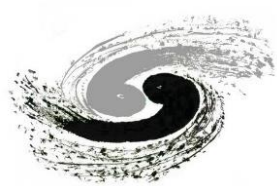


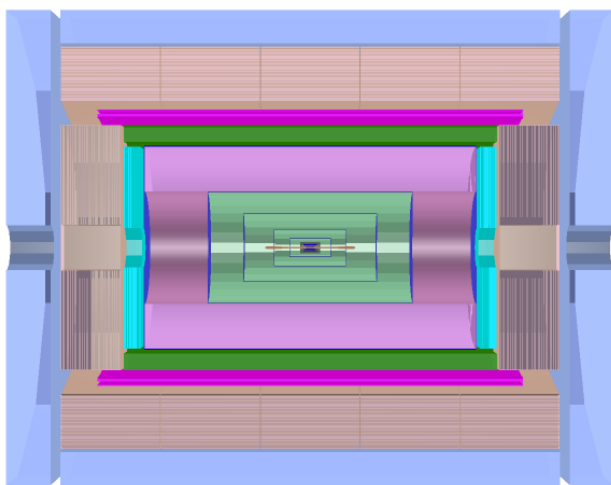
Hadron responses in scintillator calorimeters

Yong Liu
Apr. 6, 2022

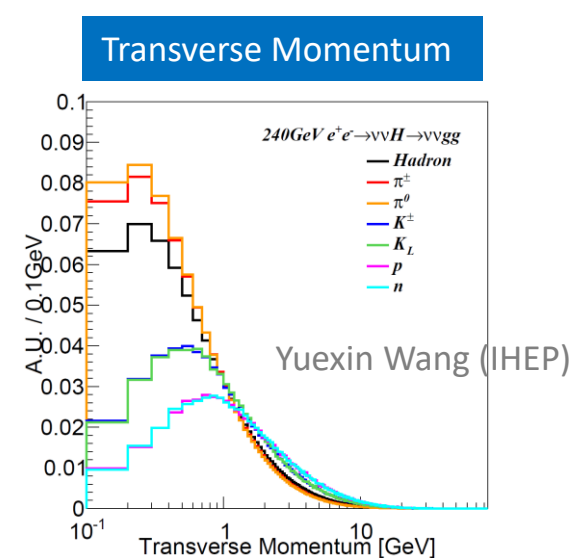
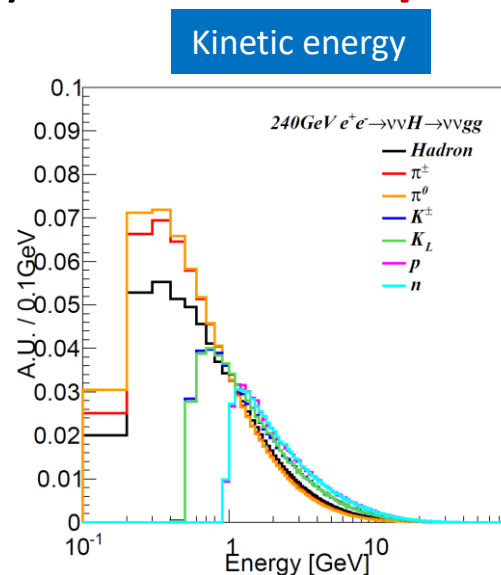


Motivations

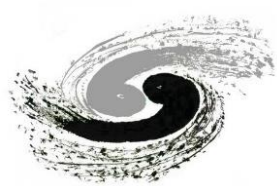
- CEPC physics programs
 - Hadronic decays of Higgs/Z/W bosons: abundant hadrons (<10 GeV) within jets
- Crucial: hadrons in scintillator-based calorimeters
 - Within the CEPC 4th concept detector: crystal ECAL + scintillating glass HCAL
 - A leap in terms of sampling fractions
 - Aim to improve the energy resolution: **esp. the hadronic resolution**



Calorimeters: crystal ECAL and Scintillating Glass HCAL

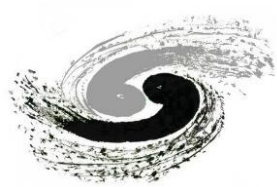


Yuxin Wang (IHEP)



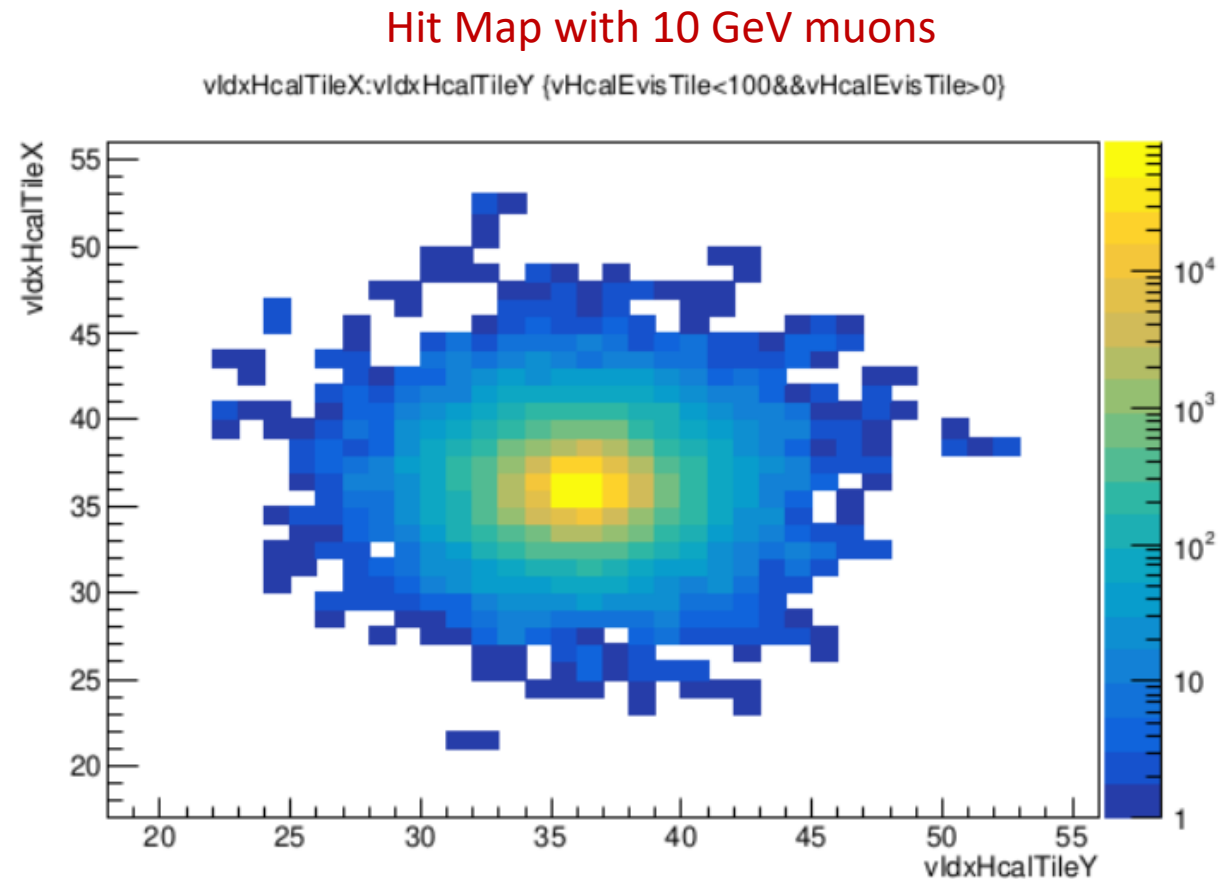
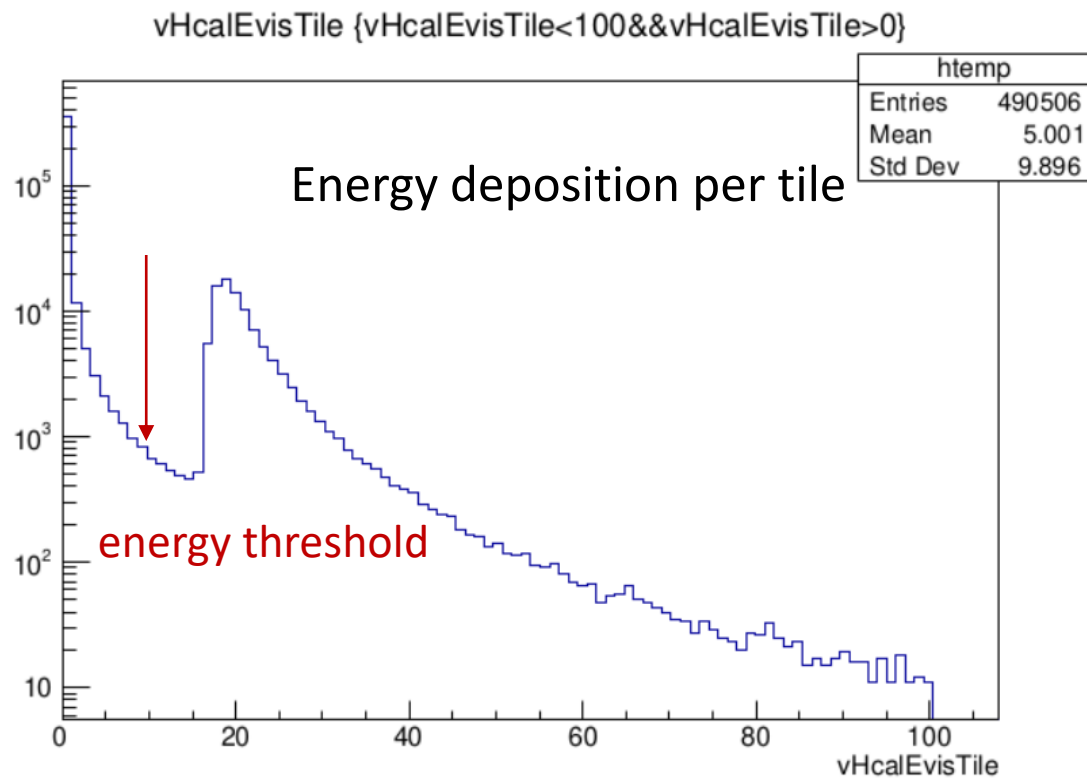
Motivations

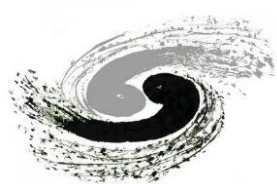
- CEPC physics programs
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 - A leap in terms of sampling fractions
 - Aim to improve the energy resolution: **esp. the hadronic resolution**
 - A large fraction of hadronic showers initiated in the crystal ECAL
 - Hadronic showers mostly contained in the scintillating glass HCAL
 - Hadronic responses: key aspects to be studied
 - Distribution of raw energy sum (response)
 - Response linearity
 - Response resolution
- Simulation geometry with scintillating glass tiles
(homogeneous structure): 100 layers with 23 mm thick tiles



MIP calibration with muons

- MIP calibration: energy scale
- Basis for the energy threshold for reconstruction





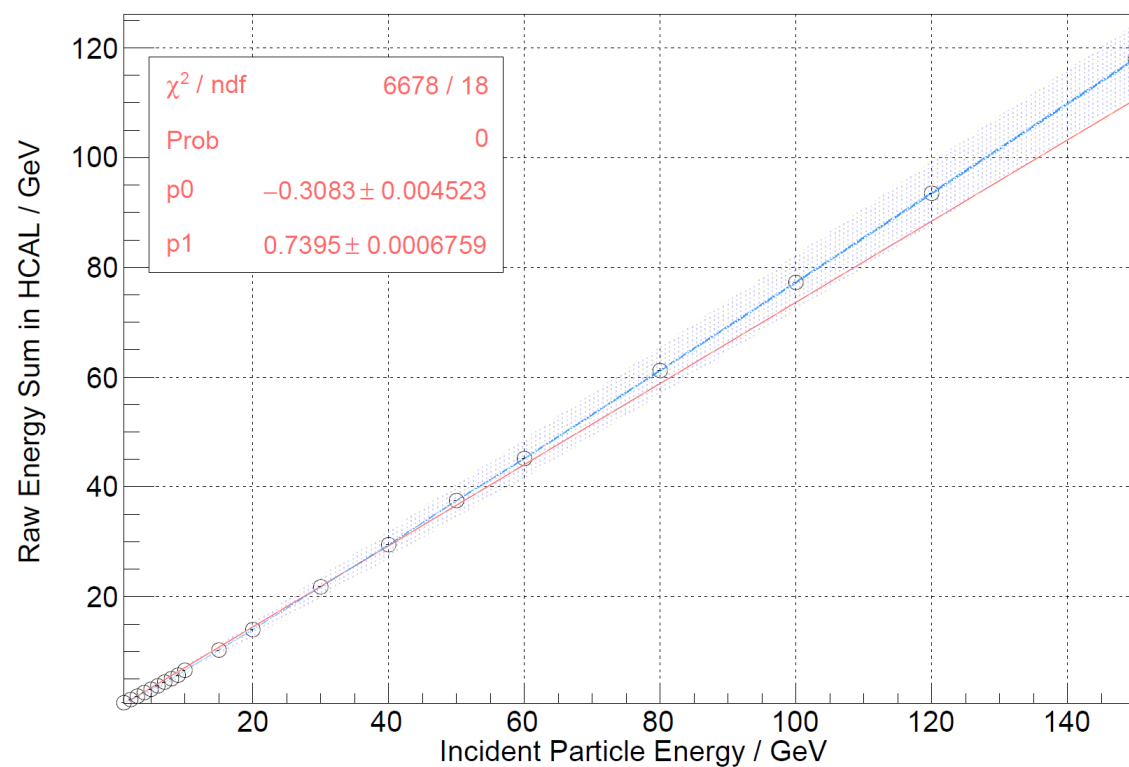
Singe charged pions

- Response linearity

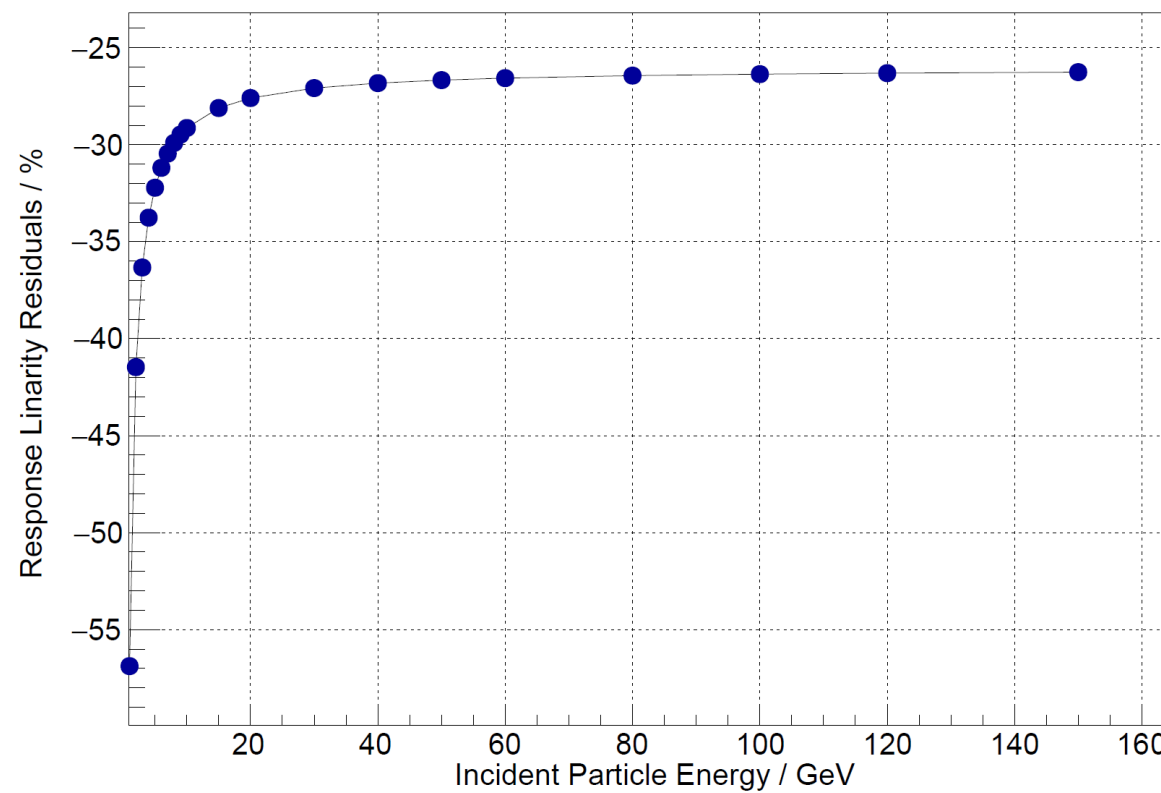
Energy threshold: 0.5 MIP

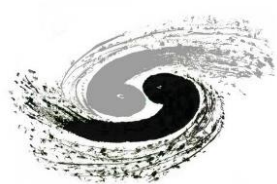
Time window: 1000 ns

Hadron Response Linearity



Calorimeter Response Linearity Residual





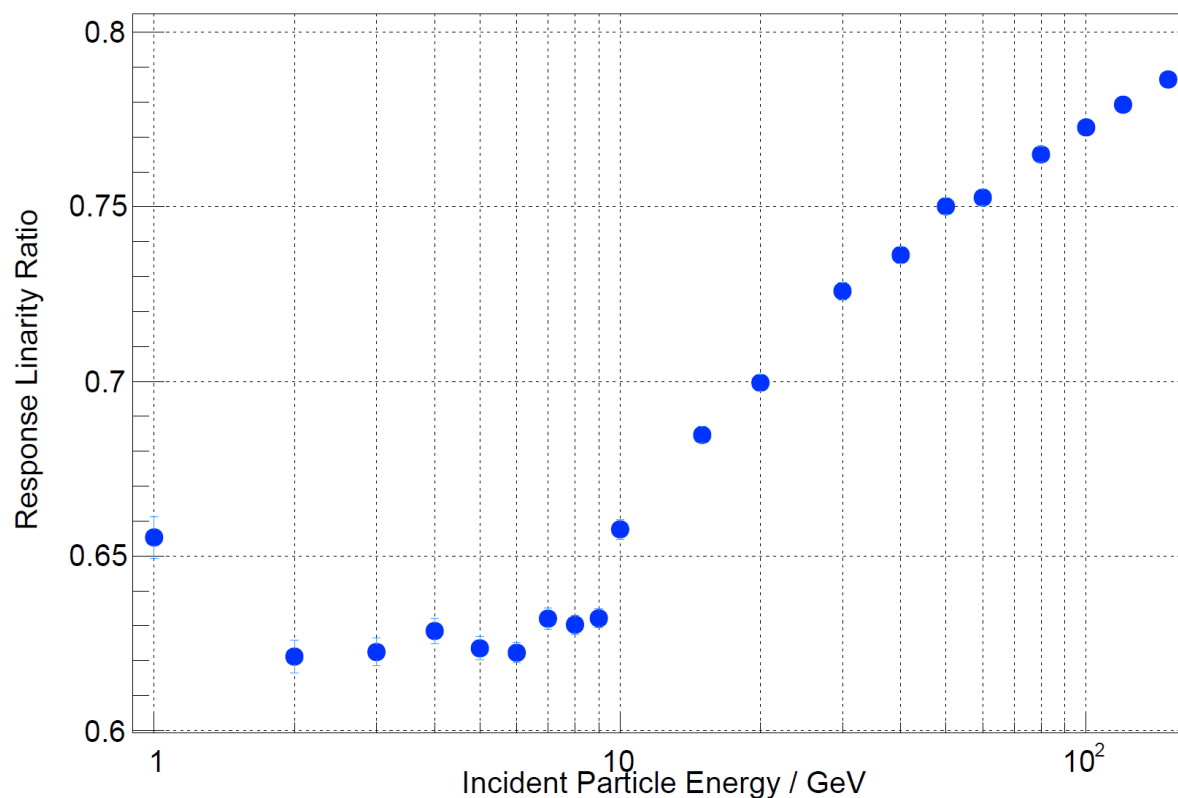
Singe charged pions

- Response ratio and resolution

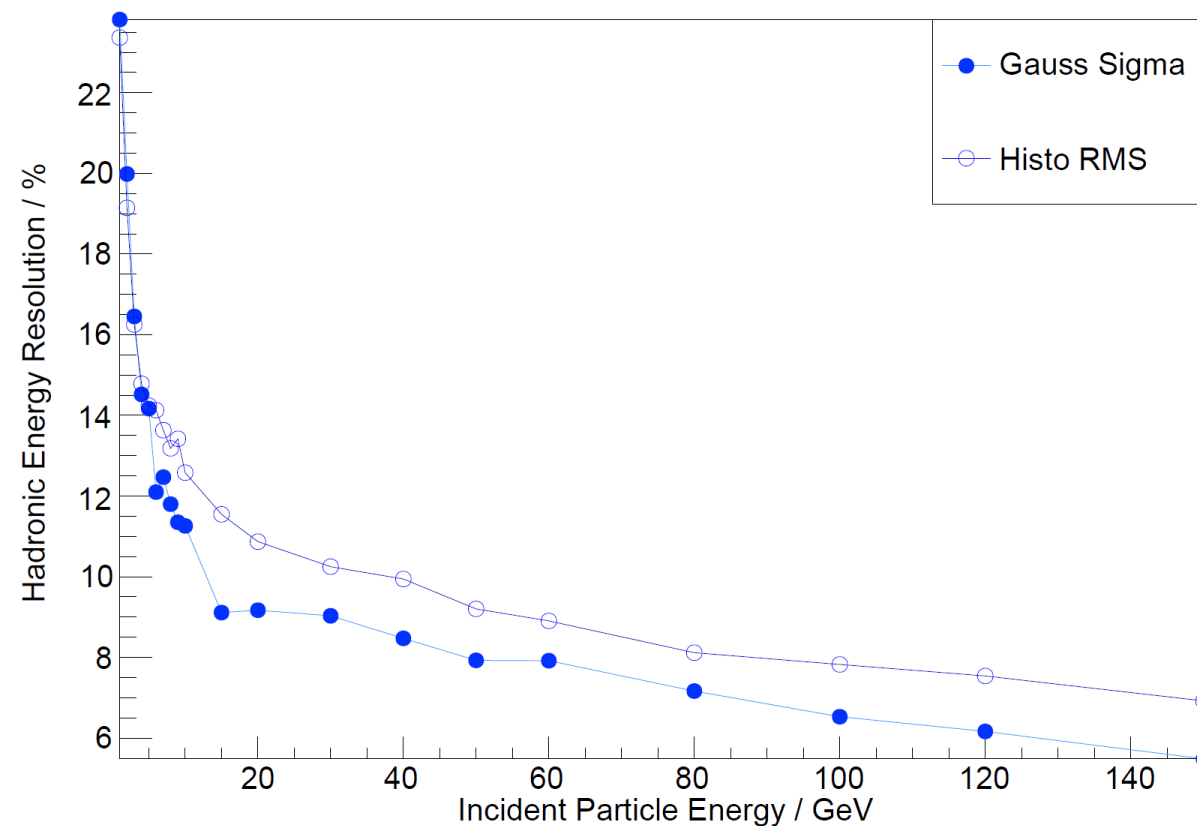
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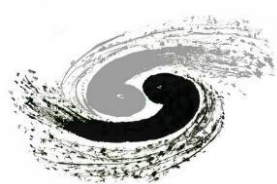
Time window: 1000 ns

Calorimeter Response Ratio



Hadronic Energy Resolution



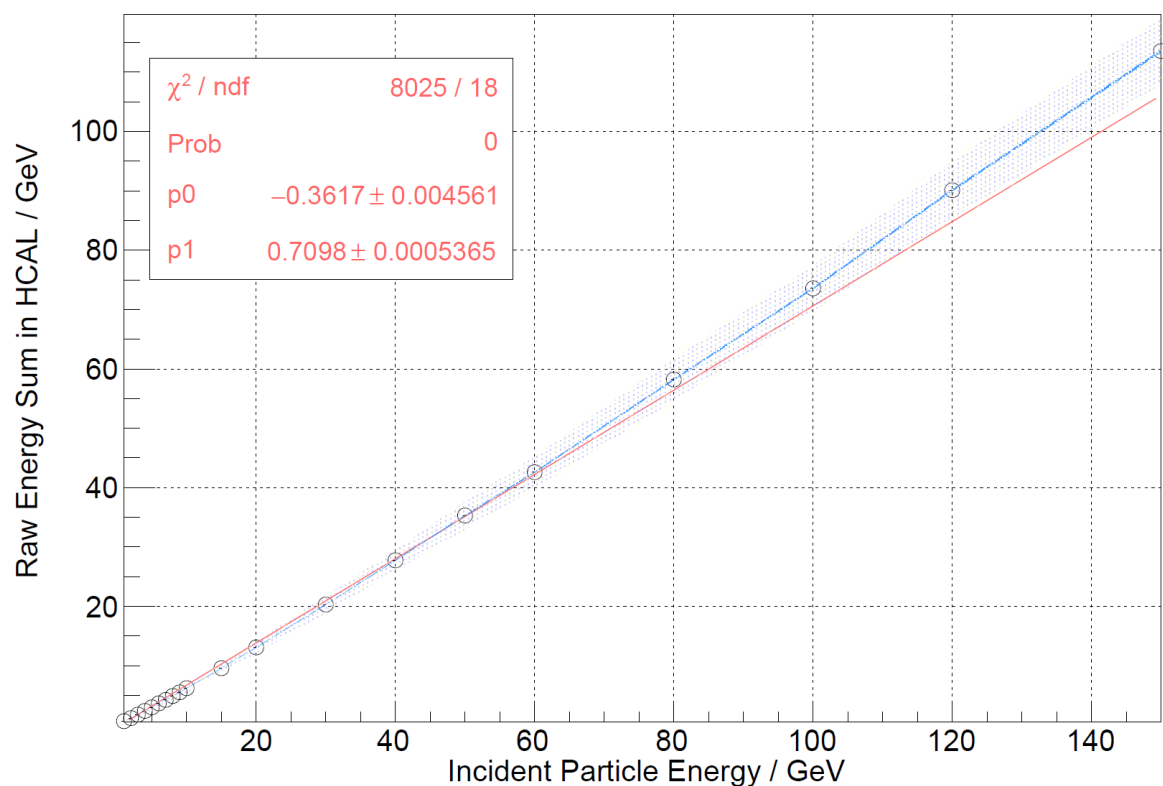


Singe protons

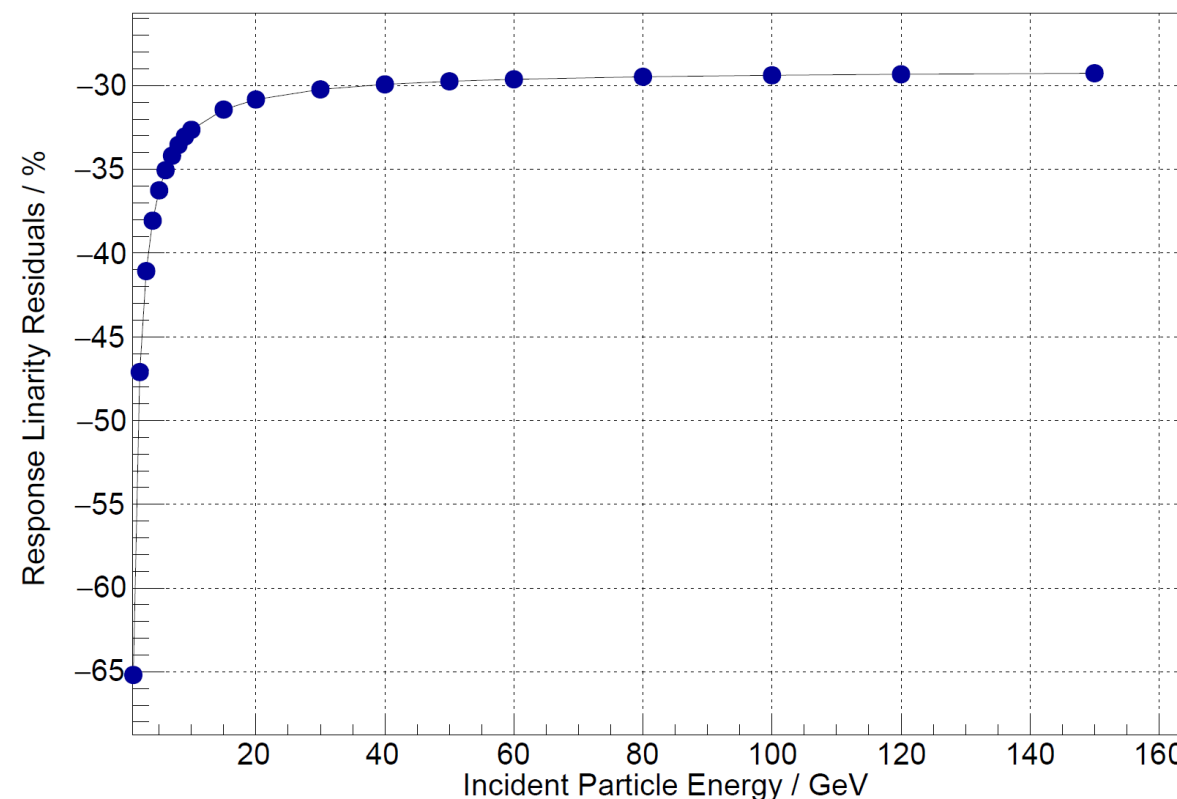
- Response linearity

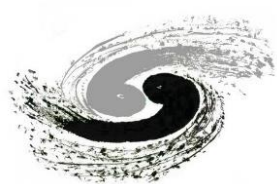
Energy threshold: 0.5 MIP
Time window: 1000 ns

Hadron Response Linearity



Calorimeter Response Linearity Residual





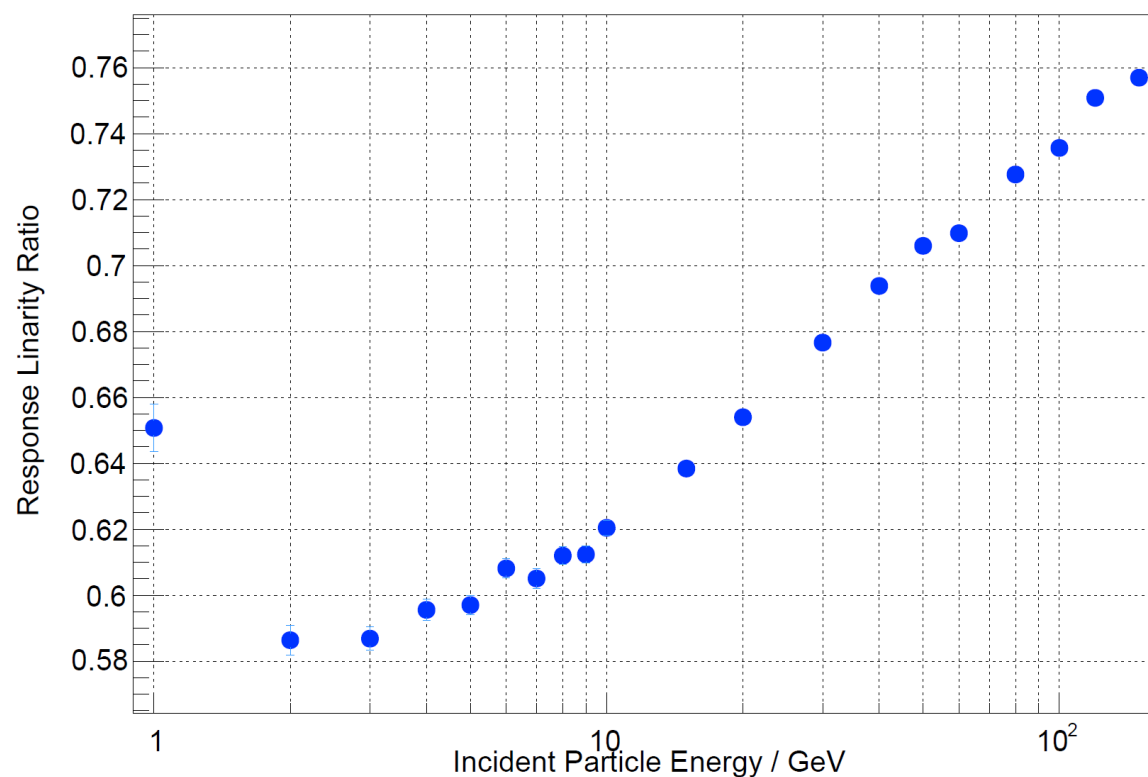
Singe protons

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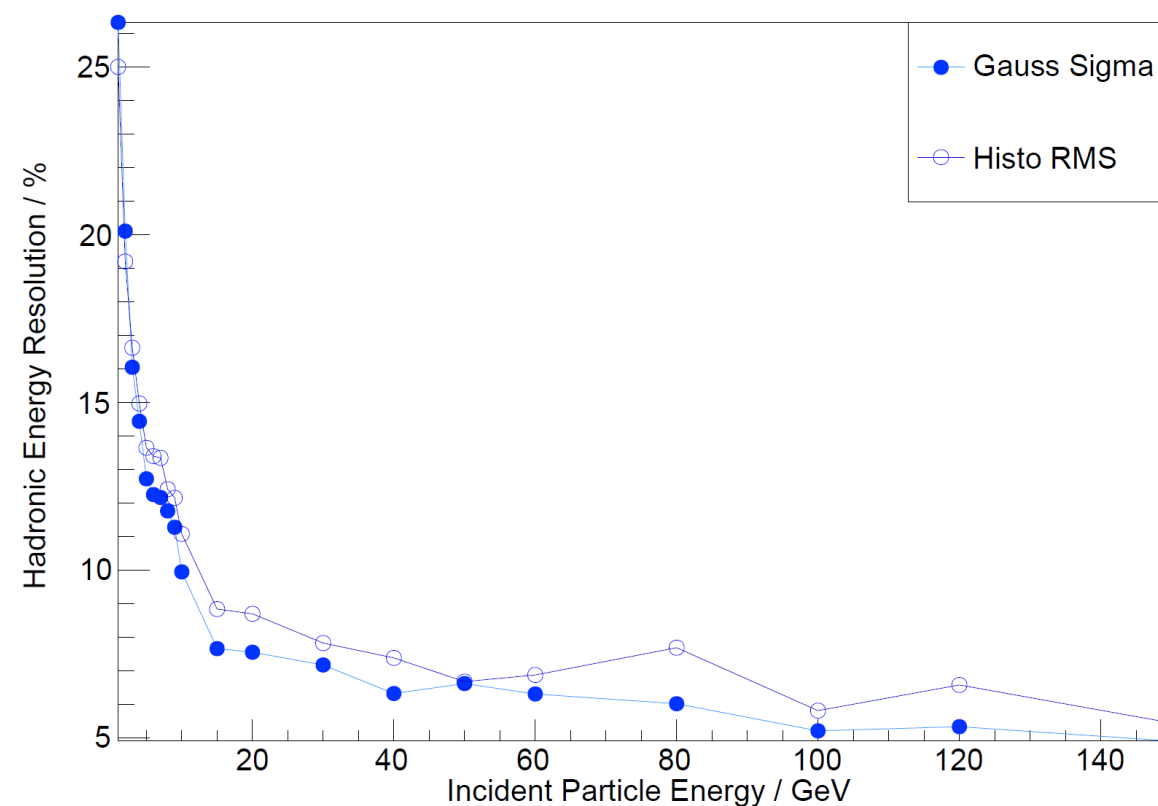
Energy threshold: 0.5 MIP

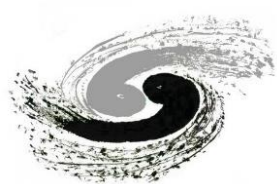
Time window: 1000 ns

Calorimeter Response Ratio



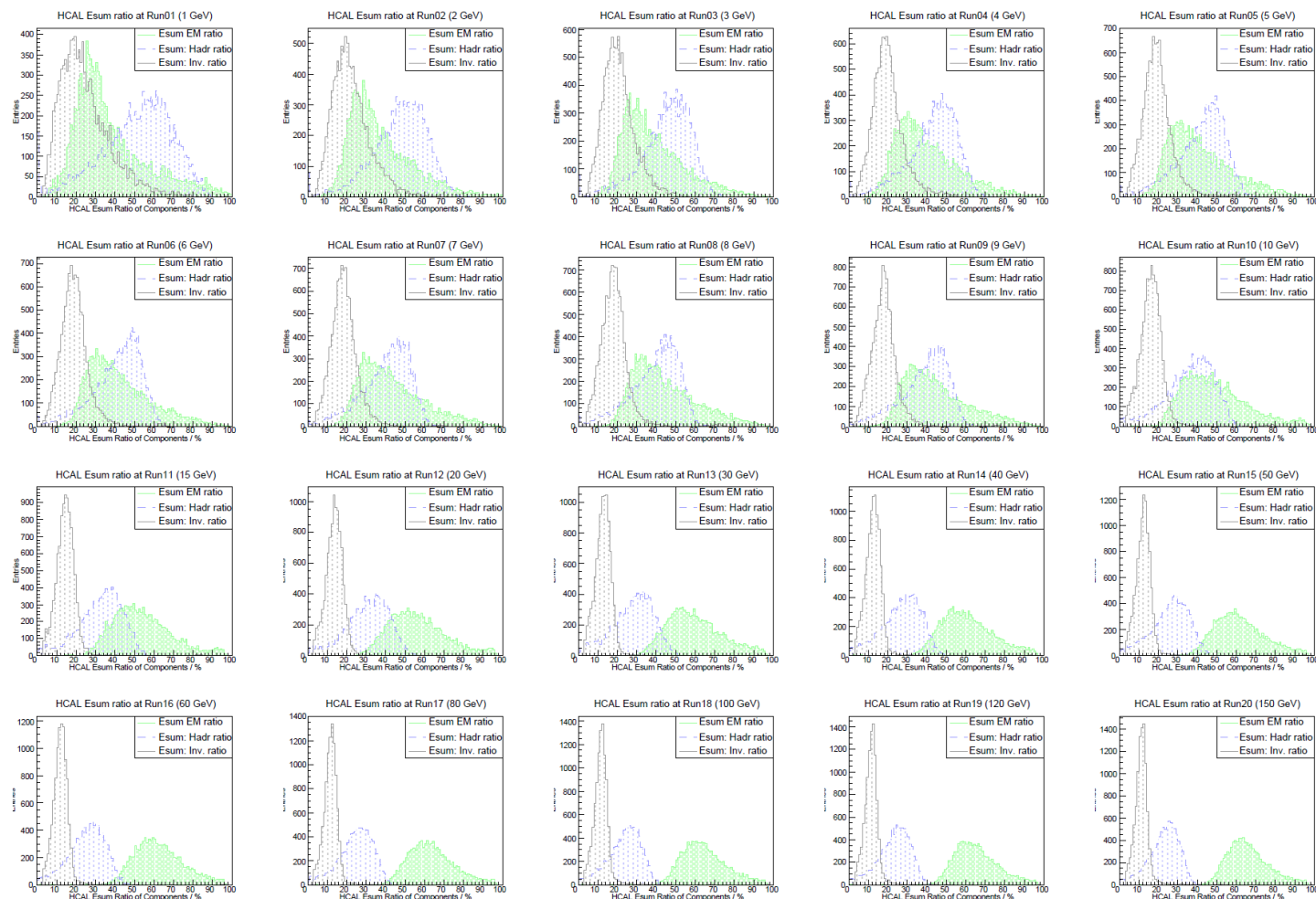
Hadronic Energy Resolution

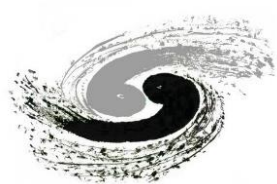




Singe charged pions

- Categorize energy depositions: EM, hadronic, invisible

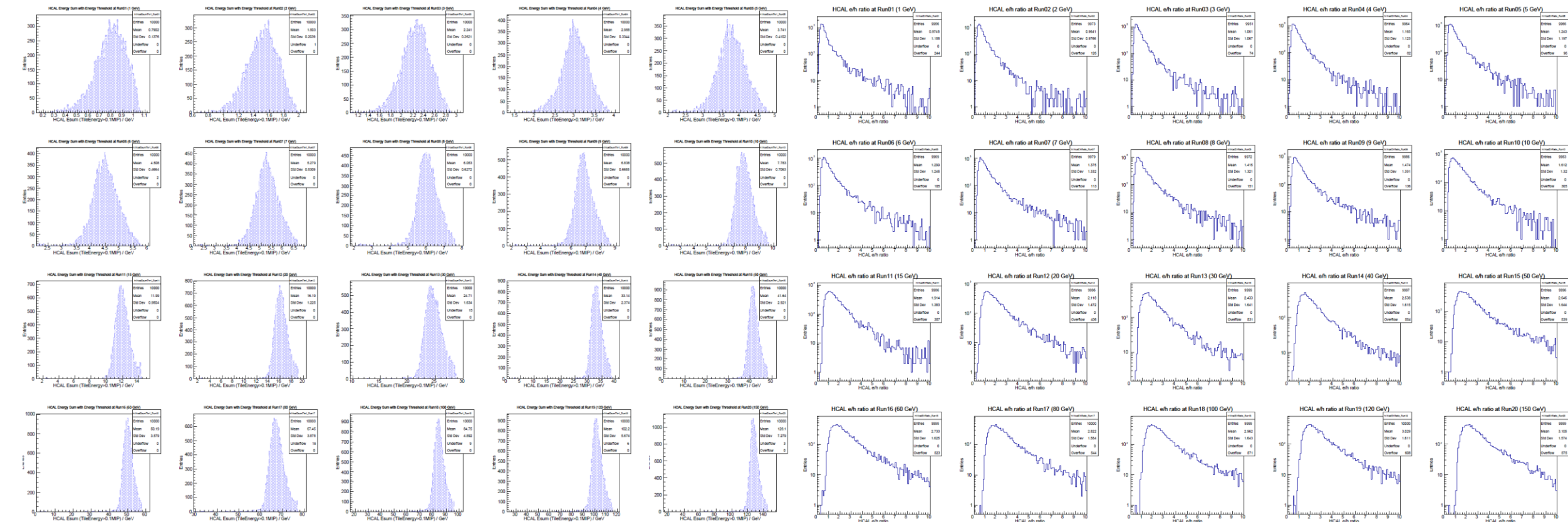


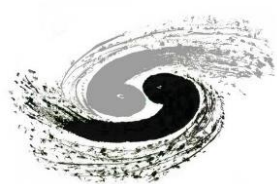


Singe charged pions

Energy sum

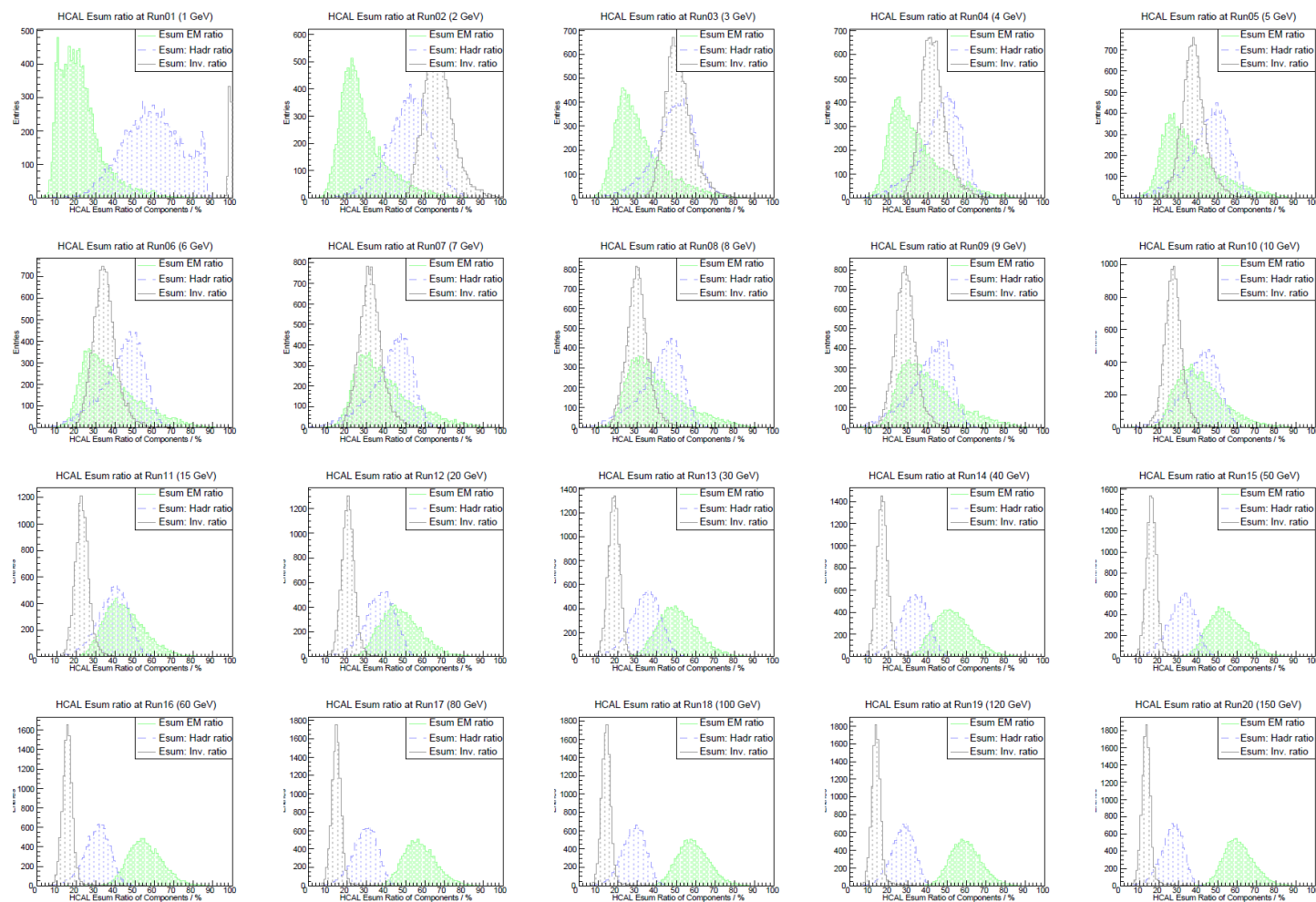
e/h ratio: event level

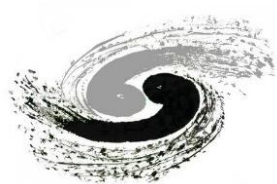




Singe protons

- Categorize energy depositions: EM, hadronic, invisible





Single protons:

Energy sum

e/h ratio: event level

