- These values (probably Belle optimized) range from 2.5 MeV for the inner rings of the endcaps to about 1.3 in the barrel region

```
2.50, 2.50, 2.50, 2.50, 2.50, 2.40, 2.29, 2.18, 2.07, 1.98,
1.88, 1.78, 1.69, 1.61, 1.57, 1.56, 1.57, 1.58, 1.60, 1.62,
1.63, 1.64, 1.65, 1.65, 1.65, 1.65, 1.65, 1.65, 1.64, 1.64,
1.63, 1.62, 1.61, 1.60, 1.59, 1.57, 1.56, 1.54, 1.53, 1.51,
1.89, 1.87, 1.85, 1.83, 1.81, 1.39, 1.37, 1.35, 1.33, 1.31,
1.29, 1.28, 1.28, 1.28, 1.29, 1.32, 1.38, 1.86, 1.56, 1.67,
1.80, 1.95, 2.12, 2.24, 2.24, 2.35, 2.50, 2.50, 2.50
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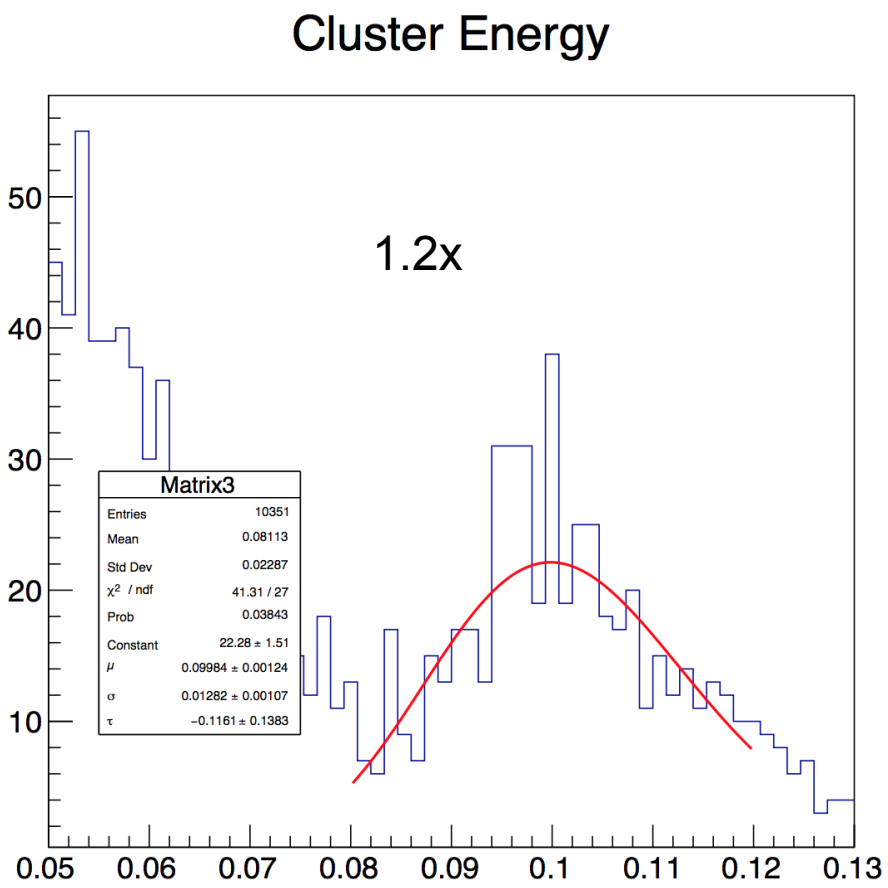
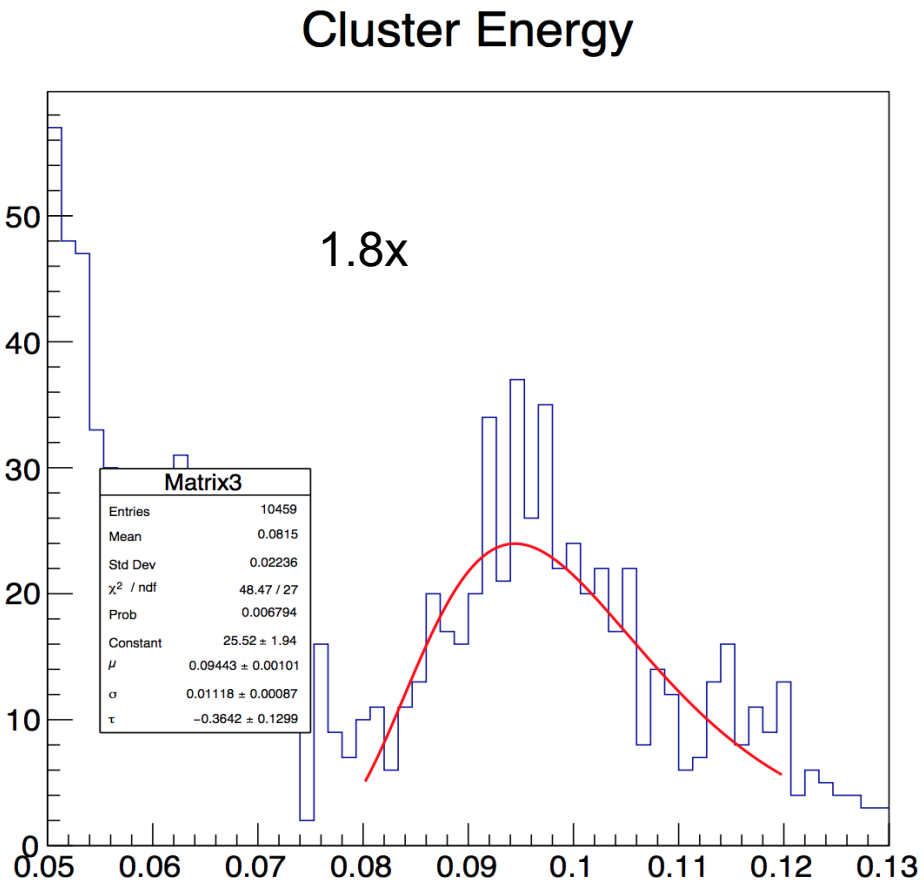
r24746 and latest bkg files, i.e. 12th campaign

Playing w thresholds

- We multiplied threshold matrix respectively by a factor: (1), 1.2, 1.4, 1.6, 1.8, 2.0

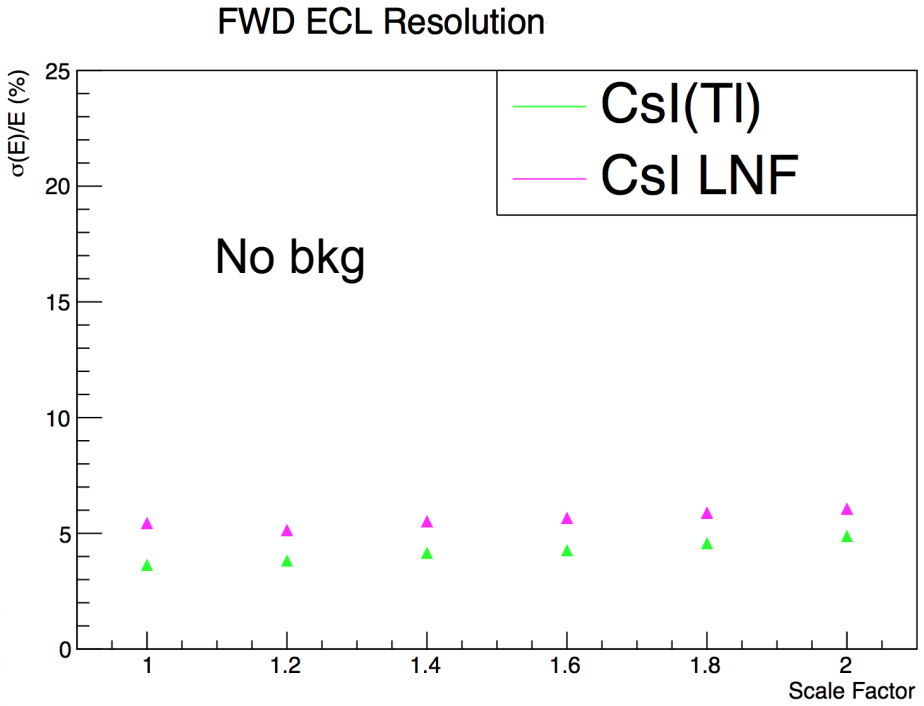


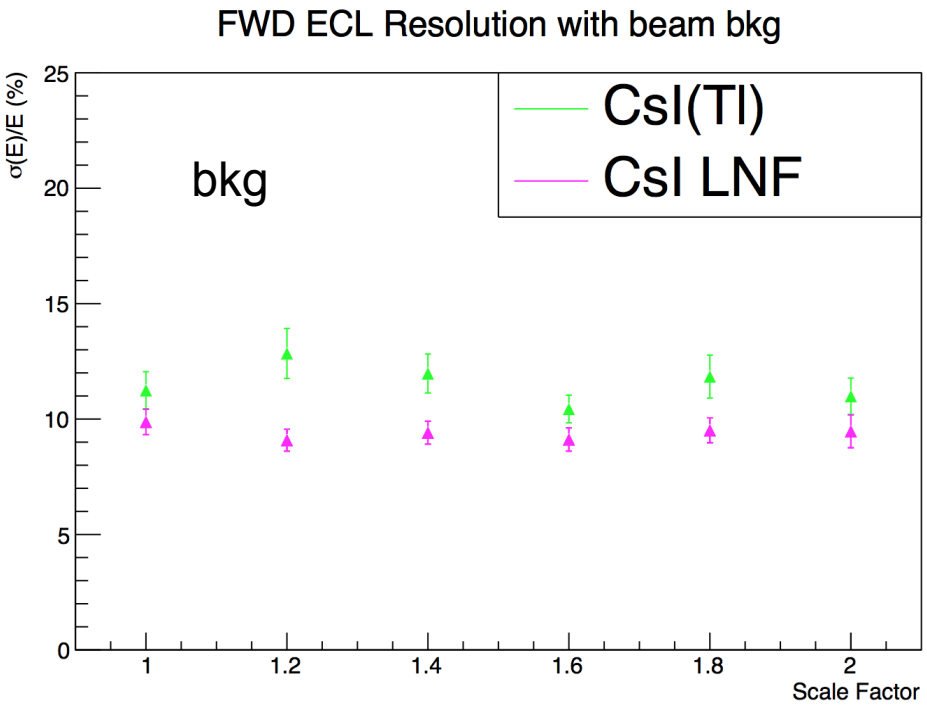


r24746 and latest bkg files, i.e. 12th campaign

Playing w thresholds (2)

- No effect is seen on sigma(E)/E neither with or w/o beam bkg

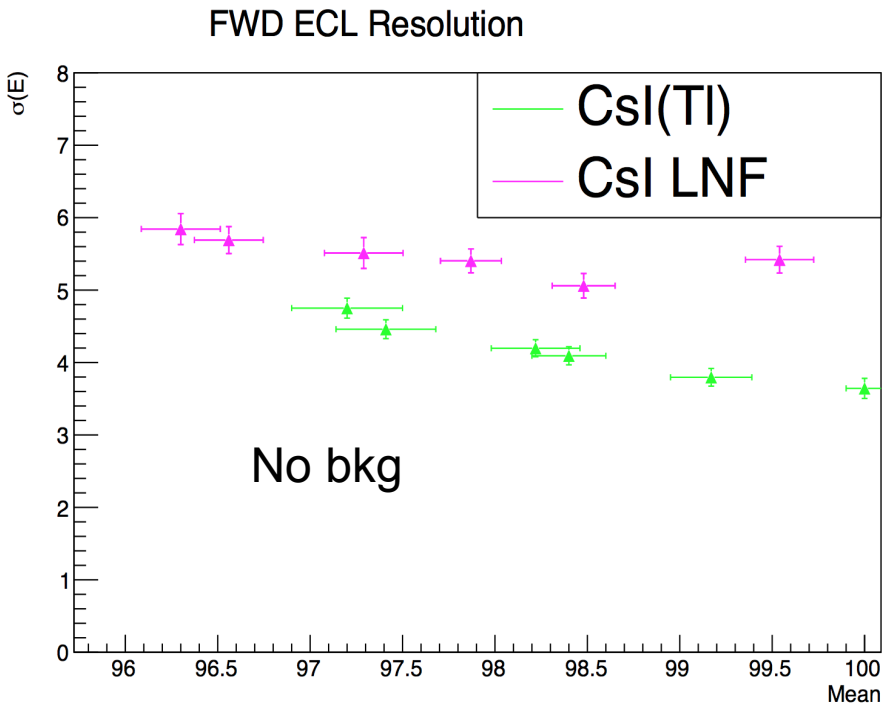


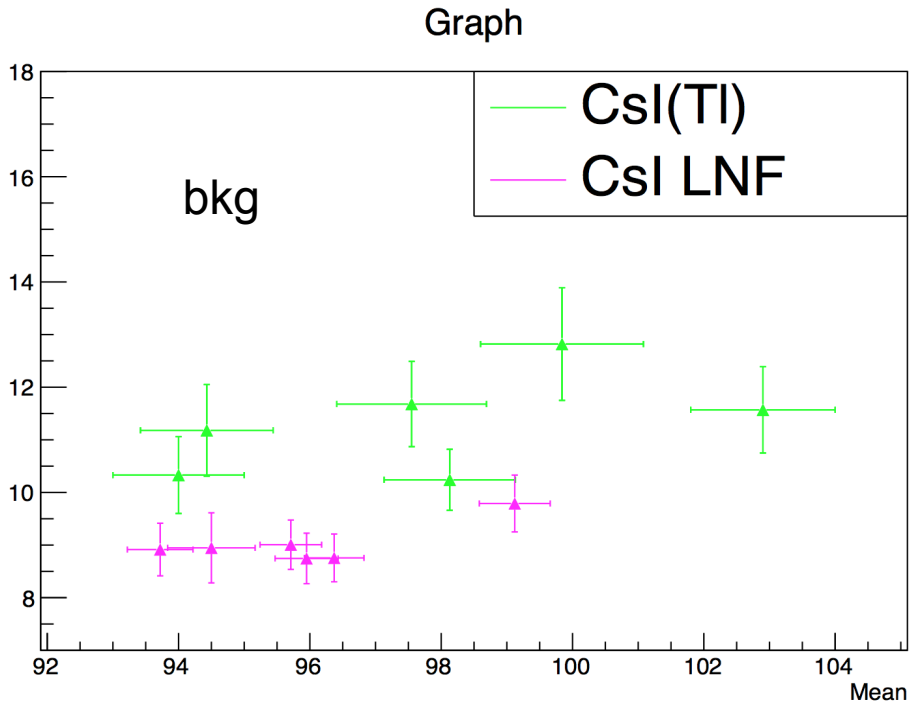


r24746 and latest bkg files, i.e. 12th campaign

Playing w thresholds (3)

- If we look to sigma(E) vs E an approximately linear relation can be seen when no beam bkg is present

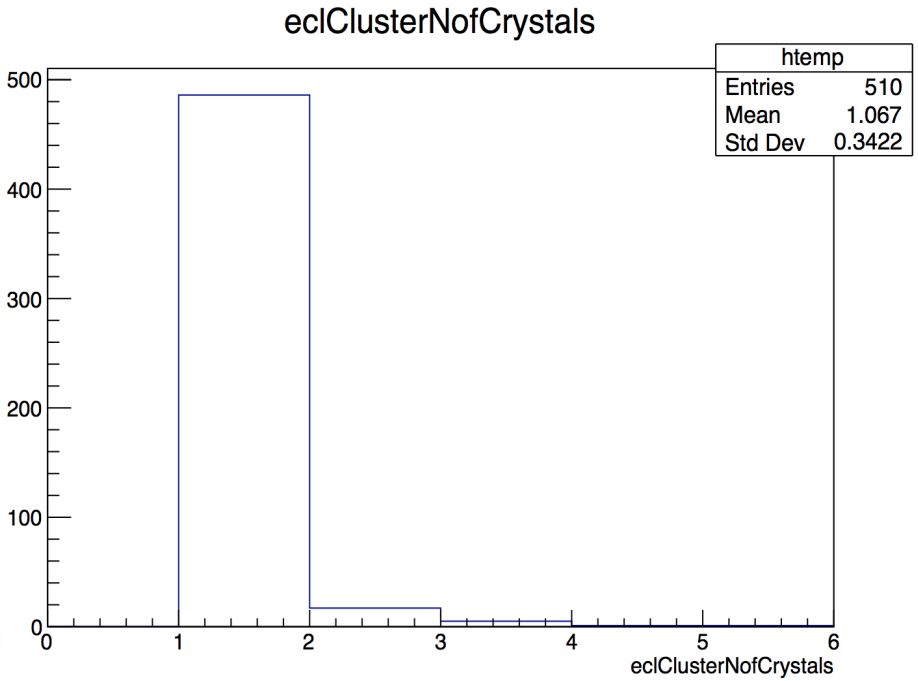


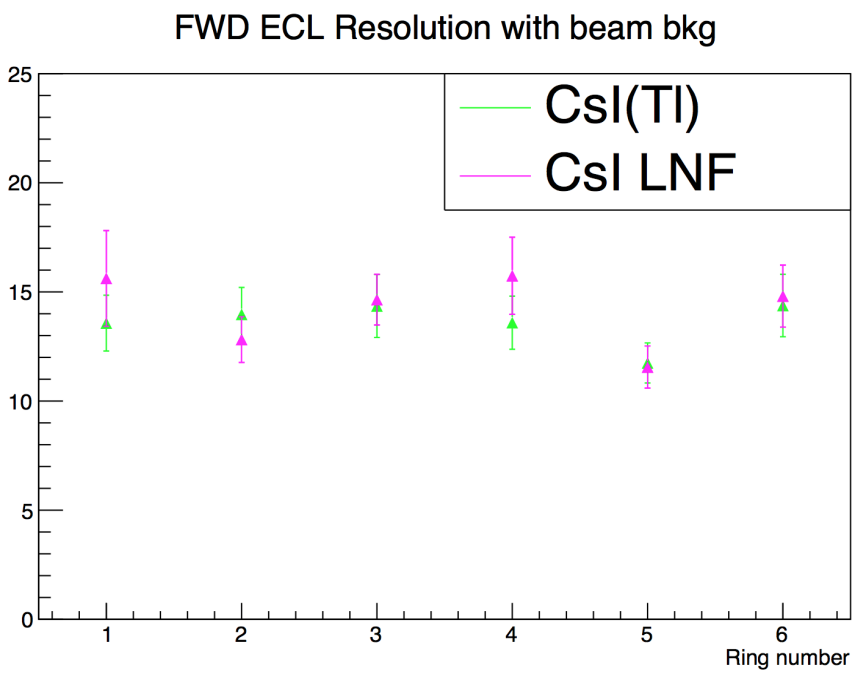


r24746 and latest bkg files, i.e. 12th campaign

Extreme threshold test

- We want to make the cluster and single crystal measurements coincide somehow
- We fix crystal threshold to 20x in order to get just one
- Result is puzzling..

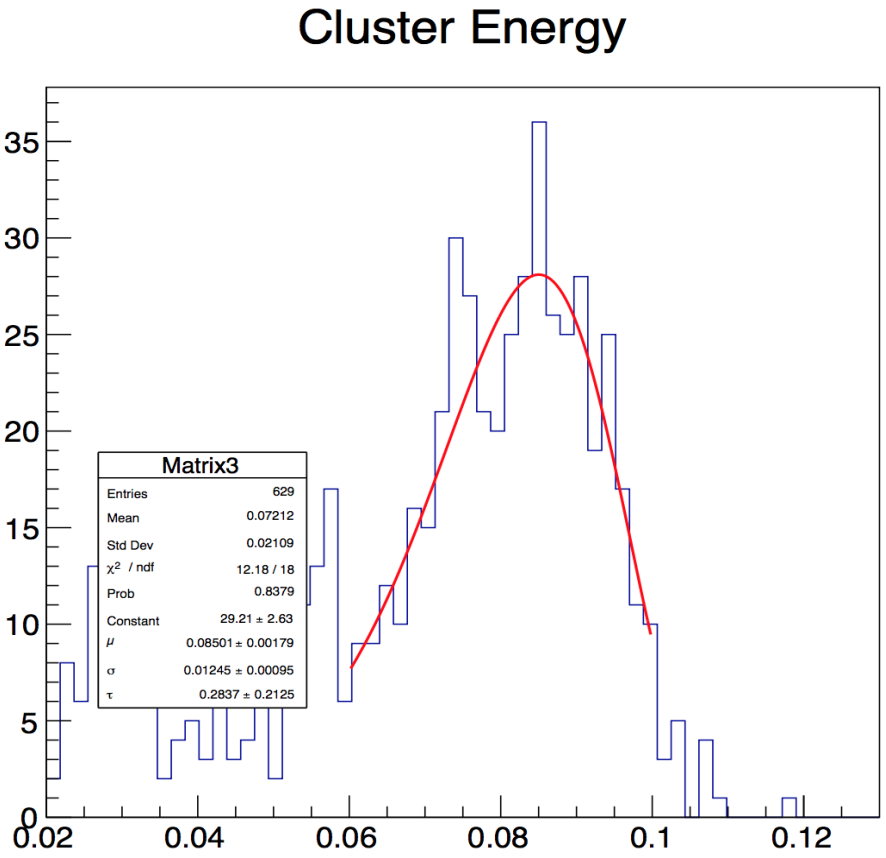




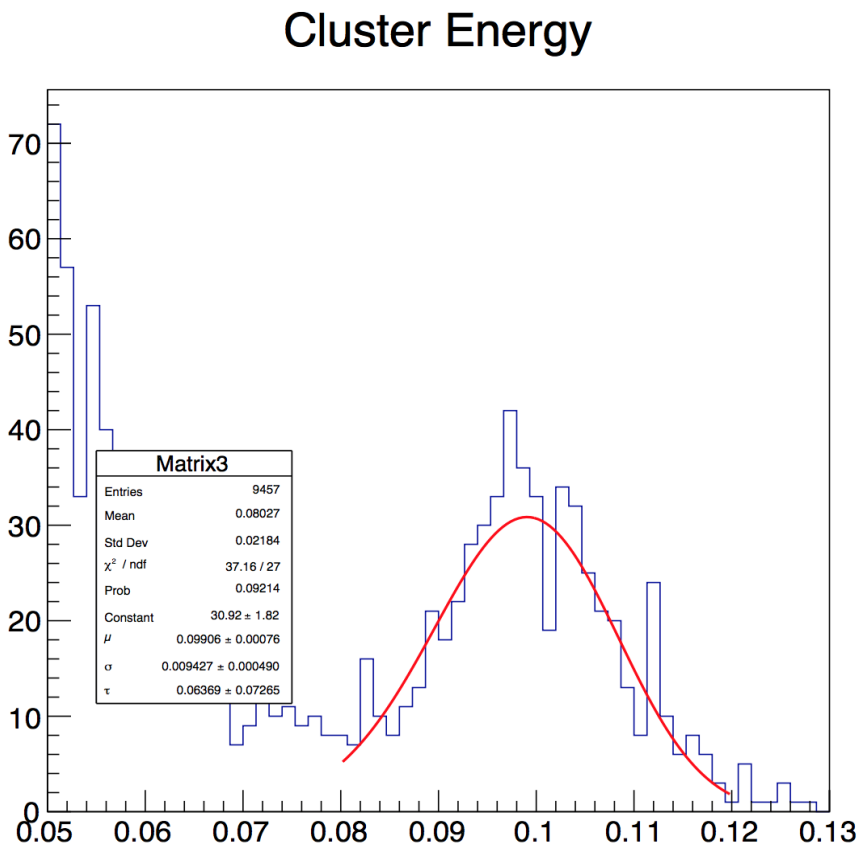
r24746 and latest bkg files, i.e. 12th campaign

Extreme threshold test

- Does it depends from the fact that we loose a considerable amount of energy due to the effective single-crystal selection?



20x threshold, ring 3



Default threshold, ring 3

Additional Slides

bkg modulation

- Crystal #1 and #161 are in the phi=0 region -> maximum bkg