

Discussion of Joined Multi-Purpose Experiment (JMPE)

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The copy of this talk one can find at the <http://www.desy.de/~morgunov>

Introduction (I)

I will not discuss Vertex detector – it could be of about of one third of the real size.

I will not discuss TPC – it could be as large as an existing big prototype.

I will not discuss Magnet – some of the existing could be utilized.

Introduction II

Next generation of R&D experiments for ILC detector that combines and models whole chain of ILD detectors at the beam.

Project aims:

- 1. Experimental proof of Particle Flow Algorithm**
- 2. Check the mutual response of joint several modern HEP detectors into one setup by pseudo-jets.**
- 3. ...**

Plans: mainly questions than answers

Proposed geometry;

First nuclear interaction ;

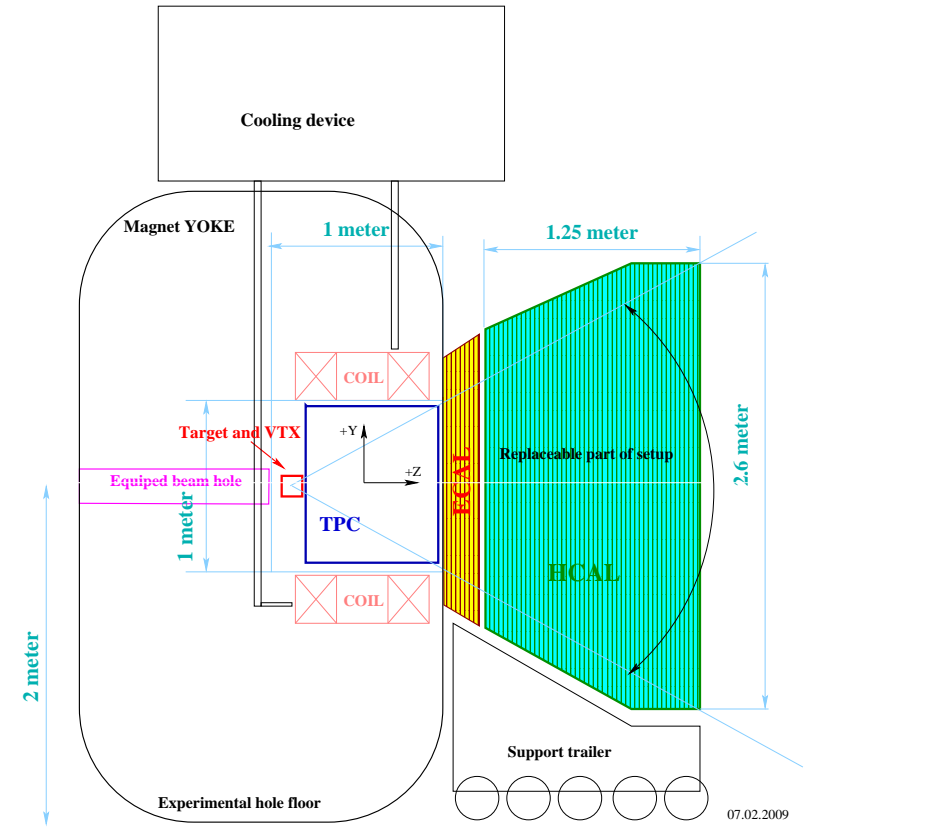
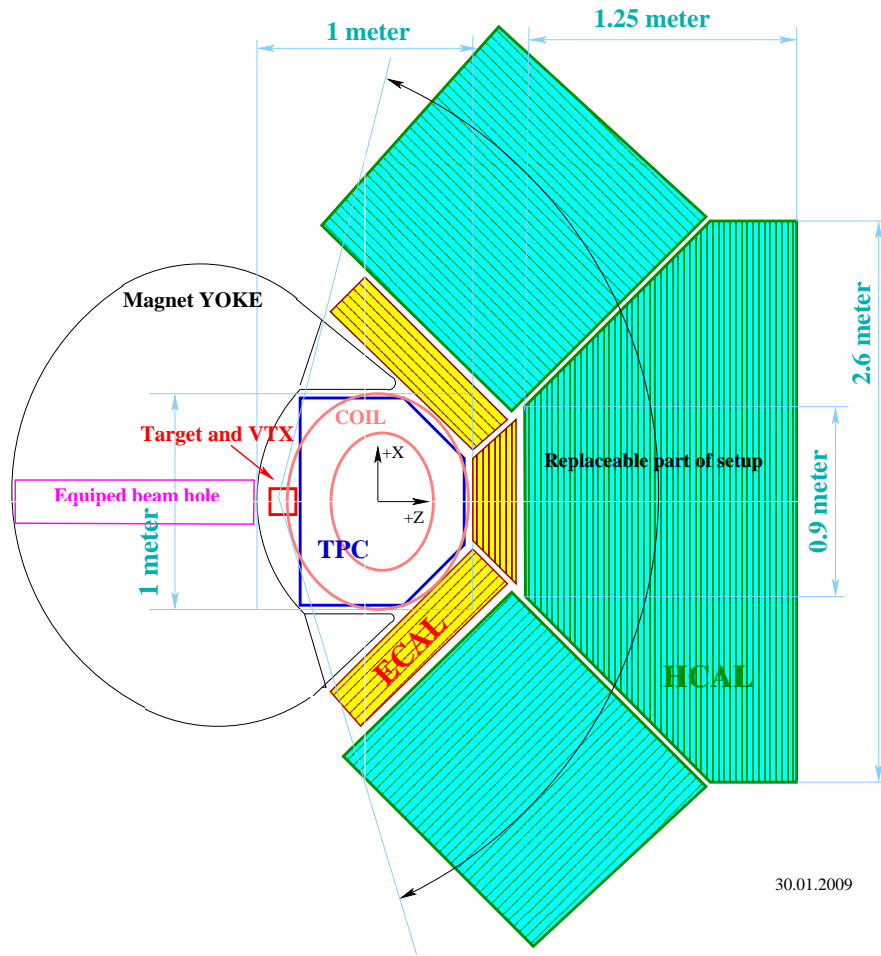
Target output (pseudo-jets);

Thin and thick targets comparison;

PFO candidates at the calorimeter face;

Disadvantages.

JMPE geometry

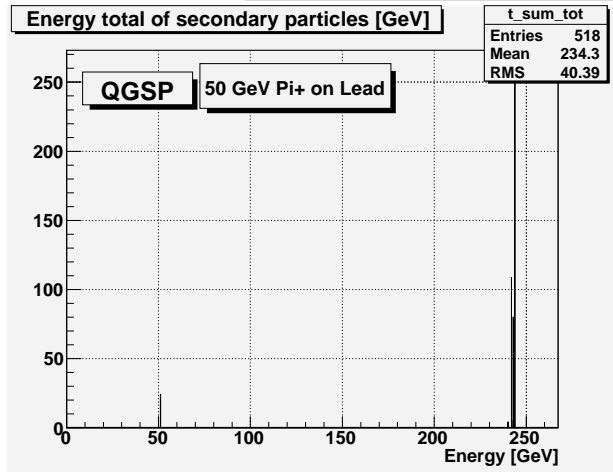


Vertical magnetic field in of about one cubic meter volume.

Analysis steps

- 1. Balance of energy and properties of the first nuclear interaction if it was occurred at the target.**
- 2. Balance of energy and properties of particles that left target.**
- 3. Balance of energy and properties for particles that reached a calorimeter face.**
- 4. Balance of energy and properties of PFOs.**

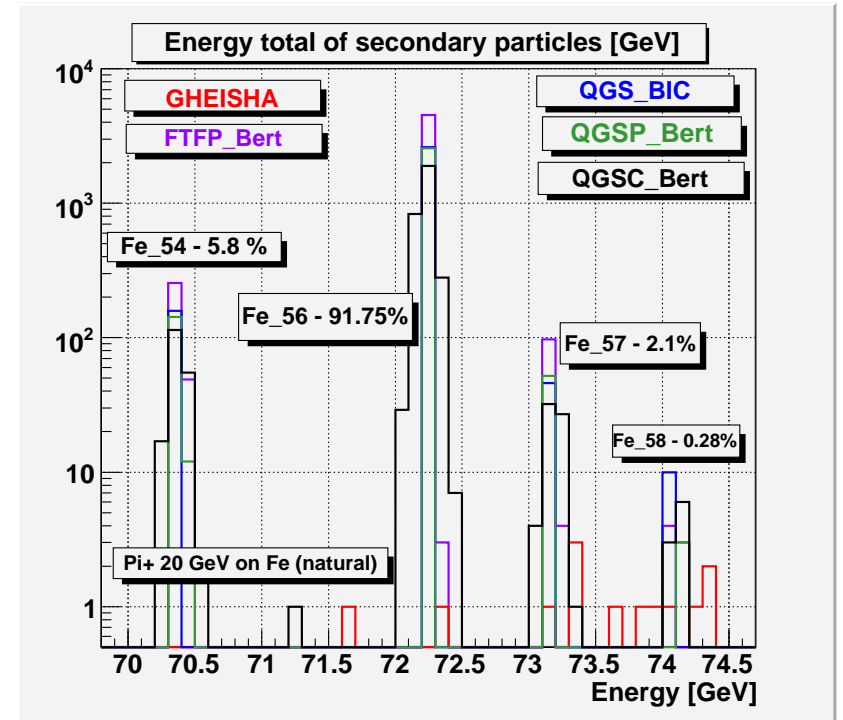
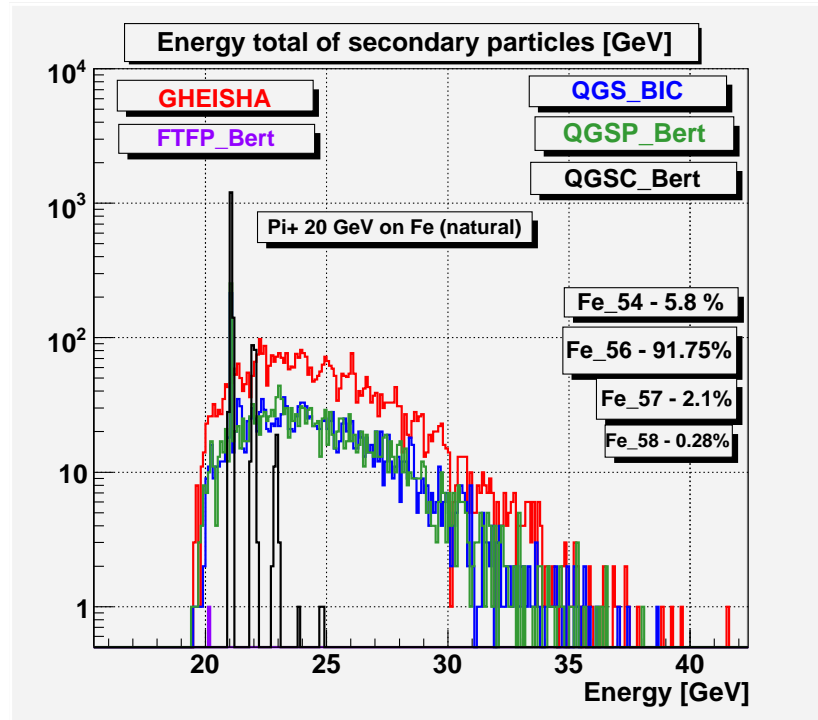
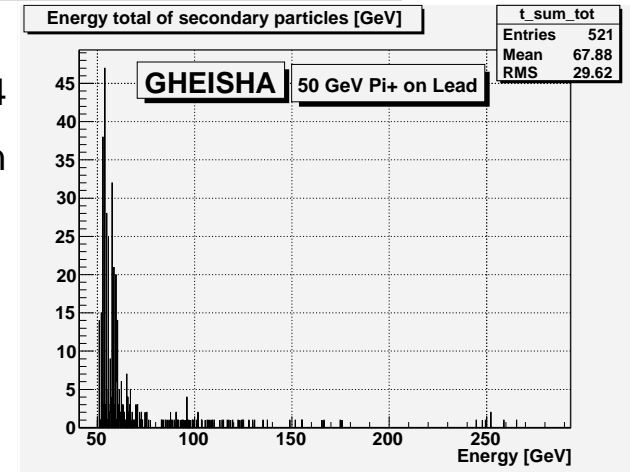
First interaction: energy conservation law ?



Some of the program in GEANT4 knows about energy conservation law, some does not.

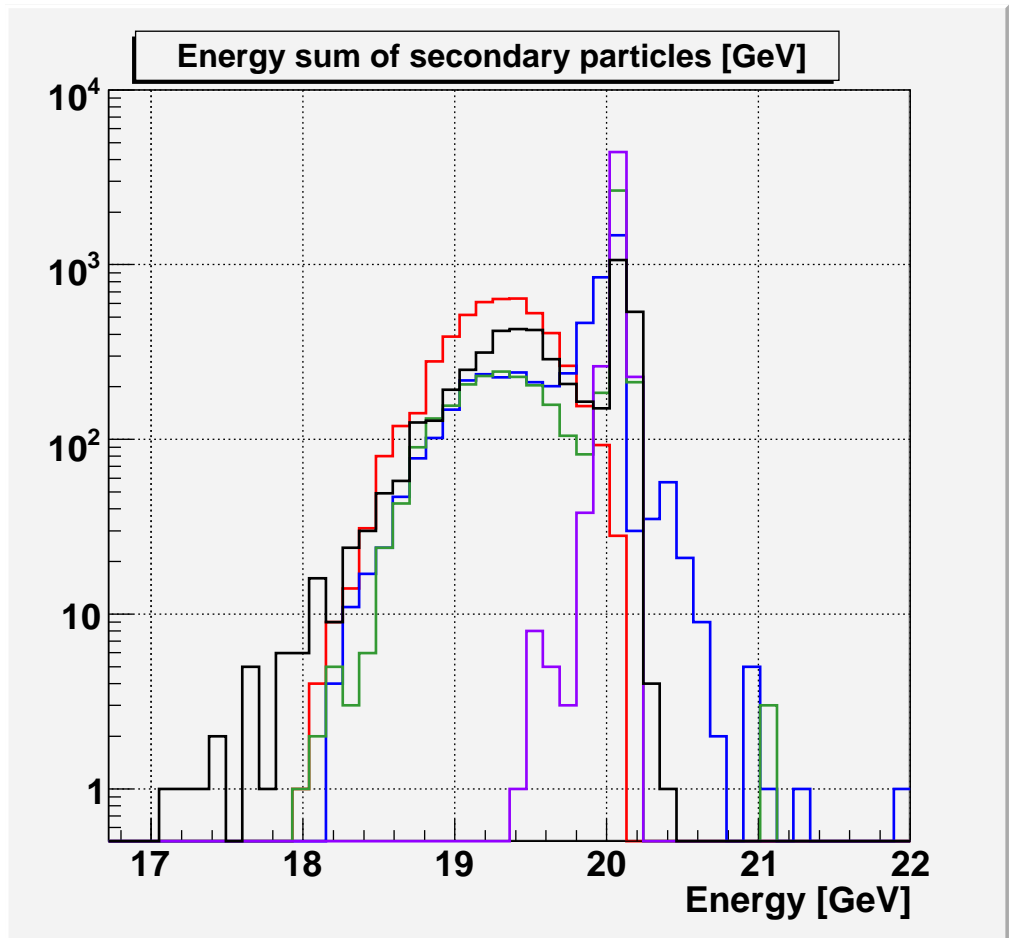
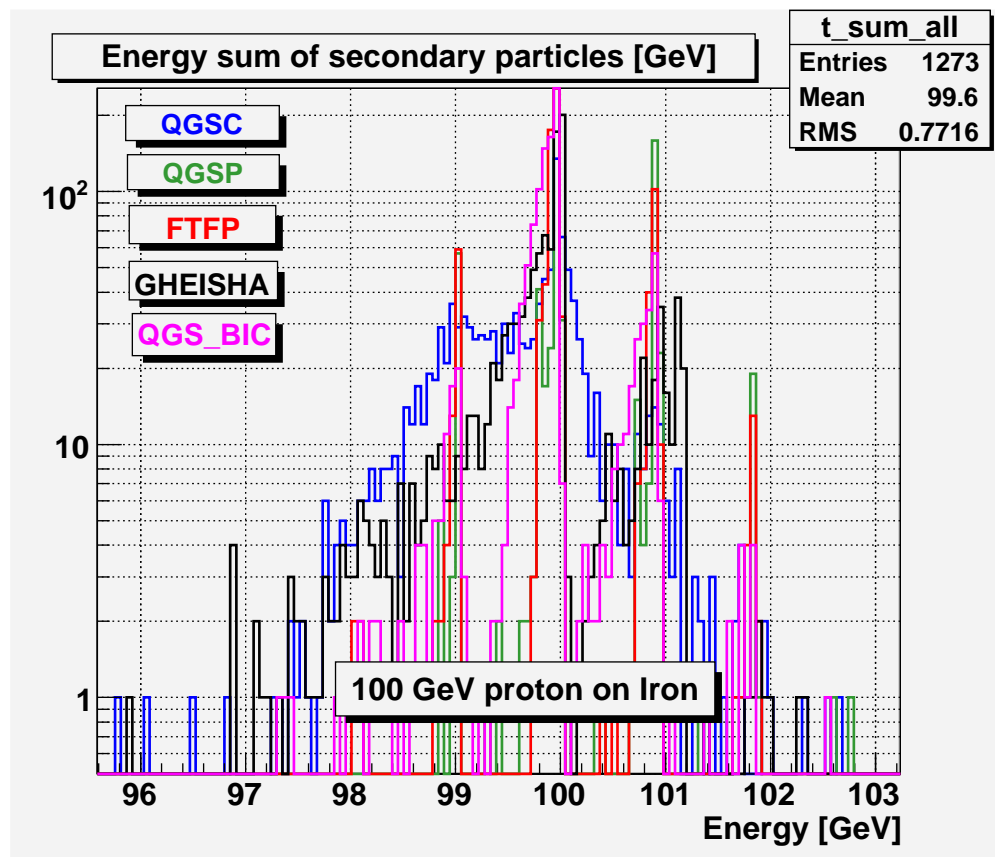
But sometimes they also know?

Simulation of residual nuclei.



Target: output energy

Different target isotopes give us different initial energies.



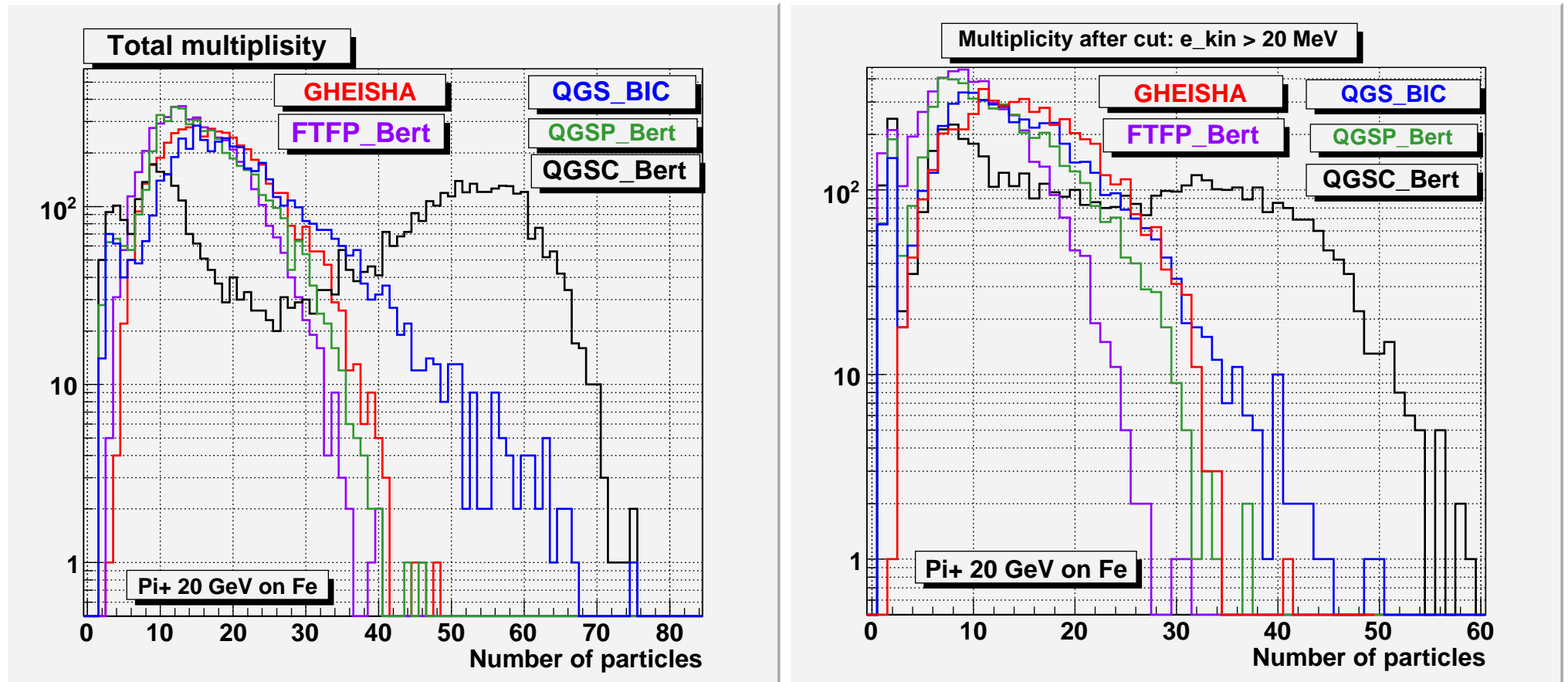
Target radius = 5 mm; Length = 10 mm.

20 GeV pion on Iron

excluding residual nucleus.

Multiplicity

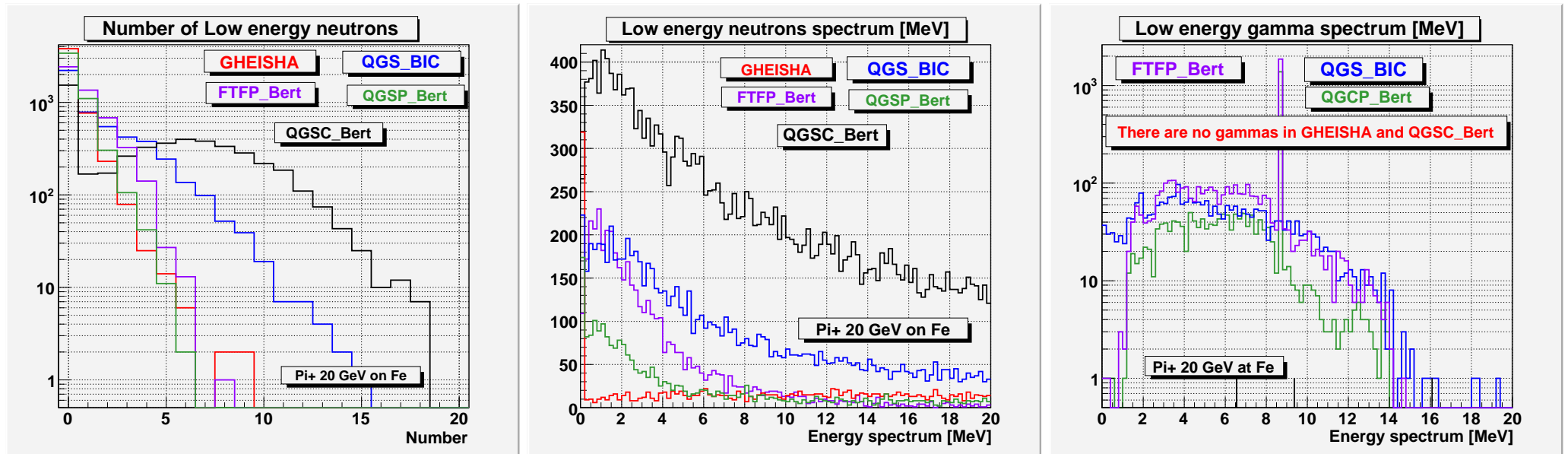
Different Physics Lists show different predictions.



QGSC_Bertini has different shape in compare with others.

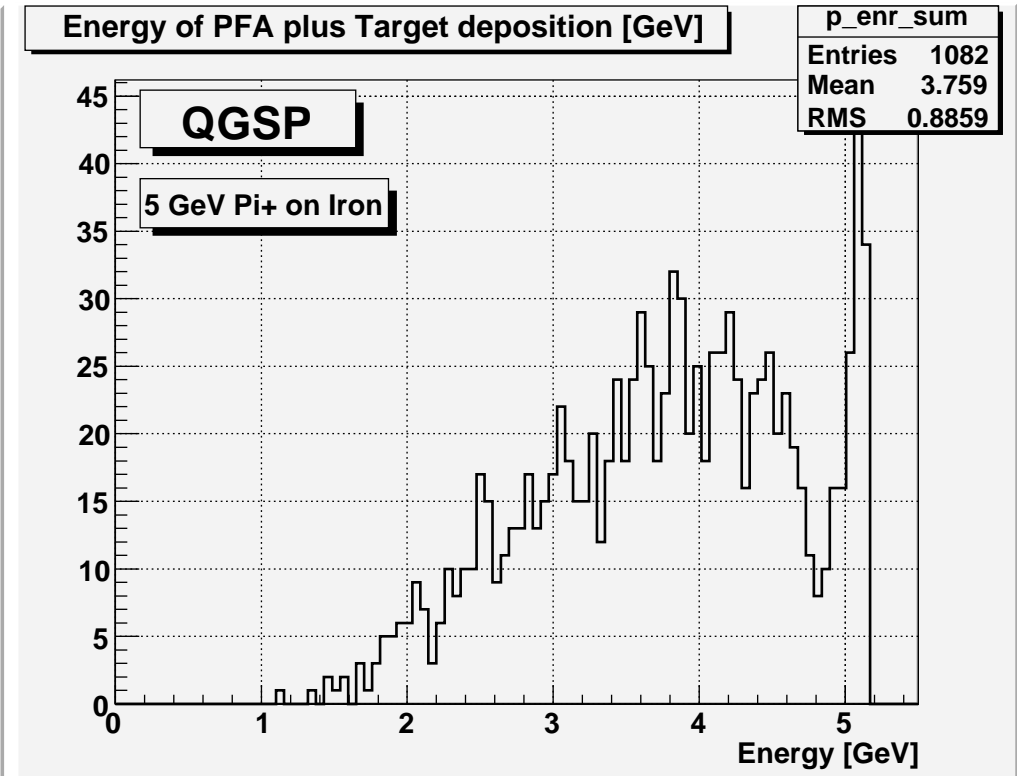
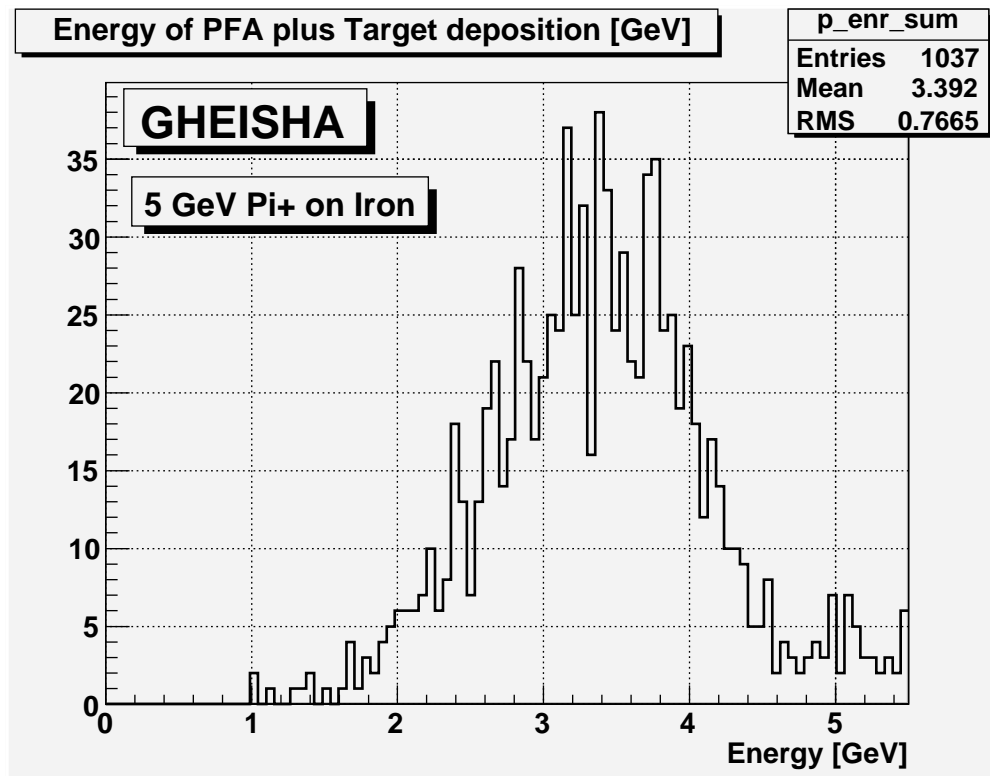
Low energy components

Different Physics Lists show different predictions.



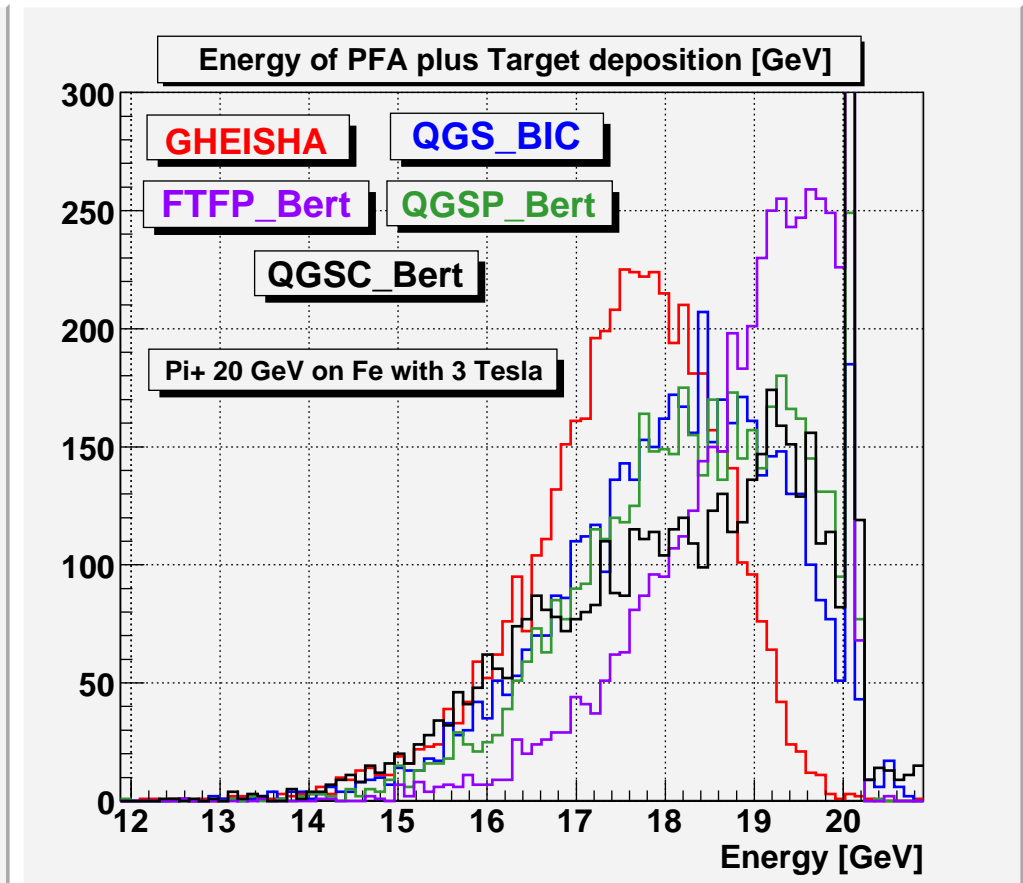
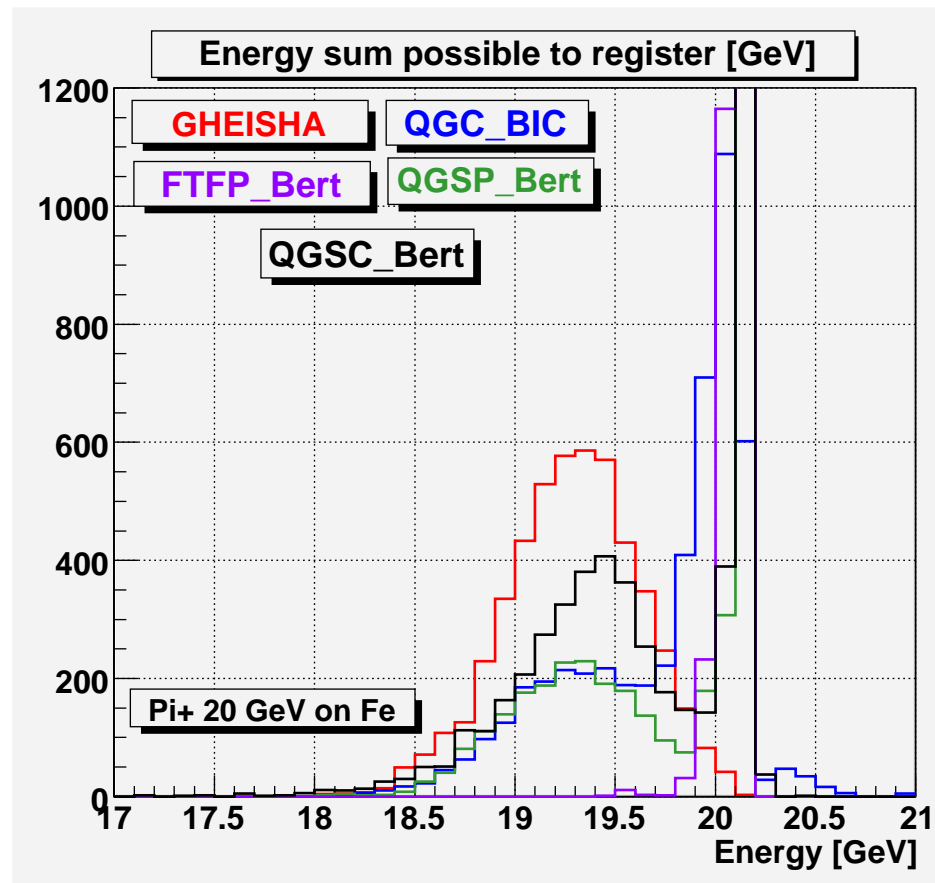
Energy possible to register (1)

Different Physics Lists show different predictions.



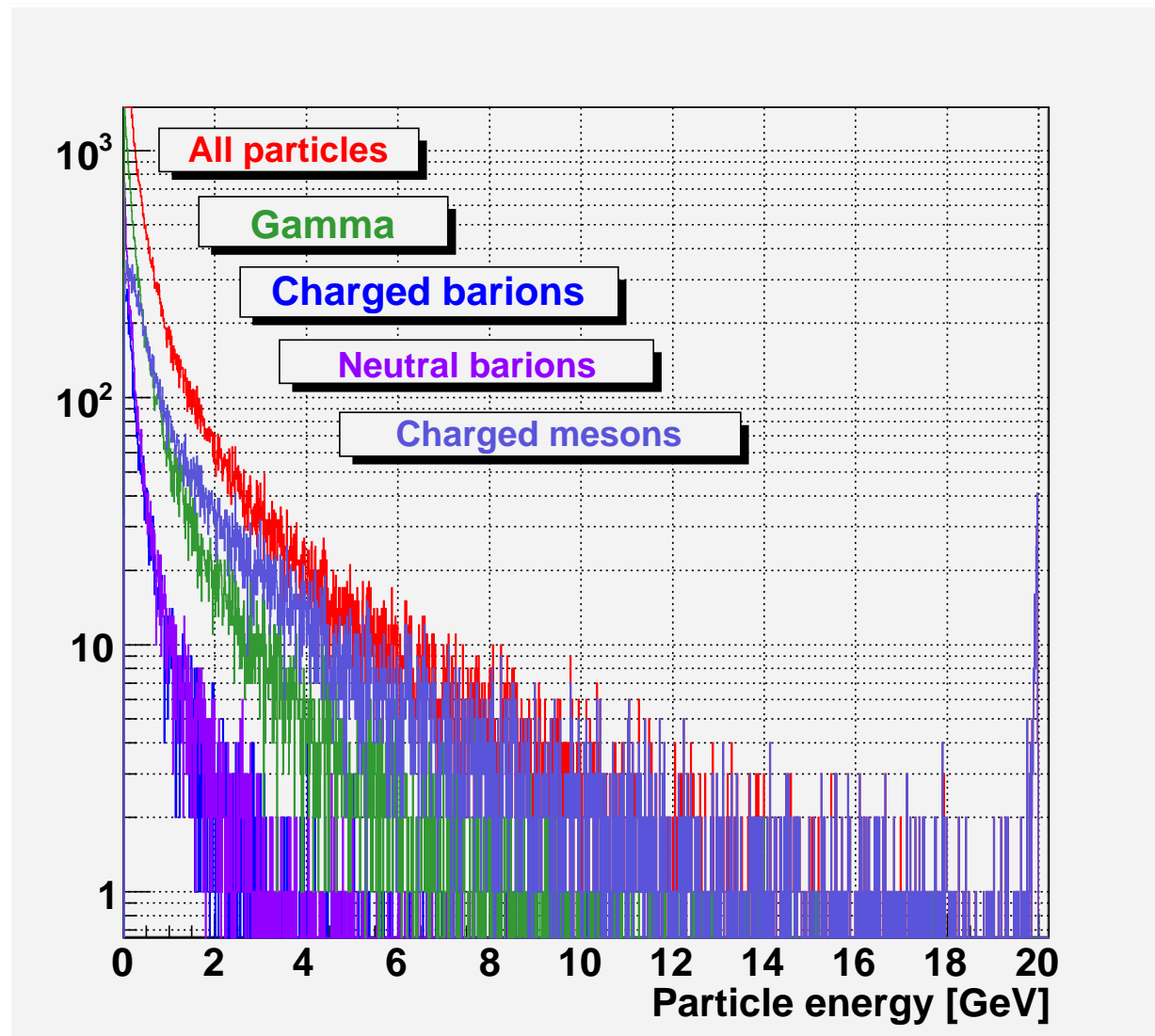
Energy possible to register (2)

Different Physics Lists show different predictions.



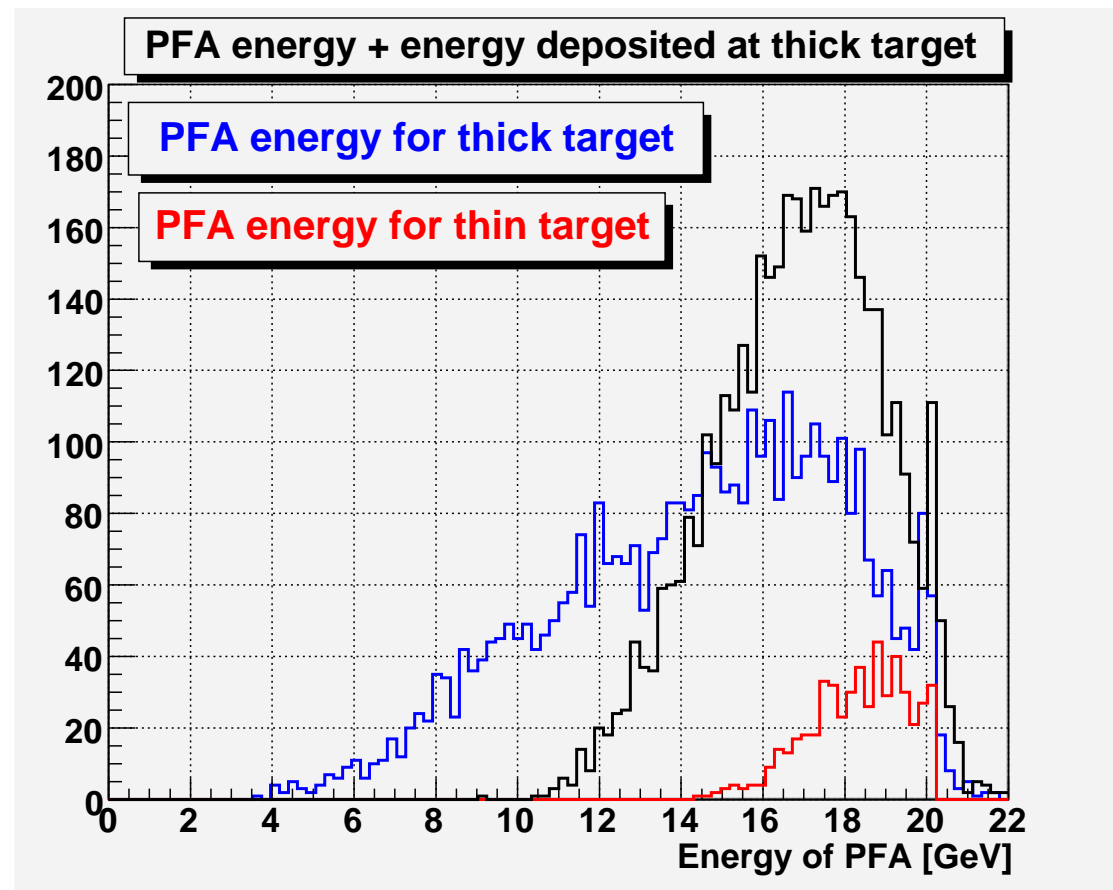
Higher than some threshold.

Energy spectrum of particles left target (by type)



π^+ 20 GeV beam

Thin and thick targets



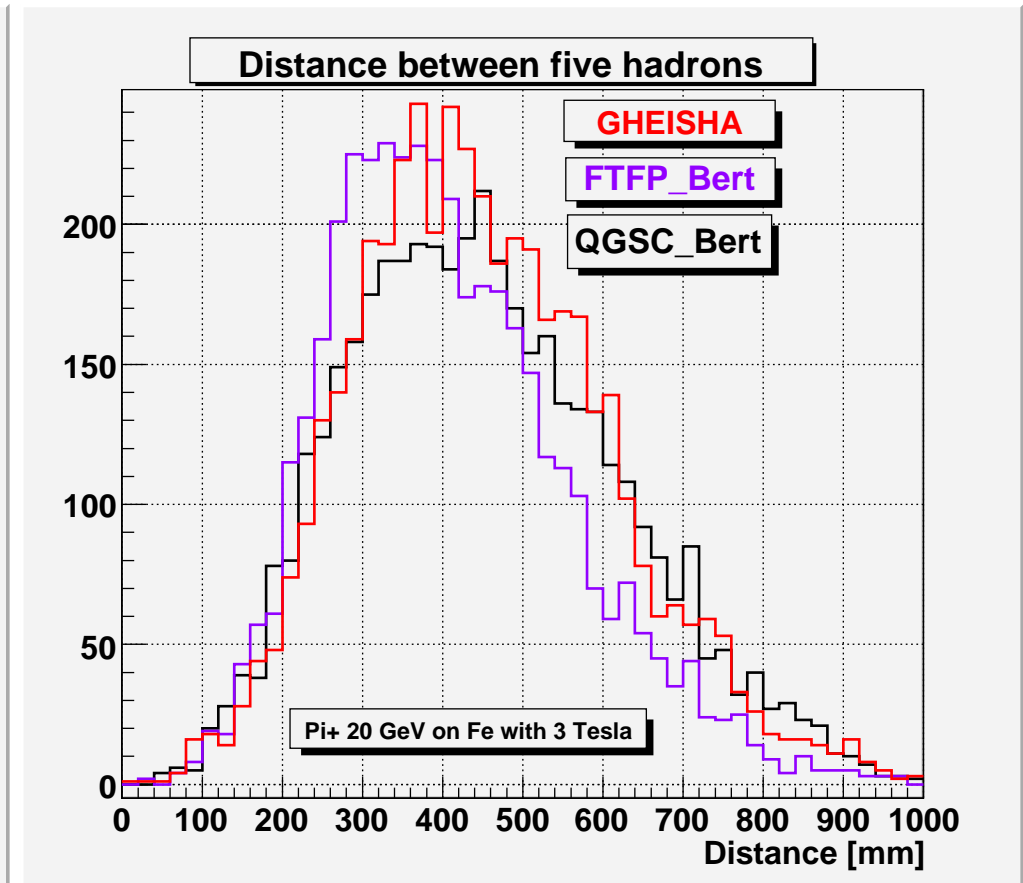
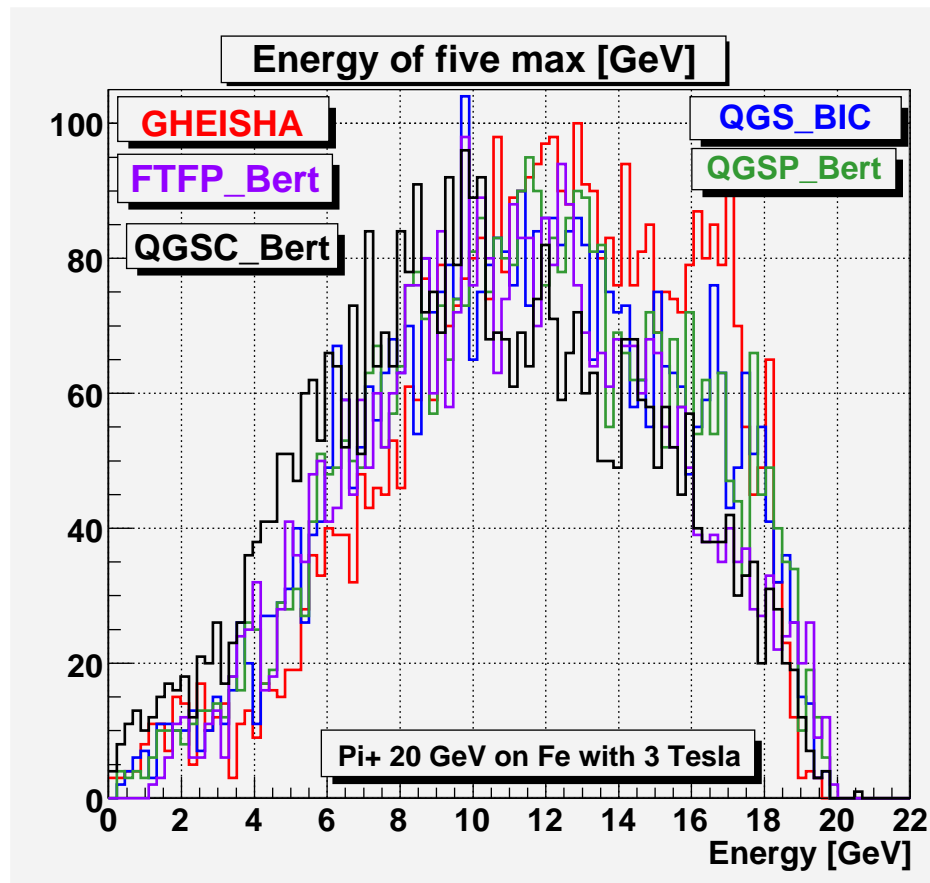
“Thin” here is 5 mm diameter 10 mm length.

“Thick” here is 50 mm diameter 100 mm length.

Energy losses in thick target could be “compensate” if one will measure energy deposited at the target.

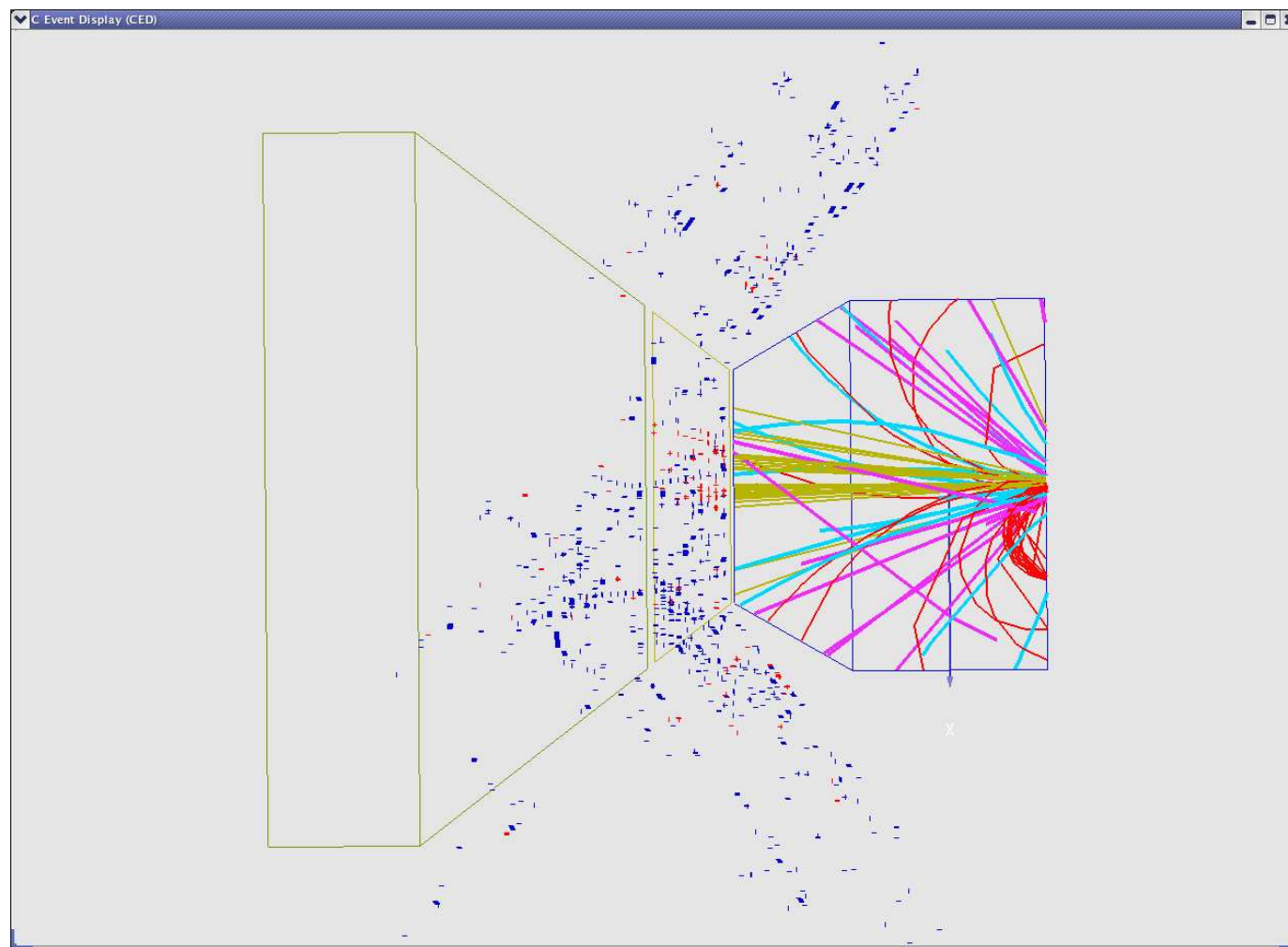
Number of interactions at thin target is much less in compare with thick one.

Five hadrons with maximal energy



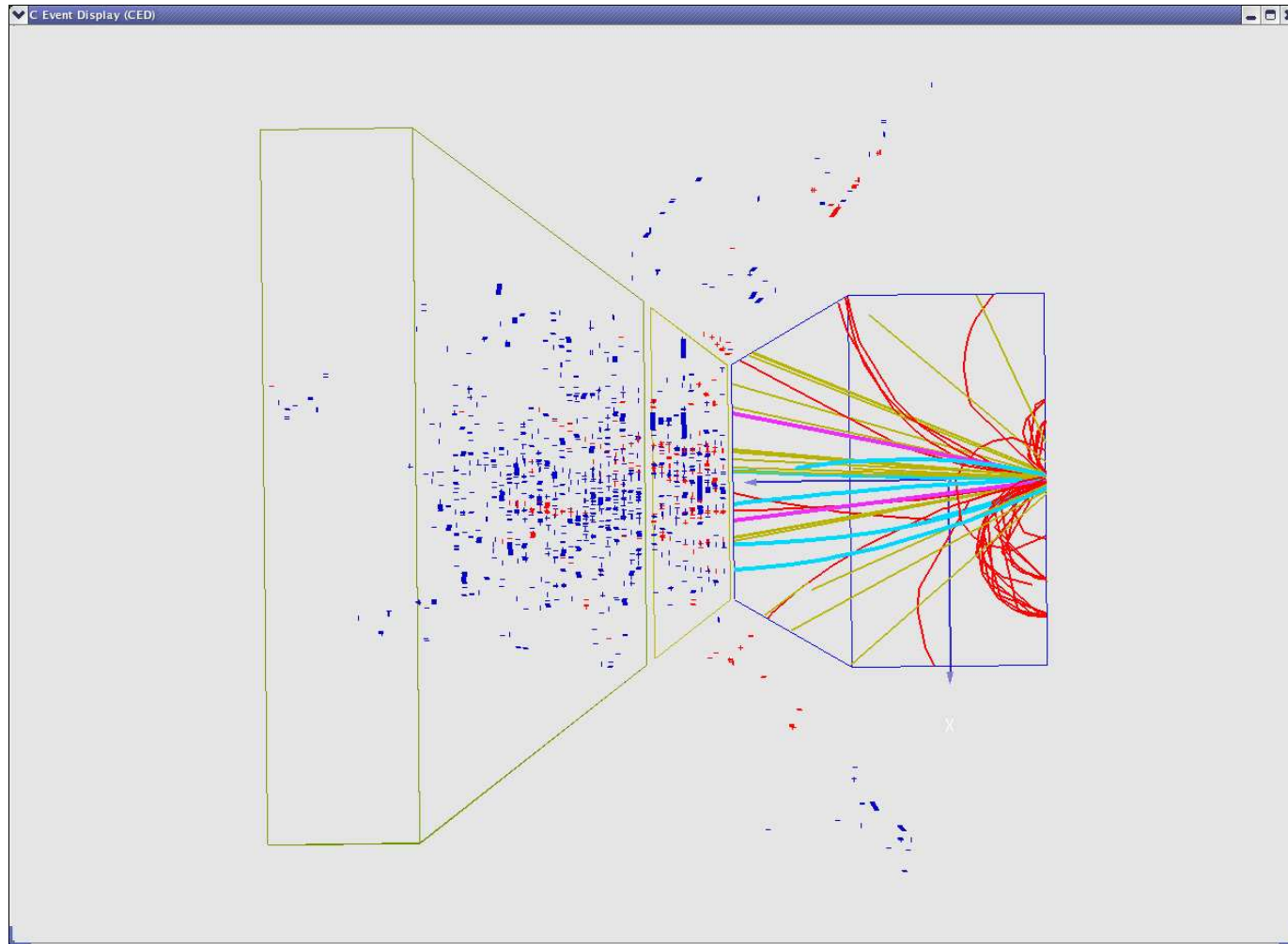
**Spectra and angular distributions of the most energetic particles are in a rather good agreement
for all GEANT4 Physics Lists.**

Simulated event



Pion⁺; 20 GeV; 0.8 Tesla; Thin target.

Simulated event

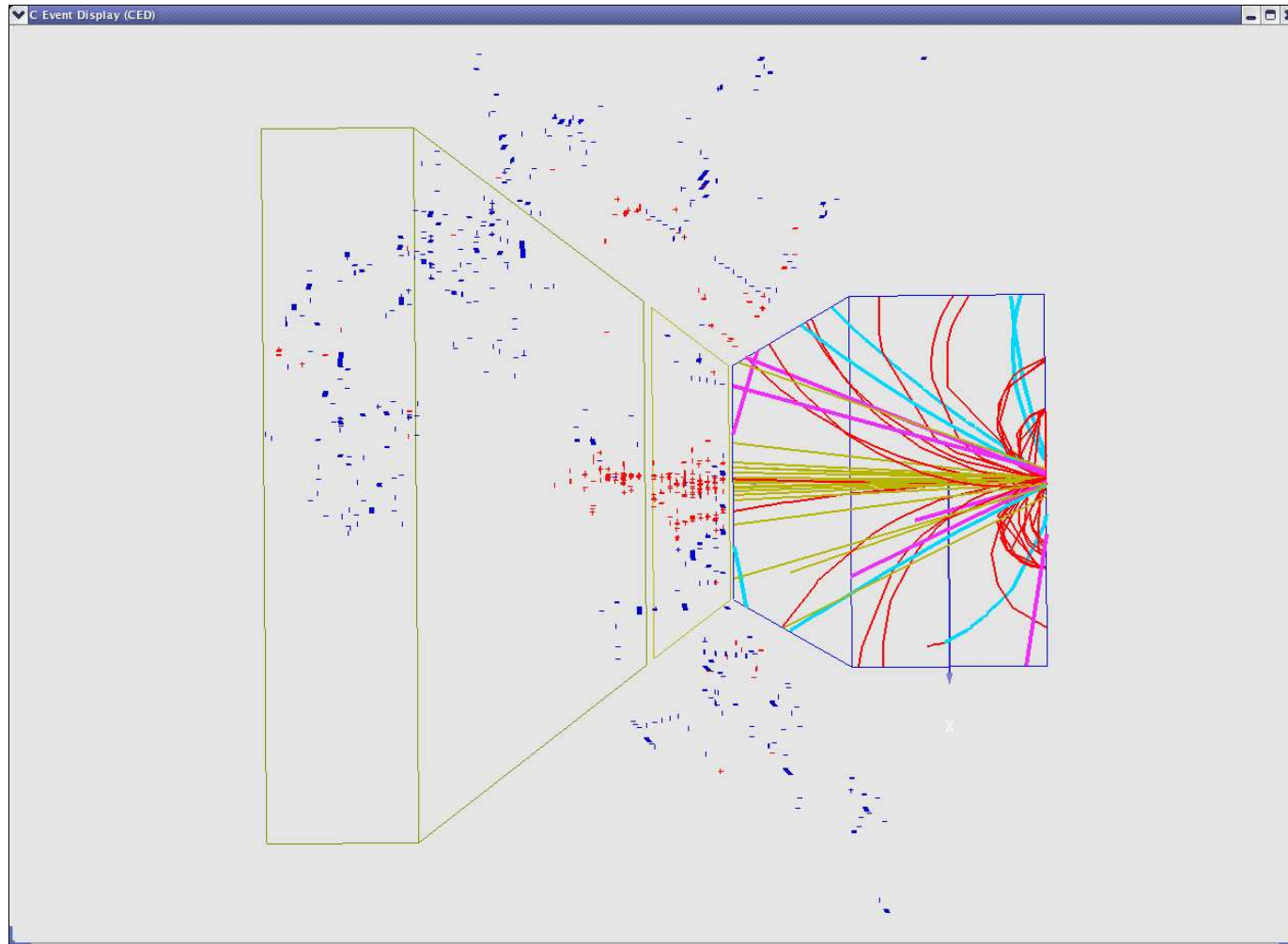


Pion+; 20 [GeV]; 0.8 Tesla; Thin target.

Energy lost in target = 1.818 [GeV]; Sum = 18.74 [GeV];

Sum of PFO energies = 16.93 [GeV]; E calo = 14.33 [GeV]

Simulated event

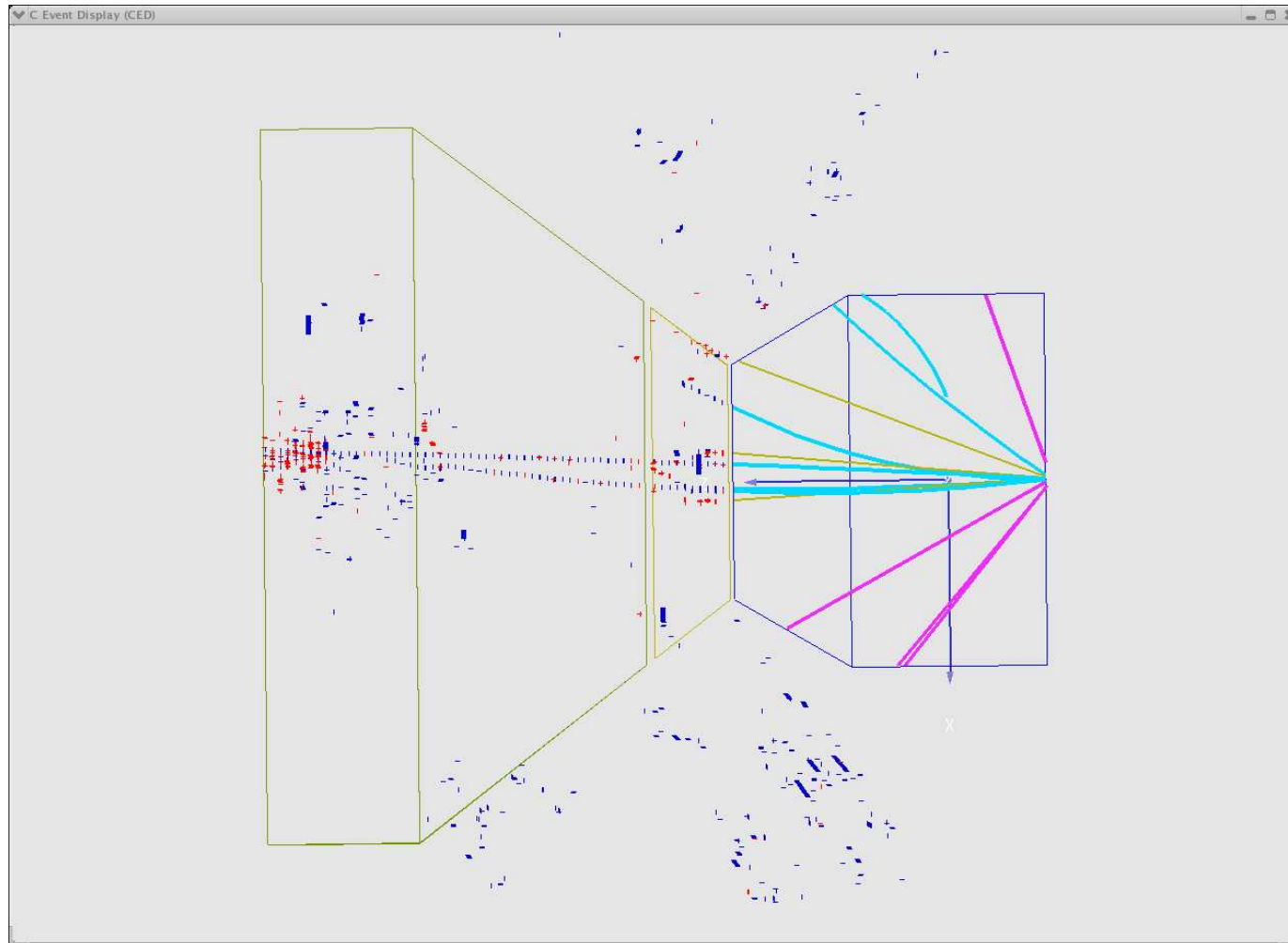


Pion+; 20 [GeV]; 0.8 Tesla; Thin target.

Energy lost in target = 3.042 [GeV]; Sum = 19.85 [GeV];

Sum of PFO energies = 16.81 [GeV]; E calo = 14.18 [GeV]

Simulated event

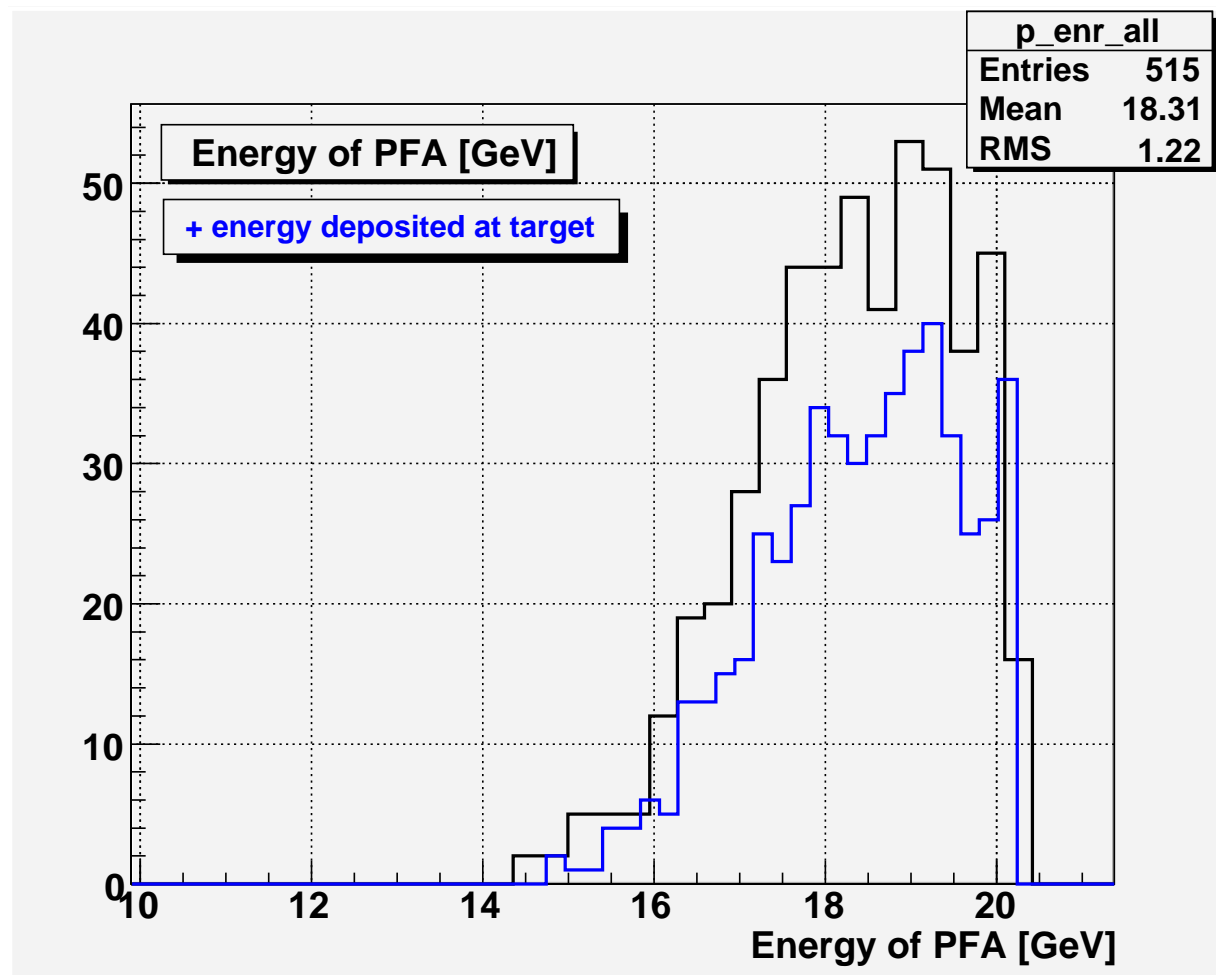


Pion+; 20 [GeV]; 0.8 Tesla; Thin target.

Energy lost in target = 0.3148 [GeV]; Sum = 19.64 [GeV];

Sum of PFO energies = 19.32 [GeV]; E calo = 13.49 [GeV]

Possible PFA test

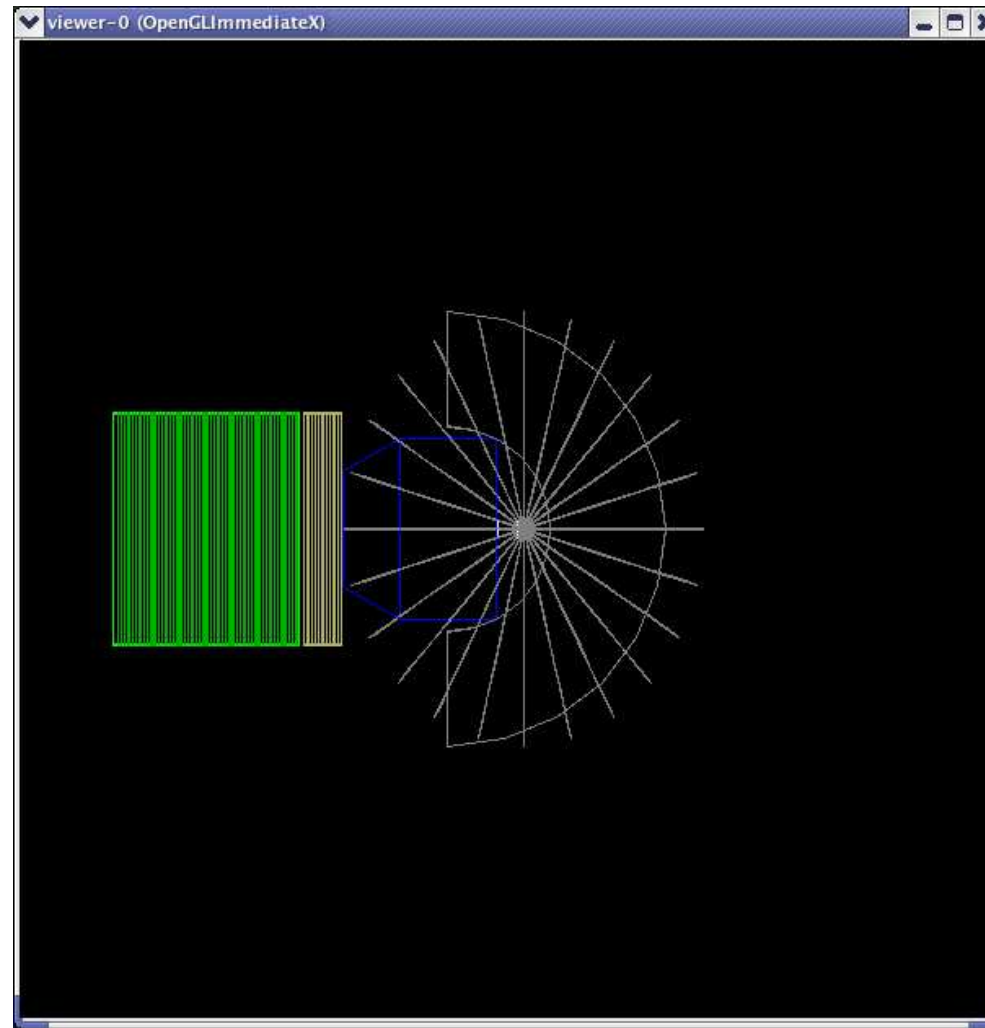


Expected PFA resolution for 20 GeV is of about 1.3 GeV
that is comparable with energy spread of pseudo-jet.

BUT one should remember page # 11 !

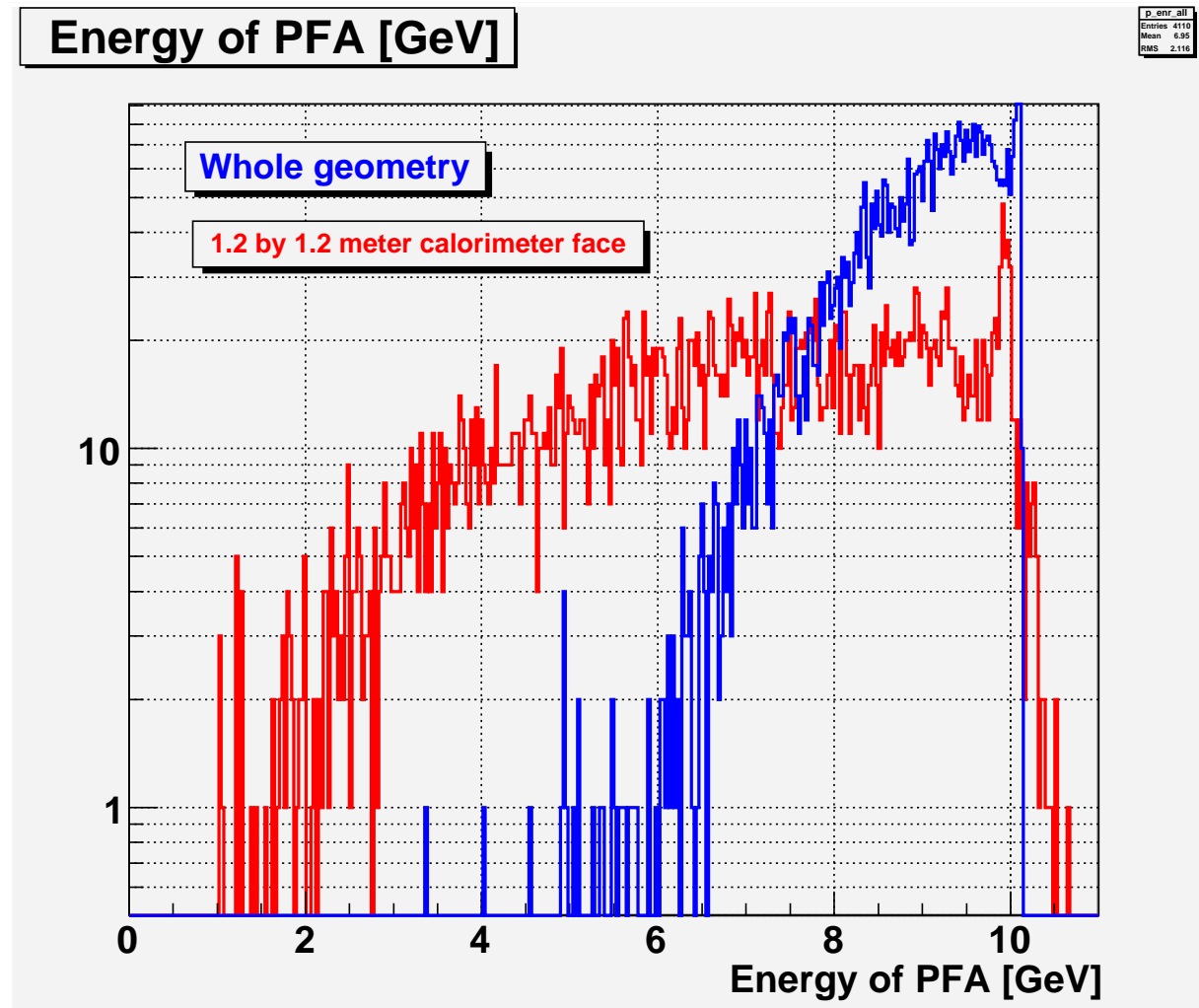
Reduced geometry

Detector has been shown is too large and too expensive.



Let us look at CALICE like calorimeter with $1.2 \times 1.2 \text{ m}^2$ size.

Reduced geometry



Transversal leakage become to be significant for PFA.

Expected PFA resolution for 10 GeV is of about 1 GeV.

Bad news

The JMPE project is too large and too expensive to be realistic.

Device with smaller calorimeter will not be able to prove PFA.

**Such a project will have a small running time because it needs small statistics to prove PFA
(if it is an aim only).**

Too much efforts for nothing.

Conclusion

From slide # 6 to slide # 11 one can see a real problem to work on.

**That is the nuclear physics experiment,
to measure inelastic exclusive hadron cross-sections on nuclei for intermediate energy range.**

**Physics of nuclear matter is in childish state,
it needs a huge amount of experimental data to be advanced science.**