

# Very High Energy Gamma-rays from Galactic Center

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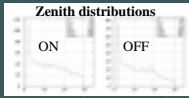


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## CANGAROO-II telescope in the southern hemisphere

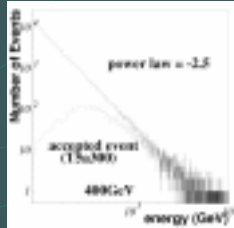


Advantage of decreased energy threshold for observations of the galactic center



76.6 degree 77.5 degree  
Elevation @ culmination ~ 88 degree

100GeV --- 10TeV gamma-rays



Observation time for the galactic center			
	2001 July	2002 July	2002 August
ON source	20.8h	32.0h	20.1h
OFF source	22.1h	17.9h	14.9h

## VHE gamma-rays from Galactic Center

1. SgrA\* or SgrA east
2. Dark matter neutralino annihilation

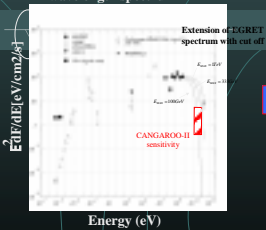


Energy threshold ~ 400GeV

EGRET (2EGJ1746-2852)



## The multi-band wavelength spectrum



The broadband spectrum calculated self-consistently using the particle decay products from proton-proton scattering in SgrA east. (Melia, Fatuzzo, Yusef-Zadeh & Markoff 1998)

Gamma-ray spectra from a power law distributions of proton energy in SgrA\*. (Mahadevan, Narayan & Krolik 1997)

Neutralino  
Large mass & stable

Density ( $\rho$ )

Angle from the galactic center

$\chi\chi \rightarrow 2\gamma$

Rate =  $\left(\frac{\rho}{M_z}\right)^2 \sigma v$

Substantial density enhancement near the center

Sub TeV gamma-rays from the galactic center

For reference, please see Bergstrom's invited review about dark Matter!

We have analyzed data from observations of the galactic center data made with the CANGAROO-II telescope in 2001 and 2002. Our analysis was made through following procedure.

### 1. Cloud cut and elevation cut for selection of good condition data

The rejection of cloudy and dew data

Cluster cut

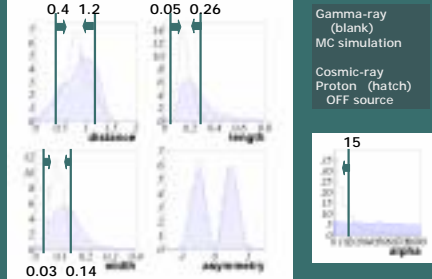
- 240 < TDC < 340
- T4a.300

ADC threshold = 300 (~3 $\sigma$ , e)  
at least 4 adjacent triggered PMTs

Shower rate > 575 events/5min (~2Hz)

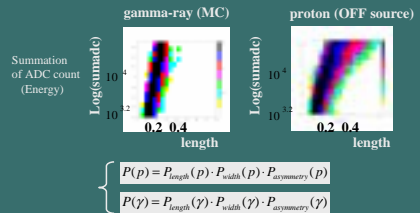
Elevation > 60 degree

## 2. 2D-Likelihood analysis



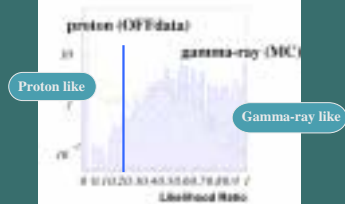
Hillas parameters  $\rightarrow$  Energy dependence more powerful than traditional Hillas cuts

sumadc vs length, width, asymmetry PDF (Provability Density Function)

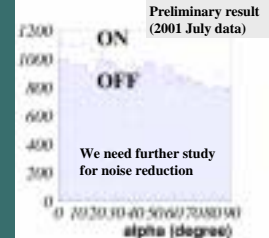


$$LikelihoodRatio = \frac{P(\gamma)}{P(\gamma) + P(p)}$$

### Likelihood ratio distribution



## 3. Alpha distribution with 2d-likelihood analysis



To further analysis

- We confirm this with 2002 data.
- Energy flux  $\rightarrow$  Radiation mechanism if gamma-ray signals detection is confirmed
- We plan to publish the result of observations for the galactic center