

# Measurement of the improved angular resolution of GRAPES-3 EAS array by the observation of the Moon shadow

Diptiranjana Pattanaik

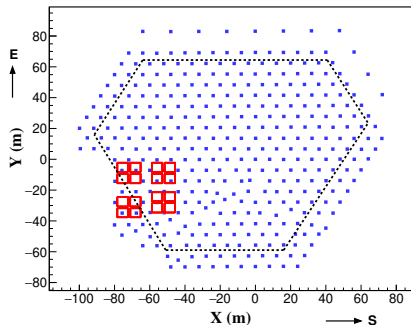
On behalf of GRAPES-3 collaboration

**PoS(ICRC2021)391**

**37<sup>th</sup> International Cosmic Ray Conference, 12-23 July 2021**

# Introduction

GRAPES-3 (**G**amma **R**ay **A**stronomy at **P**eV **E**nergie**S** phase-**3**) is an extensive air shower array experiment.



**Figure :** GRAPES-3 array consisting of the Scintillator detectors (■), Muon telescope (□) and the fiducial area (- - -).

- **Objectives:** Study of cosmic rays sources.
- Closely packed array provides very good angular resolution.
- Absolute calibration was done by observing the Moon shadow.

# Data selection for the analysis

⇒ Three years (January 01, 2014 - December 31, 2016) of air shower data are used for this analysis.

## Quality cuts:

- Successful NKG fit.
- Shower cores within fiducial area.
- Shower age between 0.2 to 1.8.
- Zenith angle below  $45^\circ$ .

# Analysis method

## Background study:

- 6 fake-Moon positions selected.
- Each with  $+10^\circ$  shift in azimuthal angle.

## Deficit in the flux:

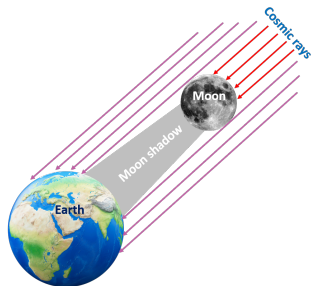
- Cosmic ray deficit was calculated by,

$$\frac{\Delta N_i}{\langle N \rangle} = \frac{N_i^{on} - \langle N_i^{off} \rangle}{\langle N_i^{off} \rangle}$$

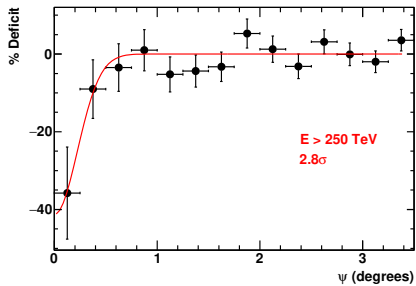
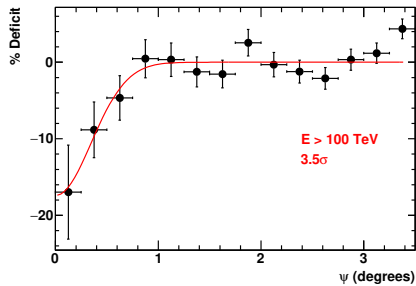
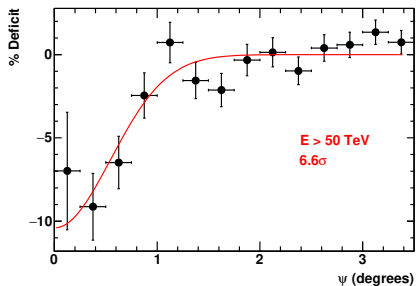
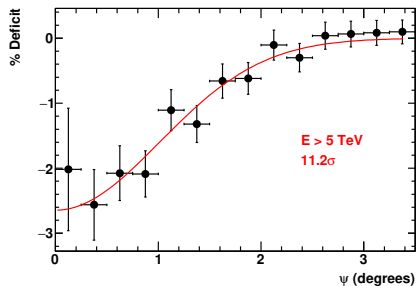
The angular resolution was obtained by fitting the deficit plot with a Gaussian function given by,

$$N(\psi) = N_0 \frac{\psi_M^2}{2\sigma_\psi} e^{-\frac{\psi^2}{2\sigma_\psi^2}}$$

where,  $\sigma_\psi$  is the angular resolution and  $\psi$  is the incident angle measured from the direction of Moon.



# Cosmic ray shadow of the Moon



# GRAPES-3 Angular Resolution

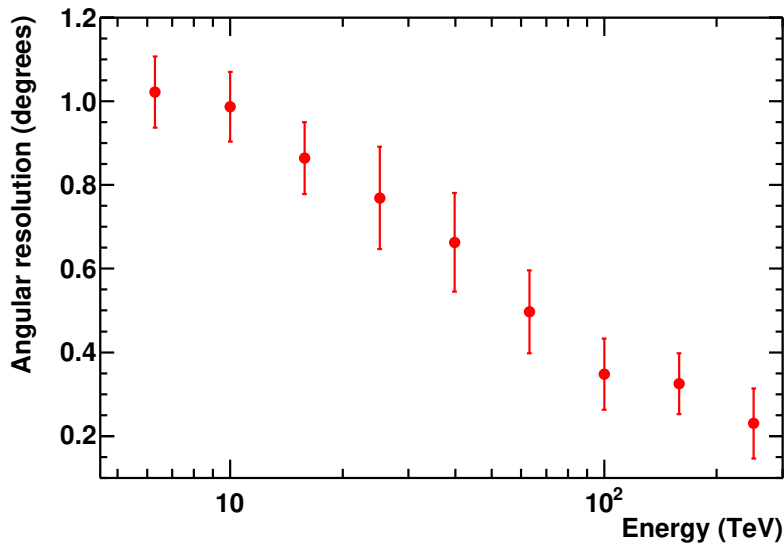


Figure : Angular resolution of the GRAPES-e experiment

# Summary

Energy (TeV)	Angular resolution ( $^{\circ}$ )	Maximum deficit (%)	Significance
> 5	$1.01 \pm 0.08$	$2.5 \pm 0.5$	$11.2\sigma$
> 50	$0.54 \pm 0.09$	$10 \pm 2.0$	$6.6\sigma$
> 100	$0.35 \pm 0.08$	$19 \pm 6.1$	$3.5\sigma$
> 250	$0.23 \pm 0.08$	$40 \pm 12$	$2.8\sigma$

- GRAPES-3 angular resolution improves with energy.
- This provides us the ability of search for the cosmic ray sources.

- Date and time (Berlin) of ZOOM-Meeting : **16. July 2021 - 18:00.**
- Presenter-Forum Number: **90**



*Thank You*