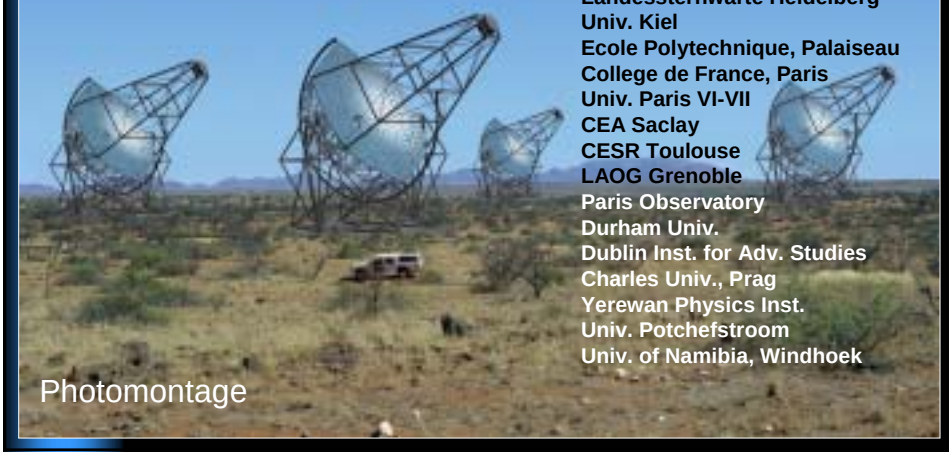
The H.E.S.S. Project

W. Hofmann, MPIK

over 70 scientists
from 19 institutes
in 8 nations



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

Photomontage

The H.E.S.S. Project
(High Energy Stereoscopic System)

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It's Real !

H.E.S.S.

Infrastructure operational
- Control building
- Residence building
- Power, telecomm. link, …

H.E.S.S.

3 Telescopes
Steel structures ready

H.E.S.S.

modified drives for
smoother operation

H.E.S.S.

1 Telescope fully operational

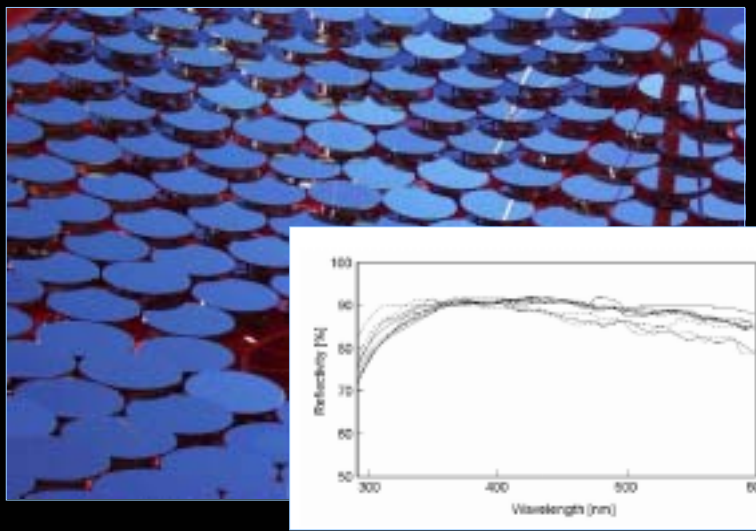
H.E.S.S.

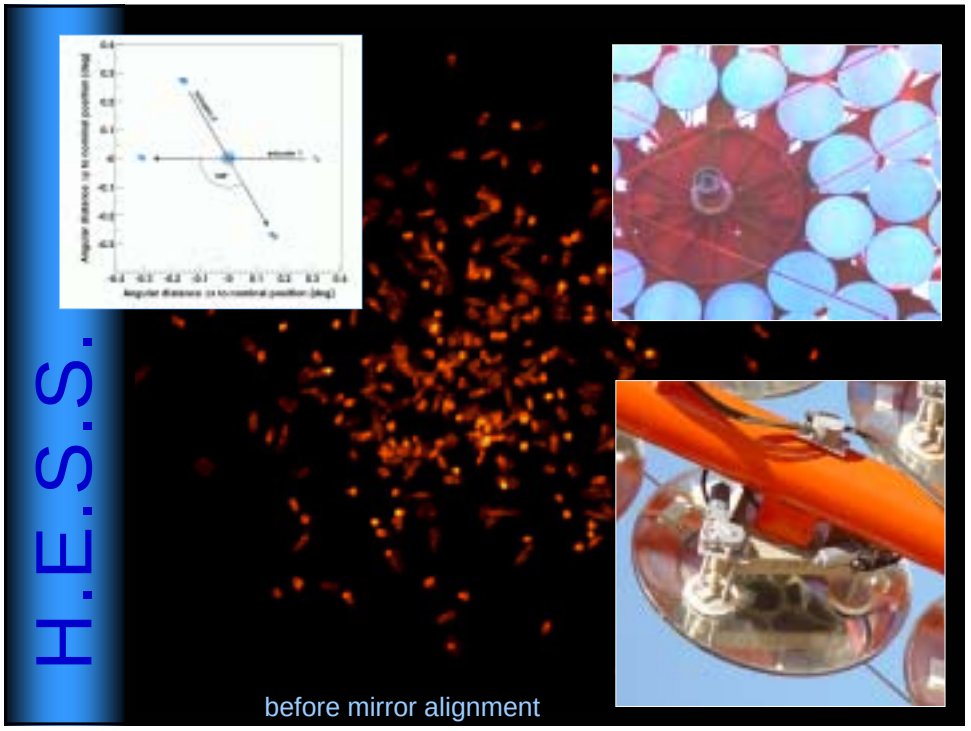
Mirror

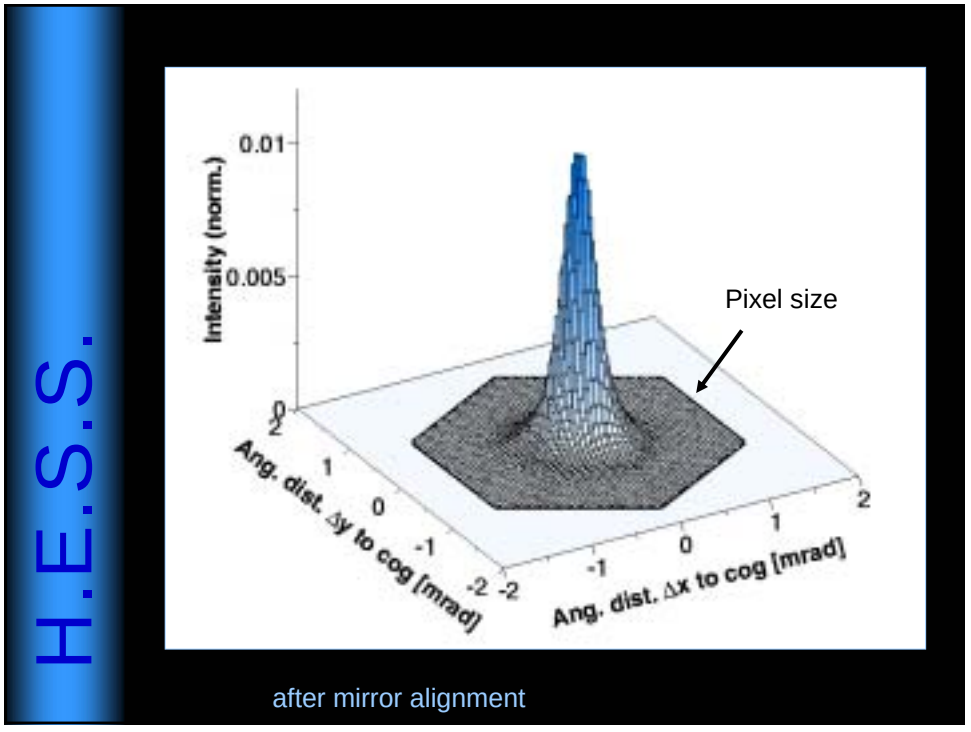
Segmented mirror with 380 facets, f = 15 m, f/d ~ 1.2

Ground glass, 60 cm diam., aluminized, quartz coated

Mirror area 107 sqm

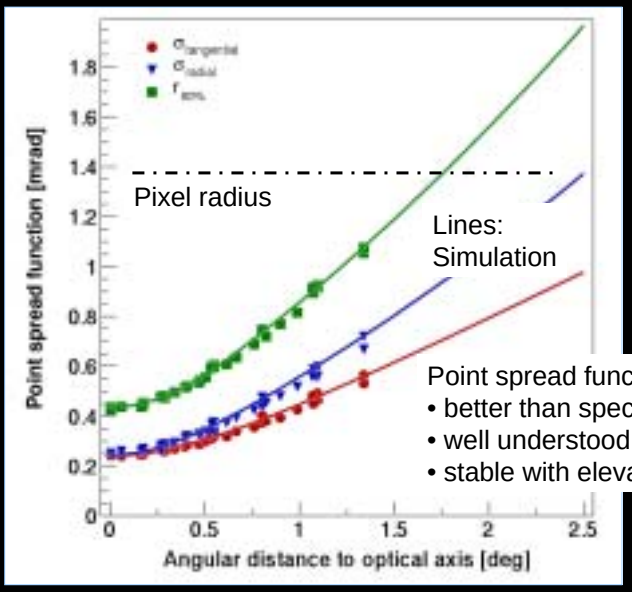



H.E.S.S.
before mirror alignment


H.E.S.S.
Intensity (norm.)
0.01
0.005
0
Pixel size
Ang. dist. Δy to cog [mrad]
Ang. dist. Δx to cog [mrad]
2
1
0
-1
-2
after mirror alignment

H.E.S.S.

Point spread function (see poster)



Point spread function is
- better than specified
- well understood
- stable with elevation

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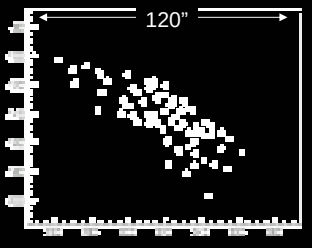
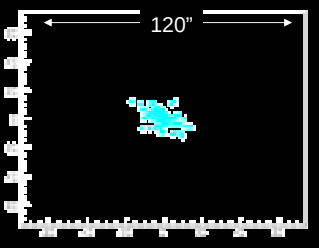
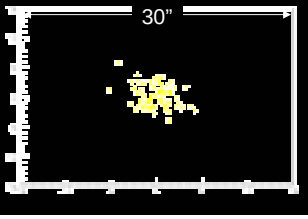
Telescope pointing



Test of pointing using stars
Uncorrected: rms = 28''



Corrected using 12-parameter pointing model: rms = 8''



Corrected using
guide telescope: rms = 2.5''

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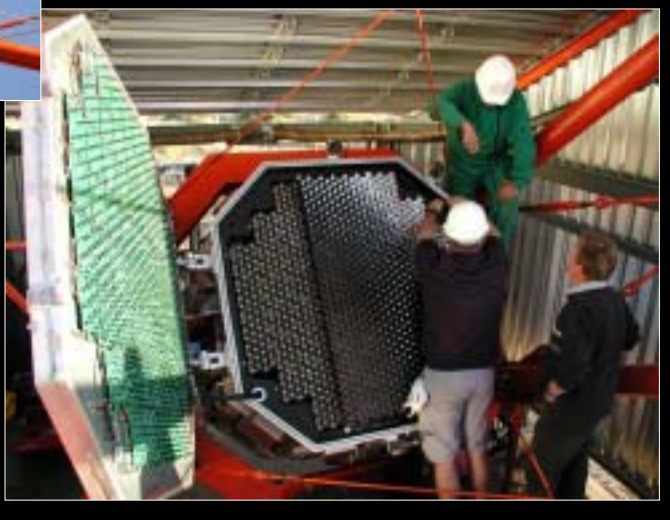
Camera
960 pixels, 0.16° size
5° field of view (1.4 m)
Electronics integrated in camera body
Light pulser system in lid



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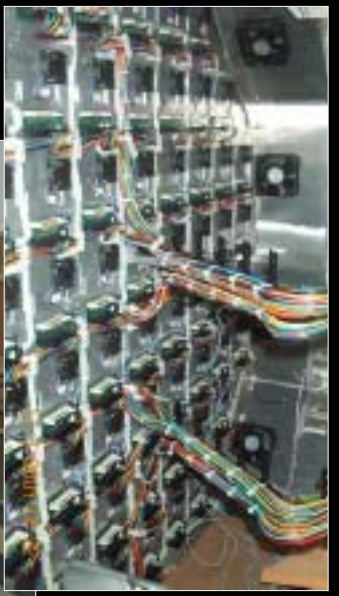
Modular construction
60 drawers with 16 PMTs each
In the rear section crates for
CPU, trigger, readout



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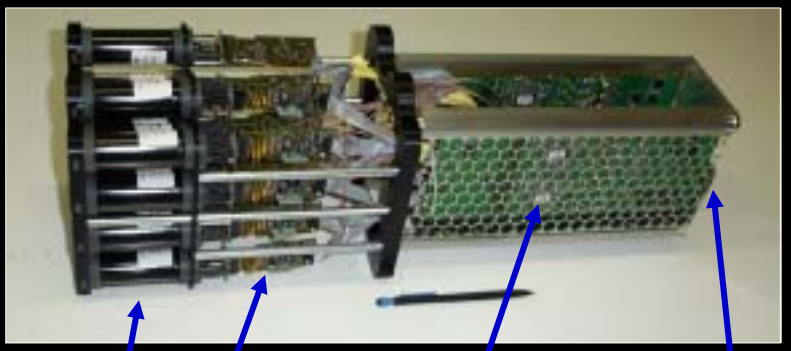


Photonis PMT XP 2960
8 Dynodes
Gain ~2 x 10^5

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

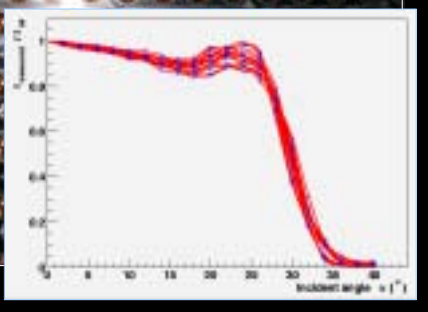
Analog Ring Sampler (ARS)
- Samples PMT signal at 1 GHz
- 128 samples ring buffer
- Serves to delay signal until trigger decision
- High/low gain channels for large dynamic range (> 2000 pe)

Multiplexed ADC to digitize signal; FPGA
- Controls conversion and readout
- Optionally sums signals over readout window (16 ns)

Parallel bus for readout, token-passing scheme

H.E.S.S.

Winston cones improve coverage and define angular acceptance



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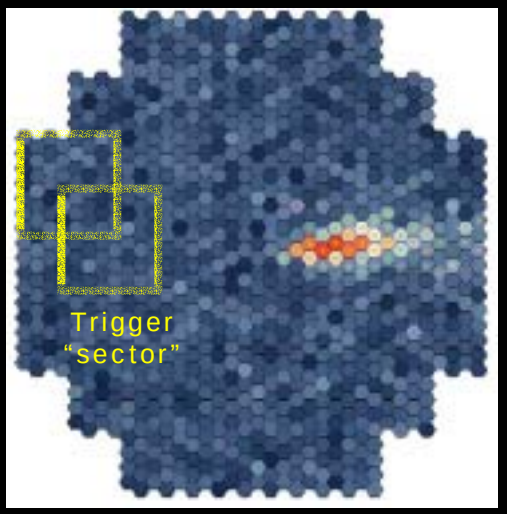
Trigger scheme



n = 3,4,5... pixels within an 8x8 pixel “sector” above a certain threshold (3...6 photoelectr.)

Pixel comparator outputs signal while input over threshold
➔
Effective coincidence window ~2 ns;
low random rates

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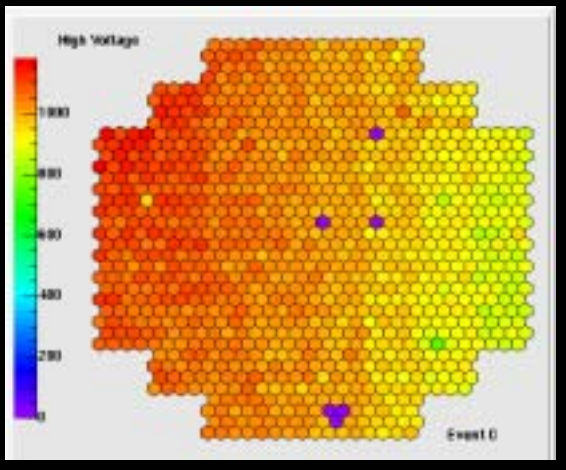
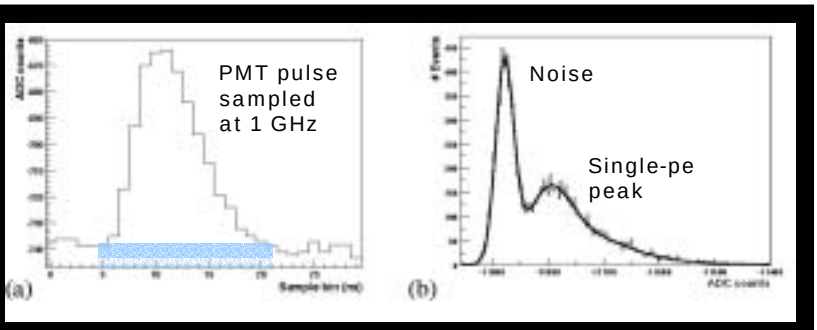
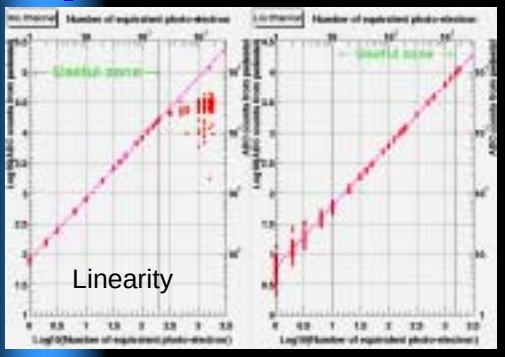
PMTs sorted according to HV to minimize transit time differences across images



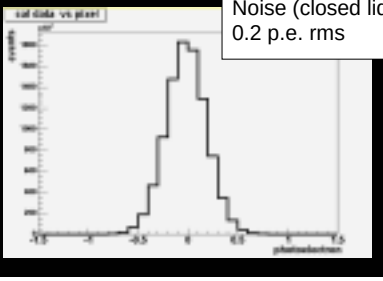
(PMTs with stars in fov turned off)



Test bench



Namibia



Noise (closed lid)
0.2 p.e. rms

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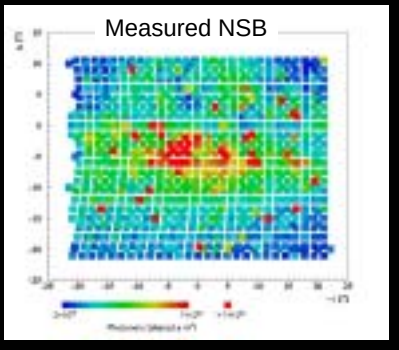
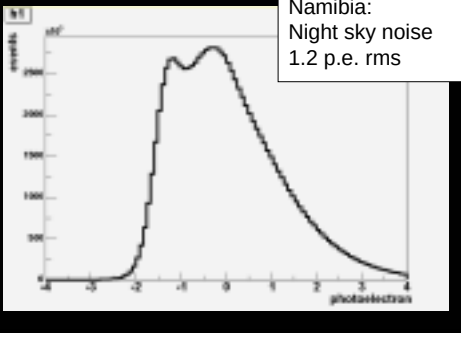


Night sky background

expect ~100 MHz /pixel in dark regions, up to 500 MHz in bright regions

Mean pixel current
2.7 μA ≅ 100 MHz NSB

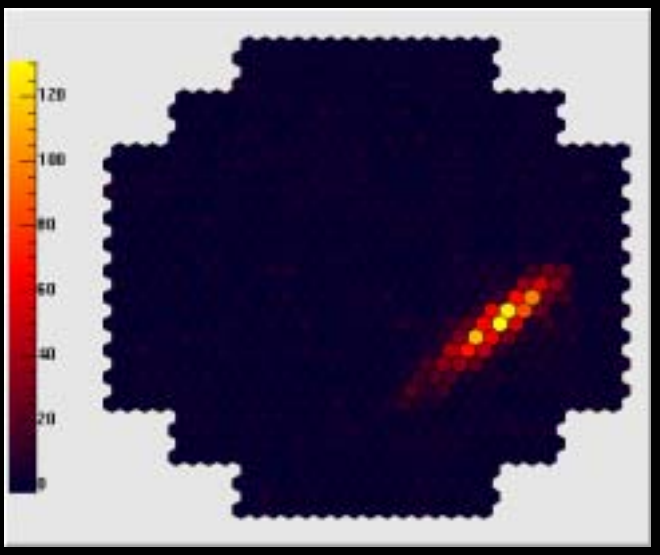
Pedestal distribution shows expected width for 16 ns integration time



Namibia:
Night sky noise
1.2 p.e. rms

H.E.S.S.

First Data (June 11)



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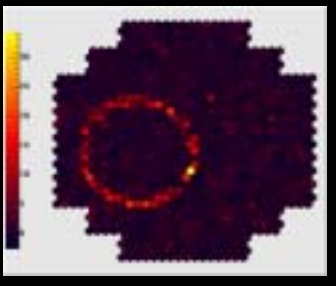
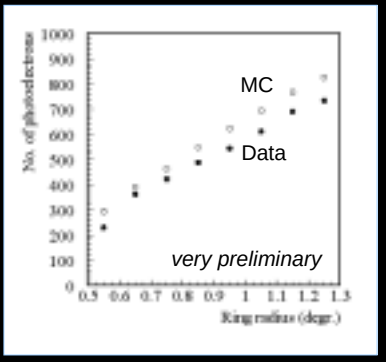
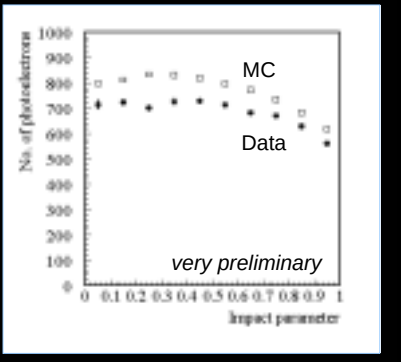
Photoelectron yield ok ?
Use muon rings to check

Data and MC agree
within ~20% …
will improve calibration,
correct for dead pixels etc.







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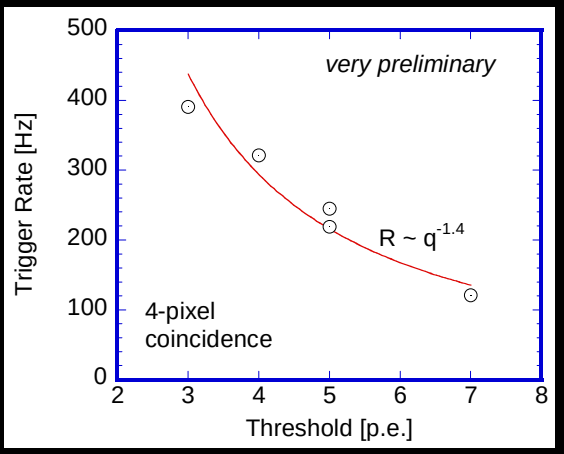
Trigger rates

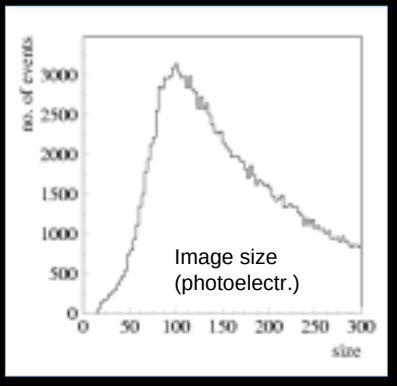


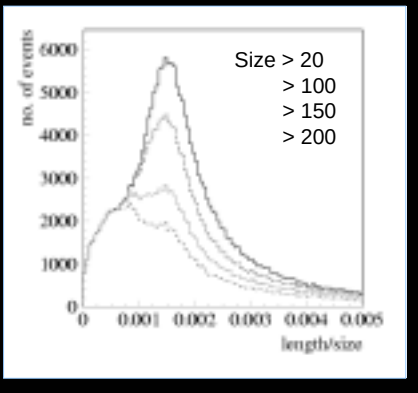
- Even for low thresholds no indications of noise
- Rate marginally consistent with MC
  - e.g. Data 220 – 270 Hz
  - MC 270 – 420 Hz

CR spectrum, composition
Shower model
Atmosphere model
Optical throughput
PMT quantum efficiencies
Electronics pulse shapes

H.E.S.S.

First data





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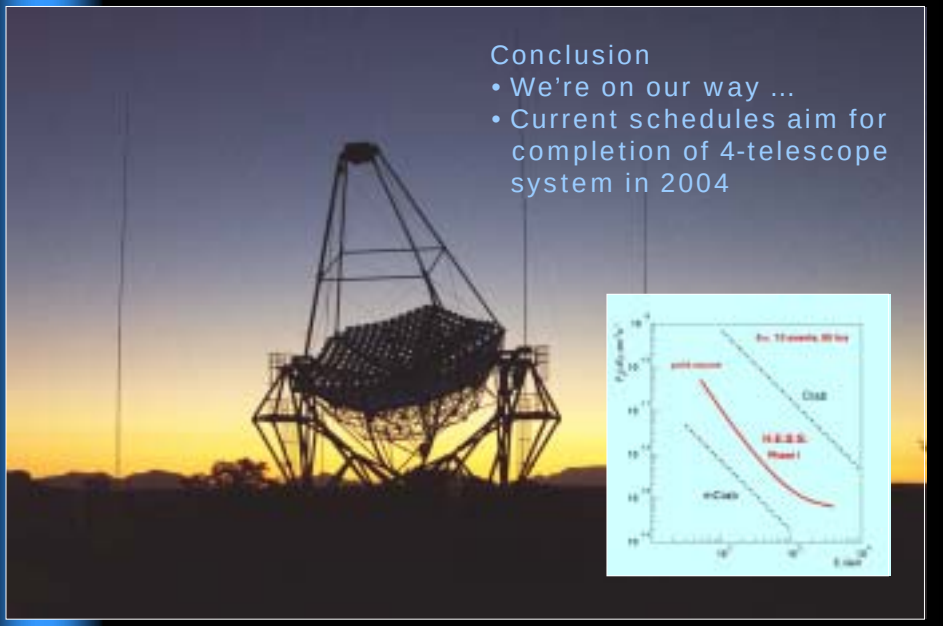
Test data taken so far

SN 1006
RXJ 1713-3946
PSR B1706-44
Crab

NGC 253
PKS 2005-489
PKS 2155-304

total ~ 65 h on/off with varying degrees of detector performance



Conclusion

- We're on our way ...
- Current schedules aim for completion of 4-telescope system in 2004