AHCAL data Sample Analysis
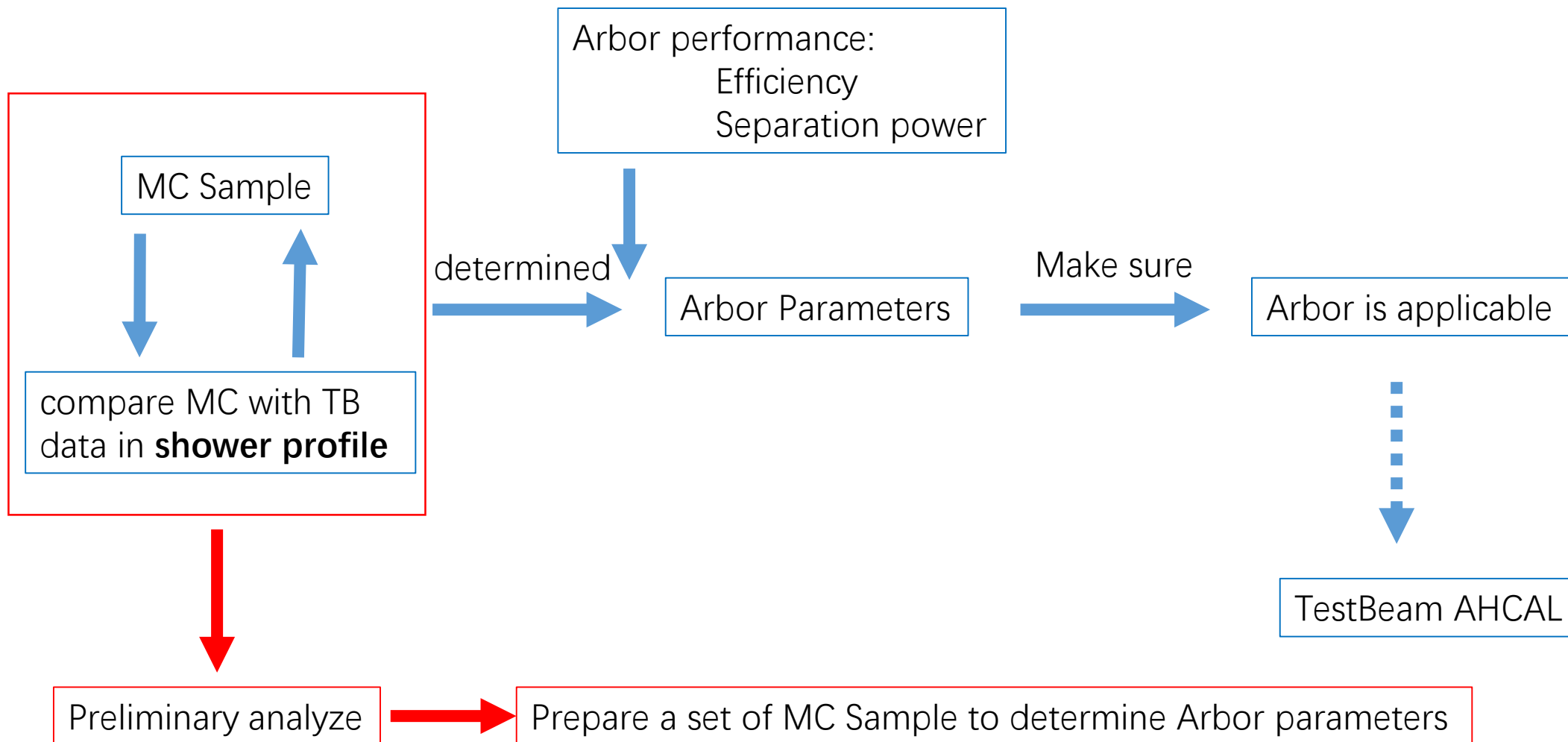
Hengyu Wang

2023.03.08

Purpose : Apply arbor to TestBeam AHCAL

| Sample	Path	File Format	Event	Sample Style
mu+	/cefs/higgs/wanghengyu/cepc/Arbor/Arbor_GlassHCAL/Test/cepc_calo/SampleAnalysis/rootfile/sim_AHCAL_Hit_mu+_1GeV.root	**ROOT**	10000	MC
	/cefs/higgs/qibh/G4Simulation/Data/SimCalModule/run20230216_AHCAL_Data/mu+/BeamData_calo_mu+_108GeV.root	**ROOT**	100000	MC by QBH
	/cefs/higgs/shiyk/Beam_2022/DataBase/Calib/Particle/mu+/AHCAL_Run119_20221023_194647.root	**ROOT**	285924	TB Data
10GeV pi+	/cefs/higgs/wanghengyu/cepc/Arbor/Arbor_GlassHCAL/Test/cepc_calo/SampleAnalysis/rootfile/sim_AHCAL_Hit_pi+_10GeV.root	**ROOT**	10000	MC
	/cefs/higgs/qibh/G4Simulation/Data/SimCalModule/run20230216_AHCAL_Data/pi+/BeamData_calo_pi+_10GeV.root	**ROOT**	100000	MC by QBH
	/cefs/higgs/shiyk/Beam_2022/DataBase/Calib/Particle/pi+_V1/10GeV/AHCAL_Run158_20221025_021822.root	**ROOT**	199612	TB Data
50GeV pi+	/cefs/higgs/wanghengyu/cepc/Arbor/Arbor_GlassHCAL/Test/cepc_calo/SampleAnalysis/rootfile/sim_AHCAL_Hit_pi+_50GeV.root	**ROOT**	10000	MC
	/cefs/higgs/qibh/G4Simulation/Data/SimCalModule/run20230216_AHCAL_Data/pi+/BeamData_calo_pi+_50GeV.root	**ROOT**	100000	MC by QBH
	/cefs/higgs/shiyk/Beam_2022/DataBase/Calib/Particle/pi+_V1/50GeV/AHCAL_Run83_20221022_182955.root	**ROOT**	187504	TB Data
50GeV e+	/cefs/higgs/qibh/G4Simulation/Data/SimCalModule/run20230216_AHCAL_Data/e+/BeamData_calo_e+_50GeV.root	**ROOT**	100000	MC by QBH
	/cefs/higgs/shiyk/Beam_2022/DataBase/Calib/Particle/e+_V1/50GeV/AHCAL_Run133_20221024_040159.root	**ROOT**	105414	TB Data

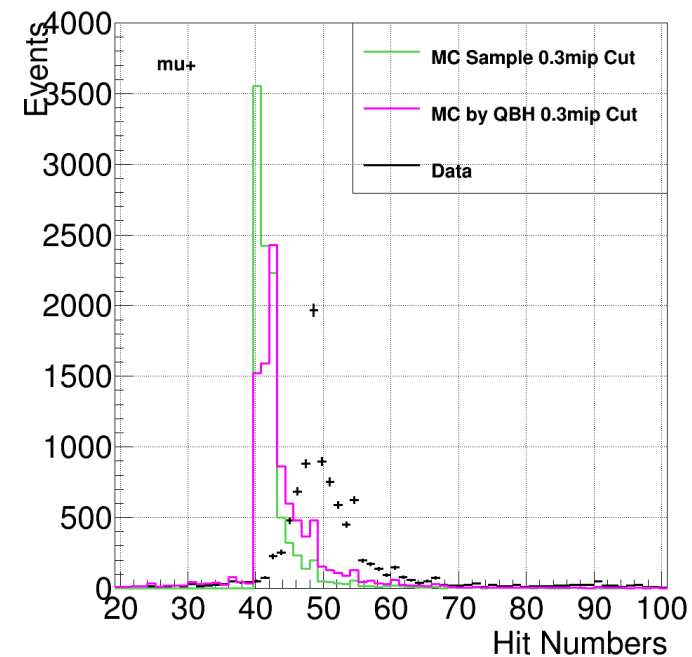| sample	Geometry	Geant4 Versions
My MC	(ESR:0.5mm,Sci:3mm,ESR:0.5mm,Fe:20mm,PCB:2mm)*40	**9.6.p02**
MC by QBH	(ESR:0.5mm,Sci:3mm,ESR:0.5mm,Fe:20mm,PCB:2mm)*40	**11.0.3**

Compare MC Sample with TB Data in **mu+** event

Events = 10000
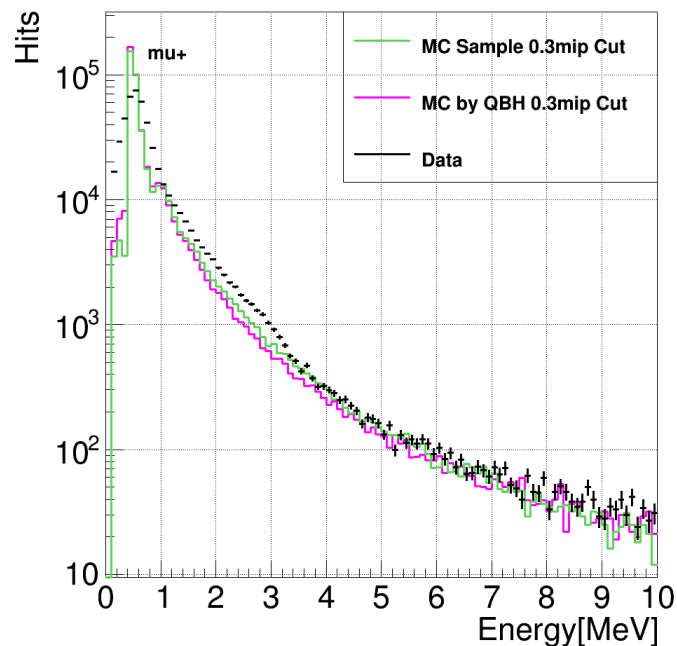
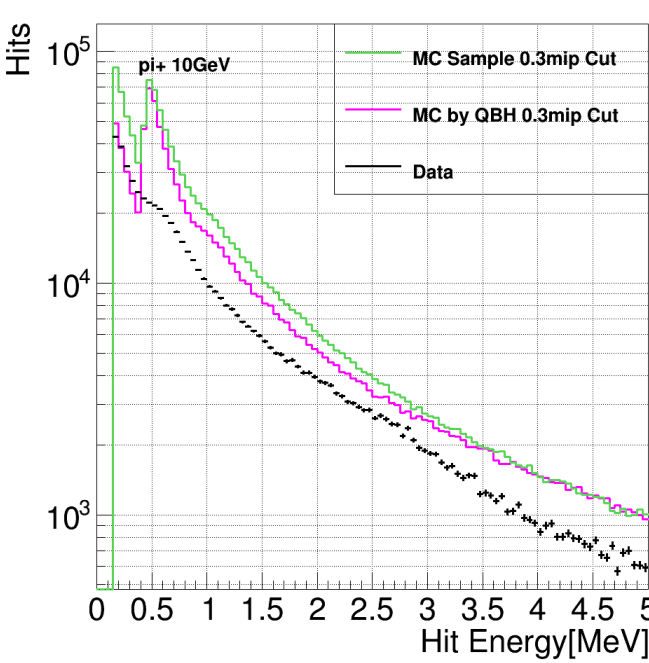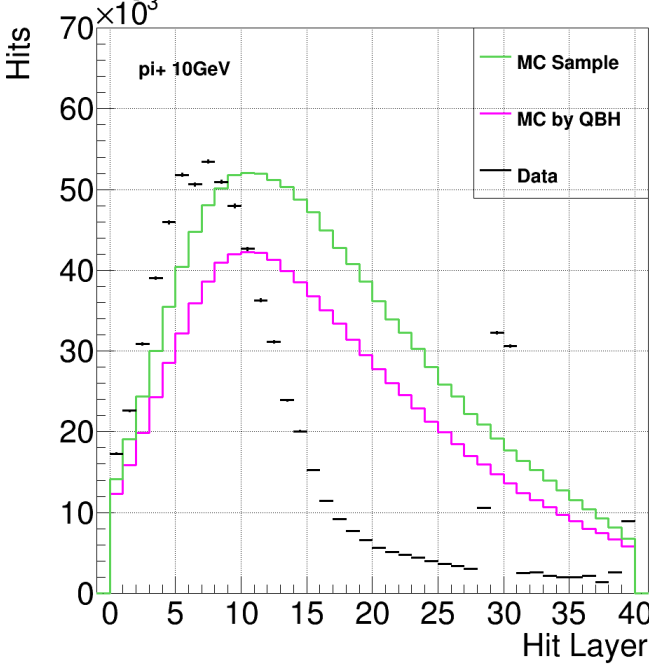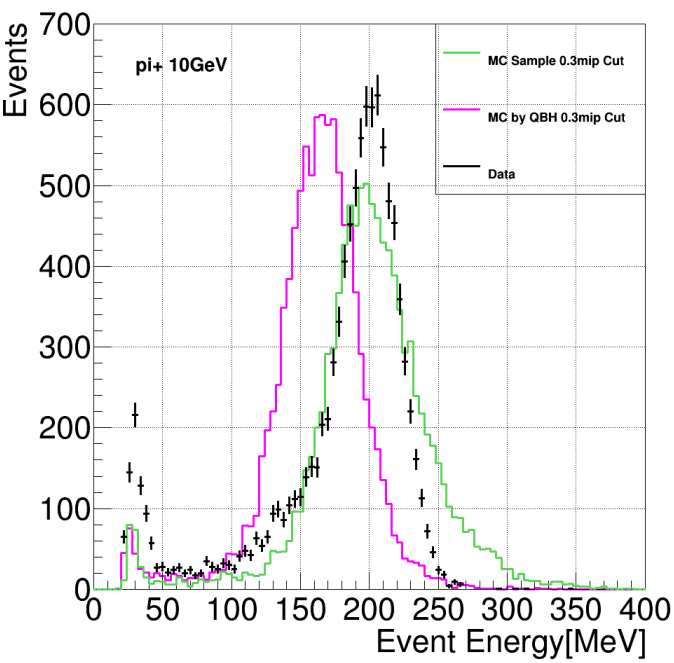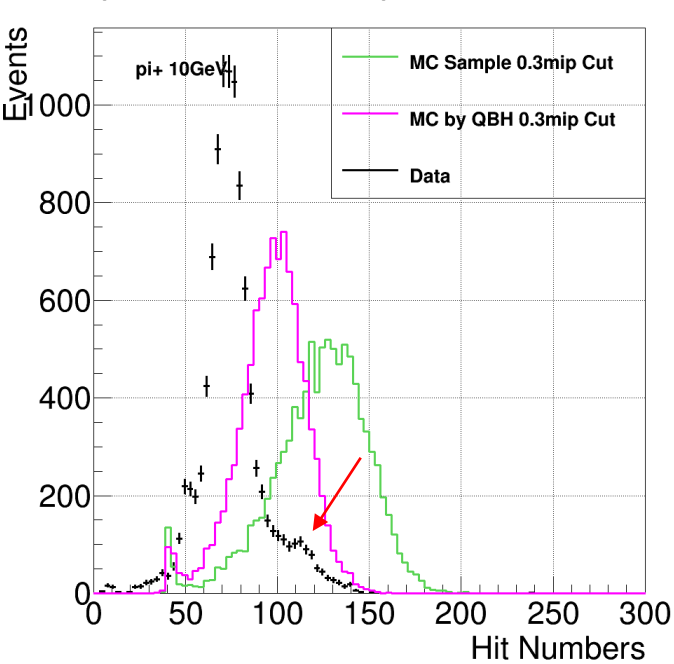Hit energy distribution. Hit counts VS Hit Energy.
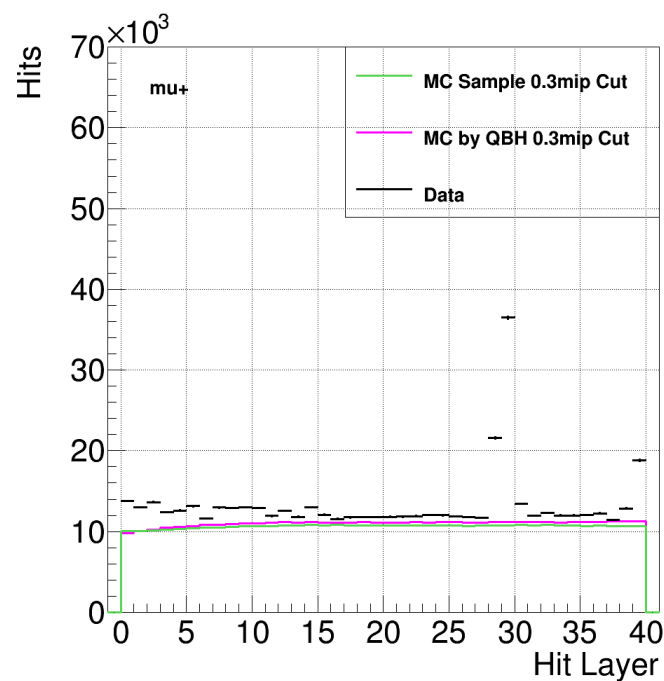
Each layer's hit number distribution.

Hit number in each event distribution.

➢ Hit Energy and hit numbers of each layer matches well for mu+ sample.

➢ The event hit number in data is about eight higher than MC sample, because of light leakage.
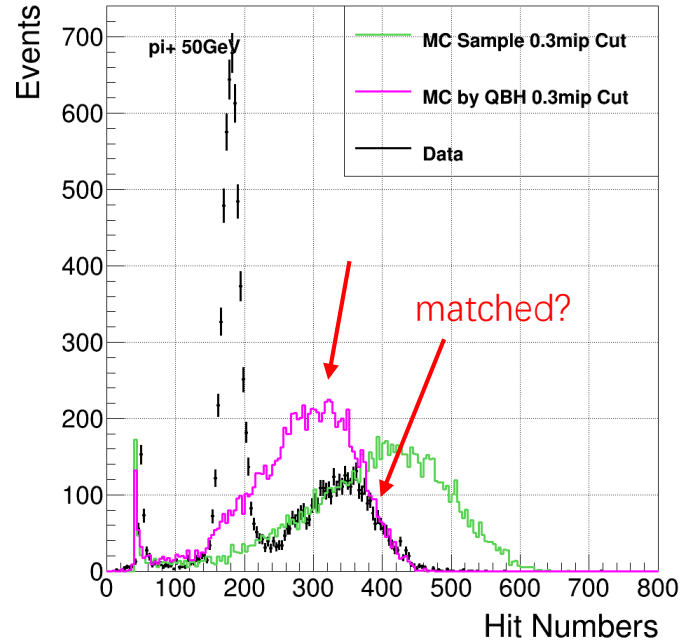
Compare MC Sample with TB Data in **10GeV pi+** event

Event = 10000

➤ Hit numbers in data is smaller than MC.

➤ Shower shape in data is further ahead ,and it is **more like an electromagnetic shower**.

➤ Event energy in data is larger than MC sample, but hit energy and hit numbers is smaller.

# Compare MC Sample with TB Data in **50GeV pi+** event
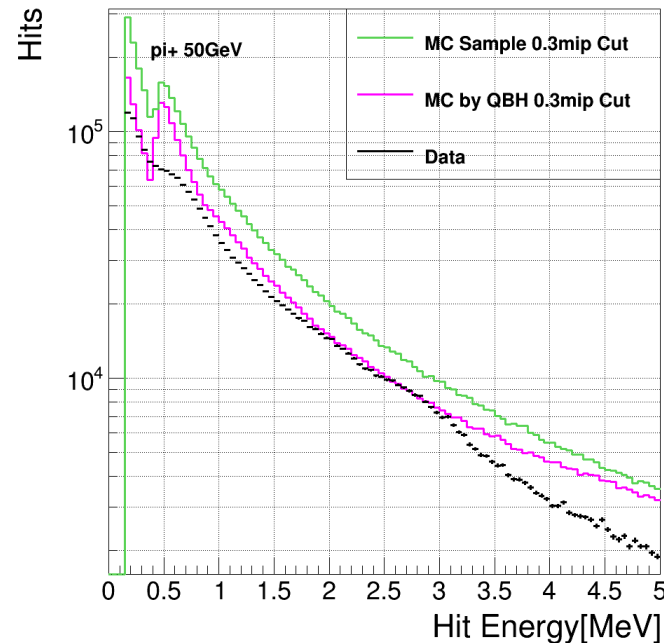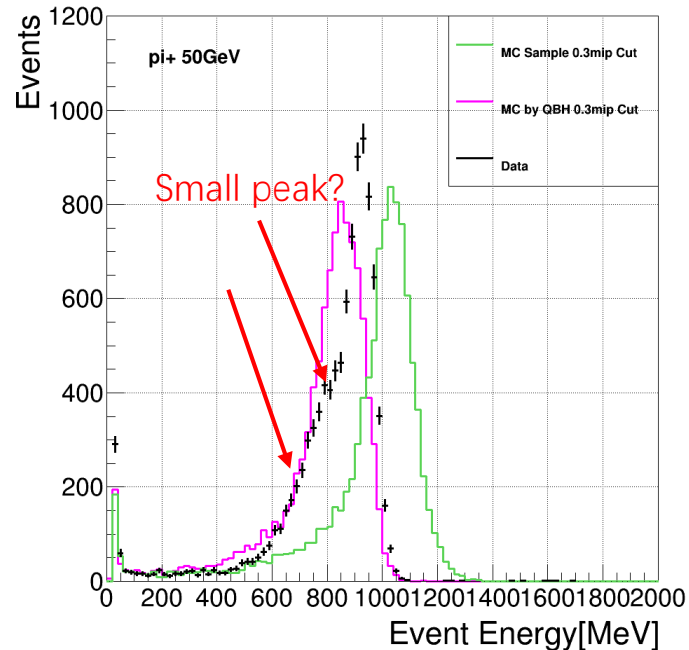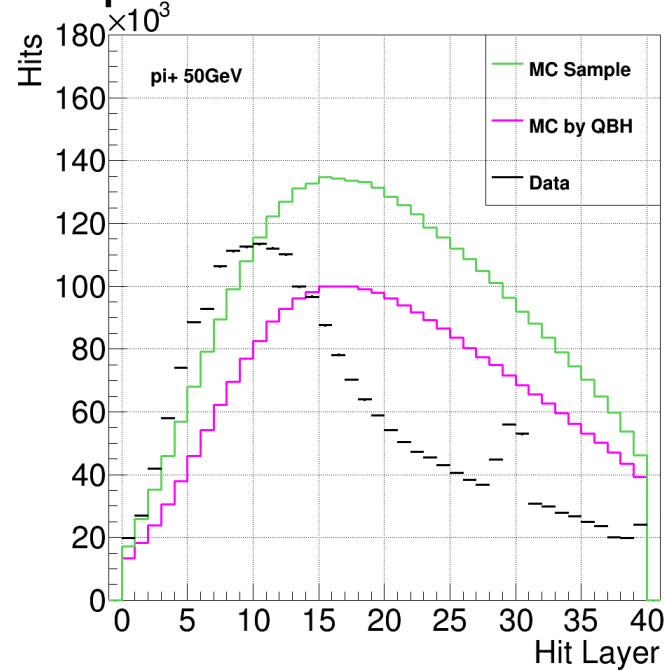
Event = 10000

➤ In higher Energy Sample(50GeV pi+),hit number in data have two peak, and the MC sample hit number peak is closer to right peak.

➤ Shower shape in data is further ahead, **more like an electromagnetic shower**.

➤ Event energy in QBH's MC sample is matched well with data in a small range. The peak is right shift in data maybe caused by mixed positron from QBH's report last time.

**QBH's MC sample is more suitable!**

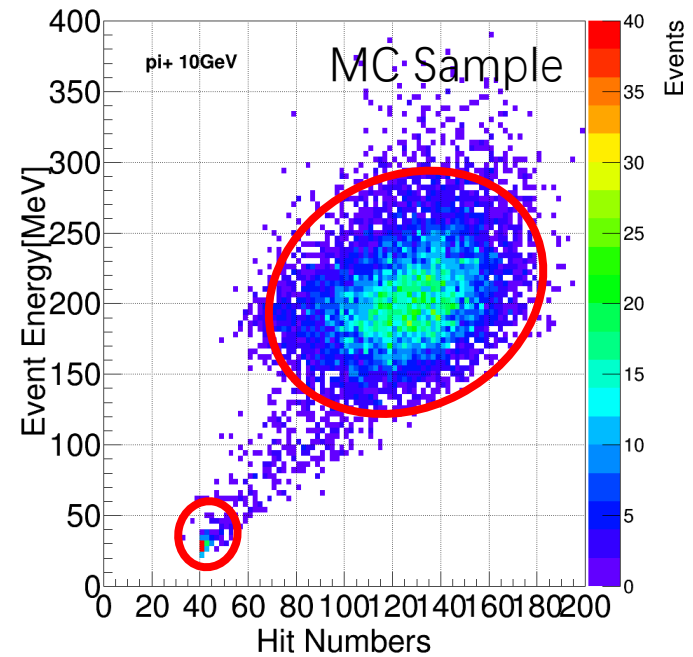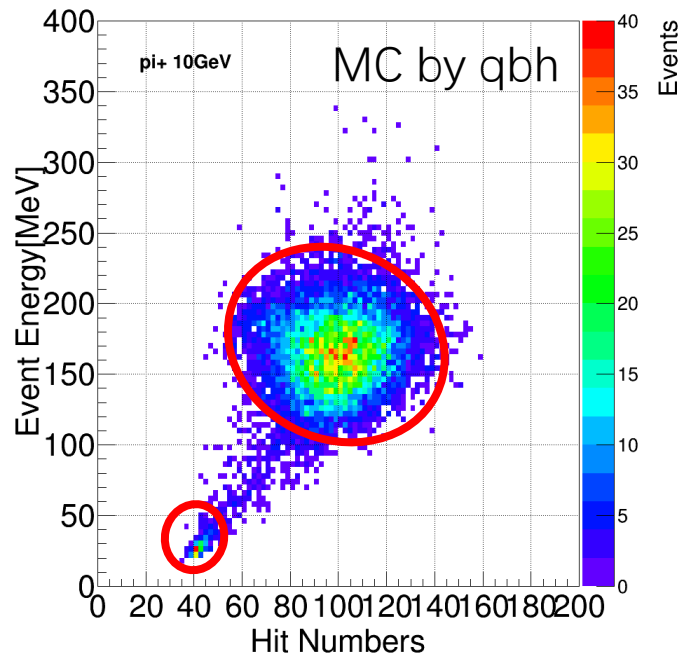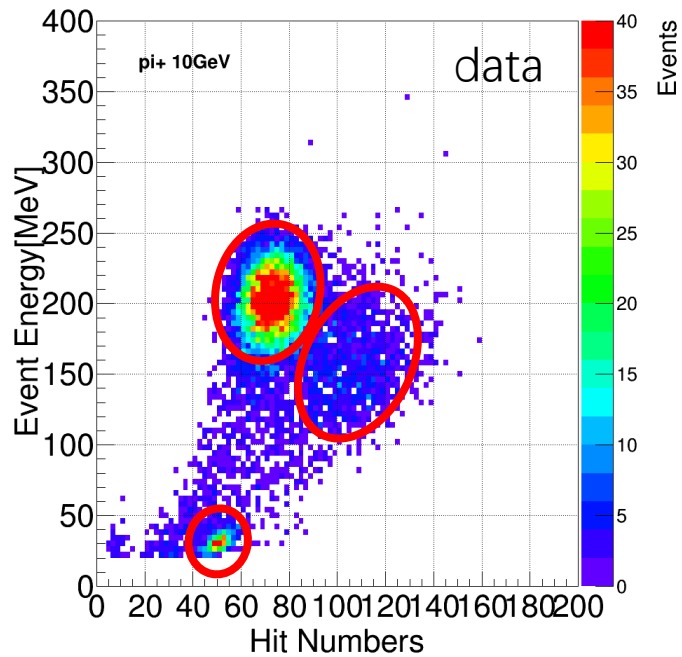# Compare MC Sample with TB Data in **50GeV pi+/e+** in hit number and longitudinal shower profile.
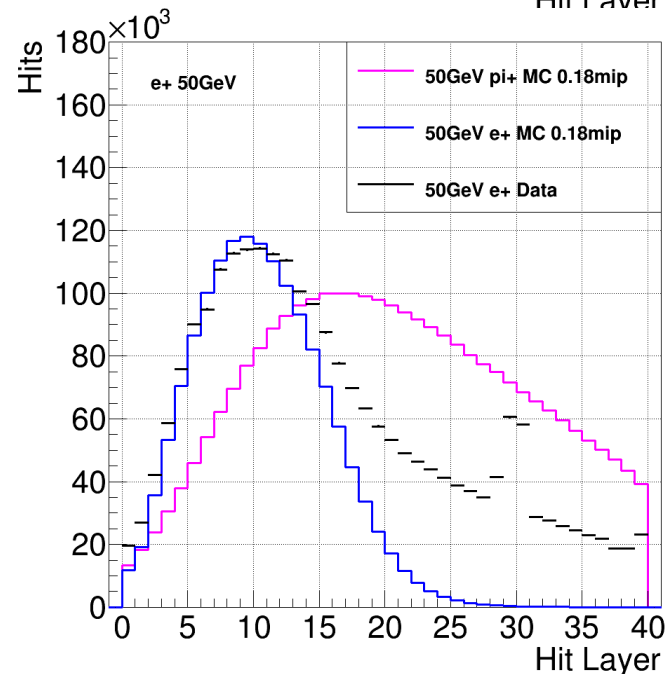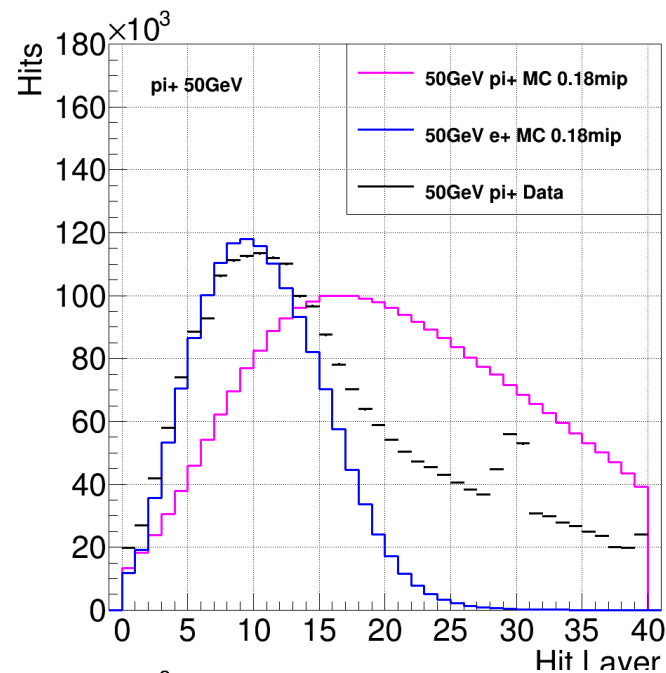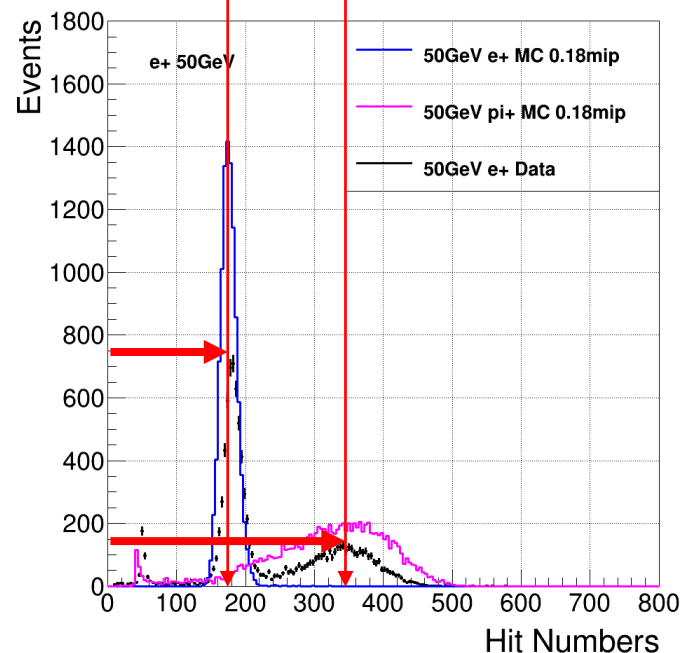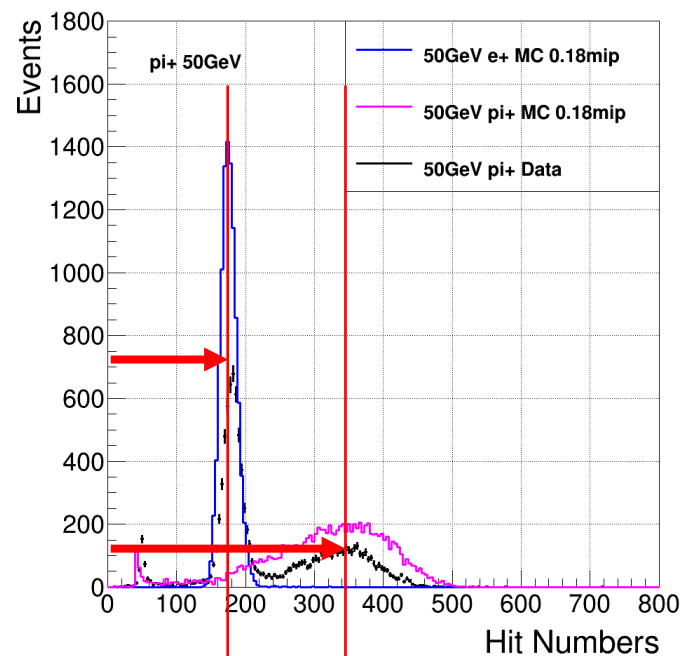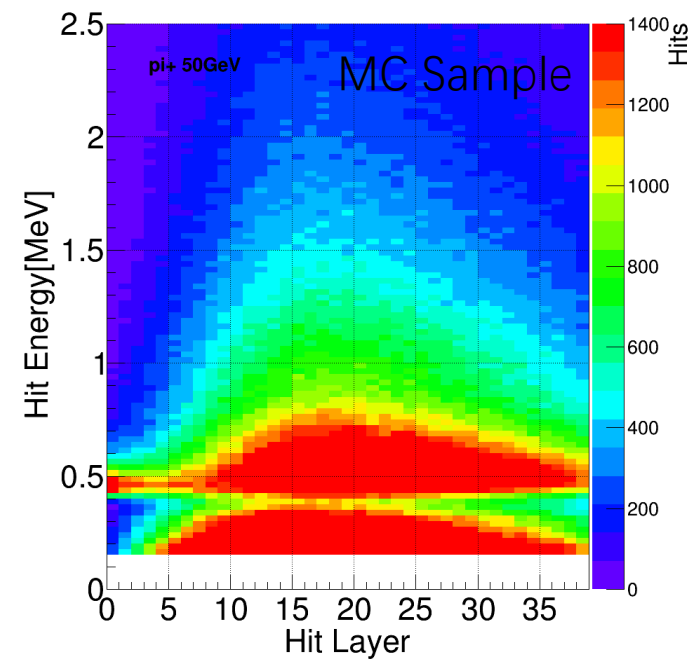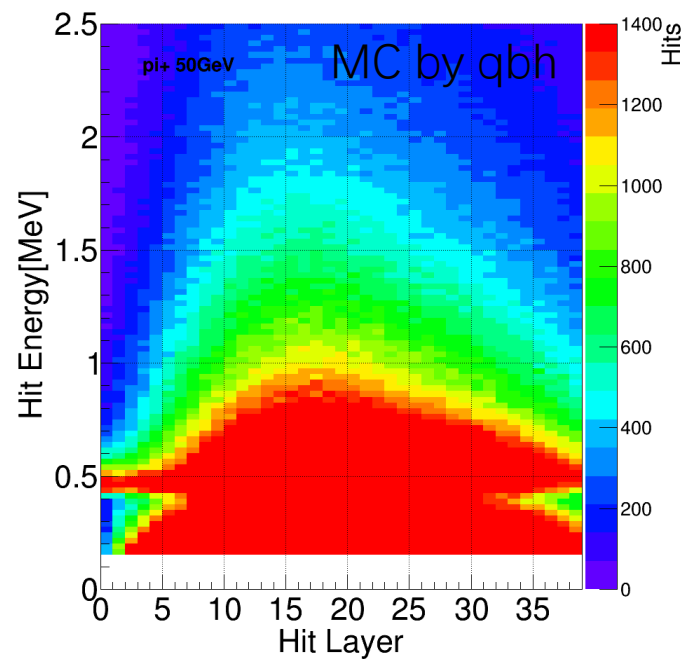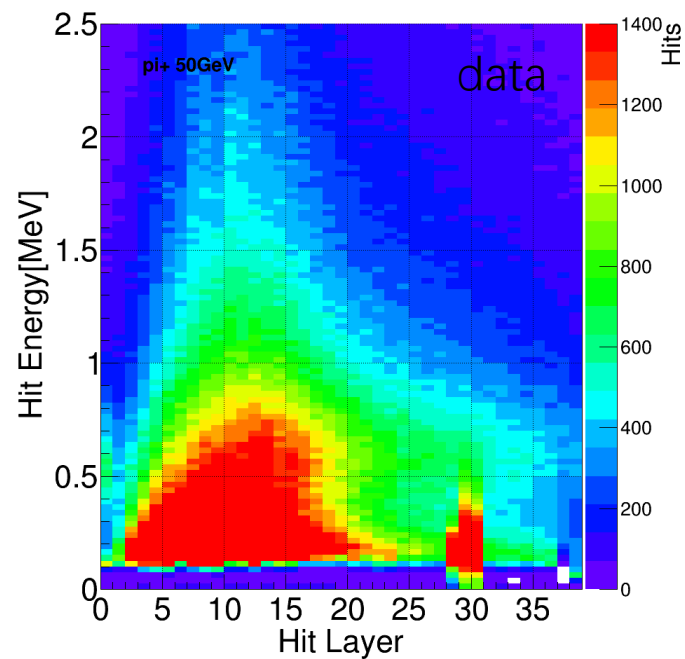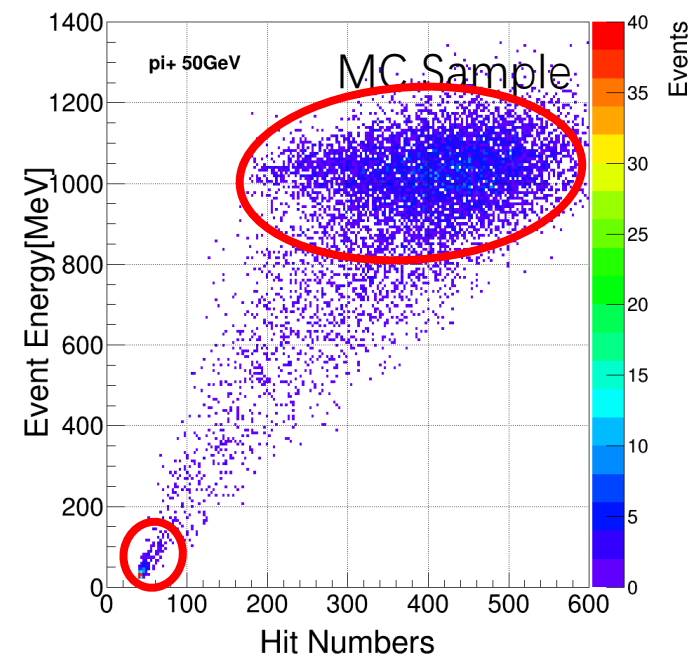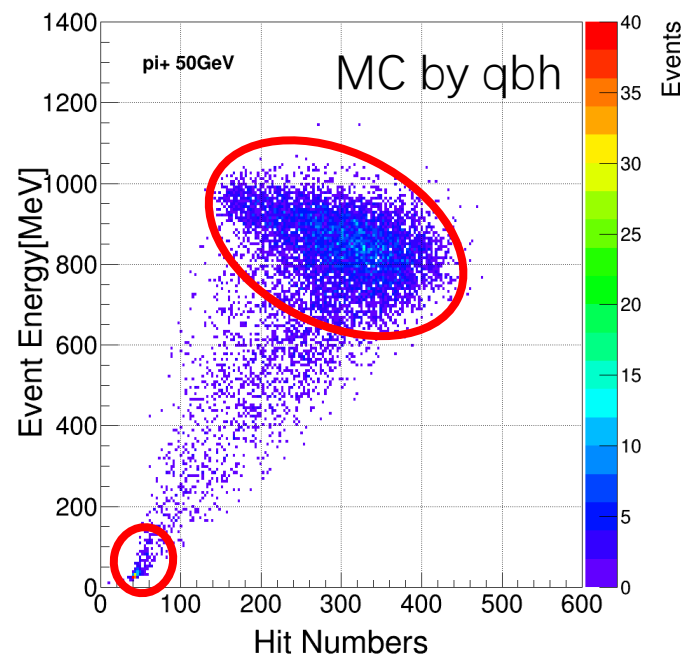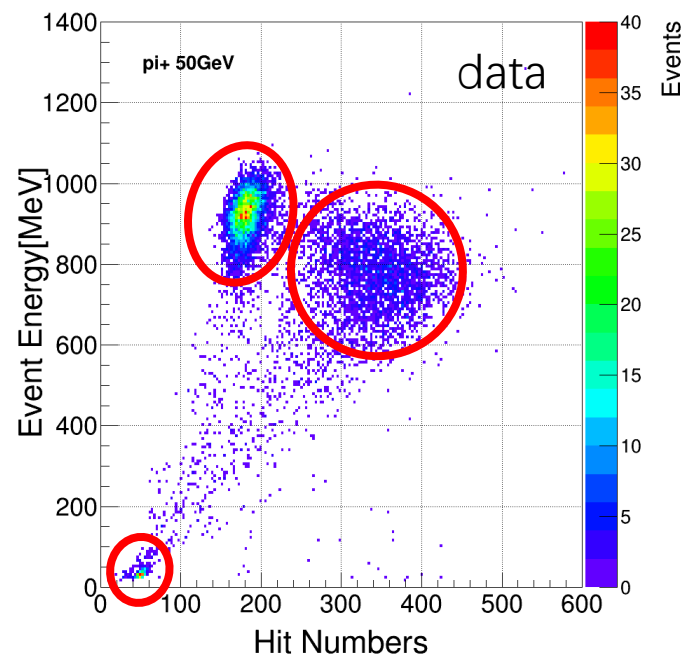

Event = 10000

- ➤ Both e+ and pi+ data have two peak in hit number, and can be matched with e+ MC sample and pi+ MC sample respectively.
- ➤ Data shower profile is more close to e+ MC sample in the front.
- ➤ There seems to be **no discrepancies** between e+ and pi+ data.

# Compare MC Sample with TB Data in **10GeV pi+** event
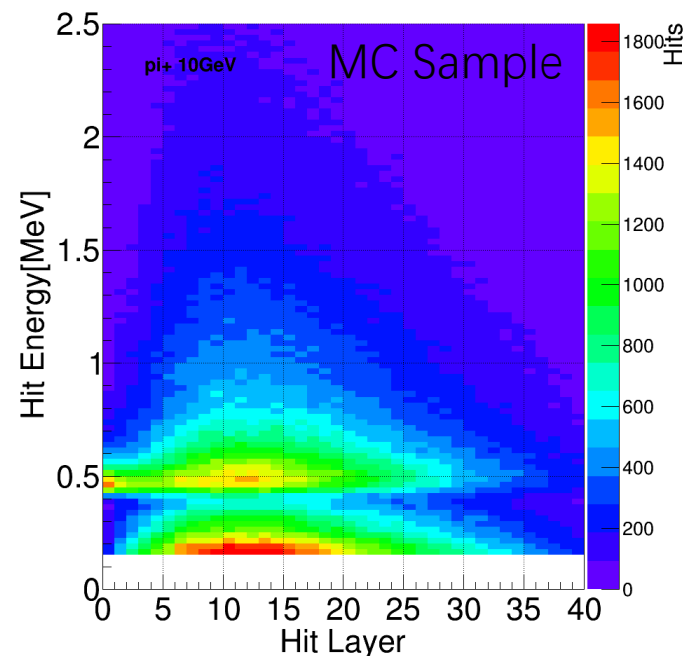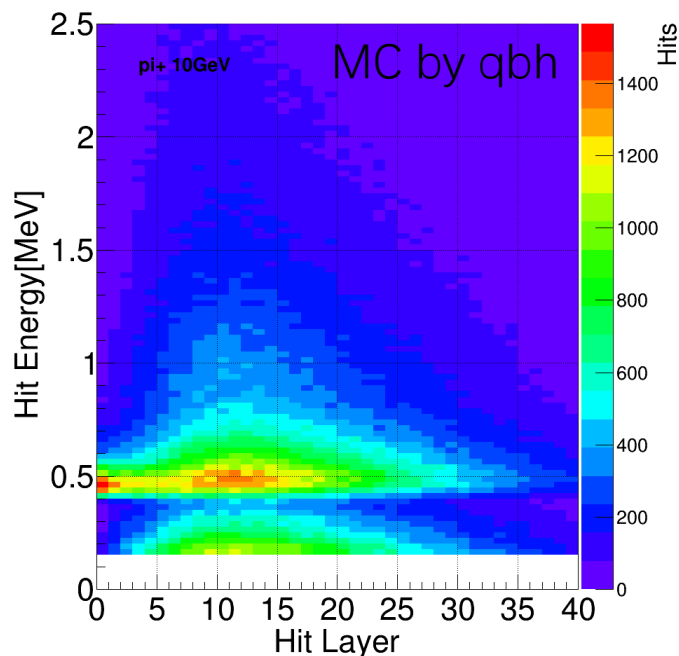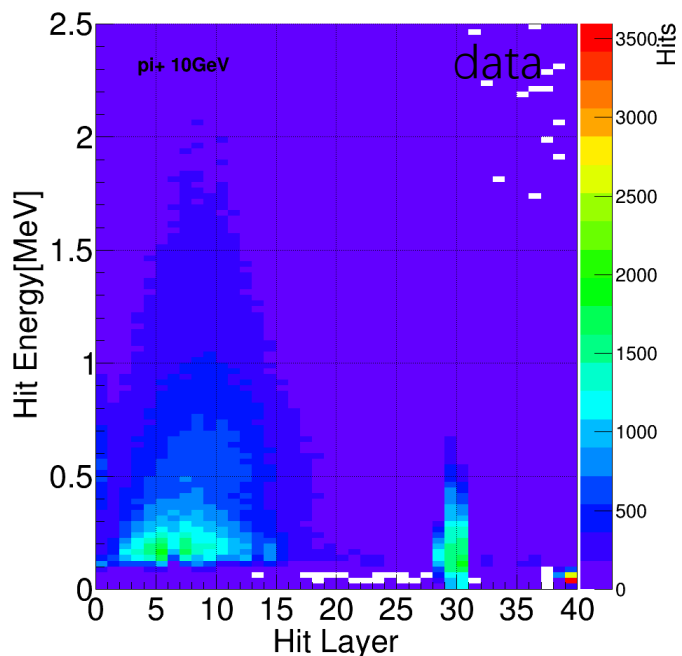
Compare MC Sample with TB Data in **50GeV pi+** event

Summery

> For mu+ sample, QBH's MC sample and data are matched well both in hit number and shower profile, besides of light leakage.

> For 10GeV pi+ sample, both hit number and shower profile are very different between data and MC.

> For 50GeV pi+ sample, data and BH's MC sample san be matched in a "small range".

> A lot of pi+ and e+ mixed both in p+ run and e+ run in TB data, and there seems no discrepancies between them.

- Comparison between tuned simulation data and TB data
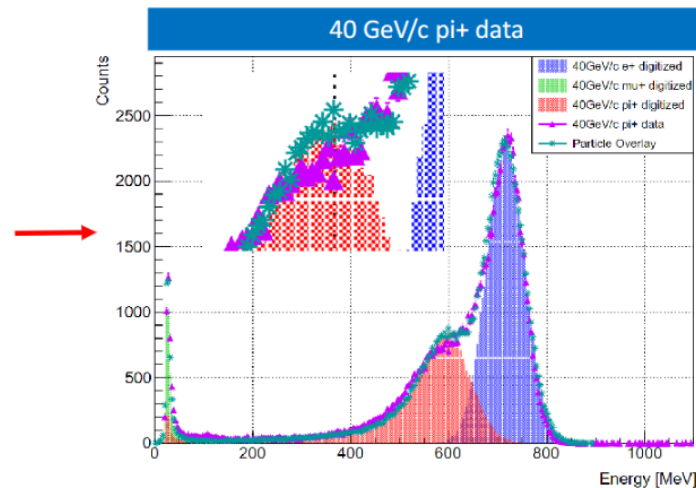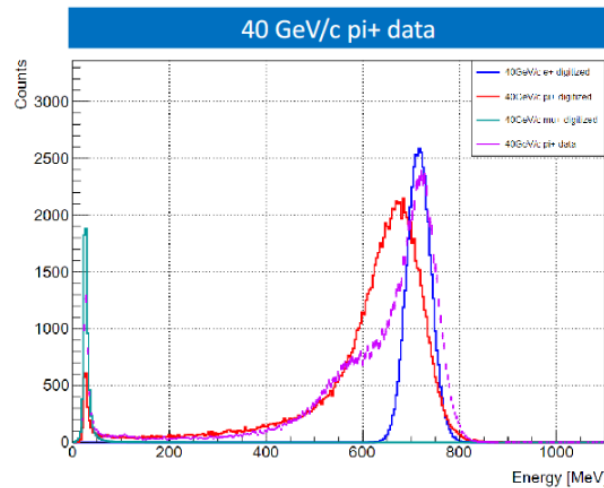
- Example beam components: 60% e+, 36.4% pi+, 0.36% mu+
- Tuned simulation generally agree with data, but may not be "physical" enough

A lot of positron mixed in pi+ sample!!!

> Trying to compare "mixed MC sample" from with data in shower profile and hit number level.

Arbor performance in MC sample

https://indico.ihep.ac.cn/event/19098/