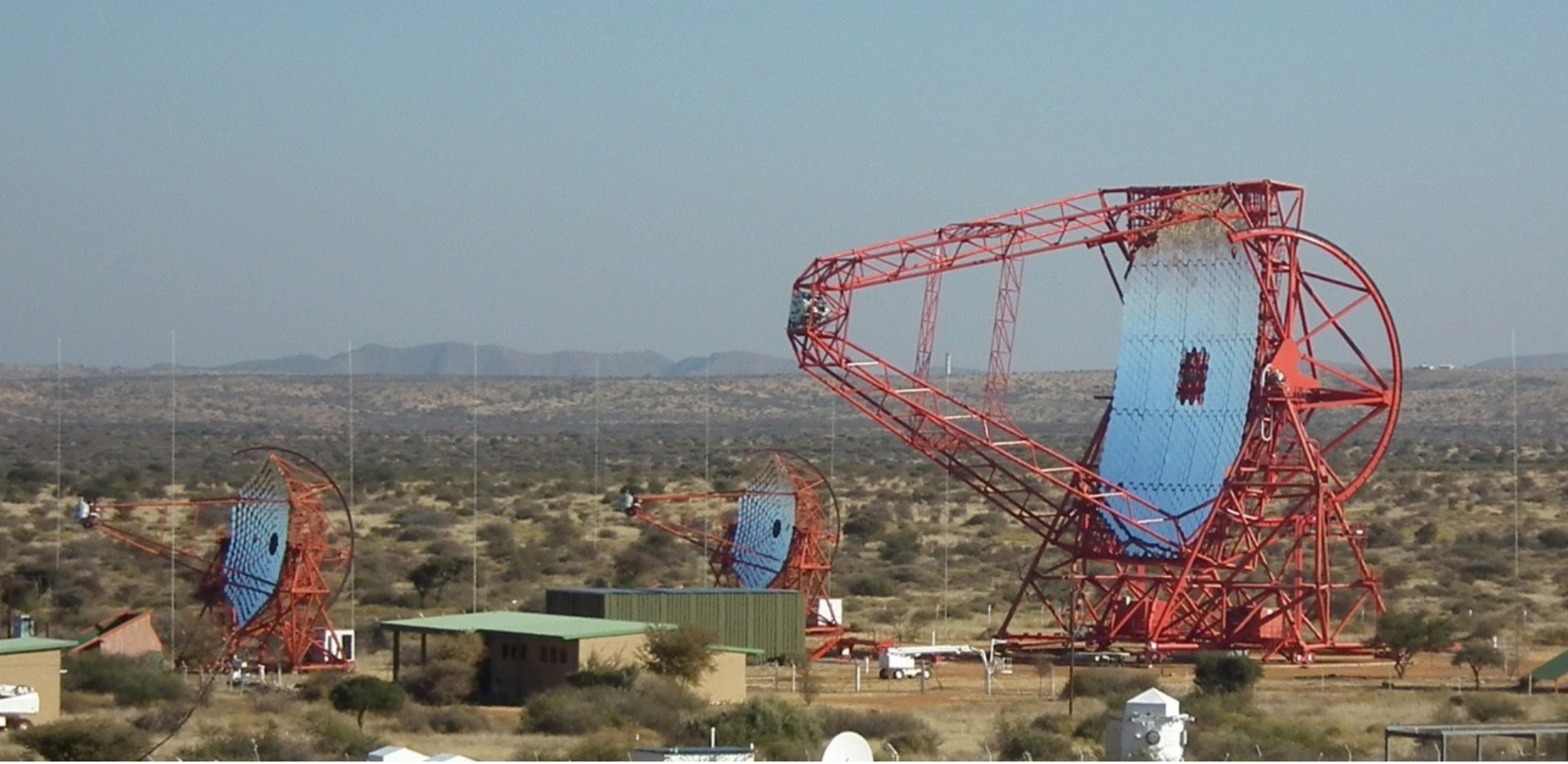
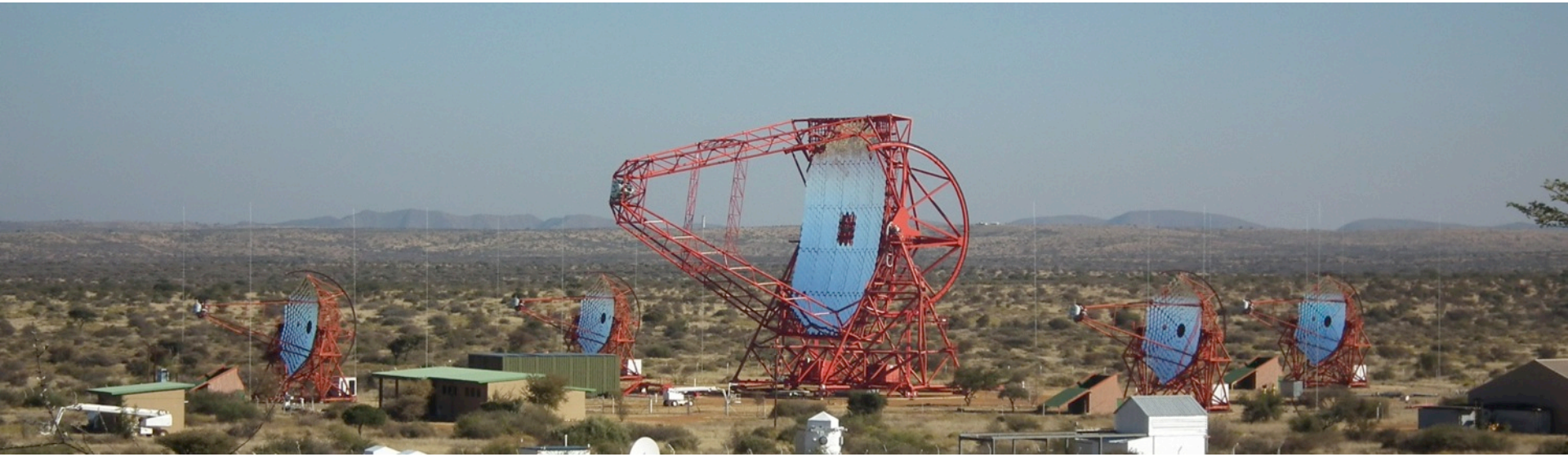


H.E.S.S. Highlights

Pierre Brun for the H.E.S.S. collaboration

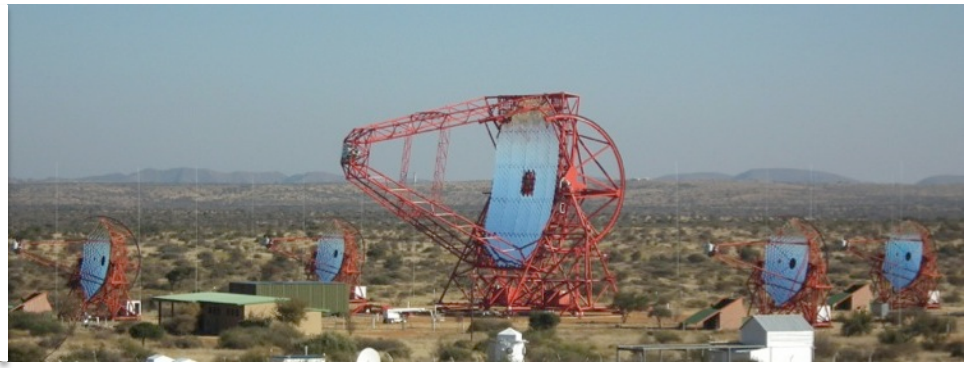
August 2014, Quy Nhon Vietnam

The H.E.S.S. collaboration



- MPI Kernphysik, Heidelberg, Humboldt Univ. zu Berlin, Ruhr-Univ. Bochum, Univ. Erlangen-Nuremberg, Univ. Hamburg, LSW Heidelberg, Univ. Potsdam, Univ. Tübingen, DESY
- Ecole Polytechnique, Palaiseau, APC Paris, Univ. Paris VI-VII, Univ. Bordeaux, Observatory Paris, Meudon, LAPP Annecy, LUPM Montpellier, CEA Saclay, IPAG Grenoble
- Durham Univ., Univ, Leicester, Dublin Inst. for Adv. Studies, GRAPPA U. Amsterdam
- Polish Academy of Sciences; Jagiellonian University, Cracow; Nicolaus Copernicus University, Torun; University of Warsaw, Warsaw
- Univ. Adelaide, North-West Univ., Potchefstroom, Wits Univ., Johannesburg, Univ. of Namibia, Windhoek

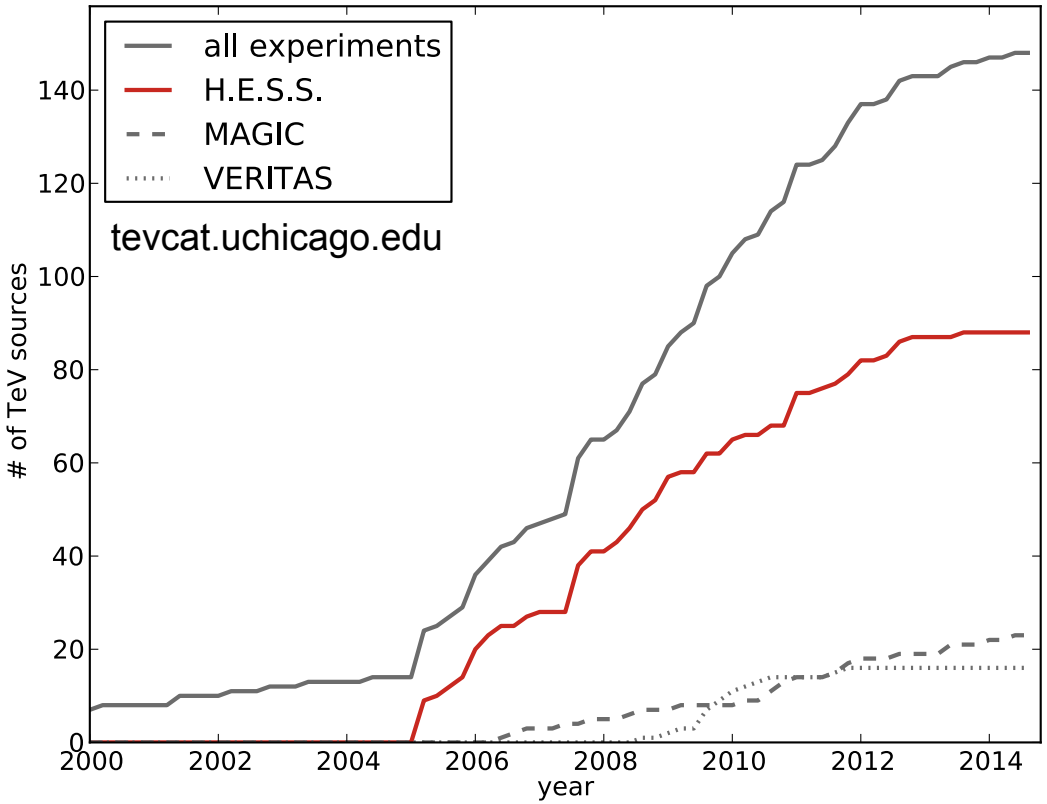
The H.E.S.S. experiment



- H.E.S.S. phase I
  - Four 12 m telescopes
  - FoV 5 deg
  - Energy threshold 100 GeV
  - Angular resolution < 0.1 deg
- H.E.S.S. phase II
  - Four 12 m telescopes
  - One 28 m telescope (FoV 3.5 deg)
  - Energy threshold O(30 GeV)
  - Angular resolution from 0.4 deg to less than 0.1 deg

H.E.S.S. phase I → H.E.S.S. phase II

The H.E.S.S. experiment

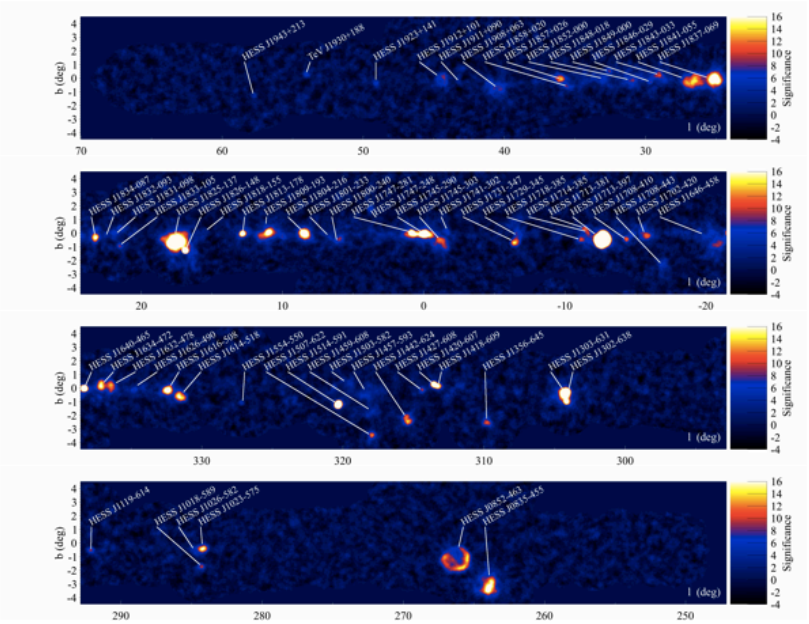


- H.E.S.S. phase I
  - More than 10000 hours of data
  - Discovered over 80 new VHE gamma ray sources
  - Published over 100 scientific papers, plus numerous conference contributions
- H.E.S.S. phase II
  - Towards lower threshold and transients

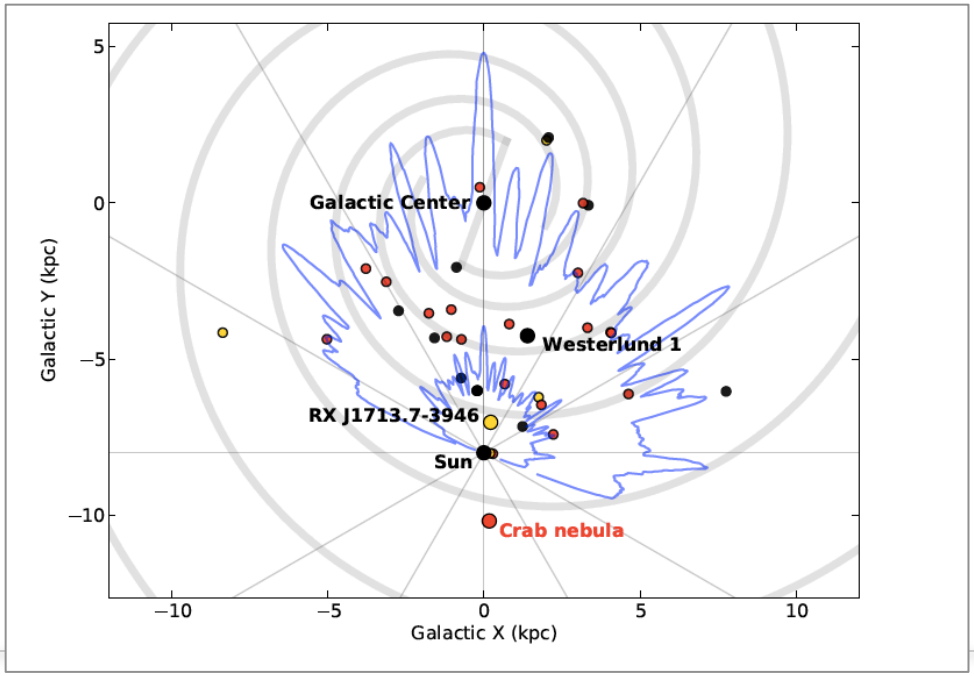
H.E.S.S. phase I H.E.S.S. phase II

H.E.S.S. I Highlights: The Galactic Plane Scan

- Pre-trials significance map, correlation radius 0.1°
- Blue-red transition corresponds to ~5σ post trial

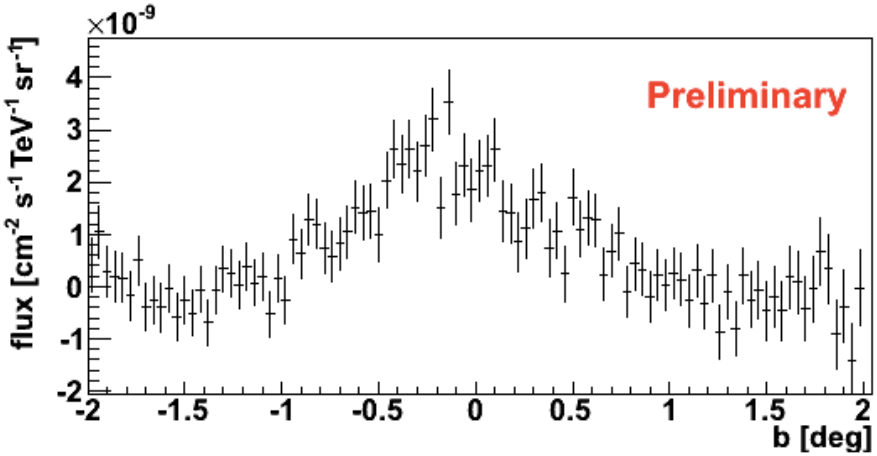


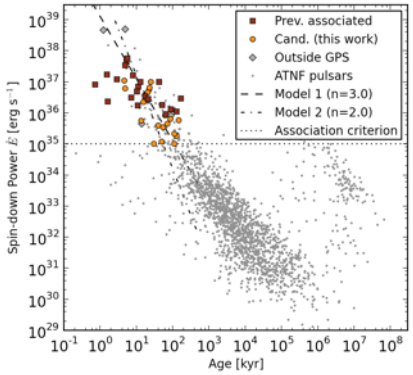
- Blue lines: H.E.S.S. horizons for 1% and 10% Crab
- Dots: H.E.S.S. Galactic sources
  - Red: PWNe
  - Yellow: SNRs
  - Black: other sources

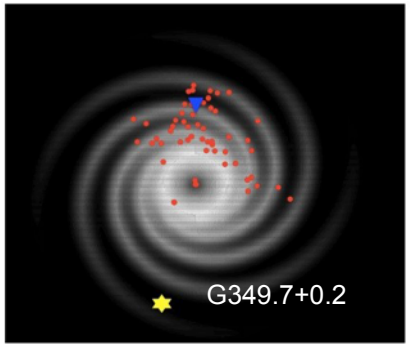


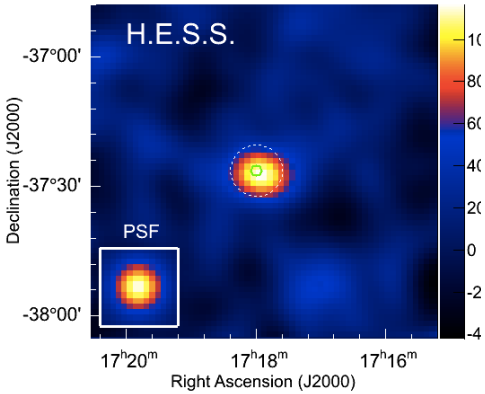
H.E.S.S. I Highlights: A selection

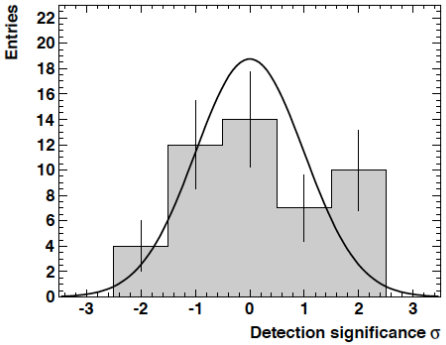
- Diffuse emission
  - After subtraction of sources
- Extreme SNR
  - HESS J1640: The brightest (Stefan Ohm)
  - G349.7+0.2: The farthest
- Pulsar wind nebulae population
- AGN limits
- Many more



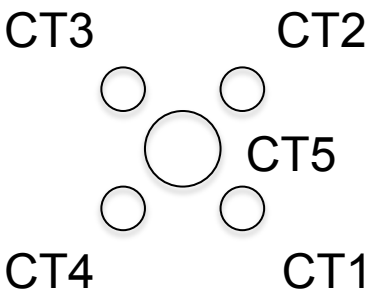




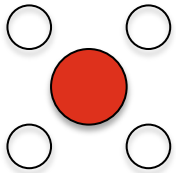




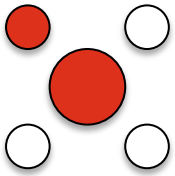
H.E.S.S. phase 2



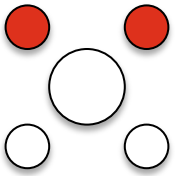
- Operation of the first mixed system of Cherenkov telescopes
- Trigger



CT5 mono
65%



CT5 + ≥ 1 CT1-4
30%

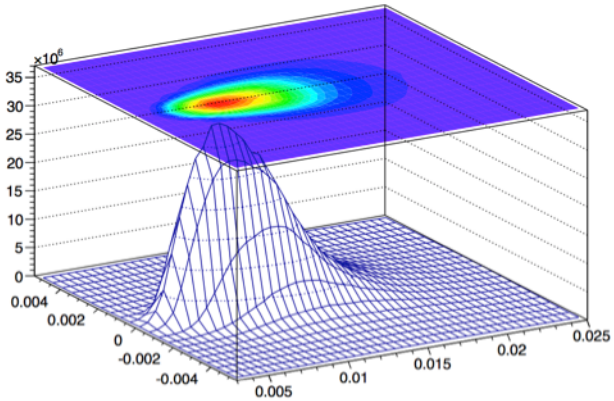


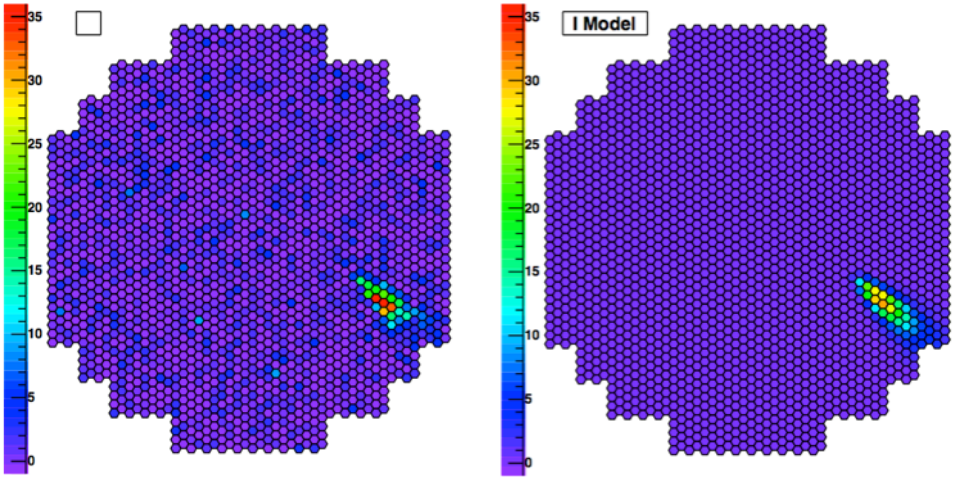
≥ 2 CT1-4
5%

  - All configurations simultaneously
- Analysis
  - **CT5 mono: presented here**
  - Full H.E.S.S. array analysis under study

Single telescope reconstruction

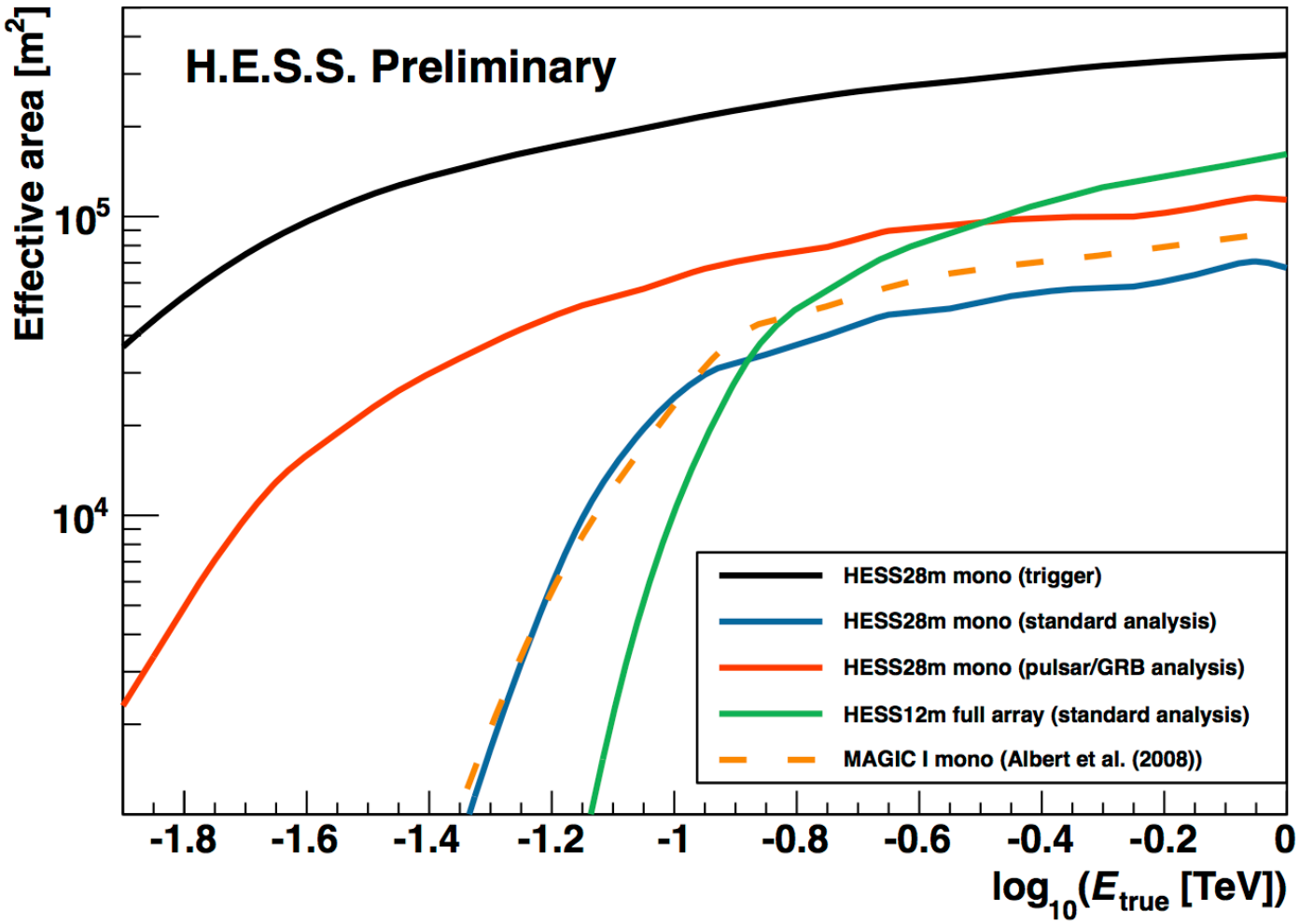
- Template (model) based photon reconstruction
  - Adapted from de Naurois et al APh 32, 231 (2009)
- Standard analysis
  - Optimized for source observations
- PSR/GRB analysis
  - Optimized for low E detections
- Template (MC) based photon reconstruction
  - ImPACT, Dan Parsons





camera event fit

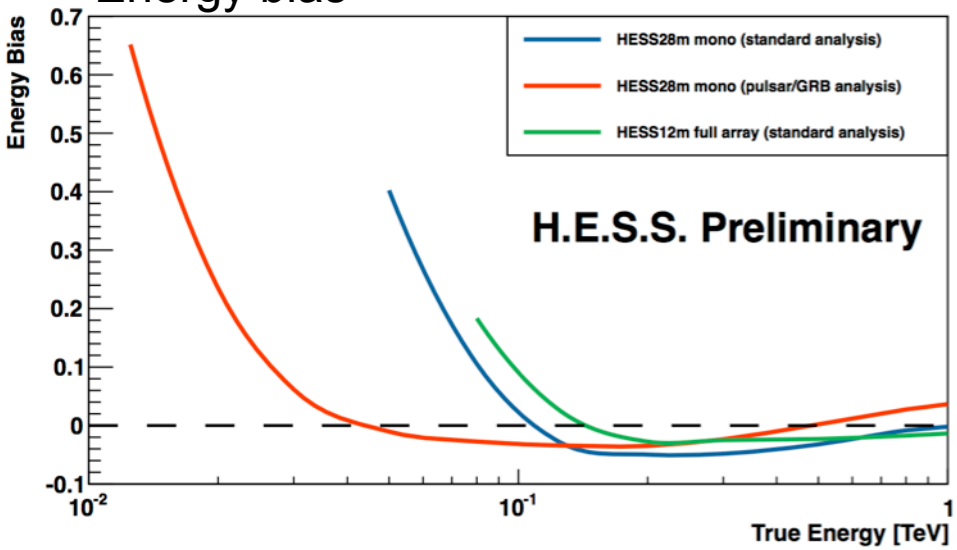
Collection area



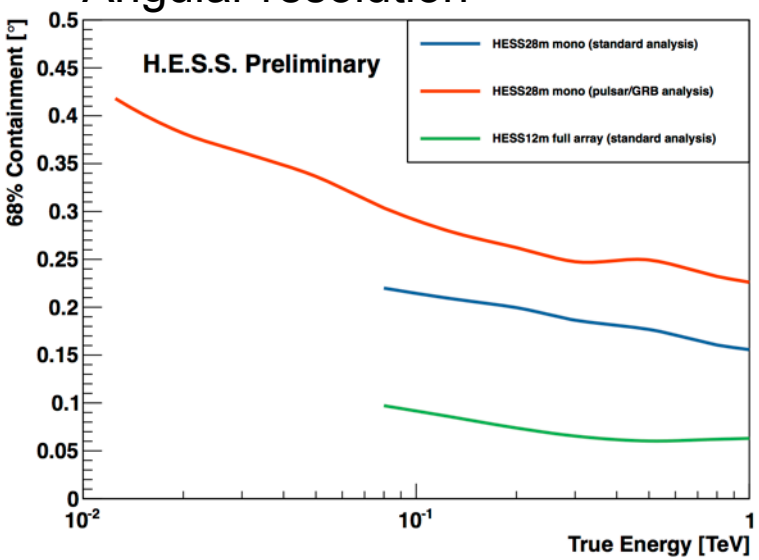
Energy and angular resolution

	Energy resolution	Angular resolution
Standard analysis	30%	0.2 deg
Pulsar/GRB analysis	30% - 40%	0.3 - 0.4 deg

Energy bias

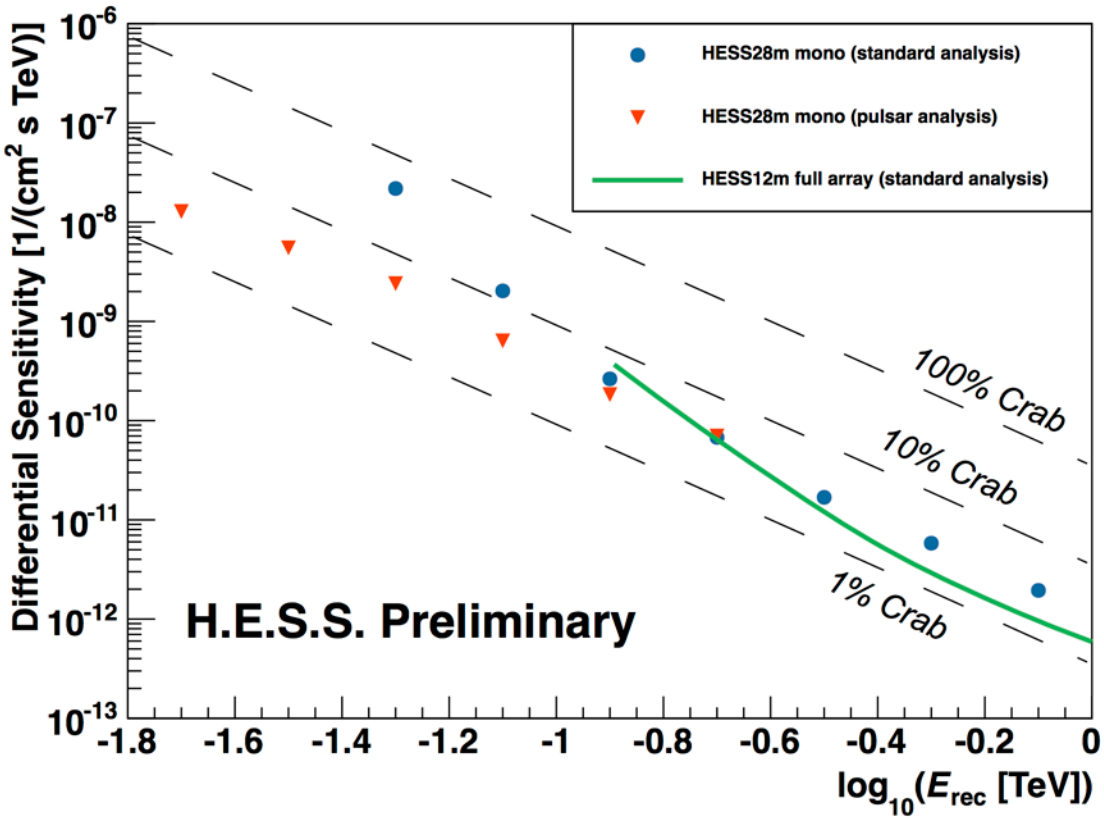


Angular resolution

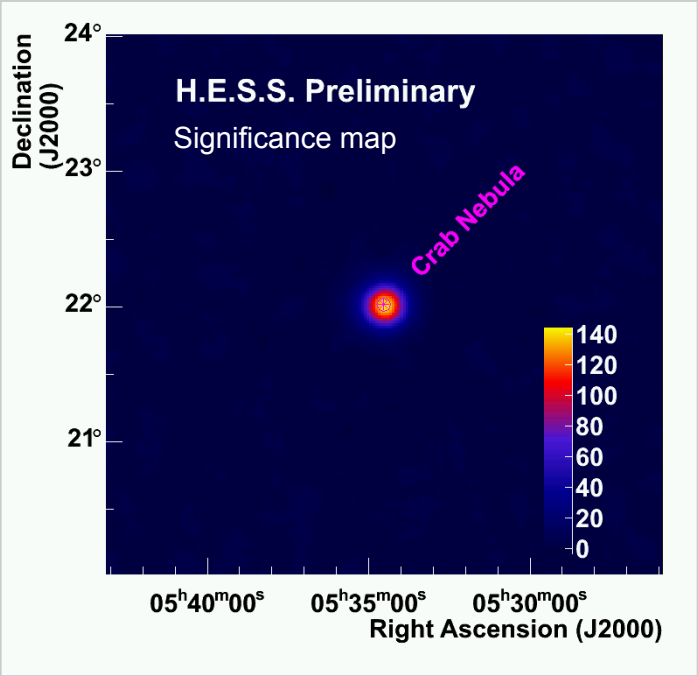


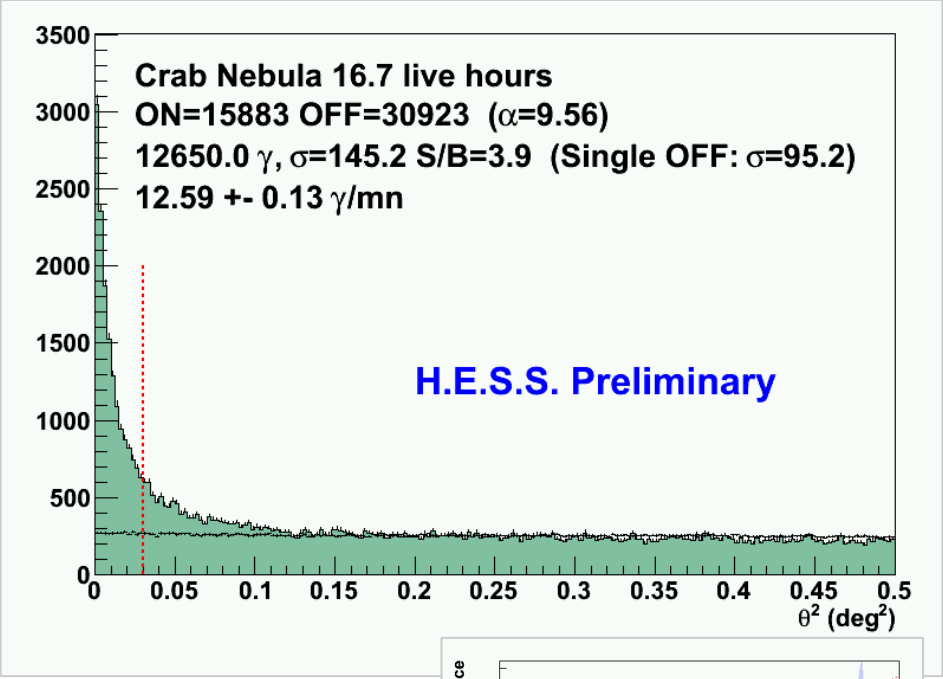
Sensitivity

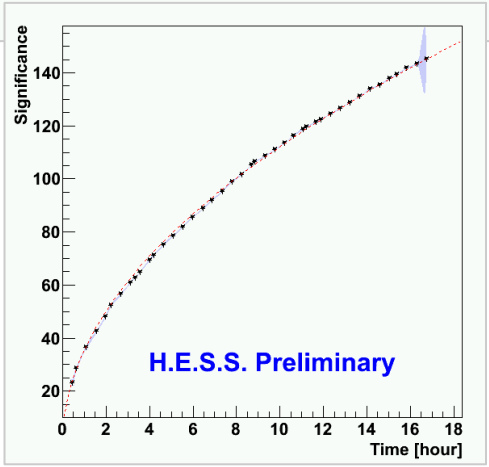
- Standard analysis
  - 5σ in 100 h
  - 5% background systematics
- Pulsar analysis
  - 5σ in 100 h
  - No background systematics



The Crab with H.E.S.S. II

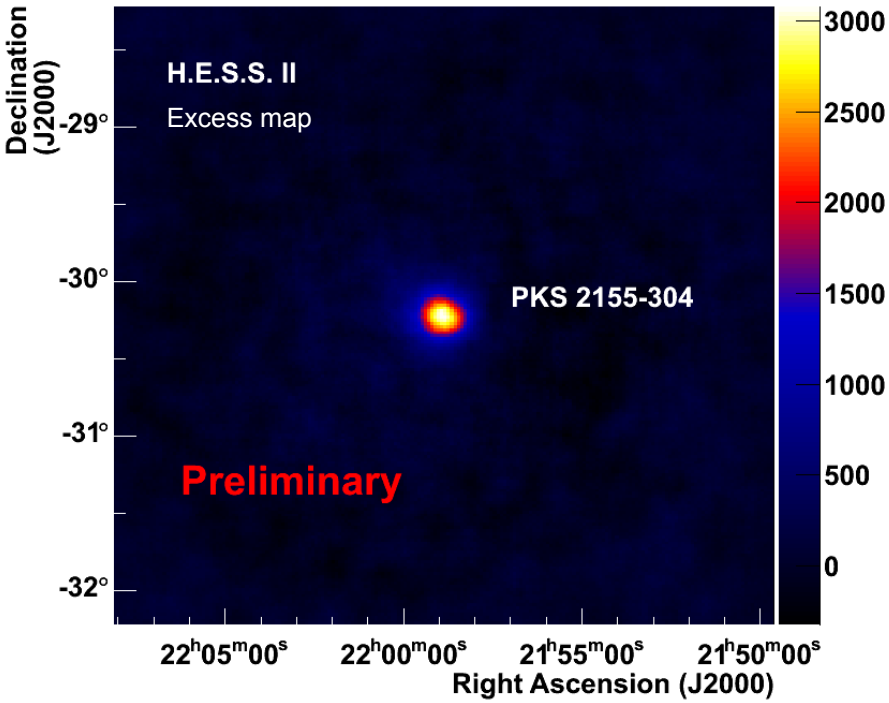


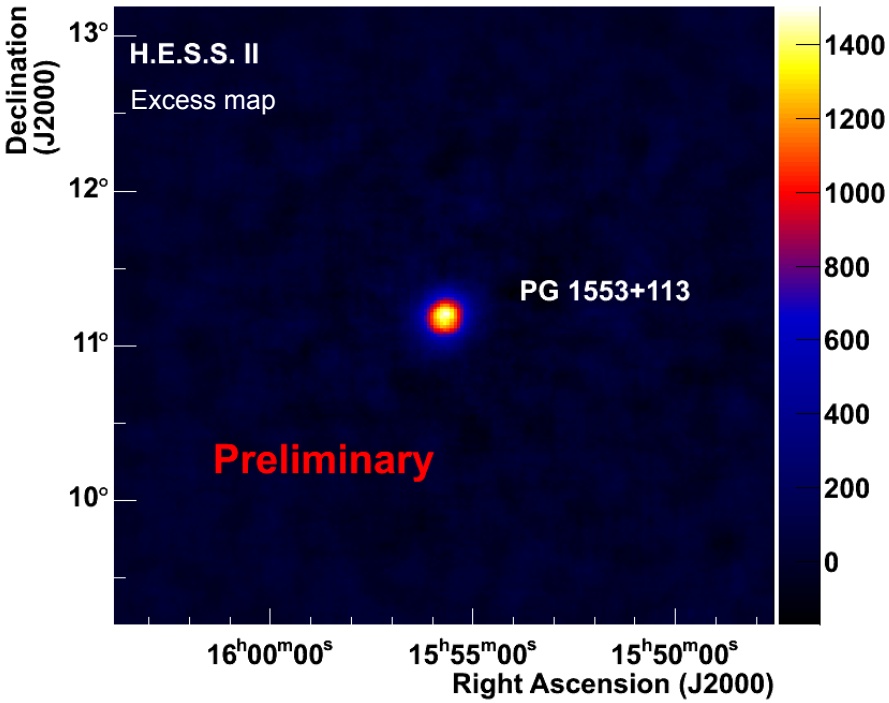




- <zenith> = 48 deg
- Standard analysis
  - Photon rate = 12.6 ± 0.1 γ/mn
  - MC expectation = 13 γ/mn

AGN seen with HESS 28m

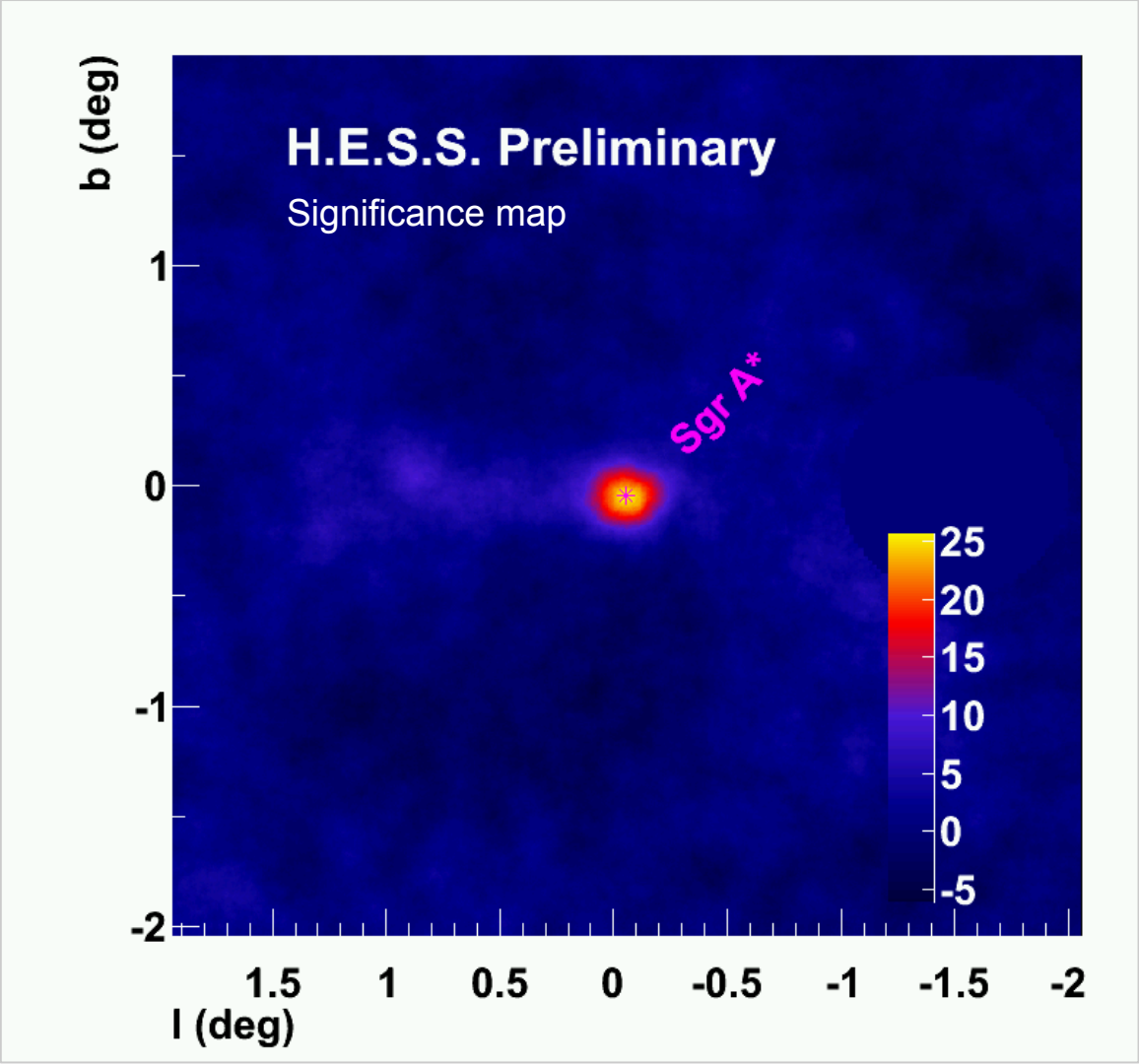




	Live time	Excess	Sign.	Rate
PKS 2155-304	35.7 h	3669 γ	29 σ	1.71 ± 0.06 γ/mn
PG 1553+113	15.4 h	2358 γ	25 σ	2.55 ± 0.11 γ/mn

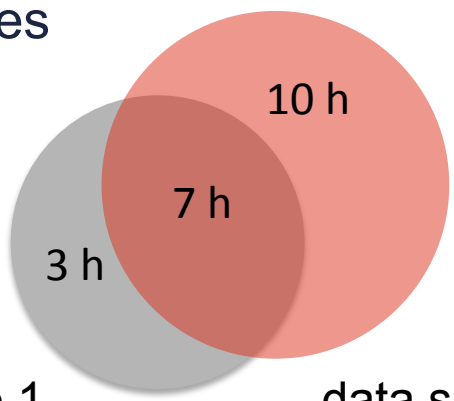
The Galactic Center

- The Galactic Center is one of the most complicated regions
- Observation and analysis
  - Live time 68.8 h
  - Signal with 25 σ
  - Extended emission
- Background needs to be further studied
- More from H.E.S.S. I observations



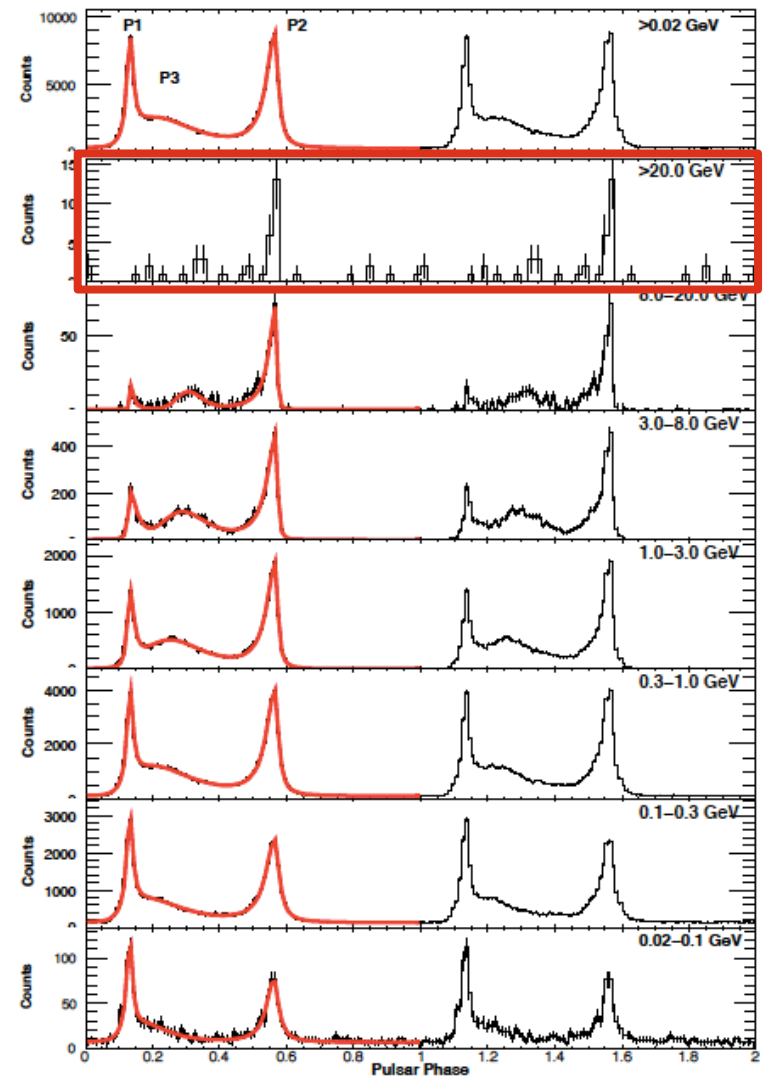
The Vela pulsar

- Observation
  - Livetime 20 h
  - Zenith angle : 27 deg – 35 deg
- PSR analysis
  - Optimized cuts for low energies
- Data samples



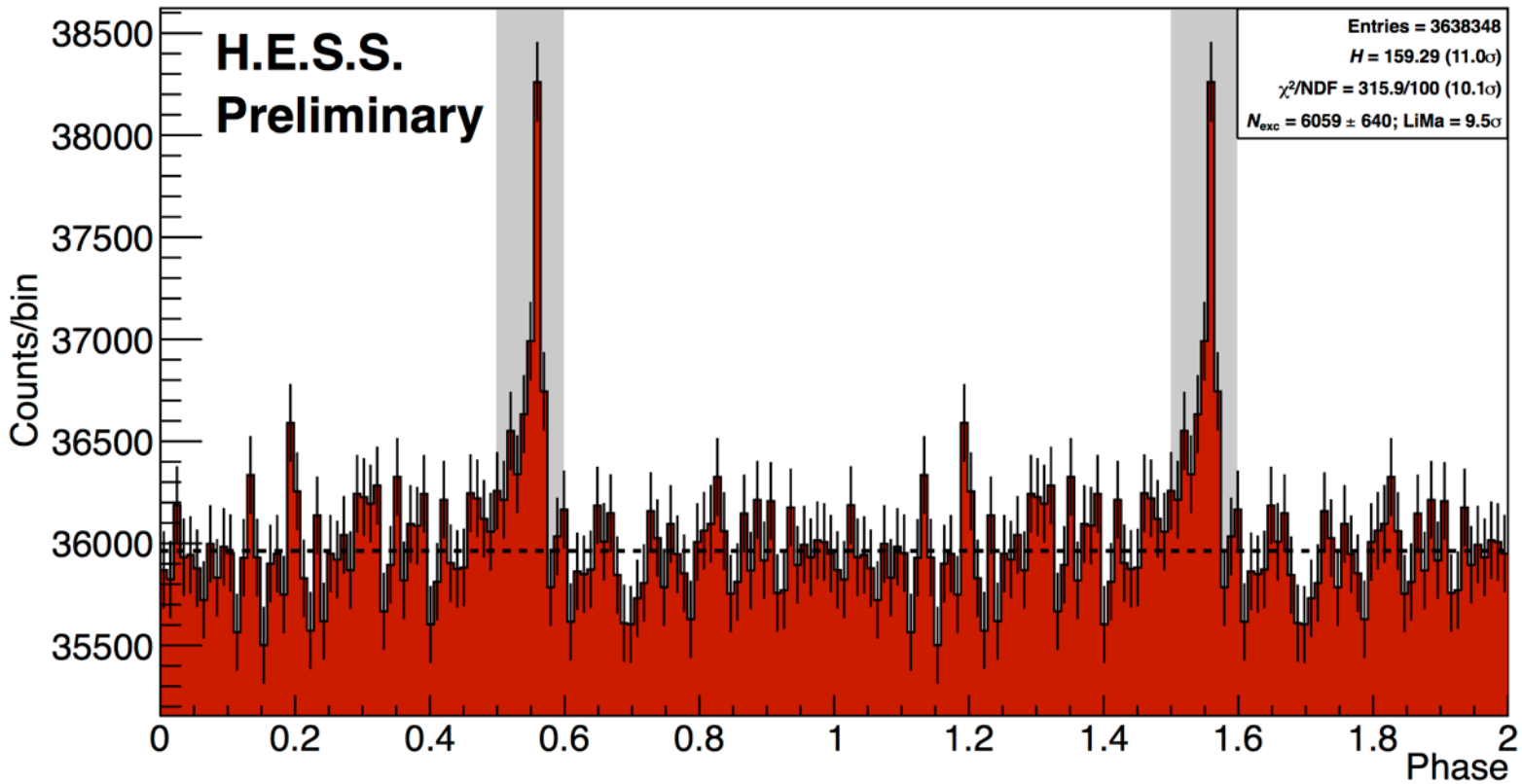
data sample 1 data sample 2

Fermi-LAT, arXiv:1002.4050



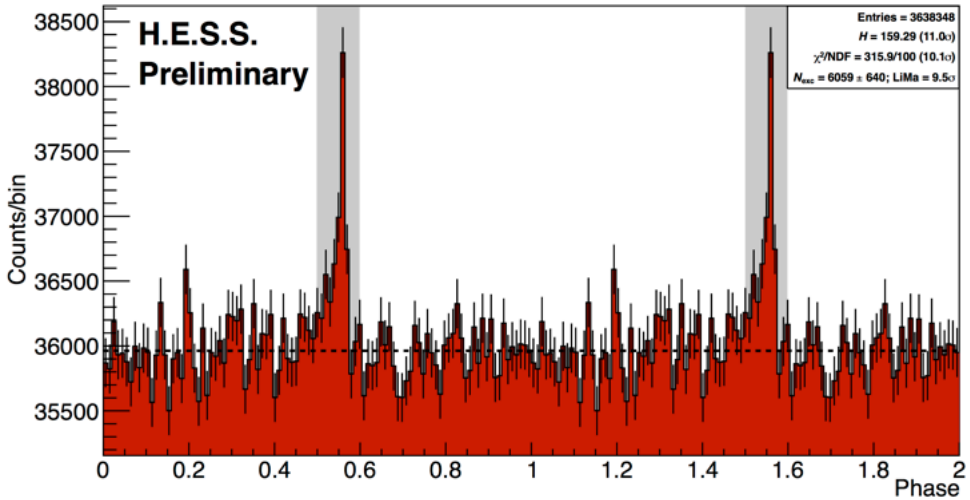
The Vela pulsar seen with H.E.S.S. phase 2

data sample 2

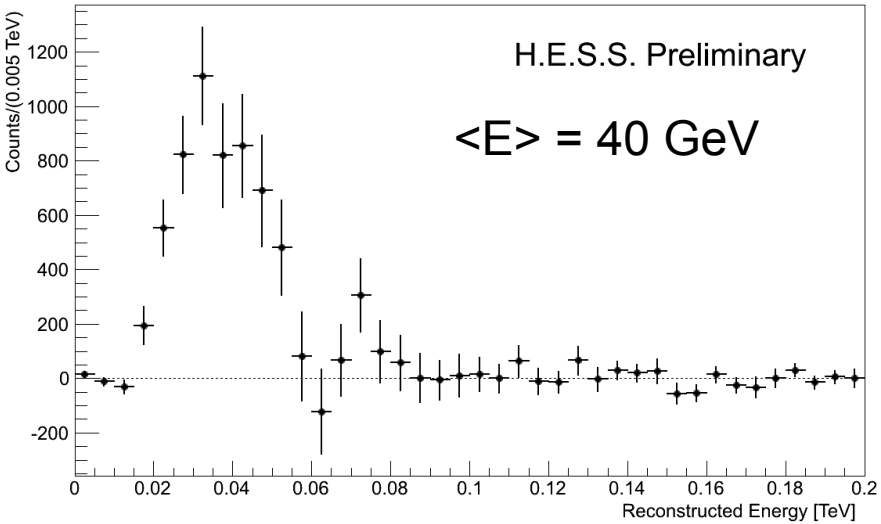


- Significance 9.5 σ
- N_{excess} = 6059 ± 640

The Vela pulsar seen with H.E.S.S. phase 2

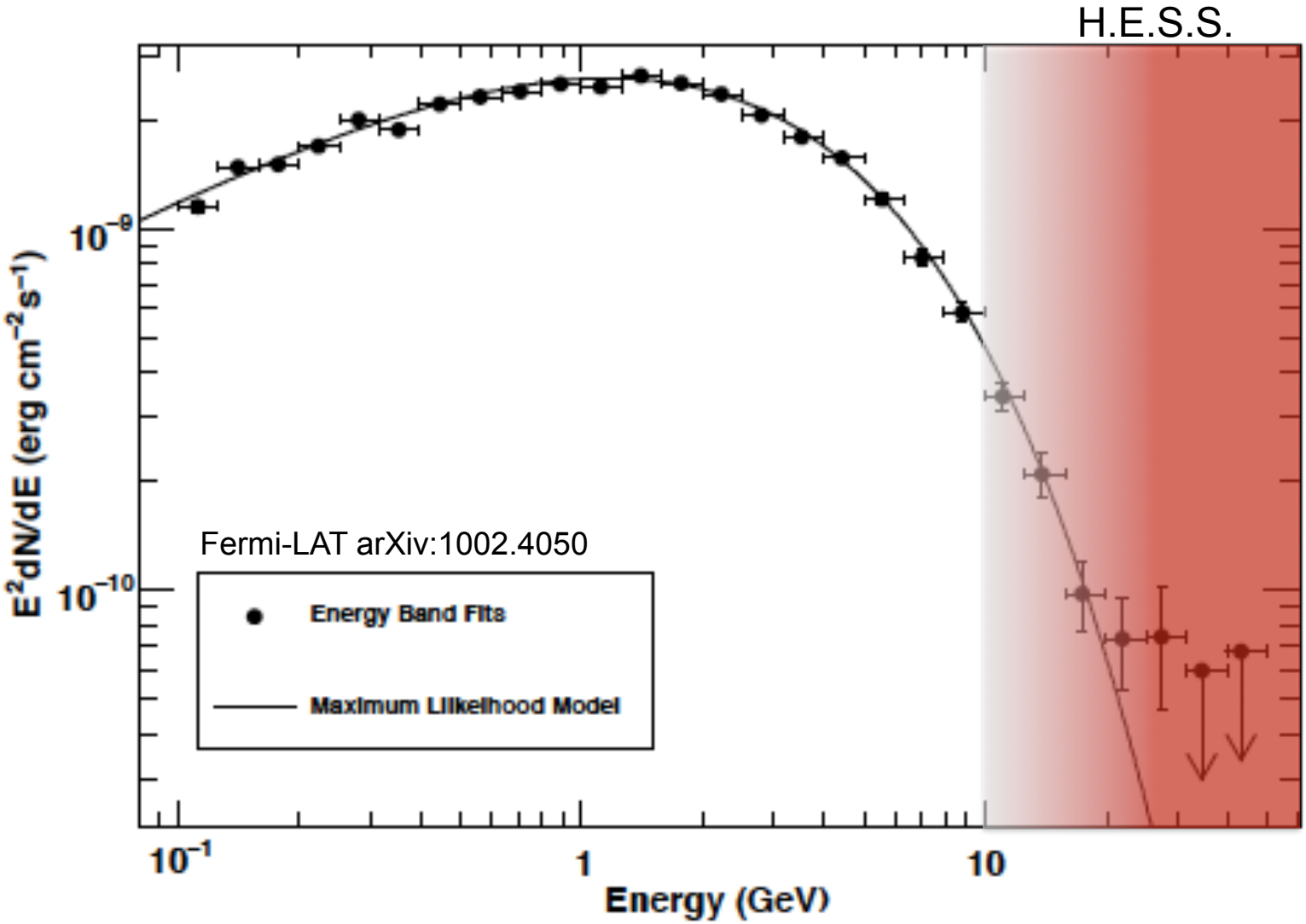


Energy distribution

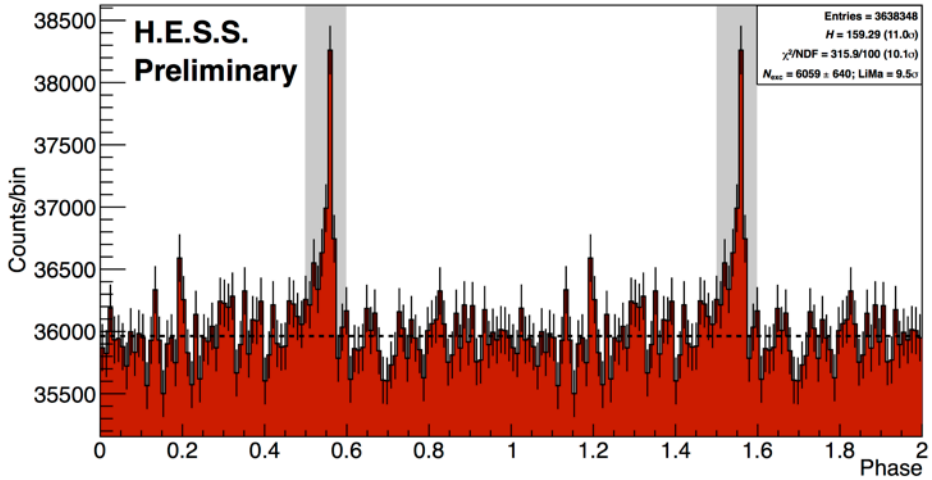


- Pulsar physics (not only Vela)
  - What is the spectrum above 20 GeV?
  - Constraining the cut-off?

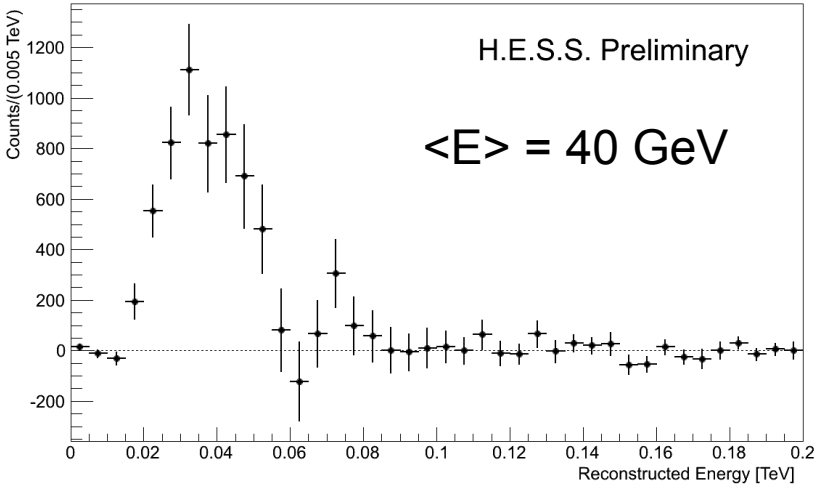
The Vela pulsar spectrum



The Vela pulsar seen with H.E.S.S.

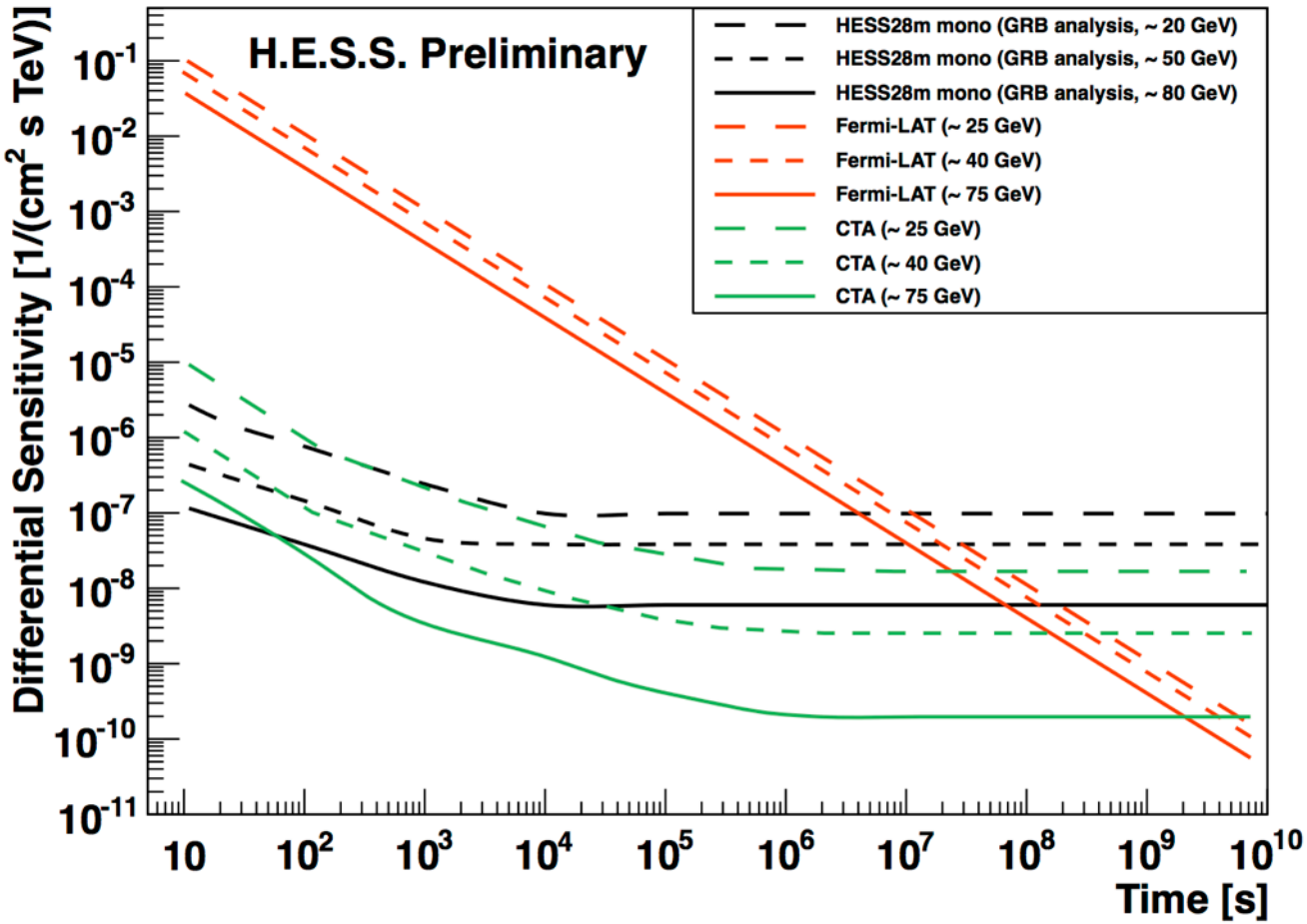


Energy distribution



- For H.E.S.S.
  - Calibration source at the threshold in standard observation mode
  - Well prepared for GRB search

Transients with H.E.S.S. phase 2

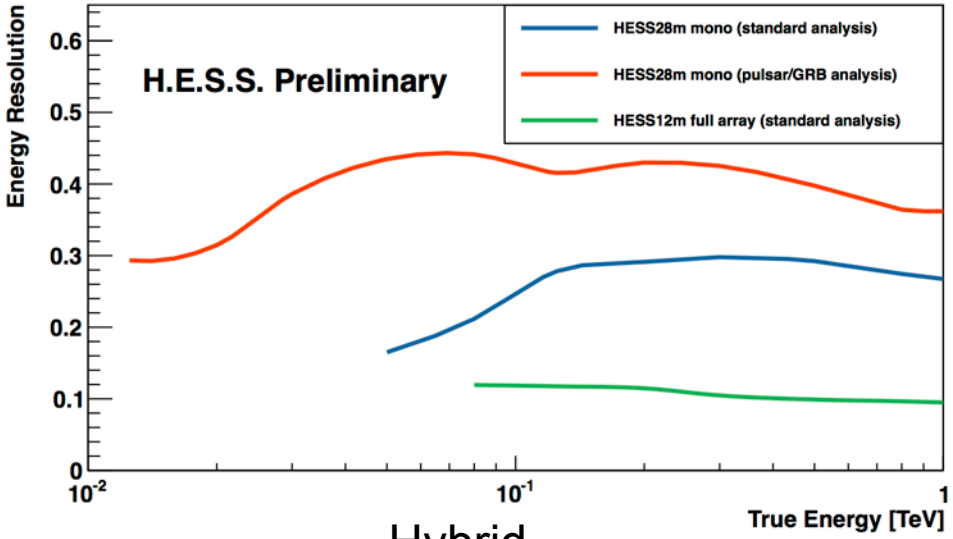


Adapted from Funk & Hinton

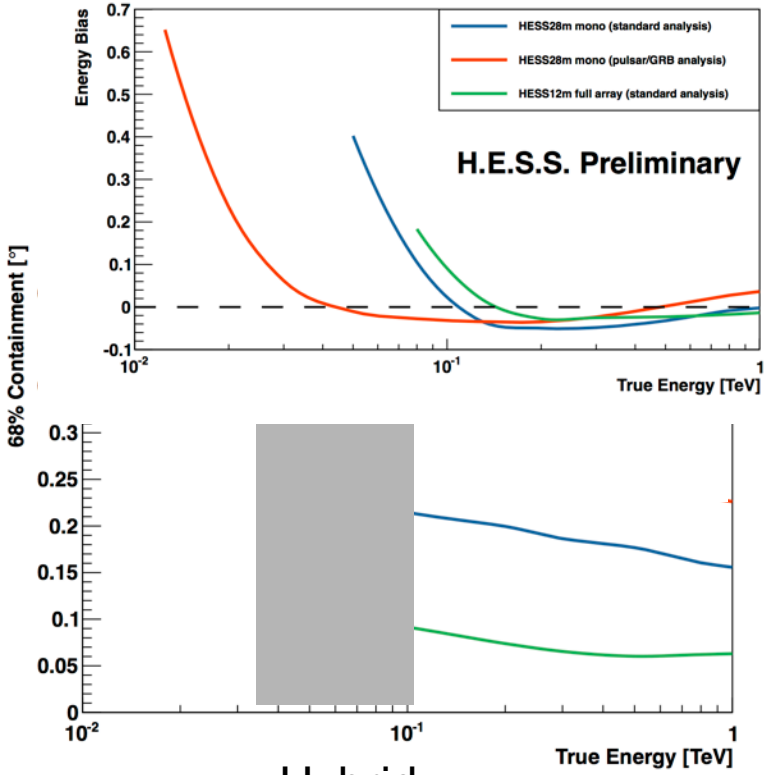
Summary

- H.E.S.S. phase 2, including the 28 m telescope is
  - Measuring point sources and extended sources
  - Filling the gap between Fermi-LAT and IACTs
- Exciting times ahead

Energy and angular resolution



Hybrid



Hybrid

	Energy resolution	Angular resolution
Standard analysis	30%	0.2 deg
Pulsar/GRB analysis	30% - 40%	0.4 deg