H.E.S.S.
High Energy Stereoscopic System

MPI Kernphysik, Heidelberg
Humboldt Univ. Berlin
Ruhr-Univ. Bochum
Univ. Hamburg
Landessternwarte Heidelberg
Univ. Kiel
Ecole Polytechnique, Palaiseau
College de France, Paris
Univ. Paris VI-VII
CEA Saclay
CESR Toulouse
LAOG Grenoble
Paris Observatory
Durham Univ.
Dublin Inst. for Adv. Studies
Charles Univ., Prag
Yerewan Physics Inst.
Univ. Potchefstroom
Univ. of Namibia, Windhoek

Physics with H.E.S.S.

Cosmic ray origin and acceleration

- Supernova remnants
- Starburst galaxies
- Clusters of galaxies
- Unidentified galactic sources/surveys

Astrophysics of compact objects

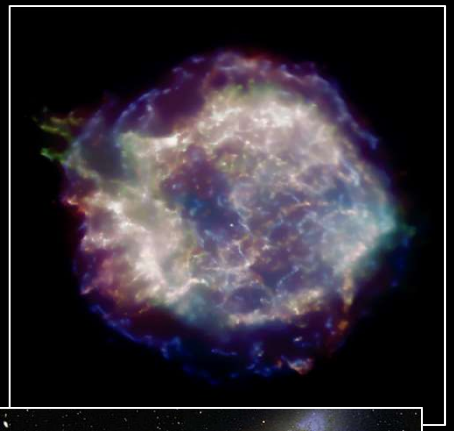
- AGNs
- Micro-Quasars & Stellar-mass black holes
- Pulsars
- Gamma ray bursts

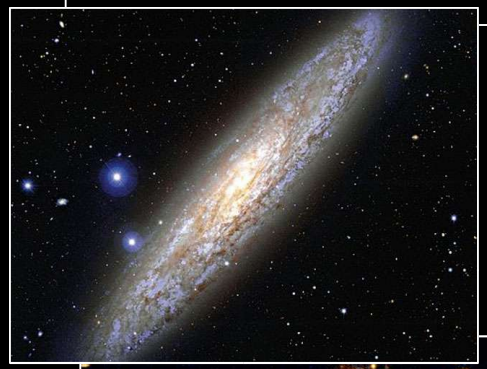
Cosmology

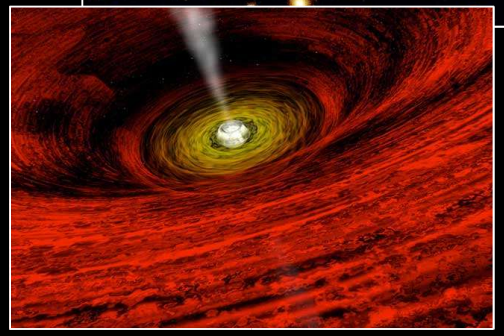
- Diffuse extragalactic radiation fields via cutoff in AGN spectra and AGN halos

Astroparticle physics

- Neutralino annihilation in DM halos



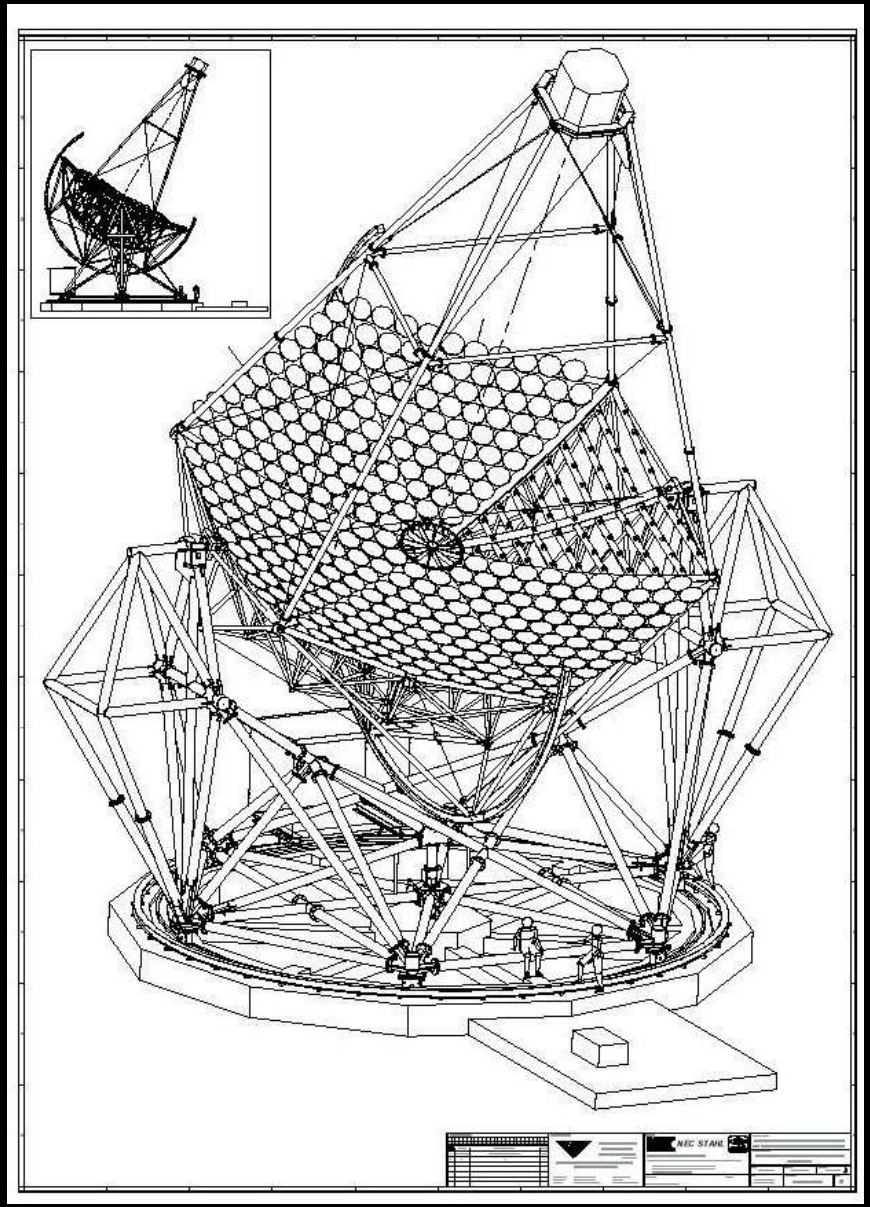




H.E.S.S. telescope design

- Alt-azimuth mount
- Mirror area ~107 m^2, diameter 13 m, focal length 15 m
- Mirror segmented into 380 individual mirrors of 60 cm diameter
- Steel spaceframe

In phase I of the experiment
4 such telescopes,
spaced by 120 m



Observation of galactic TeV gamma ray sources with H.E.S.S.
C. Masterson, OG 2.2
First results from southern hemisphere AGN observations obtained with the H.E.S.S. VHE gamma-ray te

A. Djannati-Atai, OG 2.3
Performance of the H.E.S.S. cameras
P. Vincent et al., OG 2.5
Study of the performance of a single stand-alone H.E.S.S. telescope: Monte Carlo simulations and data
A. Konopelko et al., OG 2.5
Application of an analysis method based on a semianalytical shower model to the first H.E.S.S. telescope

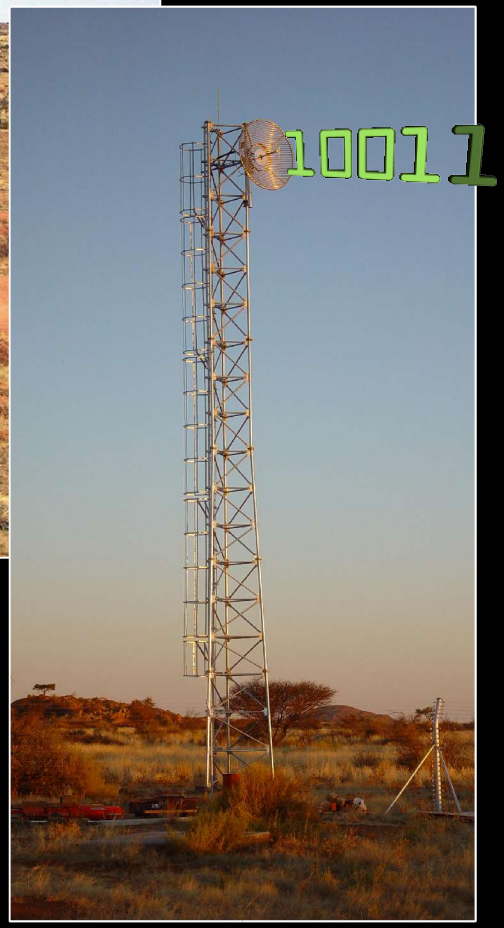
M. de Naurois et al., OG 2.5
The central data acquisition system of the H.E.S.S. telescope system
C. Borgmeier et al., OG 2.5
Mirror alignment and the performance of the optical system of the H.E.S.S. imaging atmospheric Cherenk
R. Cornils et al., OG 2.5
Calibration results for the first two H.E.S.S. array telescopes
N. Leroy et al., OG 2.5
Arcsecond-level pointing of the H.E.S.S. telescopes
S. Gillessen, OG 2.5
A novel alternative to UV lasers in flat-fielding VHE gamma-ray telescopes
K.M. Aye et al., OG 2.5
Atmospheric monitoring for the H.E.S.S. project
K.M. Aye et al., OG 2.5
Implications of LIDAR observations at the H.E.S.S. site in Namibia for energy calibration of the atmosphe

K.M. Aye et al., OG 2.5
Optical observations of the Crab pulsar using the first H.E.S.S. Cherenkov telescope
A. Franzen et al., OG 2.5

The site

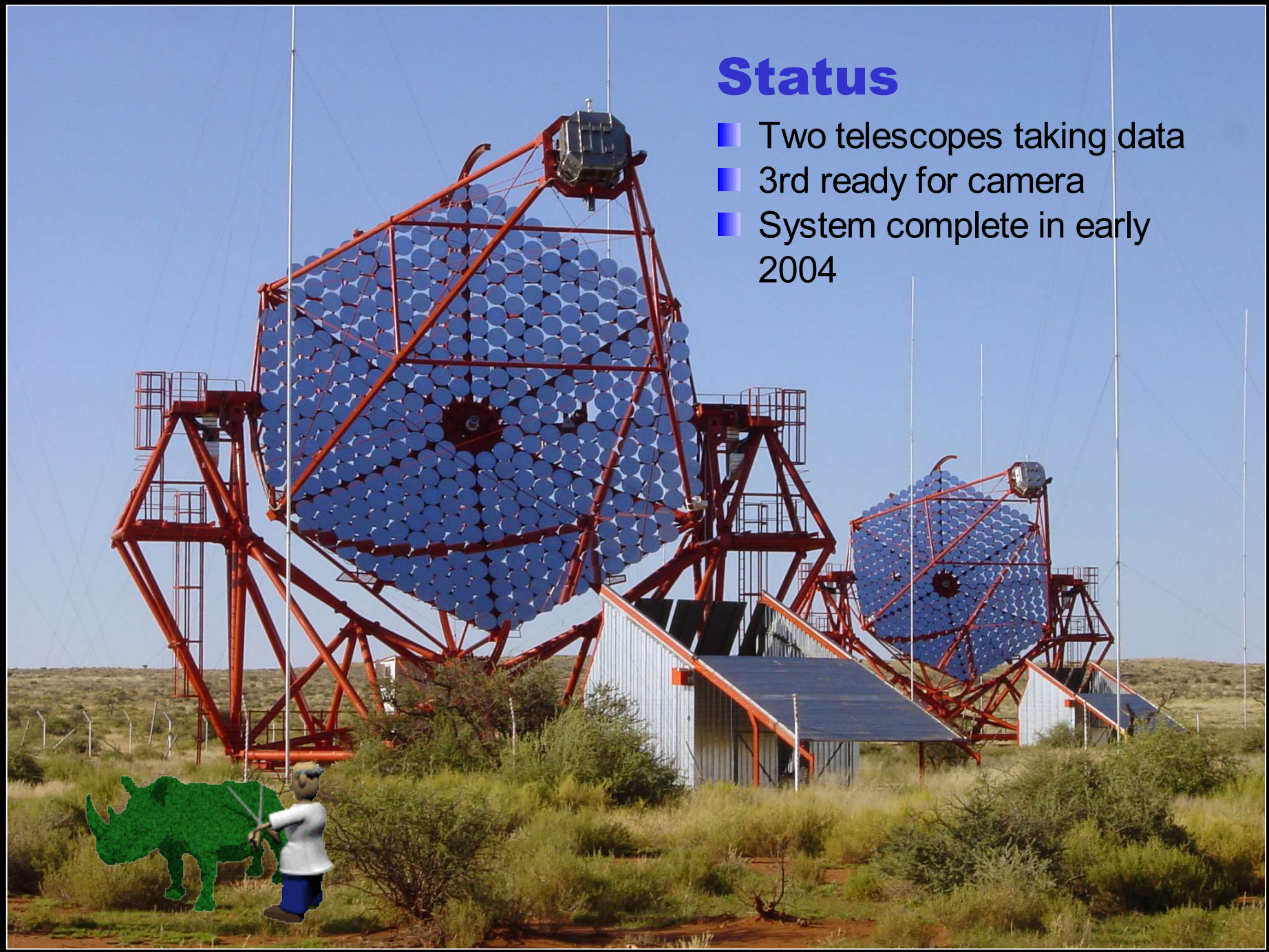
Farm Goellschau, Khomas Highland, Namibia

Coordinates 23°16’ S, 16°30’ E, 1800 m asl
100 km from Windhoek

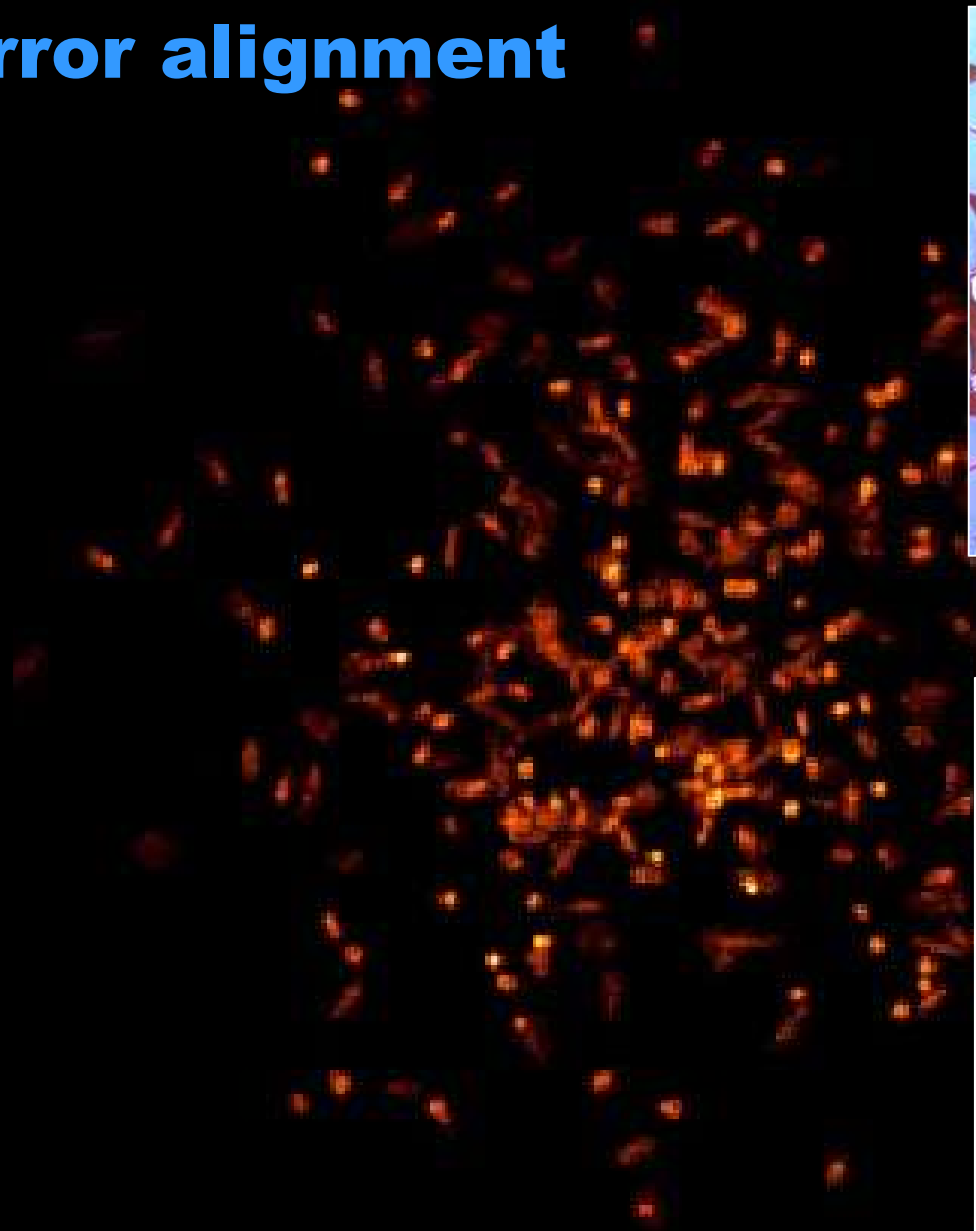


Infrastructure

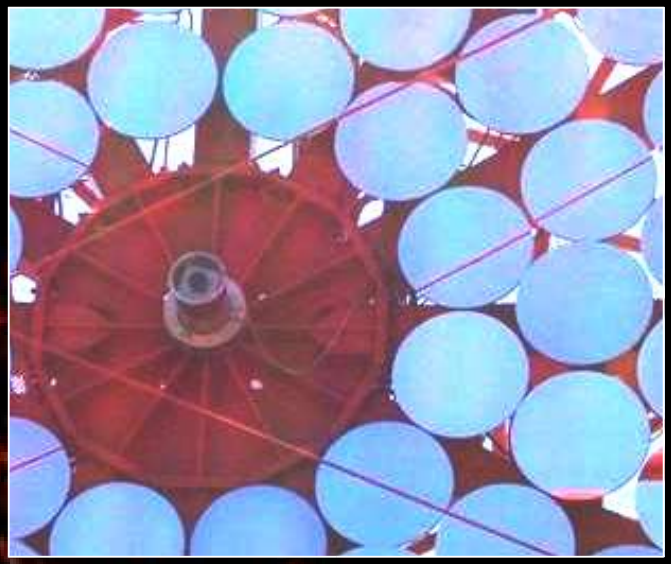
- Control building
- “Residence”
- Generators, Microwave link, …

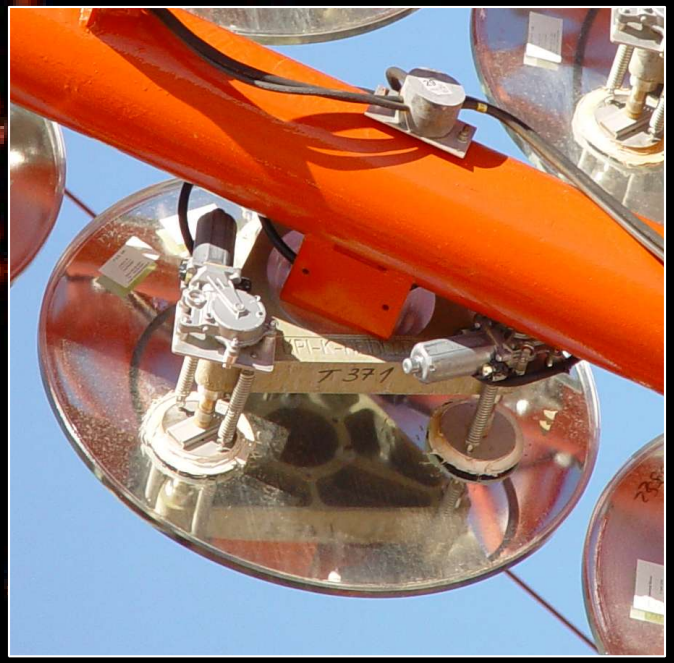

Status
Two telescopes taking data
3rd ready for camera
System complete in early 2004

Mirror alignment



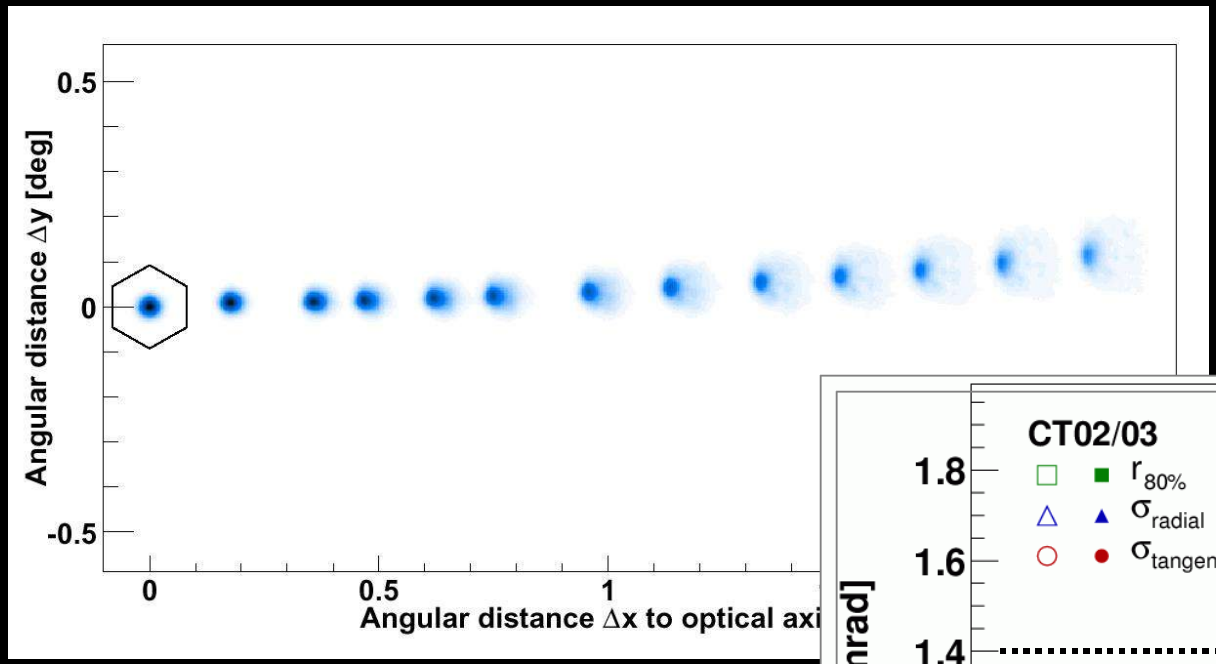
before alignment



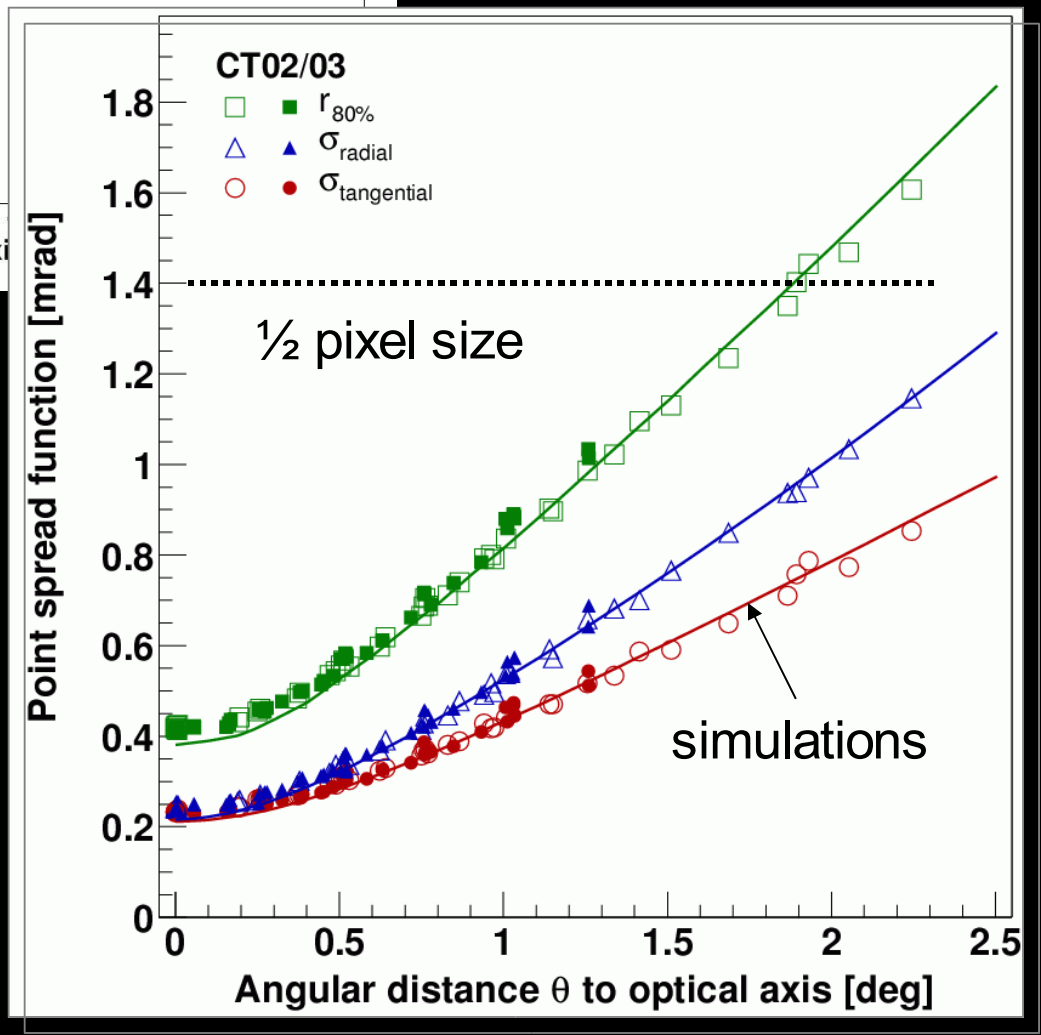



after alignment

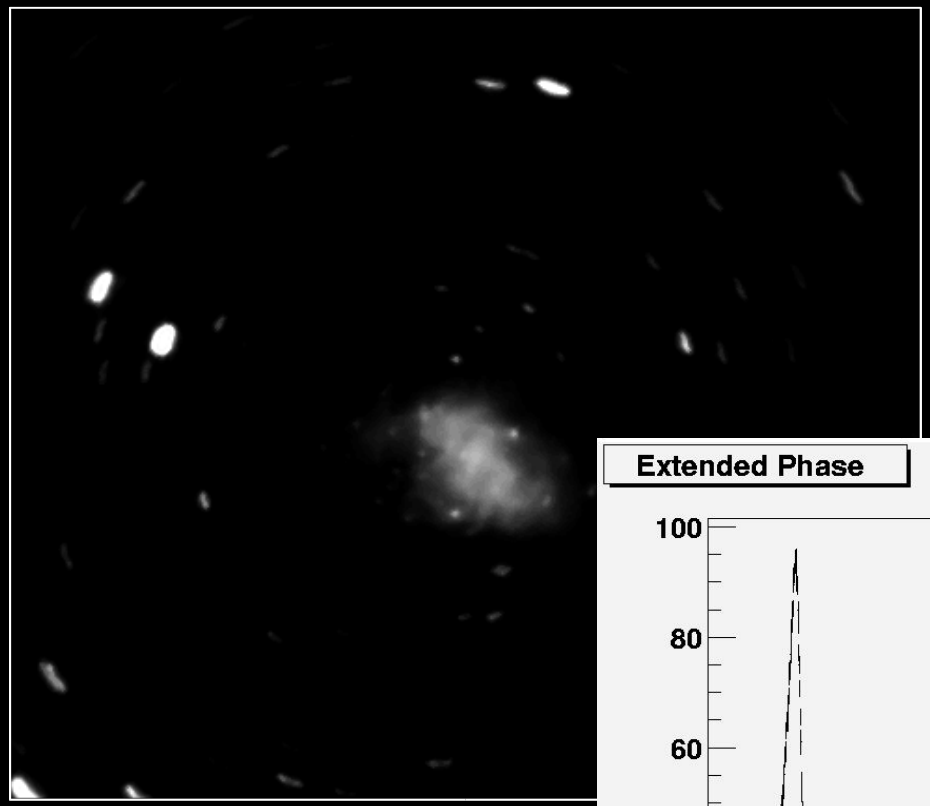
Optics and point spread function



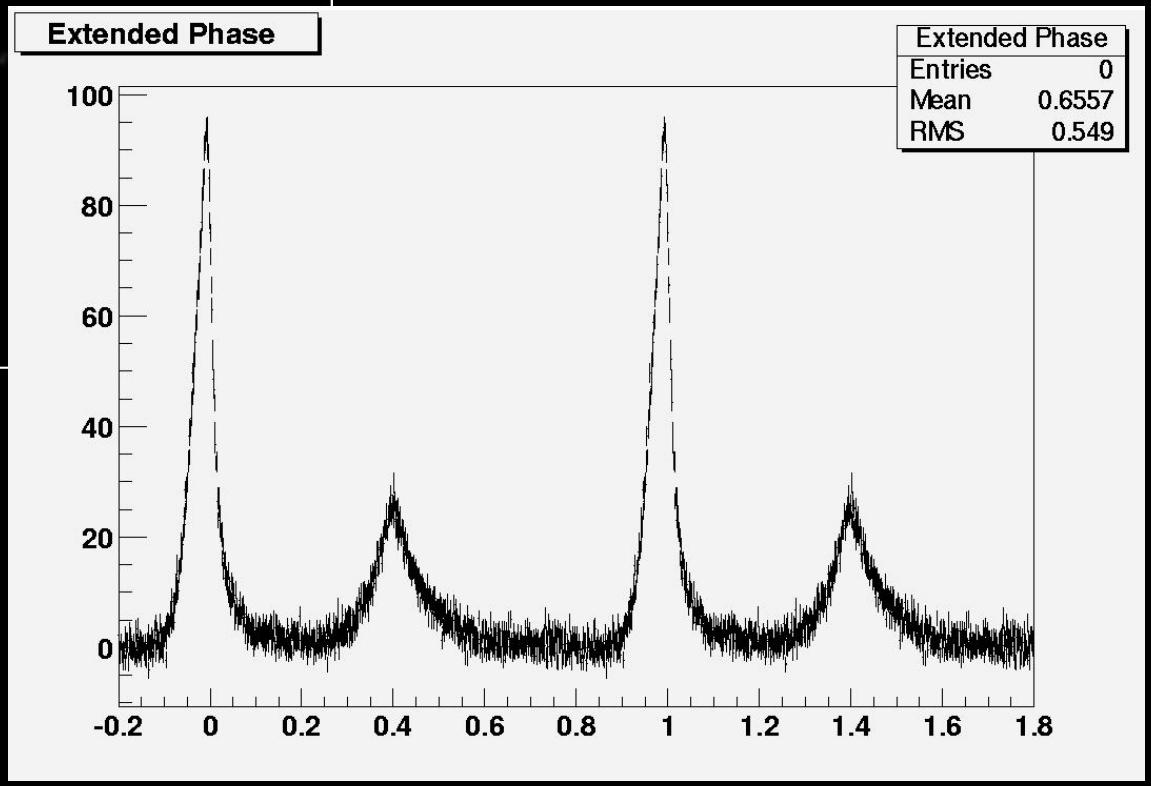
- Spot well within one pixel
- Psf well understood
- All telescopes identical
- Psf stable over > 1 y
- Absolute pointing good to ~8”, 2-3” with guide telescope



Timing the telescope



The Crab nebula viewed with the guide telescope (15 min. exposure)



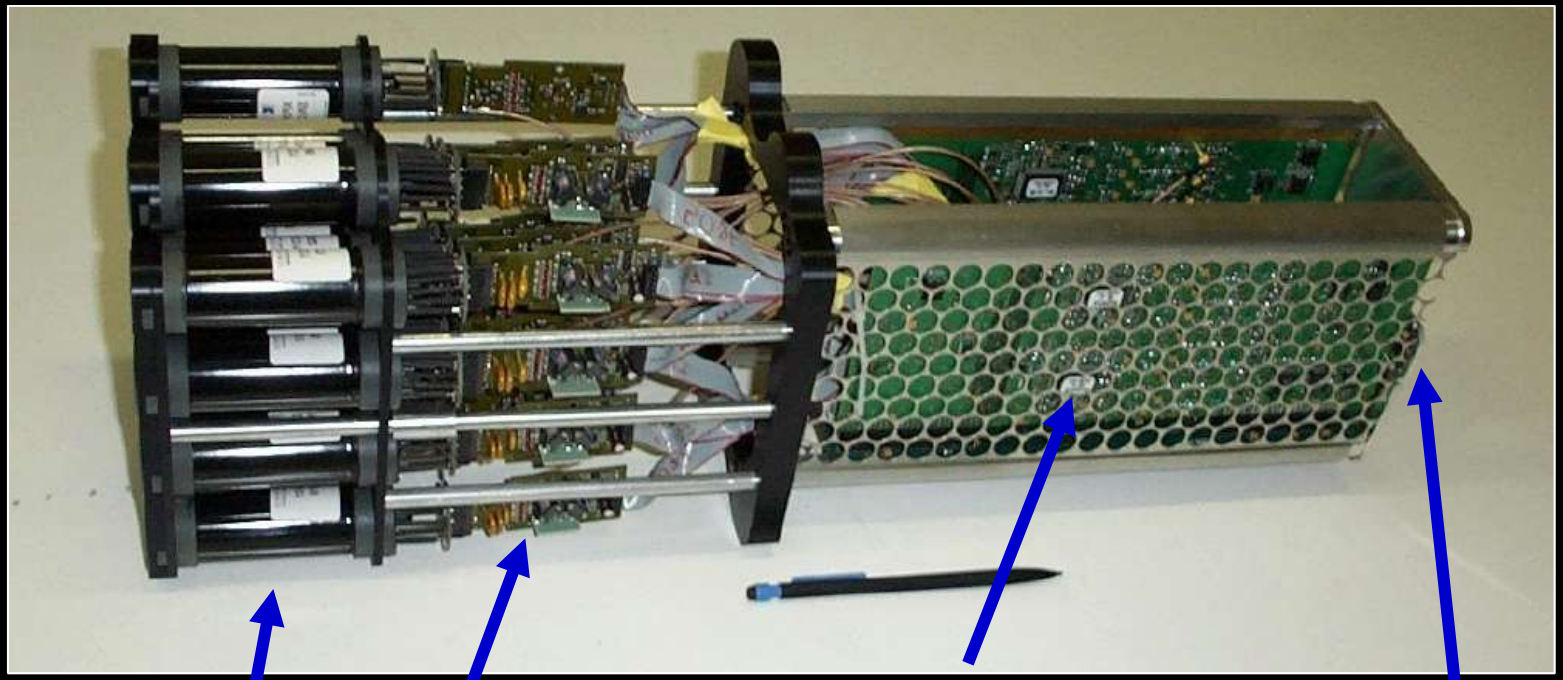
Current in PMT at camera center

Camera

960 Pixels of 0.16°

5° Field of view (1.4 m)

Readout integrated in camera body



Photonis PMT XP 2960
8 Dynodes
Gain ~2 x 10^5

Active base
- DC-DC converter 0-1500 V
- Last 4 dynodes active
- HV & current readout
- Current limit

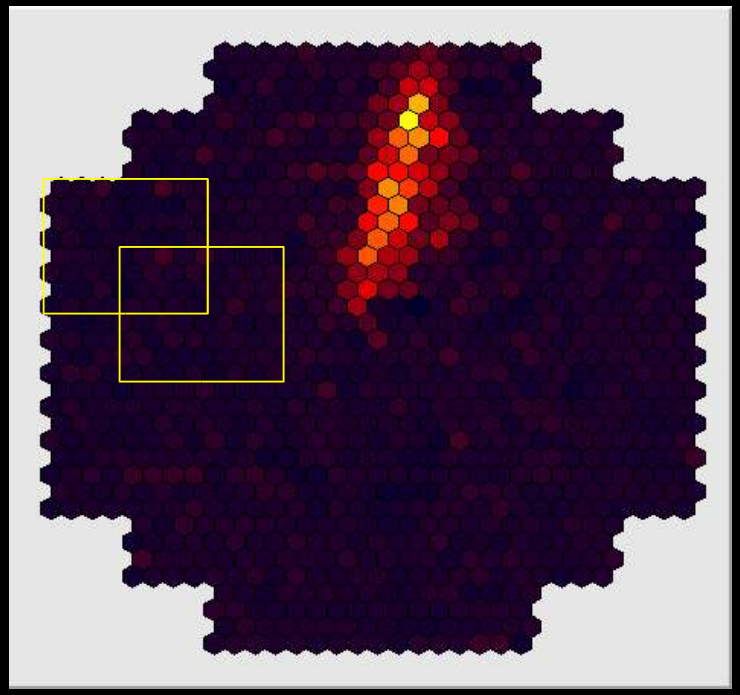
Analog Ring Sampler (ARS)
- Samples PMT signal at 1 GHz
- 128 samples ring buffer
- Serves to delay signal until trigger decision
- High/low gain channels for large dynamic range (> 2000 pe)

Multiplexed ADC to digitize signal;

FPGA
- Controls conversion and readout

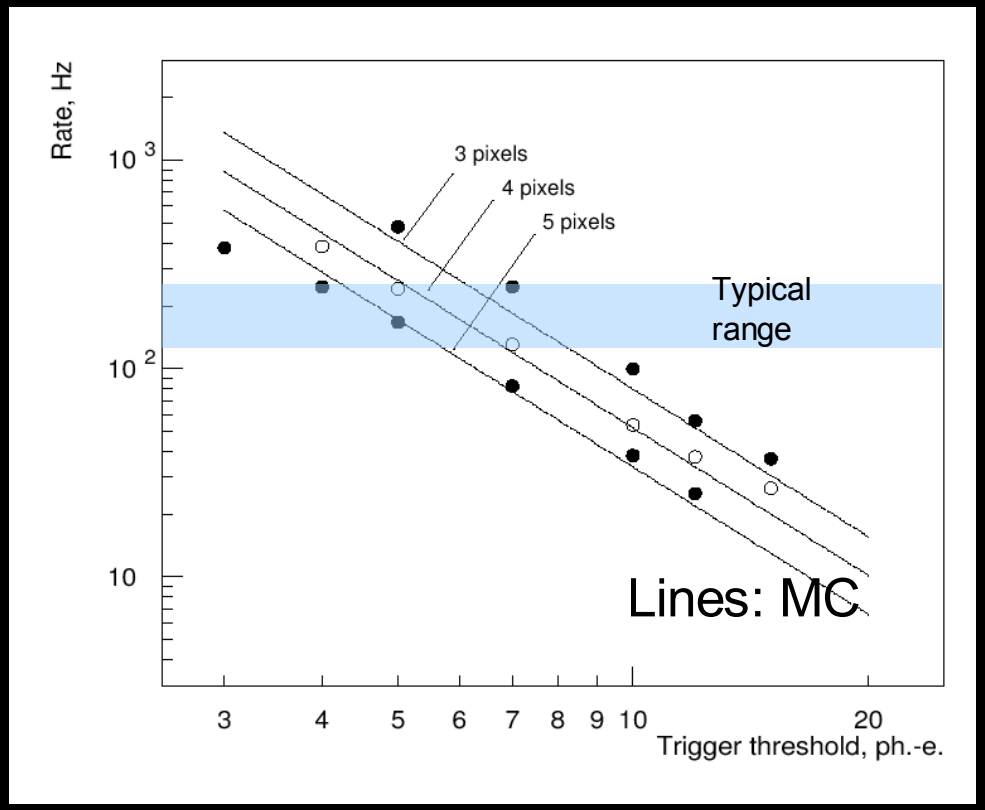
Parallel bus for readout, token-passing scheme

Telescope trigger



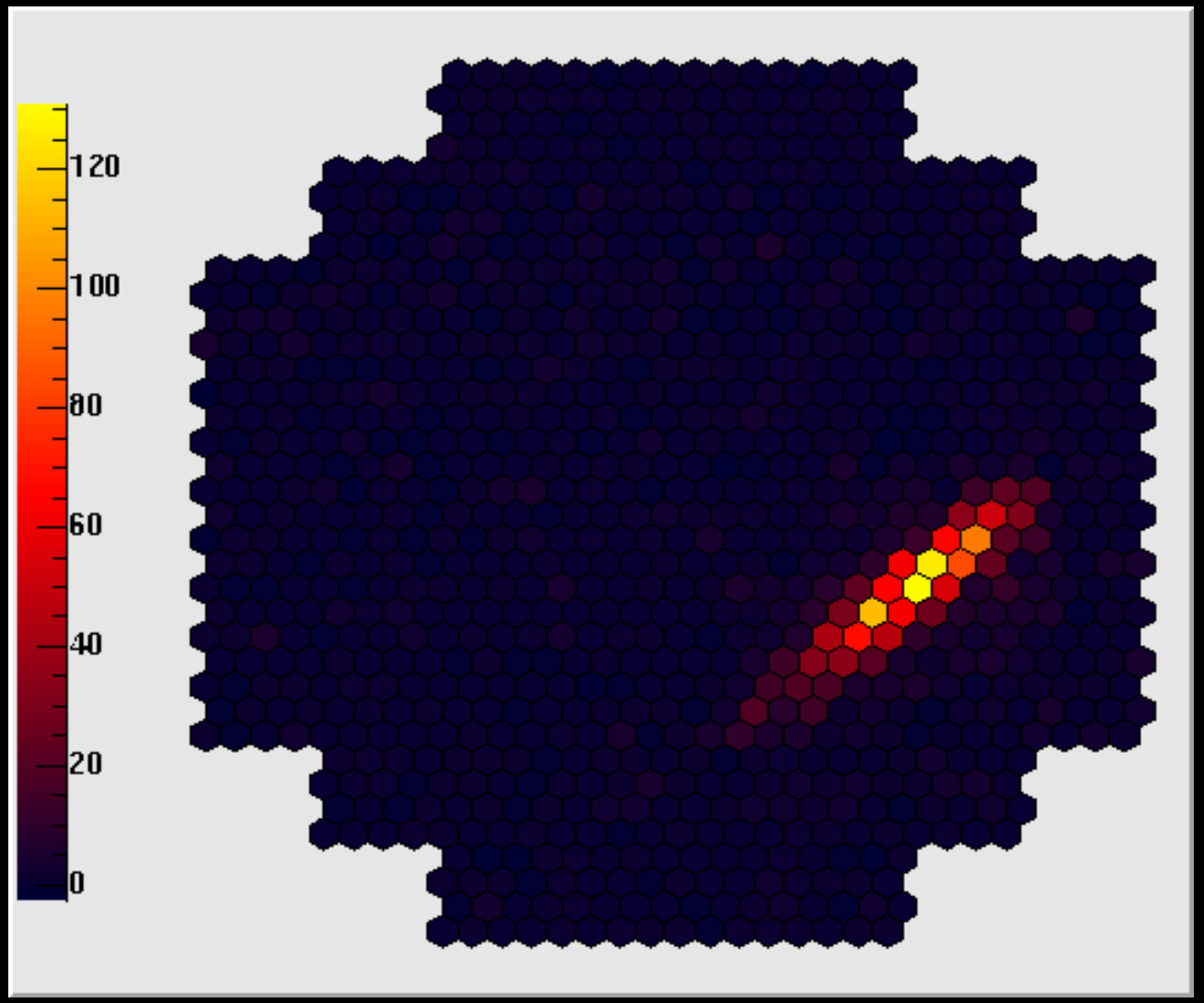
n (2...5) pixels trigger in overlapping sectors of 8x8 pixels

Effective coincidence window ~1.5 ns

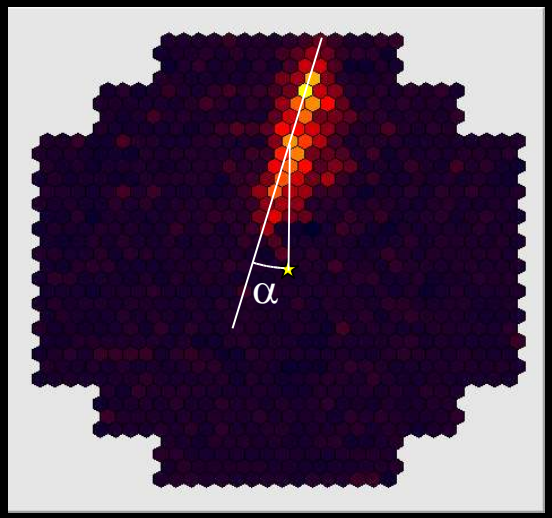


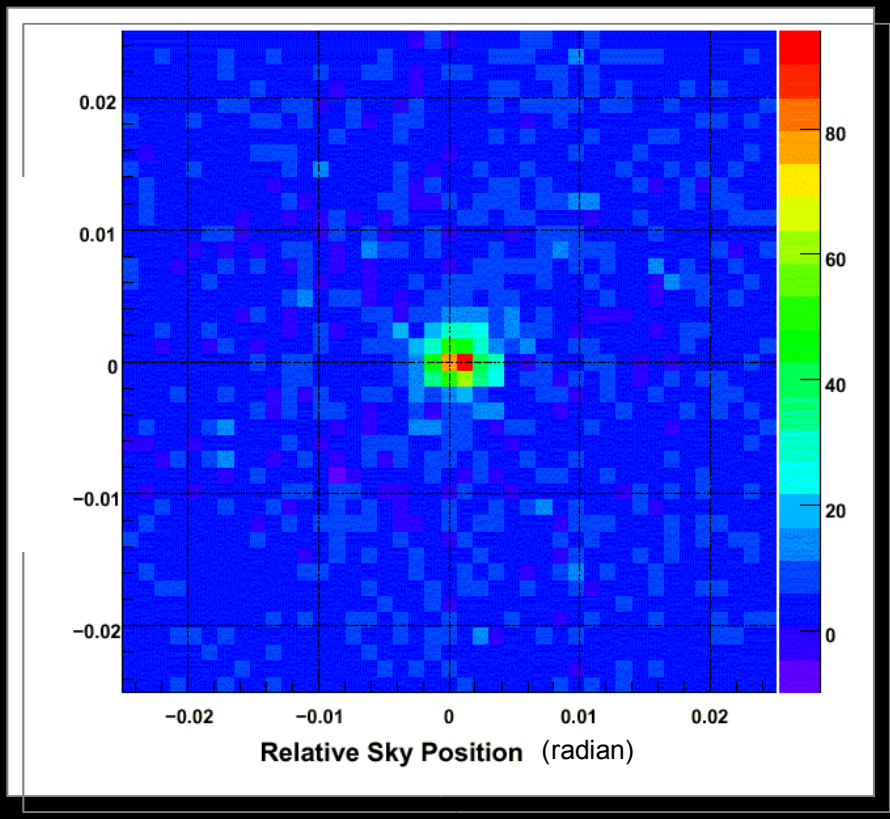
Rates reasonable well reproduced by MC

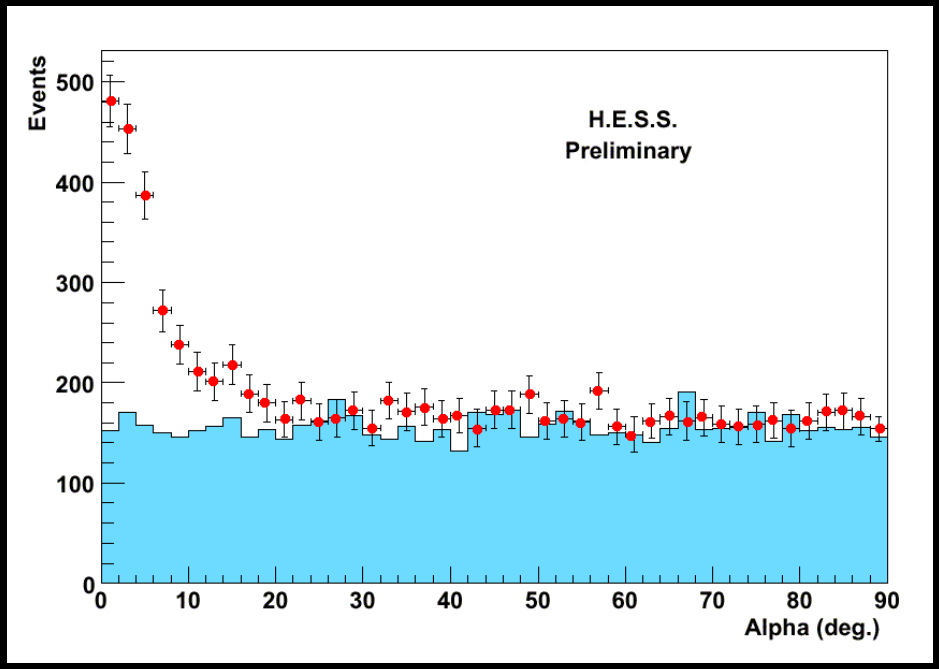
First events (June 11, 2002)



Clear signal from Crab Nebula

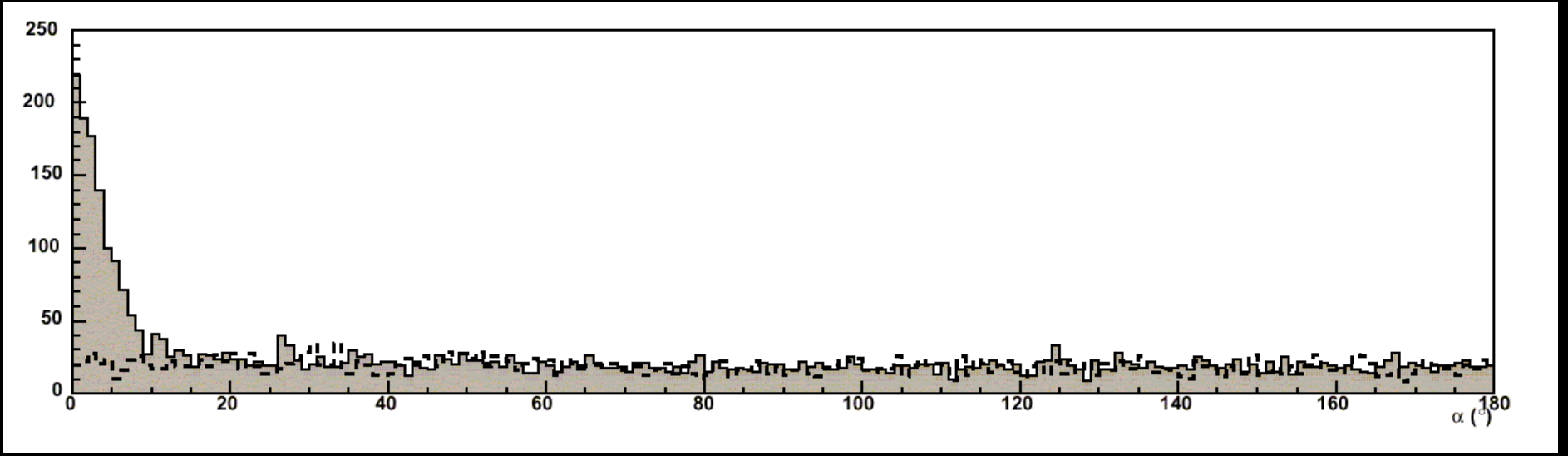






Spectral index and flux consistent with other experiments

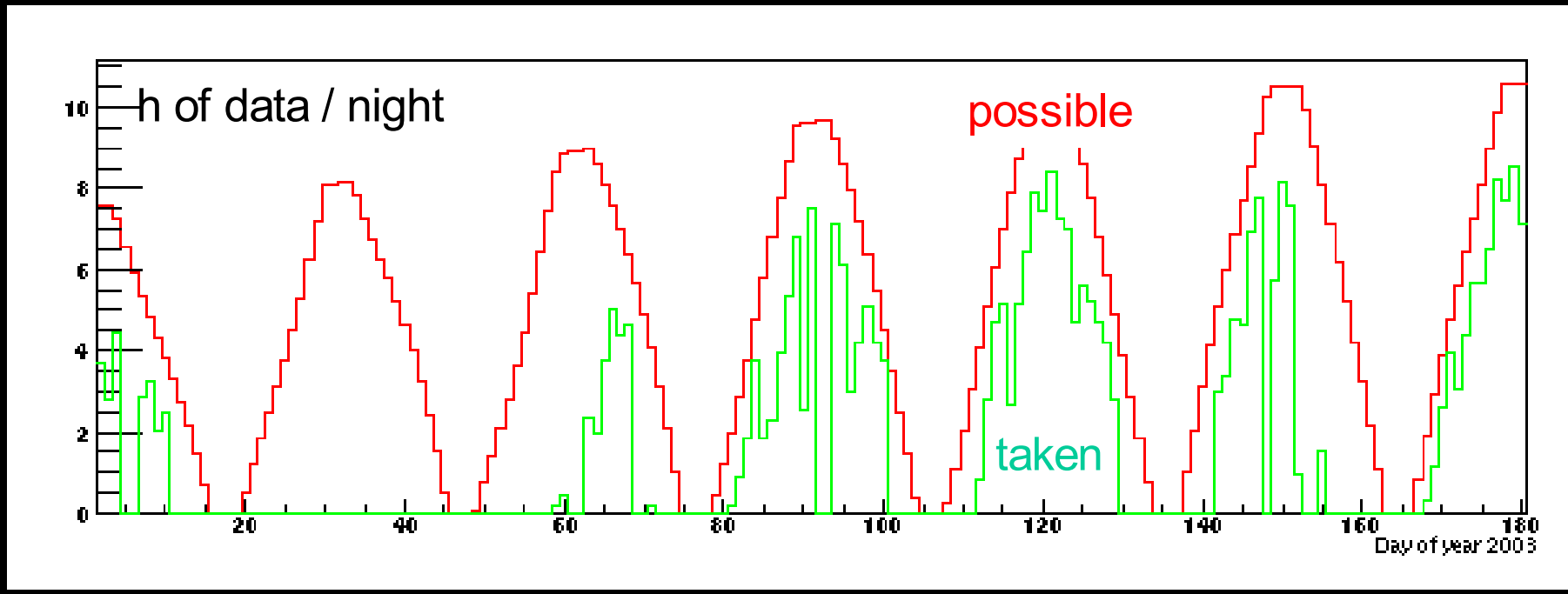
Advanced analysis techniques



Cuts on Hillas parameters combined with fit of image shape

More and more “steady running”

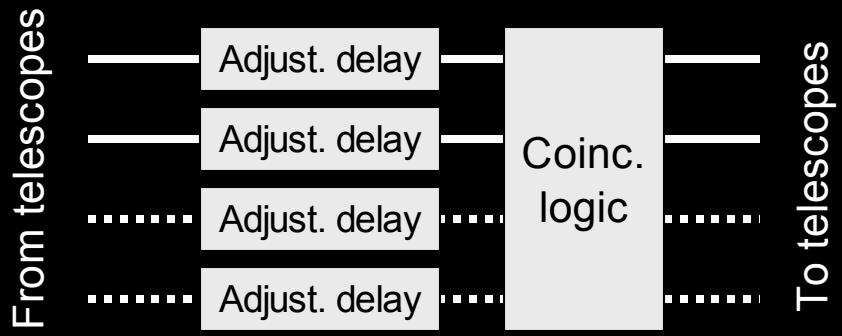
interrupted by installation periods



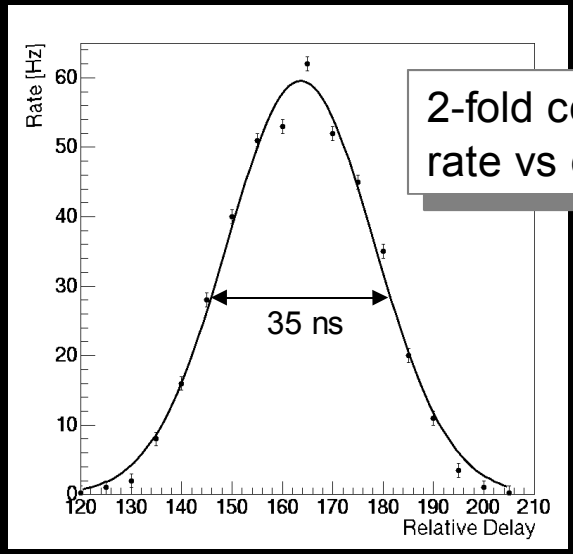
Jan. - June 2003

Mostly “classical” (CANGAROO) sources

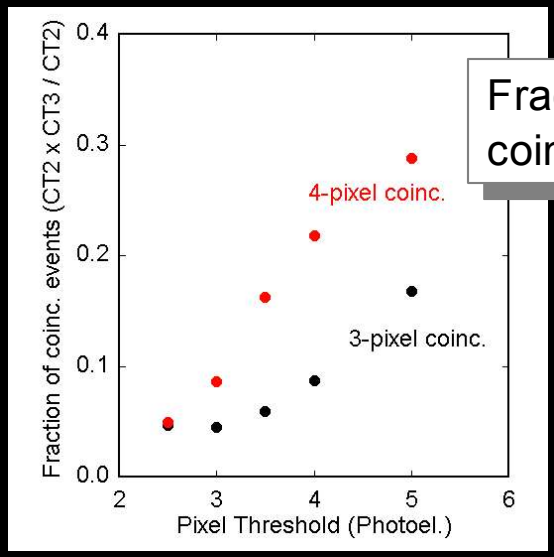
Recent addition: Central trigger system



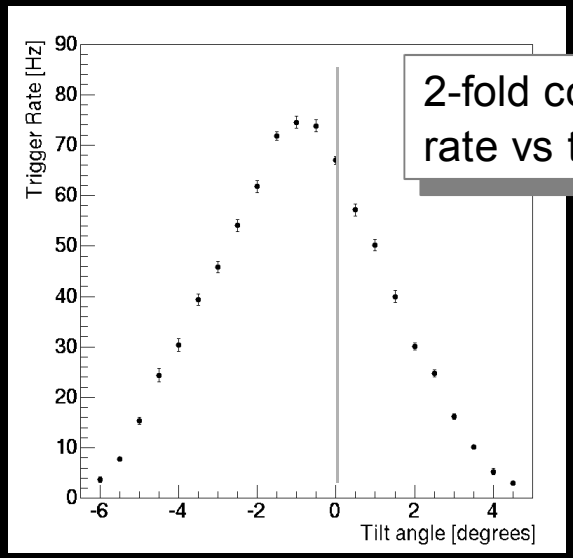
Arbitrary trigger combinations
(1/4, 2/4, 3/4, 4 x 1, 2/2 + 2/2, …)
Provides event # and destination



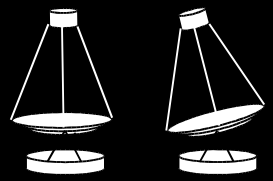
2-fold coinc. rate vs delay



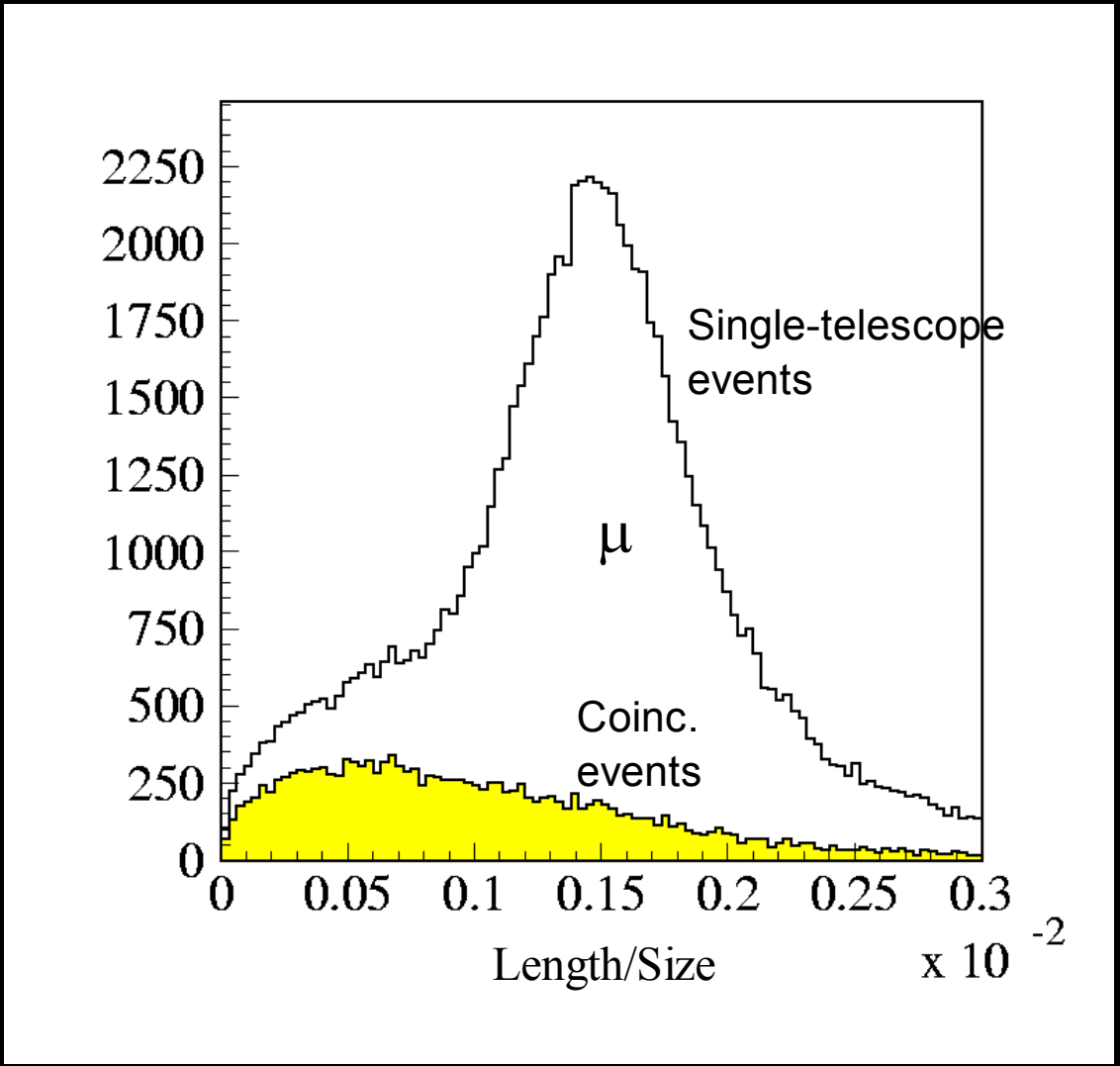
Fraction of coincident events

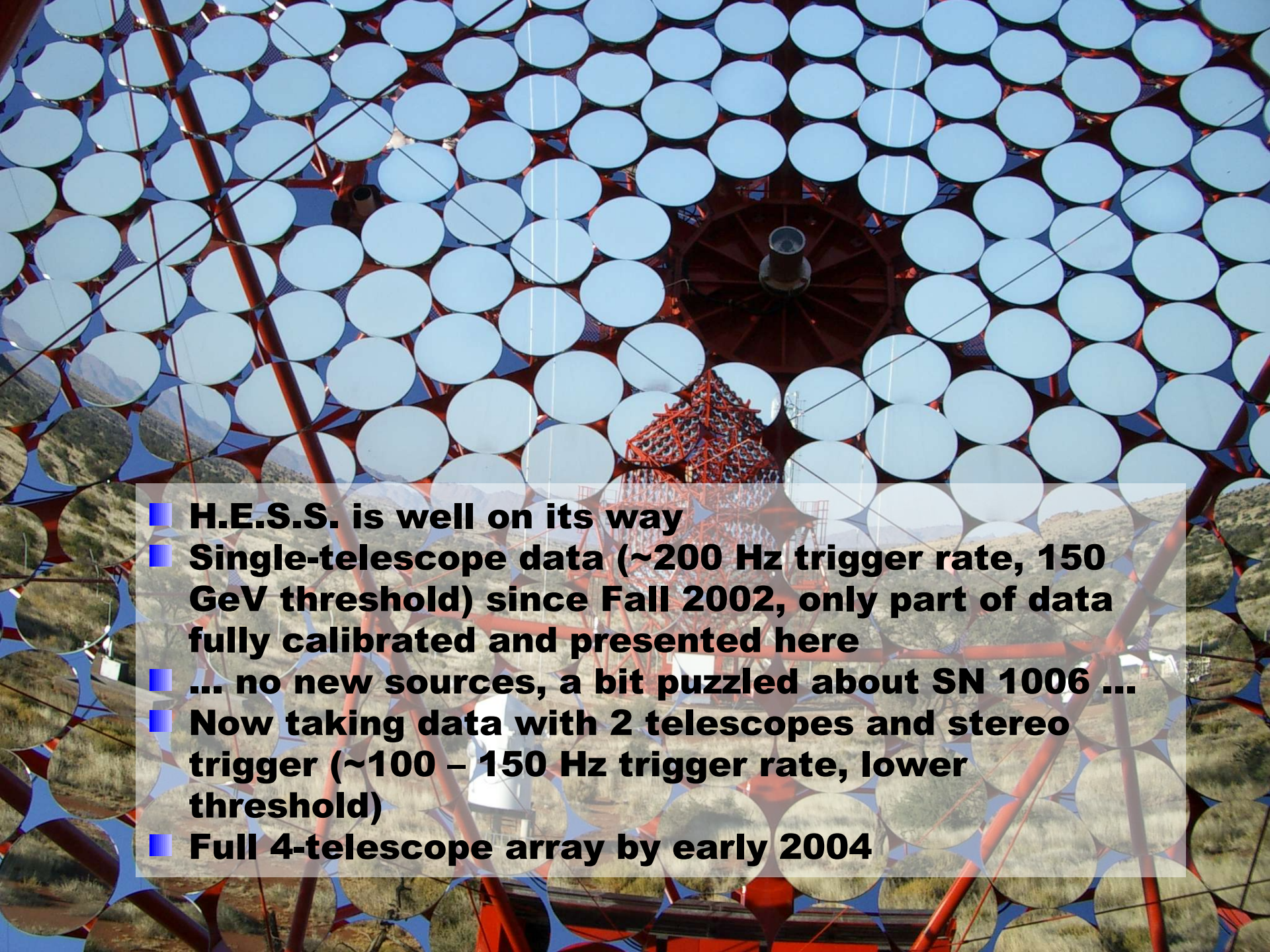


2-fold coinc. rate vs tilt



2-Telescope coincidence rejects muons





- H.E.S.S. is well on its way
- Single-telescope data (~200 Hz trigger rate, 150 GeV threshold) since Fall 2002, only part of data fully calibrated and presented here
- ... no new sources, a bit puzzled about SN 1006 ...
- Now taking data with 2 telescopes and stereo trigger (~100 – 150 Hz trigger rate, lower threshold)
- Full 4-telescope array by early 2004