

# Recent results from CANGAROO-II&III

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for the CANGAROO team














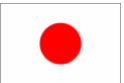
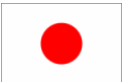
\* *ICRR, The University of Tokyo*



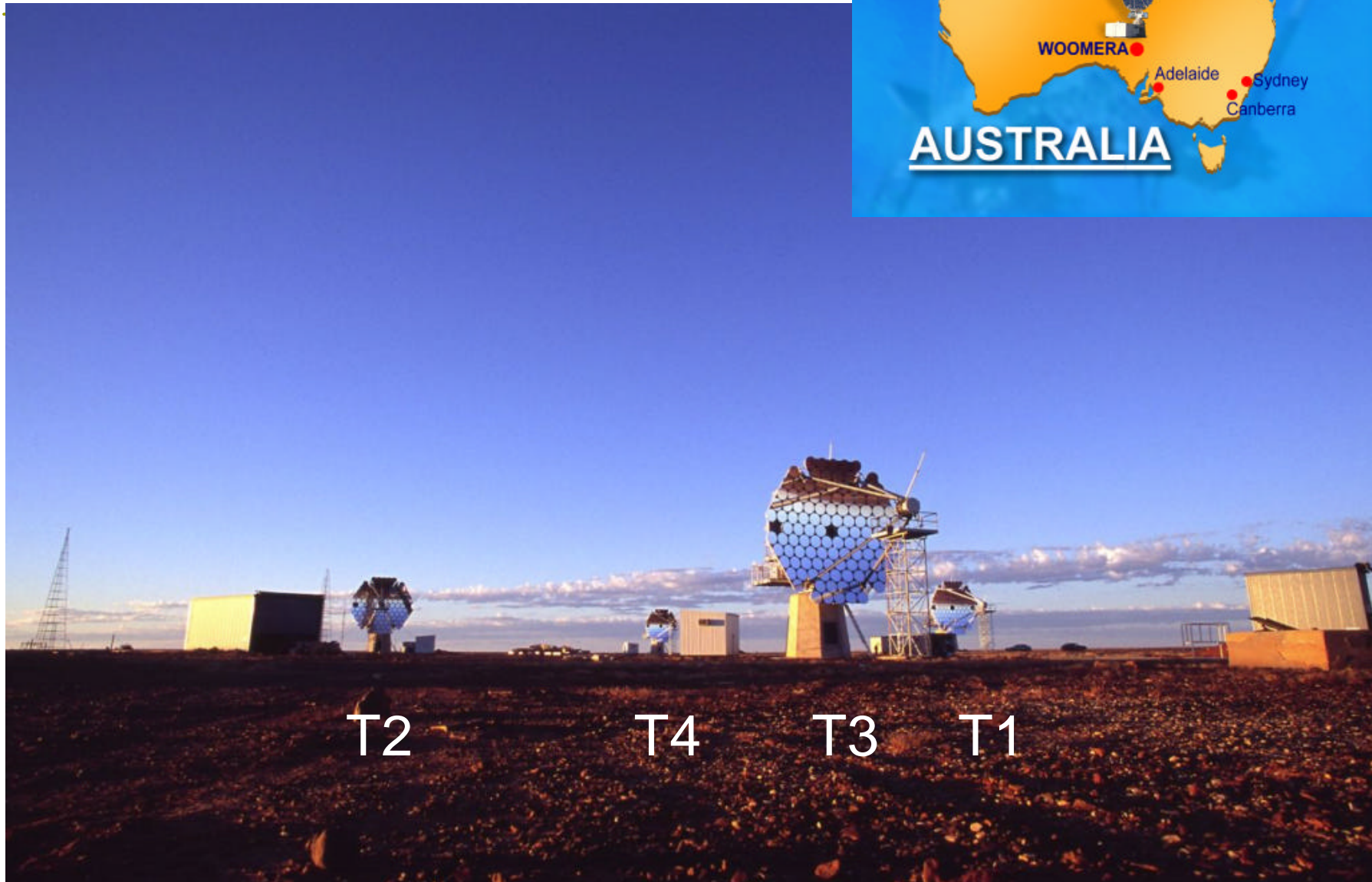
Gamma2004, July 26-30, 2004, Heidelberg

# CANGAROO team

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- University of Adelaide 
- Australian National University 
- Ibaraki University 
- Ibaraki Prefectural University 
- Konan University 
- Kyoto University 
- STE Lab, Nagoya University 
- National Astronomical Observatory of Japan 
- Kitasato University 
- Shinshu University 
- Institute of Space and Astronautical Science 
- Tokai University 
- ICRR, University of Tokyo 
- Yamagata University 
- Yamanashi Gakuin University 

# Woomera: 2004 March



T2

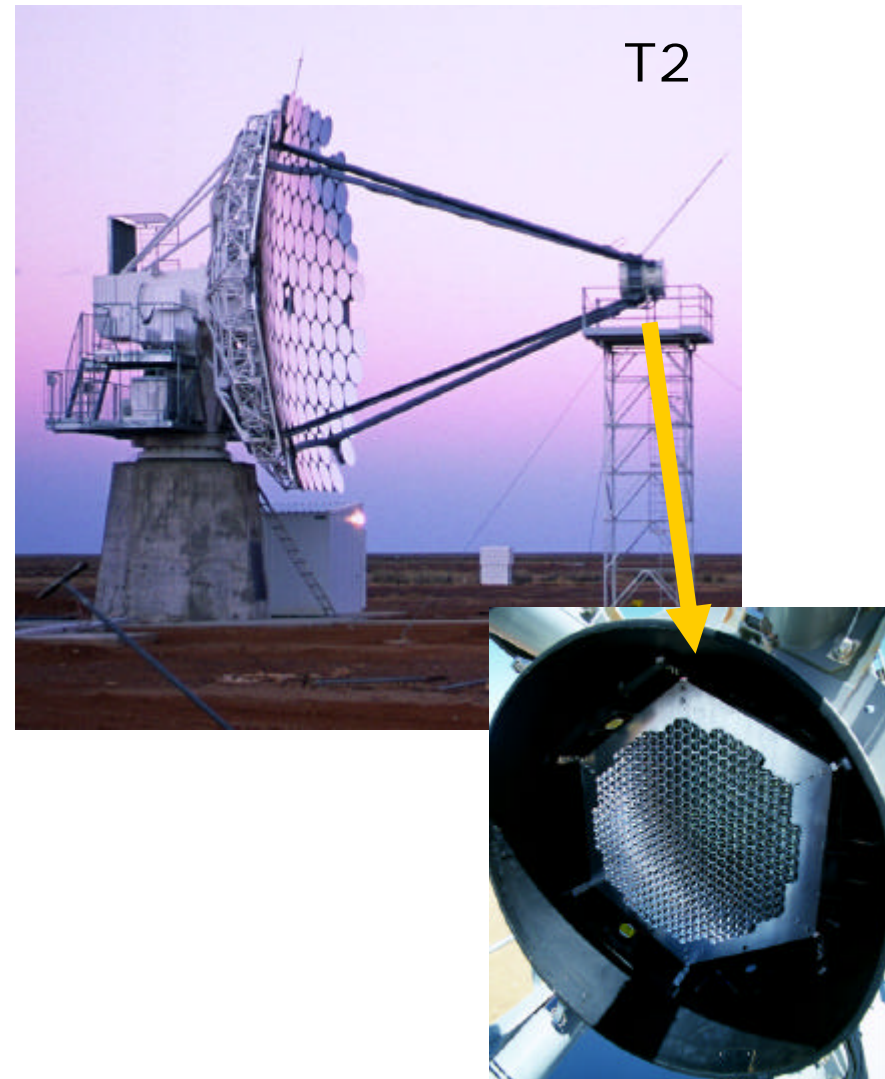
T4

T3

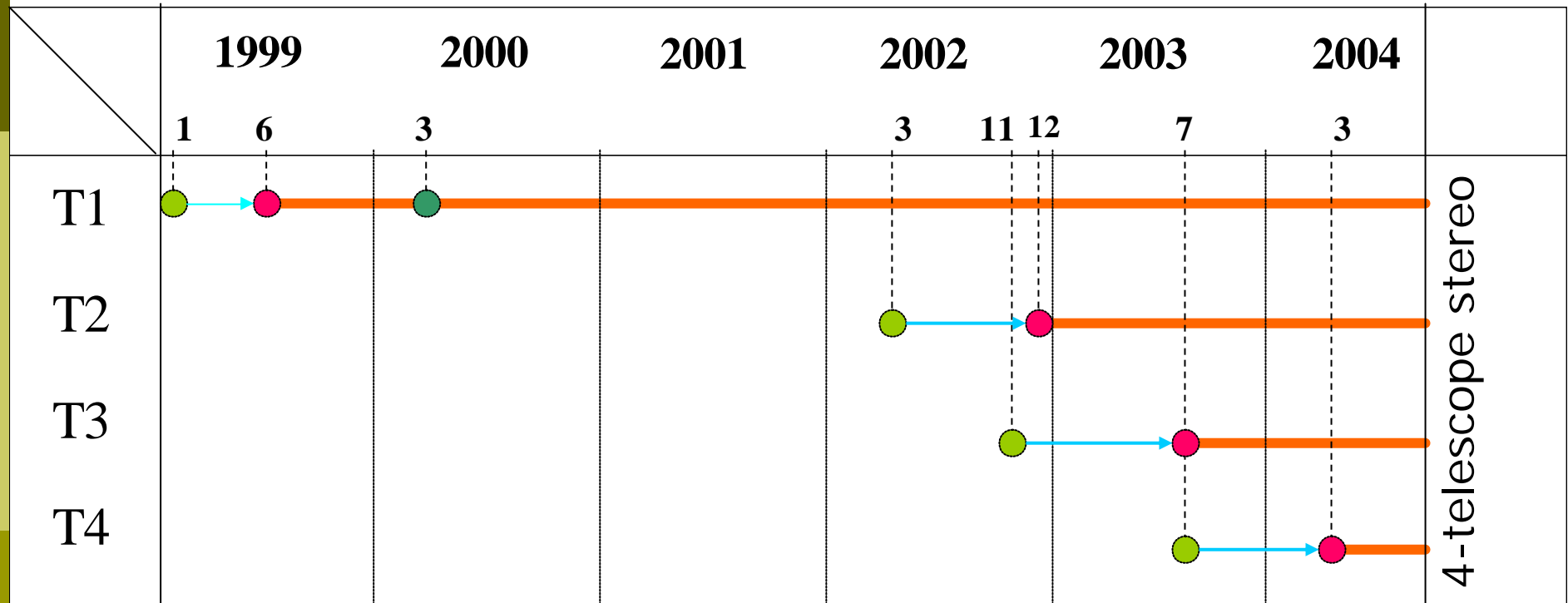
T1

# Basic specifications of telescopes

- Location:
  - $31^{\circ}06'S$ ,  $136^{\circ}47'E$
  - 160m a.s.l.
- Telescope:
  - $114 \times 80\text{cm}\phi$  FRP mirrors (57m<sup>2</sup>, Al surface)
  - 8m focal length
  - Alt-azimuth mount
- Camera:
  - T1: 552ch (2.7° FOV)
  - T2,T3,T4: 427ch (4° FOV)
- Electronics:
  - TDC+ADC



# Construction of CANGAROO-III



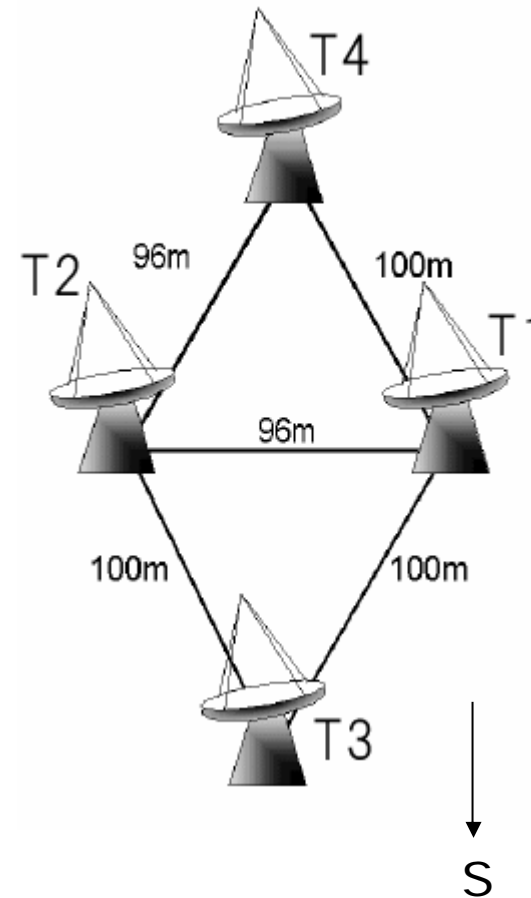
- : Construction
- : Observation start
- : Expansion to 10m
- : Observation
- : Tuning

# 4-telescope stereo observations

Mrk 421	7 hr
PSRB1259-63	22 hr
Cen A	22 hr
$\omega$ Cen	19 hr
SN1006	39 hr
PSR B1509-58	21 hr
Galactic disk	56 hr
PSR B1706-44	36 hr

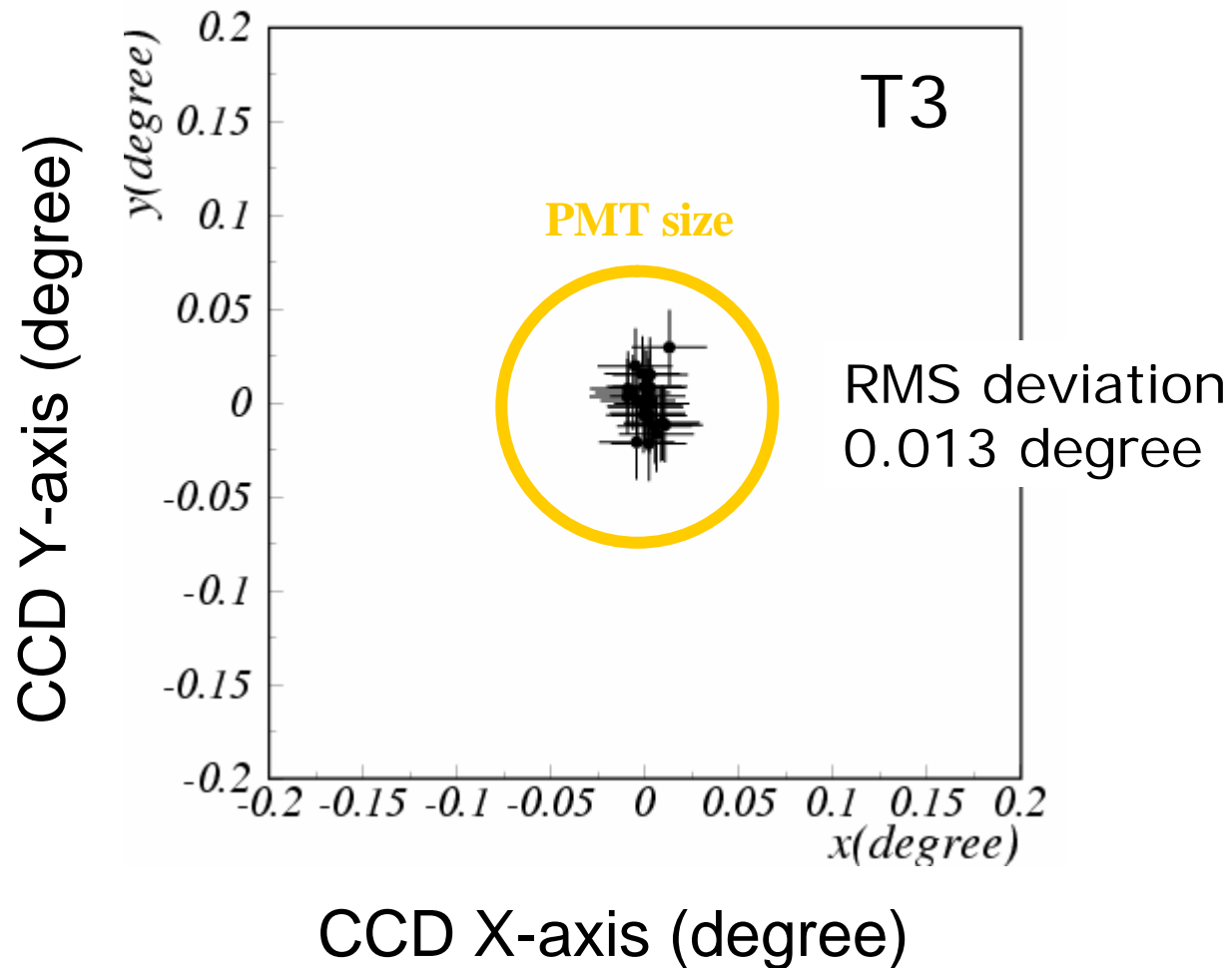
“ON” time since March 2004

Stereo data analysis is underway...

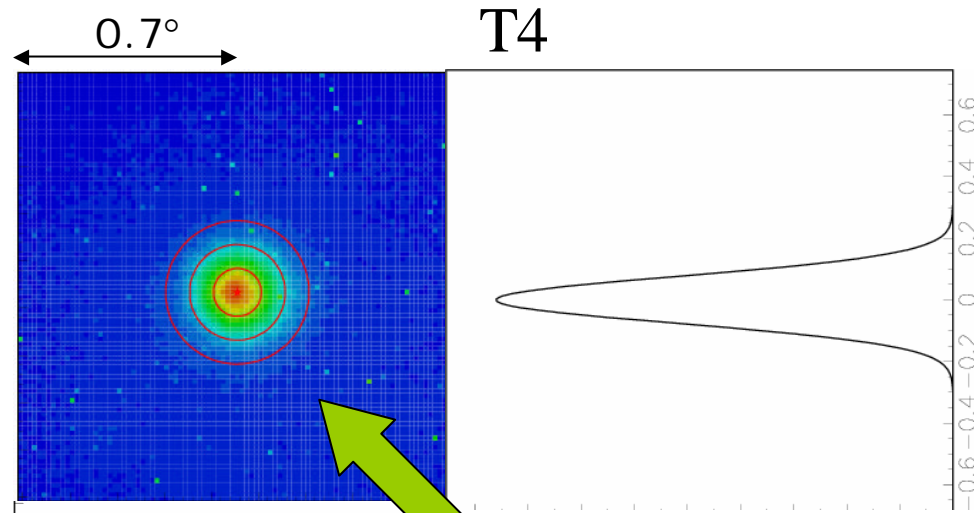


# Star tracking

Star position error observed by a CCD camera



# Spot size



Point Spread Function (FWHM)

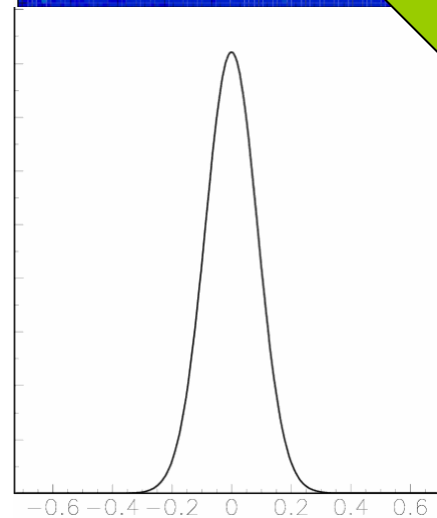
T1: 0.20°

T2: 0.21°

T3: 0.14°

T4: 0.16°

(measured at construction time)



X (horizontal)

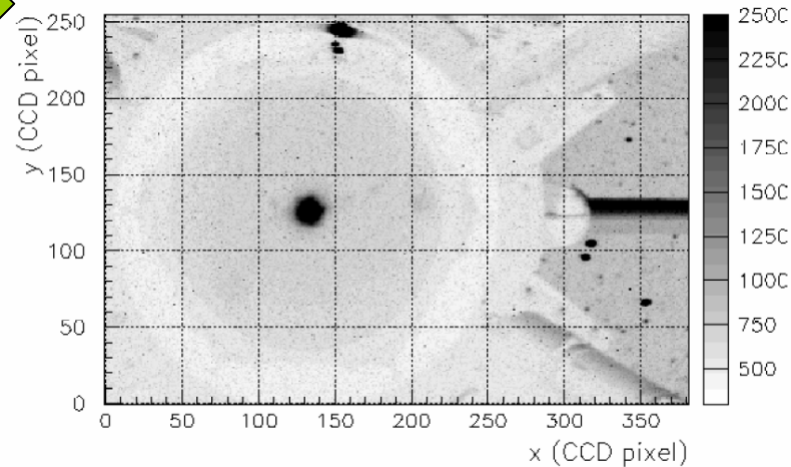
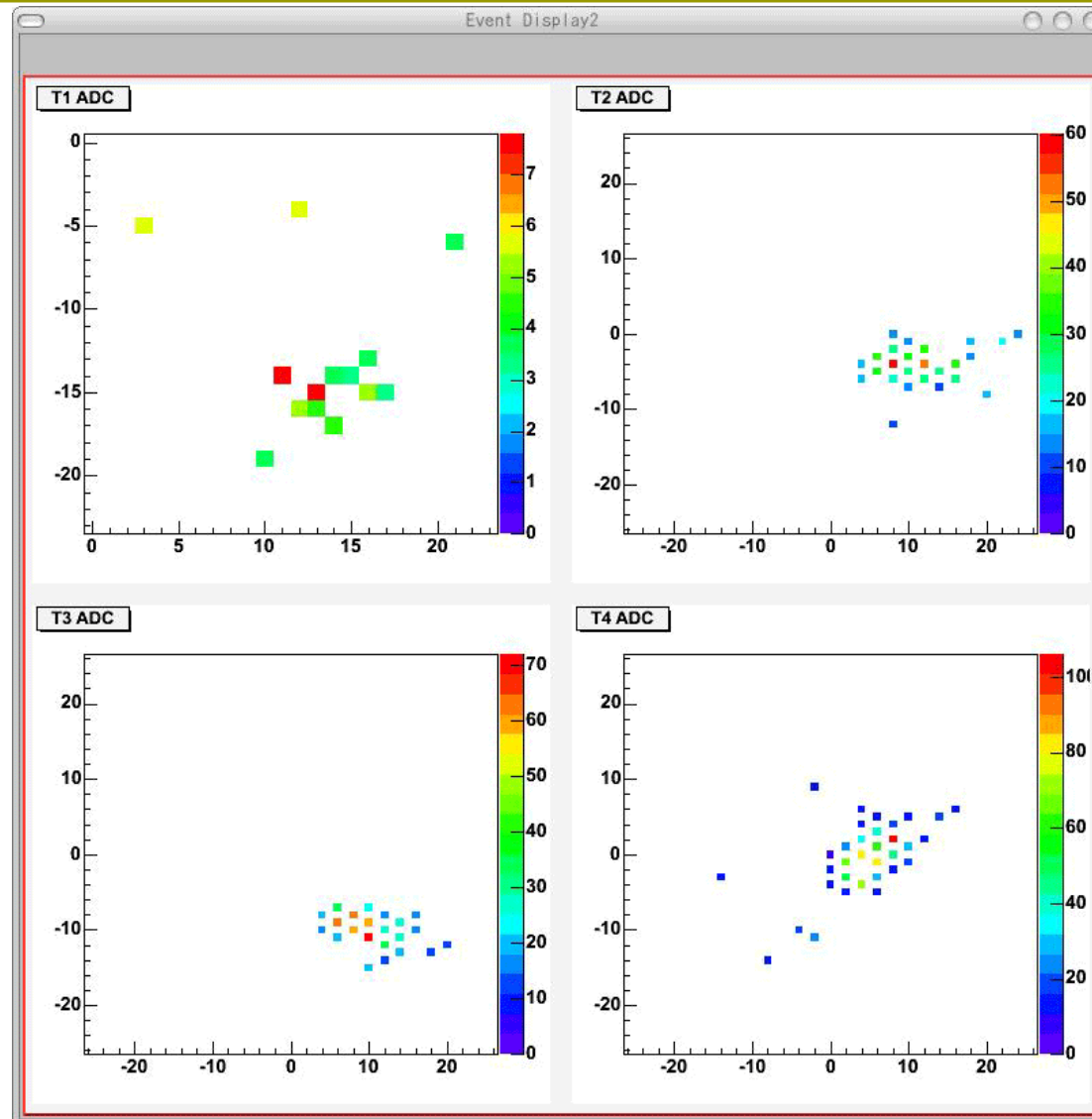


Image of a star  
on camera  
observed by a  
CCD camera



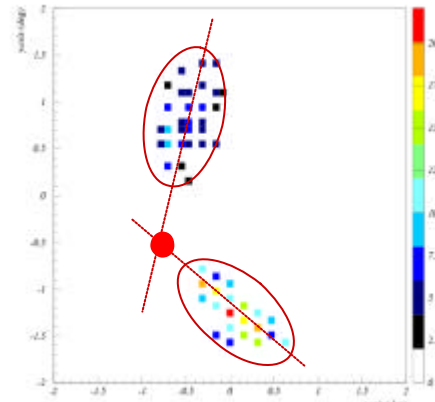
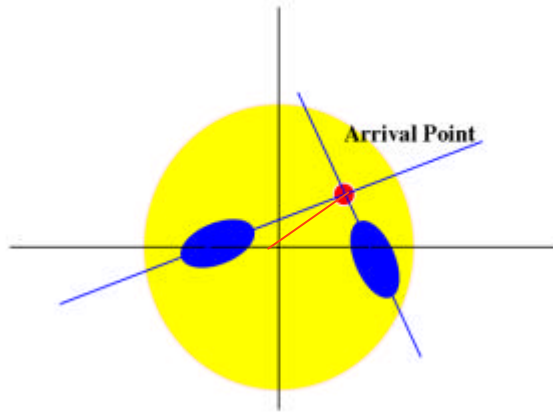
# Sample of 4-fold stereo events



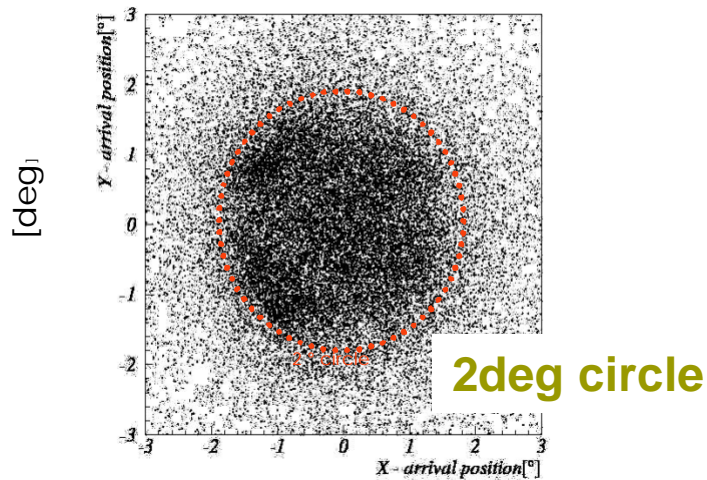
Data:  
2004  
March

# Stereo analysis: T1 & T2 (1)

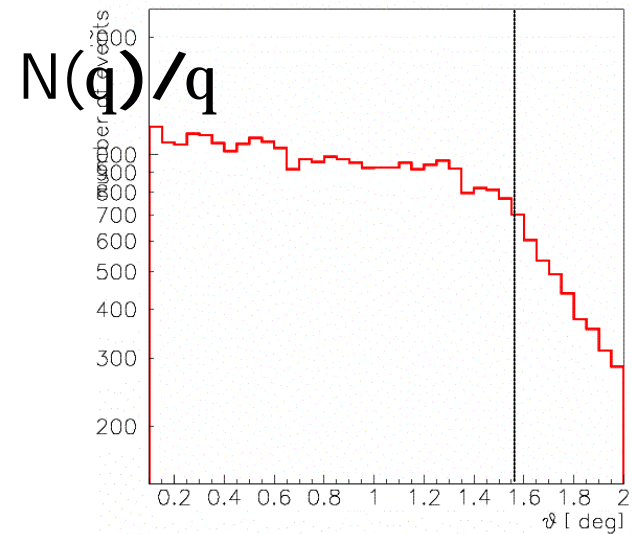
## Arrival direction



$\sim 1.5^\circ$



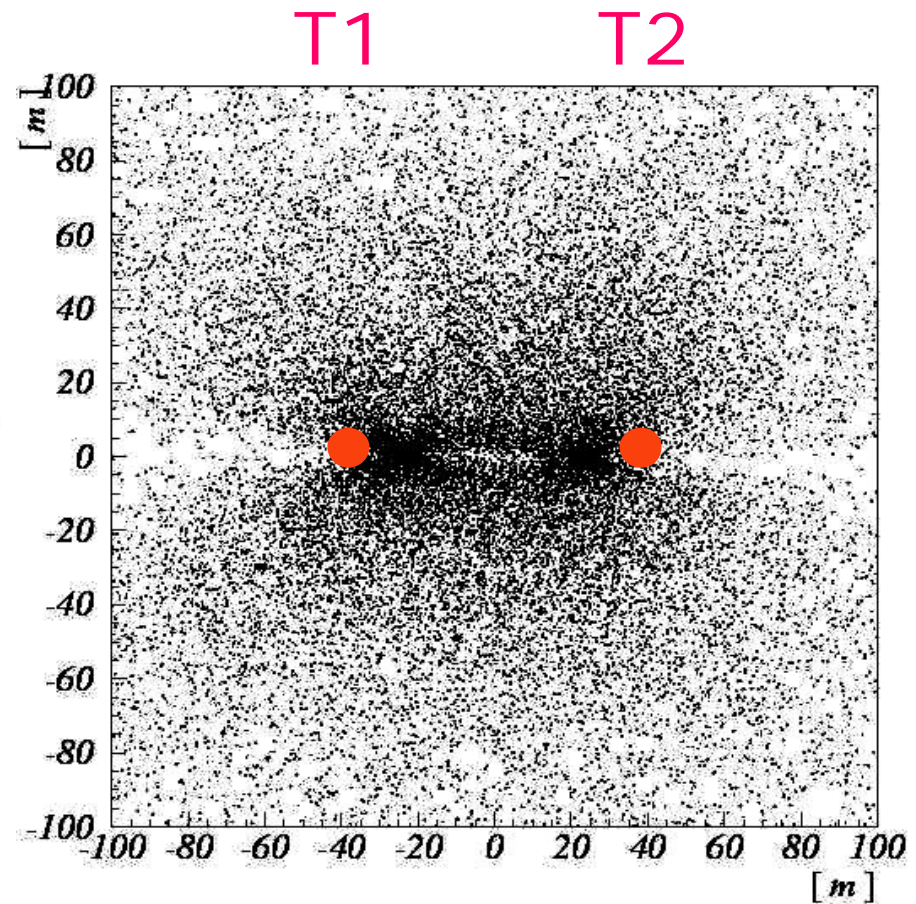
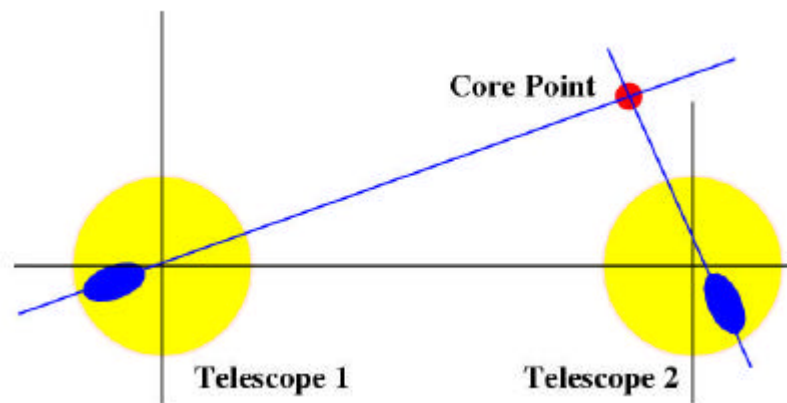
Cosmic-rays; random incidence



q (deg)

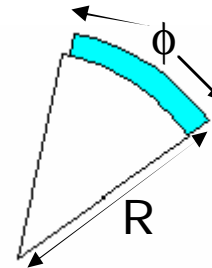
# Stereo analysis: T1 & T2 (2)

Core distribution

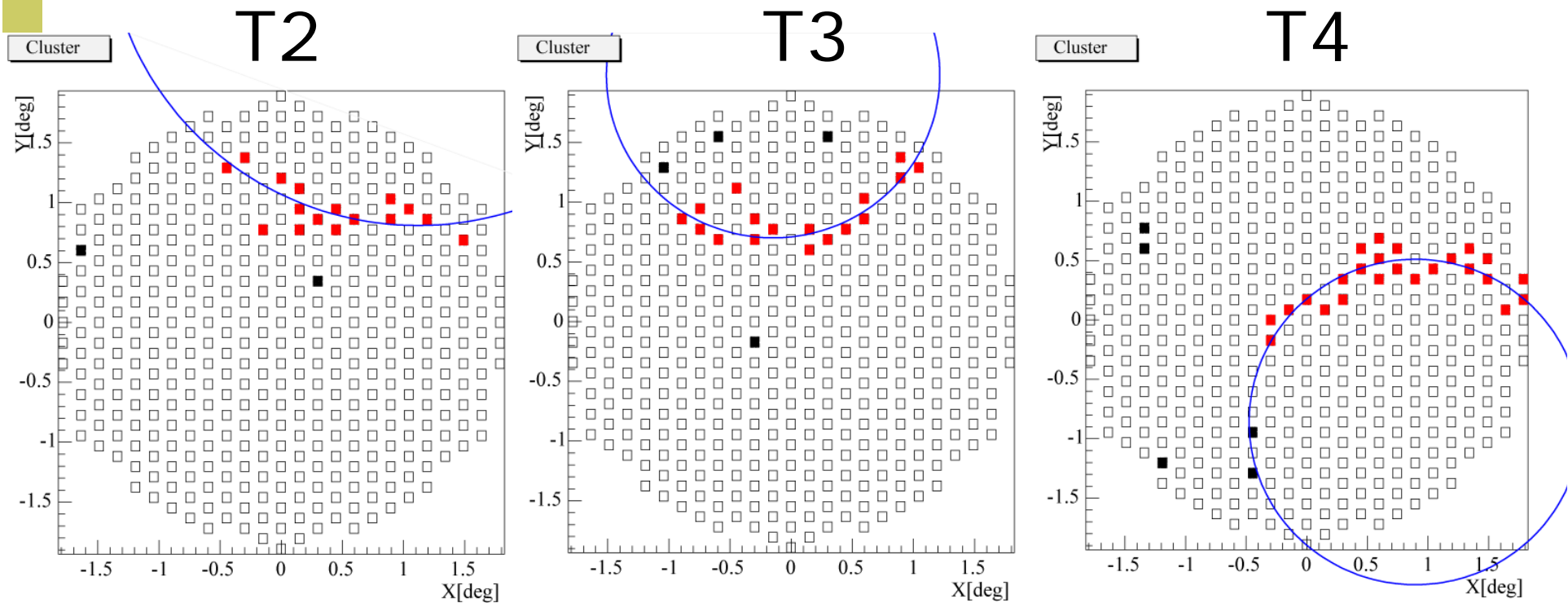


# Muon events (1)

- Selected by
  - 1) clustering
  - 2)  $R \times \phi$  (arc length)  $> 2 \text{deg} \cdot \text{rad}$
  - 3) Small  $\chi^2$  (good fit)

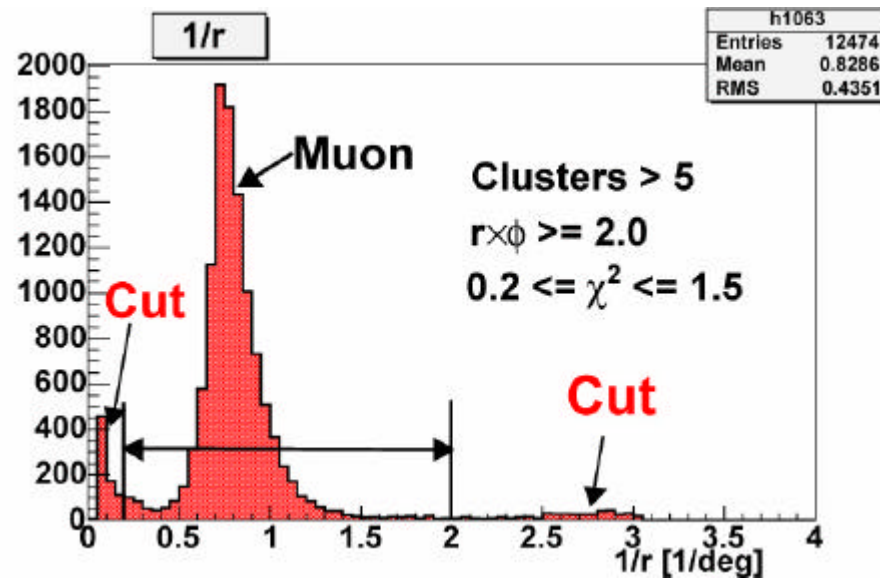


Data: 2004 March

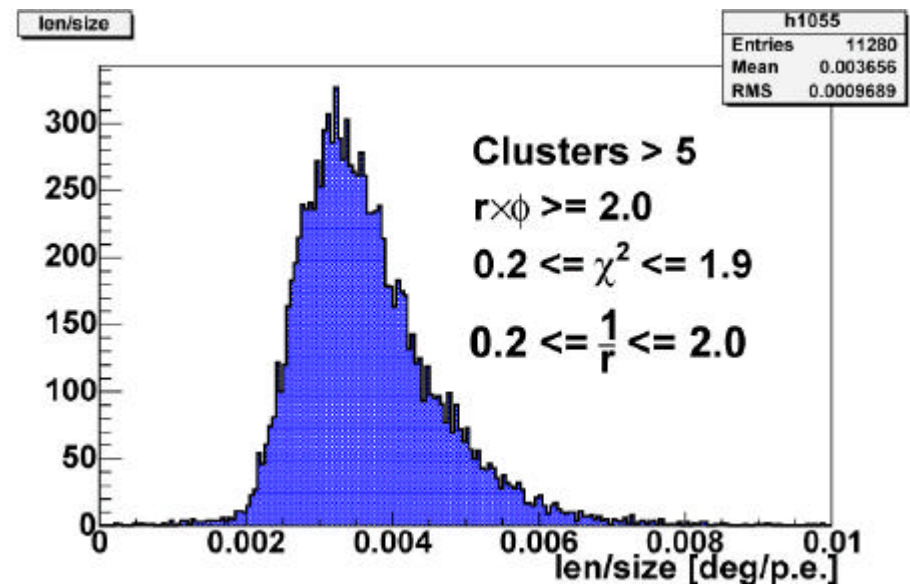


# Muon events (2)

- T4  $r[m] \approx 8 \tan q_c$   
on the focal plane



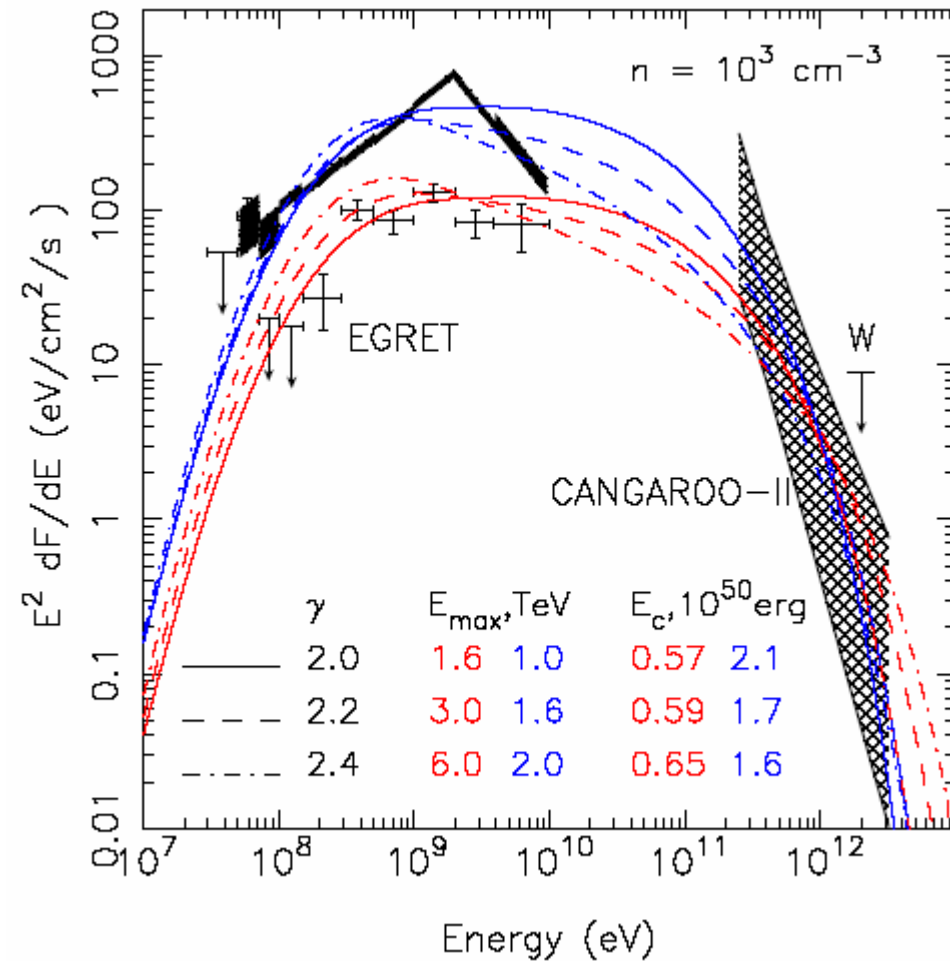
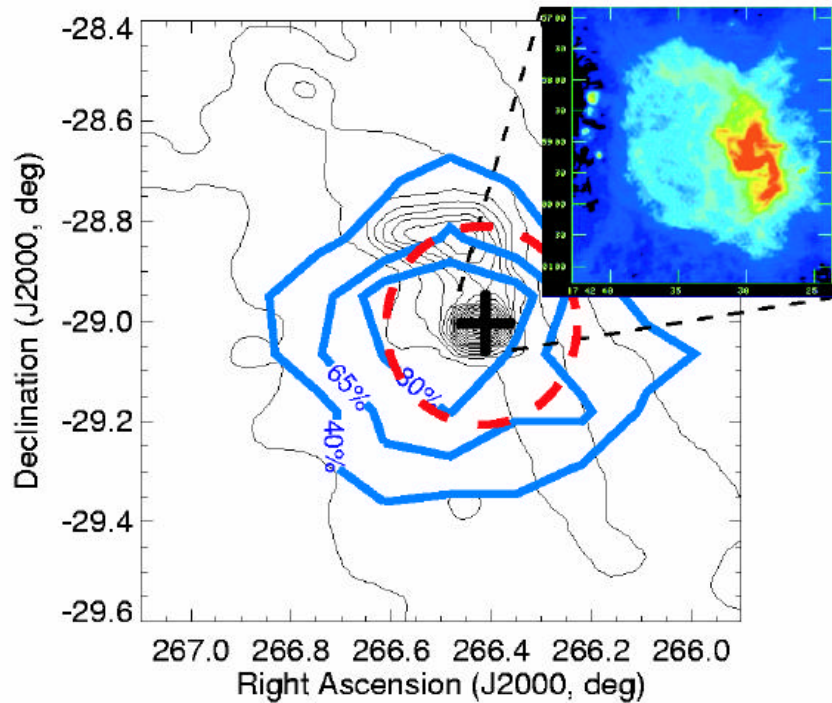
Curvature Distribution



Length/size Distribution

1-7GeV :  $1/r \geq 1.0$  [1/deg]  
 > 7GeV :  $1/r < 1.0$  [1/deg]

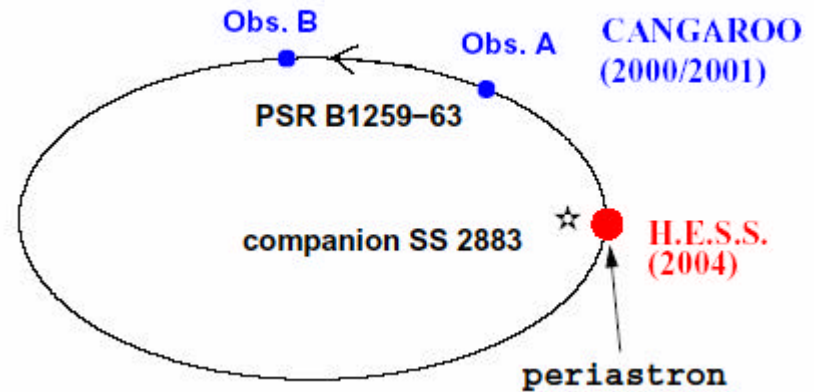
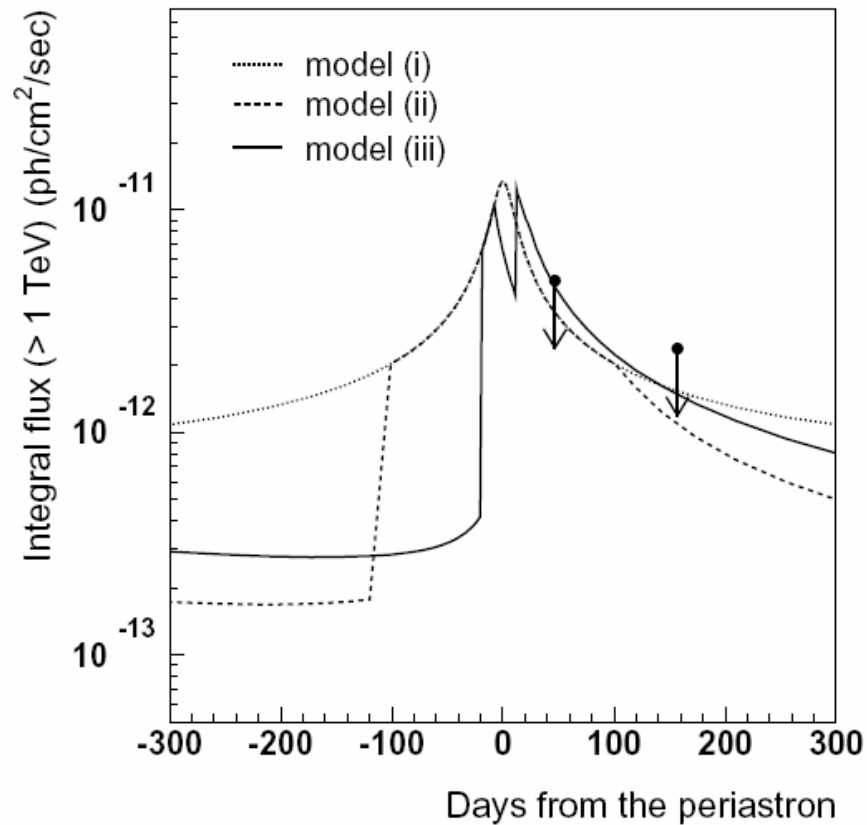
# The Galactic Center



T1, 2001-2002, 120hr

Tsuchiya et al., ApJ 606, L115-L118 (2004); **talk at this symposium**

# PSR B1259-63/SS2883



CANGAROO

$$< 0.54 \Phi_{\text{Crab}} \text{ (Obs.A)}$$

$$< 0.13 \Phi_{\text{Crab}} \text{ (Obs.B)}$$

H.E.S.S.  $\approx 0.05 \Phi_{\text{Crab}}$   
[Beilicke, Rome 2004]

T1, Dec 2000 (3 hr) & Mar 2001 (10hr)

Kawachi et al., ApJ 607, 949-958 (2004); **poster at this symposium**

# Summary

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- ❑ We have been carrying out 4-telescope stereo observations since 2004 March.
- ❑ Stereo characteristics are under investigation and analysis is underway.
- ❑ Recent results with the first 10m telescope were given for the Galactic center and a pulsar binary PSR B1259-63/SS2883.