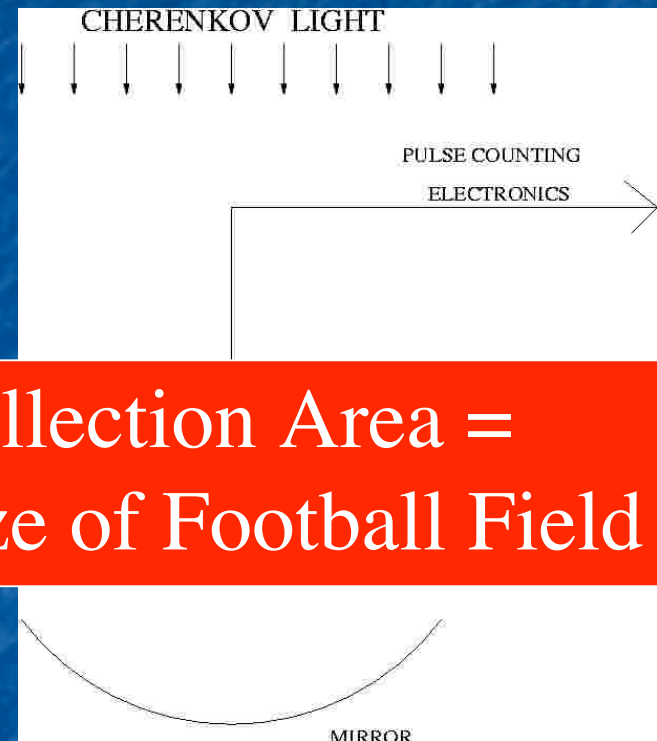
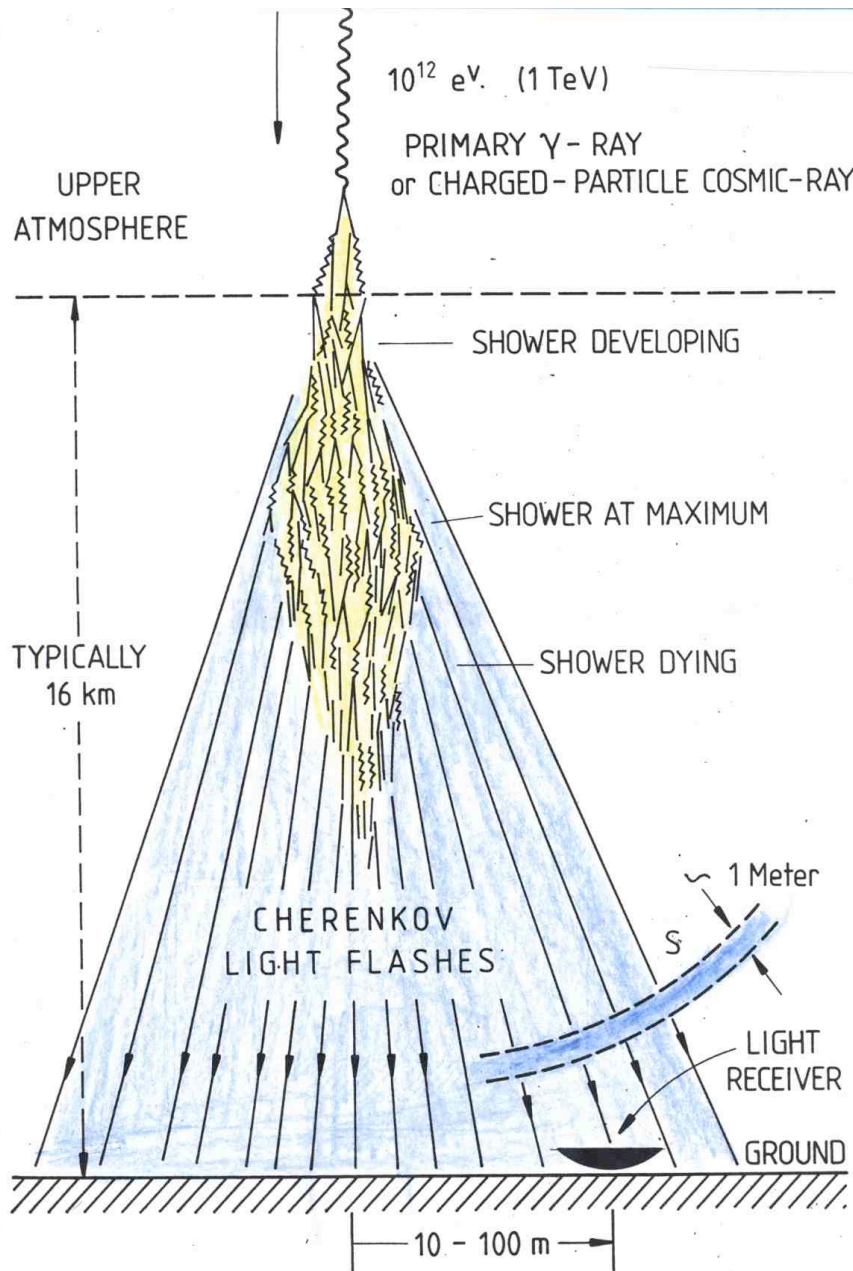


Status of VERITAS, July 2005





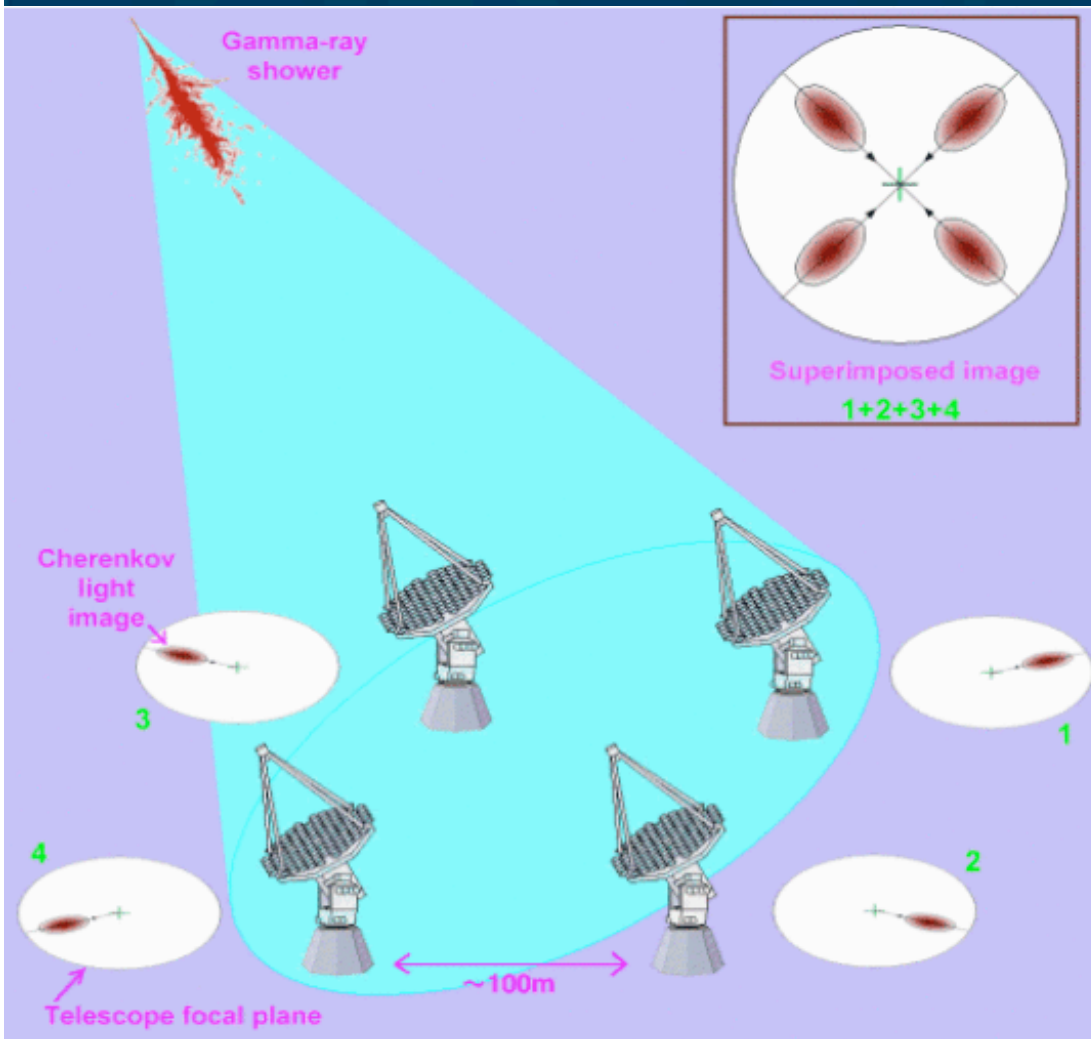
Simple Technique,
Simple Detectors,
Low Cost



Collection Area =
Size of Football Field

Direction $\sim \rightarrow$ arc-min
Energy Resolution $\sim \rightarrow$ 10%
Background $\sim \rightarrow$ 0

Array Imaging



Multiple Telescopes:
improve angular resolution
improve energy resolution
reduce background
eliminate muons
improve stability



Development of the ACIT

- First Generation Systems 1960 – 1985
 - Weak or no discrimination
 - Lebedev, Glencullen, Whipple, Narrabri, Crimea....
- Second Generation Systems 1985 – 2004
 - Atmospheric Cherenkov Imaging Telescopes
 - Whipple, Crimea, CAT, HEGRA, Durham, SHALON, CANGAROO.....
- Third Generation Systems 2004 –
 - Arrays of Large ACITs
 - MAGIC, HESS, CANGAROO-III VERITAS
- Fourth Generation Systems?
 - Watch this space!

ACIT
Sources

Zero

~ 12

-> 100

1000?



Whipple 10m (VERITAS-0) Observing Program



2004-5 Observing Season Programs

- * Monitoring known TeV Blazars
- * Search for flaring AGN
- * Search for Dark Matter: Perseus, M32, M33
- * Supernova remnant: IC433
- * Milagro Hotspot
- * Strip Survey
- * GRB Swift follow-ups

2005-6 Observing Season Programs

- * Longterm AGN monitoring
- * GRB Swift follow-ups

VERITAS : status c. 2005

(Very Energetic Radiation Imaging
Telescope Array System)



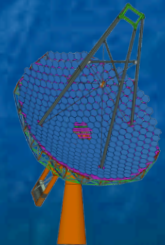
The VERITAS Collaboration

Teaming Agreement

- Iowa State University
- Leeds University
- McGill University
- National University of Ireland, Dublin
- Purdue University
- Smithsonian Astrophysical Observatory
- University of California, Los Angeles
- University of Chicago
- University of Utah
- Washington University, Saint Louis

Collaborators

Adler Planetarium
Argonne Nat. Lab.
DePauw University
Grinnell College
U.C. Santa Cruz
U. Mass.
N.U.I., Galway
Cork I.T.
Galway-Mayo I.T.
Barnard College

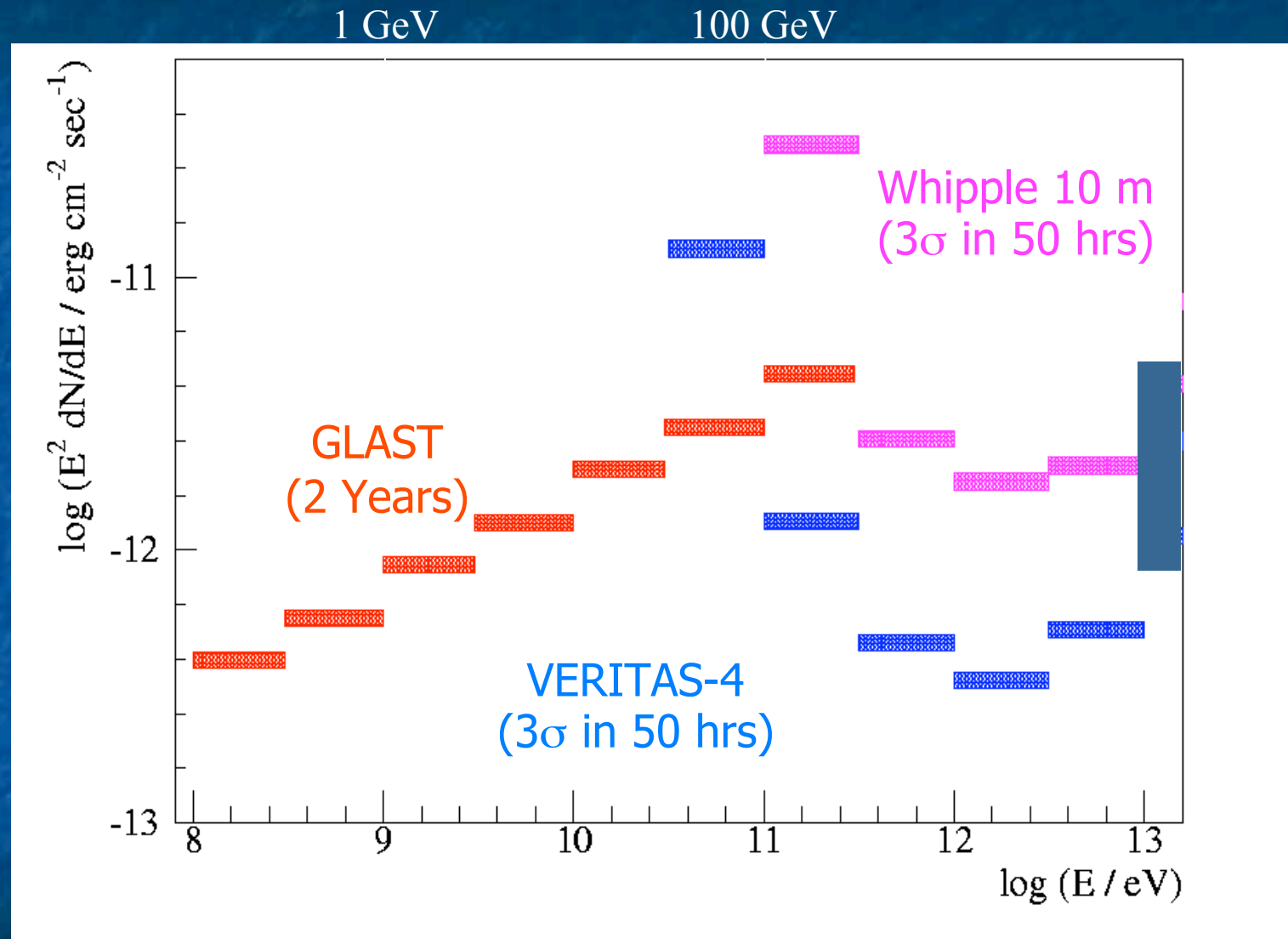


Project Office: Whipple Observatory, SAO

VERITAS 12m Telescope

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

Differential Flux Sensitivity



VERITAS-4: Definition



System of four telescopes

Aperture 12 m

Hexagonal Mirrors

Cameras with 499 pixels

Individual pulse shapes;

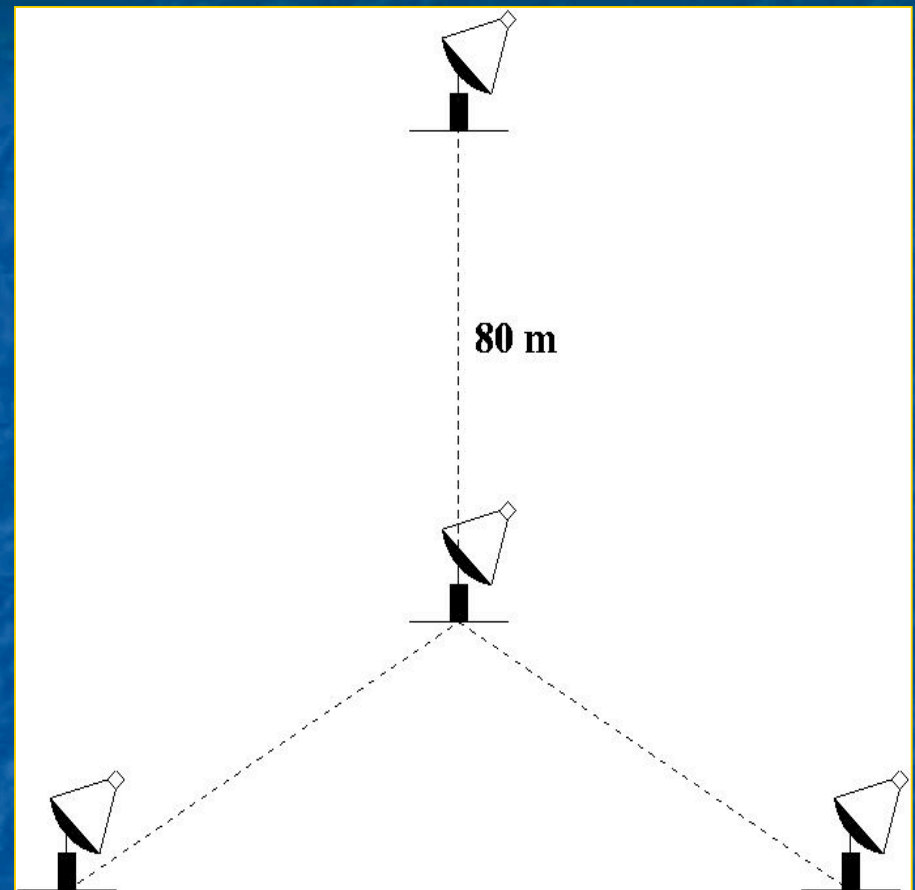
FADCs 500MHz sampling

High data rate; zero suppress.

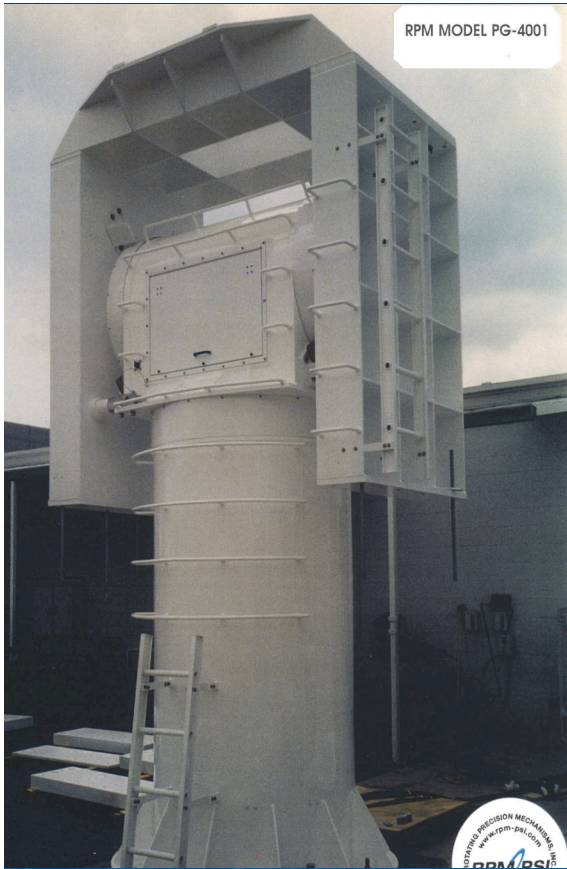
Array Trigger

Southern Arizona location

Dark site: 1.8 km



History: 1996 VERITAS proposed
2001 Prototype funded
2003 VERITAS approved
2006 VERITAS completed



RPM MODEL PG-4001



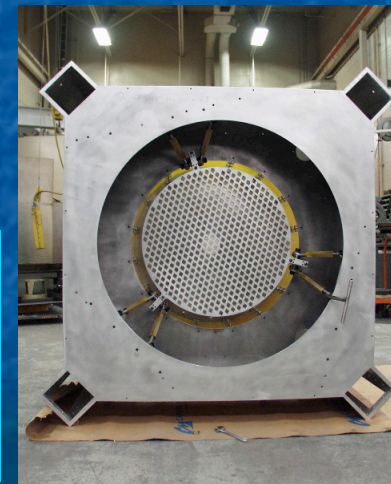
Positioner
R.P.M.,
Northridge, CA



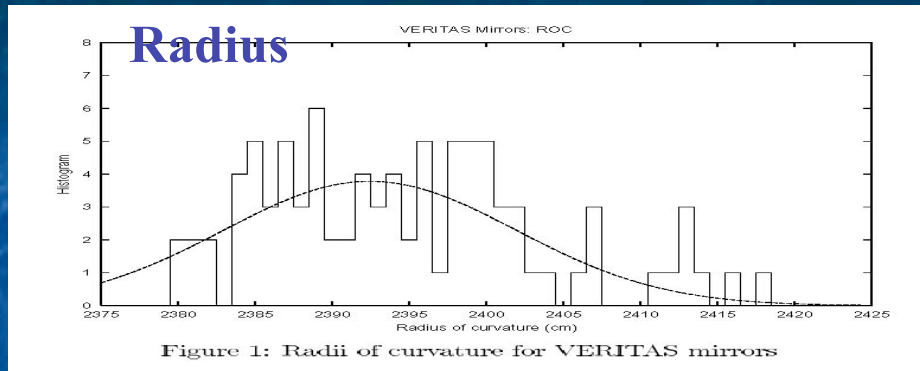
Optical Support Structure
Amber Steel, Chandler, AZ



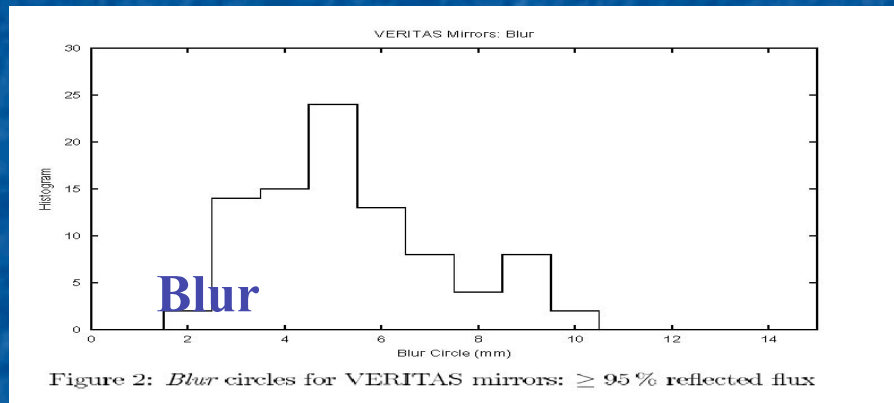
Focus Box
Aluminium
University of
Arizona



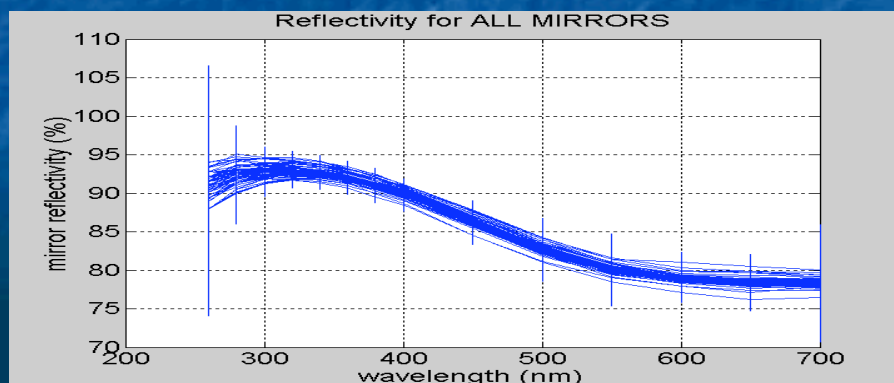
VERITAS Mirror Characteristics: Measurements



Radius of Curvature
 $\langle R \rangle = 23.92 \text{ m} \pm 0.4\%$
Specification: $\pm 1\%$



Blur Circle Diameter
 $\langle D \rangle = 4.9 \pm 1.9 \text{ mm}$
Specification $< 10 \text{ mm}$



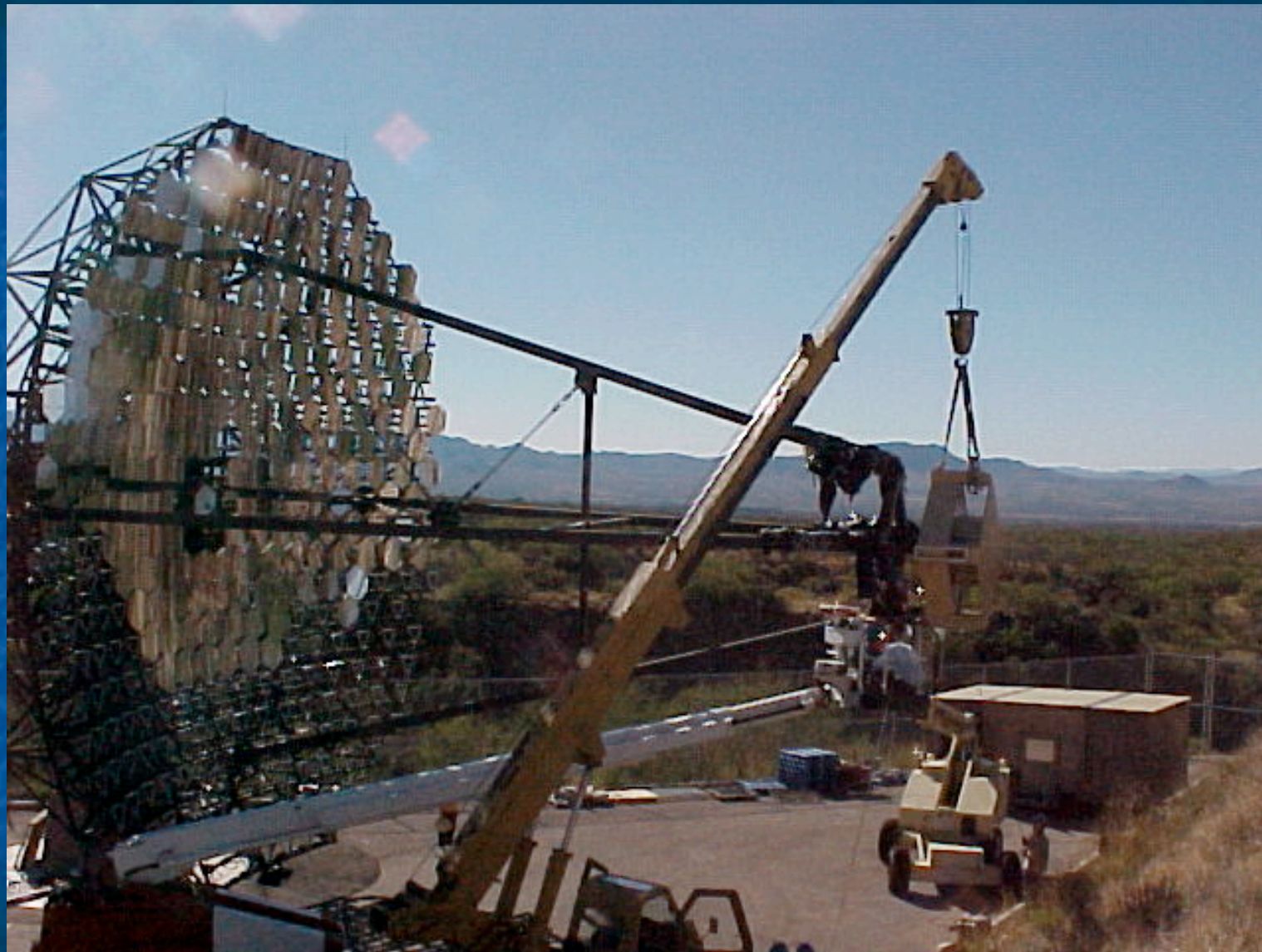
Glass Facets
Manufacturer: D.O.T.I.,
Austin, Texas
Aluminized and Anodized
in house (Whipple)

First VERITAS Camera

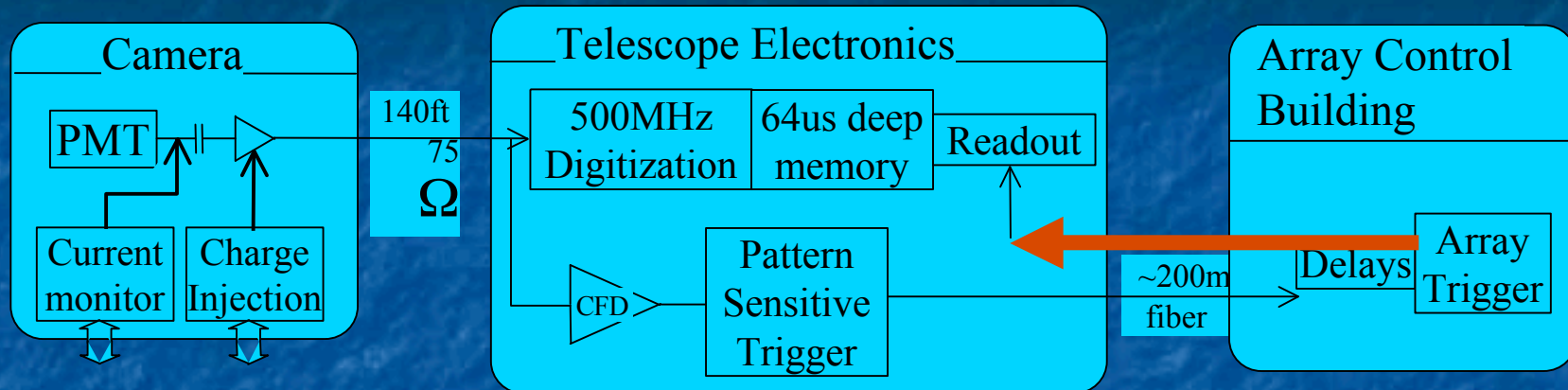


**499 pixels; 0.15 degree diameter
3.5 degree FoV**

Camera Installation: November, 2004



VERITAS ELECTRONICS



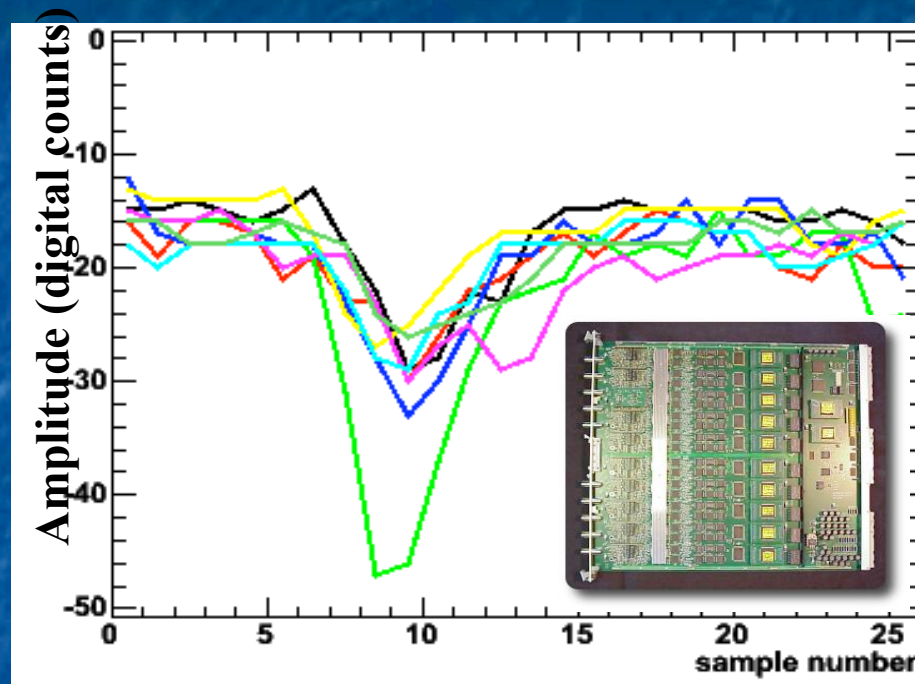
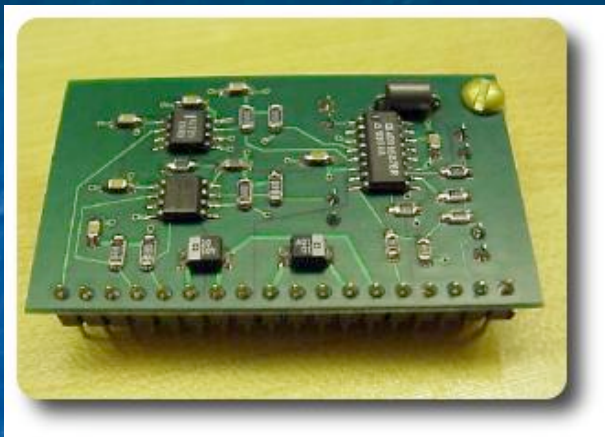
Pixel: 29mm Photonis XP2970/02 PMT
Pre-amplifier located in the base of each pixel
Readout of each PMT through dual-gain 8-bit FADC boards
Three Level Trigger System: Pixel
Pattern
Array



Constant Fraction Discriminators



Flash ADC 500MHz digitization



- Data Acquisition
 - High Rates \sim 200 Hz without zero suppression
 - Dead Time $<$ 10%
- Front-end Electronics
 - Low noise
 - Low current

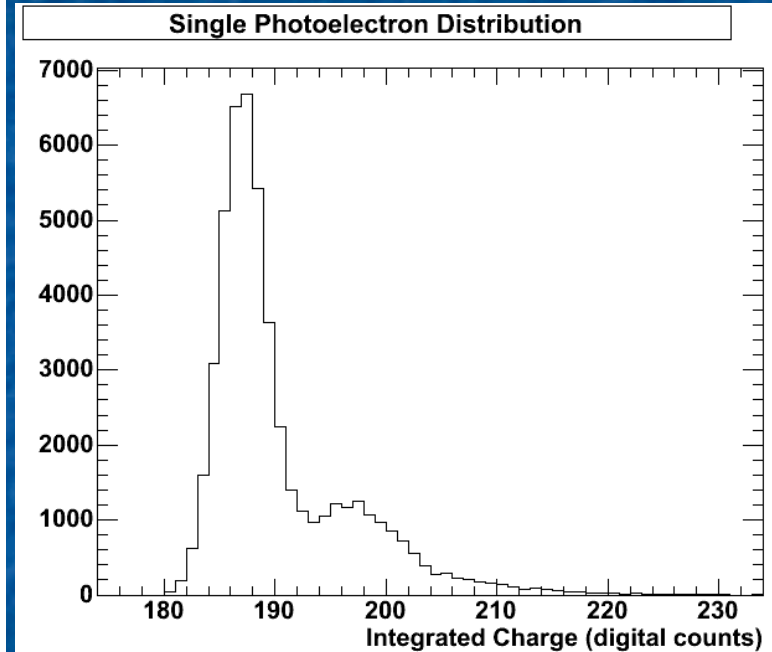
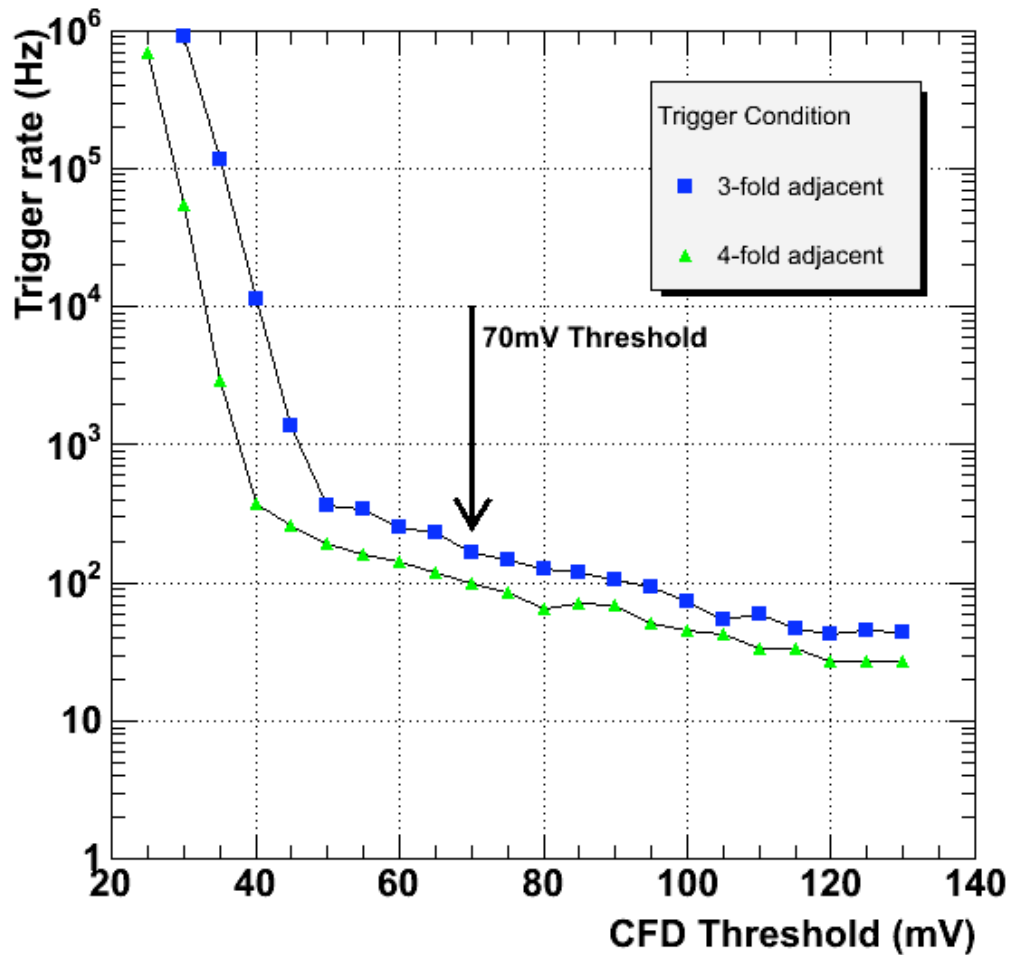
VERITAS TELESCOPE-1



VERITAS Telescope-1 completed and operating at temporary site.
First Light on February 1, 2005 (Crab detection)



Trigger Details



Current Threshold (conservative)
~ 5-6 p.e. per channel
Trigger Rate (3-fold) ~ 200 Hz

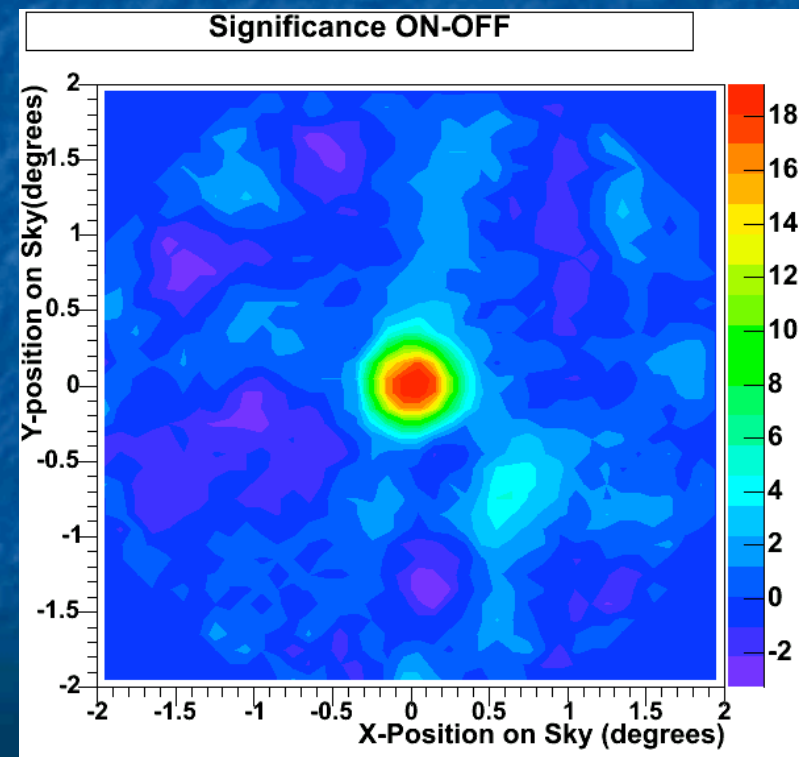
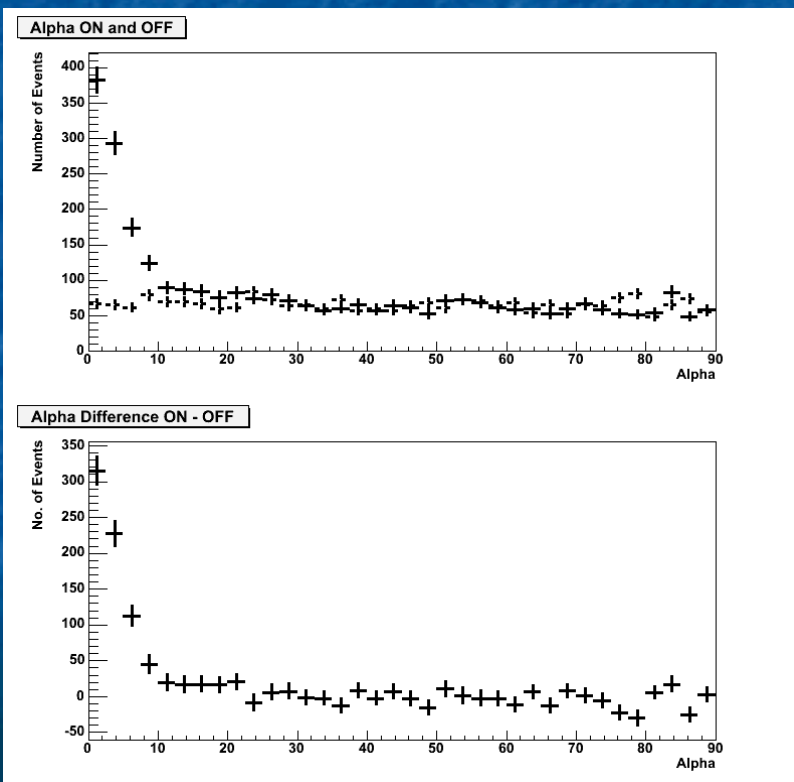
Crab Nebula



4.37 hours ON; +21.1 sigma

2.56 gammas/minute

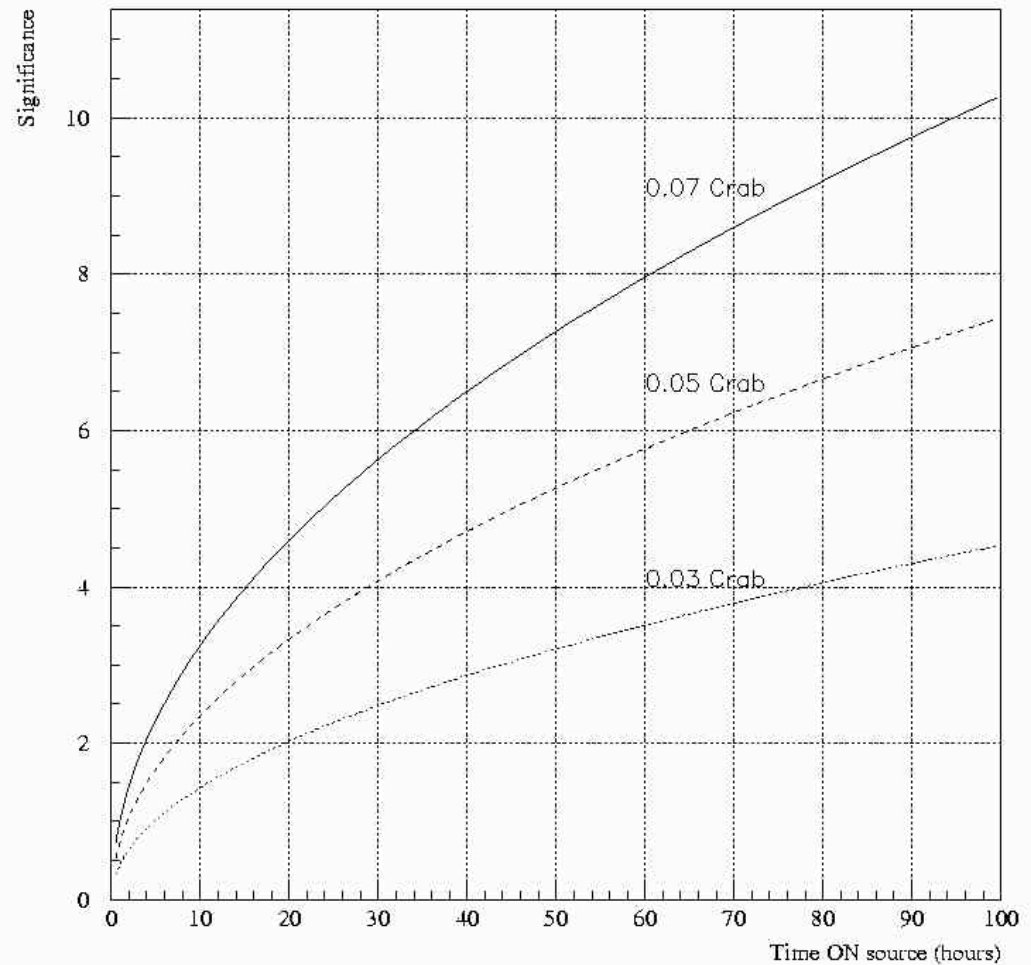
10.1 sigma/sqrt(time in hours) - 5σ in 15mins



Sensitivity of Telescope-1



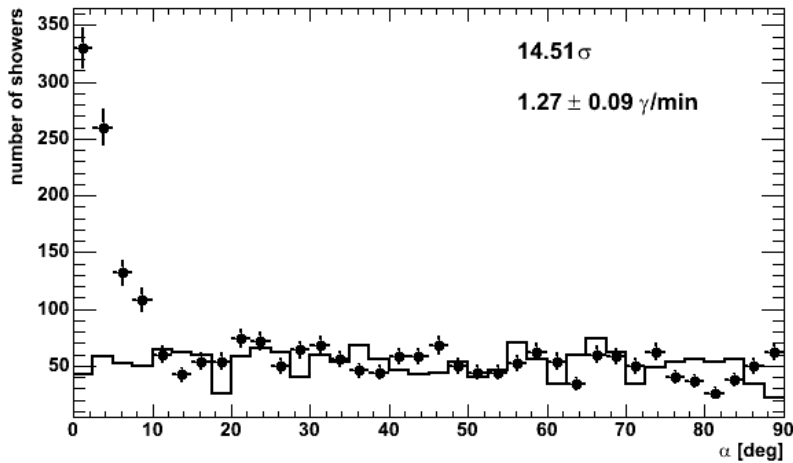
Based on Crab
detection rate
- limited by
"muon wall"



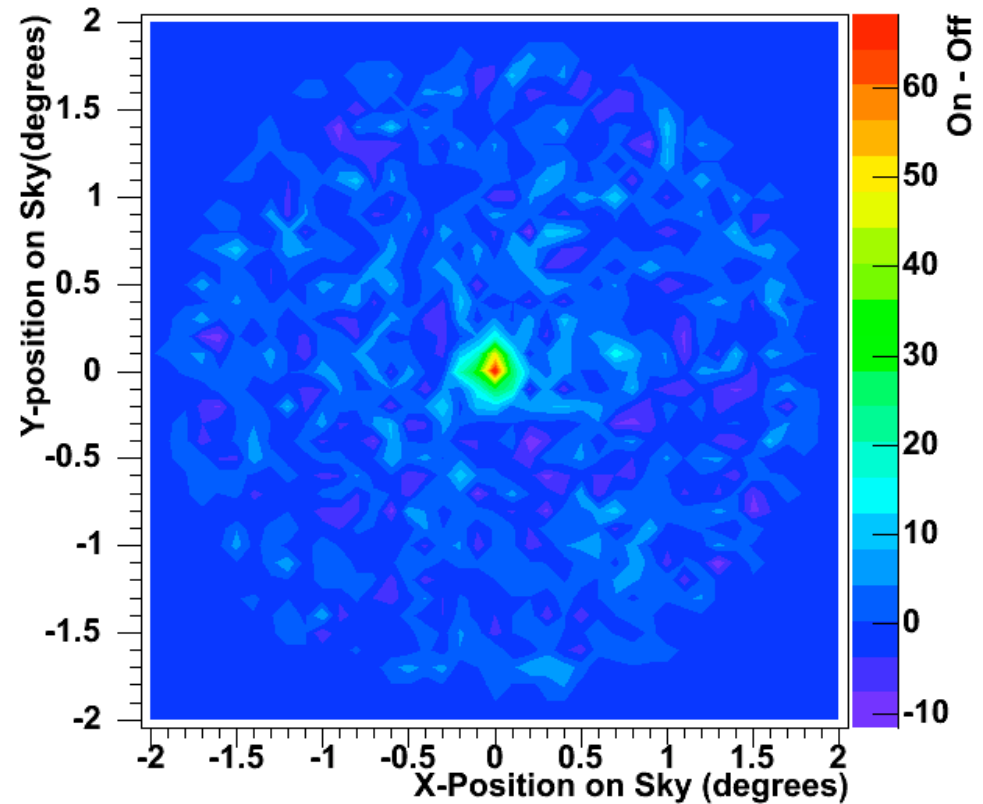
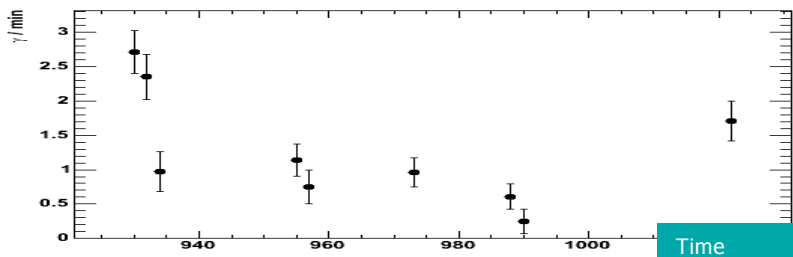
Markarian 421

5.6 hours ON

+14.51 sigma



Light Curve





The Good News!

- Telescope-1 meets all technical specifications
- FADC camera works well
- Component parts for Cameras for -2, -3 and -4 are on schedule
- Telescopes -2, -3 and -4 will be delivered in the next month
- Site infrastructure is complete
- VERITAS is currently on time and within budget!



Original Master Plan for VERITAS

- Install Telescope-2, -3 and -4 in Horseshoe on Kitt Peak in summer of 2005
- Complete Integration of cameras in fall
- Operate Telescope-1 until February, 2006
- Relocate at Horseshoe Canyon in March, 2006
- VERITAS first light in May, 2006
- VERITAS in operation October, 2006





Horseshoe Canyon, Kitt Peak



Kitt Peak, Arizona

VERITAS

Telescope and Camera Trailer Pad





Horseshoe Canyon
site is ready
for installation
of Telescopes
March, 2005



The Bad News!

- National Science Foundation issued Stop Work order for VERITAS activity on Kitt Peak on April 7, 2005
- NSF has leased Kitt Peak mountain as site for national optical observatory since 1958 when lease was signed with Indian Nation; VERITAS sub-leases site from NSF
- Complaint lodged by Tohono O'Odham Nation;
- New Environmental Assessment required; site delay access estimated 6 months



**“DISASTER HITS,
VERITAS
RECOVERS”**

VERITAS

O'Hare Airport Display

TeV Part.-Astro. FNAL 2005



Some Good News!

- Installation of Telescope-2 proceeding at temporary site (Whipple Basecamp)
- Array Operation will be tested (Telescopes-1 & 2)
- Observations with two telescope array will begin in October, 2005
- Optimize operation of array
- Continue with integration of Cameras for -3 and -4
- Install Telescopes/Cameras-3 and -4 when site problems cleared up ~ October '05?
- Relocate Telescopes-1 and -2 in April, 2006
- Target date for VERITAS operation is still October, 2006

Temporary Location of VERITAS Telescopes-1 and -2: Whipple Basecamp



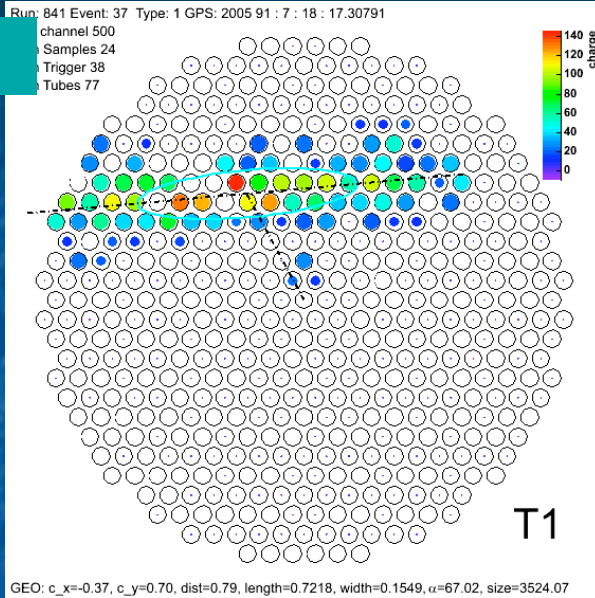
VERITAS in March, 2006



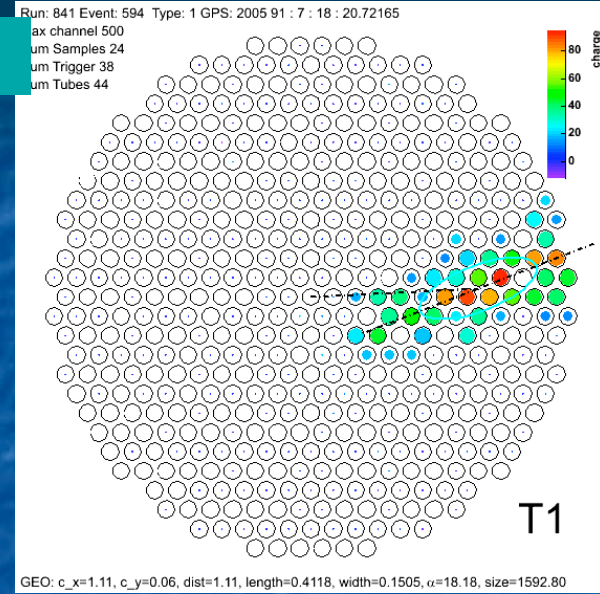
Shower Images from Telescope-1



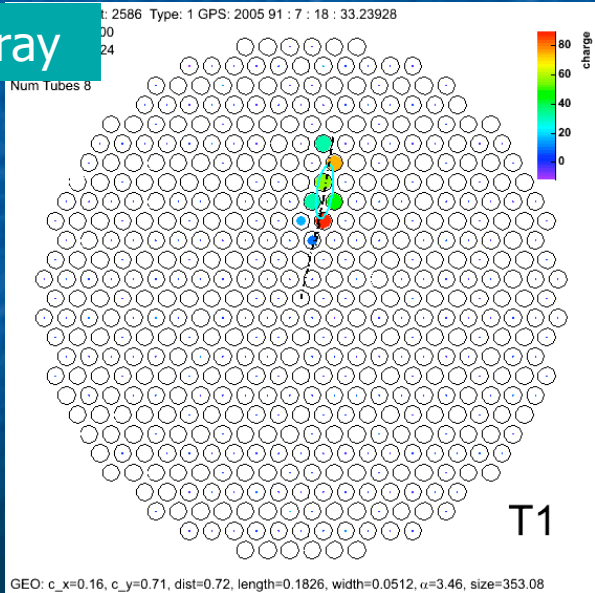
Hadron



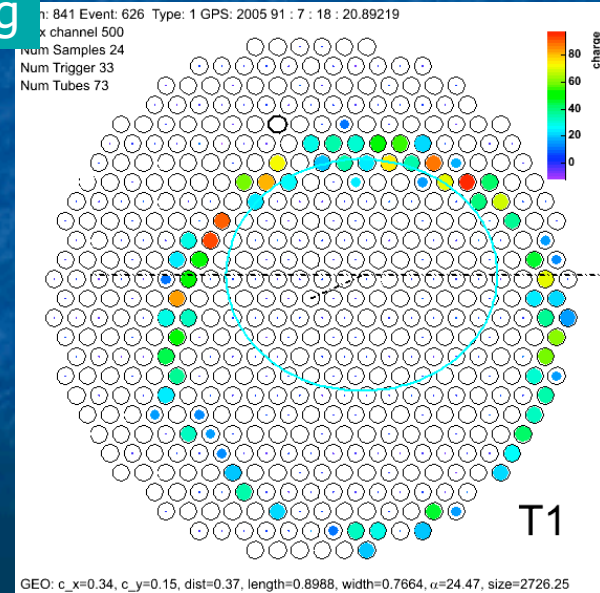
Hadron



Gamma ray



Muon Ring





The VERITAS Camera Movie

You have seen the pictures –
now see the movie

Starring Jamie Holder with VERITAS Supporting Cast



Run: 574 Event: 305 GPS: 63 : 3 : 56 : 51.08530

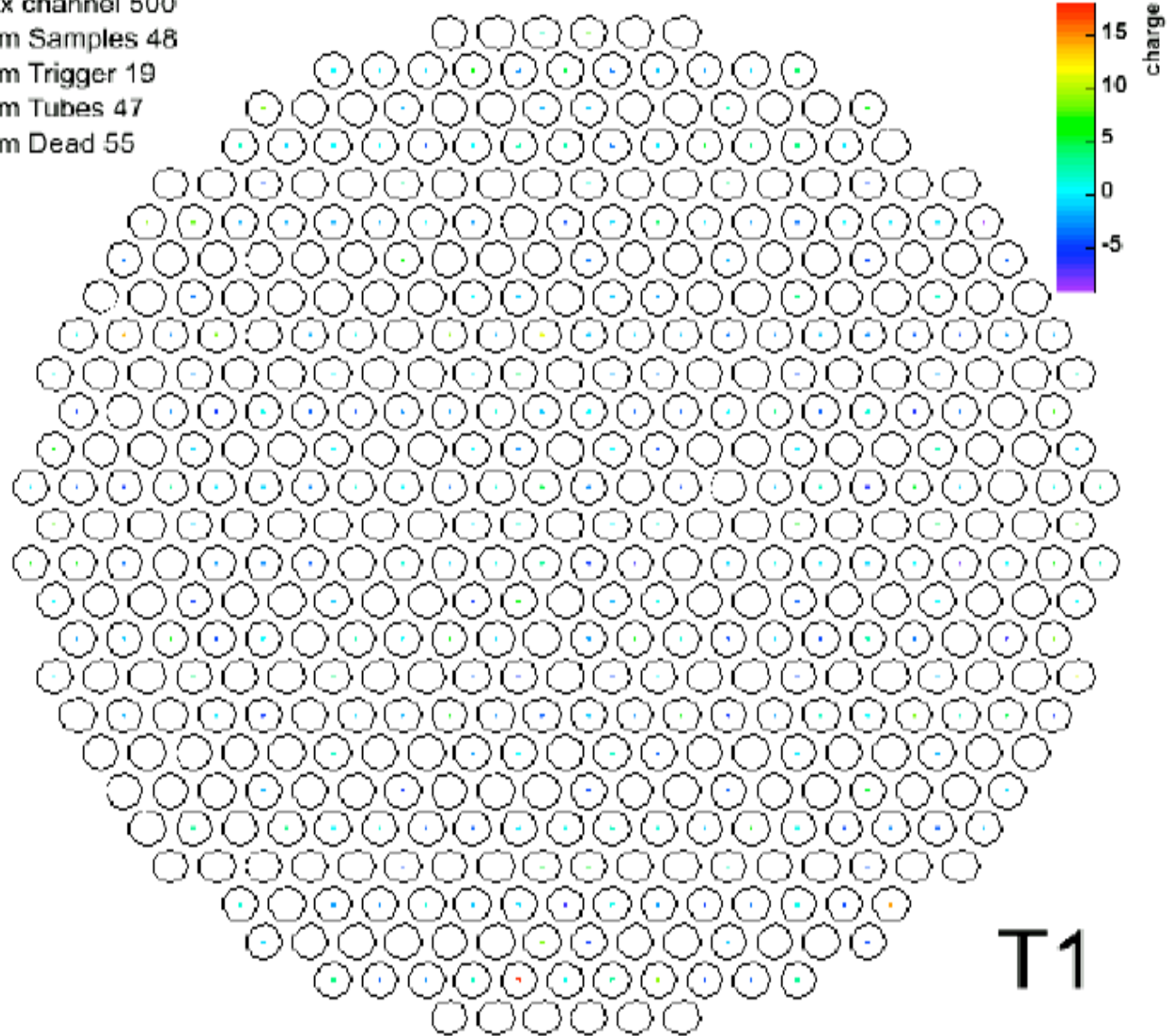
Max channel 500

Num Samples 48

Num Trigger 19

Num Tubes 47

Num Dead 55



GEO: c_x=0.73, c_y=0.07, dist=0.73, length=0.6909, width=0.5157, $\alpha=75.47$, size=2350.66



Run: 574 Event: 34 GPS: 63 : 3 : 56 : 45.59971

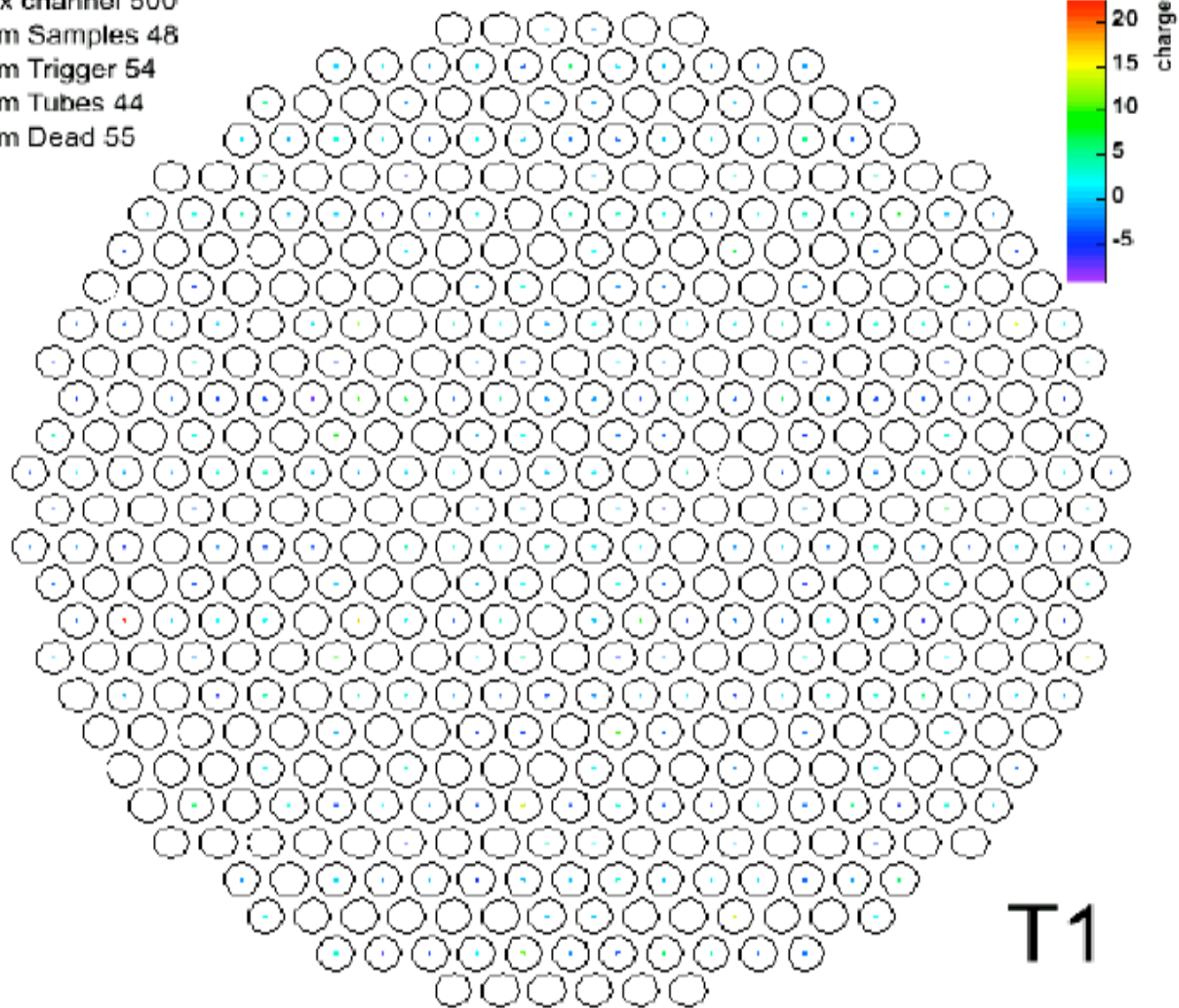
Max channel 500

Num Samples 48

Num Trigger 54

Num Tubes 44

Num Dead 55



GEO: $c_x=0.07$, $c_y=-0.00$, $dist=0.07$, $length=0.9564$, $width=0.3997$, $\alpha=33.97$, $size=2189.19$



Run: 574 Event: 897 GPS: 63 : 3 : 56 : 57.94600

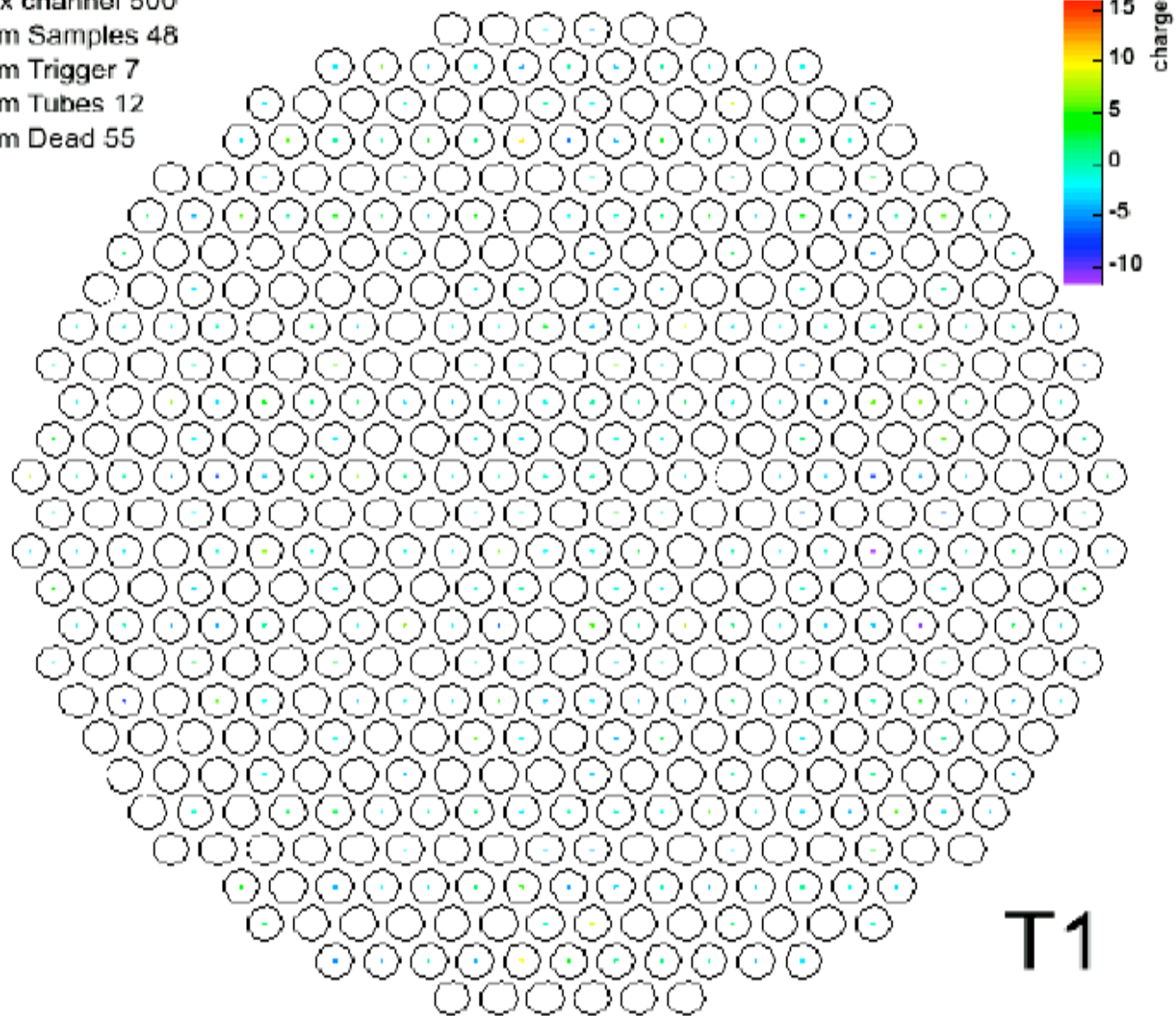
Max channel 500

Num Samples 48

Num Trigger 7

Num Tubes 12

Num Dead 55



GEO: c_x=0.27, c_y=-0.58, dist=0.63, length=0.1599, width=0.0763, α =2.98, size=811.76



Conclusions

VERITAS is on schedule

VERITAS meets technical specifications

VERITAS is locked out (temporarily)

VERITAS will recover; stereo basecamp
in October 2005, KPNO 4 Spring 2006