TRD-SAS

MEPhI meeting and plans.

Summary, detailed presentations will be done on our WS in March

- Radiator simulation
- GasPixel results
- Beam composition reconstruction technique
- Preparation to March TRD & XSCRC2017 WSs
- Paper issues

Reminder: basic considerations

$$\omega = 28.8\sqrt{\rho Z/A}$$

$$\gamma_{sat}=0.6\cdot\omega_1\sqrt{l_1 l_2}/c$$

$$\omega_c = \omega_1 \cdot \gamma$$

$$\omega_{max} = \omega_1^2 \cdot l_1/2\pi c$$

$$\gamma_{sat} \sim \sqrt{\omega_{max} \cdot l_2}$$

$$\gamma_{th} \sim \cdot\omega_1 l_1$$

What happens if we change foil densyty

Ignoring gamma terms: $Z_{form} \sim \omega_1^{-2} \sim \rho^{-1}$

for TR formation we have to keep: $\rho \cdot l_1 = \omega_1^{-2} \cdot l_1 \approx$ const

$$\gamma_{th} \sim \cdot\omega_1 l_1 \sim l_1^{3/2}$$

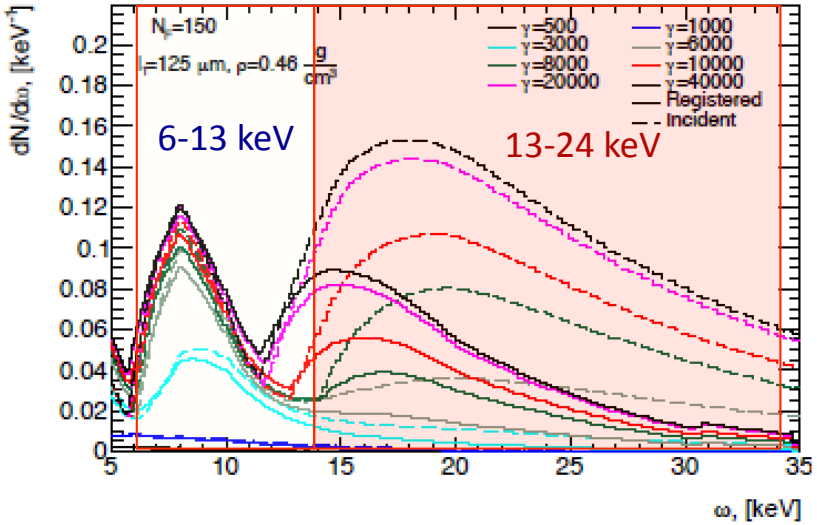
Evgeny Shulga: More radiator simulations

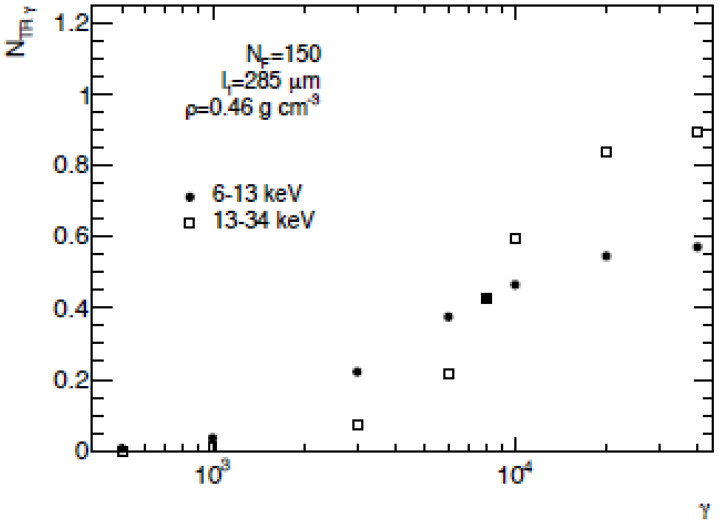
Variation of foil thickness 50-100 μm foil (normal density) Variation of gap 1-2 mm

TR spectrums

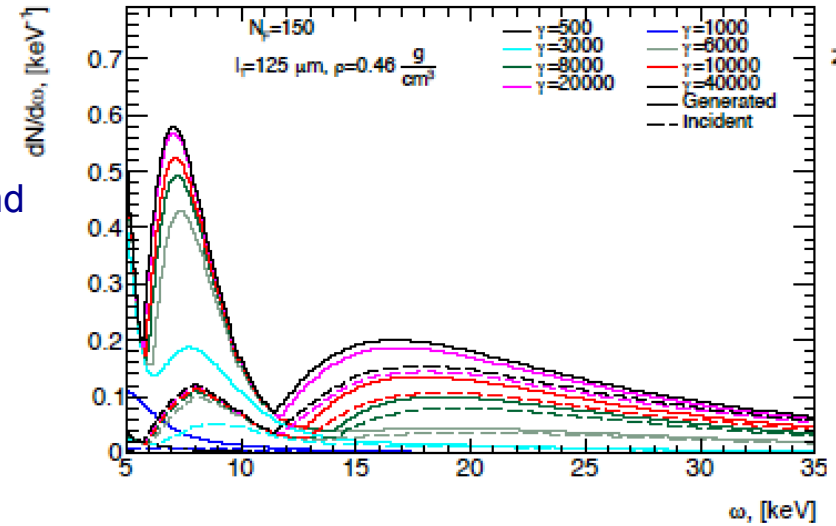
Averaged number of produced photons in two energy ranges

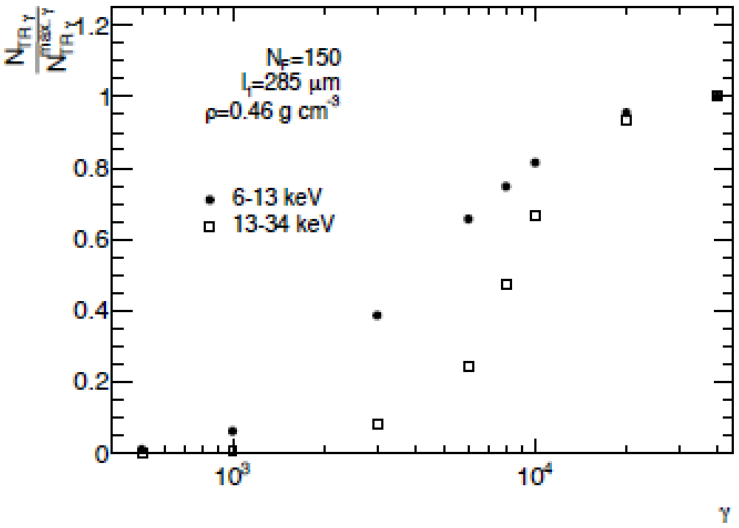
Incident and absorbed TR spectrums





Generated and incident TR spectrums



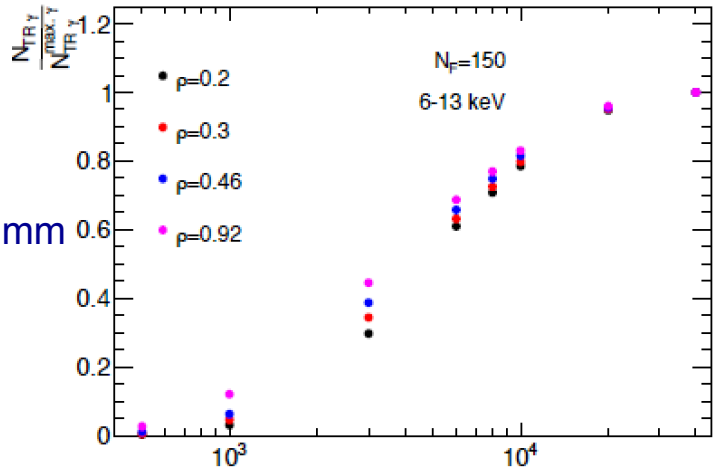


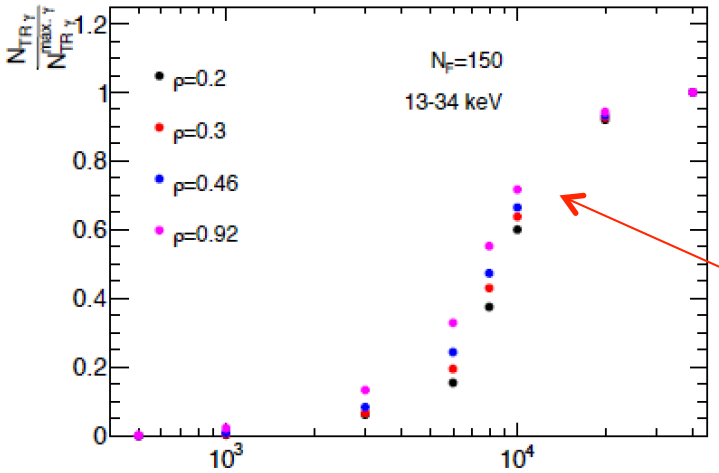
Evgeny Shulga: More radiator simulations

Variation of foil thickness 62 μm foil (normal density). Variation of gap 1-2 mm

Normalized number of produced photons in two energy ranges

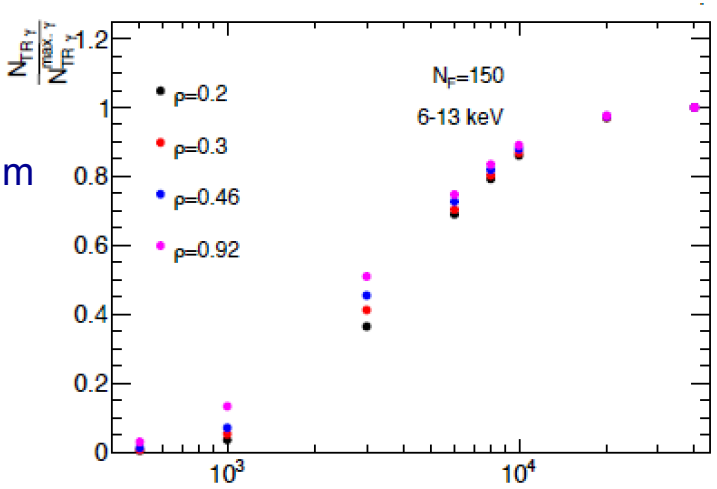
2 mm

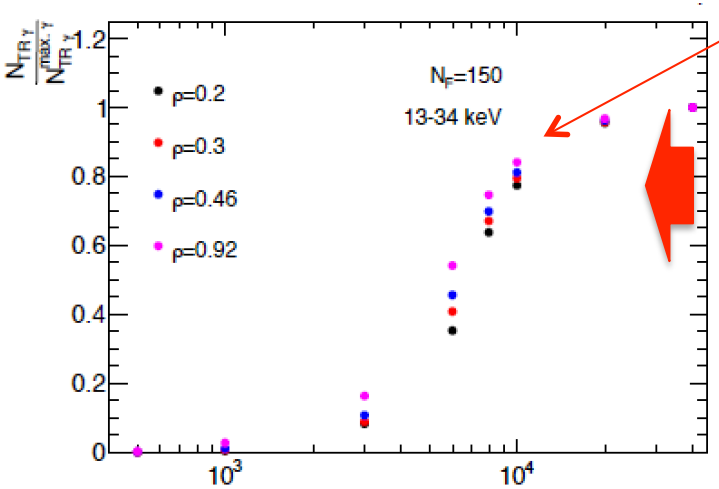




As expected change is in the area close to saturation

1 mm





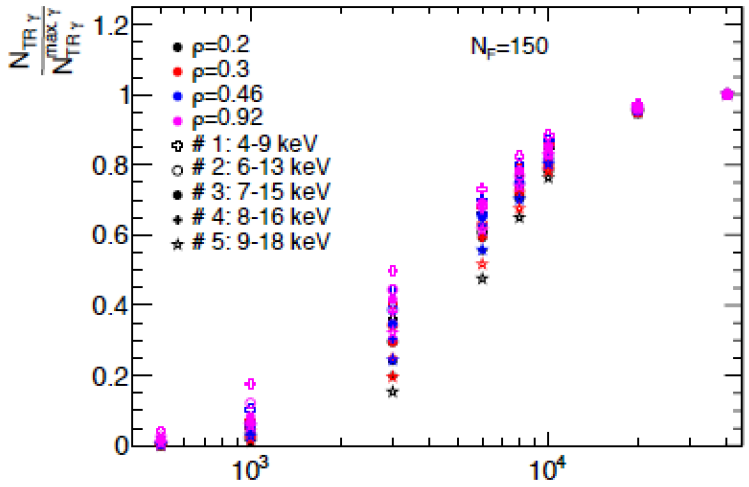
Evgeny Shulga: More radiator simulations

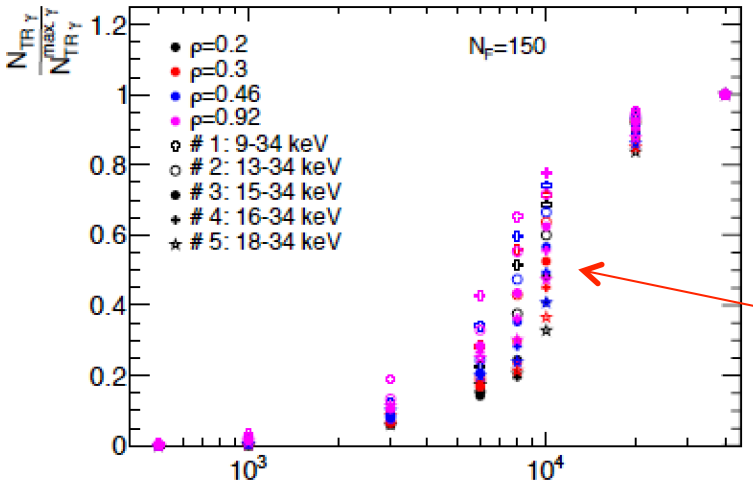
Variation of foil thickness 50-100 μm foil (normal density) gap 2 mm

Normalized number of produced photons in two energy ranges

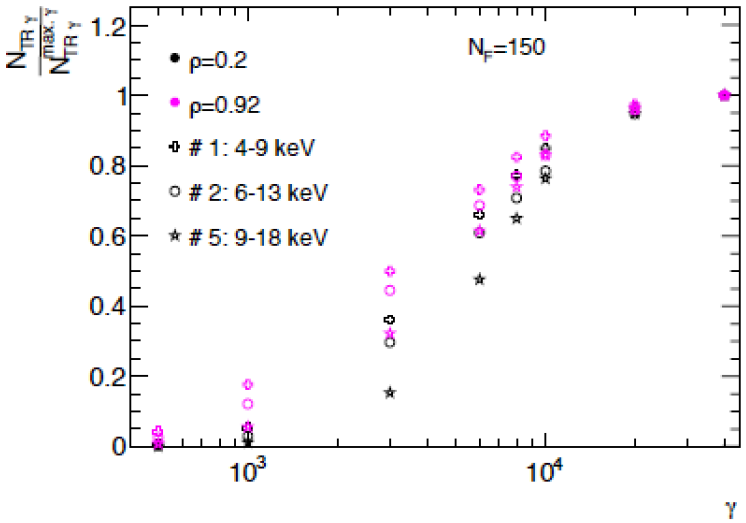
Range for last peak is changed according to spectrum change

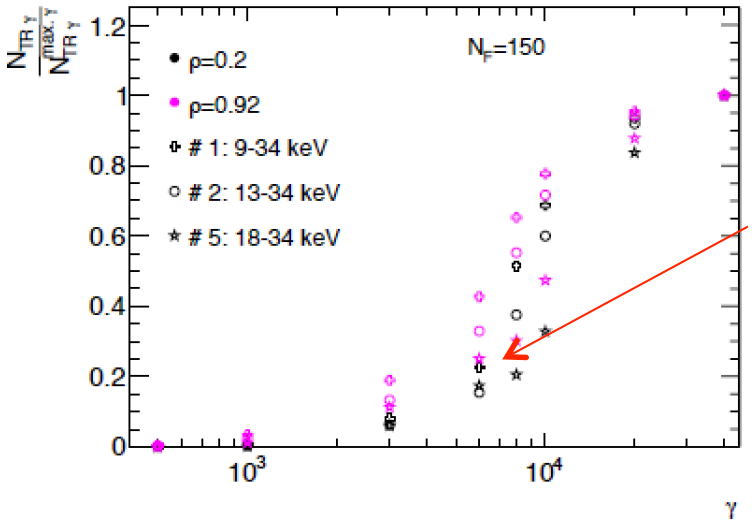
50 μm
65 μm
7 5μm
85 μm
100 μm





Wide range of Dependencies

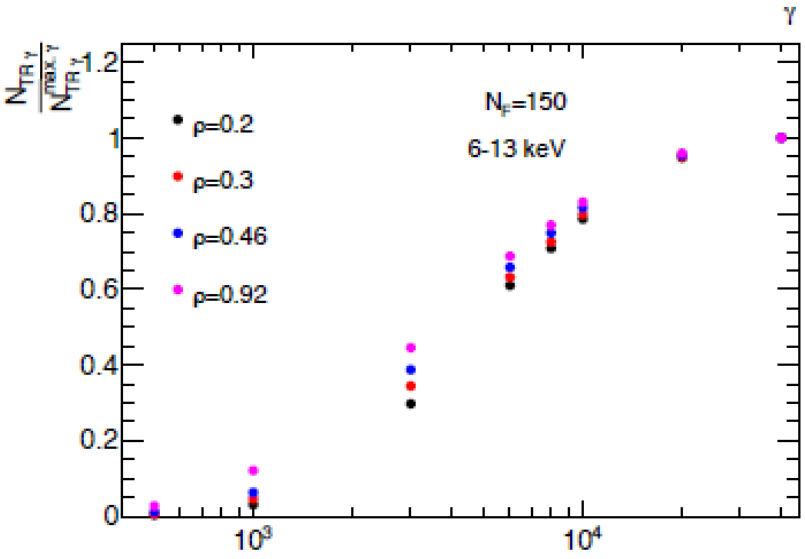


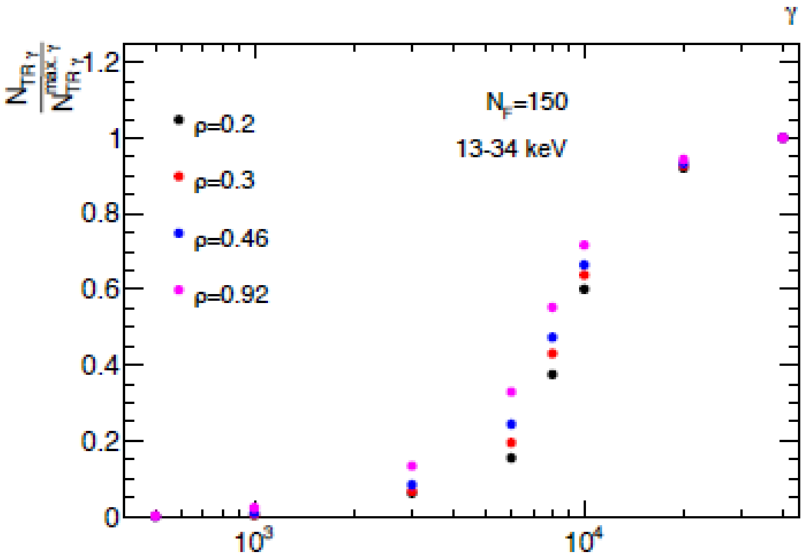


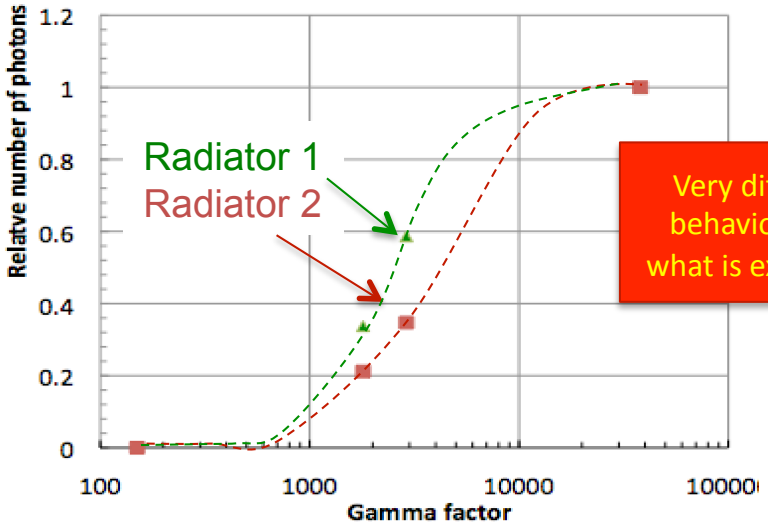
50 μm seems not bad because also softer spectrum (depends on the detector)

Comparison with straw prototype data

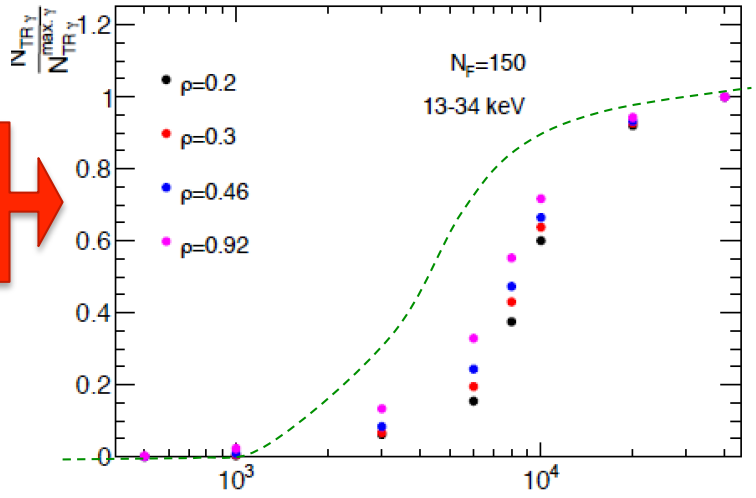
Density effects: 62 μm radiator at normal density, **I_2 fixed.**





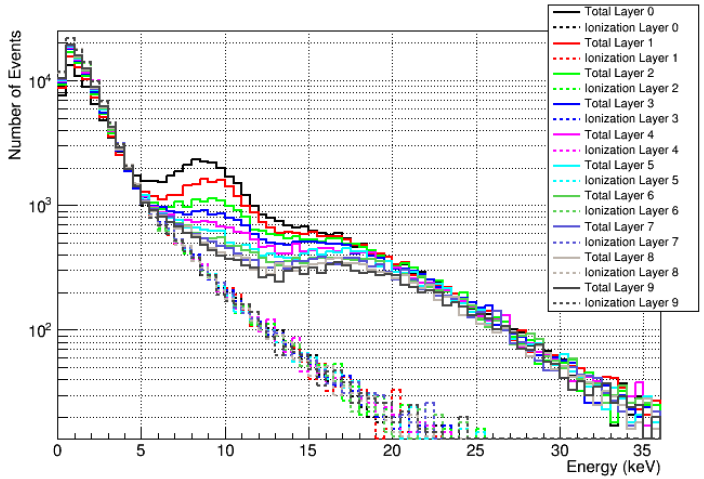


Very different behavior from what is expected!

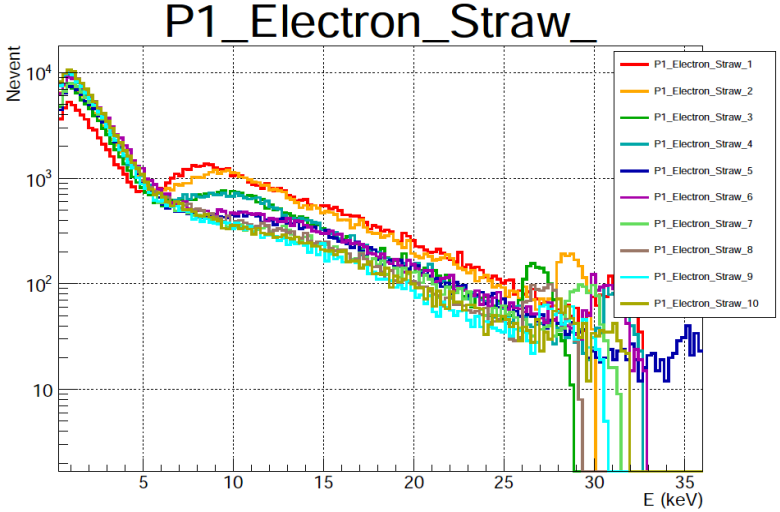


2. Spectrums are different.

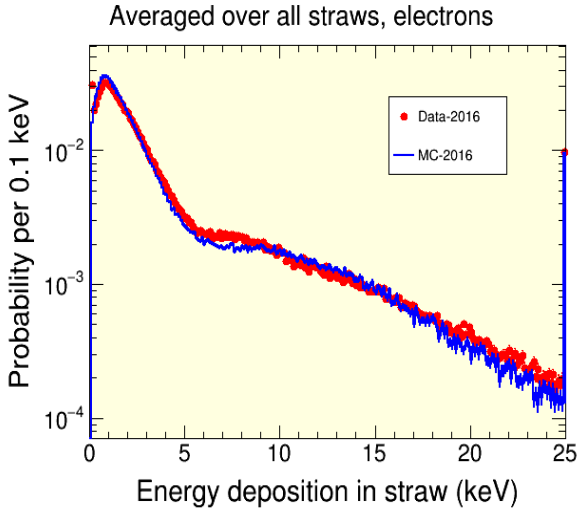
Simulated spectrums without photo-electron pass. *(Nicola Mazziotta)*

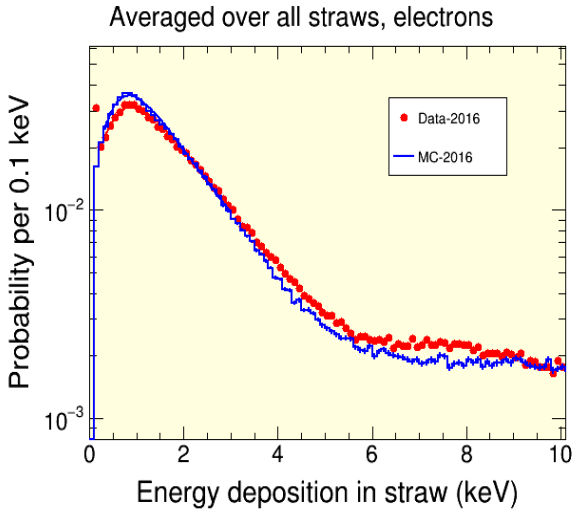


Straw Prototype 1 Radiator1



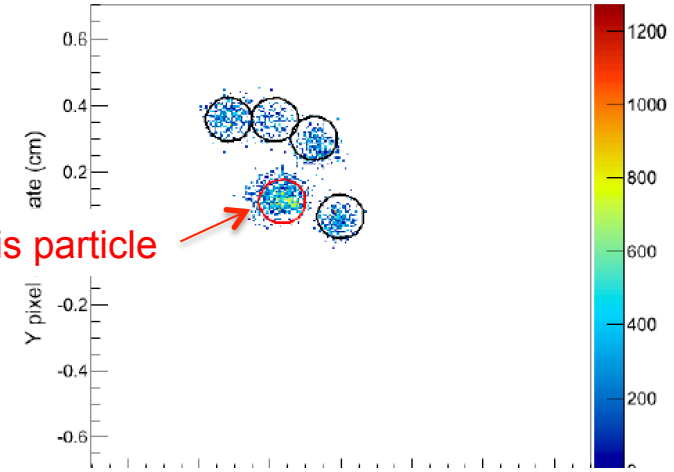
Data/simulation comparison (all straws) secondary electron pass is taken into account. (V.Tikhomirov).



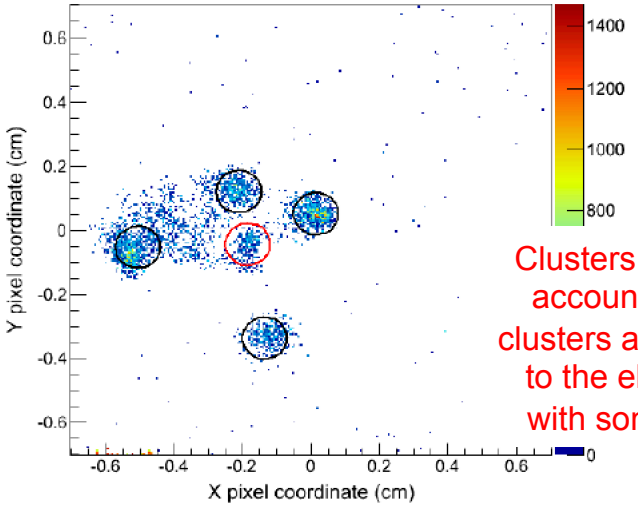


Yuri Smirnov: GasPixel analysis.

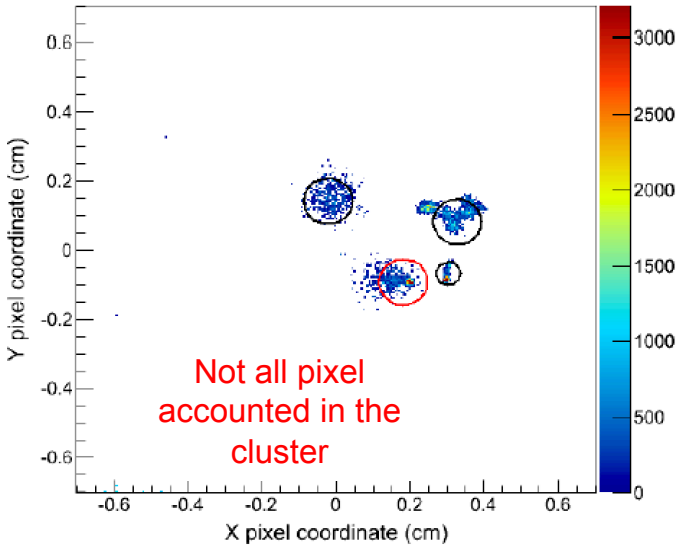
Radiator in 2 meters from the detector (small angle ~2 degrees)



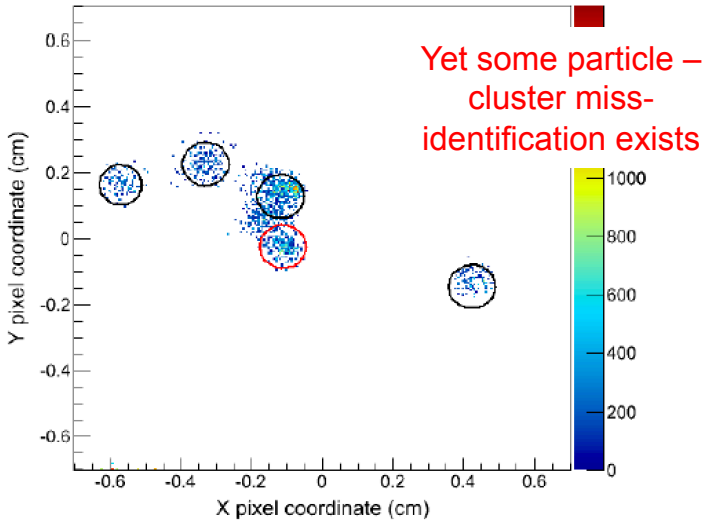
Red is particle



Clusters only are accounted. No clusters associated to the electrons with some path



Not all pixel accounted in the cluster



Yet some particle – cluster miss-identification exists

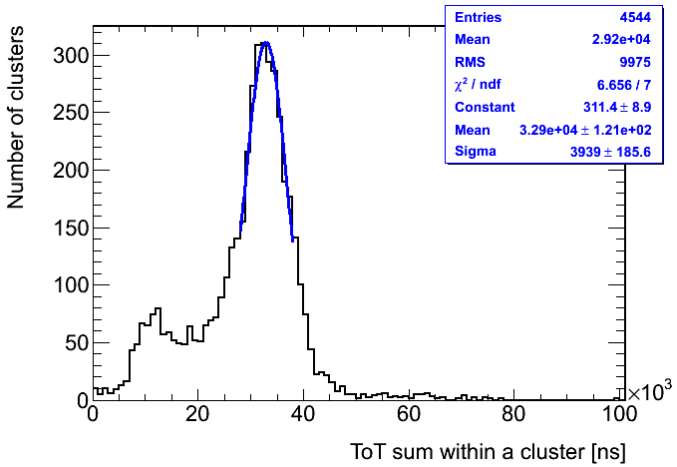
In most cases reconstruction works properly but not everything accounted for clusters.

Yuri Smirnov: GasPixel analysis.

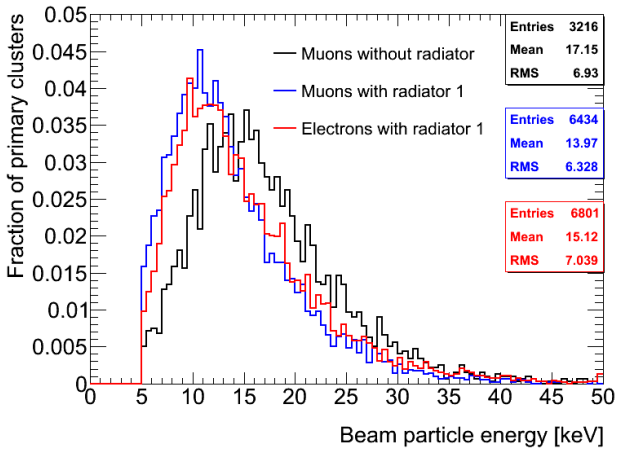
Radiator 1 in 2 meters from the detector (small angle ~2 degrees)

125 μm radiator at density ½ of normal I_2 **= 2 mm**

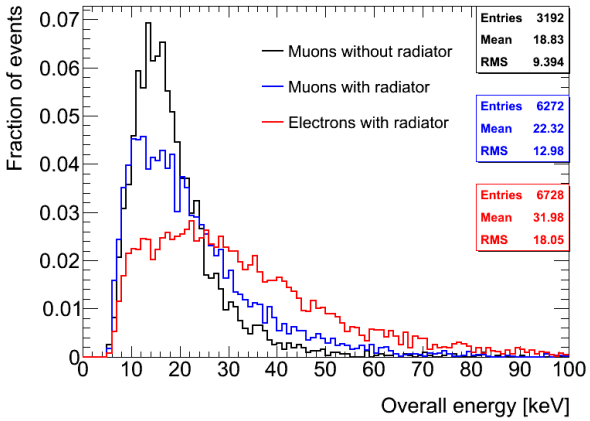
Fe 55 calibration



Energy on particle track



Total Energy



Not all pixel accounted in the cluster

Muons without radiator seems have different gain.

In most cases reconstruction works properly but not everything accounted for clusters.

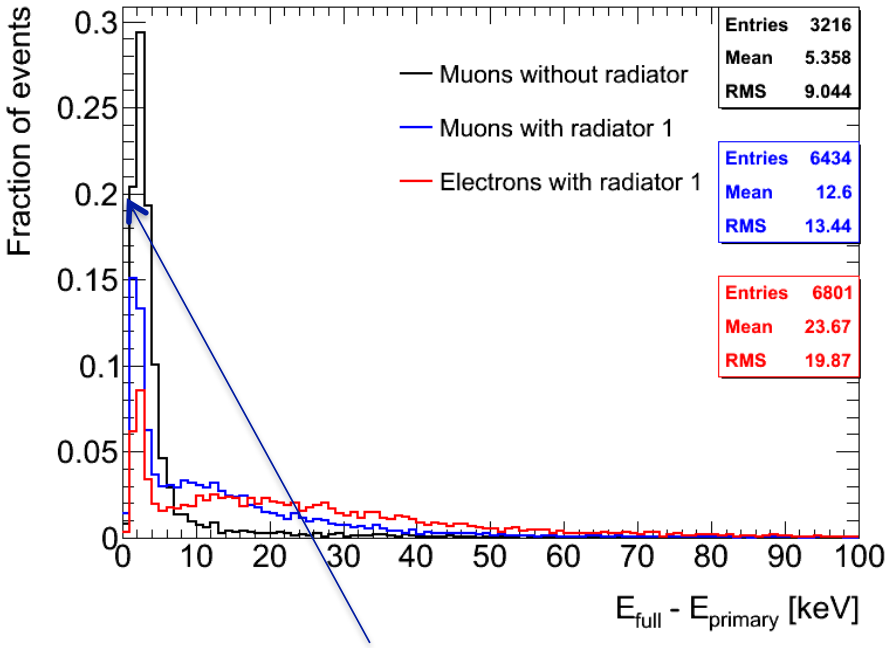
Yuri Smirnov: GasPixel analysis.

Radiator 1 in 2 meters from the detector (small angle ~2 degrees)

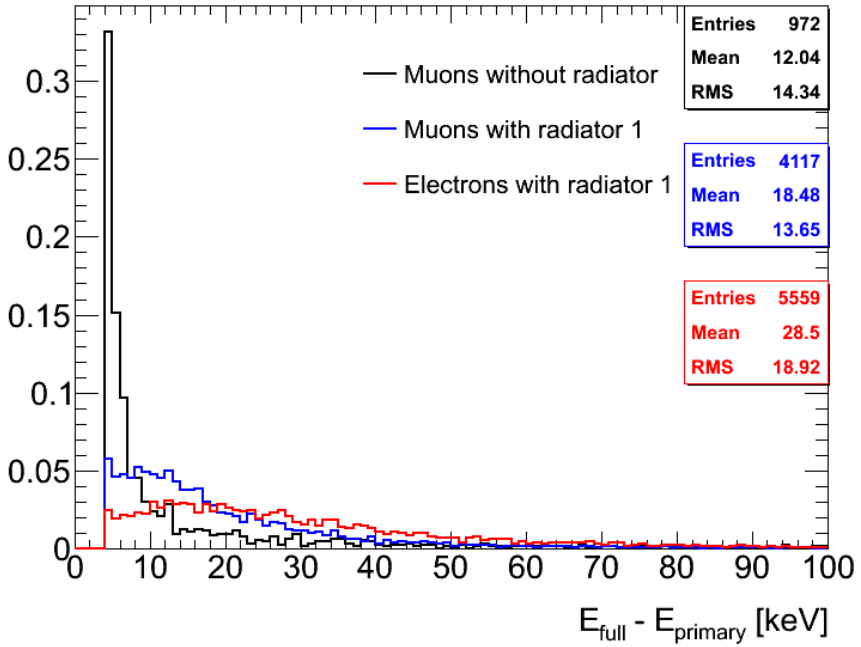
Total energy out of particle cluster

Total energy out of particle cluster above 4 keV

For data with radiator all events. Integral over energy is 1.



Tail from pixels from particle track which are not included in particle cluster

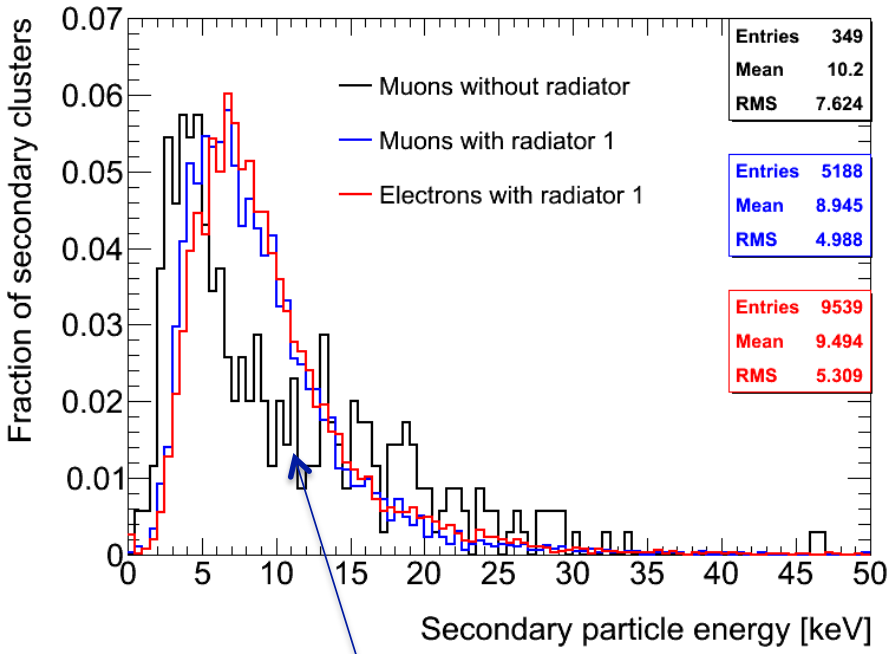


Obvious difference between electrons and muons of 180 GeV.
High energy tail is more pronounces.

Yuri Smirnov: GasPixel analysis.

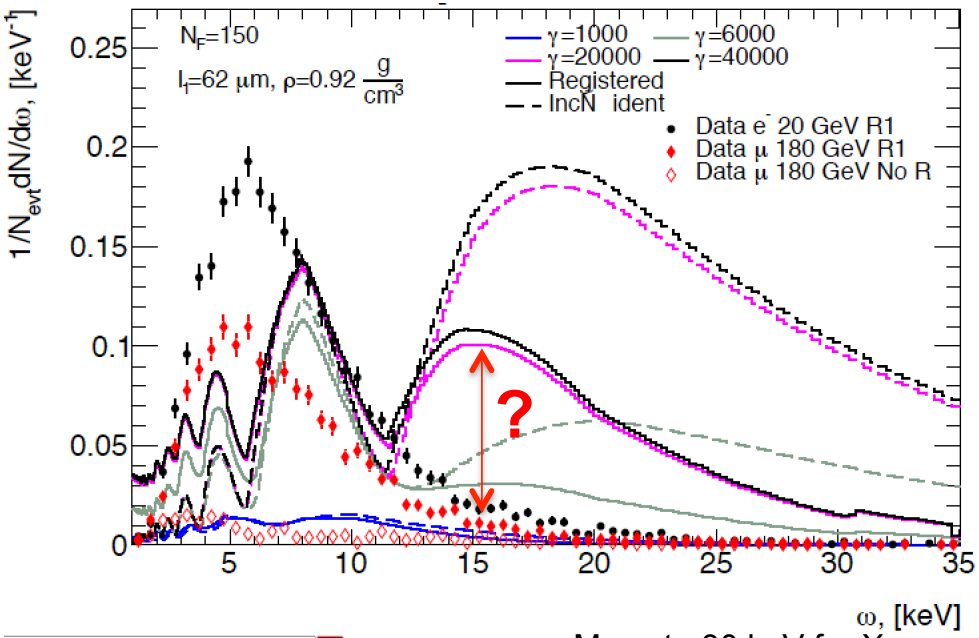
Radiator 1 in 2 meters from the detector (small angle ~2 degrees)

Energy in clusters -> TR spectrums.
Integral over energy is 1

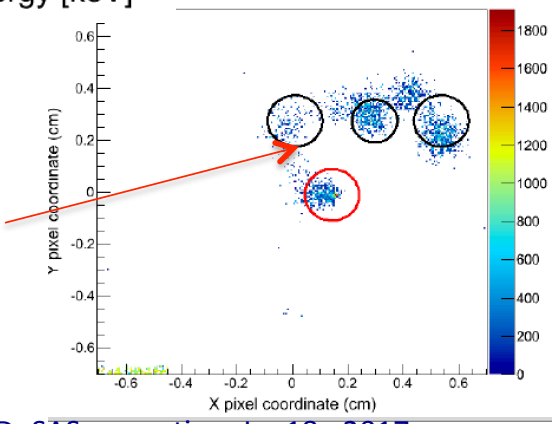


Tail from δ-electrons from particle tracks

Data/MC comparison.
Spectrums are very different.



The reason for discrepancy is not very clear. One problem can be that photo-electron has some track with a few clusters!?



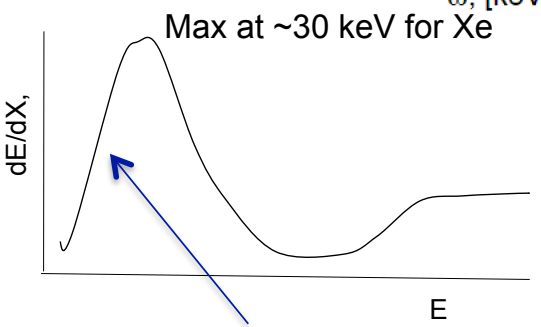
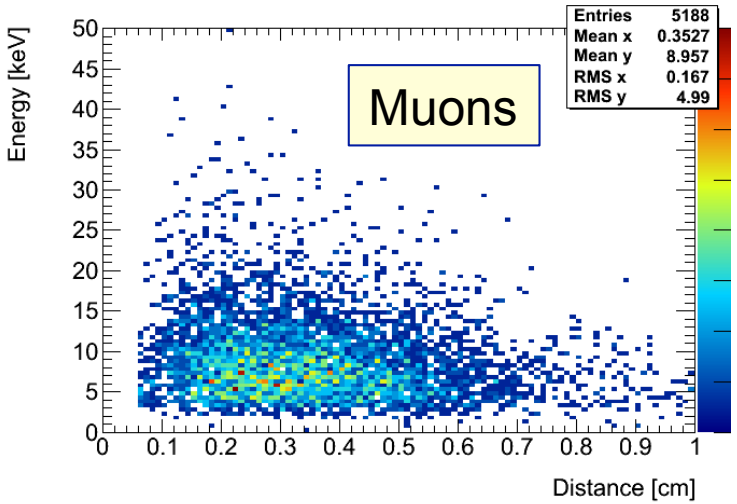


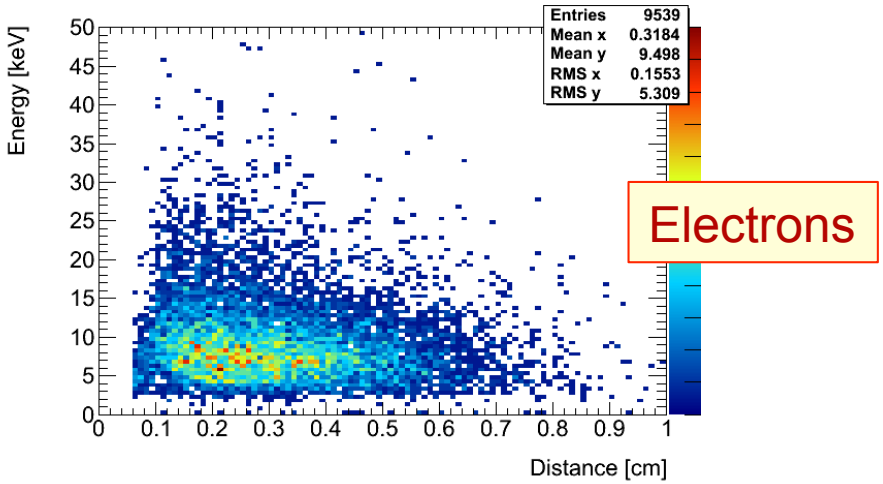
Photo electrons are mainly here.
It is important to study this effect.

Yuri Smirnov: GasPixel analysis.

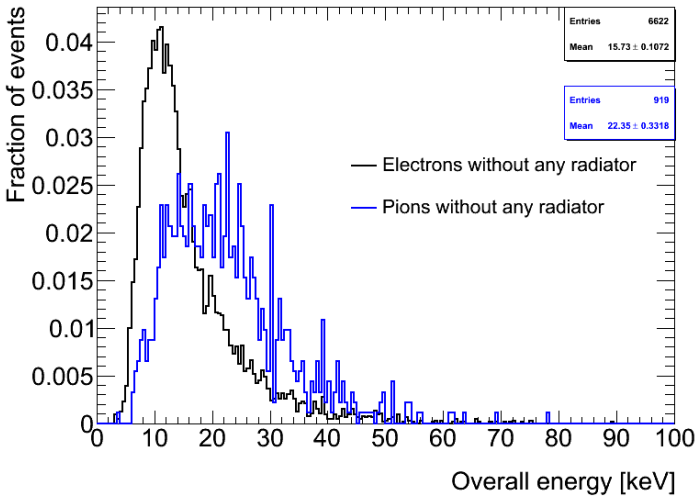
Radiator 1 in 2 meters from the detector (small angle ~2 degrees)

Track-to-cluster distance => Angular distribution



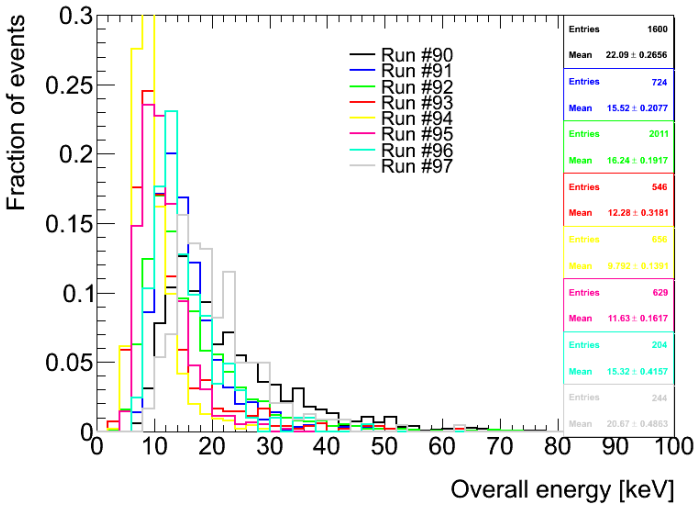


Some difference seen but not very significant!



Electrons an pions neighbor runs

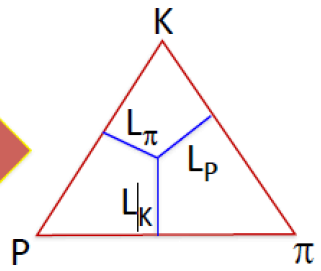
There are many thins still to understand and analyze. One of them is calibration issues.



Electrons different runs

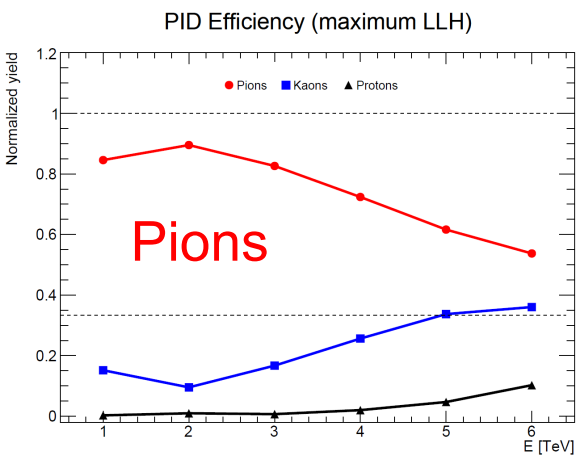
Nikita Belyev: p/K/π composition reconstruction.

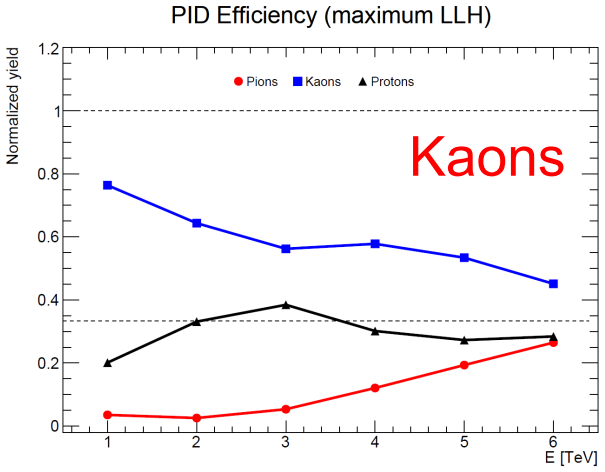
$L_\pi+L_P+L_K=1$

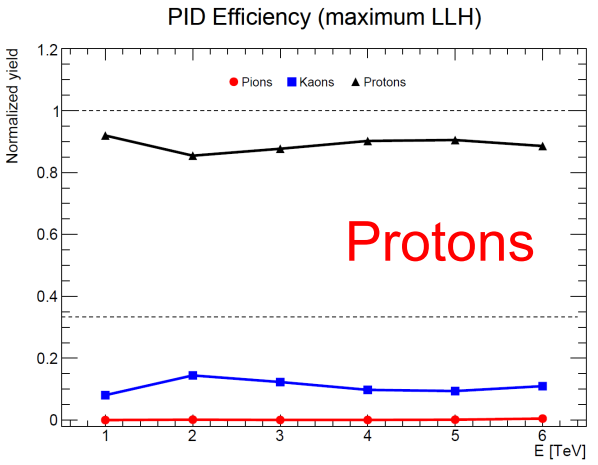


Max likelihood used to define sort of particle!

If we know response of each detector as a function of gamma factor
Then we know identification probabilities for pure beams

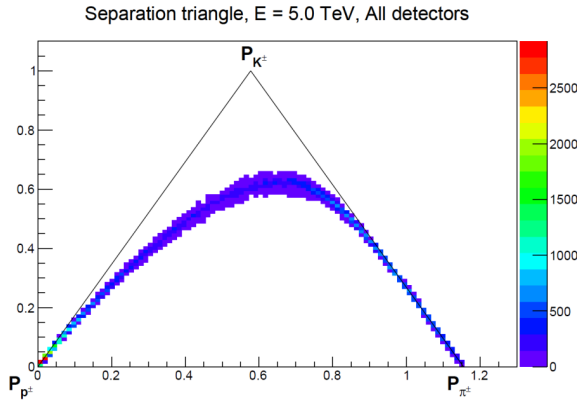


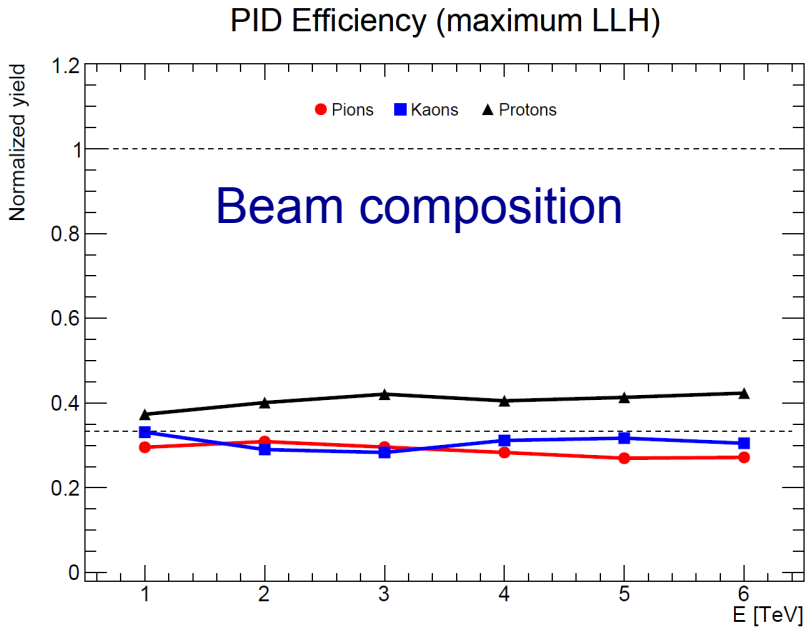




Nikita Belyev: p/K/π composition reconstruction.

Mixed beam
p : K : π
1/3 : 1/3 : 1/3





Detector is not optimal yet but one obtains good composition efficiency.

Conclusion

- There are a lot of things to do for this in different areas.
- Many things we don't understand and a lot of work yet to finish last year data analysis including simulations. Without this it is difficult to make accurate predictions.
- It is important that each participant of work should understand what other people are doing and try to reach mutual understanding (parallel communications).
- It is clear that there is no magic solution and optimizations have to be done in different areas.
- One of the main issues is an inappropriate technique of the beam composition reconstruction efficiency. This will allow to formulate detector requirements.
- We expect to have Test Beam early May (to be confirmed soon).
    - Si pixel detector
    - TimePix Si detector?
    - Straw based detector?
    - Radiators?
    - Simulations and monitoring for new detectors.

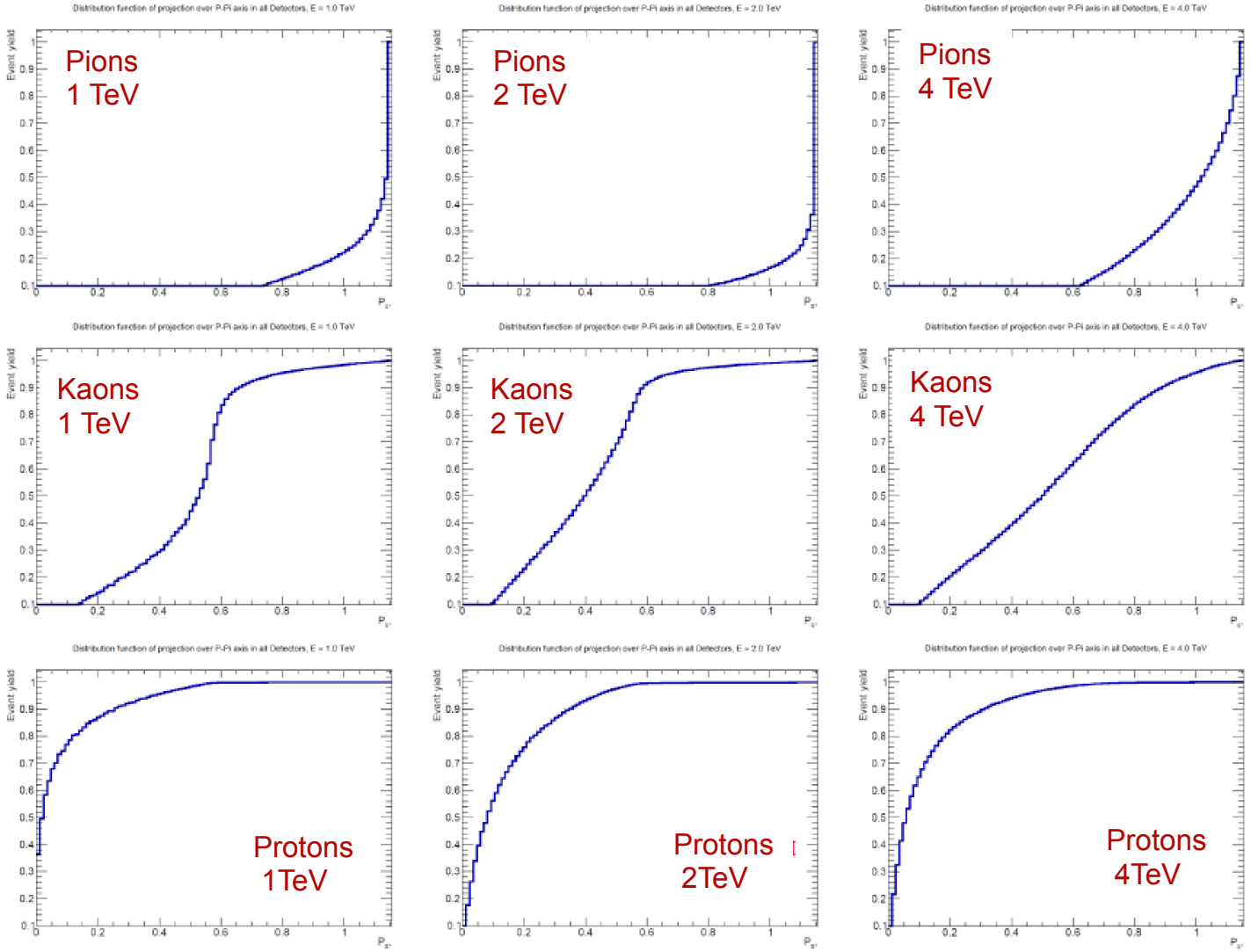
Nearest Plans

- Target is the TRD WS ate CERN 27-28 of March followed by **XSCRC2017: Cross sections for Cosmic Rays @ CERN (March 29-31)** where there will be 20 min SAS proposal presentation and 20 min TRD report.

- We have to come to this moment not only with some ideas and estimates of what can be done but also prepare 6 pages of TRD part of the paper which will be published in JINST.
- Plan of talk and plan for paper
  - *What to report?*
  - *What needed to be done by that time?*
  - *What we are going to put in the paper*
  - *What must be done by March?*
  - *……*
- TRD_SAS meeting each 2 weeks?

Detector concept

Probabilities for different particles and particle energies.



URGENT NEED: Bayesian approach to reconstruct beam composition + detector requirements.

Conclusions

1. A lot of confusing things.
2. Lack of requirements to make good particle separation.
3. Many simulations of radiator compositions and design.
4. More ideas for the detector concepts.
5. Many simulations of the radiator-detector concepts.