VERITAS Status

D. Kieda, *University of Utah*
for the VERITAS Collaboration

2/6/2007

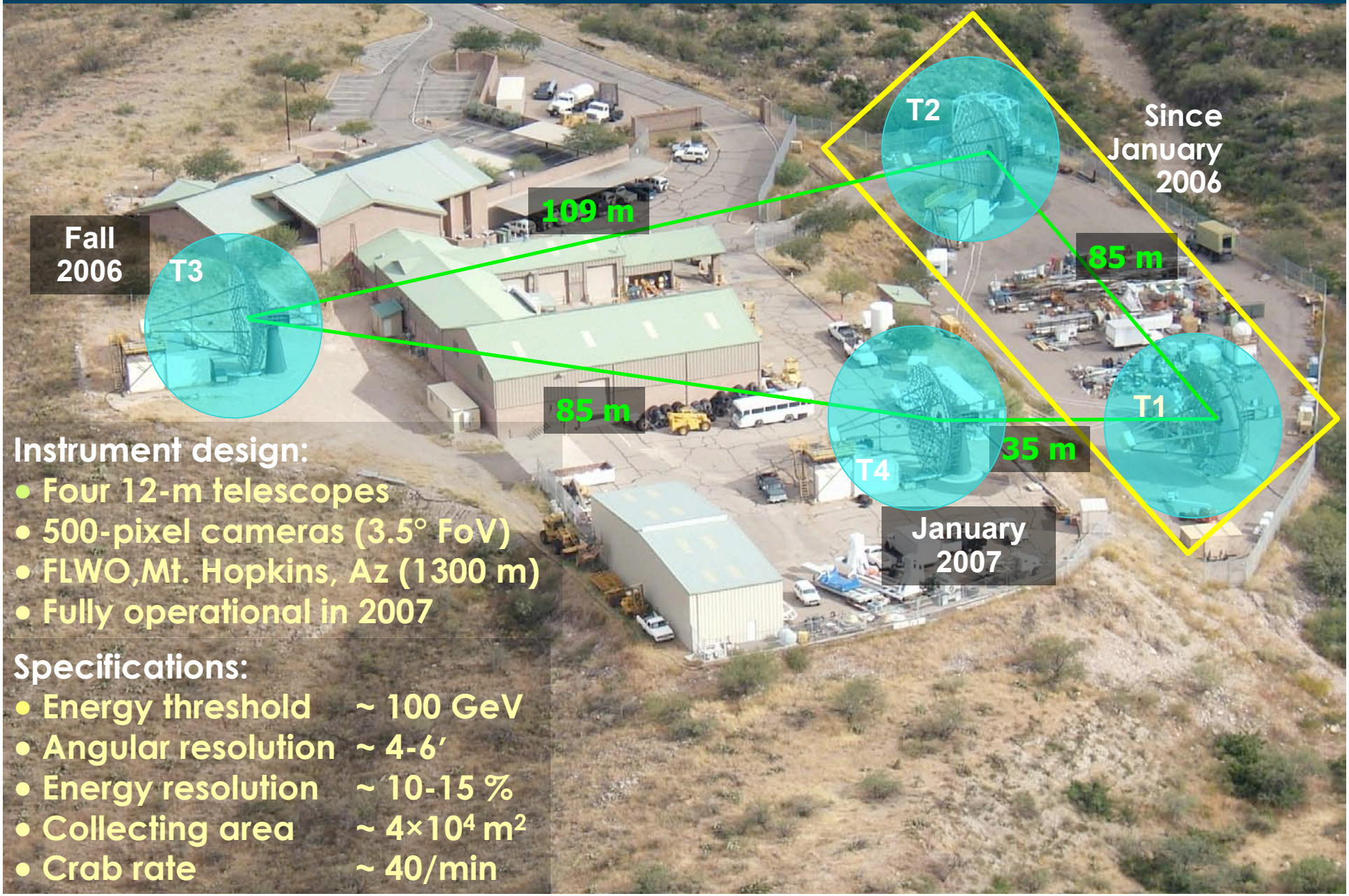
Outline

- Construction Update
- Initial Performance
- VHE γ-ray Source Observations

VERITAS Web Page

http://veritas.sao.arizona.edu

VERITAS-4 at the Whipple Observatory



Instrument design:

- Four 12-m telescopes
- 500-pixel cameras (3.5° FoV)
- FLWO,Mt. Hopkins, Az (1300 m)
- Fully operational in 2007

Specifications:

- Energy threshold ~ 100 GeV
- Angular resolution ~ 4-6′
- Energy resolution ~ 10-15 %
- Collecting area ~ 4×10^4 m^2
- Crab rate ~ 40/min

VERITAS Collaboration
~65 members in more than 20 institutions

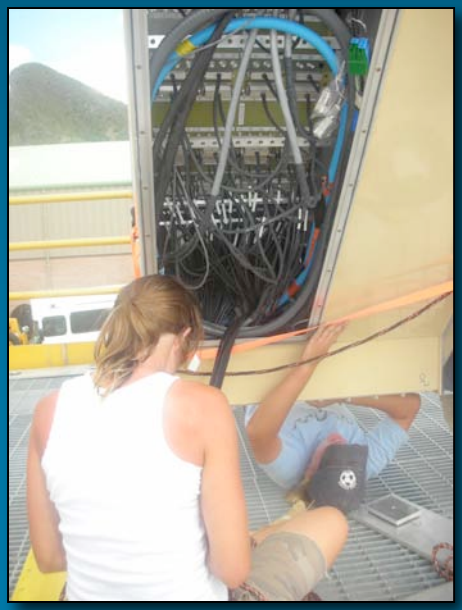
- Smithsonian Astrophysical Observatory *
- Adler Planetarium
- Purdue University *
- Barnard College, NY
- Iowa State University *
- DePauw University, IN
- Washington University, St. Louis *
- Grinnell College, IA
- University of Chicago *
- University of California, Santa Cruz
- University of Utah *
- University of Massachussetts
- University of California, Los Angeles *
- Cork Institute of Technology
- McGill University, Montreal *
- Galway-Mayo Institute of Technology
- National University of Ireland, Dublin *
- National University of Ireland, Galway
- University of Leeds *
- Argonne National Lab
- Associate Members

Project office: F.L. Whipple Observatory, SAO

Funding from
NSF/DOE/Smithsonian/PPARC/SFI/NSERC

Telescope Construction

Camera Integration

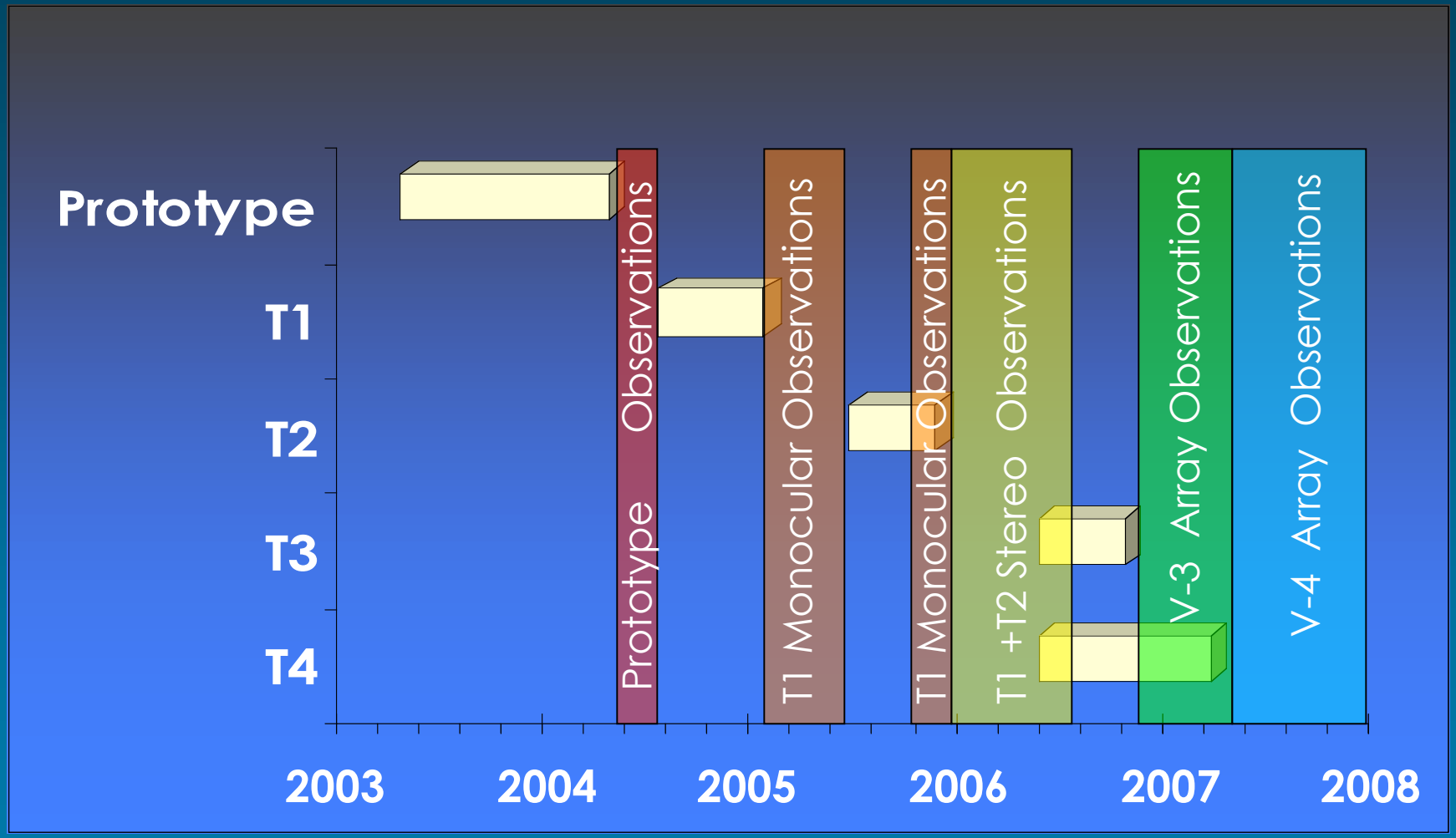


January 2007

February 6, 2007

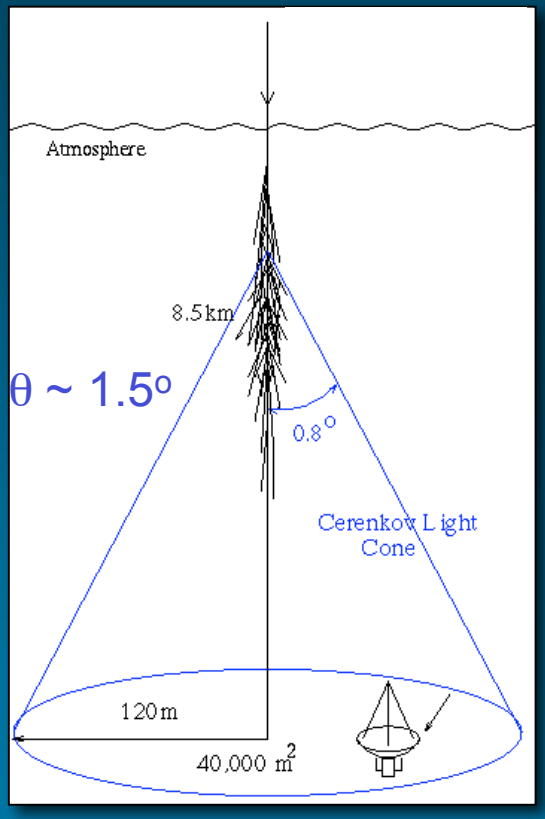
First GLAST Science Symposium

VERITAS – Base Camp History

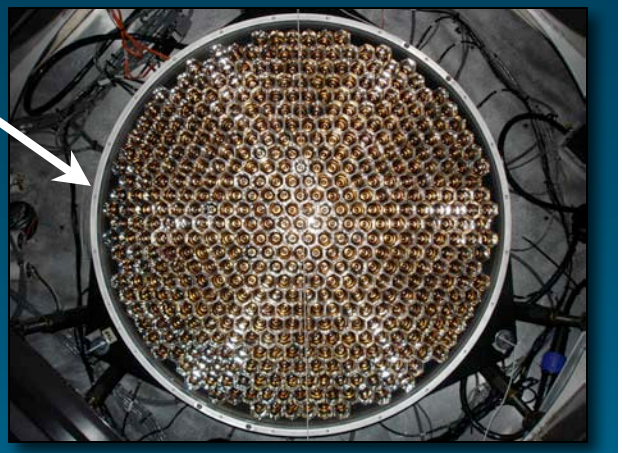


Atmospheric Imaging Technique

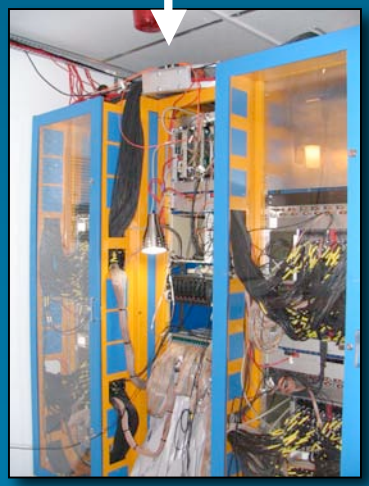
γ–ray



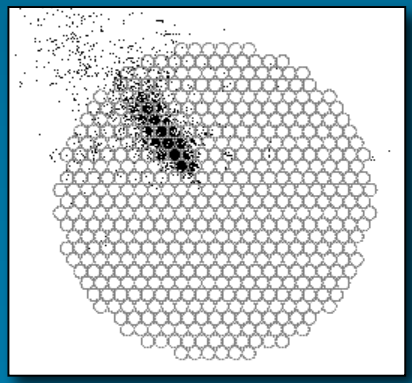
12 m Mirror



499-PMT camera

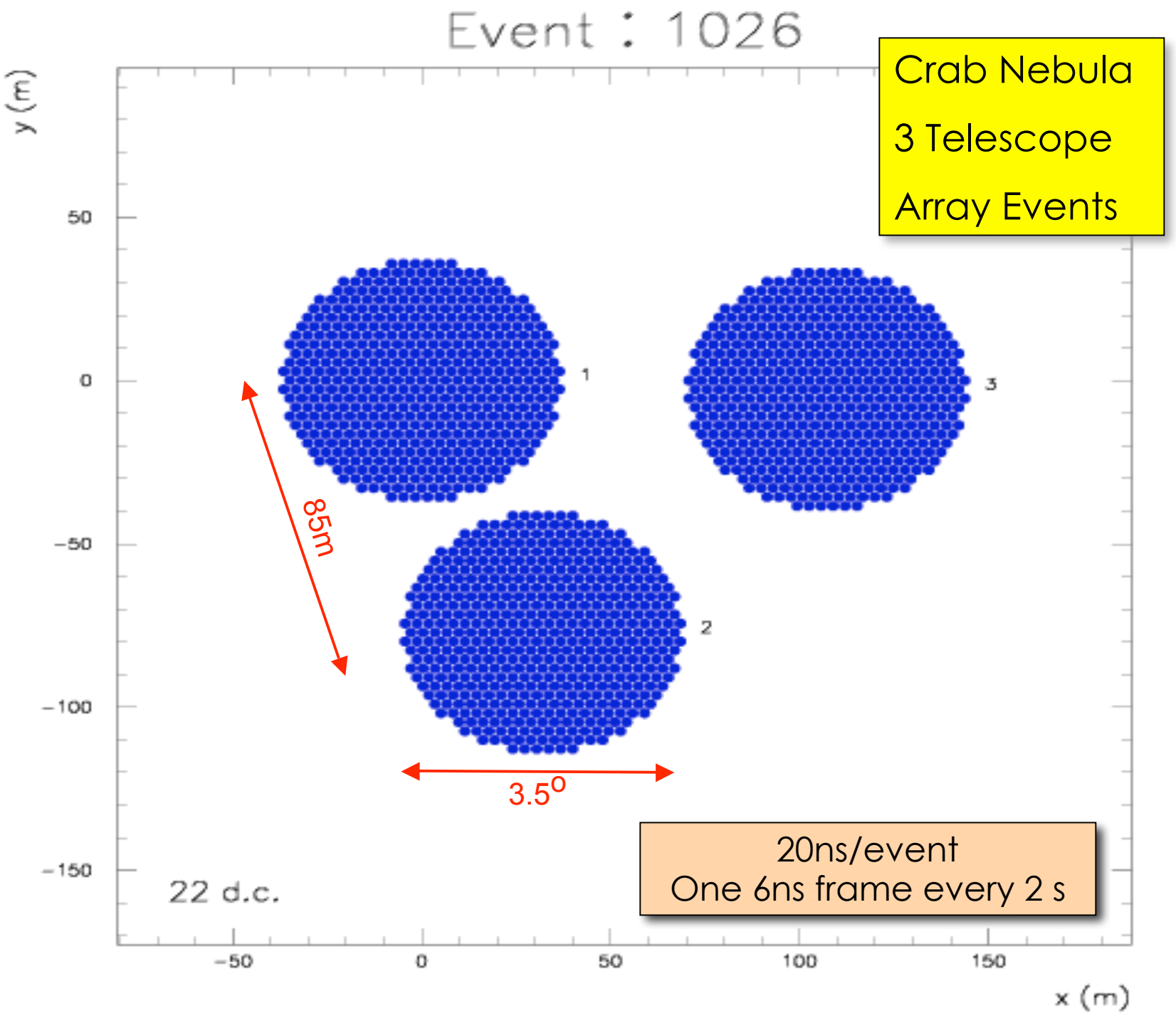


500-MHz FADC electronics

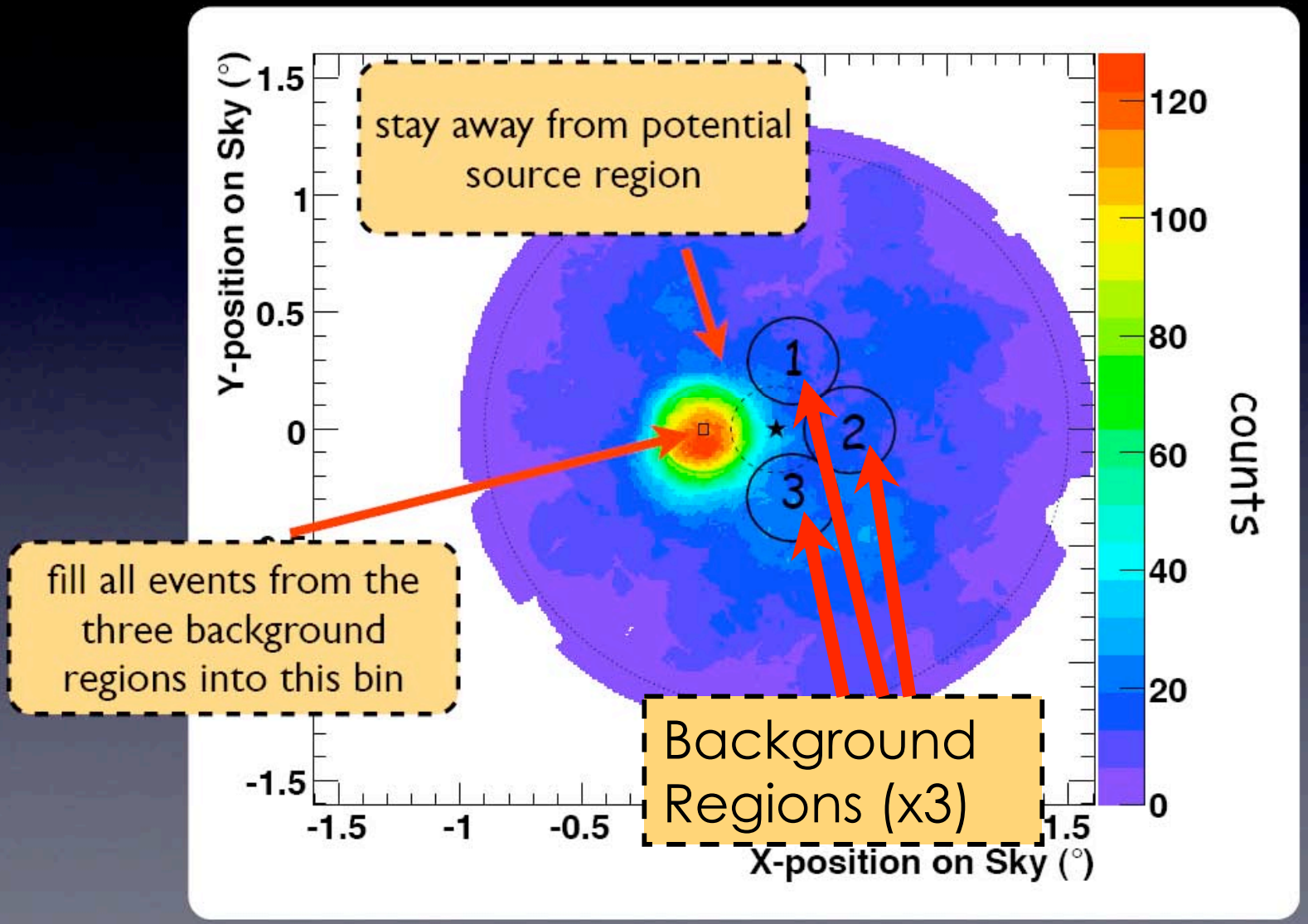


Cherenkov image

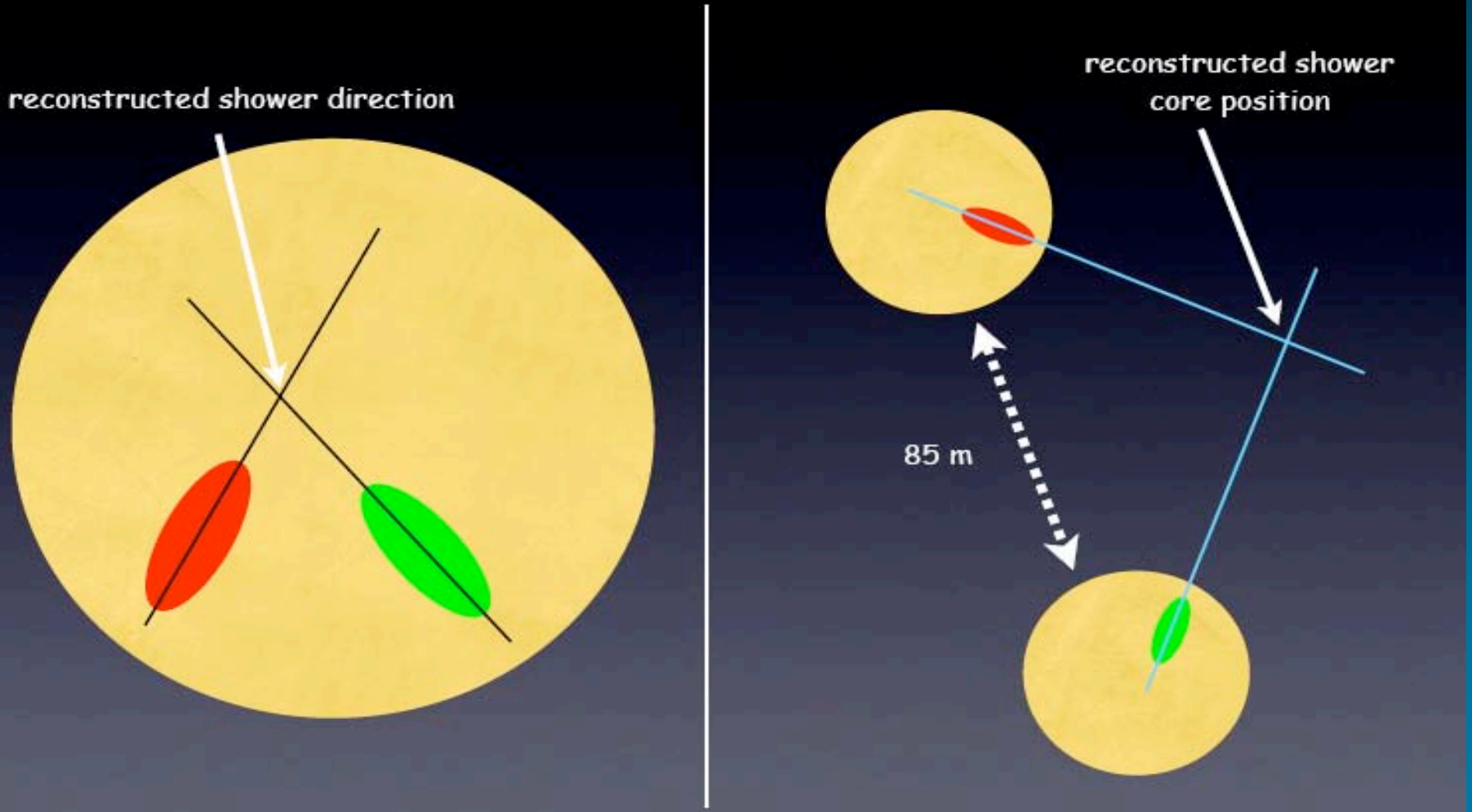
Area = 10^4 – 10^5 m^2
~60 optical photons/m^2/TeV


Event : 1026
Crab Nebula
3 Telescope
Array Events
y (m)
50
0
−50
−100
−150
1
2
3
85m
3.5°
22 d.c.
20ns/event
One 6ns frame every 2 s
−50
0
50
100
150
x (m)

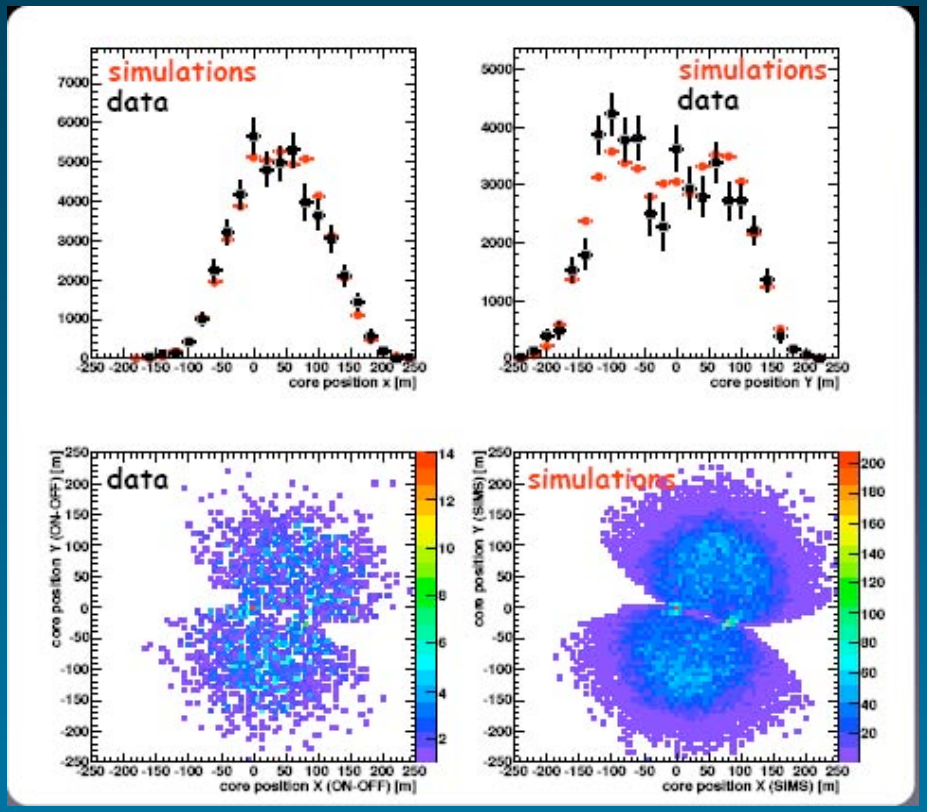
Wobble Mode Observations

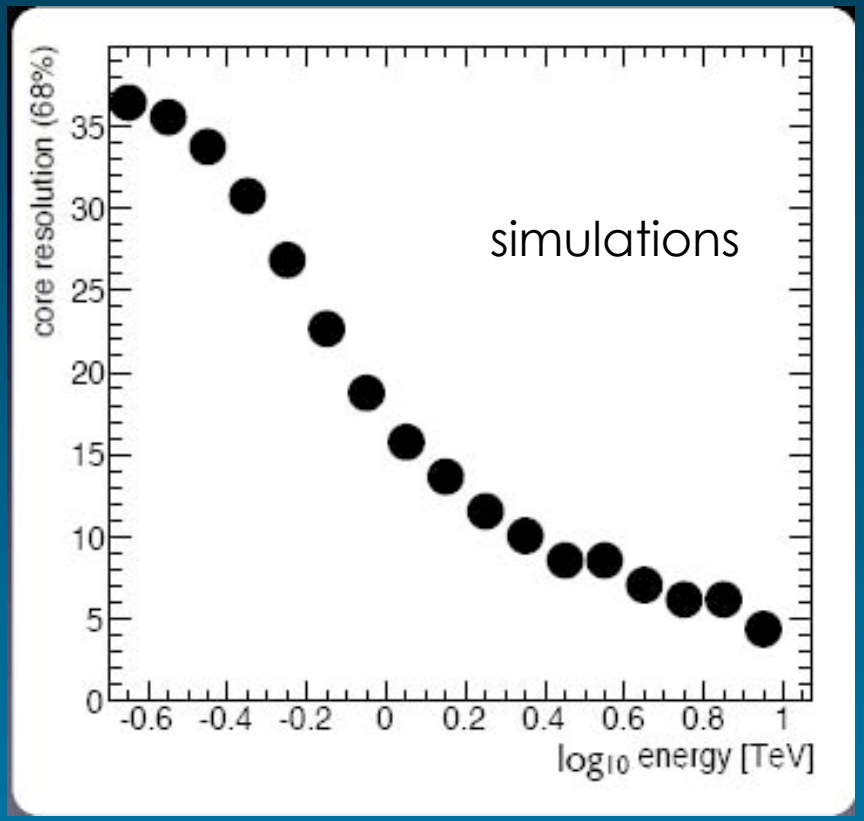


shower direction and shower core reconstruction



Core Reconstruction: 2 Telescope Data

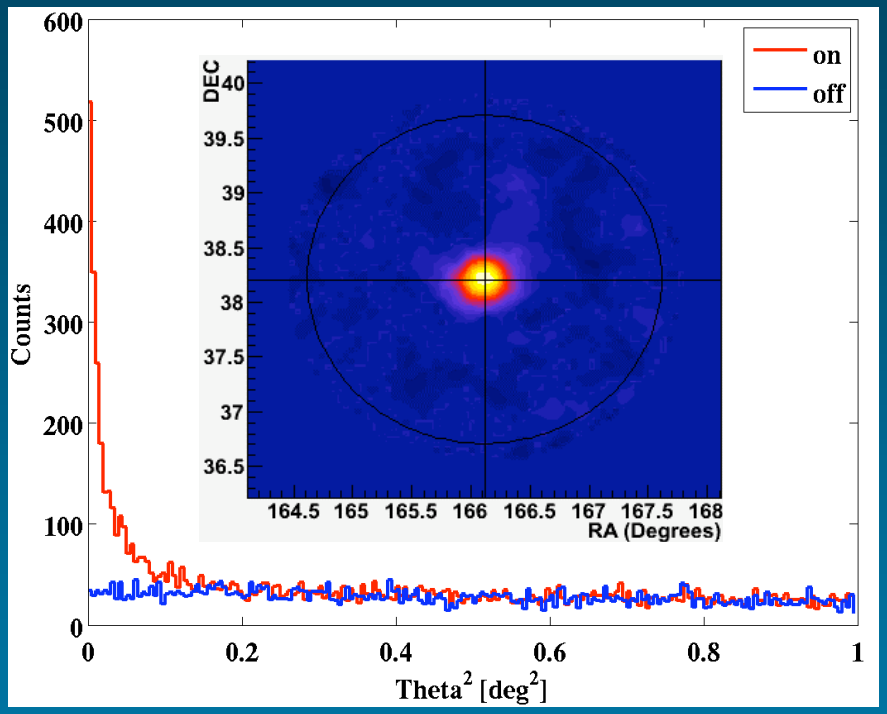


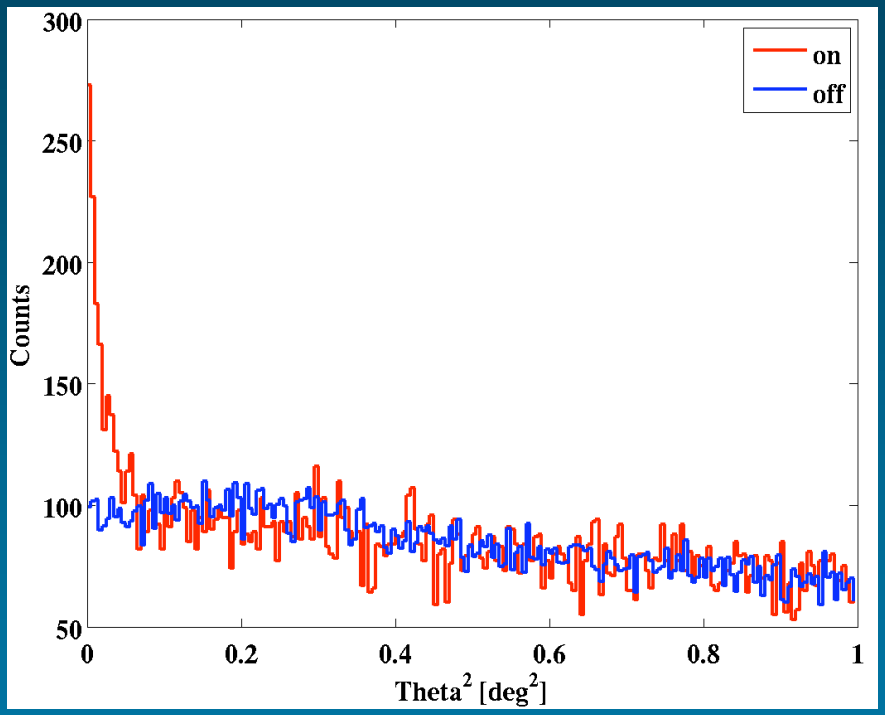


7 Crab runs (On/Off) + 7 Mrk421 runs (On/Off)

Typical Resolution in Core Reconstruction ~5-30 m

Spring 2006 T1/T2 Observations



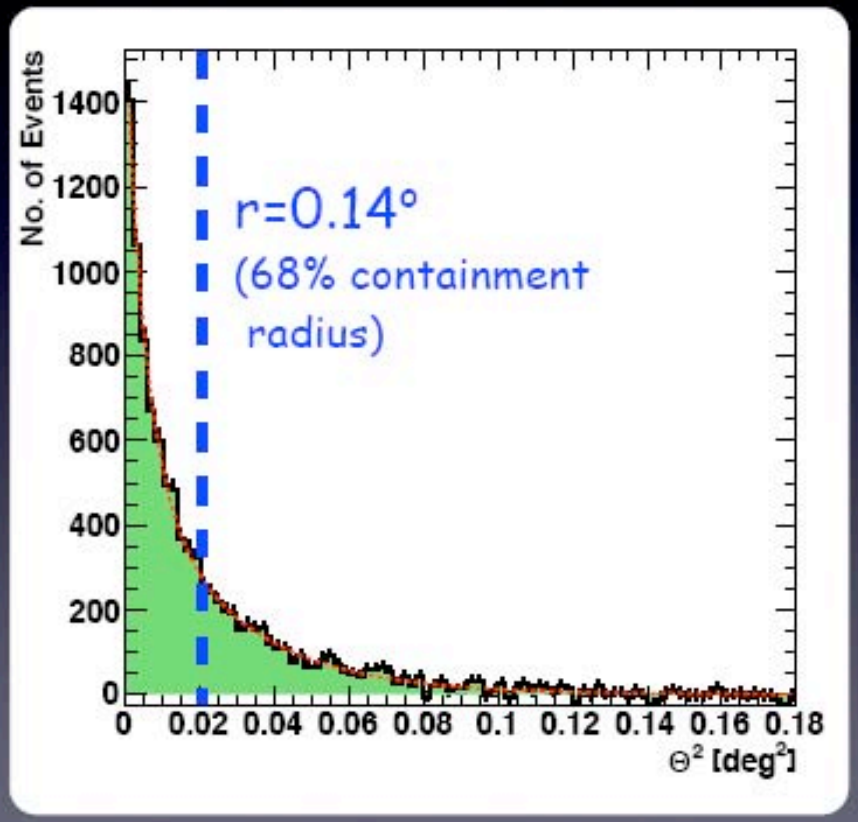


Mrk421: 7.2 hours
5.6 γ/minute

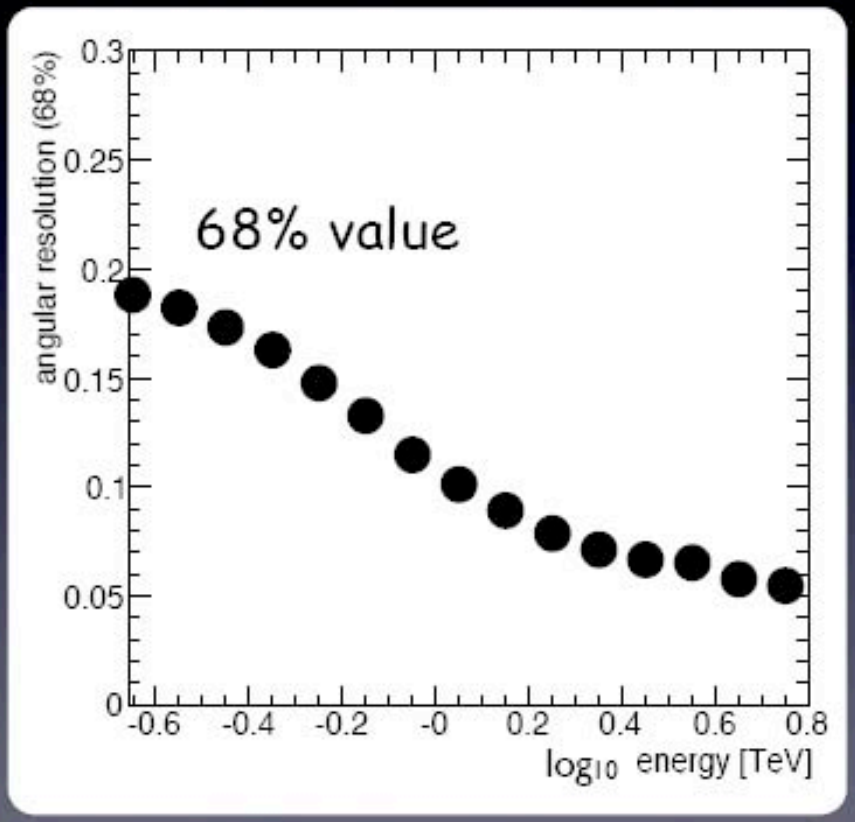
Mrk501: 11.4 hours
0.8 γ/minute

angular resolution

103 Crab runs (0.3° wobble offset)

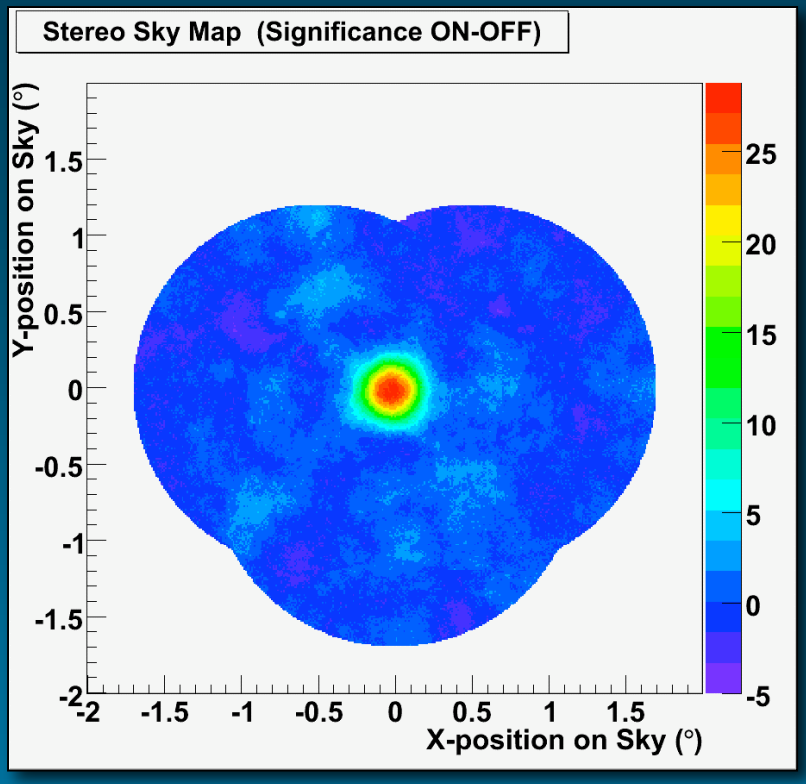


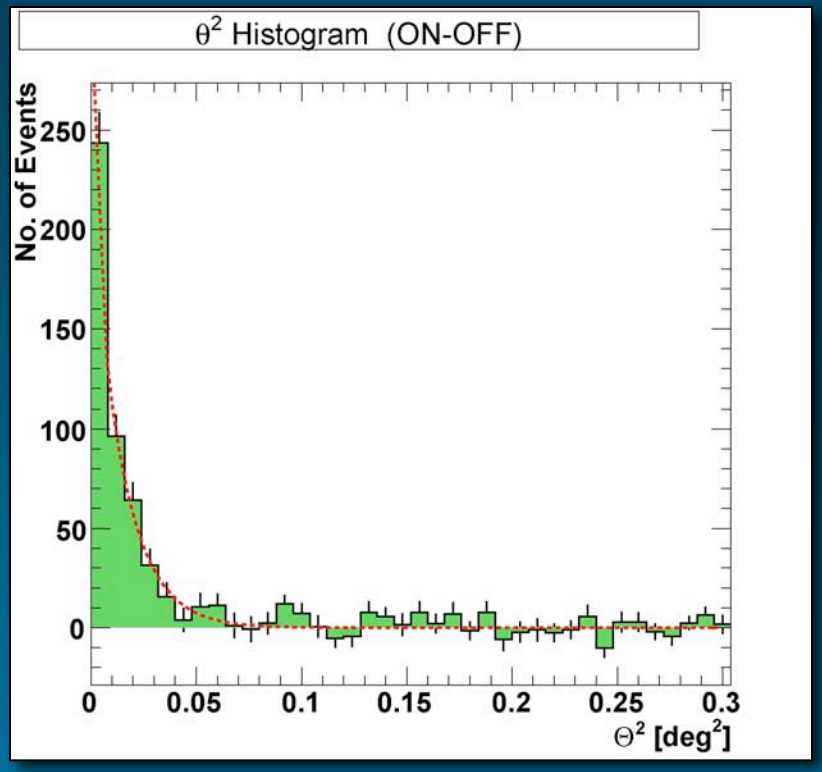
simulations (70° elevation)



typical angular resolution ~0.1-0.2°

3 Telescope Crab Data (Jan 2007)

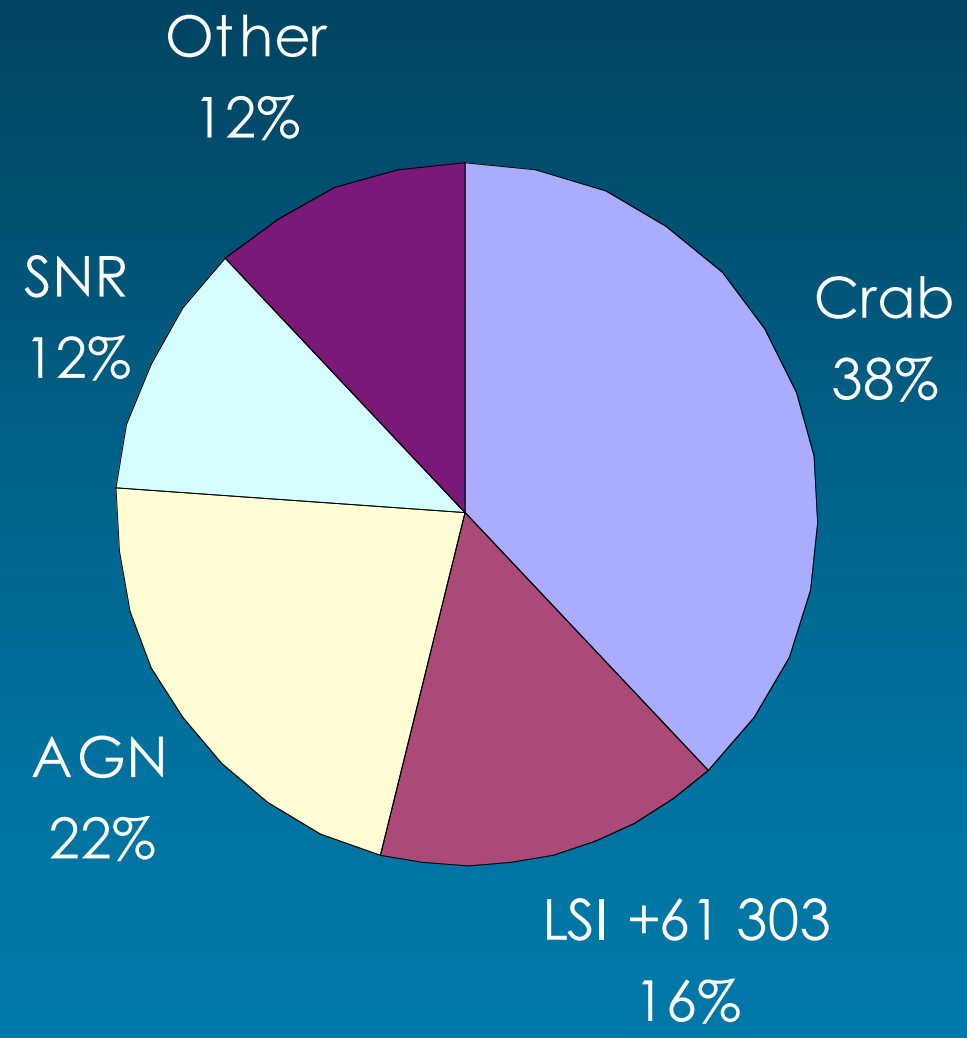




- **Wobble runs, 76° Elevation**
- **653 On/126 Off Counts**
- **Significance: 28.1σ**
- **3 T: improved angular resolution**

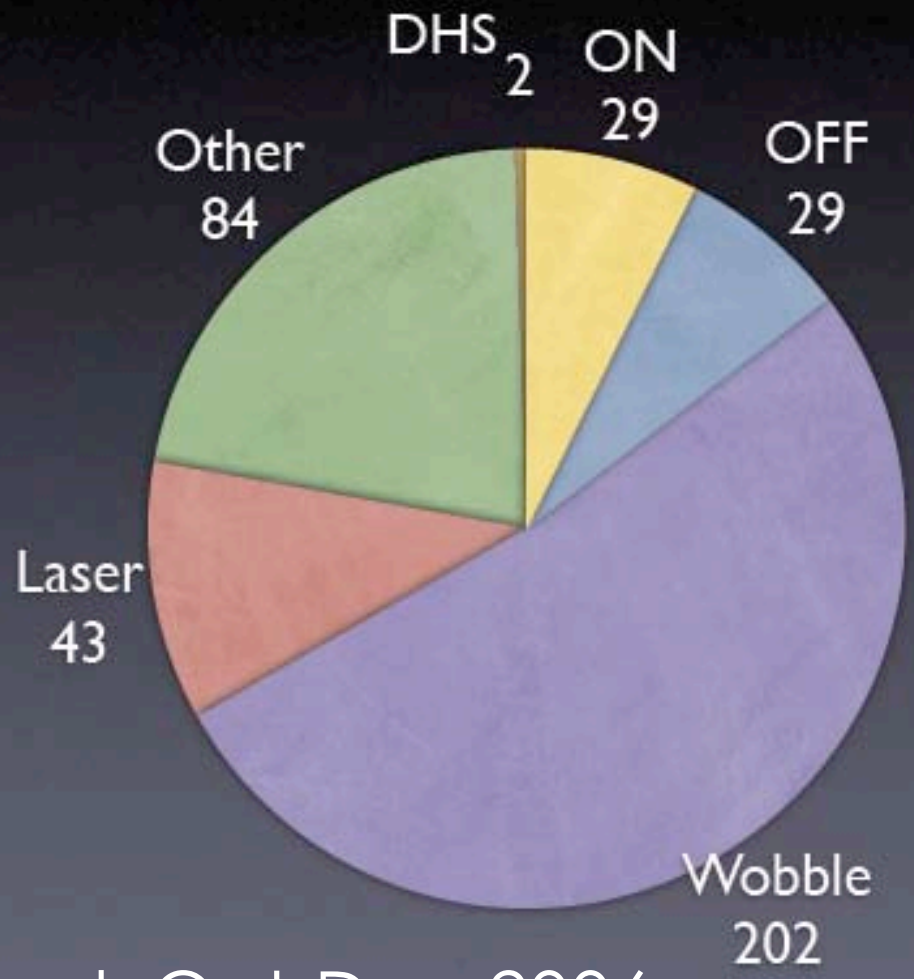
Hours Observed: Oct-Dec 2006

- Mostly 2 T Data
- 202 Wobble Hours
- 29 On/Off Hours
- 231 Hours Total



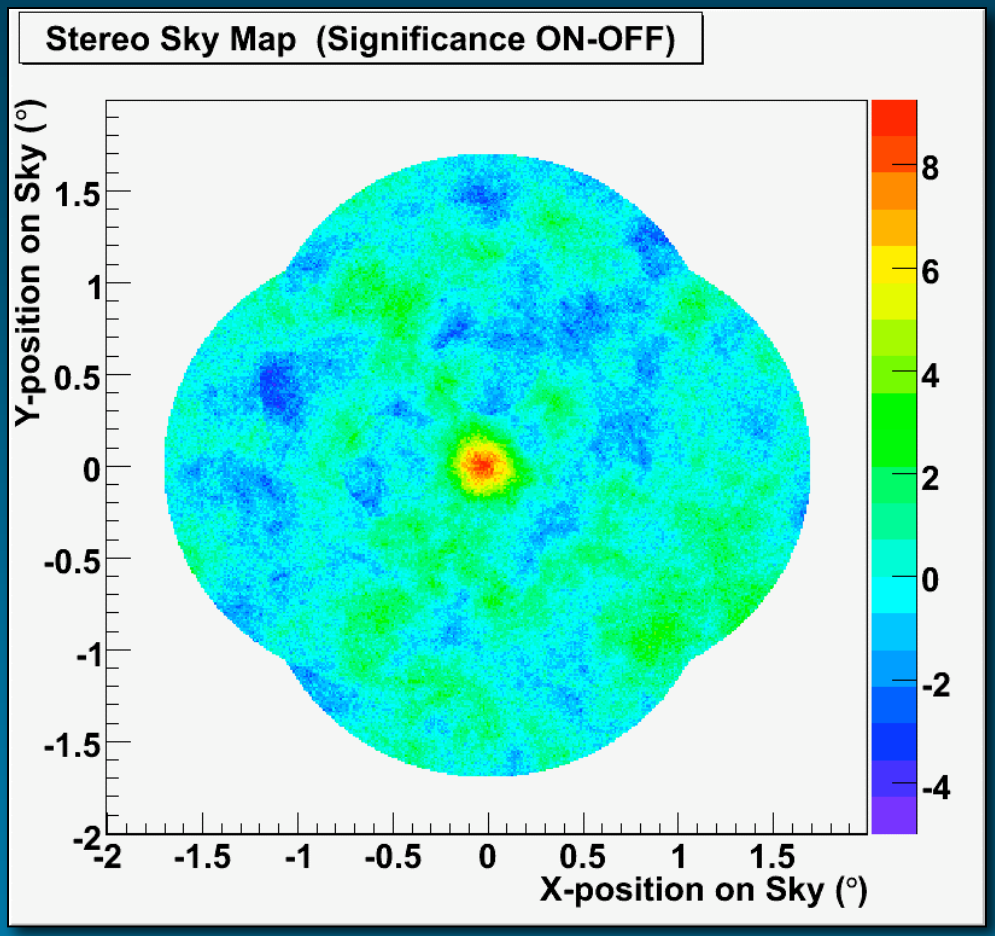
Division of Hours

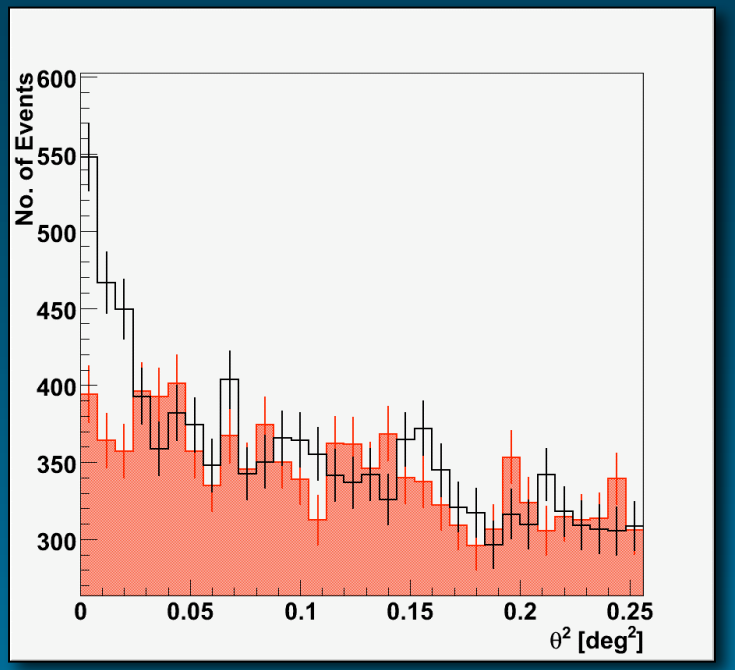
- There were a total of 388 possible observing hours this fall.
- We lost about 18% due to various issues including weather



Hours Observed: Oct-Dec 2006

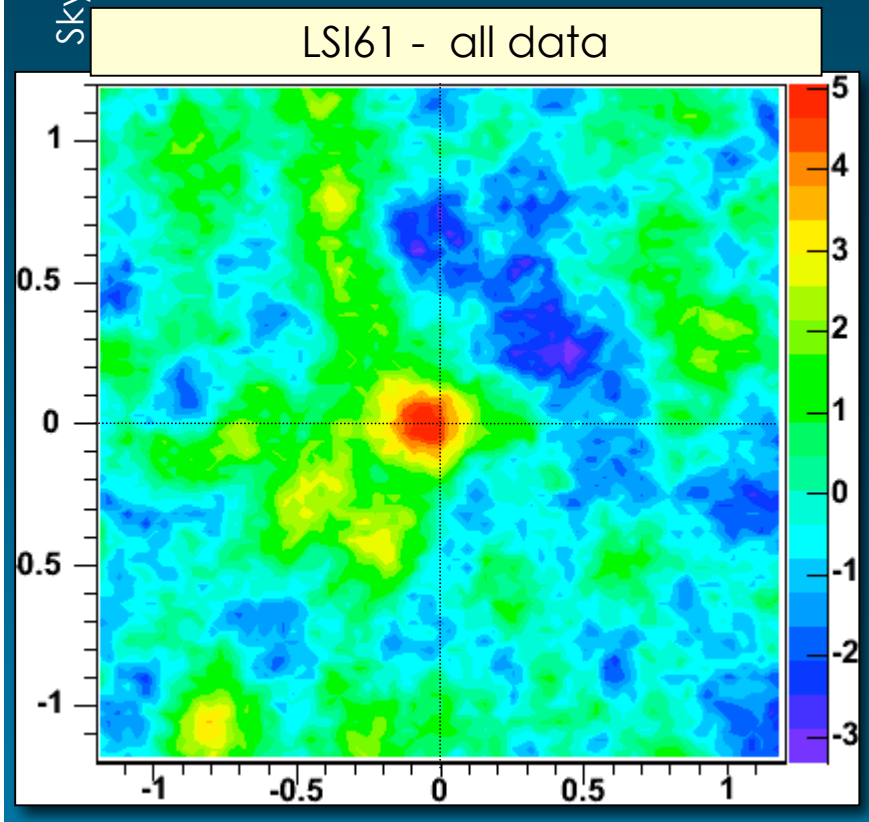
1ES1218+30.4

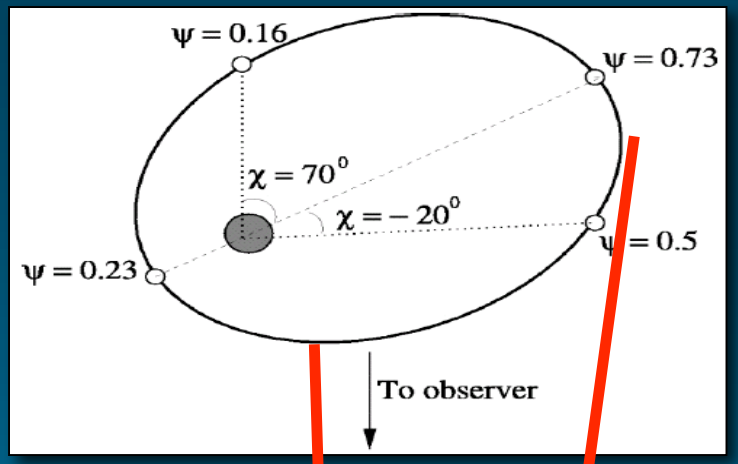


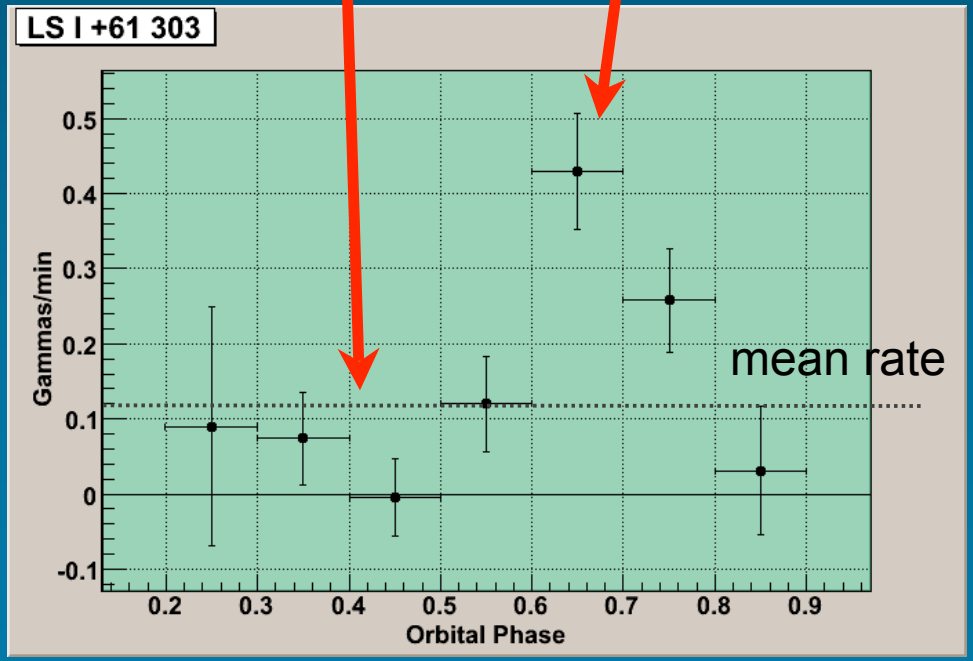


- z=0.182 => 2nd farthest VHE blazar
- MAGIC 8.2 hr, 6.4σ, E>120 GeV
- VERITAS-2: 59 runs, 20.6 hr
- Ring Model Background
- 8.0σ, 0.3 ± 0.05 γ/min

LSI +61 303

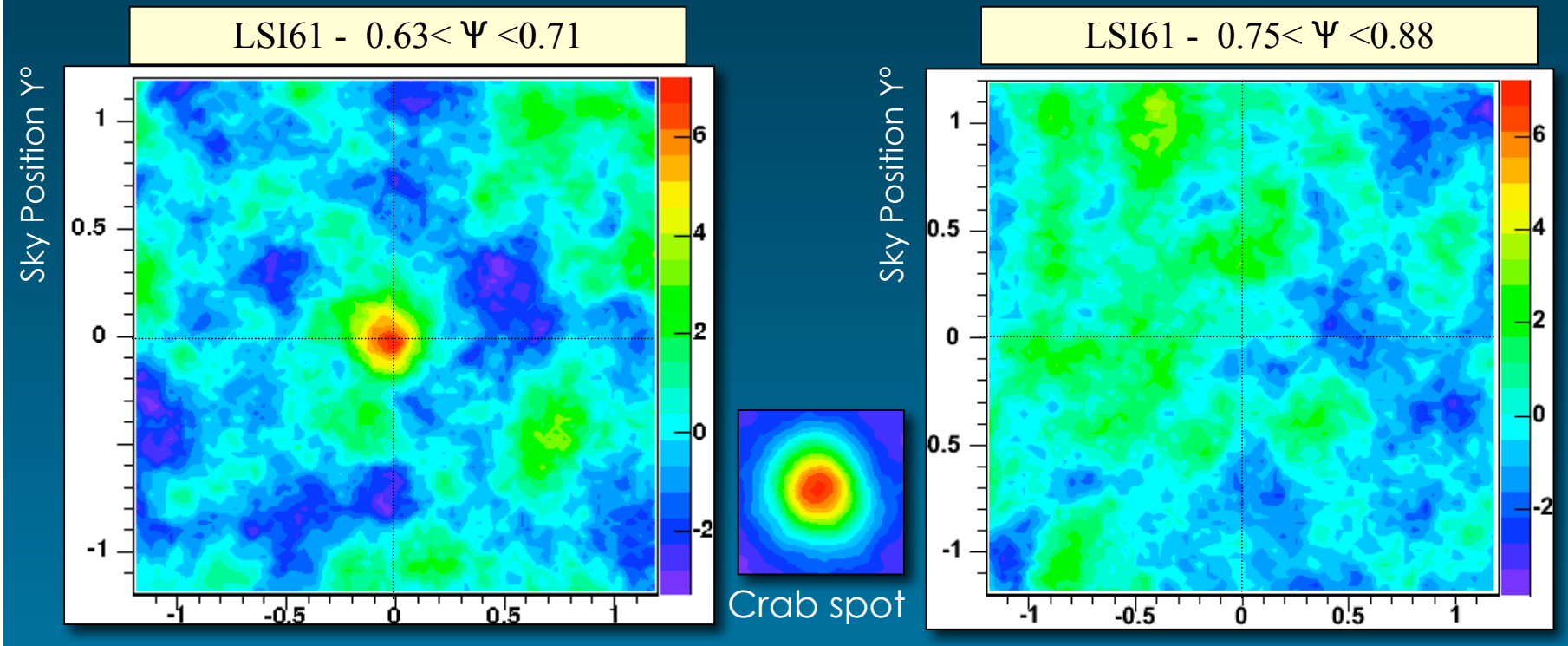






33.25 hr of data:
Significance = +5.1 σ
Mean rate = 0.126 γ/min

LSI +61 303



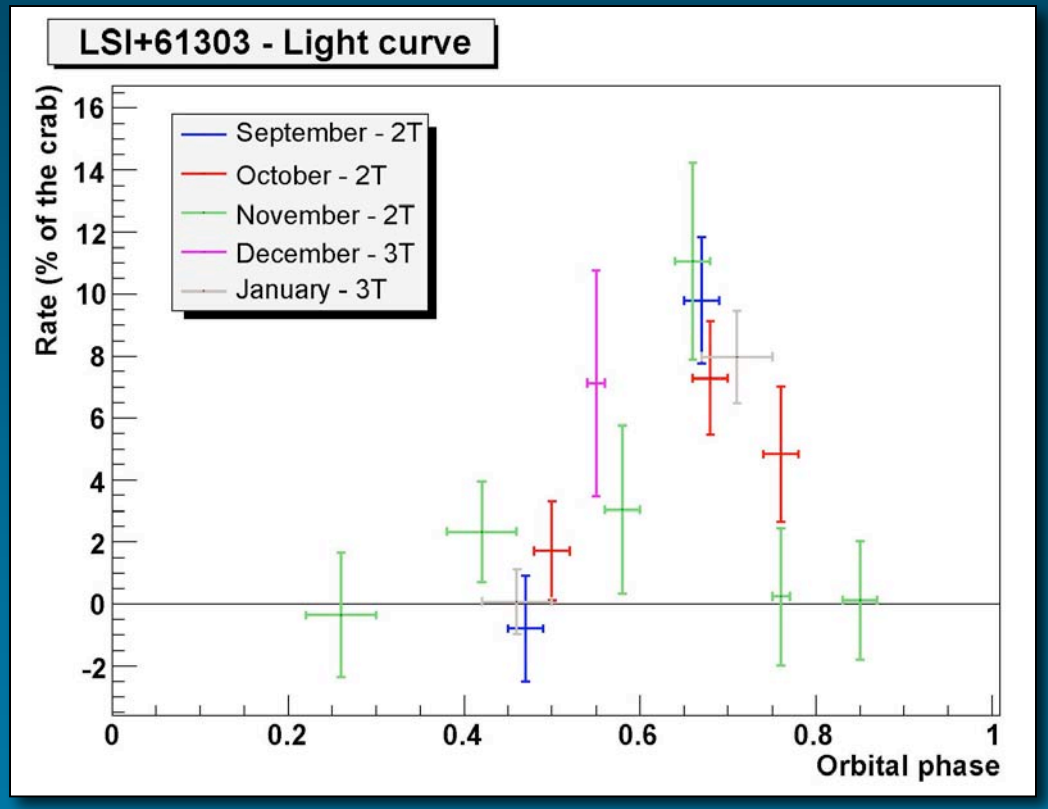
8.25 hr of data:
Significance = +7.1 σ
Rate = 0.33 γ/min

7hr of data:
Significance = +0.24 σ
Rate = 0.013 γ/min

MAGIC detection: 54 hr, 9.0σ, E>200 GeV

LSI +61 303

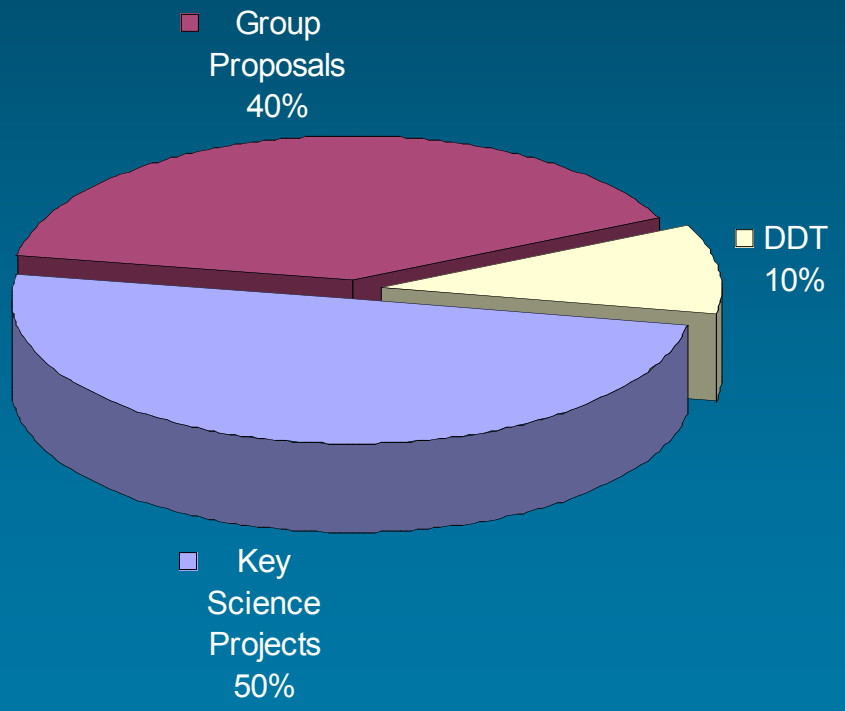
1 period = 1 month = 1 dark run



Every dark run in good agreement !

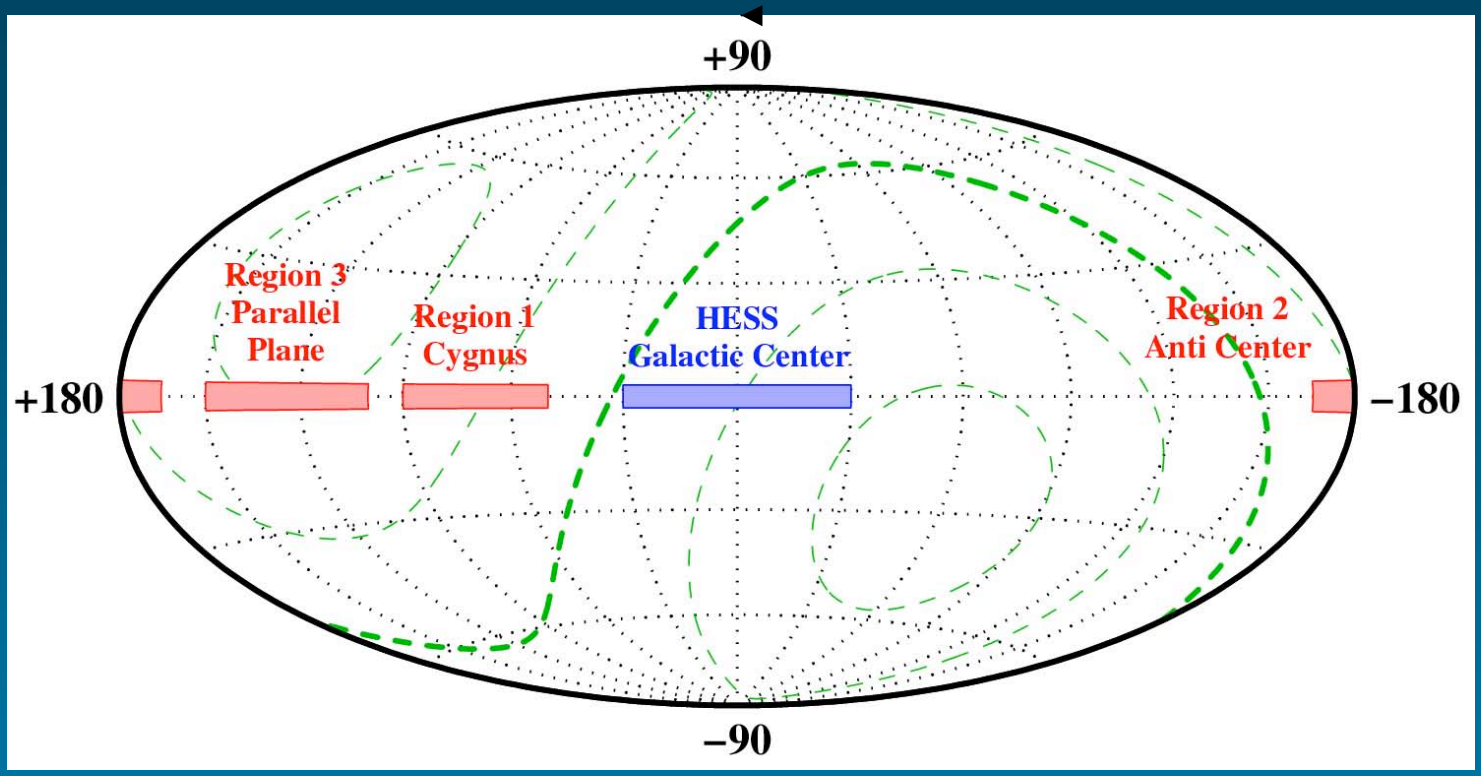
VERITAS Time Allocation (2008-2009)

- Key Science Projects
  - Galactic Plane Survey
  - Dark Matter
  - Supernova Remnants
  - Blazars
- Groups Proposals administered by VERITAS Time Allocation Committee (TAC)
- Director's Discretionary Time (DDT) for Engineering, ToO



Proposed Survey Regions

Time to survey overhead sky with
zen<30º (18kdeg^2): 18.6 yrs



- 3 regions of Galactic Plane: 30º/40º/50º×6º = 720 deg^2.
- Survey at 5-6% of Crab flux.
- 350 hrs for Regions 1 & 2 (prime), 250 hrs for Region 3.

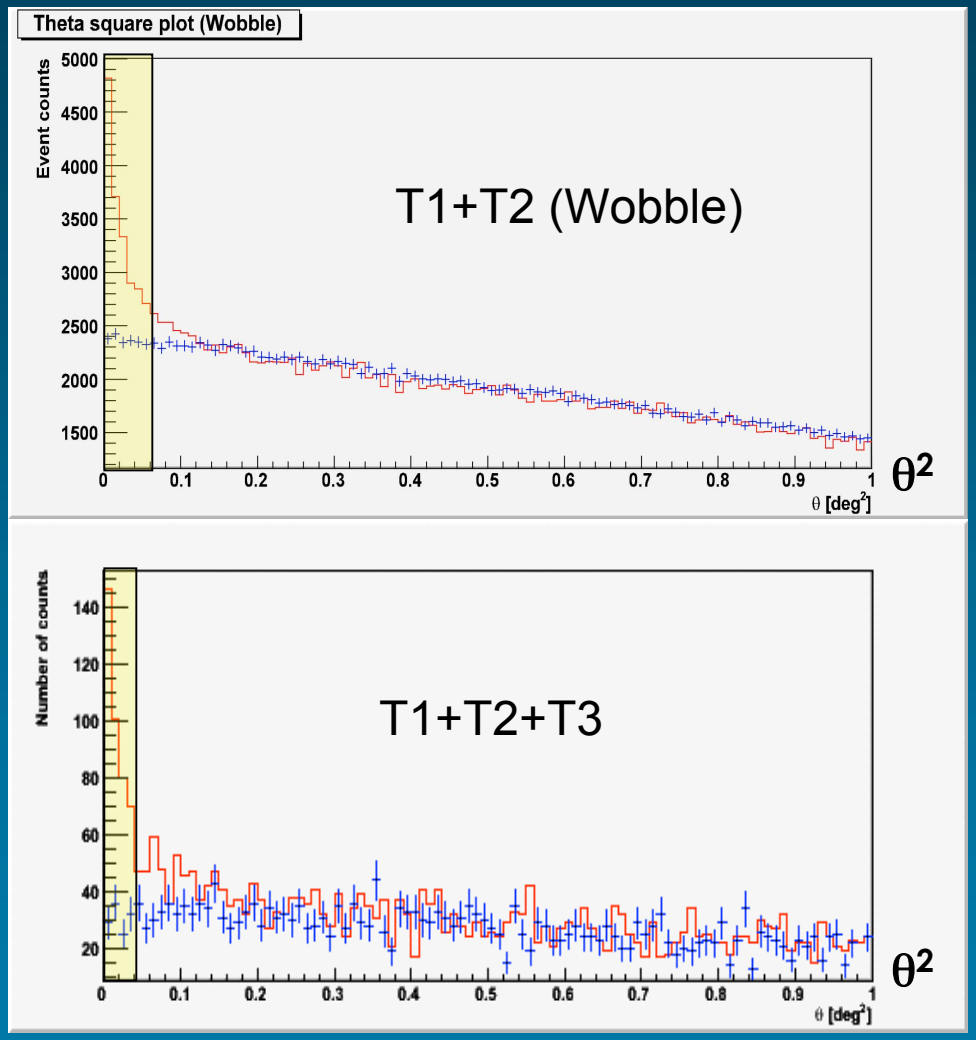
(Simple) Population Study

	HESS	Region 1	Region 2	Region3
	Gal Center	Cygnus	Anti-Center	Parallel
SNR (Green)	82 18	22 5	3 1	10 2
EGRET (3EG)	14 18	8 10	1 1	2 3
EGRET (GeV)	8 18	5 11	0 0	1 2
ROSAT (RASS-BSC)	3932 18	2465 11	311 1	2428 11
Extrapolation		5-11	0-1	2-11

Summary

- VERITAS Array Construction Complete
- 3 Telescopes Operational
  - Engineering Tests
  - Optimizing Sensitivity with Crab , Mrk Observations
  - Beginning Science Observations
- VERITAS 2/3 Telescope Detections (2006)
  - Crab Plerion, Mrk 421, Mrk 501
  - New: 1ES 1218 AGN z=0.182
  - New: LSI +61 303 galactic HMXB binary/μ quasar
- *Spring 2007: Veritas -4 Full Operation*
- Cygnus Region Survey campaign with V4

Theta Squared Distribution



- Crab : Point Source
- 2/3 Telescope Observations
- On-Source gamma rays point back to source direction ($\theta^2 << 0.1$).

Crab Source

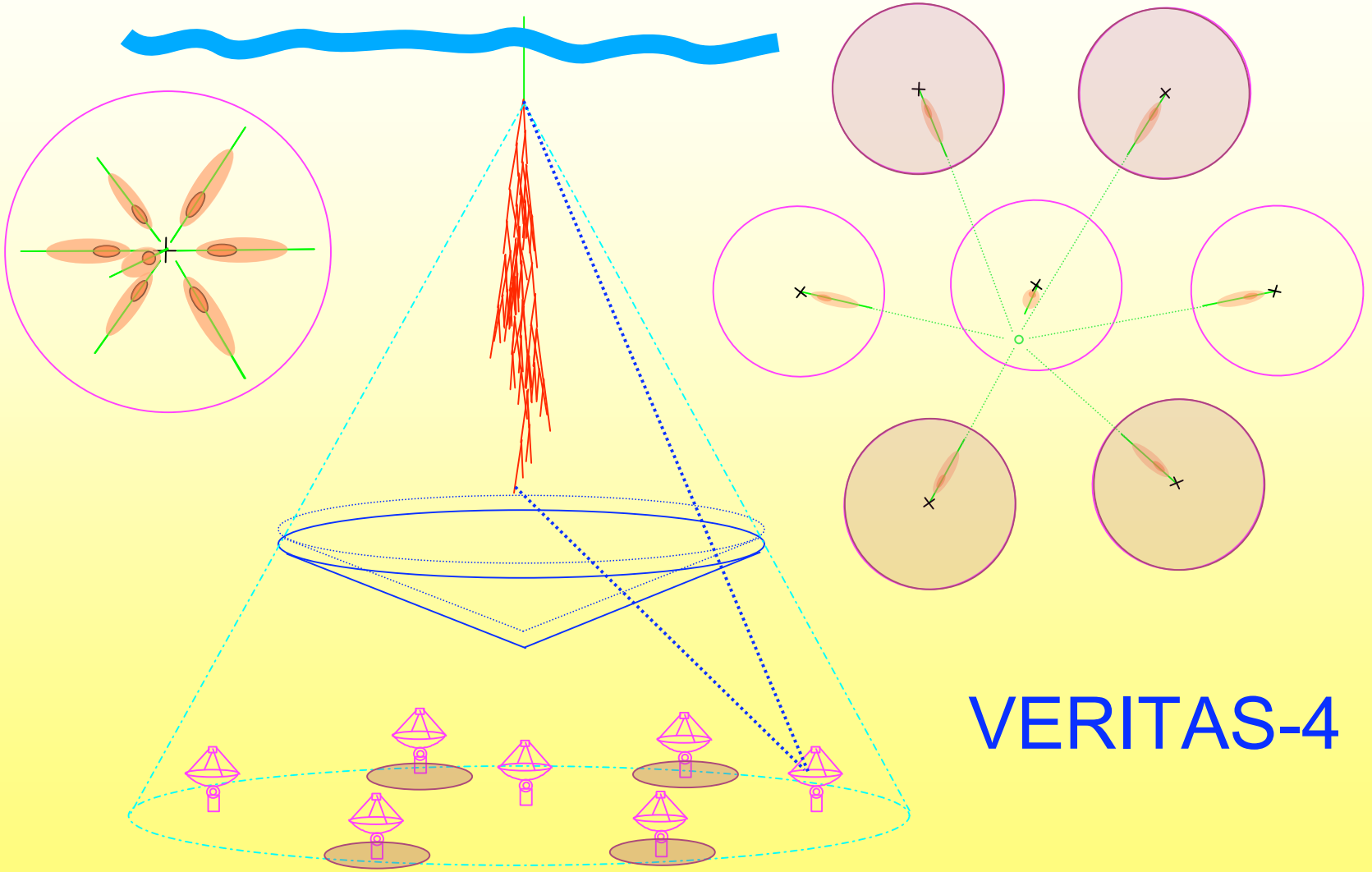
Background

Construction Rate

- T1 proto : 1 year — 0.5 tele/year
- T1 finish : 1 year — 0.5 tele/year
- T2 finish : 9 month — 1.3 tele/year
- T3/T4 finish : 10 months — 2.4 tele/year

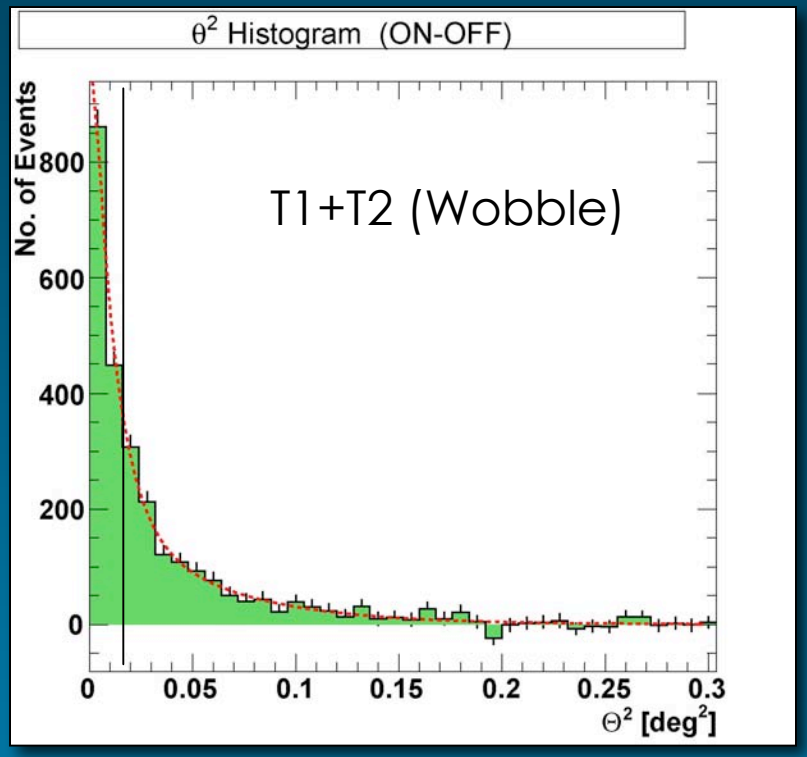
VERITAS

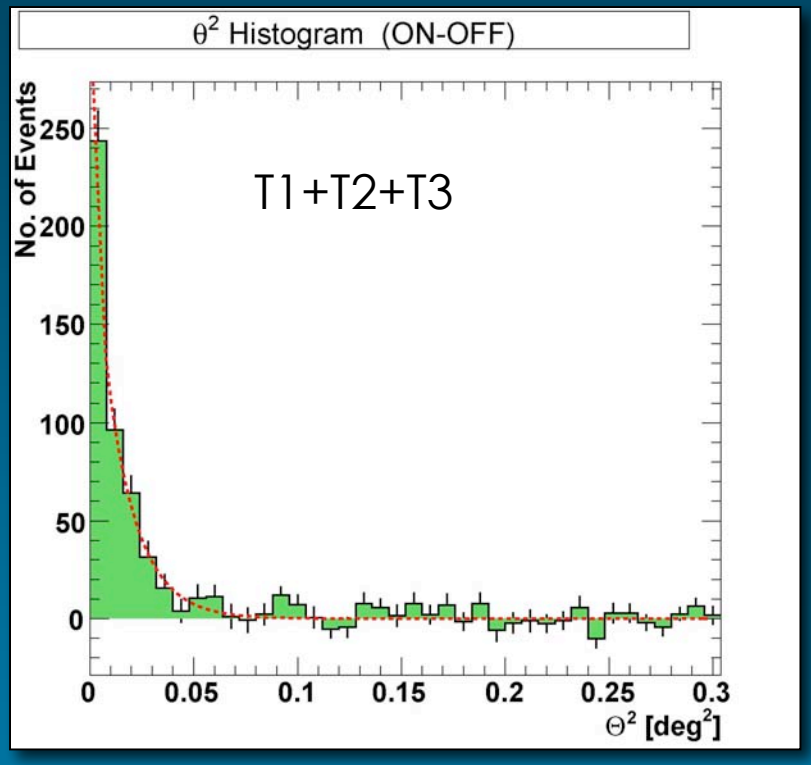
Very Energetic Radiation Imaging Telescope Array System

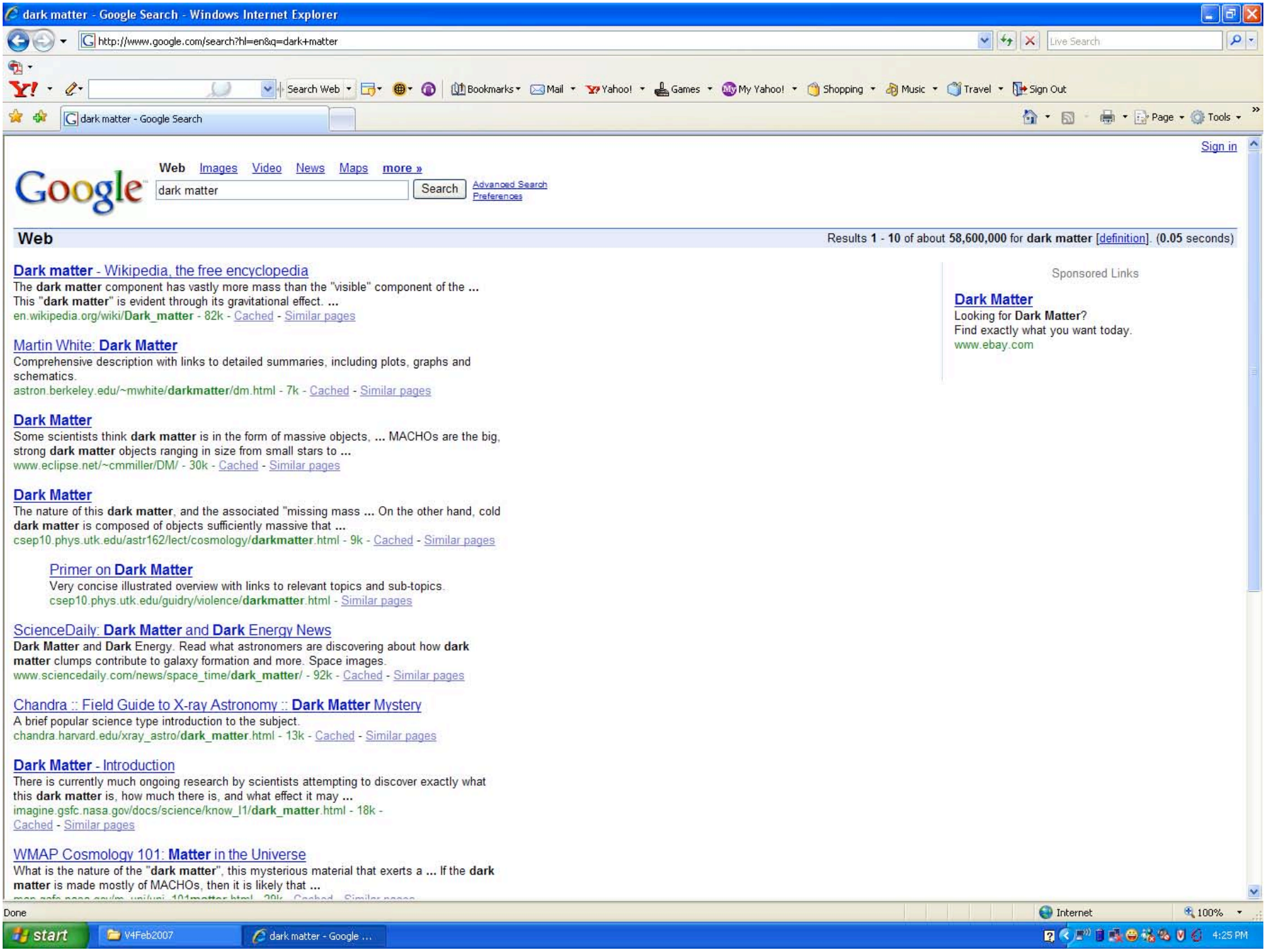


VERITAS-4

Theta Squared Distribution



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Results 1 - 10 of about 58,600,000 for dark matter [definition]. (0.05 seconds)
Dark matter - Wikipedia, the free encyclopedia
The dark matter component has vastly more mass than the "visible" component of the ...
This "dark matter" is evident through its gravitational effect. ...
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Martin White: Dark Matter
Comprehensive description with links to detailed summaries, including plots, graphs and schematics.
astron.berkeley.edu/~mwhite/darkmatter/dm.html - 7k - Cached - Similar pages
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Some scientists think dark matter is in the form of massive objects, ... MACHOs are the big, strong dark matter objects ranging in size from small stars to ...
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