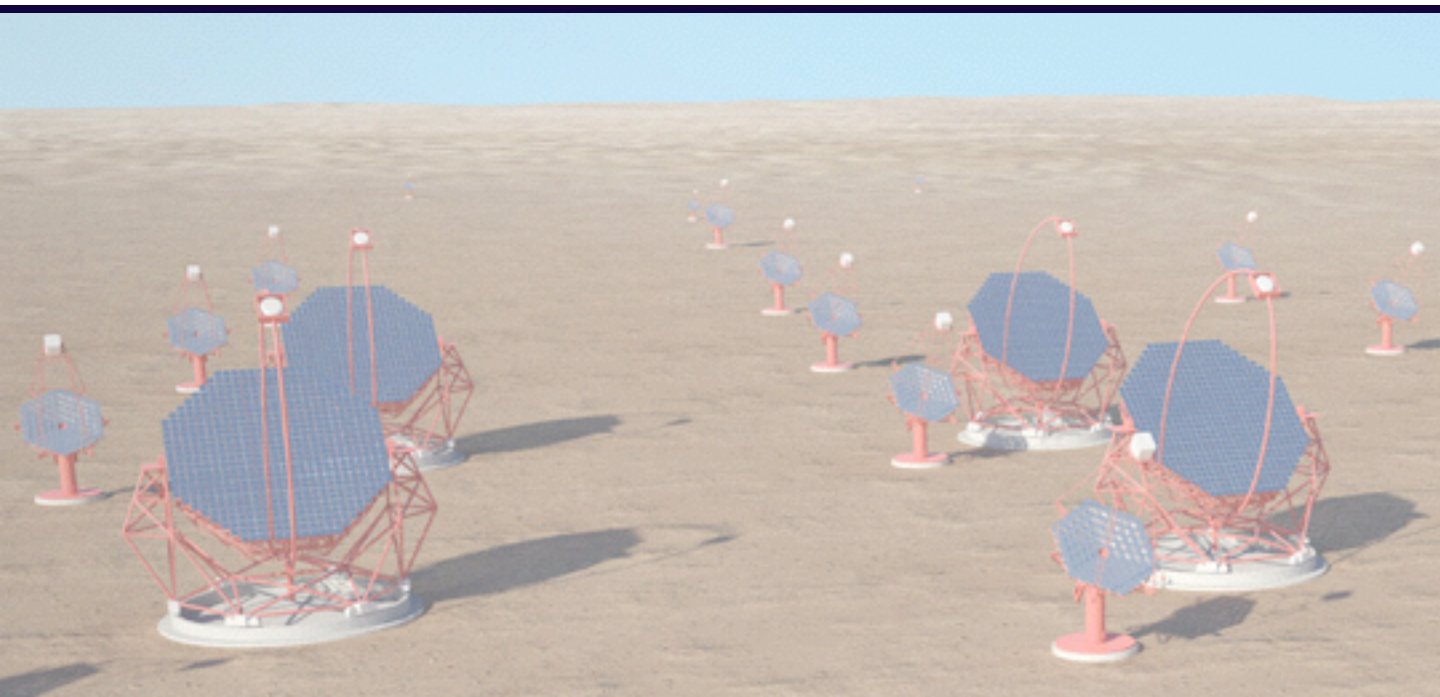


CTA 報告83: CTA大口径望遠鏡分割鏡 の性能評価とシミュレーションによる 光学系パラメータの考察

2014.9.18
日本物理学会 2014年秋季大会

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LST (Large-Sized Telescope)

◆ Play role in lower energy regions ($\sim 1\text{TeV}$)

◆ Specifications:

diameter : 23m

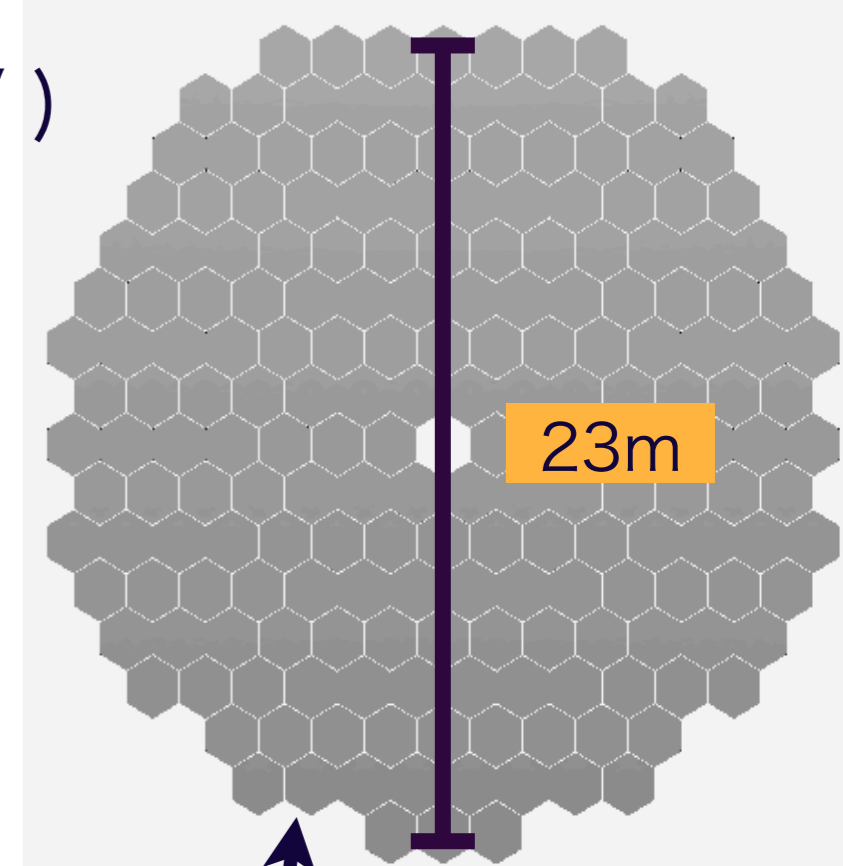
focal length : 28m

surface shape : parabolic

overall PSF (requirement) : 33mm
(2/3 pixel in camera)

consist of about 200

segmented mirrors



Segmented mirrors for LST

◆ Specifications

diameter: 1.51m

weight: 45kg

surface shape: spherical



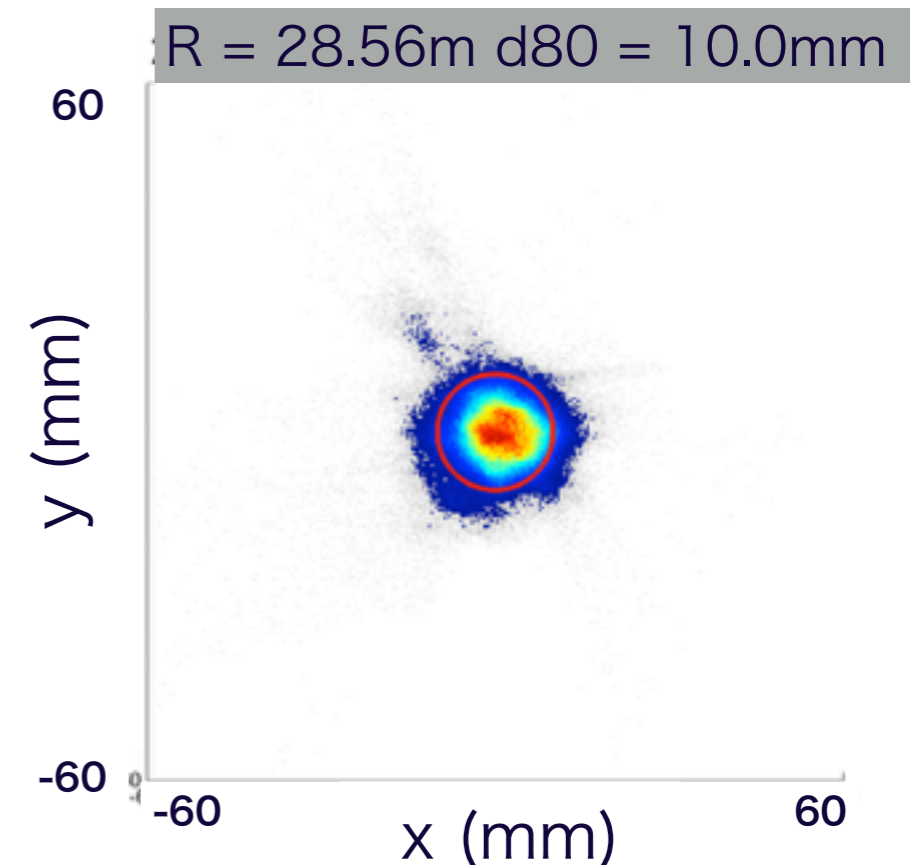
◆ Requirements

Point Spread Function (PSF) :

$d80 < 1/3$ pixel (16.6mm @1f)

diameter of a circle which includes 80% of the total reflected light

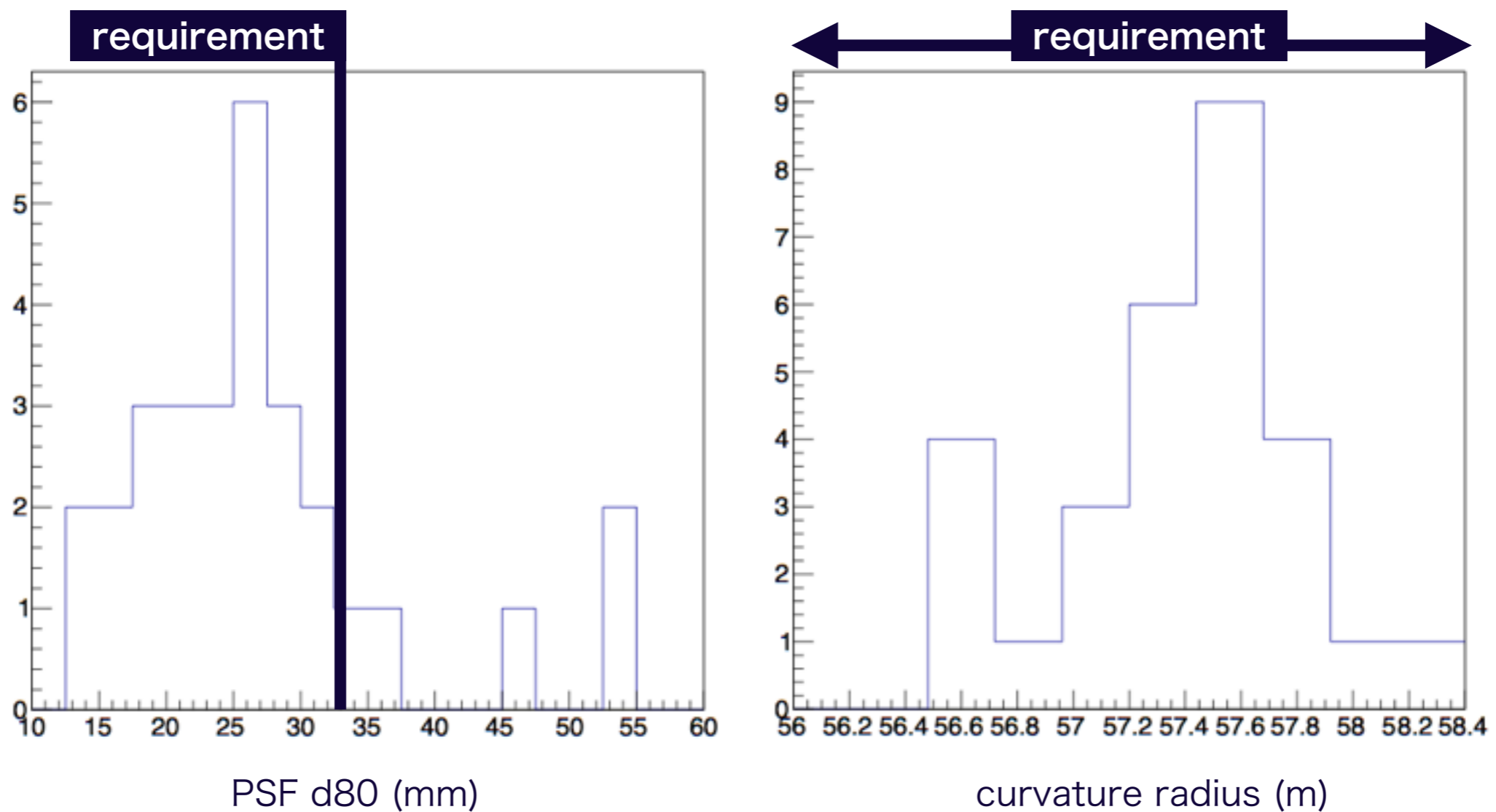
Focal length : 28.0 - 29.2m



Requirement

◆納品された29枚の分割鏡のPSFと曲率半径を測定

requirement : PSF d80 < 33mm Focal length : 28.0 - 29.2m



80%以上の分割鏡が要求を満たしている

MC simulation for LSTs

光学系パラメータの変化による望遠鏡性能の評価

◆LST：数十GeV-数TeVのエネルギー帯域の観測

◆4台のLSTに関するモンテカルロシミュレーションで光学系パラメータを調整し、1TeVまでの望遠鏡の性能（感度）を比較

◆パラメータ例；

Zenith: 20deg from north @Tenerife

Core range: 1600m (gamma) / 2100m (proton, electron)

Focus offset 12km (arXiv:1307.6461) / infinity

このパラメータを考慮して感度まで踏み込んだ性能評価はこれまでに
行われていない

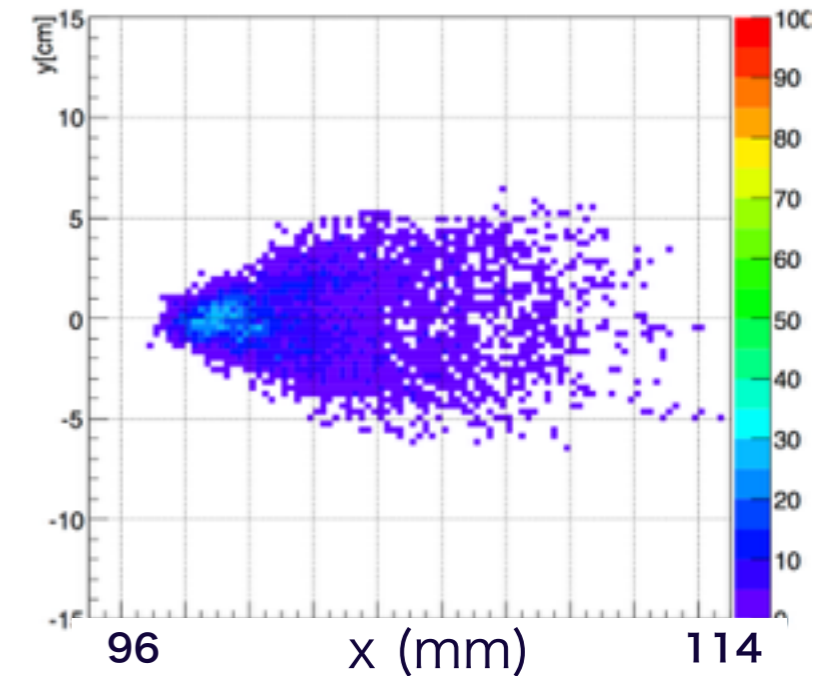
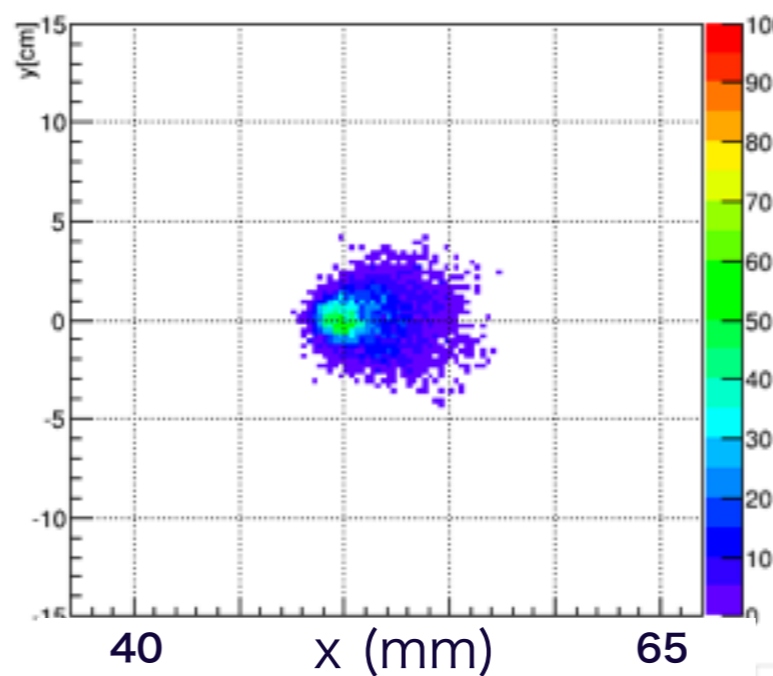
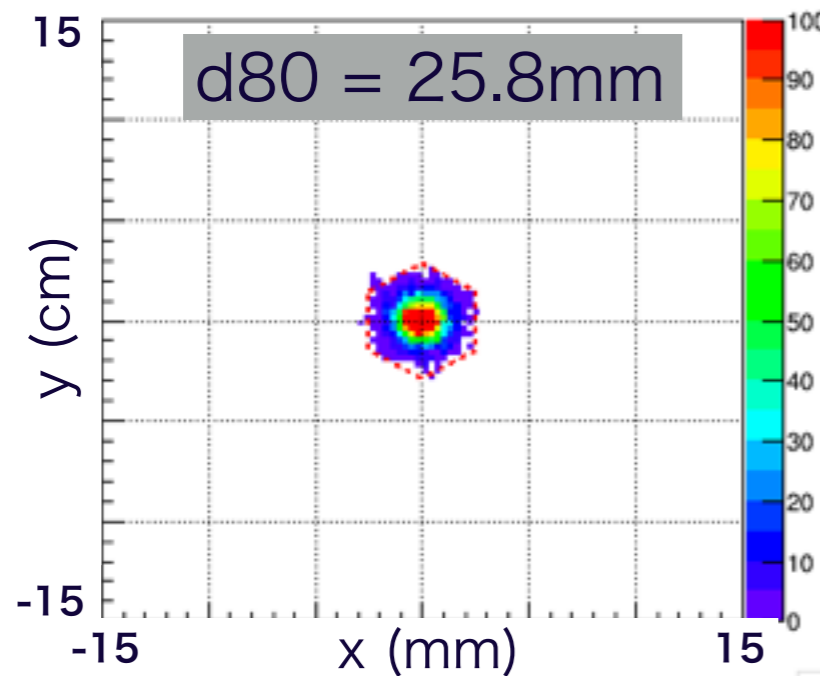
Focus on 12km

0.0 deg

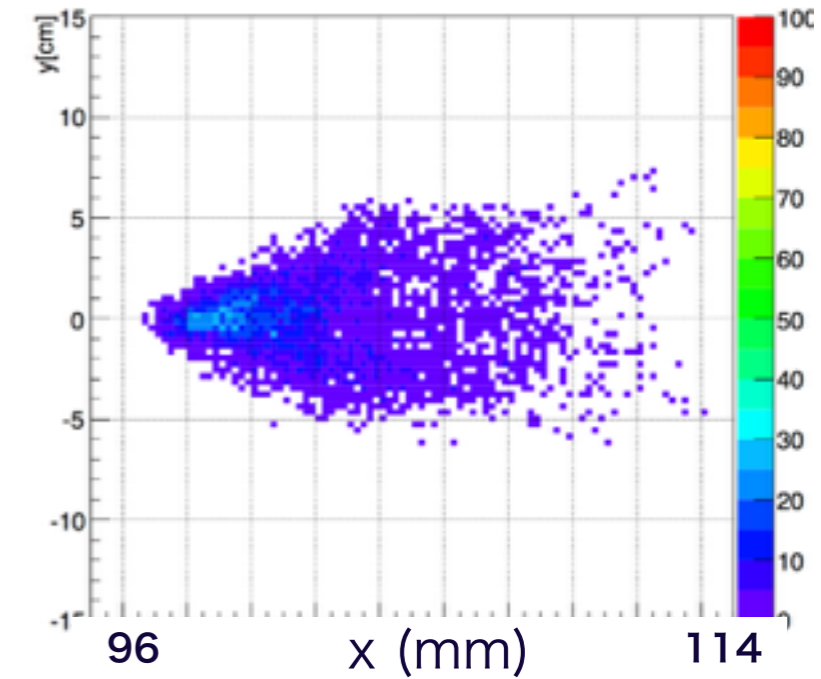
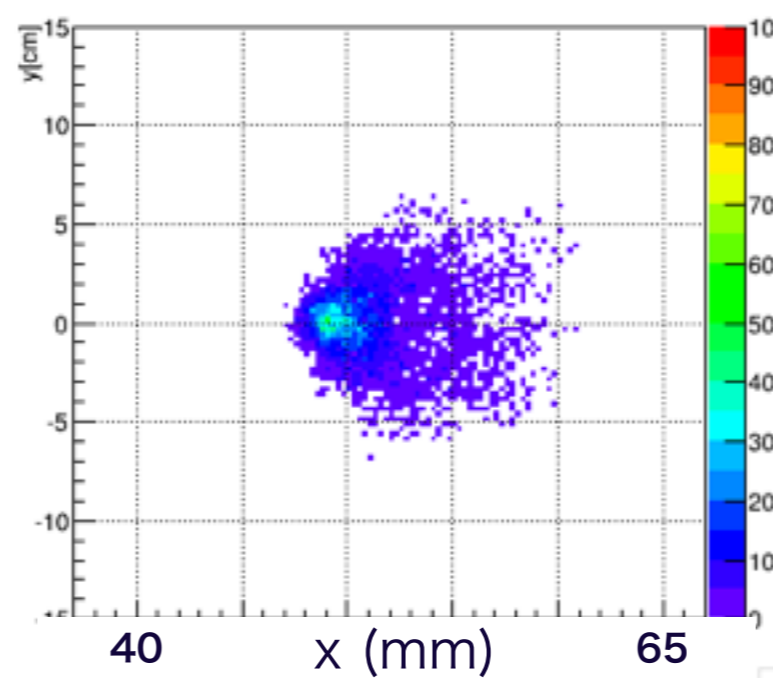
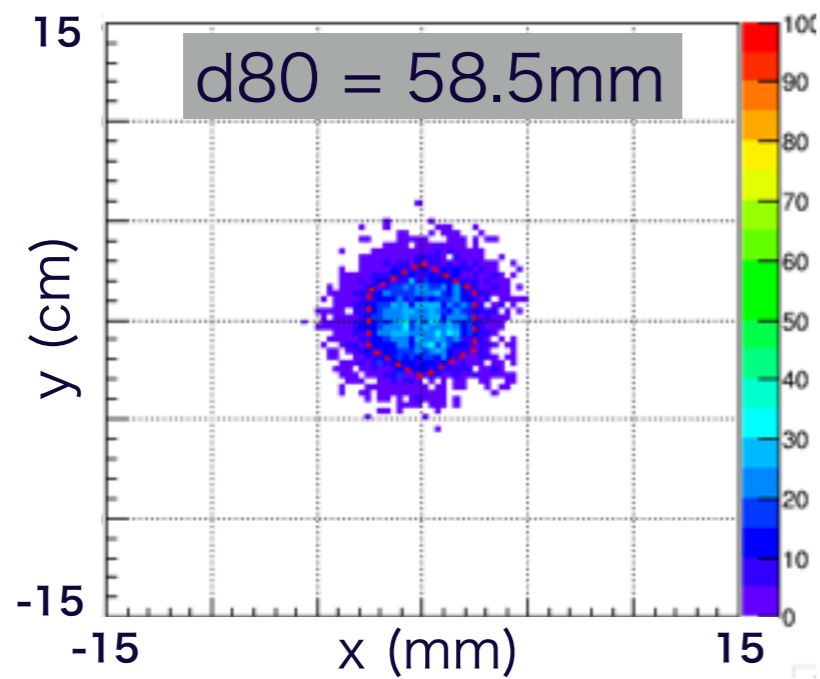
1.0 deg

2.0 deg

point source at 12 km



point source at infinity



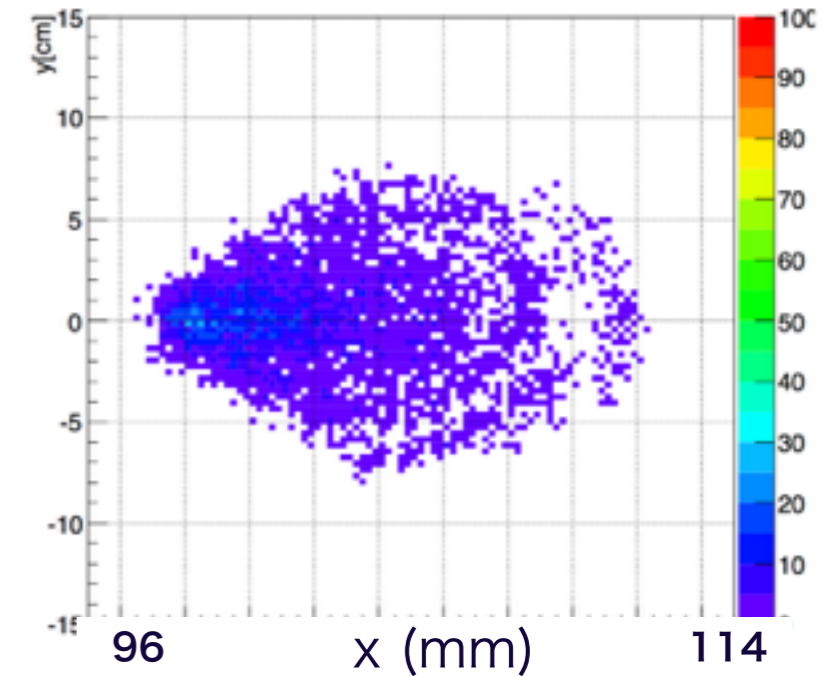
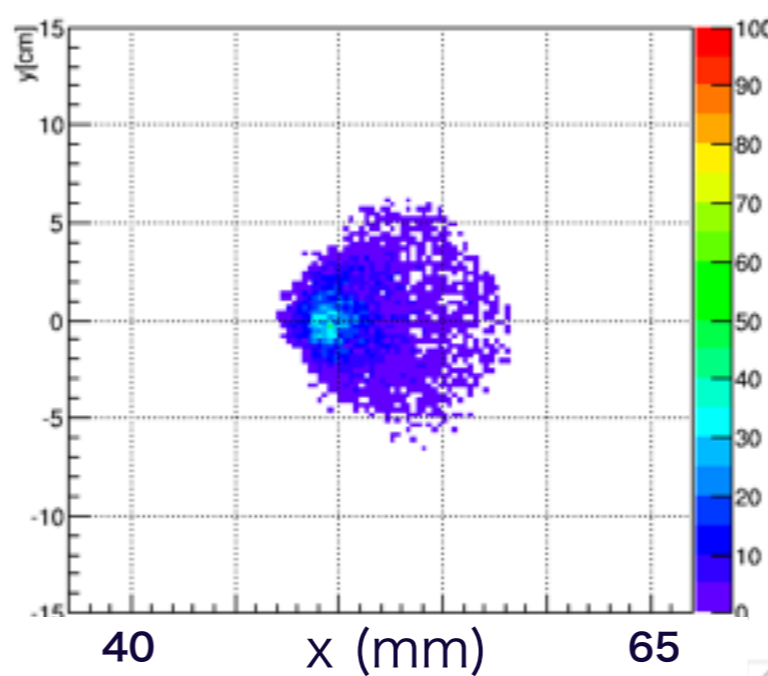
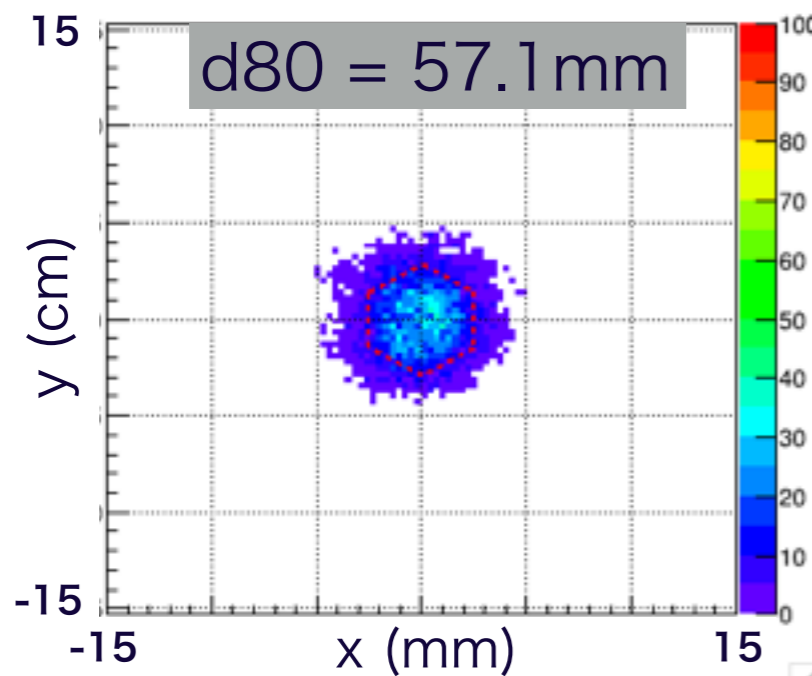
Focus on infinity

0.0 deg

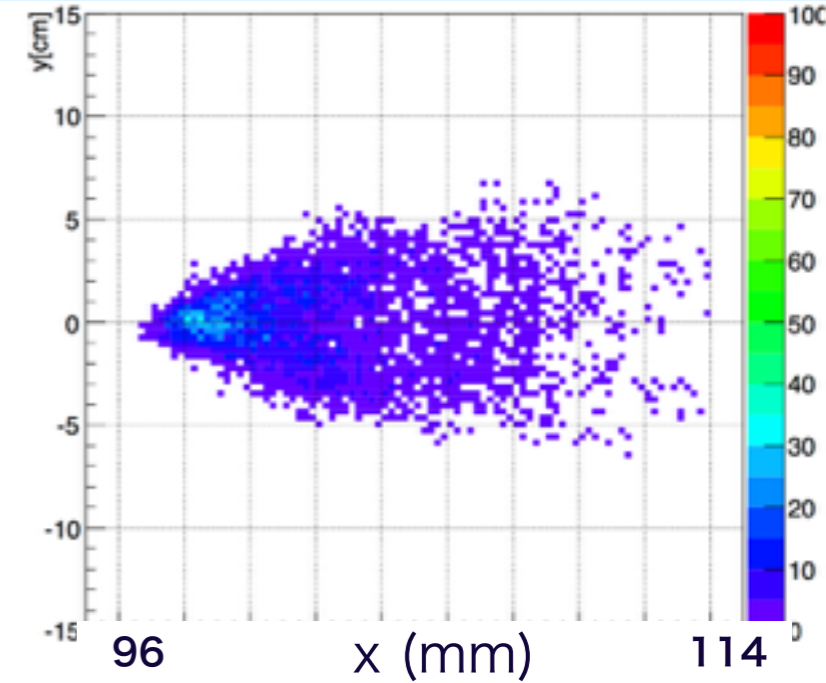
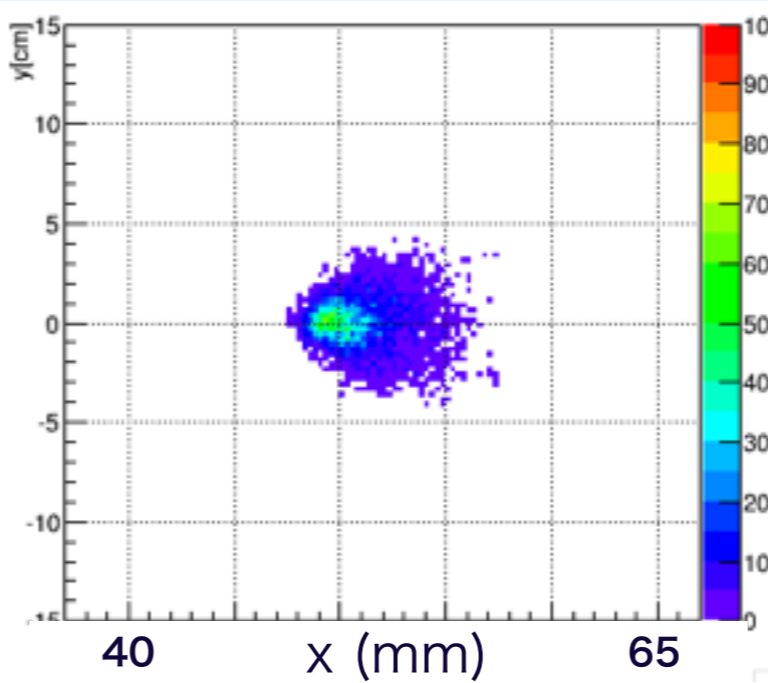
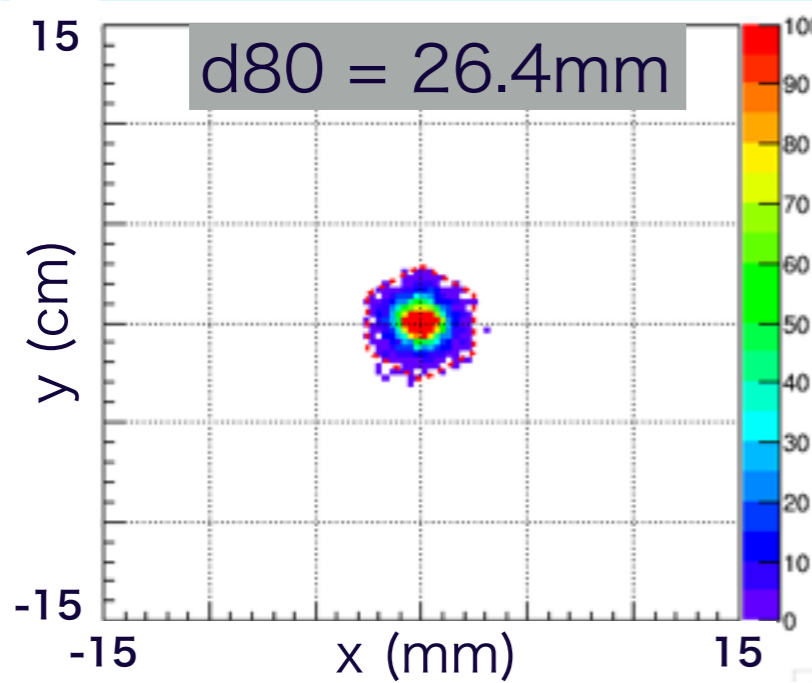
1.0 deg

2.0 deg

point source at 12 km



point source at infinity



Random Forest Method

- ◆ gamma/hadron separation :
Make the “Decision Tree” from training samples and image parameters selected randomly
→ Define “Hadroness”

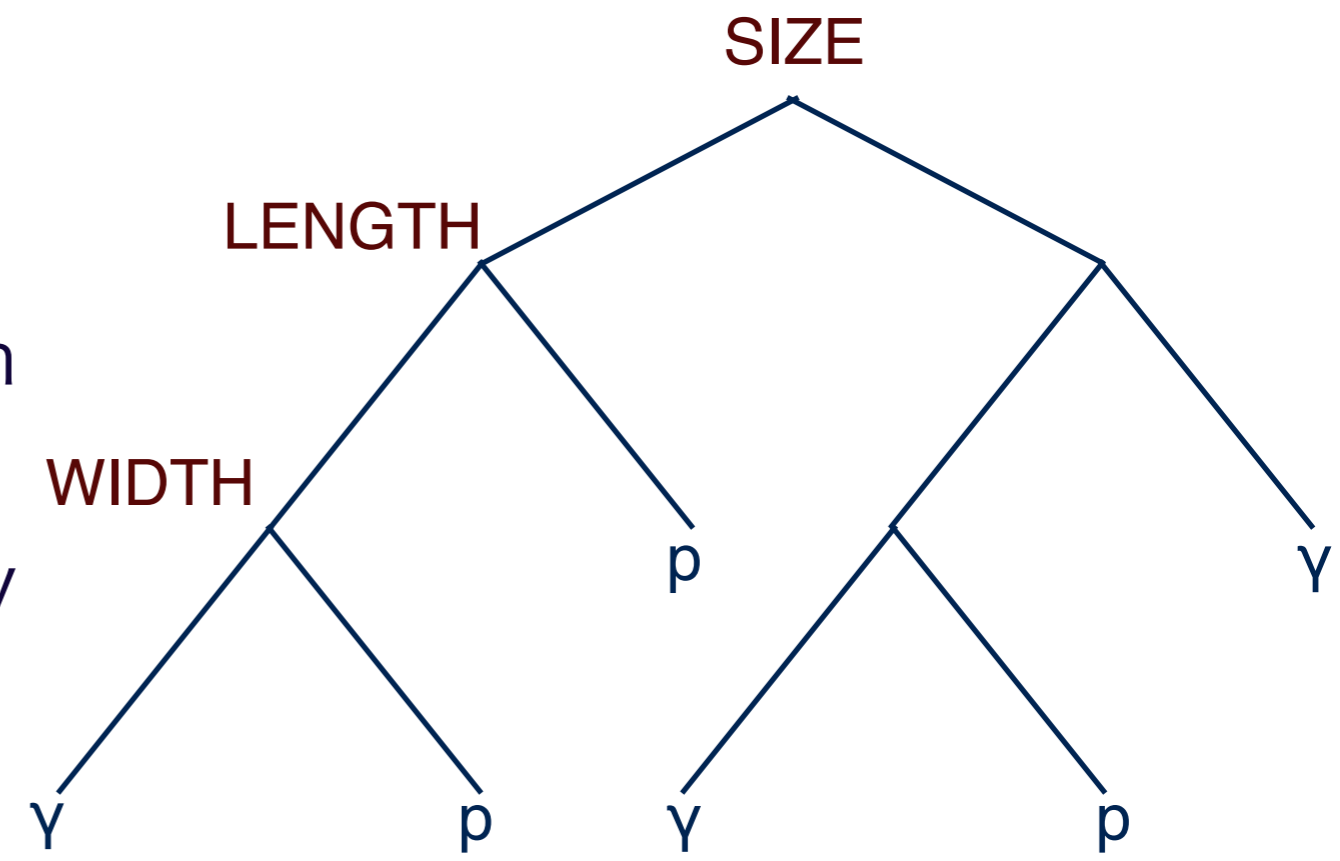
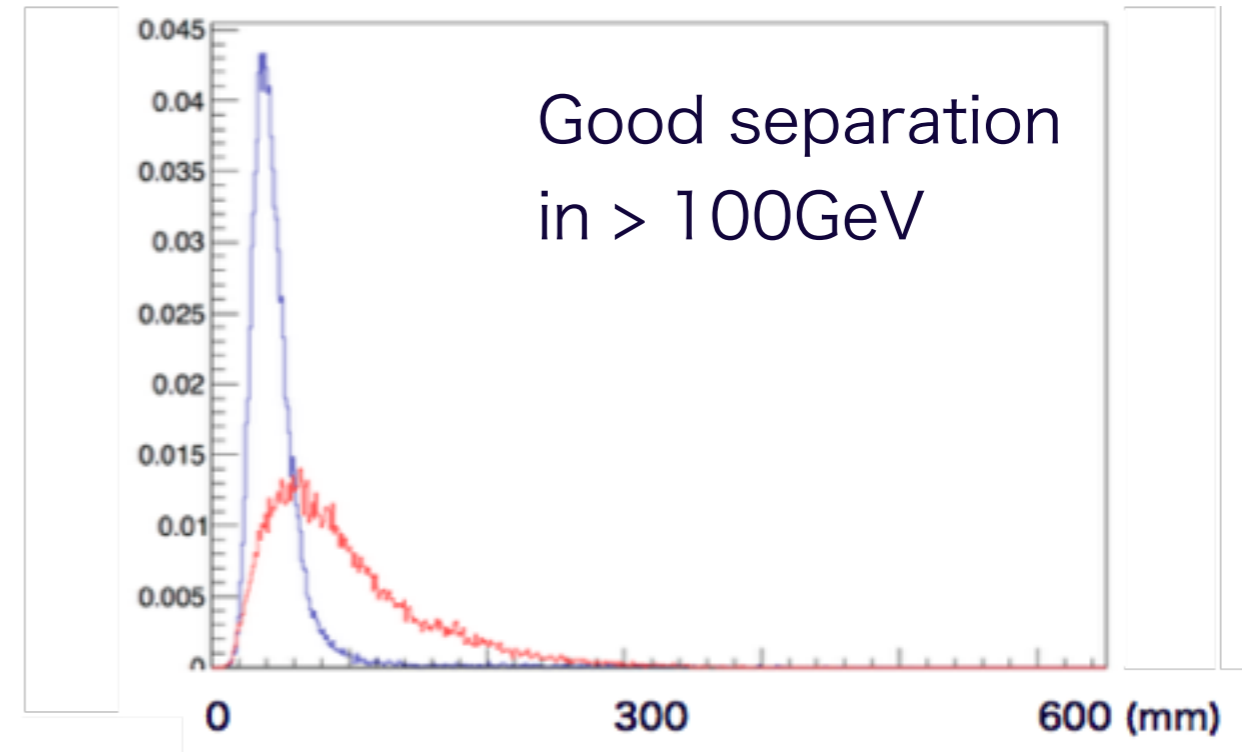
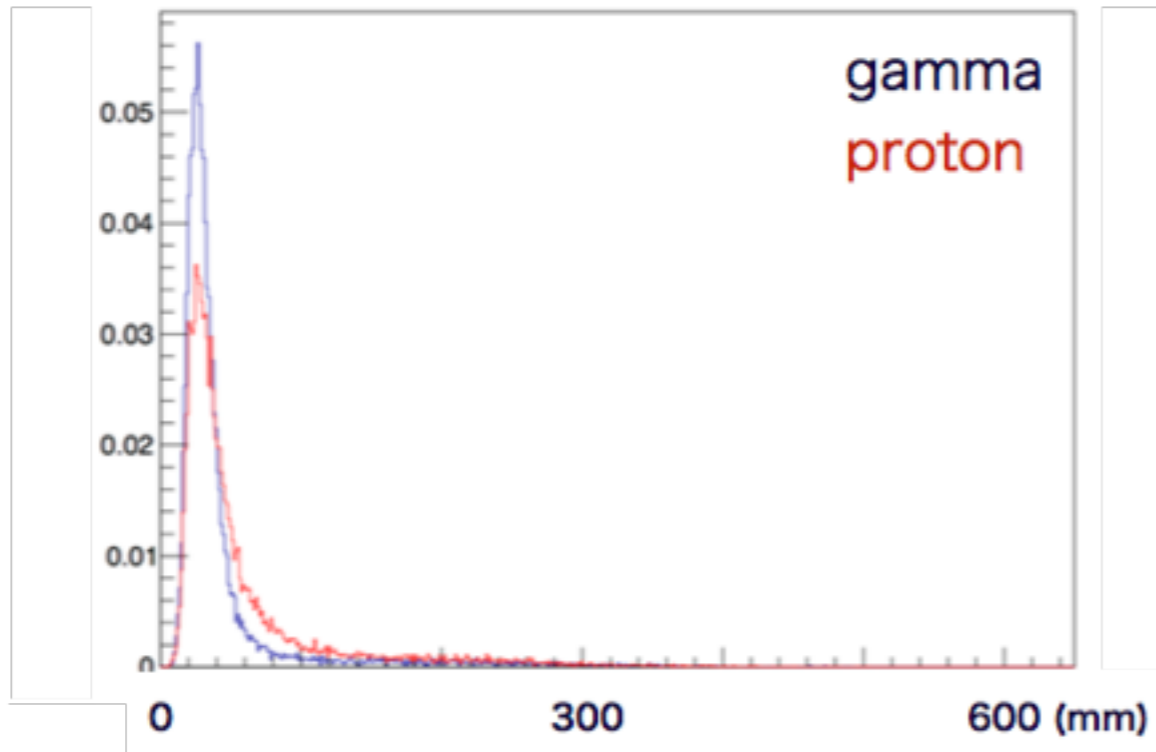


Image parameter

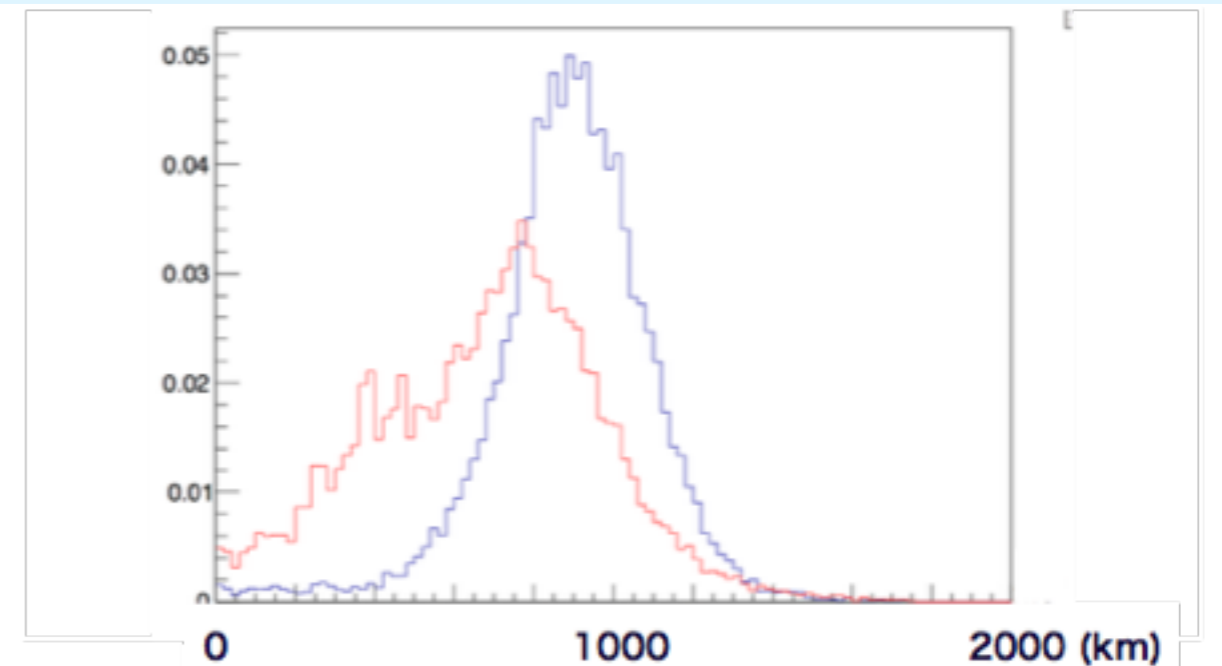
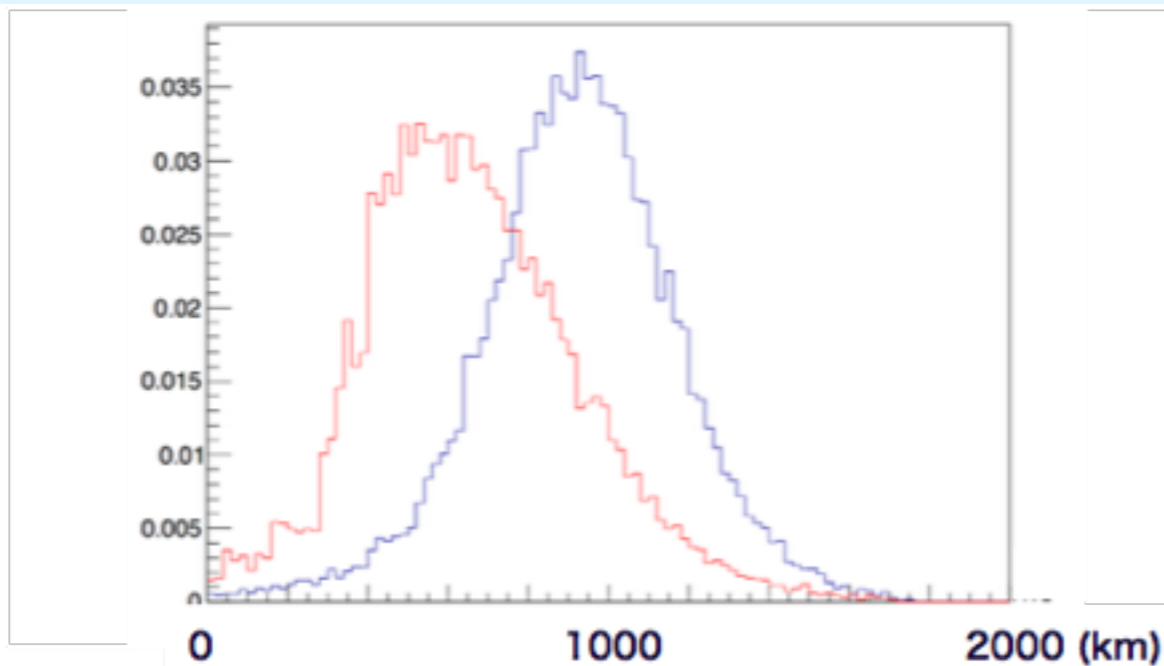
$E < 100 \text{ GeV}$

$E > 100 \text{ GeV}$

Width



Maximum shower height



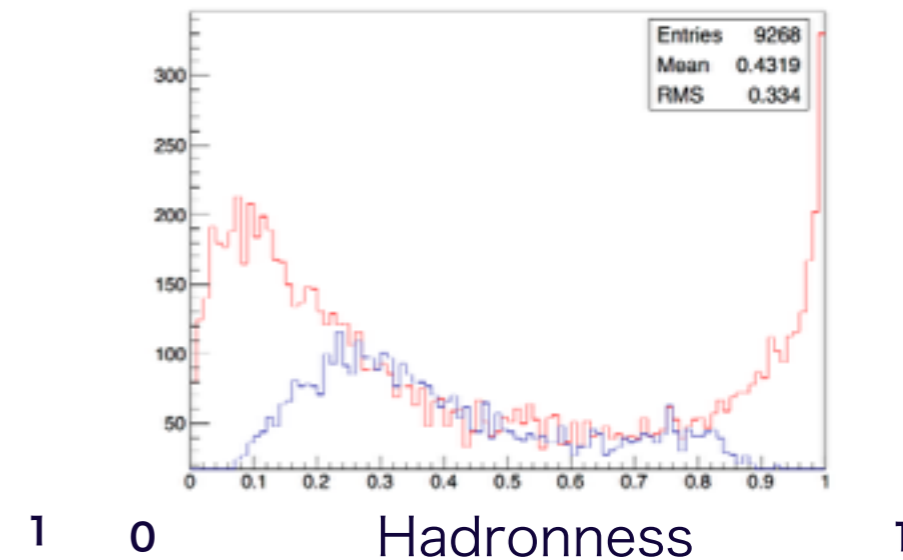
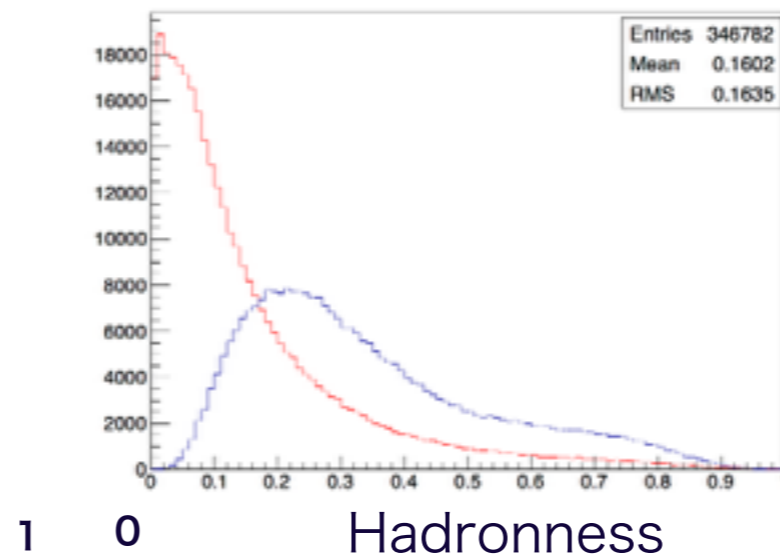
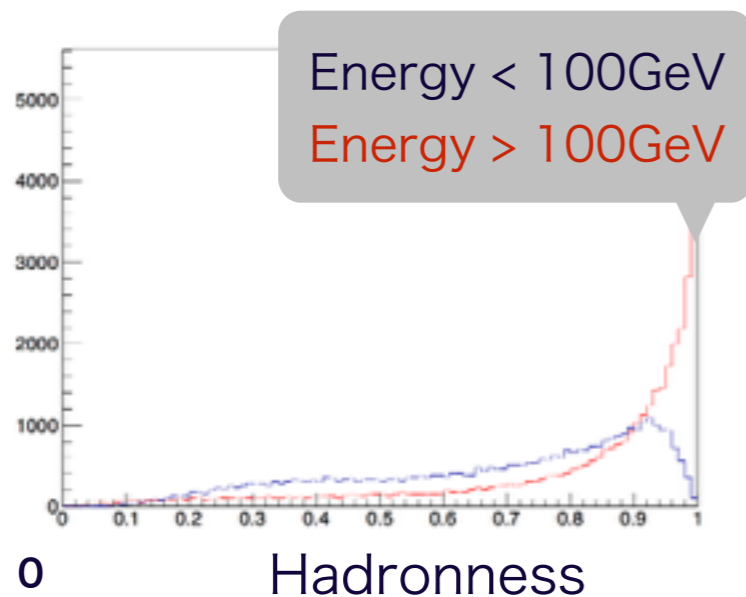
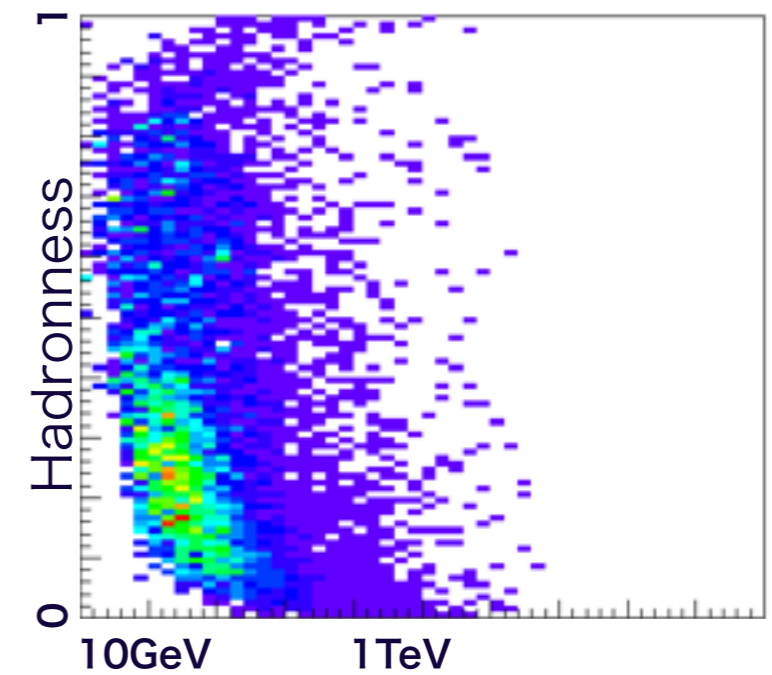
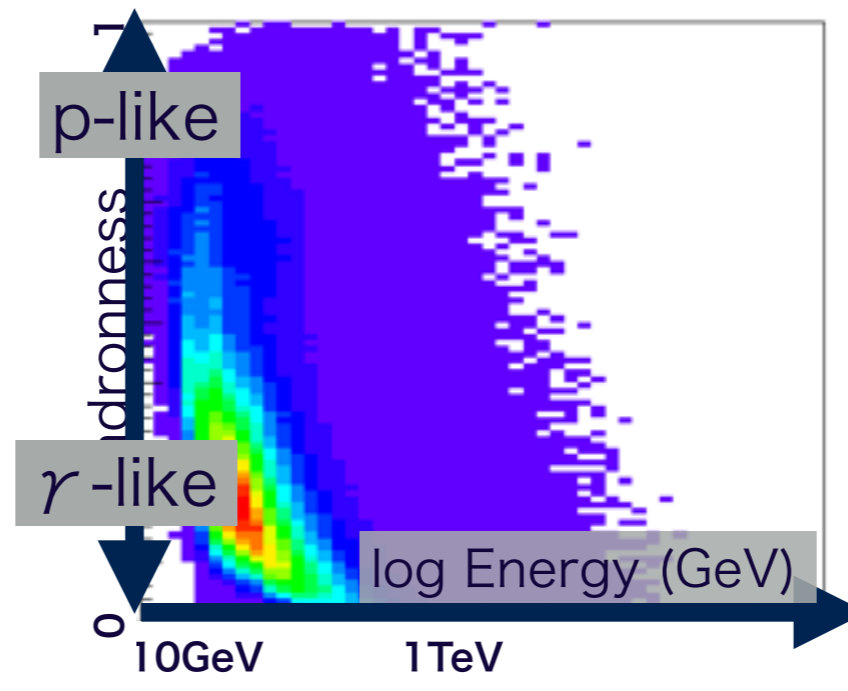
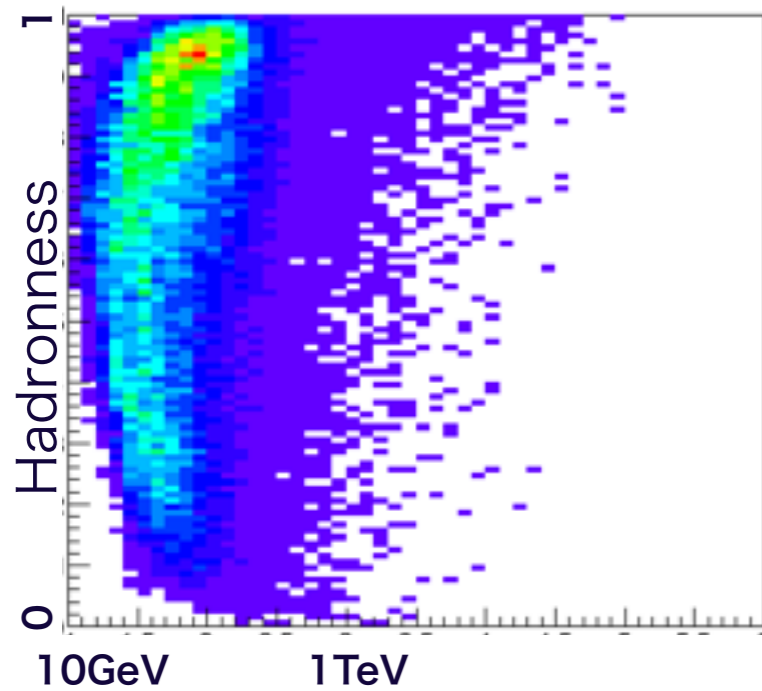
Hadronness

proton

gamma

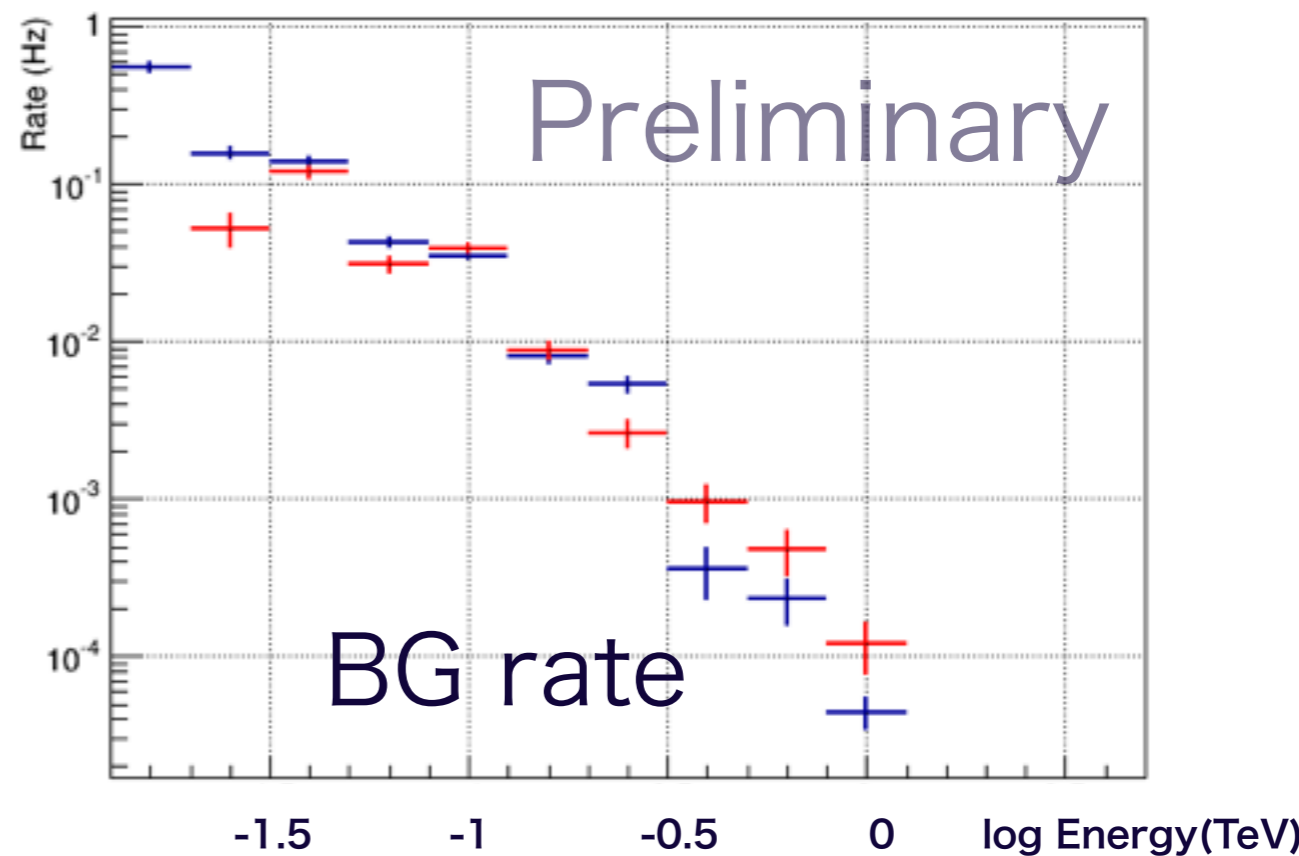
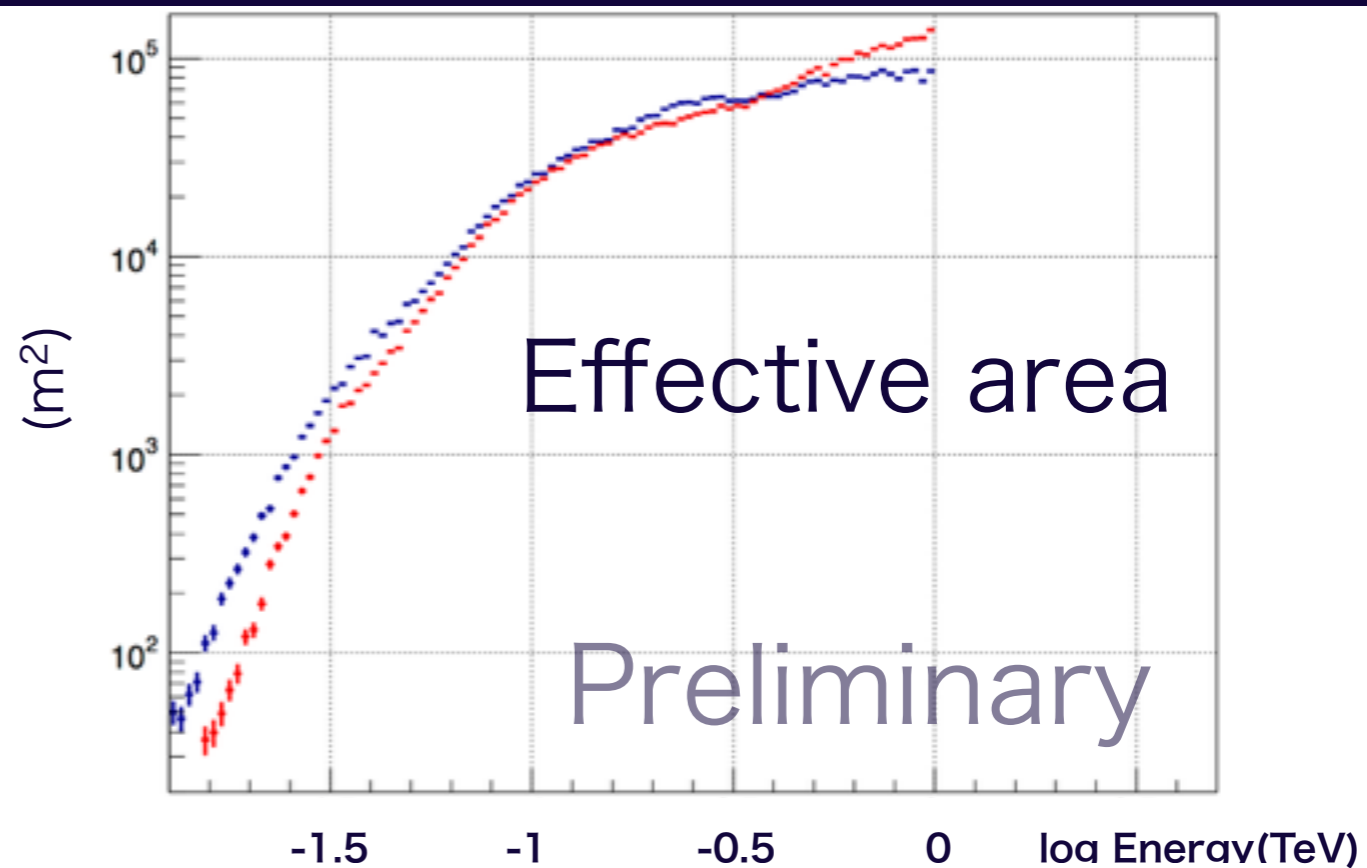
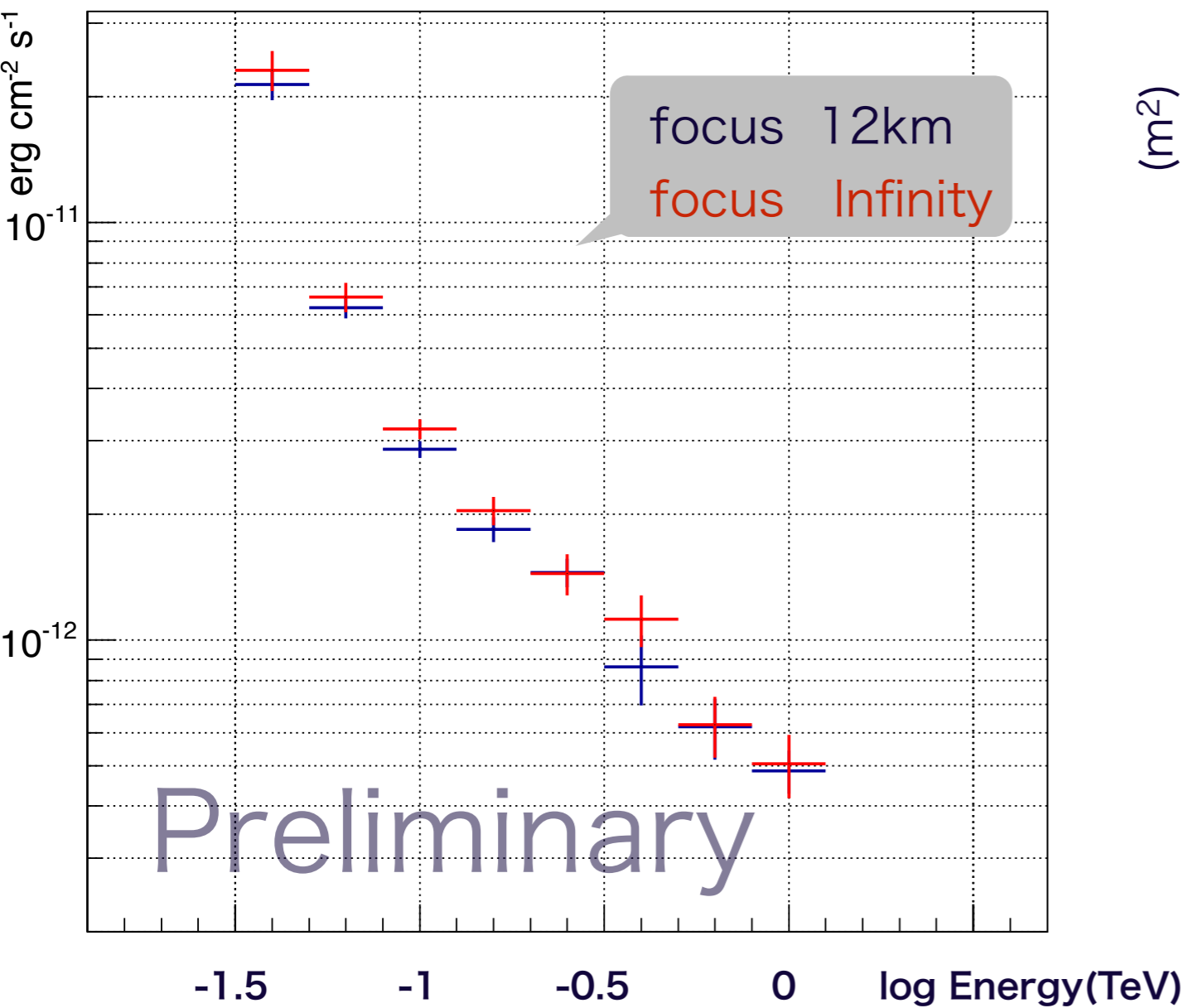
electron

focus offset: 12km



Results (4 LSTs, 50hours @Tenerife)

Sensitivity



Summary & Outlook

◆空気シャワーシミュレーション、Random Forest 法に基づく望遠鏡性能の評価

◆個々の光学系パラメータの望遠鏡性能への影響を具体的に比較した

- ・カメラのfocus offsetの違いによる望遠鏡性能の影響

これまでの解析からは、camera offsetの設定による優劣の結論はまだ出せていないが、パラメータの値の確認・最適化を行い最終結論を導く予定

今後評価する光学パラメータ：

◆測定結果に基づいた鏡面精度（集光性能）の導入

◆それぞれの焦点距離などに応じた分割鏡の配置の最適化