

eRD1. Status of MC toward high resolution HCAL
using timing, not yet.

Jan. 25 , 2019

O.Tsai

Recommendation

The Committee finds this suggestion intriguing and encourages its pursuit through a detailed Monte Carlo simulation to study the overall feasibility of the study before starting to build an actual module. **The collaboration is requested to report on the simulation study in order to verify adequate shower containment by any proposed device and report to the committee before starting the hardware effort.** Some economy in re-using of existing materials and optical readout systems and electronics to accomplish these tests is strongly encouraged.

Current Status:

UCLA GEANT4 Model. EM + HAD1 + HAD2

- EM – Stack 16x16 towers (Shashlyk) ~ 18X0, ~ 0.5 int.l.
- HAD1 – Fe/Sc (20mm/3mm) Stack 6x6 towers ~4.3 int.l
- HAD2 – same as HAD 1.

Transverse size 0.6m x 0.6m x 9 int. length

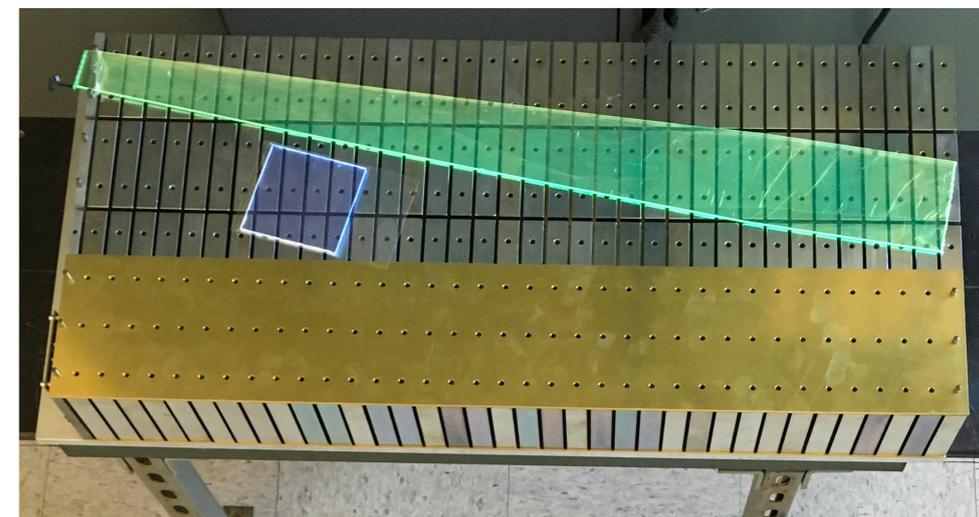
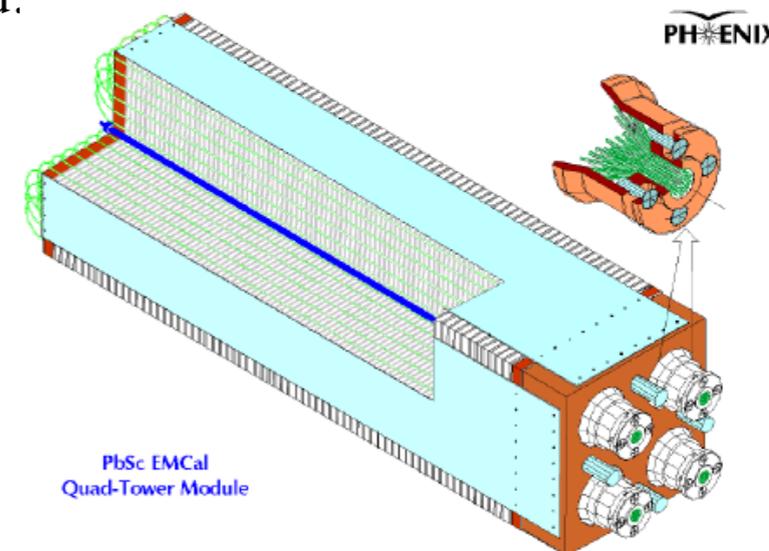
Goal:

Compare three configuration

- No leakages (EM + HAD1 + HAD2)
- Leakage from back (EM + HAD1)
- Leakages from back and from side (EM + HAD1, restricted to 0.4m x 0.4m central region)

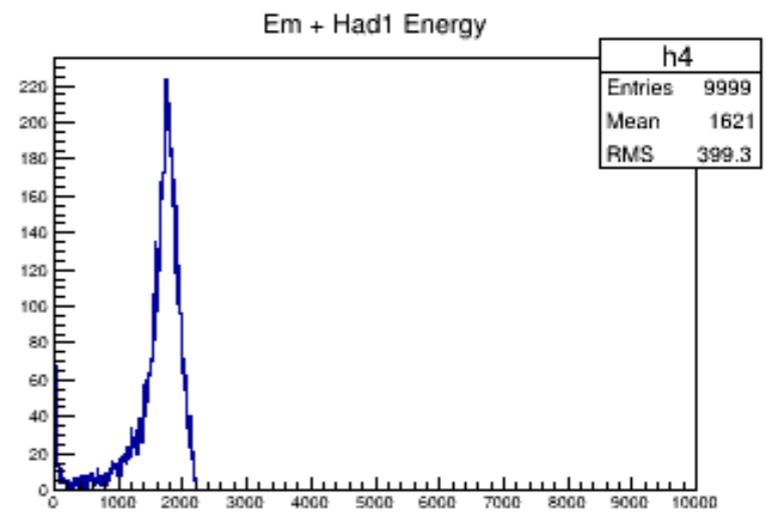
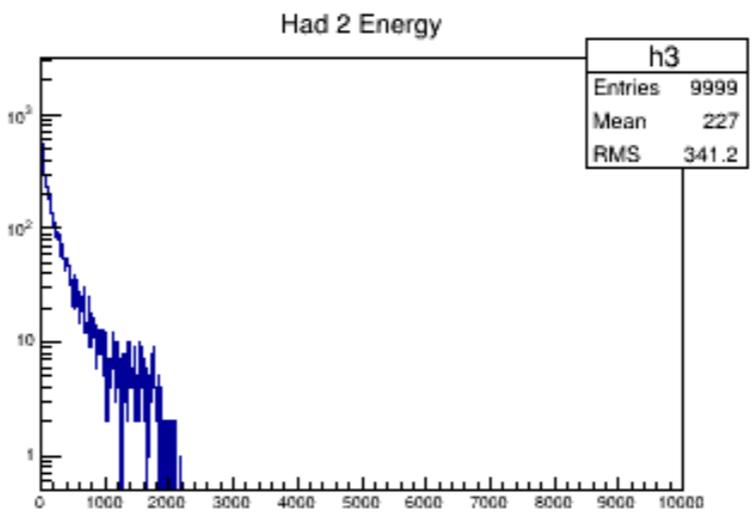
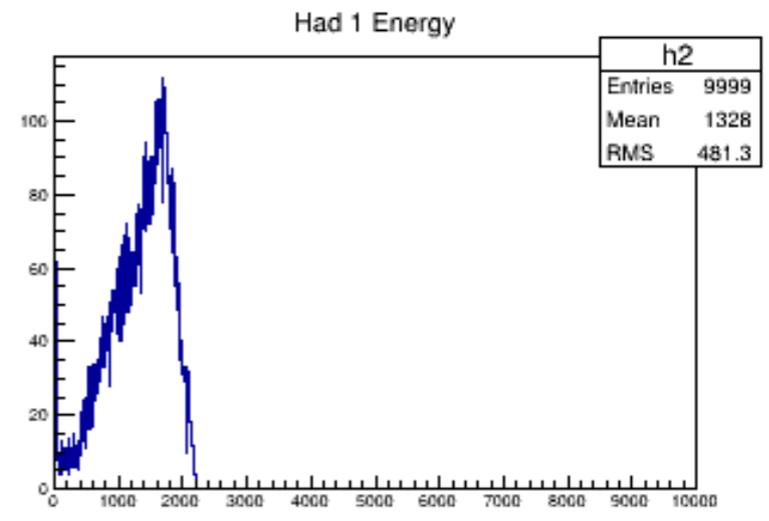
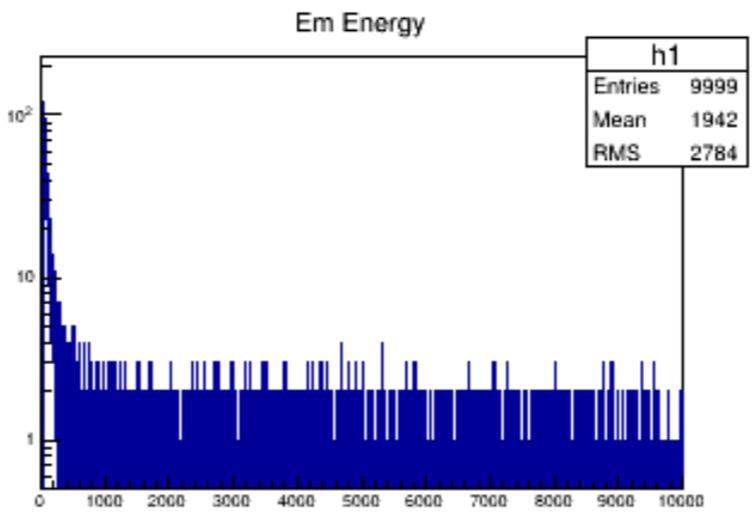
(Model implemented by M. Sergeeva, data being analyzed by N.Yao and R.Milton undergraduate)
Energies: 6 – 100 GeV (FNAL test beam Range). FTFP_BERT_HP. Two sets: Birks On, Birks Off
Additional data set with Sc plates 6 mm thick for HCAL.

All results shown below are PRELIMINARY.

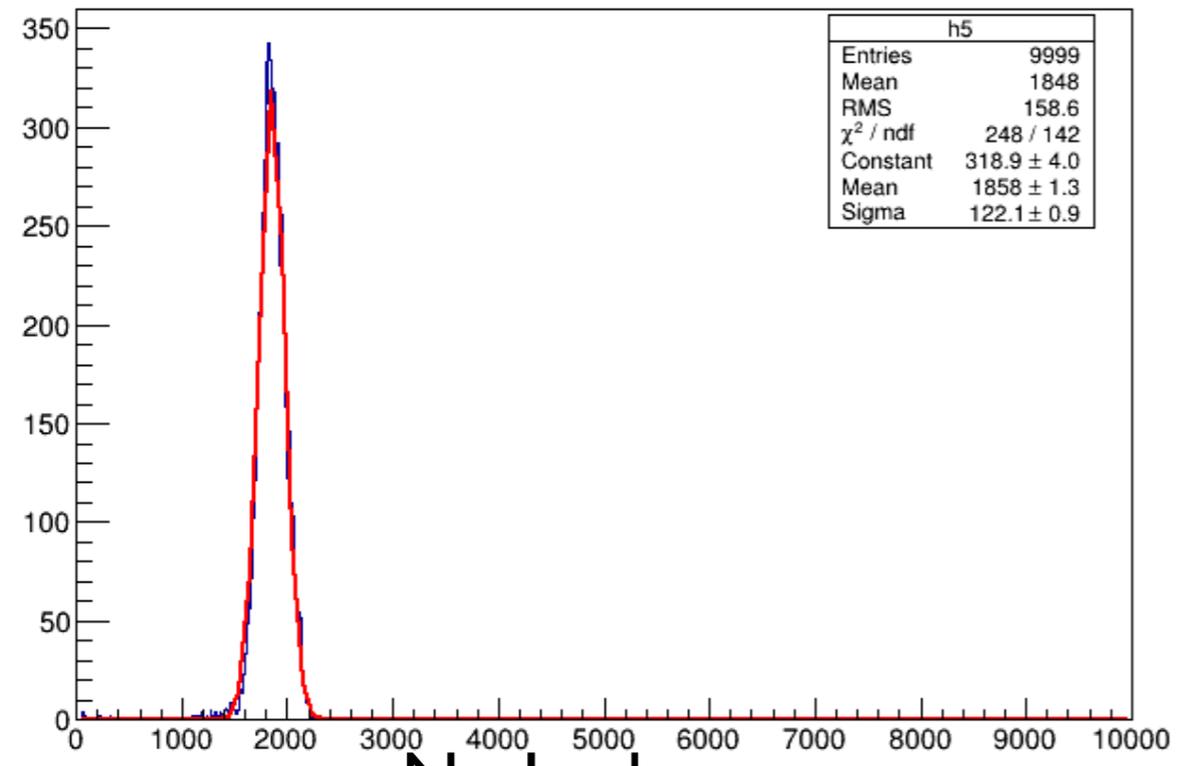


Basics, 100 GeV pi-

- Non-Compensated
- Weighting for EM energy dependent.
- Used average weight for

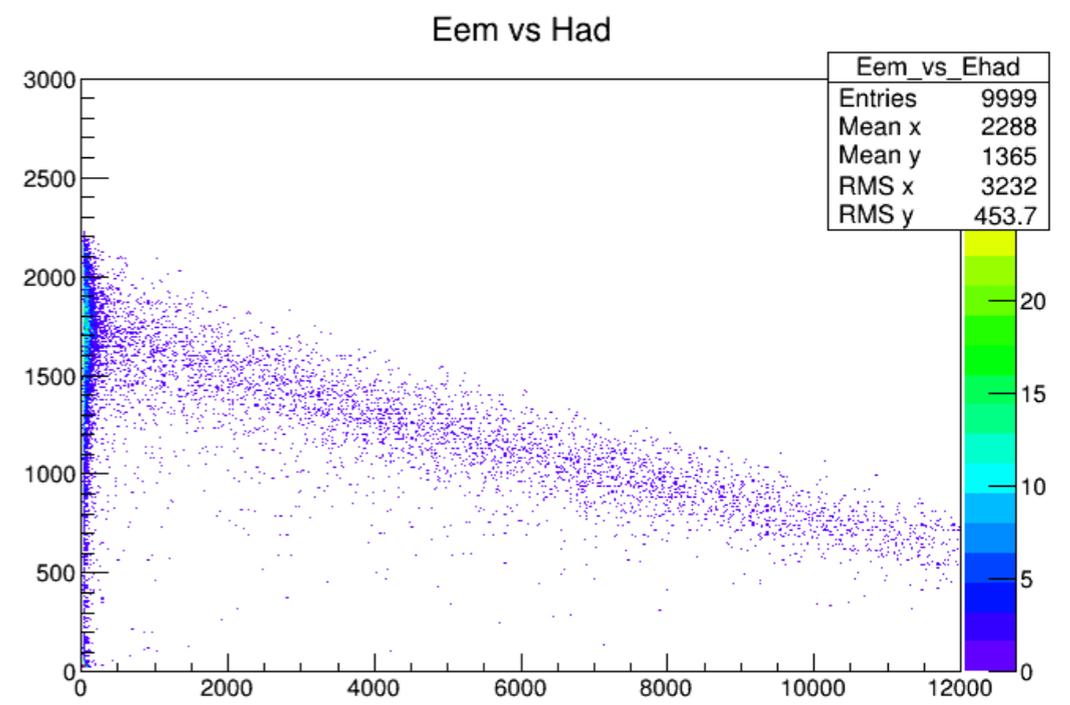


Total Energy

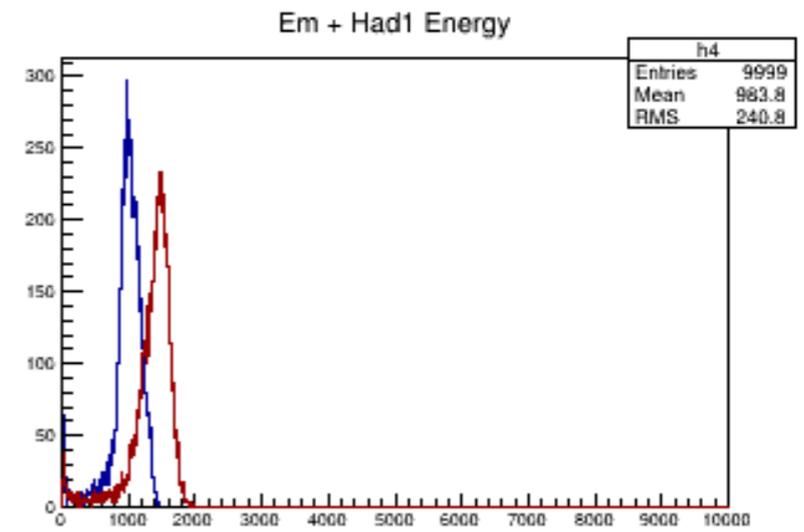
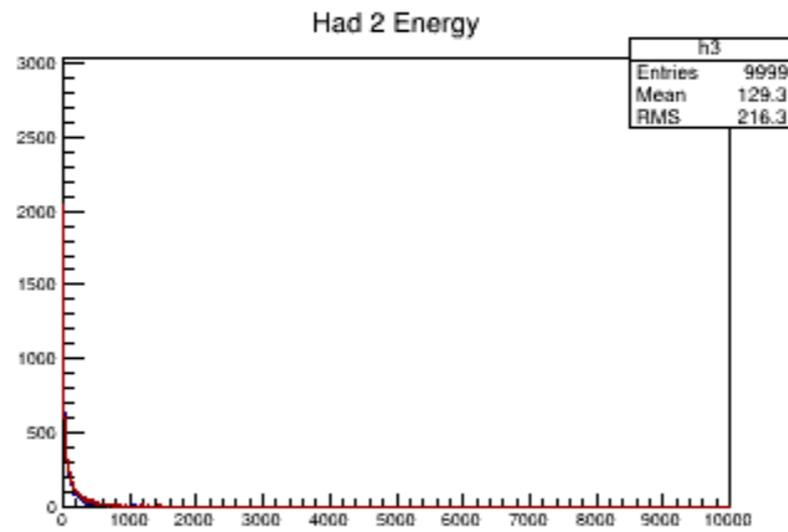
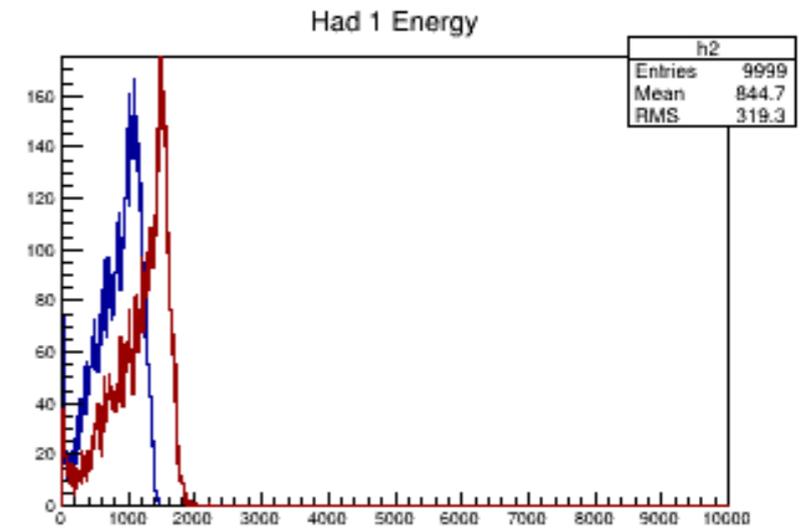
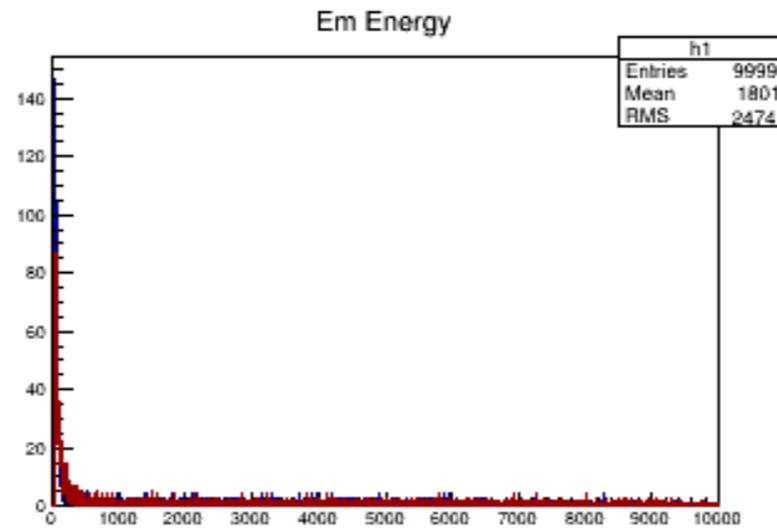


No Leakages

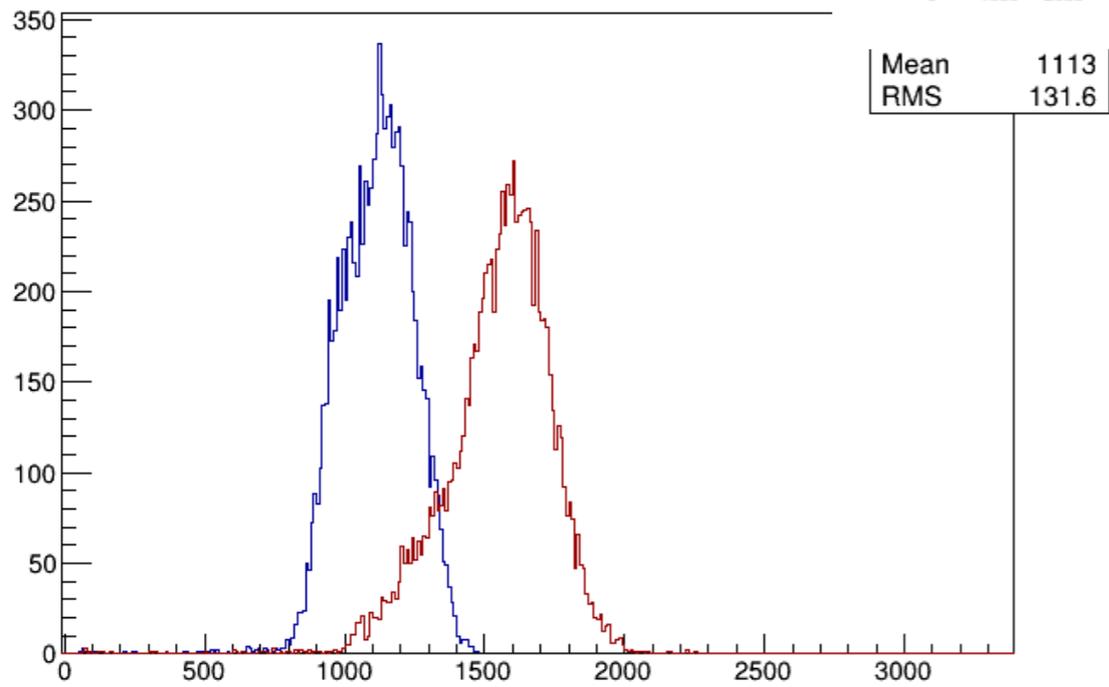
Leakage from back



Proxy to recolis, i.e. heavy ionizing components

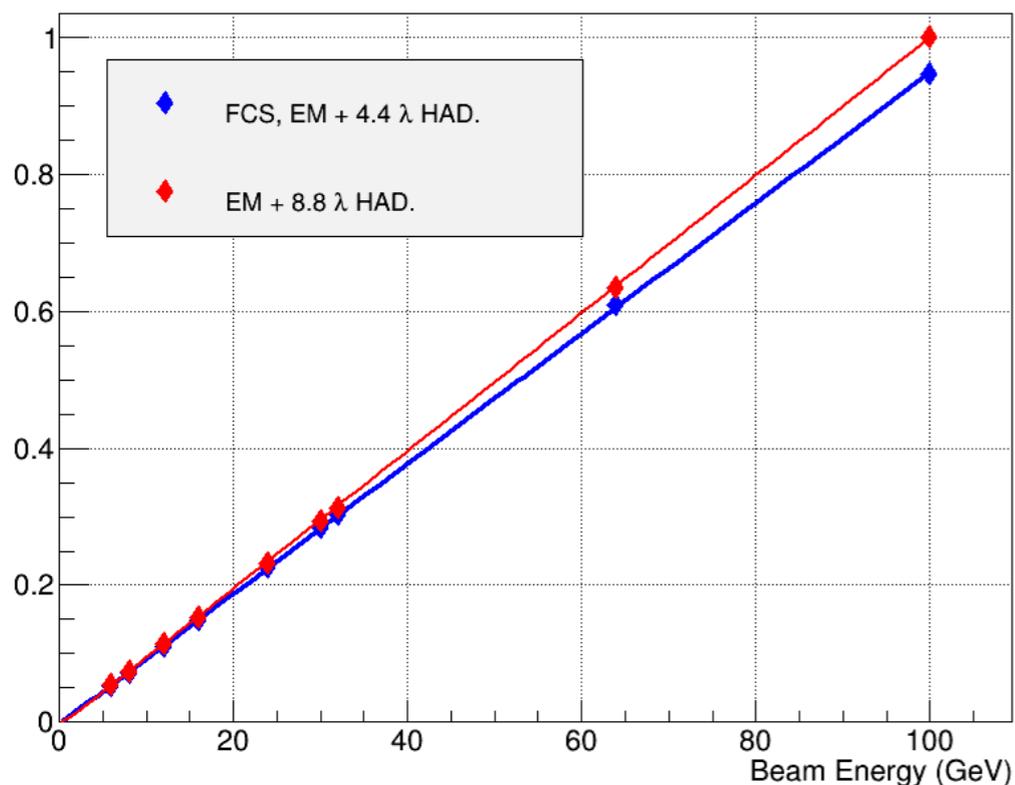


Total Energy

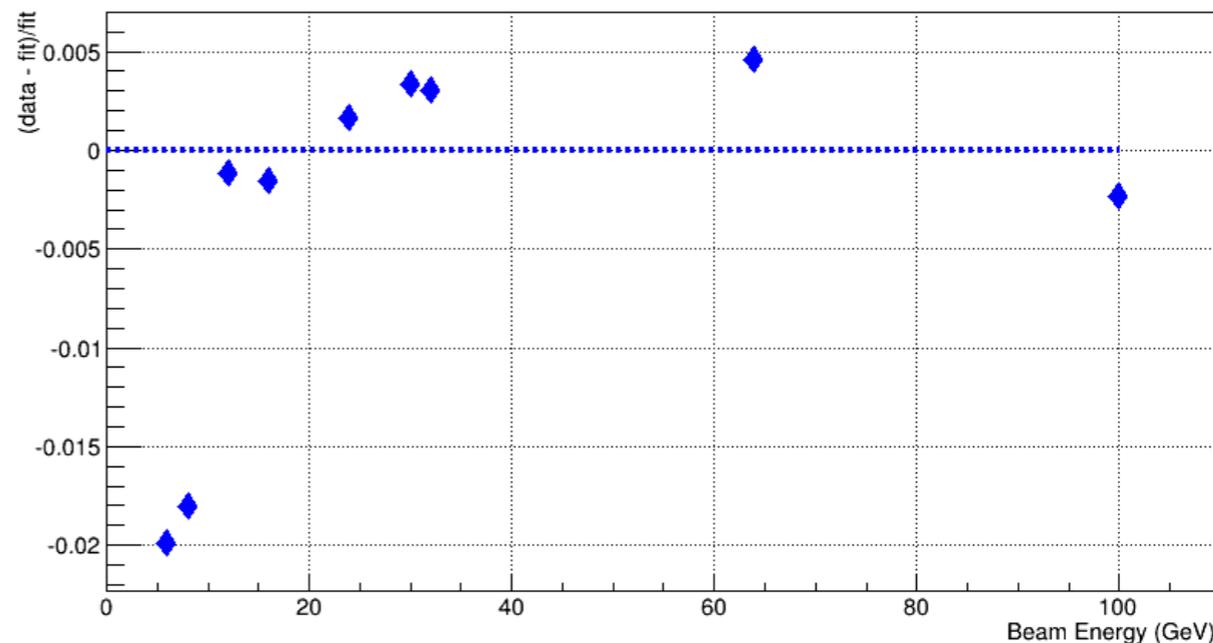


Resolution. EM +HADI, vs EM +HADI +HAD2

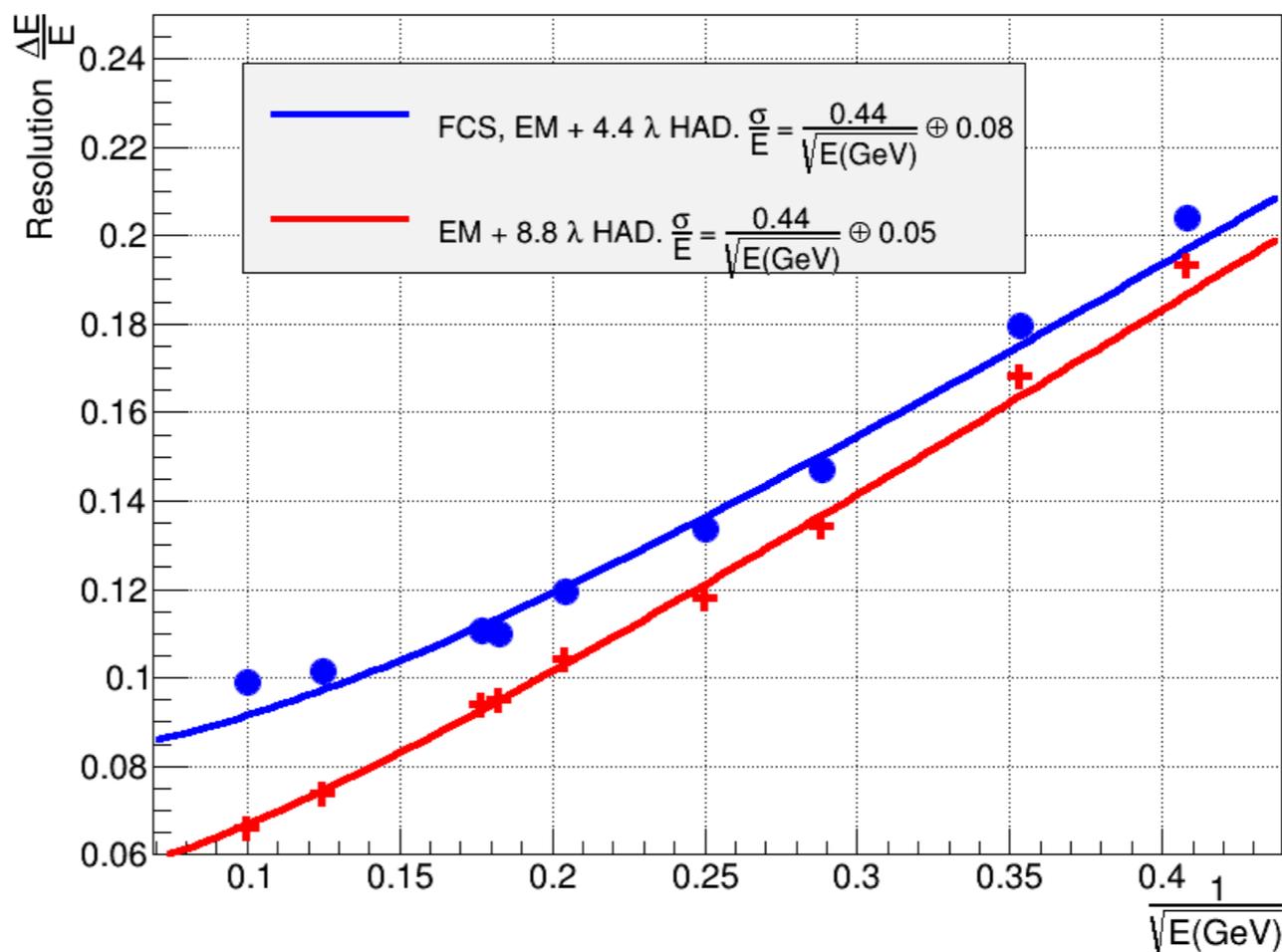
FCS, EM+HAD. Linearity



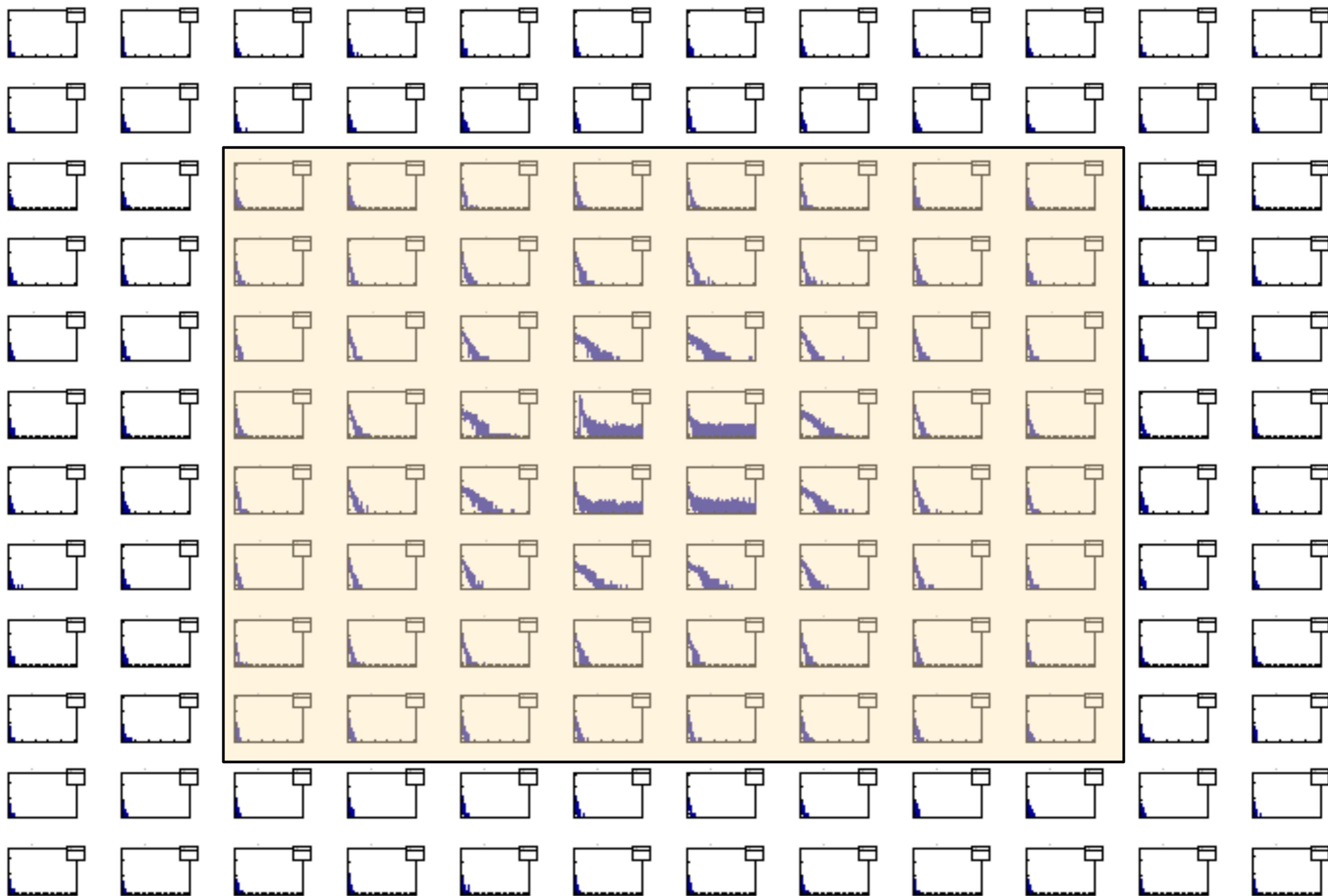
EIC BEMC at eta=0.5, Linearity



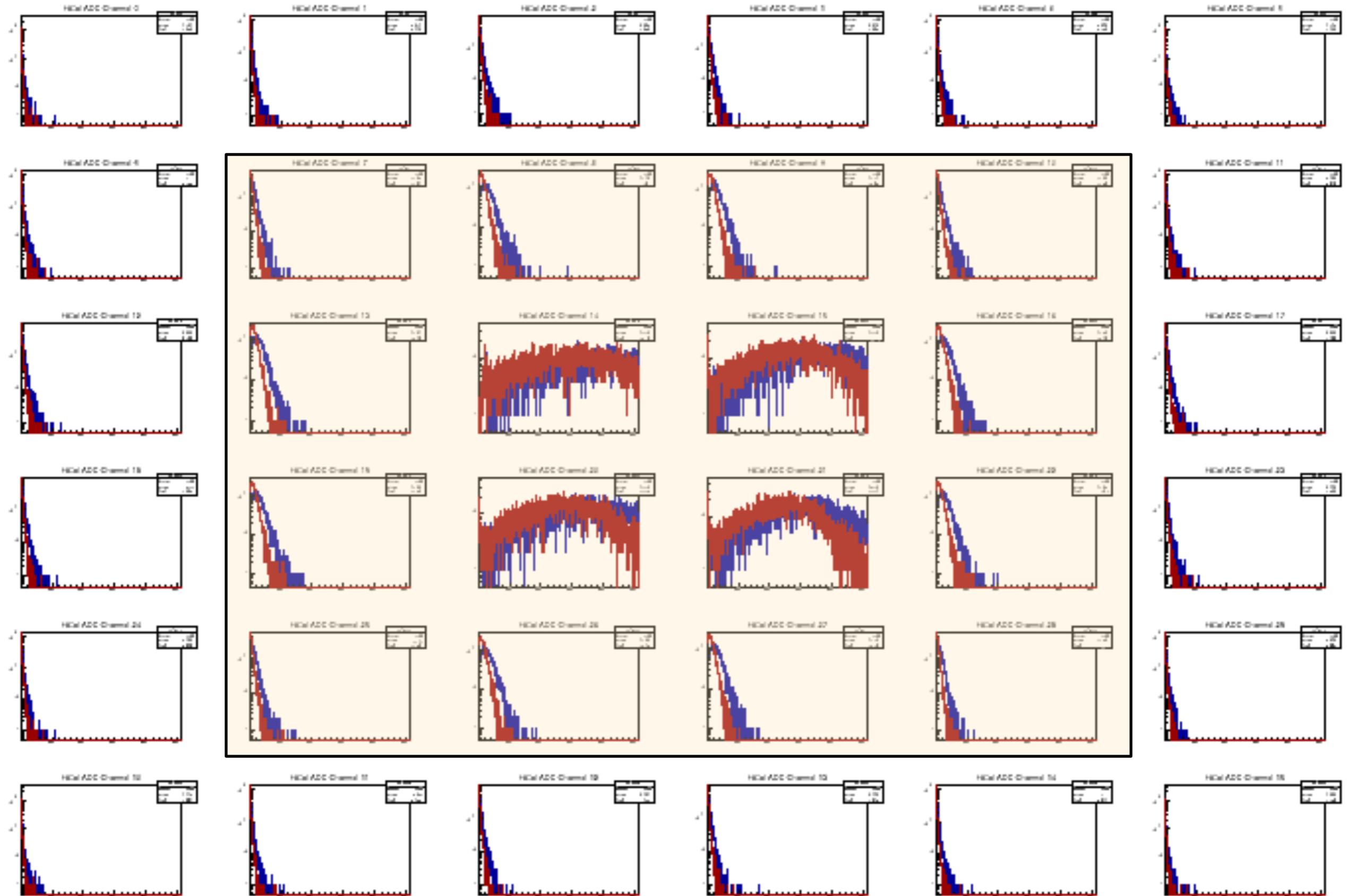
FCS, Energy Resolution

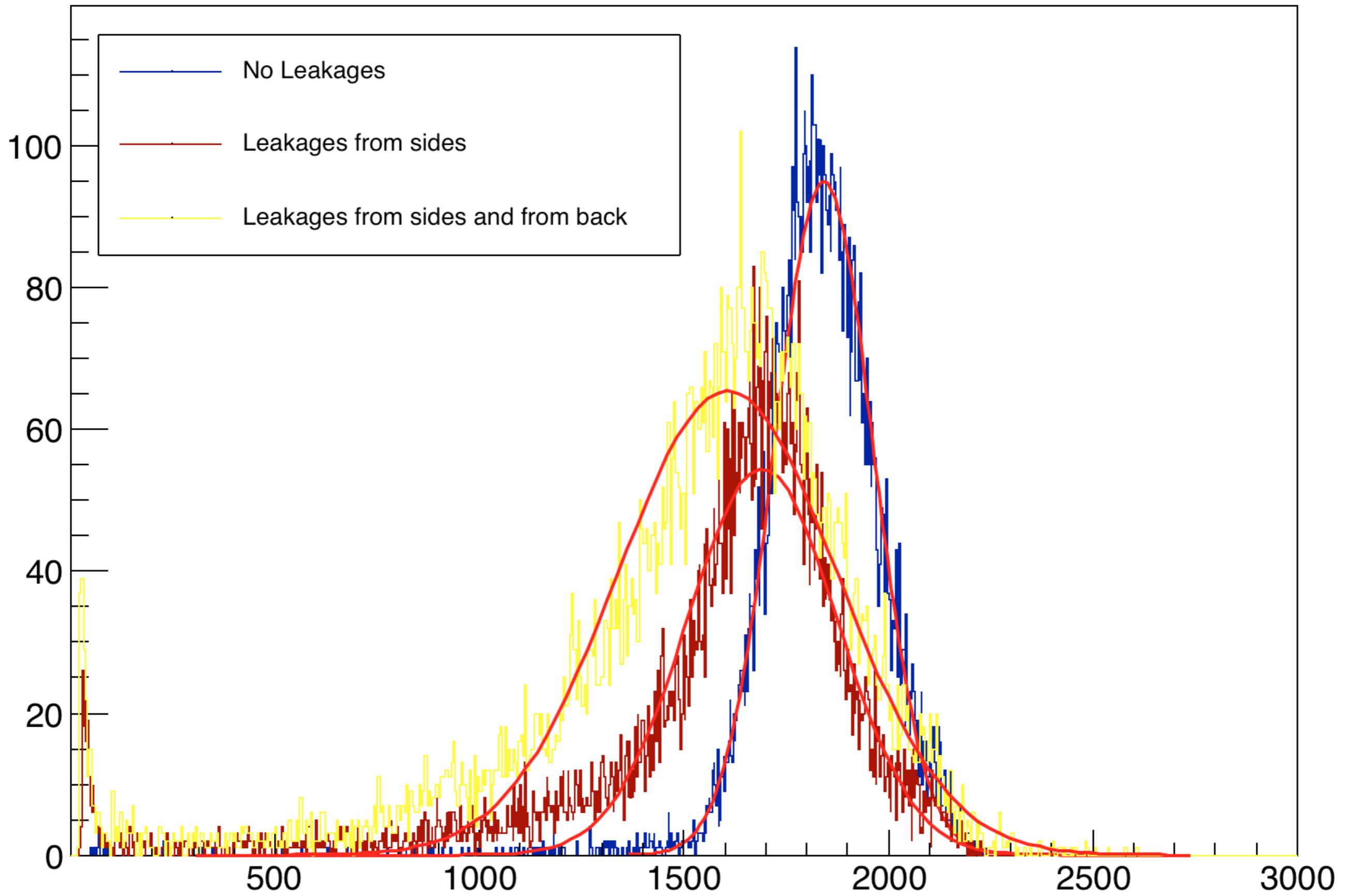


EM Section, configuration 3, transverse leakages. 100 GeV

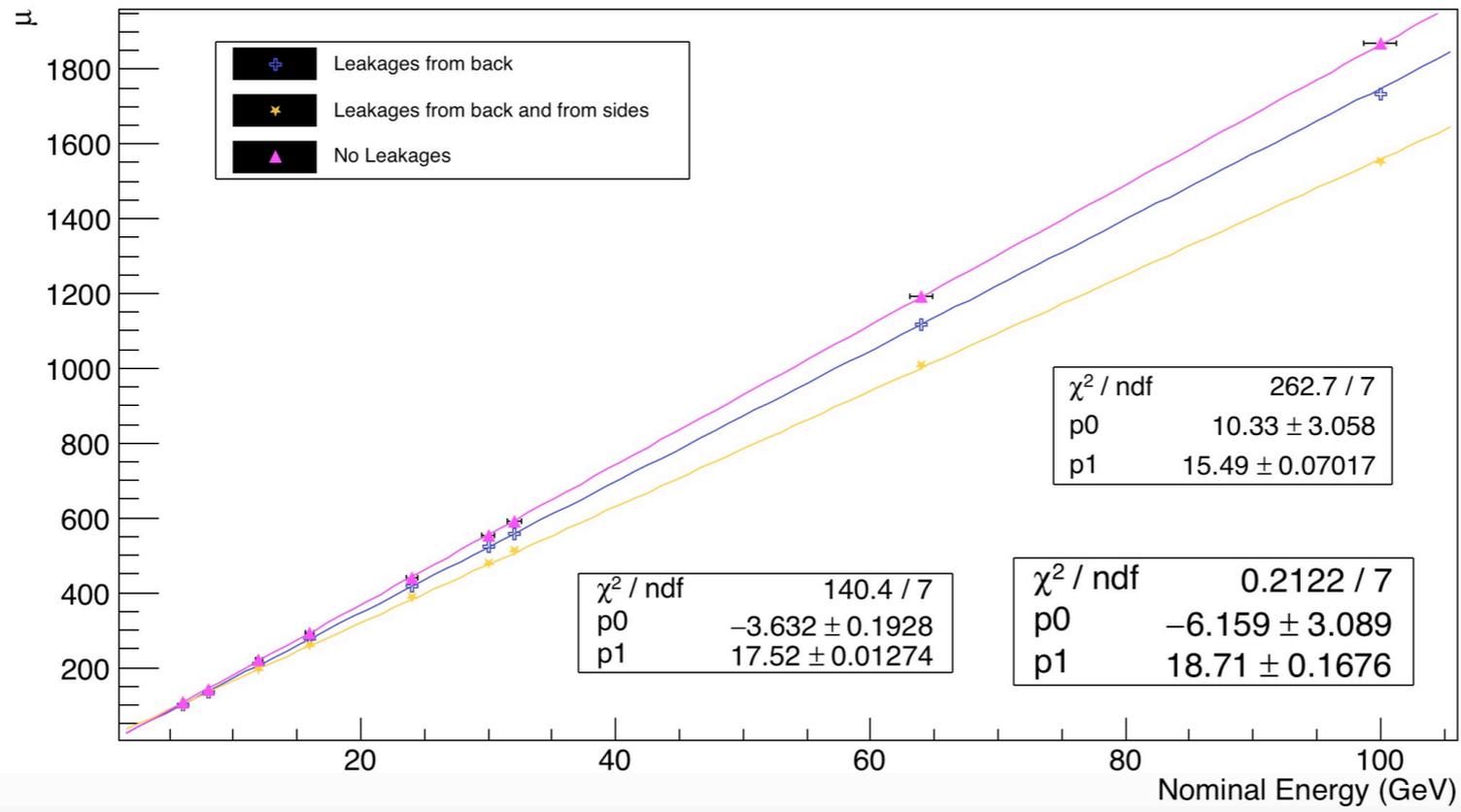


HAD1, configuration 3, transverse leakages. 100 GeV

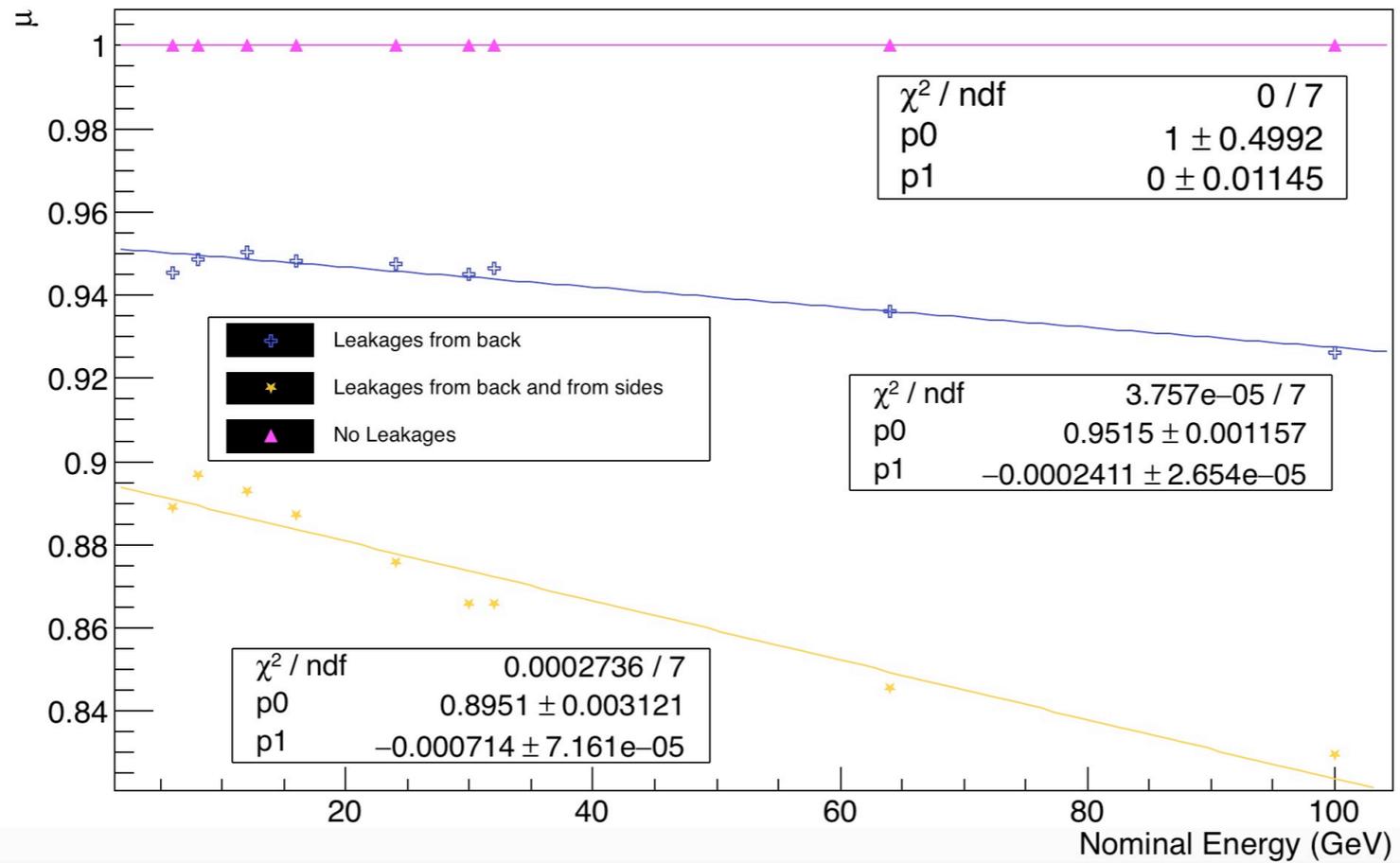




μ VS Nominal Energy



μ VS Nominal Energy



- Work in progress. **All Results are preliminary !**
- Leakages are important, no surprise. But, we don't think it is show stopper to prove how well timing may work.
- Some configuration will be tested by STAR during April test run at FNAL.
- In addition aiming to test W/ScFi (2014) + Fe/Sc.
- And may be glance at timing with fast PMTs.
- More sophisticated MC with timing will be done by A. Kiselev in spring. Different geometry (Pb/Sc Hcal + W/ScFi Emcal, i.e. BEAST EIC configuration, tested at FNAL in 2014

Monte-Carlo modeling

Microscopic description of the shower development:

- Precise definition of geometry (construction elements, material budget, optical properties of volumes and surfaces, etc)
- High-precision GEANT4 physics lists: FTFP_BERT_HP and more modern LEND
- Ionization energy deposits with Birk's correction for saturation effects
- Optical photon propagation: absorption and re-emission in WLS material, etc
- Essential signal distortions at all stages (scintillator rise and decay times, WLS decay time, SiPM response, electronics effects)
- Modeling results (absorber combinations, wave forms, etc) to be ready by April test run

