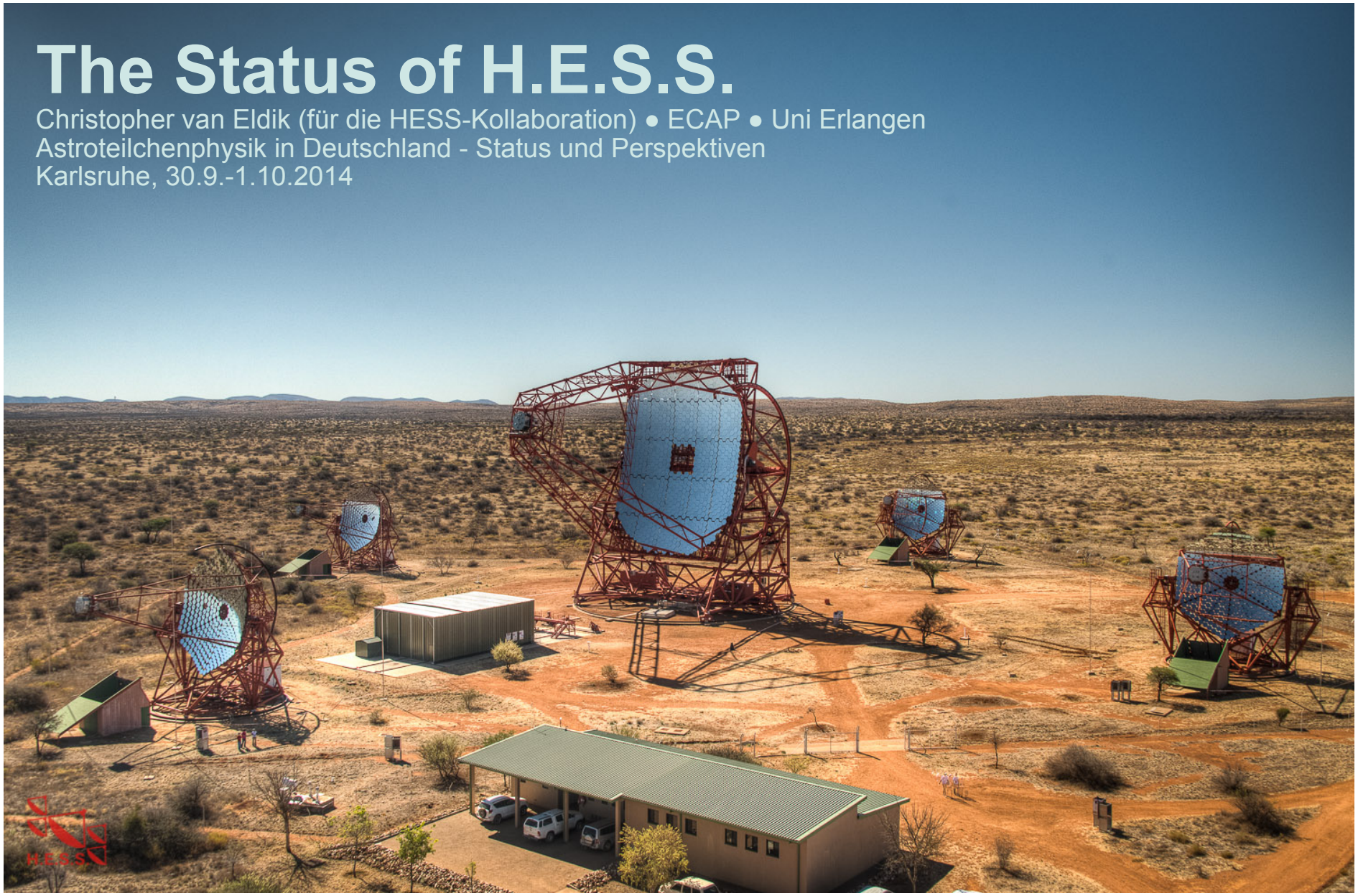
The Status of H.E.S.S.

Christopher van Eldik (für die HESS-Kollaboration) • ECAP • Uni Erlangen

Astroteilchenphysik in Deutschland - Status und Perspektiven
Karlsruhe, 30.9.-1.10.2014



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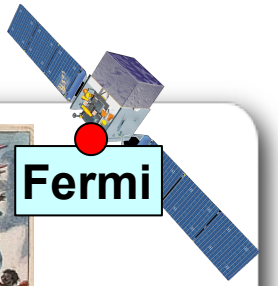
ERLANGEN CENTRE
FOR ASTROPARTICLE
PHYSICS

Gamma-ray telescopes world-wide



HU B
U Bo
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U HD
U HH
U PD
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U Wü

DESY

MPIE
MPIK
MPIP

- (almost) complete sky coverage
- coverage of energy range 20 MeV - 100 TeV

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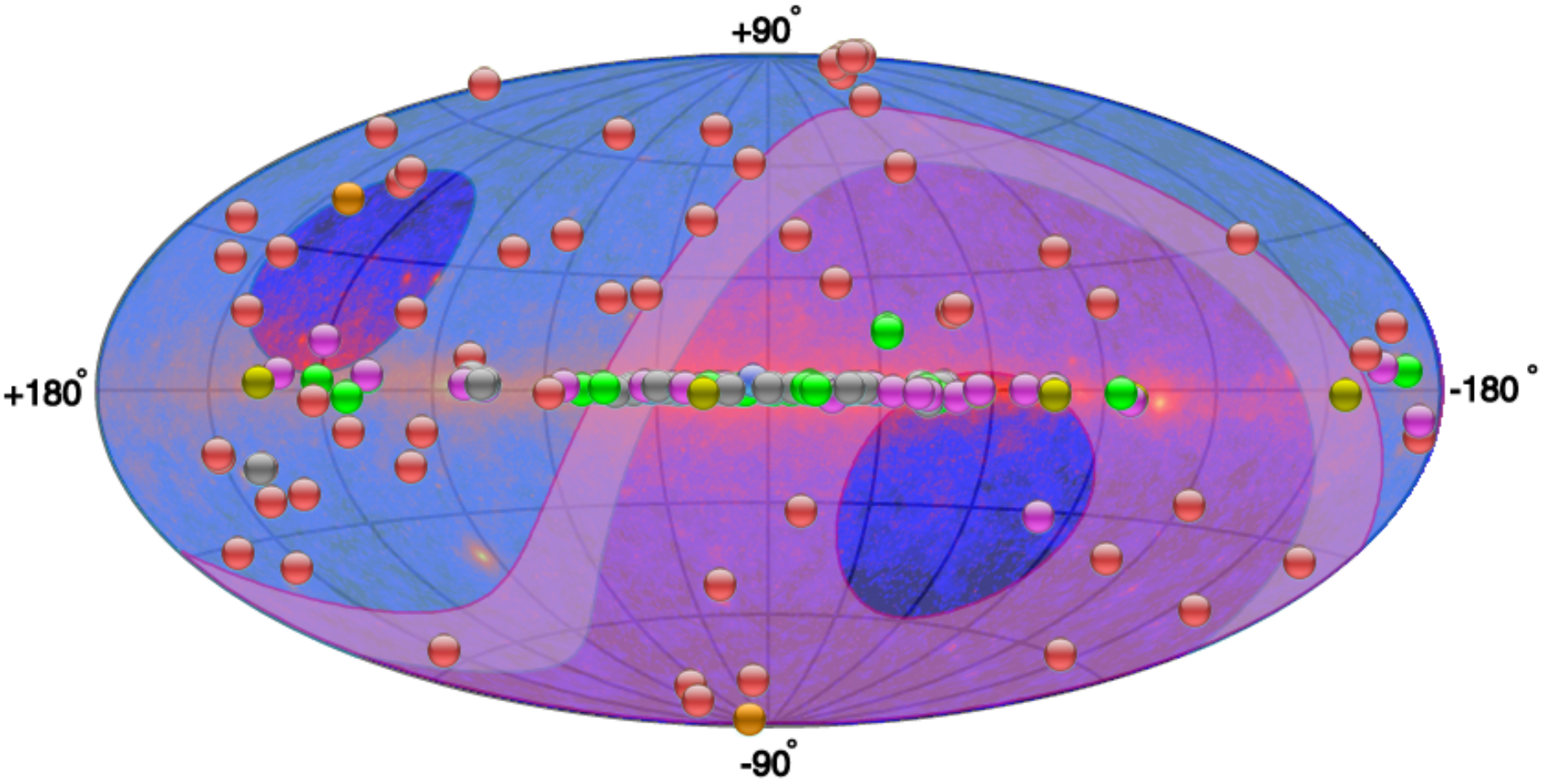
Source Statistics and Sky Coverage



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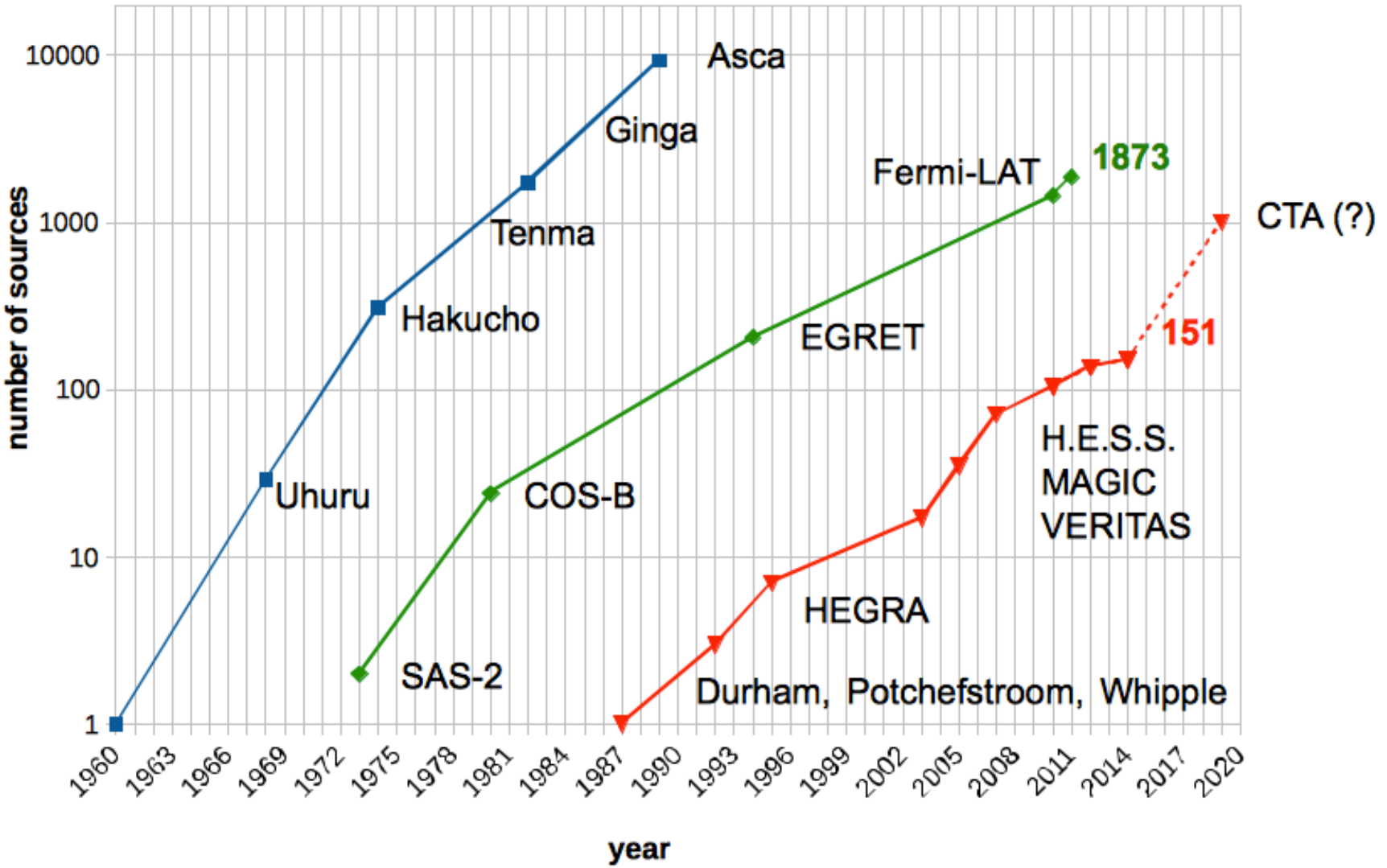

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The Status of H.E.S.S.

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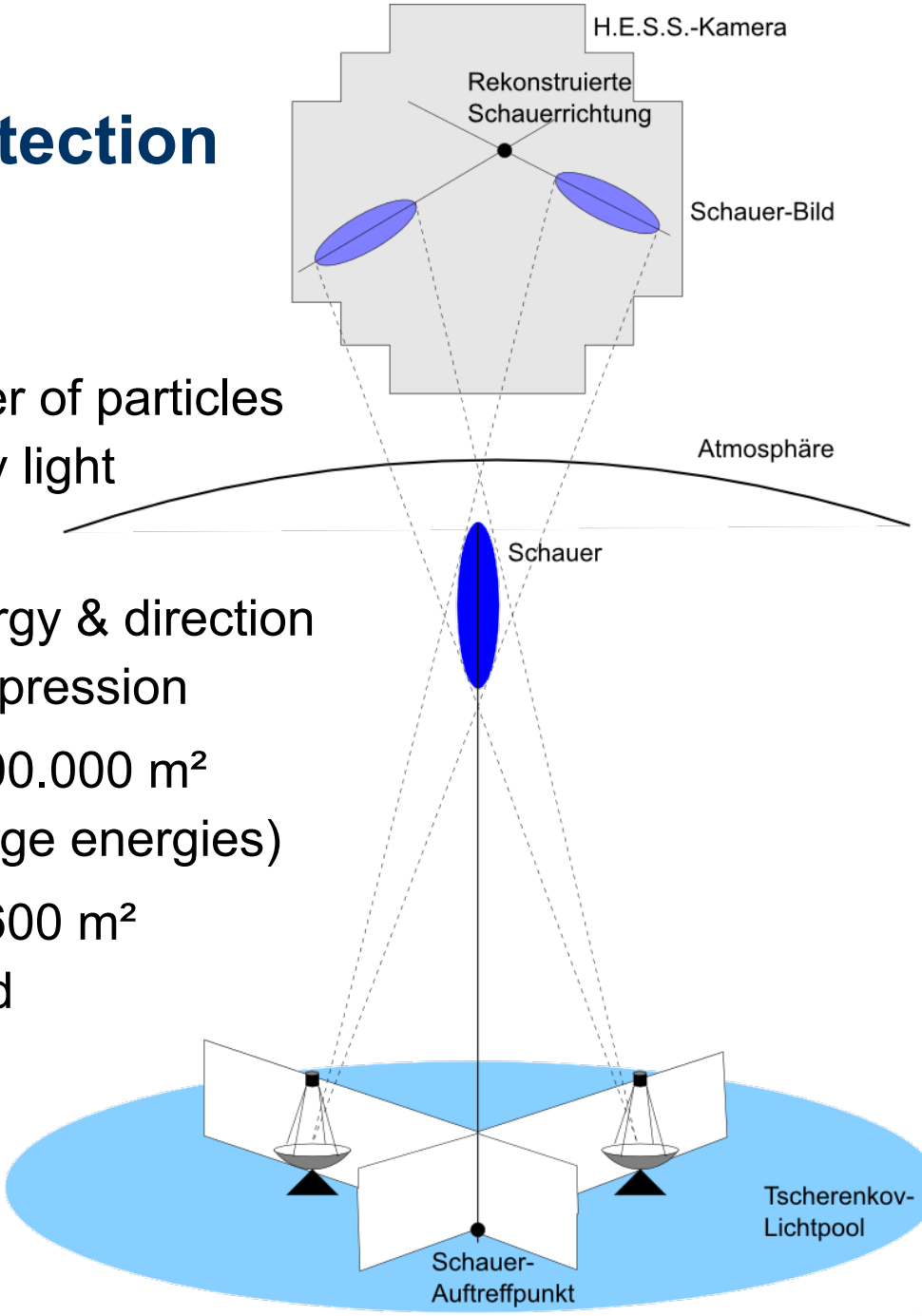
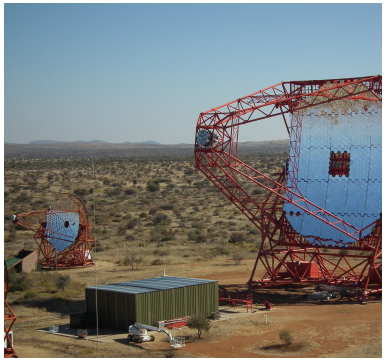
Ground-based gamma-ray detection

- detection principle:
  atmospheric shower of particles emitting Cherenkov light
- image analysis:
  → gamma-ray energy & direction
  → background suppression
- detection area ~ 100.000 m²
  → sensitivity (at large energies)
- mirror area ~ 100-600 m²
  → energy threshold





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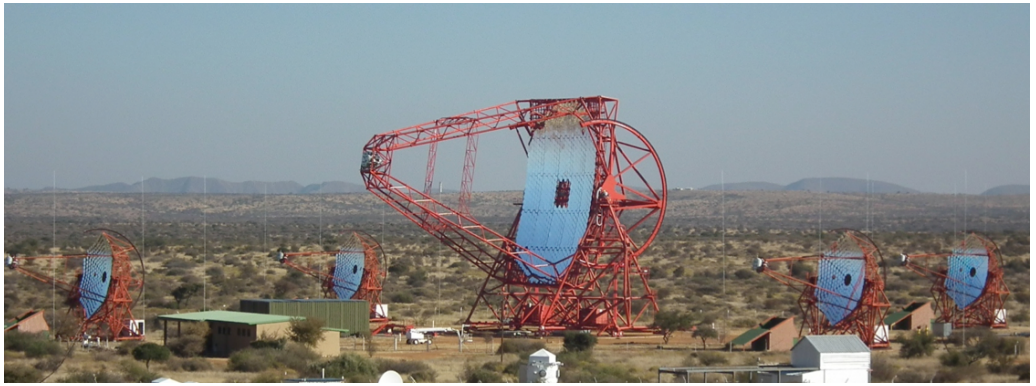
The H.E.S.S. instrument and its phase transition

H.E.S.S. Phase I

- 4 telescopes à 100 m^2

- energy threshold: 100 GeV
- field-of-view: 5º
- angular resolution: <0.1º

H.E.S.S. Phase II



- 4 telescopes à 100 m^2
- 1 telescope à 600 m^2
  → first hybrid array

- energy threshold: O(30) GeV
- field-of-view: 3.2º - 5º
- angular resolution: 0.1º - 0.4º

- adds important physics potential (e.g. pulsed emission, transients)
- helps closing the gap to Fermi-LAT

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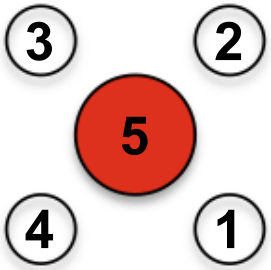
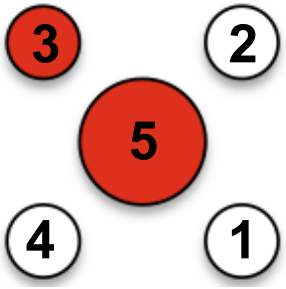
H.E.S.S. Phase II - event topologies

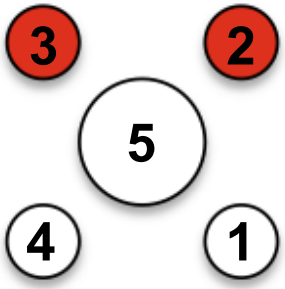


mono event (65%)
CT5 only

hybrid event (30%)
CT5 + at least one of CT(1-4)



CT1-4 stereo (5%)
no CT5 + at least two of CT(1-4)



- each event topology is triggered
- successfully analyzed both mono and hybrid data
- this presentation: only CT5 considered in analysis!

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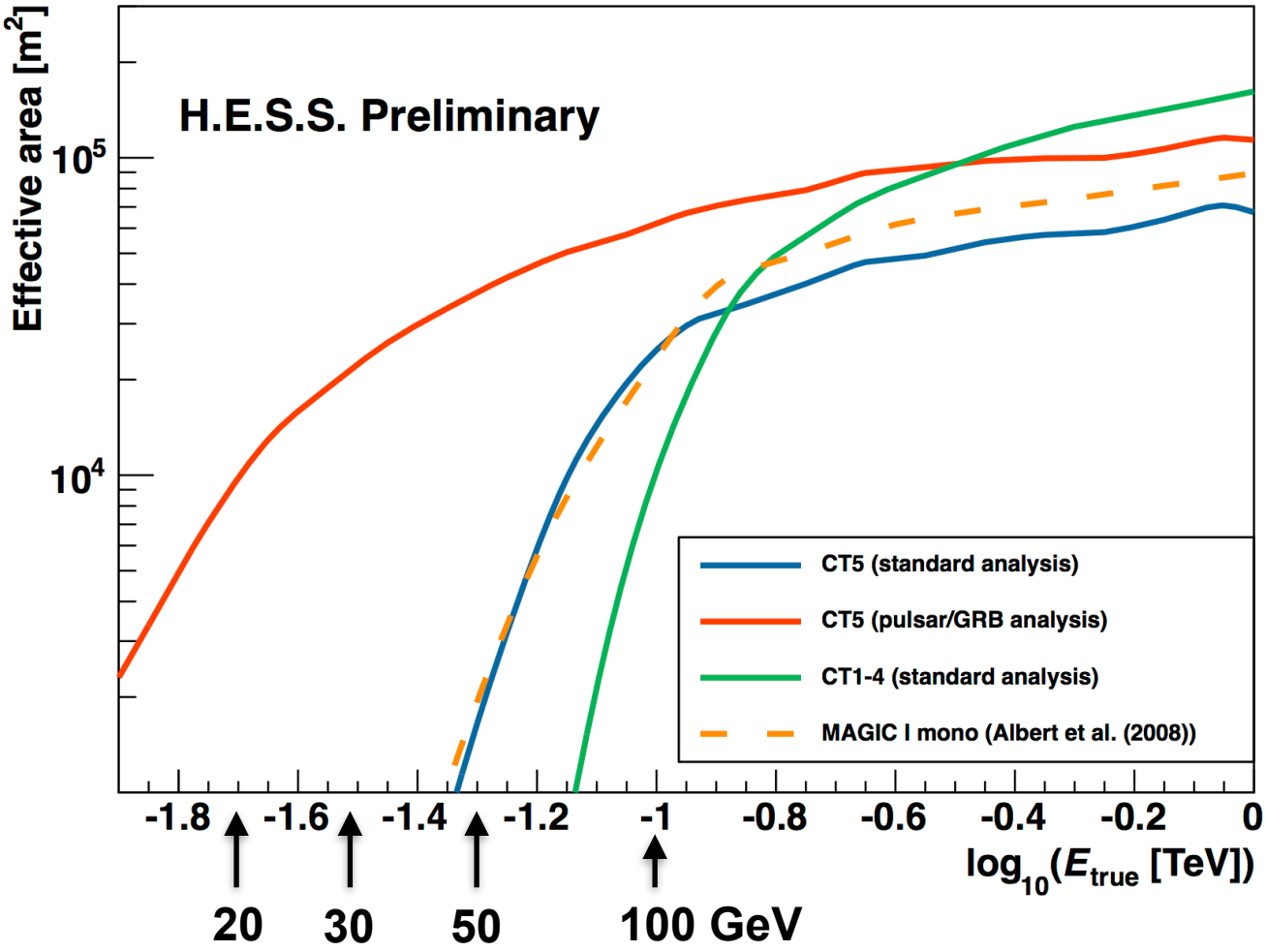
Effective Detection Areas (mono analysis)

two (preliminary) event selections:

- standard: balancing resolution vs. energy threshold
- pulsar: pushing for the lowest energy threshold



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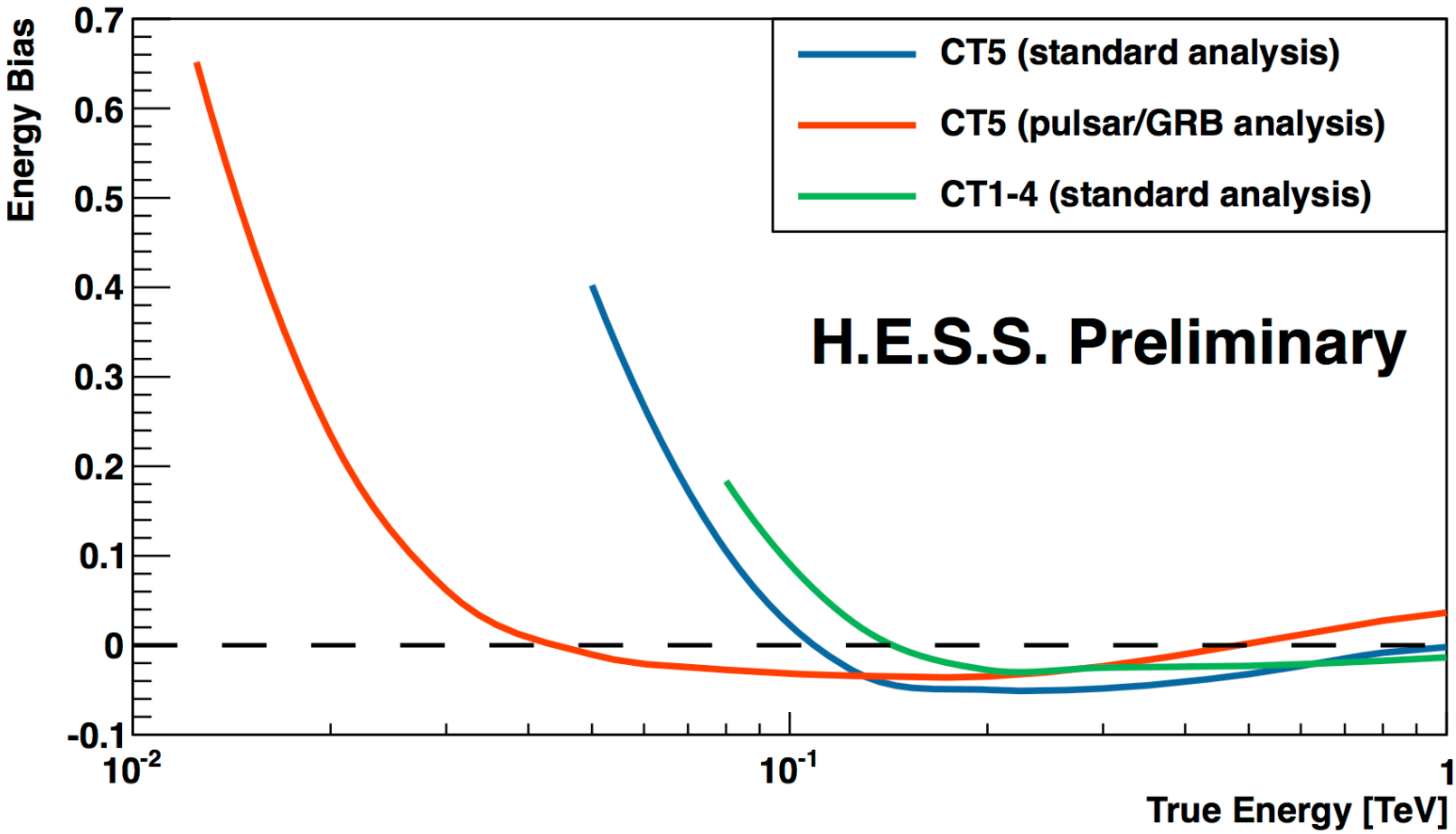
Energy reconstruction (mono analysis)



- typical (positive) bias towards the energy threshold
- energy resolution ~ 30% for standard event selection

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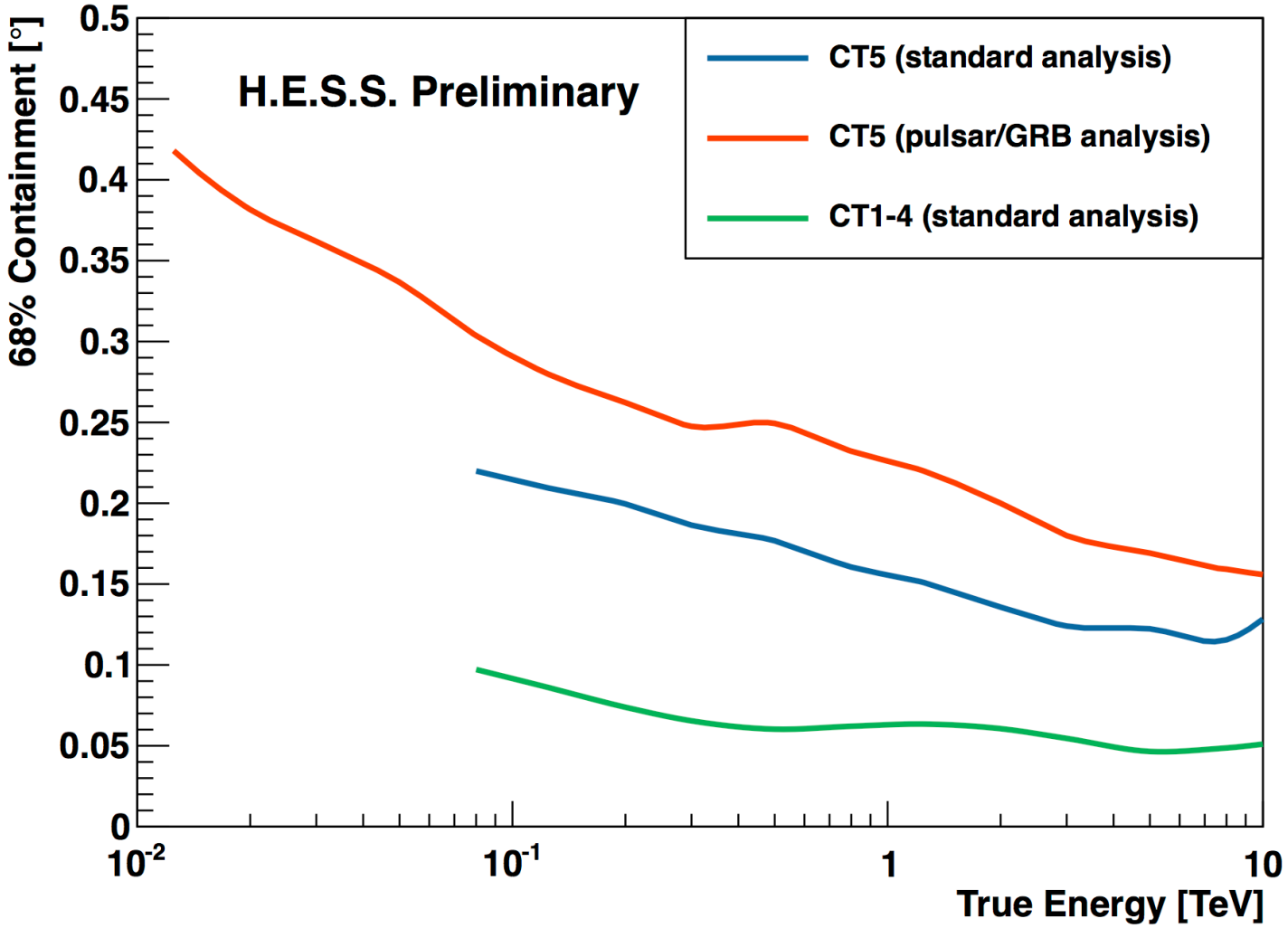
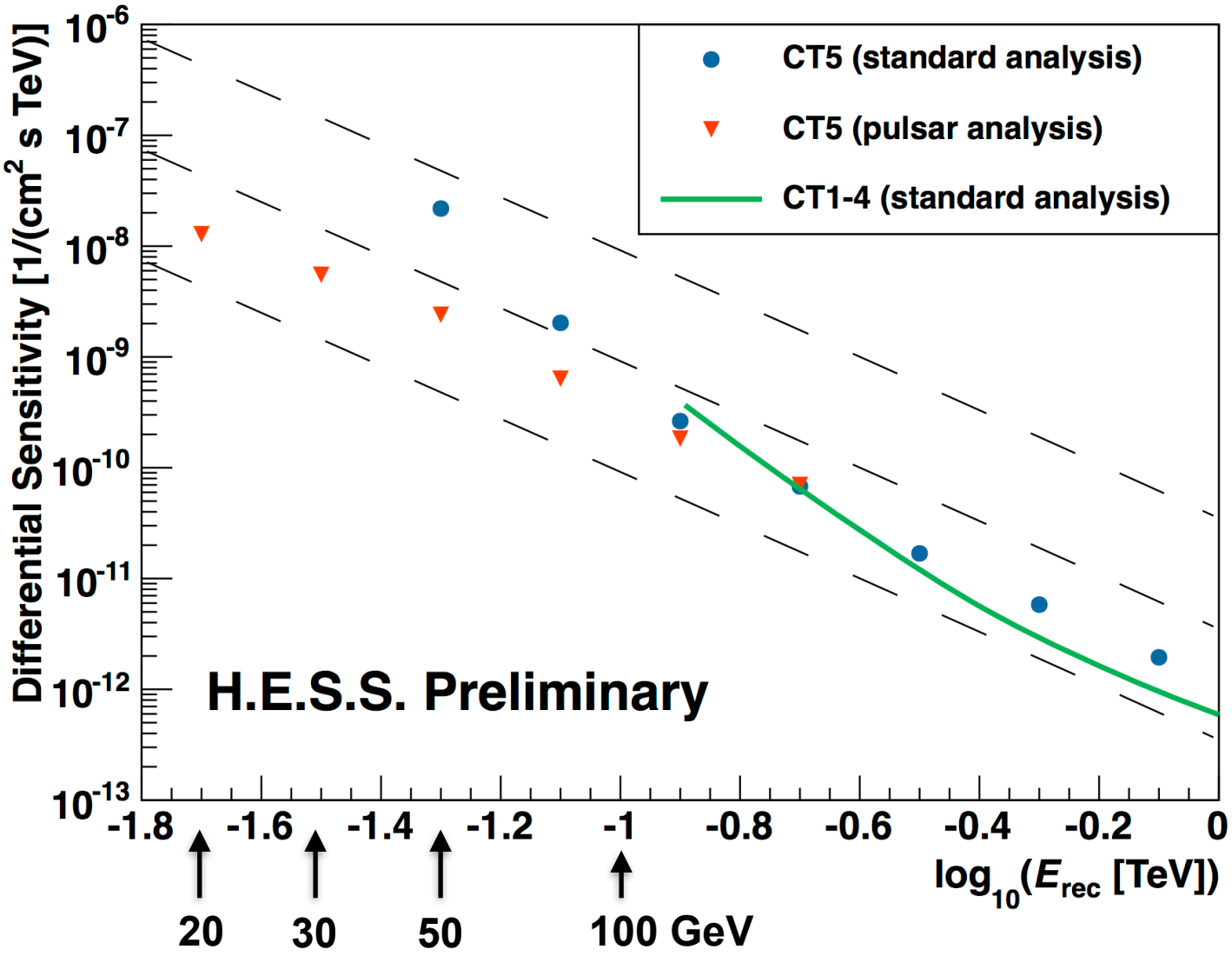
Direction reconstruction (mono analysis)



Differential Sensitivity (mono analysis)



100% Crab flux

10%

1%

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Physics with H.E.S.S. Phase II
(a selection of preliminary results)

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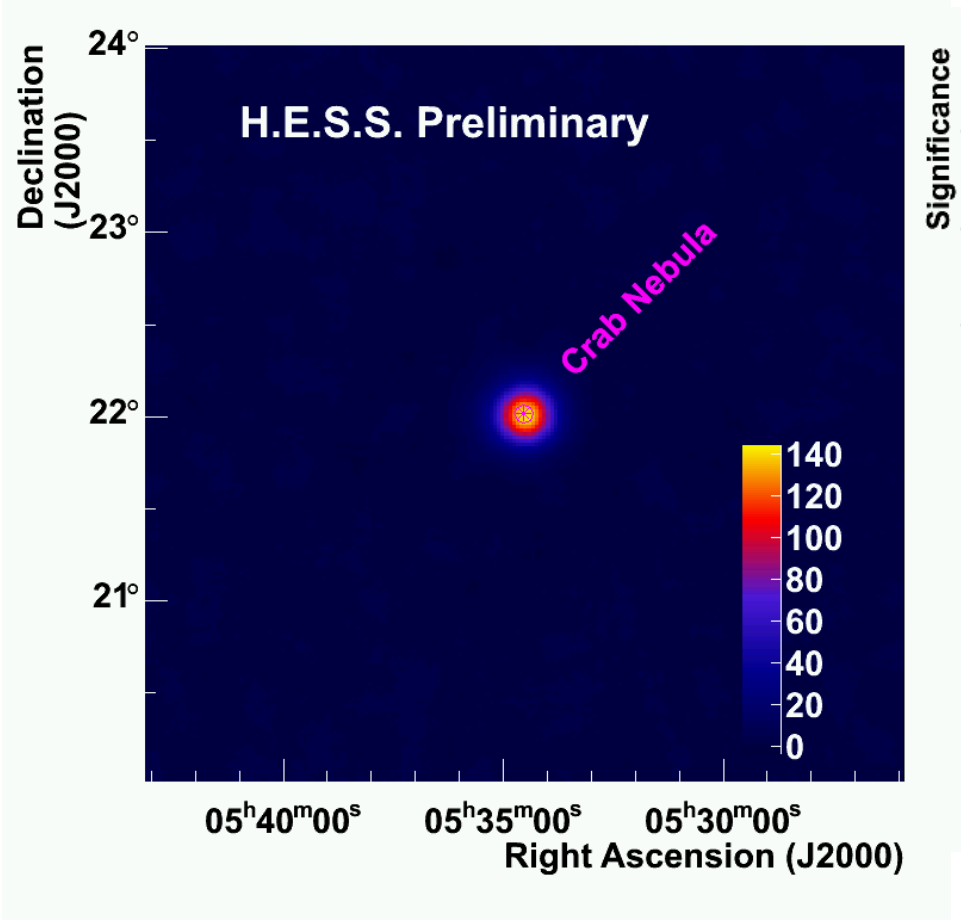
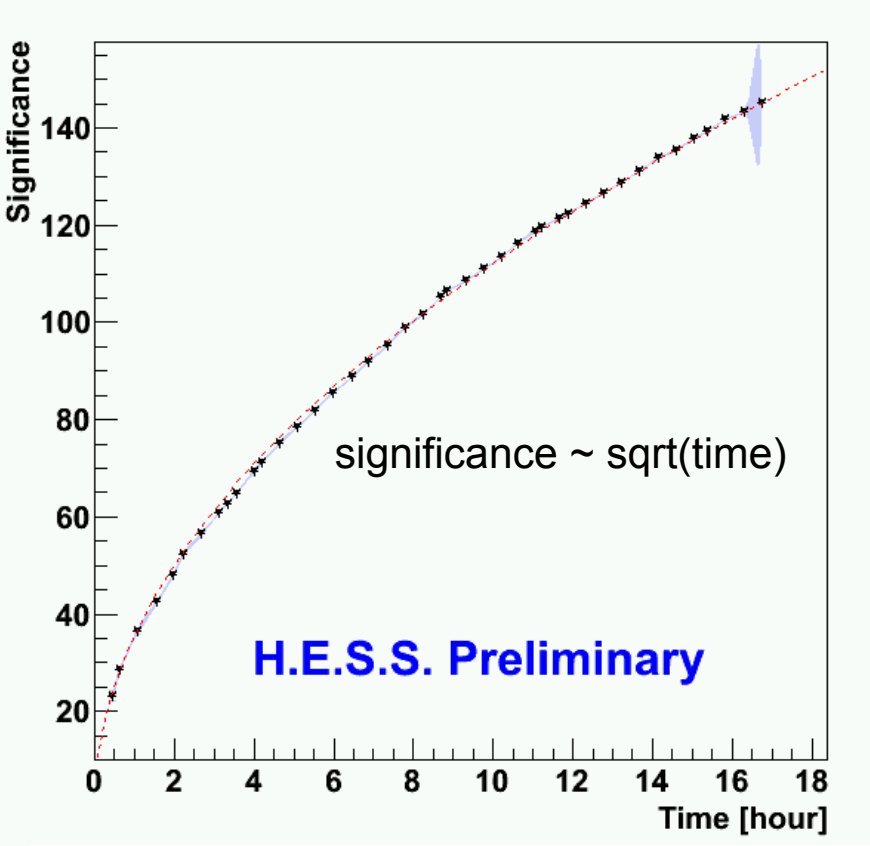
The Crab nebula - a standard candle





- needs large zenith angles: ⟨zenith⟩ = 48°
- standard event selection
- gamma-ray rate: 12.6 ± 0.1 min^{-1}
- MC expectation: 13 min^{-1}
- spectrum extends down to ~150 GeV, being worked on

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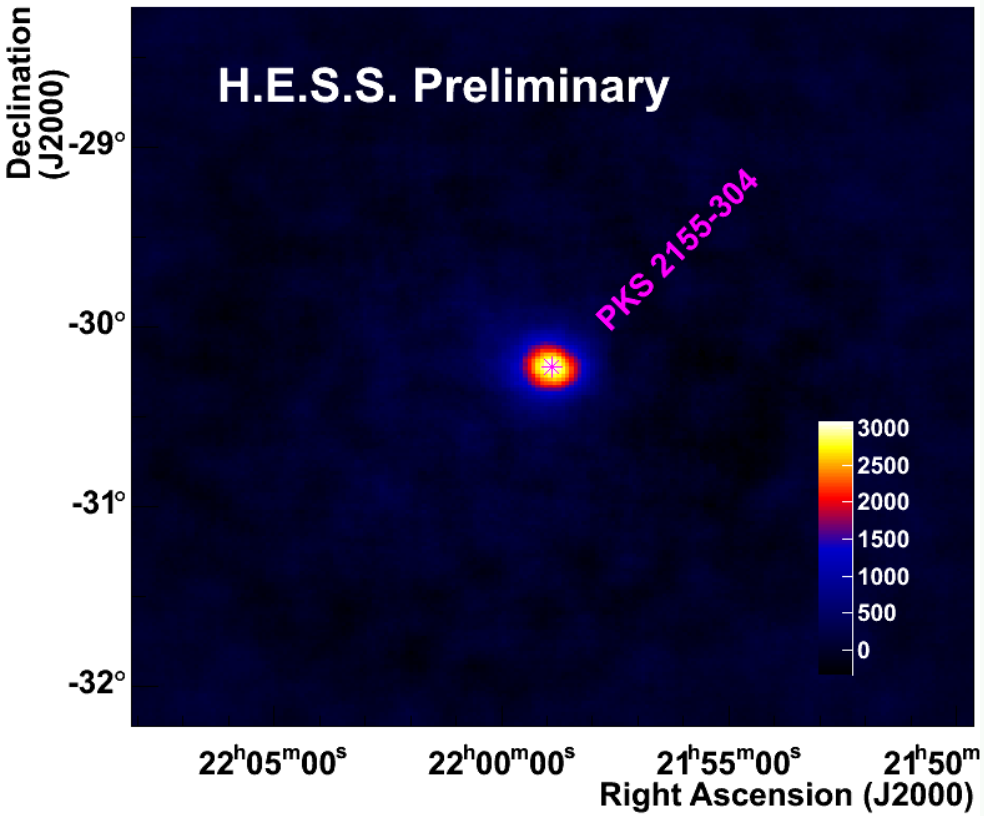
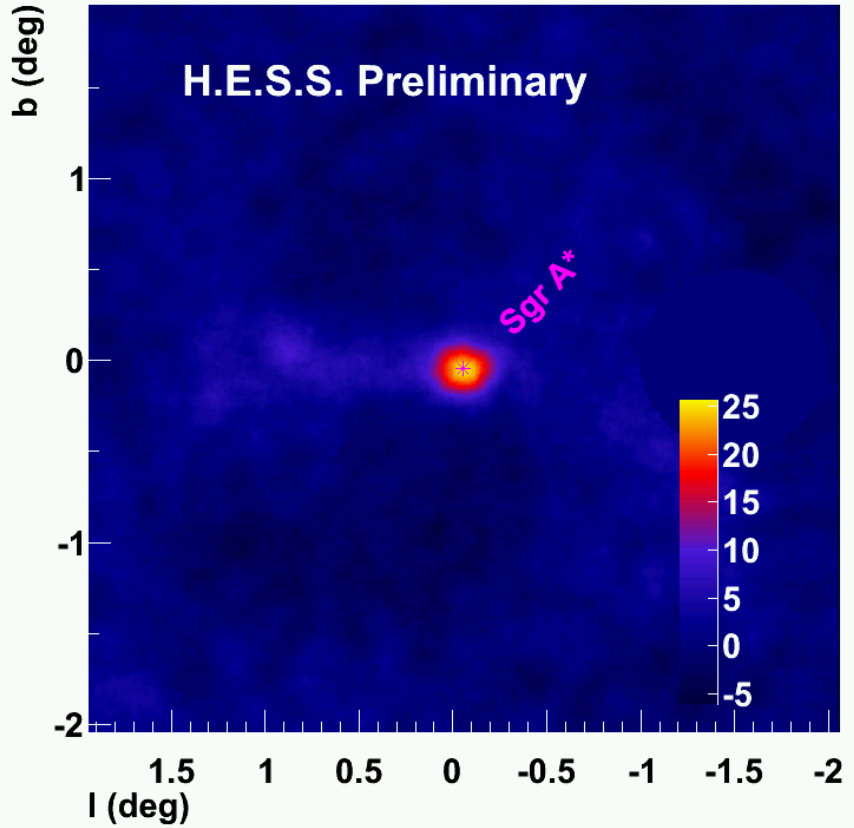
Active Galactic Nuclei and the Galactic Center





- PKS 2155-304 as an AGN example
- 35 h live time
- detection significance: 29 std. dev.
- gamma-ray rate: 1.7 ± 0.1 min^{-1}

- Galactic Center region
- 69 h live time
- detection significance: 25 std. dev.
- background needs further studies

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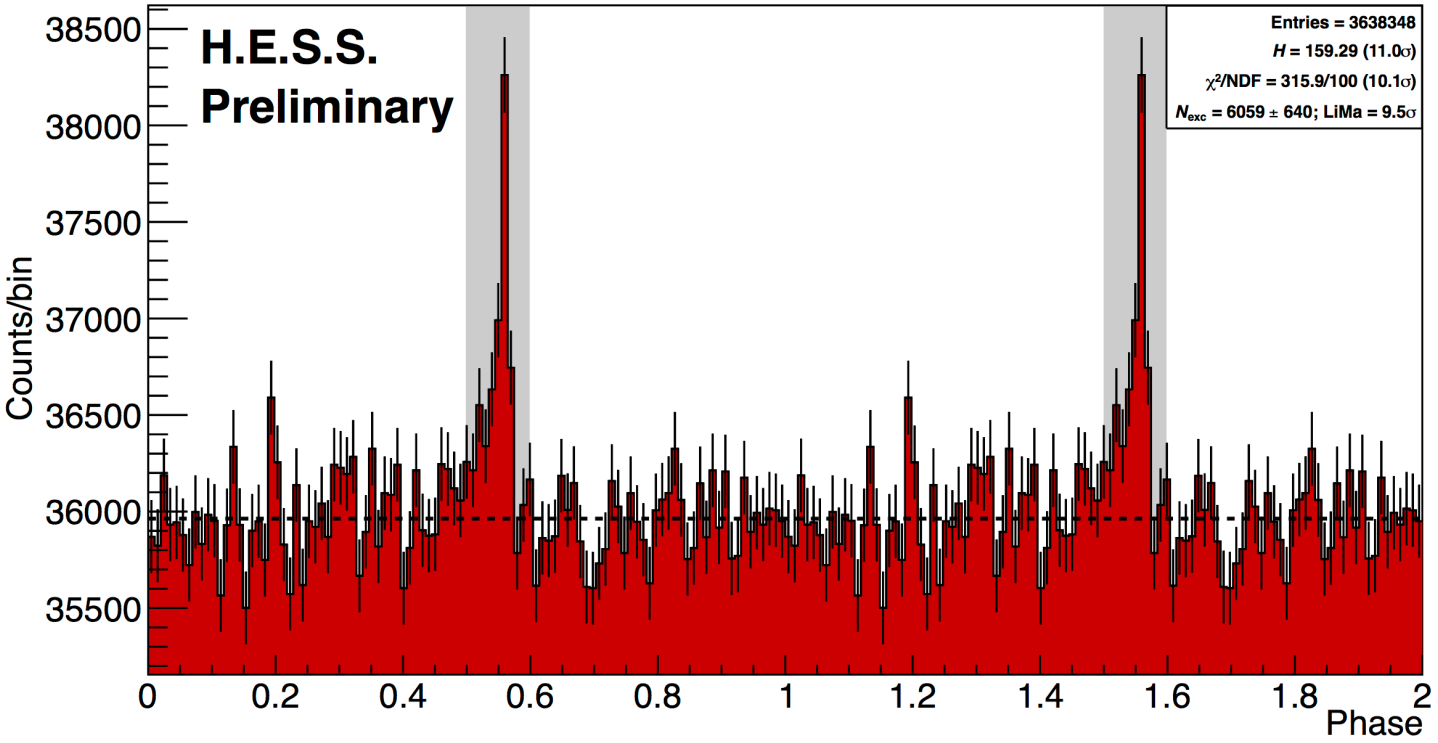
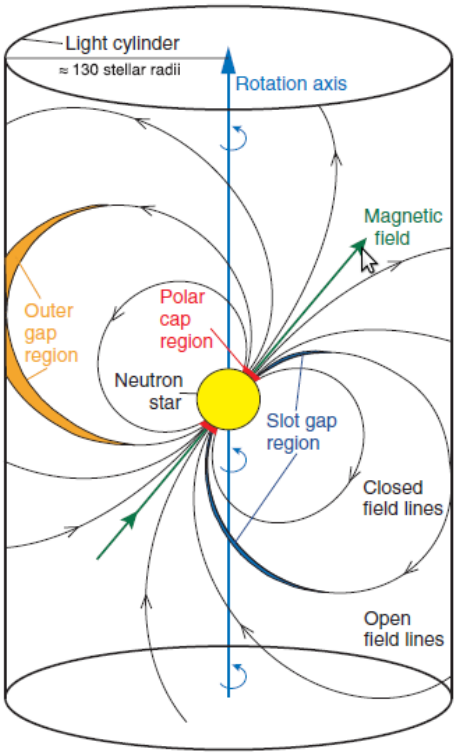
The Vela Pulsar

- 20 h live time, zenith angles 27-35º
- cuts optimized for low energy threshold





- clear detection of pulsed emission in Fermi-LAT phase range
- 2nd pulsar detected by ground-based instrument
- demonstrates H.E.S.S. phase II potential for pulsar and low energy physics

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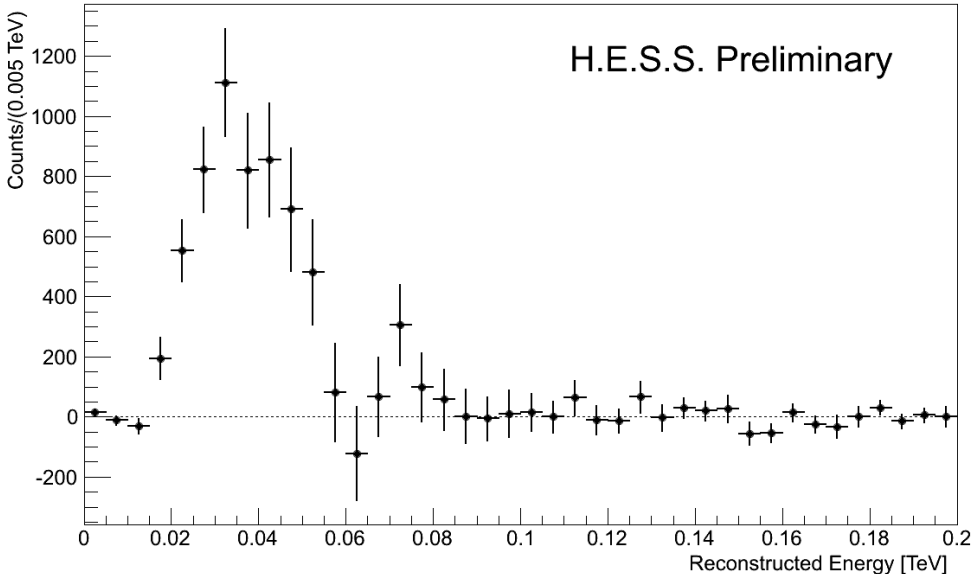
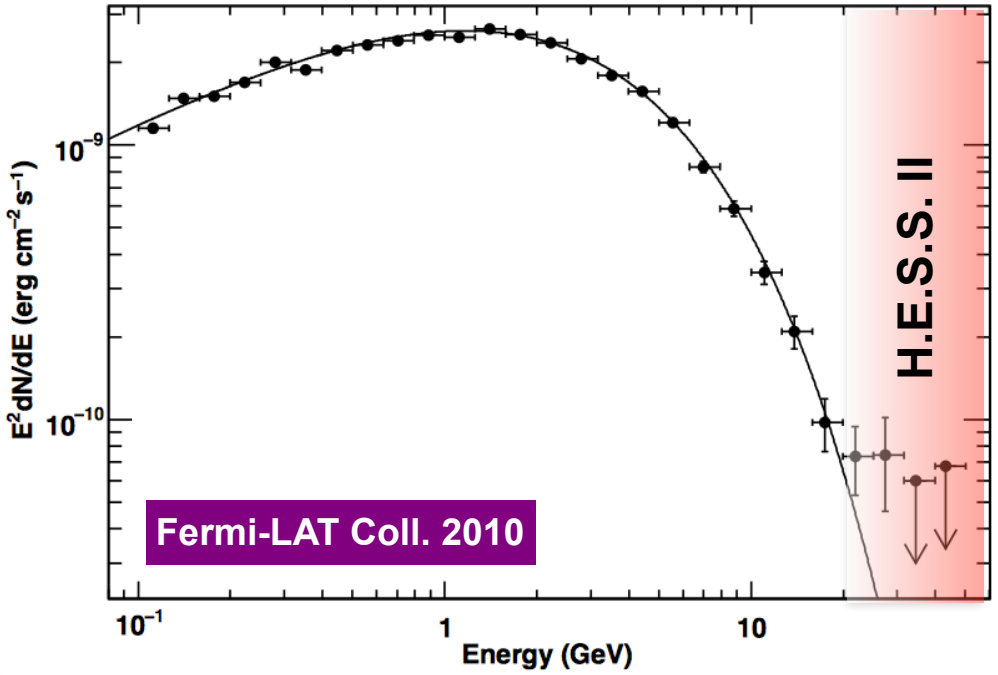
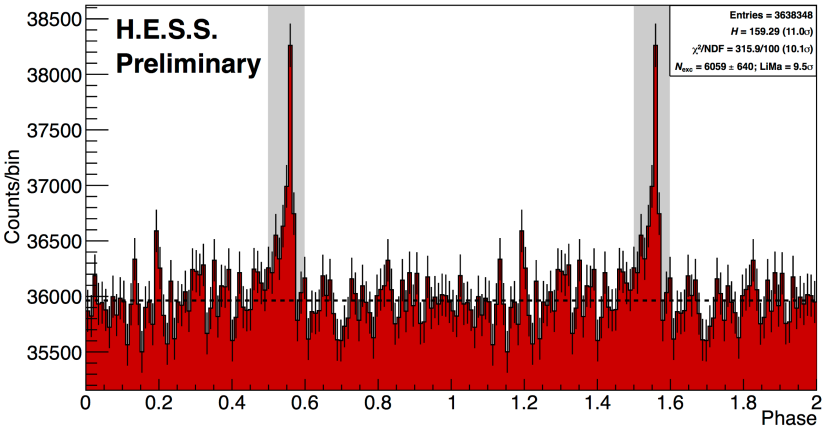
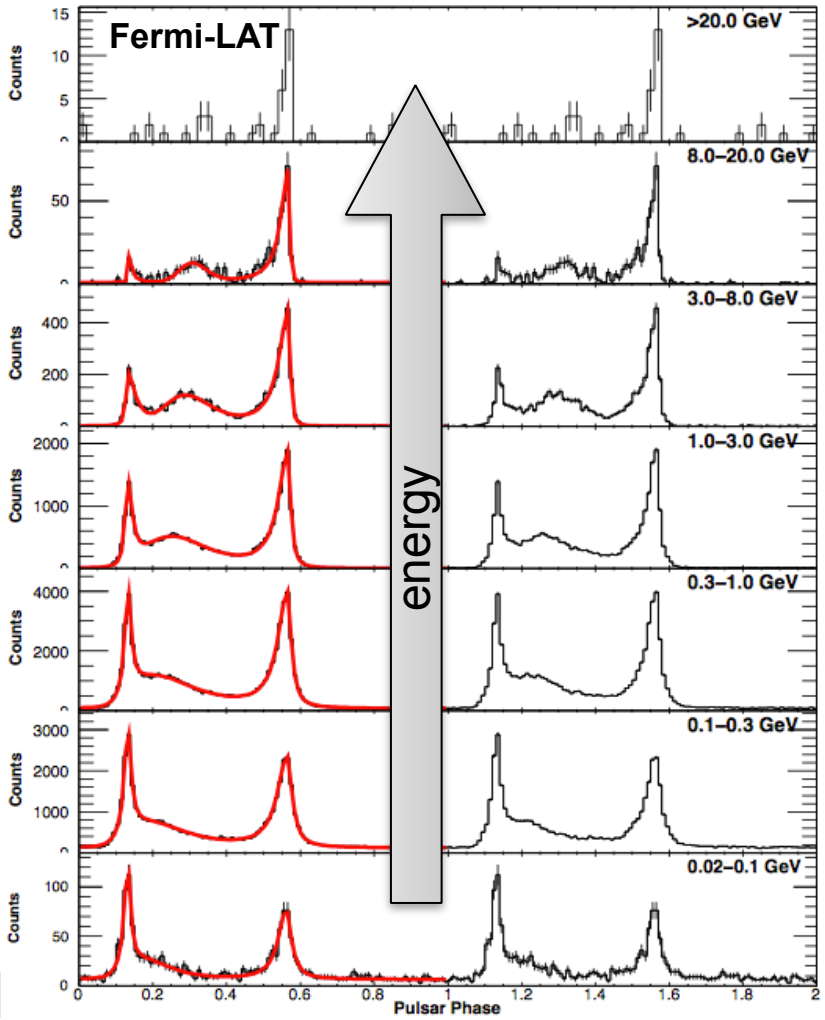
The Vela Pulsar









Physics with H.E.S.S. Phase I

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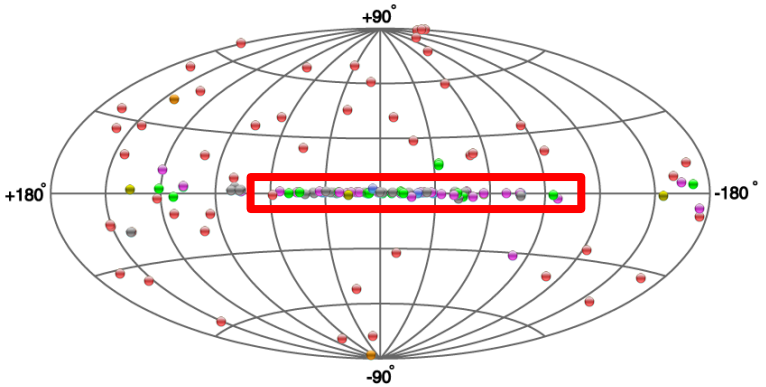
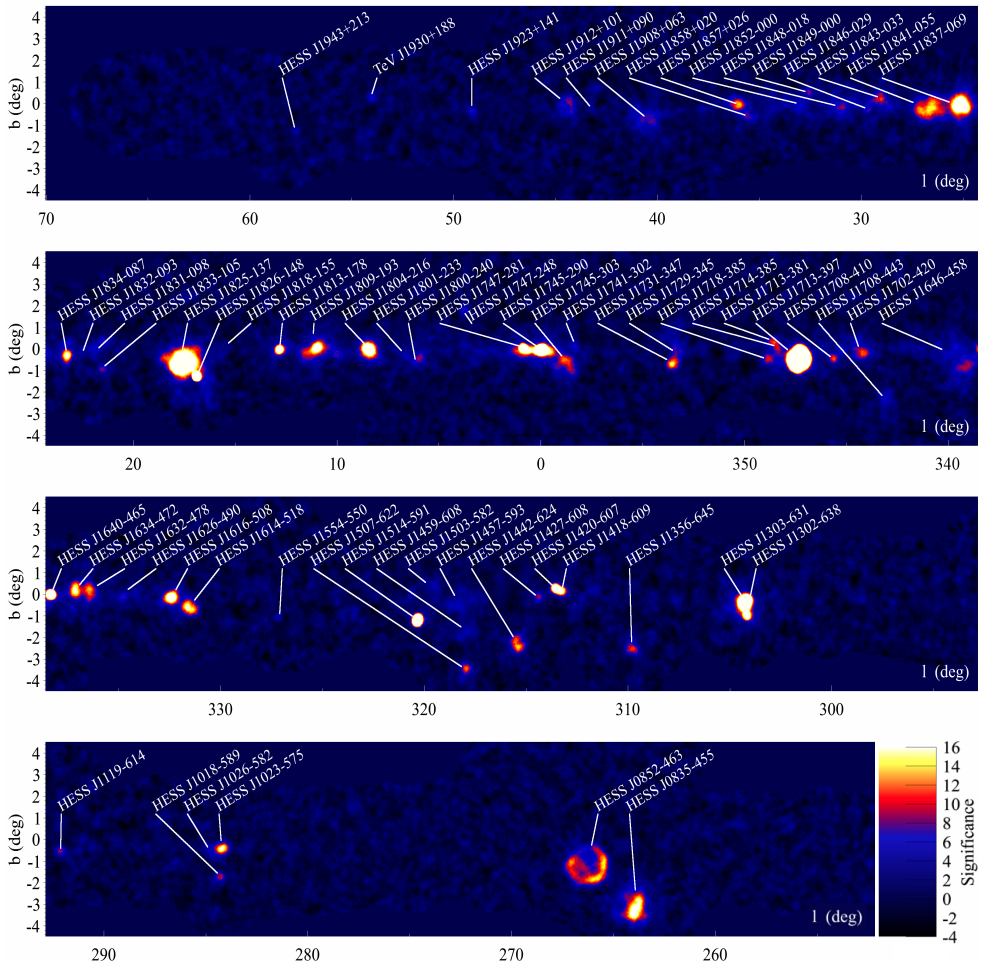
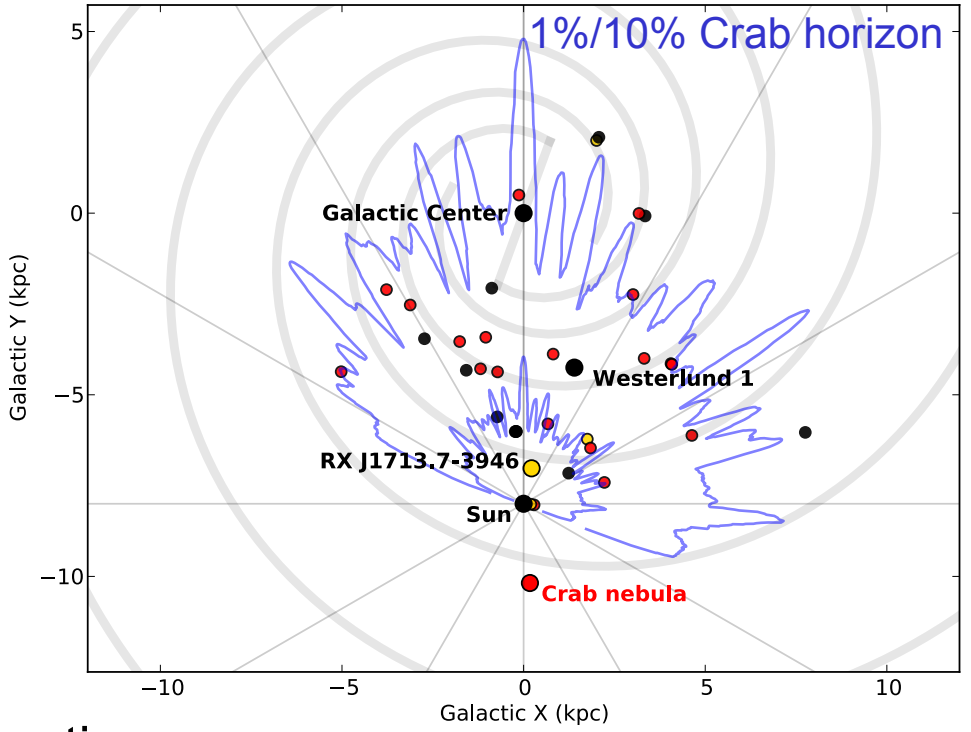
Survey of the inner Milky Way

- 8 years of data (2800 h)
- sensitivity < 2% Crab across scan region





Gast et al. (HESS Coll) 2013



- final publication of data set in preparation (maps, catalogs, population studies)

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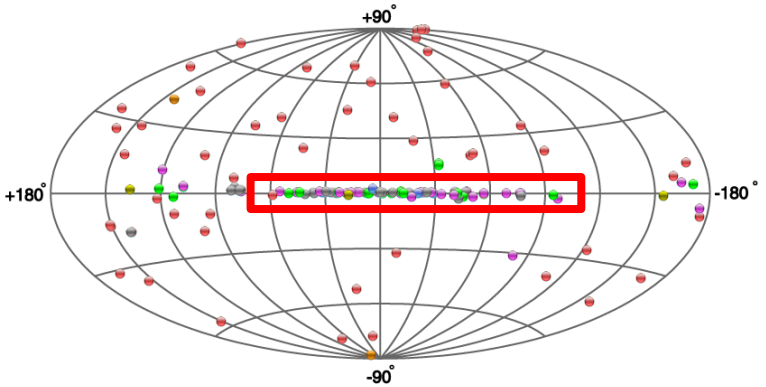

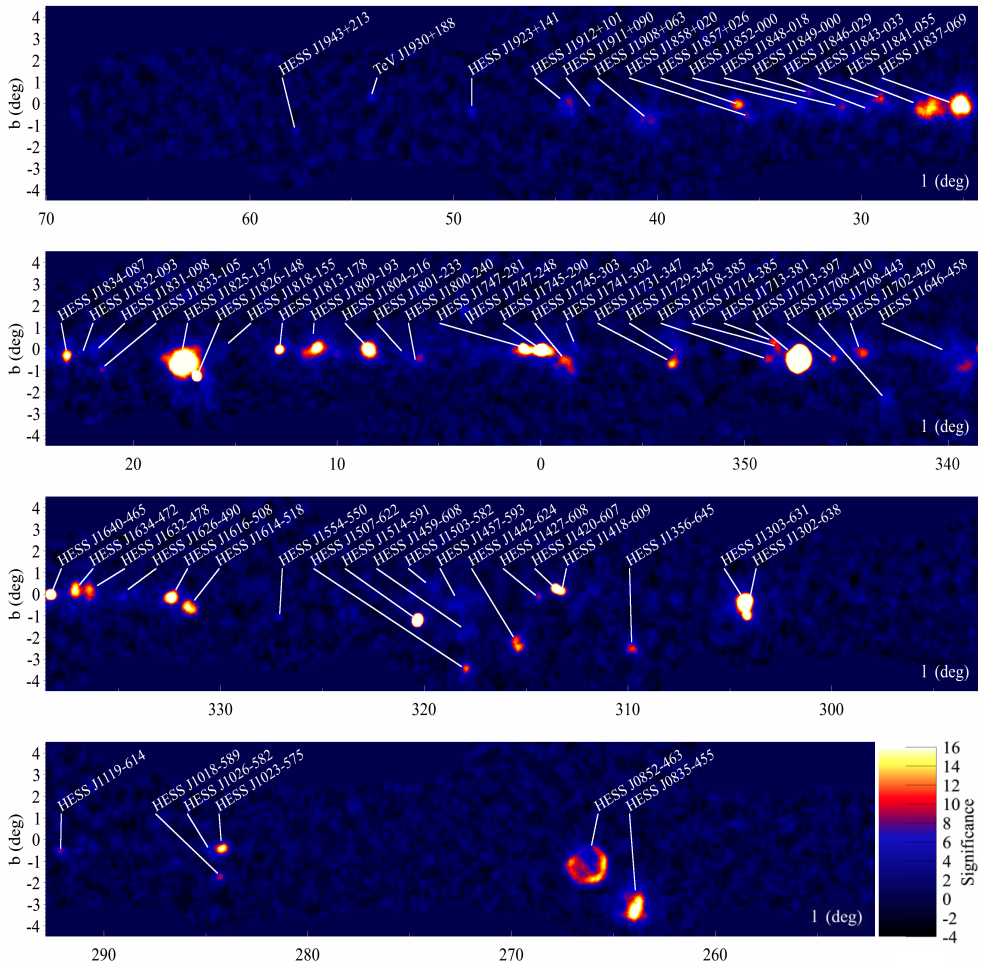

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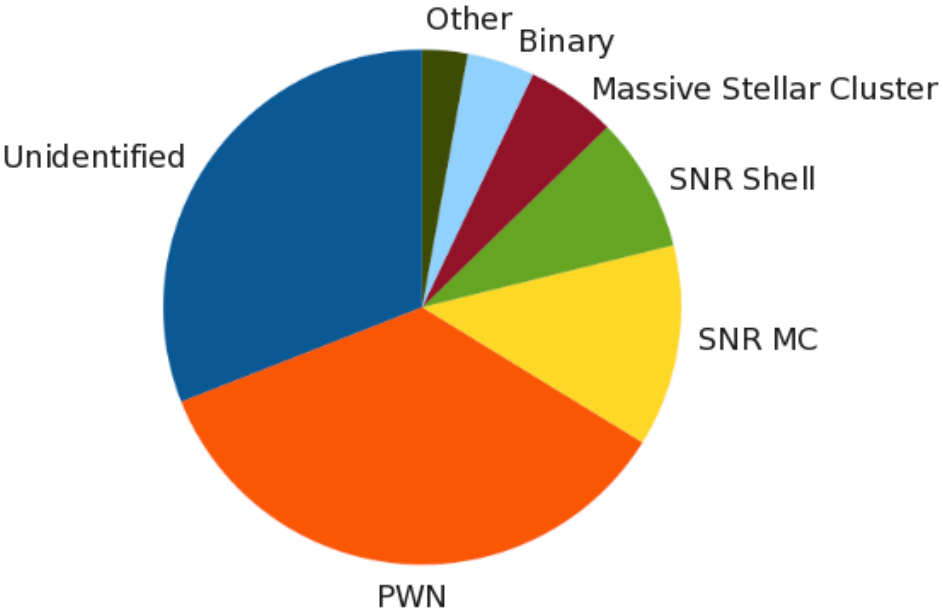

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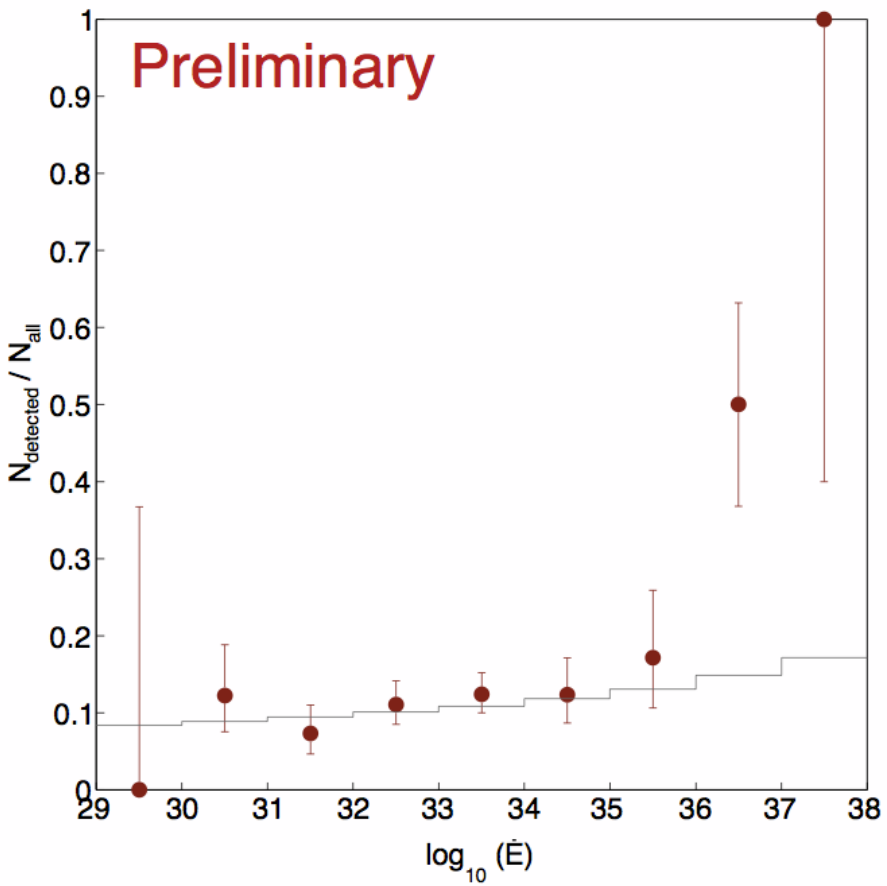
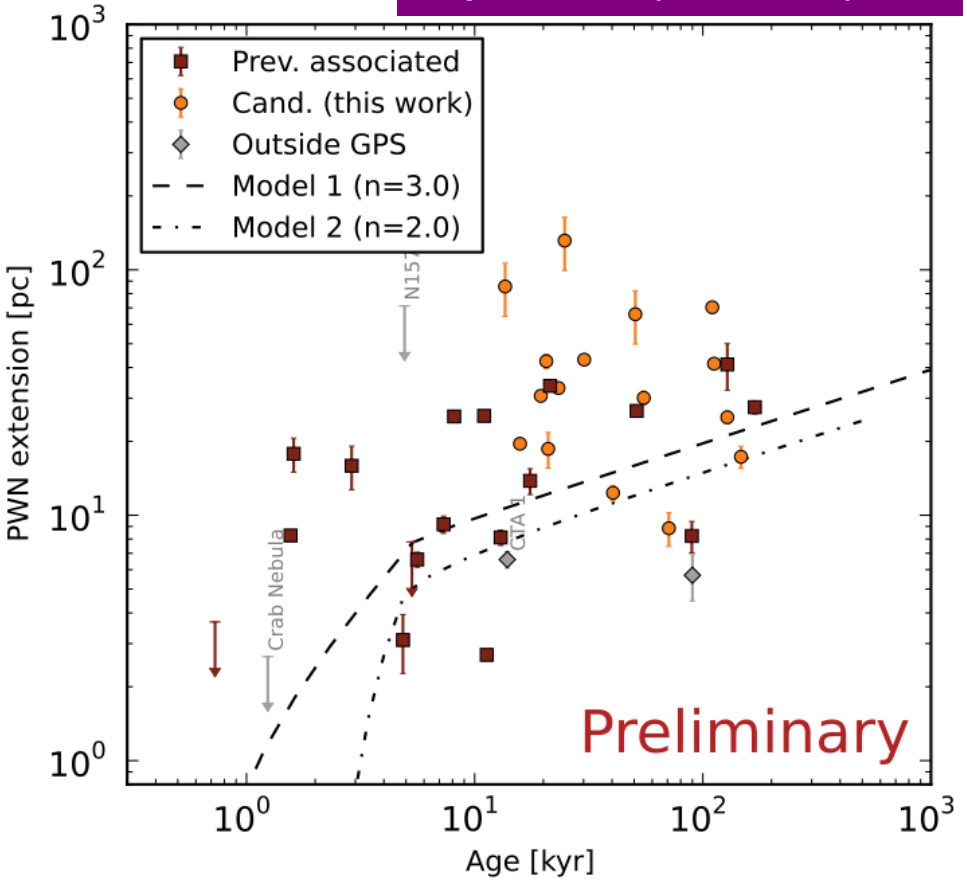
Population Studies based on H.E.S.S. Survey

- example: pulsar wind nebula population (largest class of Galactic TeV sources)



Klepser et al. (HESS Coll) 2013



- Which pulsars power TeV nebulae?
- Derive constraints on evolution models

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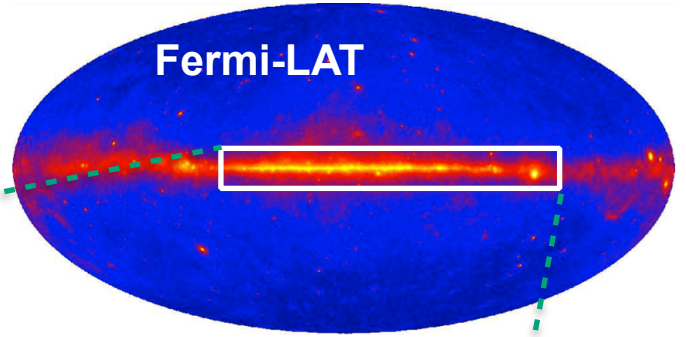
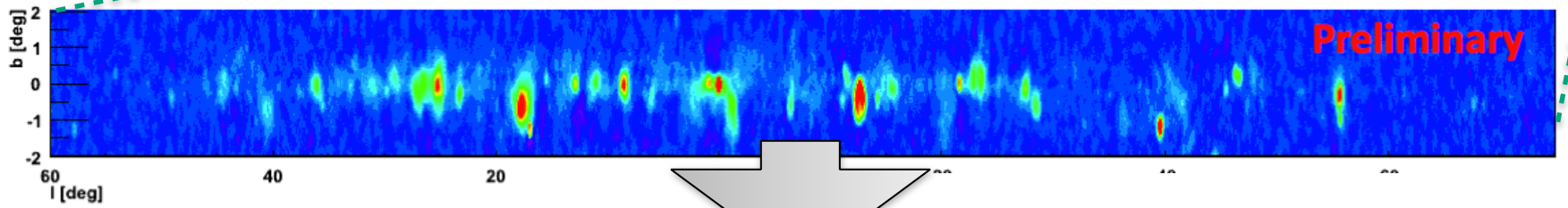
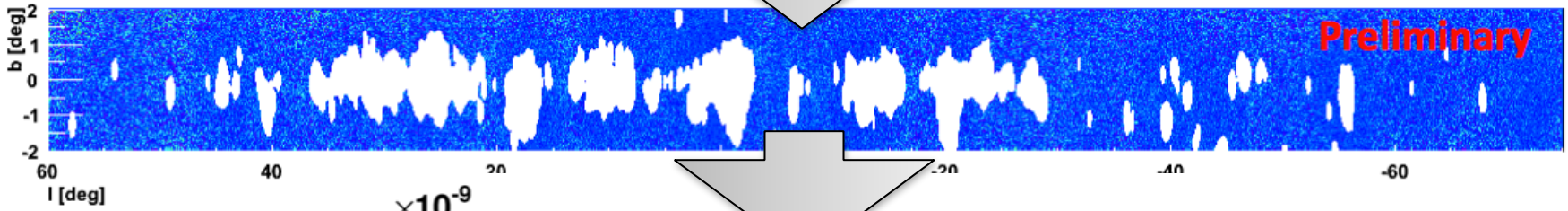
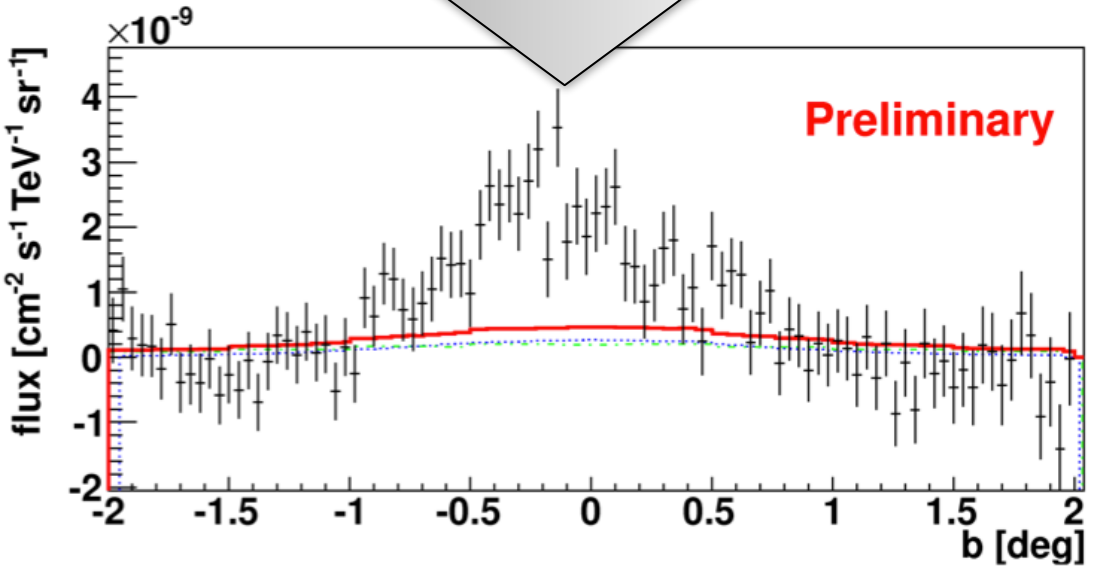
Galactic Diffuse Emission

- GeV energies: diffuse emission dominates Galactic plane
- But what's the level of TeV diffuse emission?









Egberts et al. (HESS Coll) 2013

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The (near) future of H.E.S.S.

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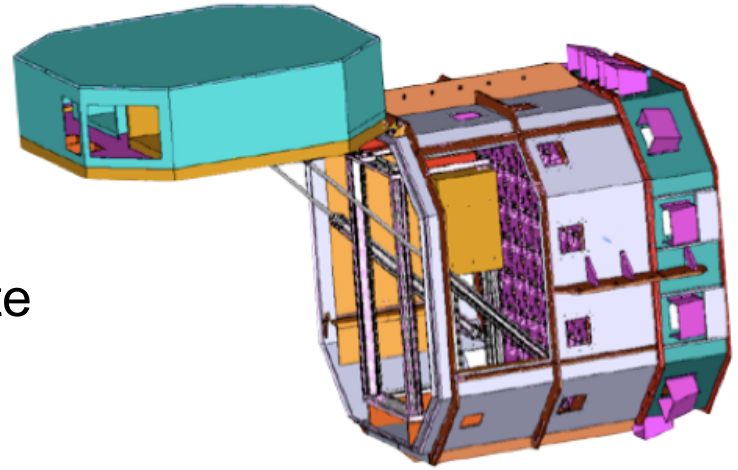
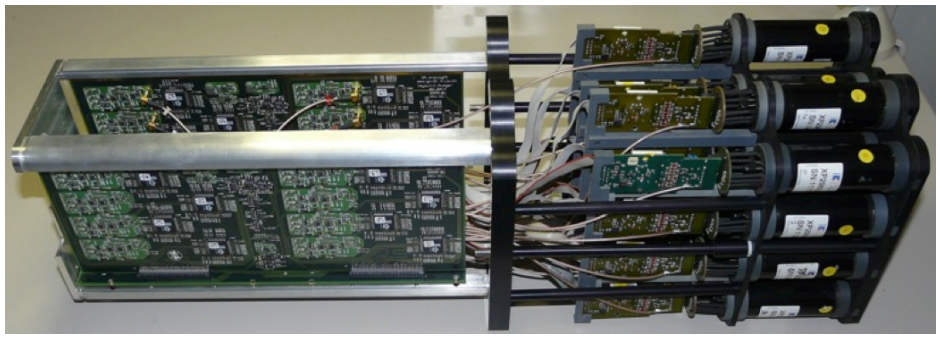
Camera Upgrade (CT1 - CT4)



- CT1-4 cameras operated for 10 years now
  → aging of electronics, increased failure rate
- dead time (450 us) large compared to CT5
  → performance loss in hybrid operation



photos curtesy G. Giavitto (DESY)

- redesign of electronics based on
  NECTAR readout chip (CTA technology)
- keep PMTs and camera housing

current schedule:

- deployment/commissioning 1st camera in 2015
- remaining three cameras in 2016

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Herzlichen Dank!

GEFÖRDERT VOM

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für Bildung
und Forschung

HELMHOLTZ
ASSOCIATION

Alliance for Astroparticle Physics

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