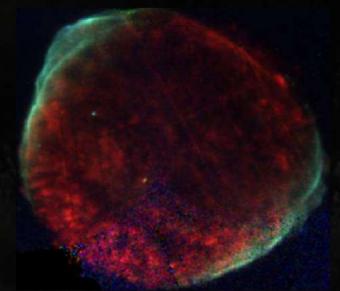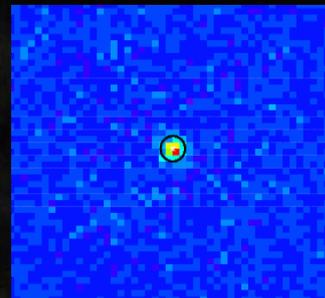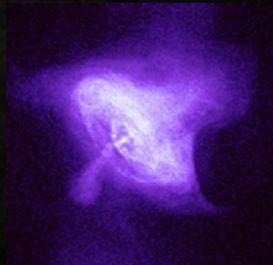# Observations of Galactic Sources with H.E.S.S.

Conor Masterson, MPI-K, for the H.E.S.S. Collaboration

The H.E.S.S. Experiment

Overview

See O.G. 2.5-7 (W. Hofmann)

Array

Situated in Namibia, southern Africa

$23^{o}16'$ S, $16^{o}30'$ E, 1800 m asl

4 telescopes, 120 metre separation

Telescope Structures

12 metre diameter reflector dish (Davies - Cotton)

15 metre focal length

Mirrors

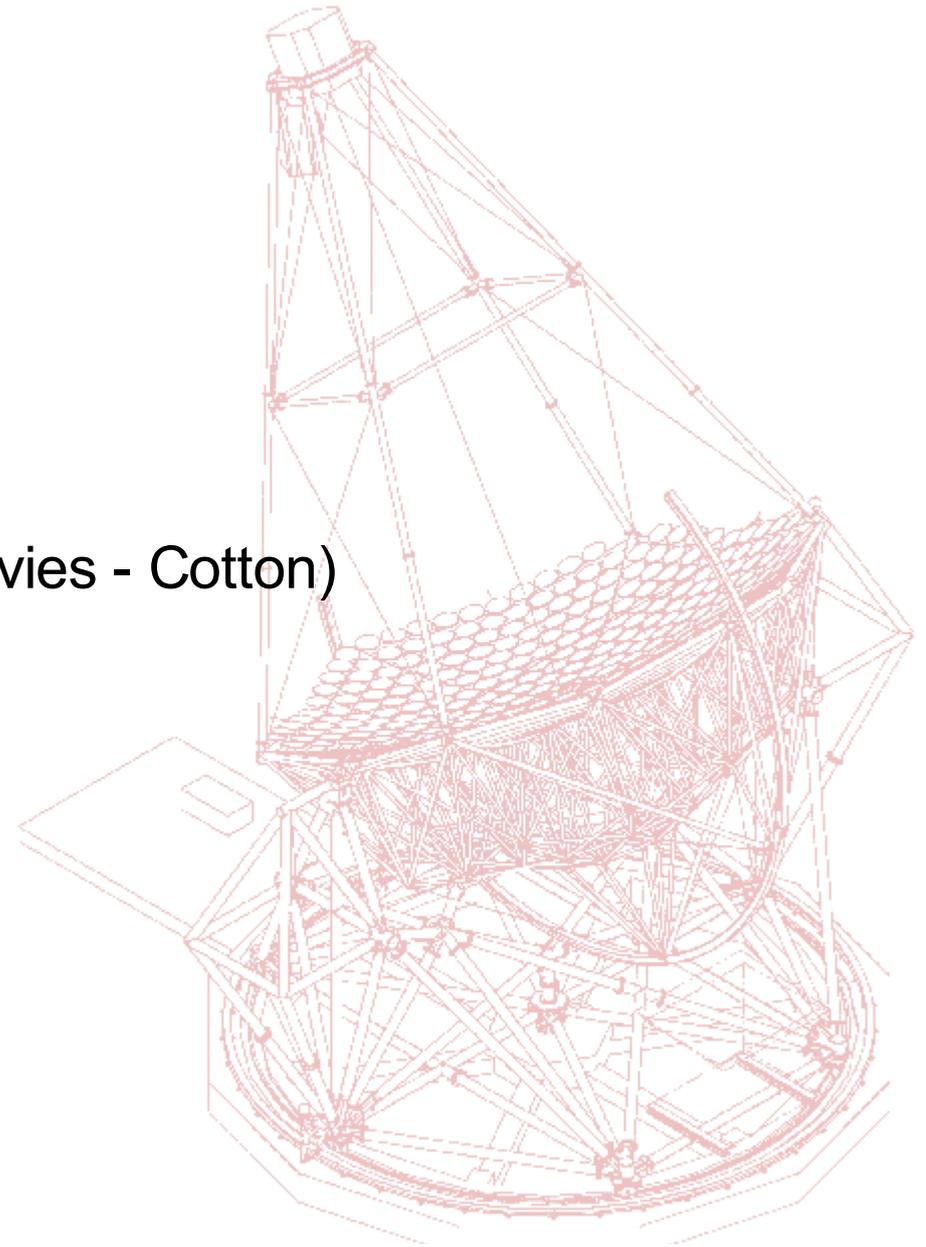380 front aluminised glass mirrors

Camera

See O.G. 2.5-10 (P. Vincent)

960 photomultiplier tubes

0.16 deg. pixel size

5 deg. field of view

Integration time 16ns

Galactic Sources

Crab Nebula

Observed October - December 2002

    Single telescope (CT3)

Conservative run quality selection

    4.86 hours of data (on source, livetime corrected)

SN 1006

Observation position:

    Centre of SNR (15h2m21.6s, -41˚d54'0")

    Cangaroo hotspot offset by 0.3 degrees
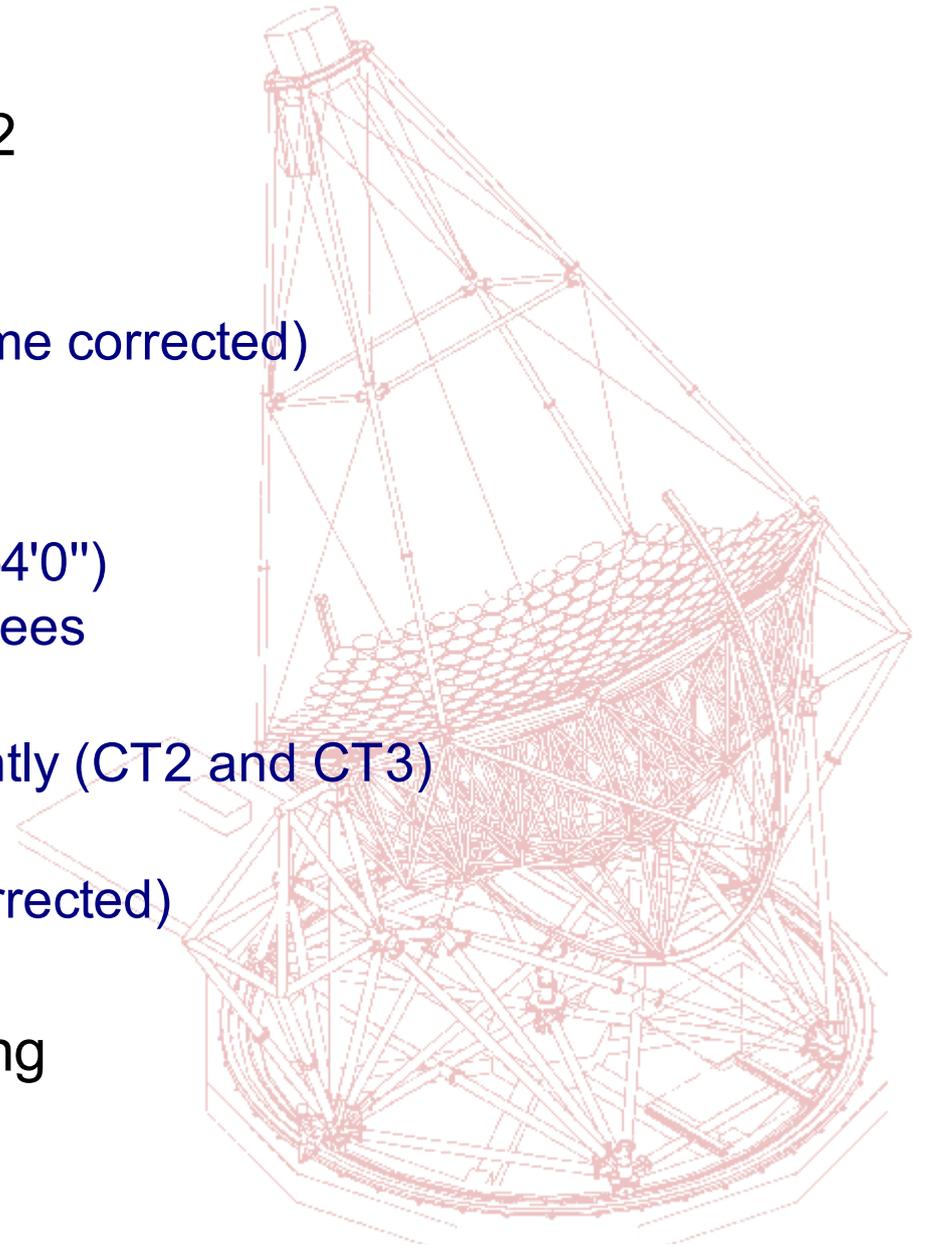
Observed March – May 2003

    2 Telescopes, triggered independently (CT2 and CT3)

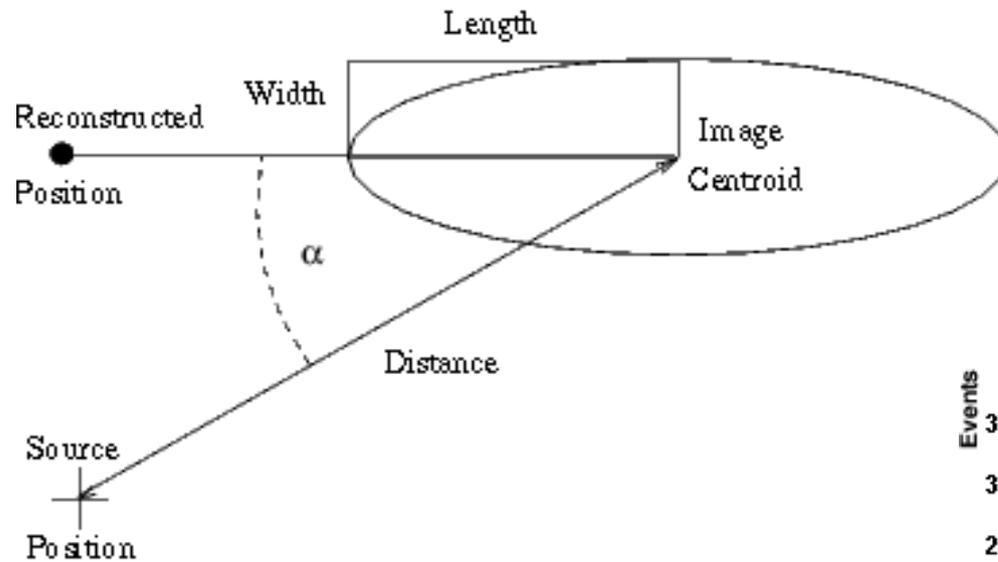Good quality On/Off pairs selected

    7 hours total (on source, livetime corrected)

Other Sources

Observations made, analysis ongoing

Analysis of Data

Calibration

See O.G. 2.5-11 (N. Leroy)

Parameterisation

Two level "Tailcut" image cleaning
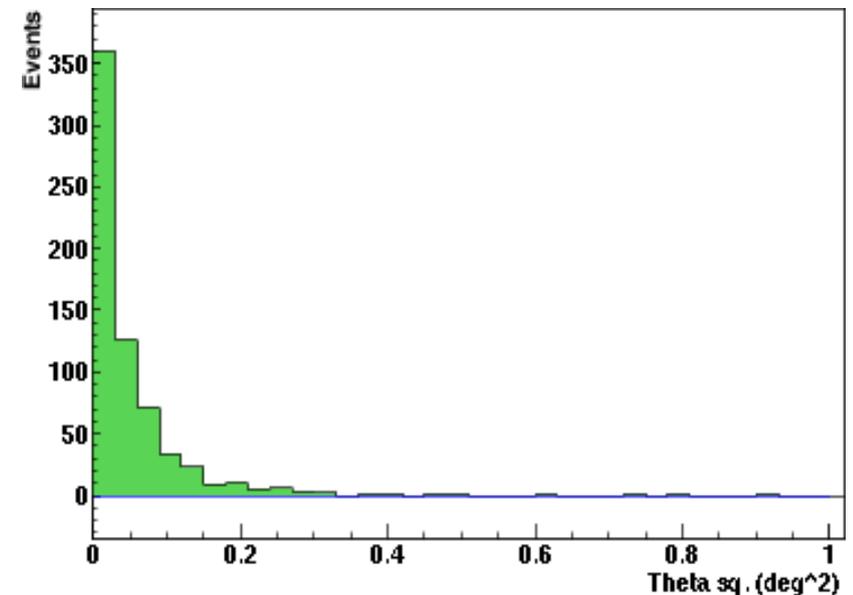
Standard Hillas moment analysis

Background rejection

Simple cuts optimised on simulated γ – rays

Separate cuts for large and small zenith angles

Source position reconstruction

Single telescope 2-D reconstruction technique

Reconstructed theta^2 distribution for simulated γ - rays

Crab Nebula

Crab result:

4.86 hours livetime

Alpha analysis

17.7 σ (8.1 σ hr $^{-0.5}$)

3.09 γ min^{-1}

2-D analysis:

22.4 σ (10.2 σ hr $^{-0.5}$)

2.94 γ min^{-1}

Flux (>1 TeV):

2.58 ± 0.2 x 10^{-7} m^{-2} s^{-1}

Paper: 2.64 ± 0.2 x 10^{-7} m^{-2} s^{-1}

On/Off Theta^2 distribution

On/Off Alpha
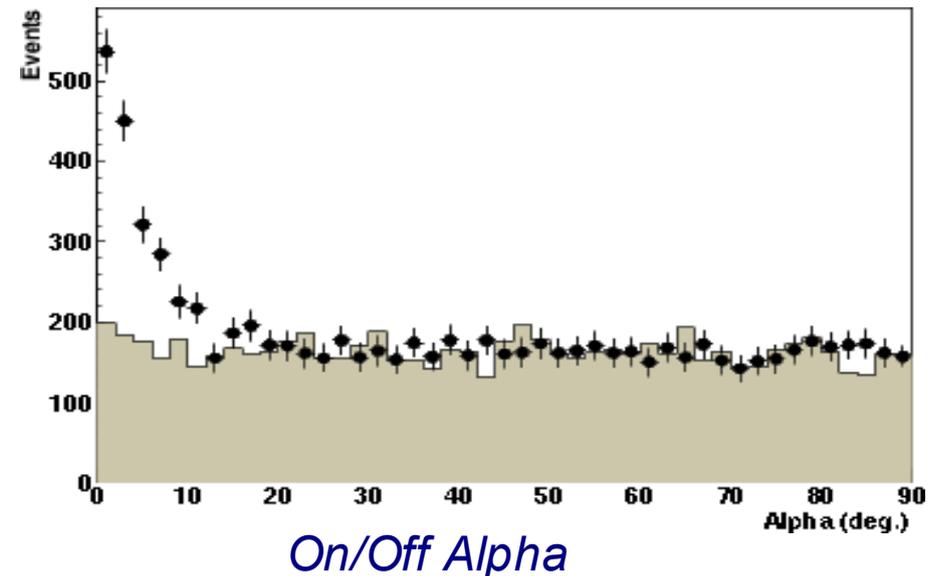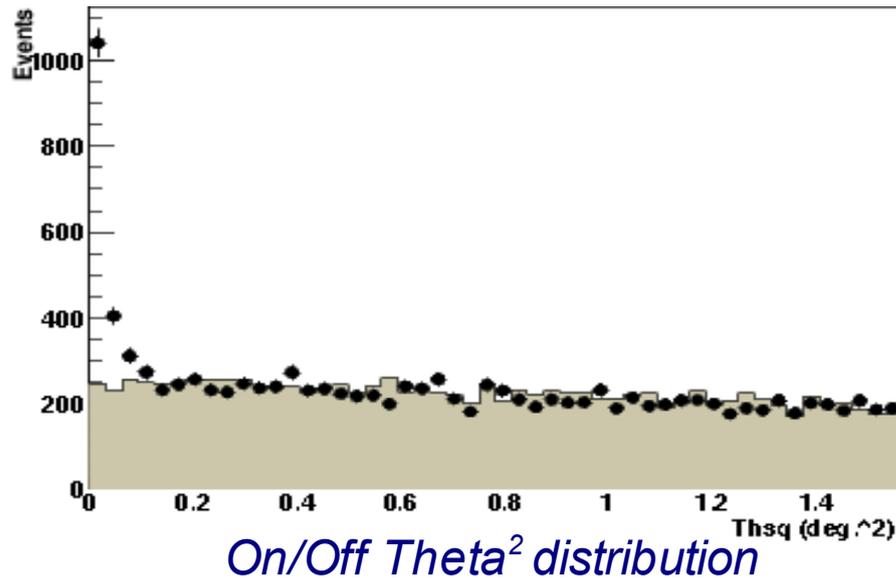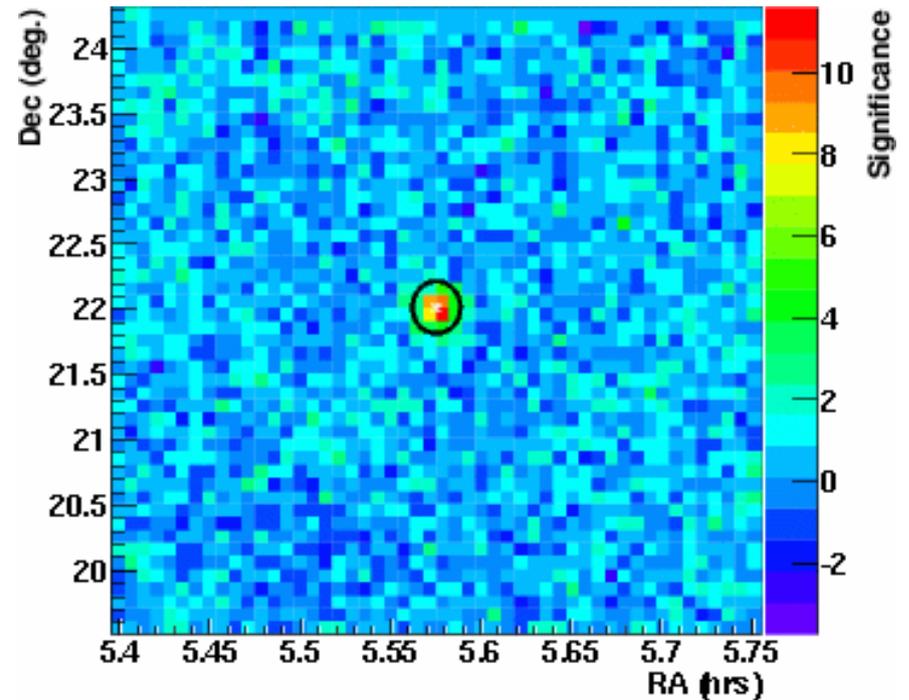
Crab Stability

Stable excess
three months of obs.

Mean zenith angle:
46 deg.

Energy Threshold:
780 GeV
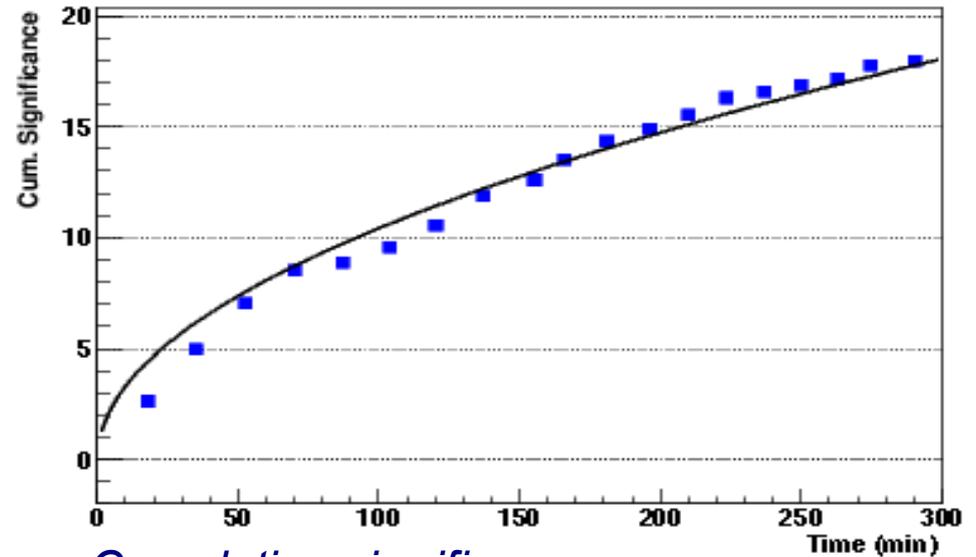
Cumulative significance

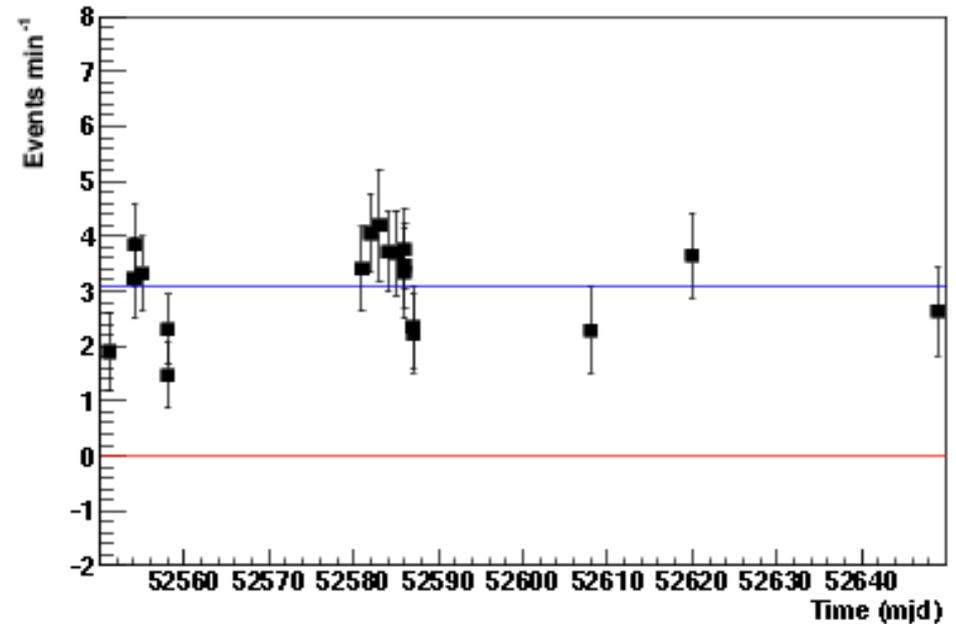| χ^2 / ndf	28.79 / 26
Constant	309.8 ± 7.598
Mean	-0.005681 ± 0.02181
Sigma	1.077 ± 0.0151
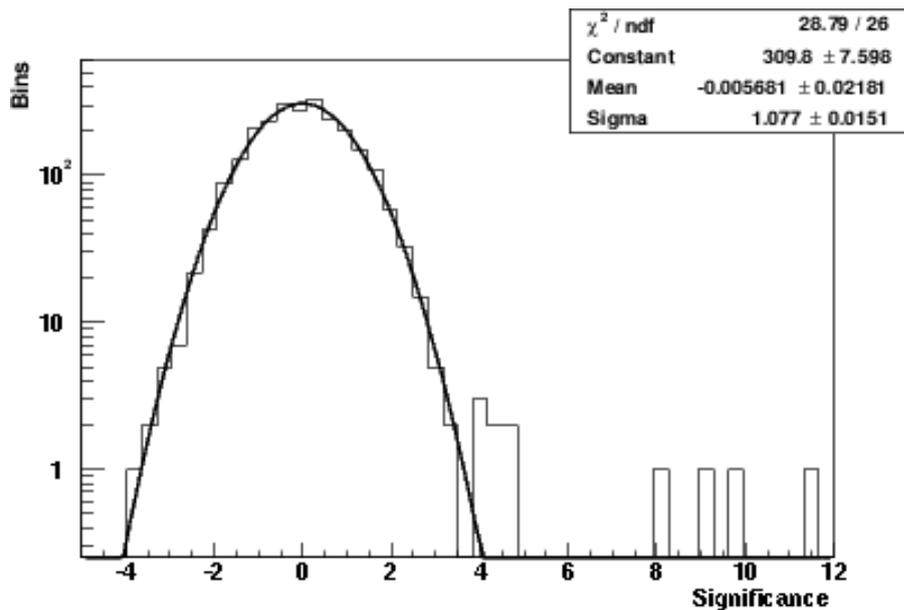
Significance distribution per bin in 2-d plot

Run by run light curve

Offset Position Observations

Offset of 0.3 deg RA

19 min. on source livetime

2-D analysis

5.8 σ (10.2 σ hr$^{-0.5}$)

2.63 γ min^{-1}
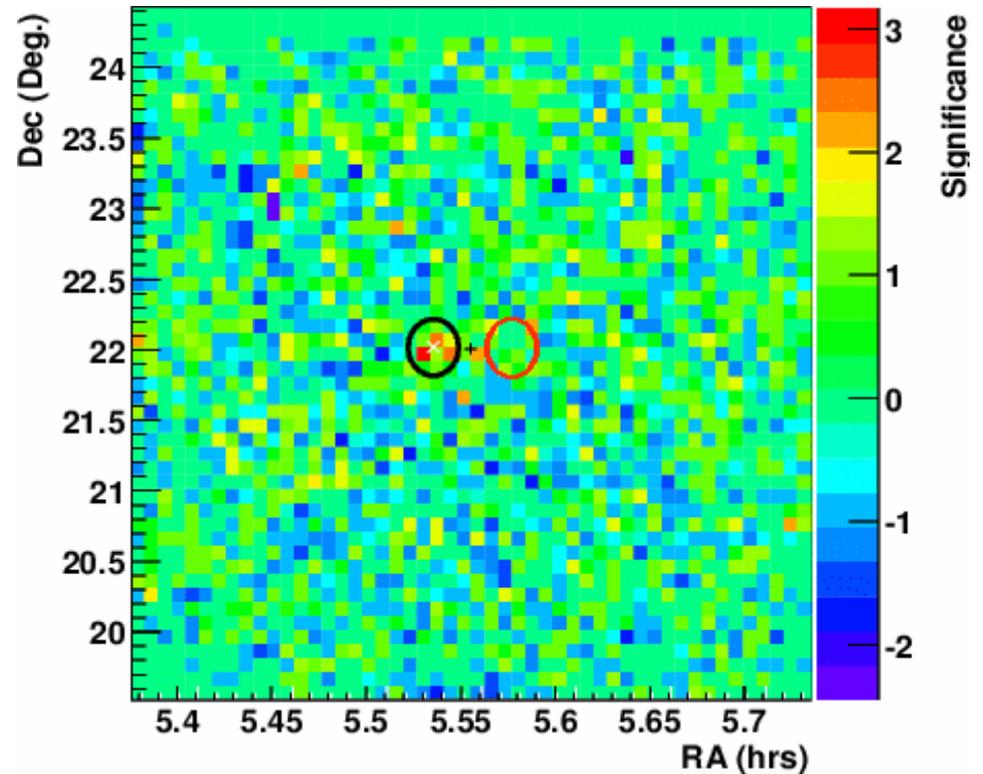
Consistent with on source obs.

Wobble mode

4.9 σ (8.7 σ hr$^{-0.5}$)

2.32 γ min^{-1}

Ra/Dec skymap of significance,
black circle - Crab position
red circle - wobble Off region
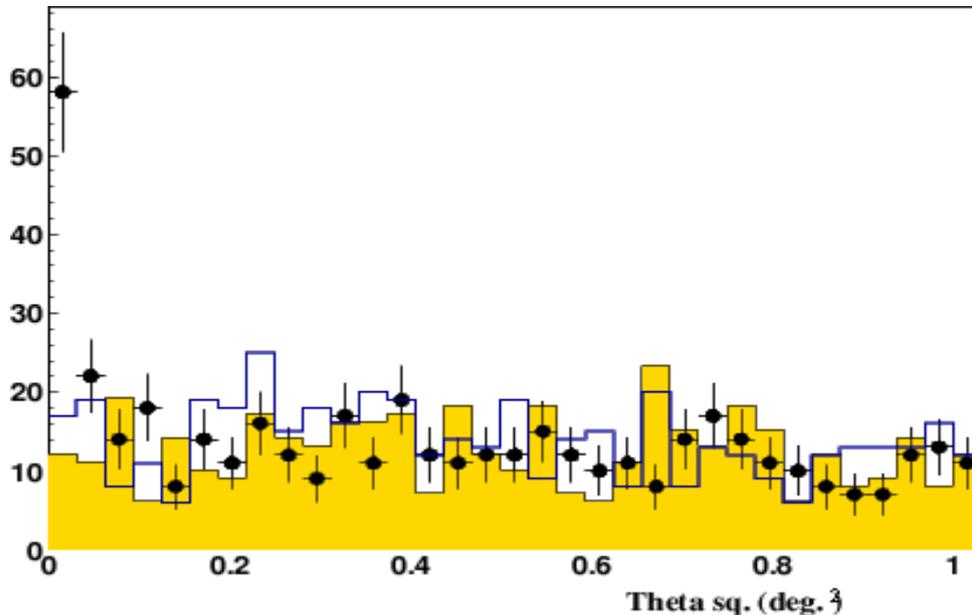
Theta^2 distribution
black points – Crab position
Filled region – Off run data
blue line – Wobble position

SN1006 CT2

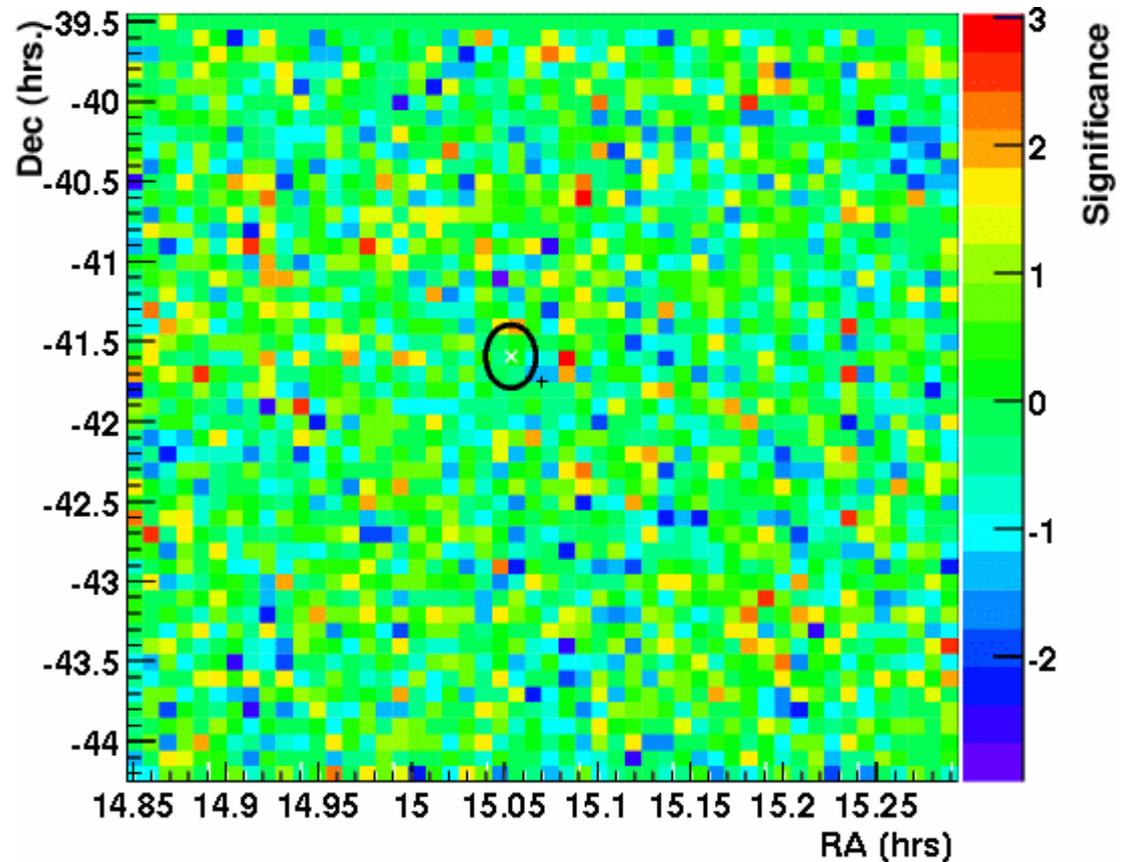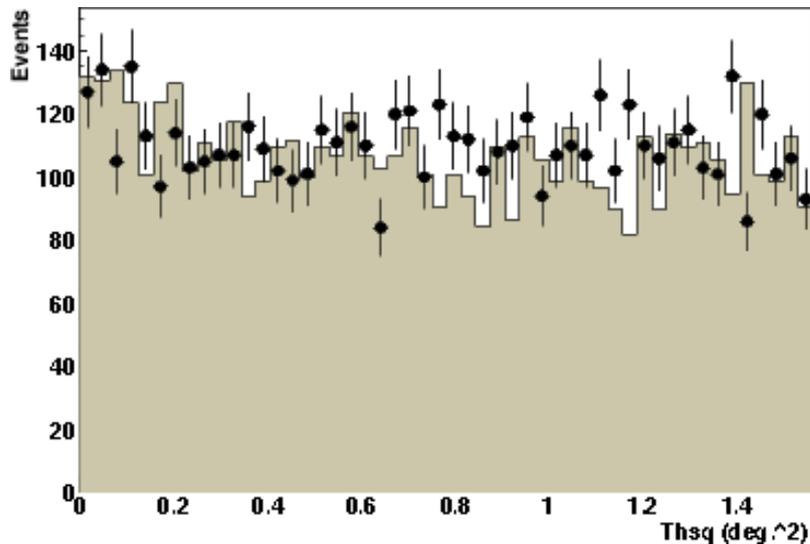## Observations
2.54 hrs livetime

9 On/Off pairs

    after quality selection

2-D Excess:
-1.3 σ

Background after cuts
0.96 min.$^{-1}$

Cangaroo hotspot marked by circle

*Excess as function of distance from
Cangaroo hotspot*

SN 1006 CT3

CT3 Observations:
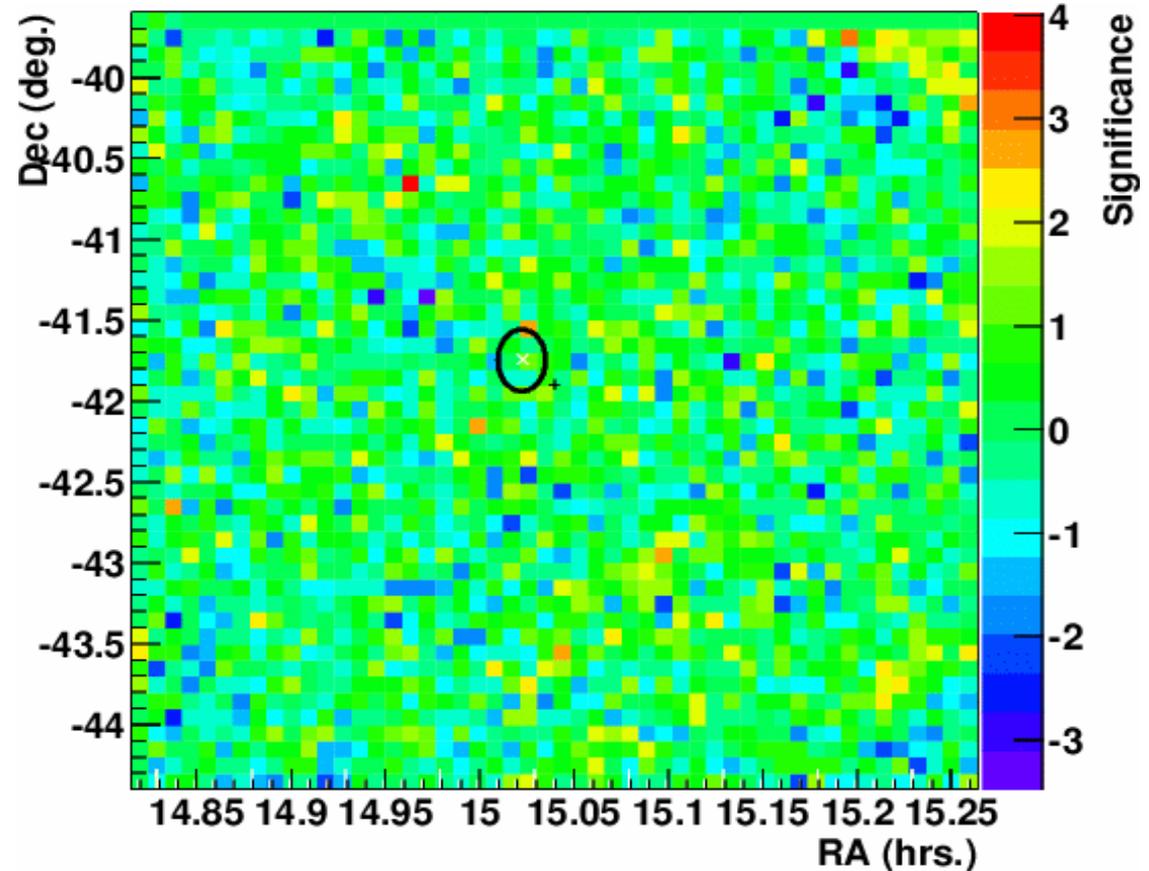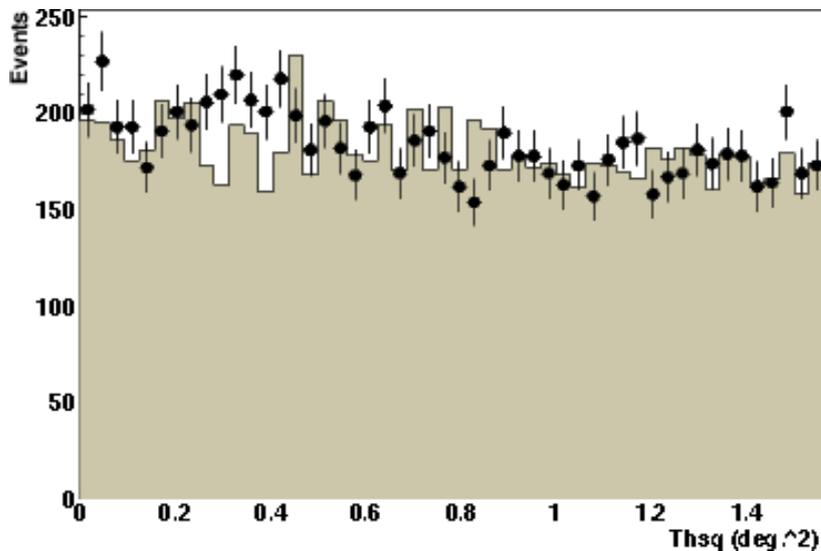4.5 hrs livetime

14 On/Off pairs

    after quality selection

2-D excess:
1.0 σ

Background after cuts
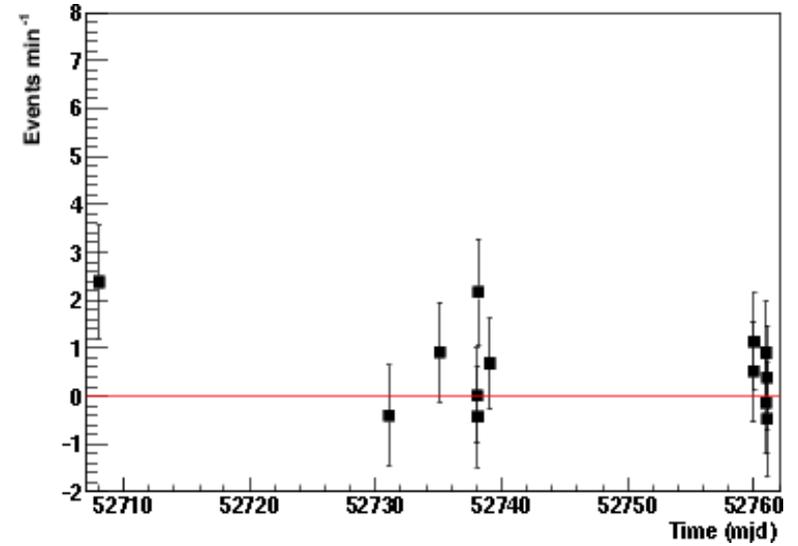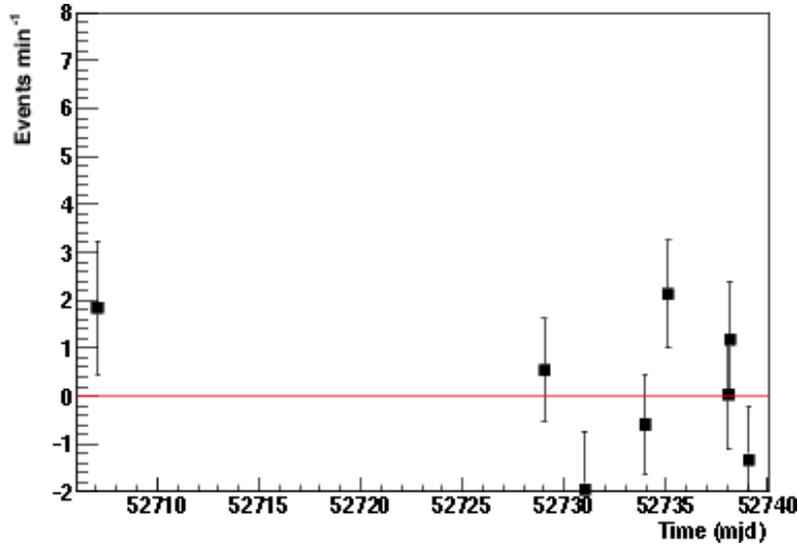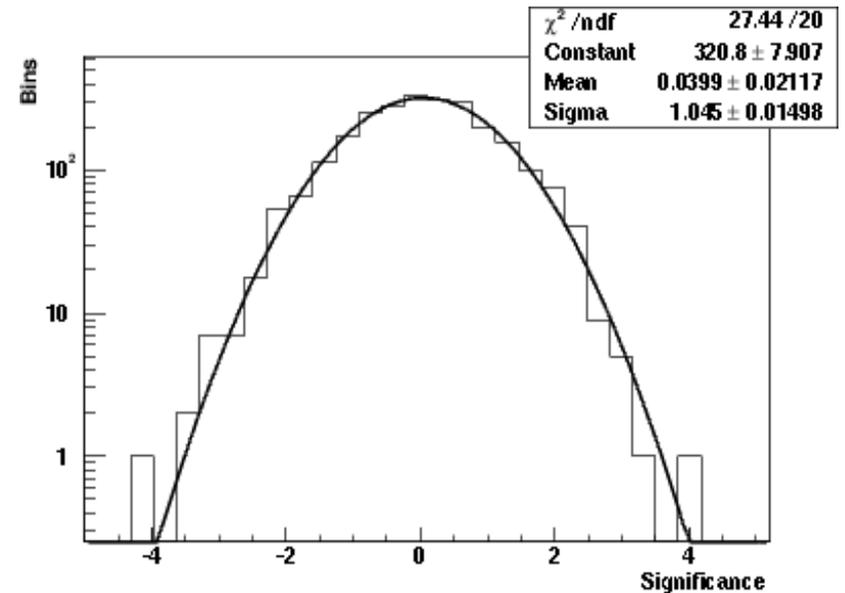0.96 min.$^{-1}$

Cangaroo hotspot marked by circle

Excess as function of distance from Cangaroo hotspot

SN 1006 stability

CT2

CT3

Run by run Light curve
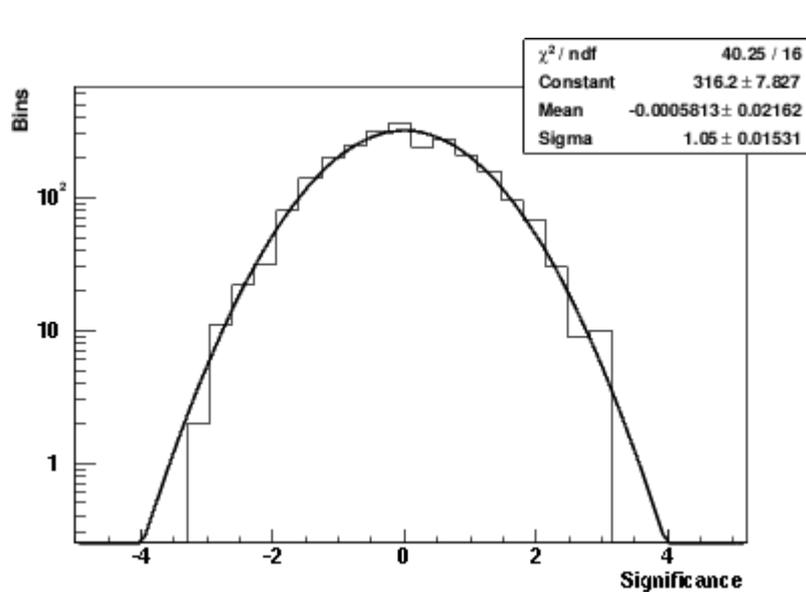
Distribution of significance in 2-d plot

Data checks for SN1006

Run by Run Trigger rate, On and Off

RA/Dec plot of pixel currents for SN1006 (run 9951)

Pointing

Star positions measured with pixel currents

Stars match to 10th mag.
Good correlation in all SN 1006 runs

Trigger Rate

Runs selected for trigger rate stability

Camera Efficiency

Measured from muons, stable over epoch

Conclusion

Crab Nebula

Observed with high significance

Signal stable over epoch
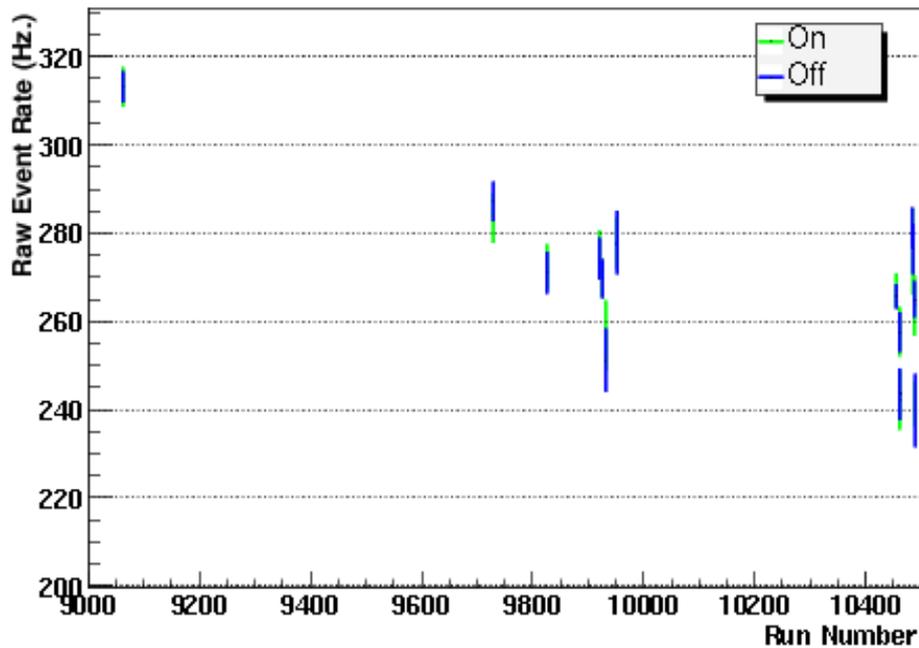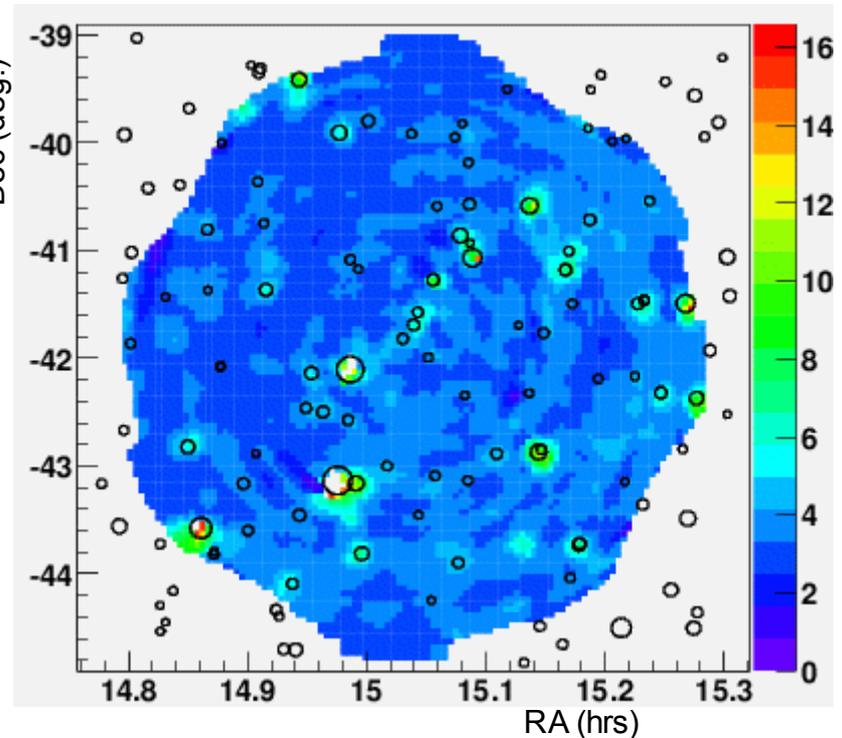
Flux (> 1 TeV):

$2.58 \pm 0.2 \times 10^{-7} \text{ m}^{-2} \text{ s}^{-1}$

consistent with other measurements

Energy threshold (post selection cuts)

780 GeV

average zenith angle 46 deg.

Wobble mode, 2-d analysis consistent

SN1006

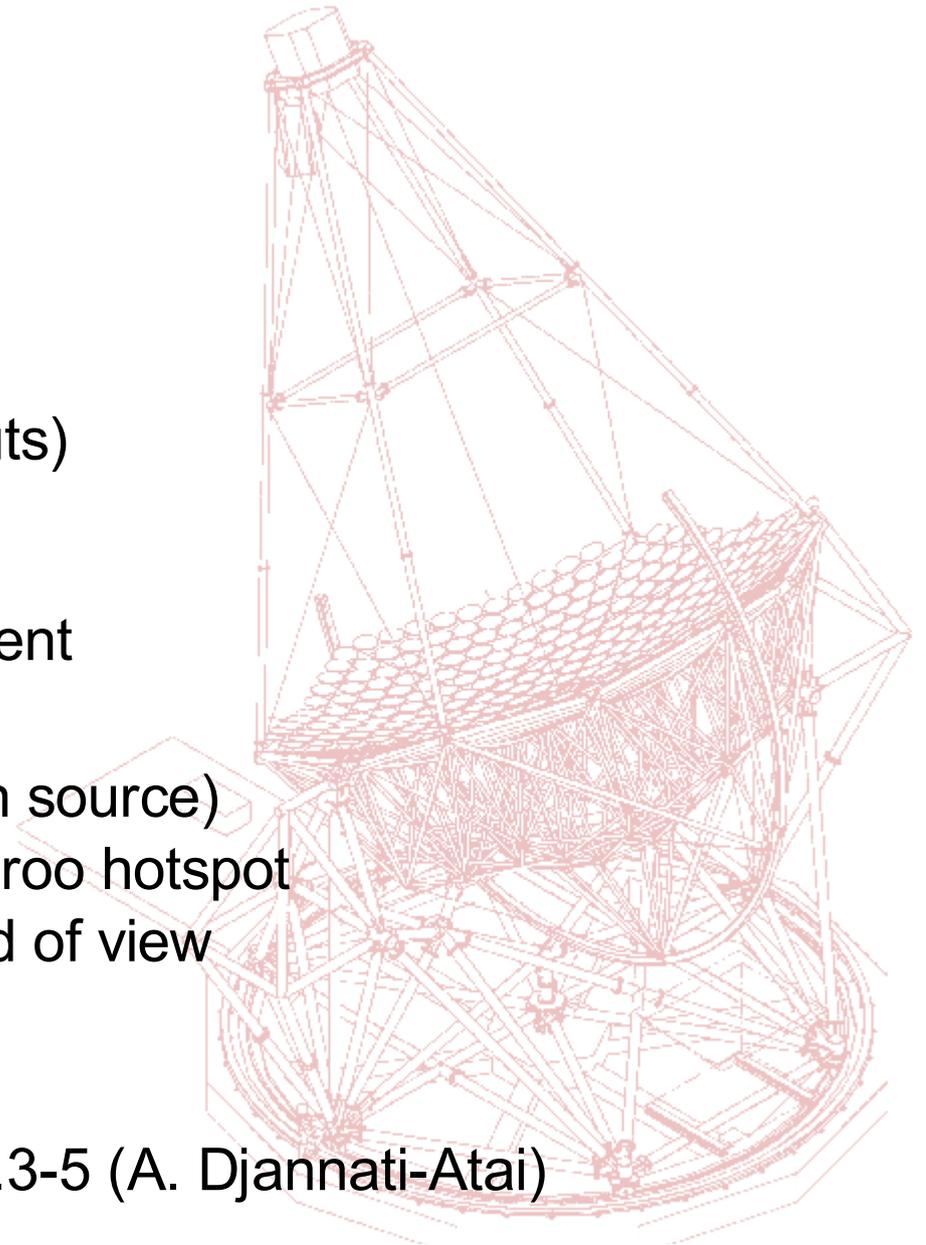7 hours of observations (livetime on source)

No significant signal seen at Cangaroo hotspot

No other significant emission in field of view

Other Galactic Sources

Analysis is ongoing

Extragalactic sources – see O.G. 2.3-5 (A. Djannati-Atai)

Selection Cuts

Image Cleaning thresholds
   5,10 (pe)

Large Zenith Angle (Crab)
   Shape cuts:
      $0 <$ Length < 4.8 (mrad)
      $0.05 <$ Width < 1.3 (mrad)
      $0 <$ Len/Size < 0.016 (mrad/pe)
   Alpha Analysis
      $0 <$ Dist < 17.0 (mrad)
      Alpha < 9 degrees
   2-d Analysis
      $0 <$ Theta^2 < 0.04 (deg.^{2})

Small Zenith Angle (SN 1006)
   Shape cuts:
      $0 <$ Length < 6.8 (mrad)
      $0 <$ Width < 1.5 (mrad)
      $0 <$ Len/Size < 0.016 (mrad/pe)
   Alpha Analysis
      $0 <$ Dist < 19.0 (mrad)
      Alpha < 6 degrees
   2-d Analysis
      $0 <$ Theta^2 < 0.04 (deg.^{2})

Other Systematic checks

Exact Run selection criteria

Trigger rate variations

Rate, rms variation

Radiometer data

Calibration

Gain stability

Pedestals, drifts

Flatfielding

Muon efficiencies

Evolution plot

Length/size peak pos.

MC/data parameter comparison

Hillas parameters

Selection efficiencies

Offset MC selection efficiency

Problematic pixel selection

Broken Pixel plots

Run – Run Muon efficiency