

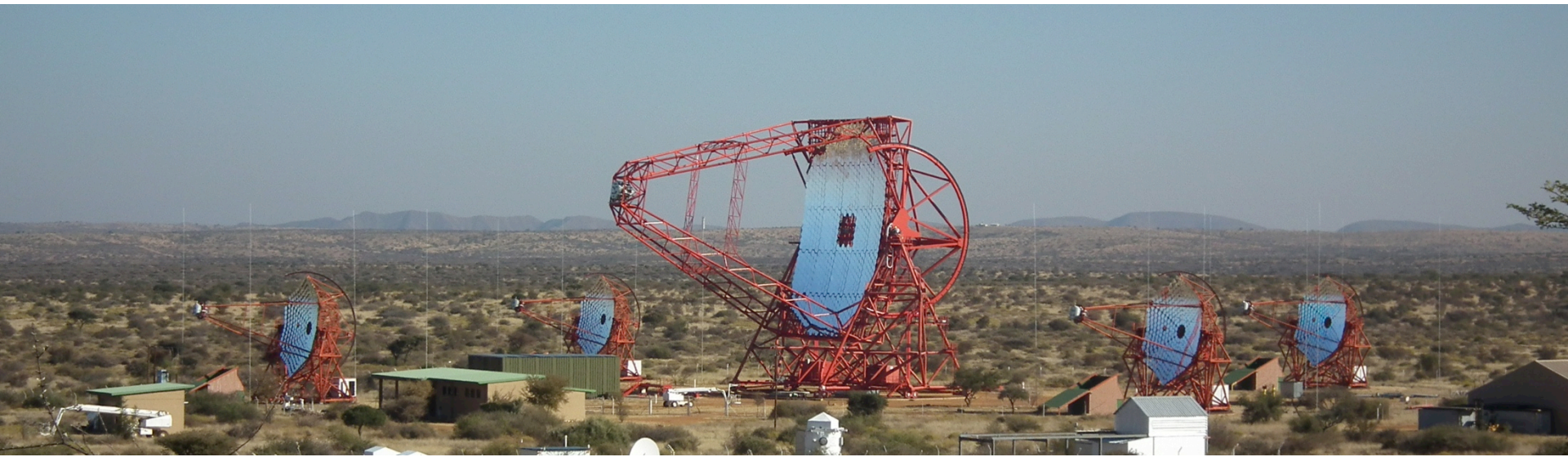


H.E.S.S. Highlights



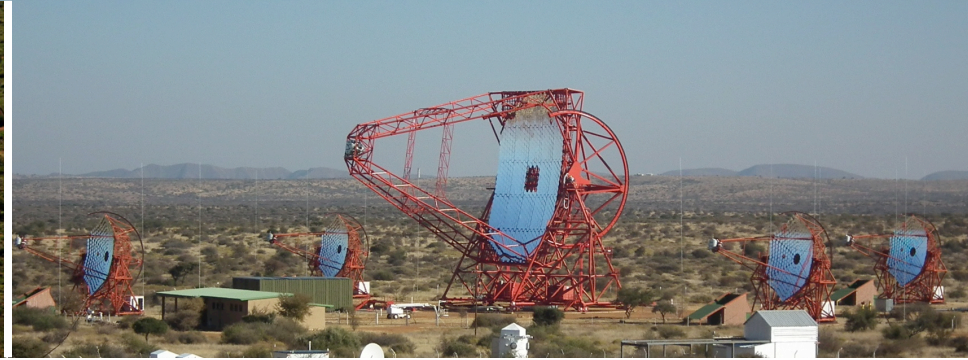
**Christian Stegmann for the H.E.S.S. collaboration
Astroparticle Physics 2014 - A joint TeVPA / iDM conference
June 2014, Amsterdam**

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
- Stockholm University, Royal Institute, Linnaeus University, 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 12m telescopes
- FoV 5 deg
- energy threshold 100 GeV
- angular resolution < 0.1 deg

■ H.E.S.S. phase II

- four 12m telescopes
- one 28m telescope (FoV 3.5 deg)
- energy threshold $O(30)$ GeV
- angular resolution from 0.4 deg to less than 0.1 deg

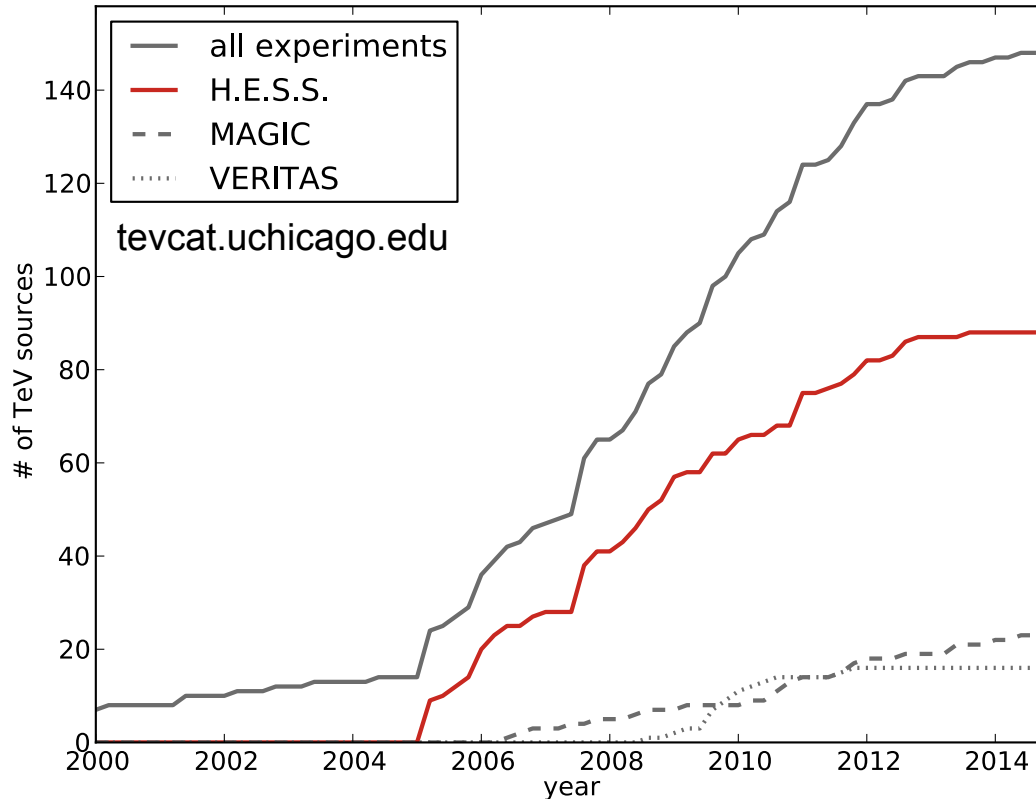


H.E.S.S. phase I

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

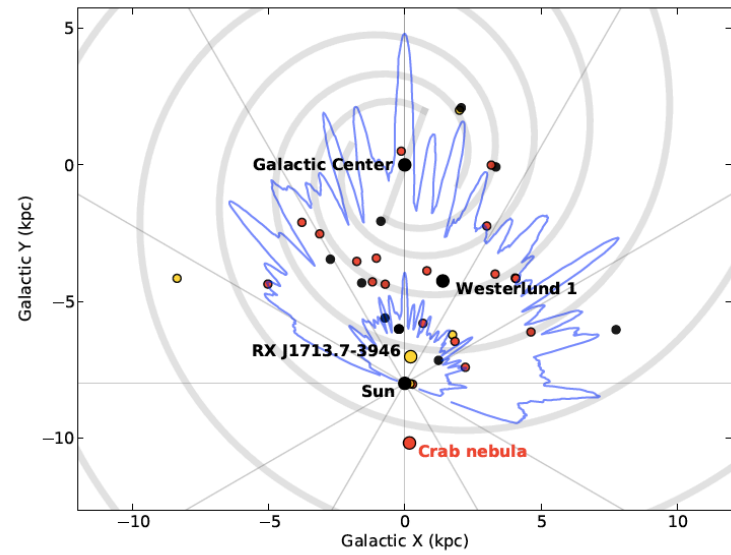
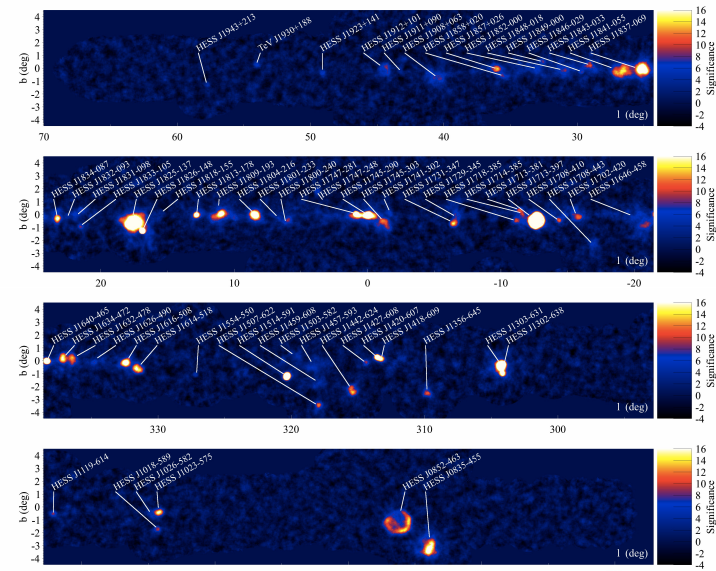
H.E.S.S. phase I

H.E.S.S. phase II



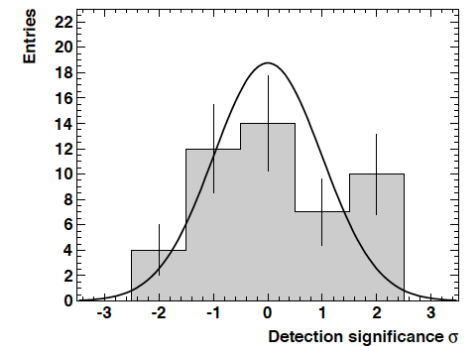
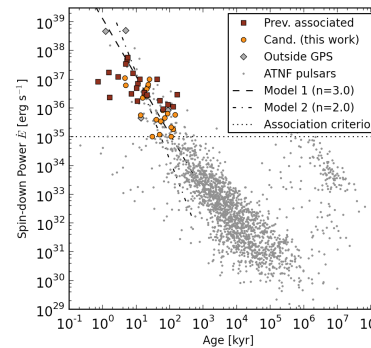
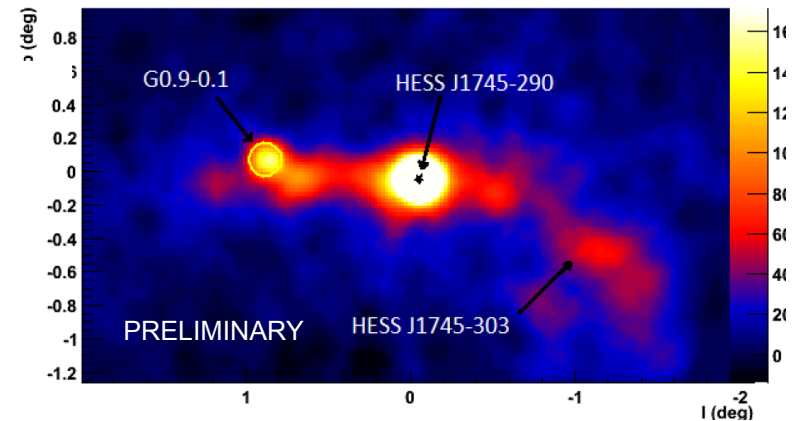
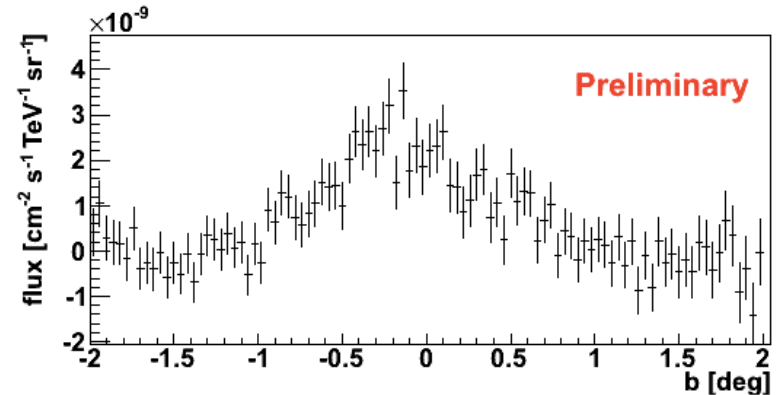
H.E.S.S. I Highlights: The Galactic Plane Scan

- Pre-trials significance map, correlation radius 0.1°
- Blue-red transition corresponds to $\sim 5\sigma$ 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



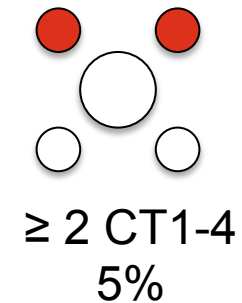
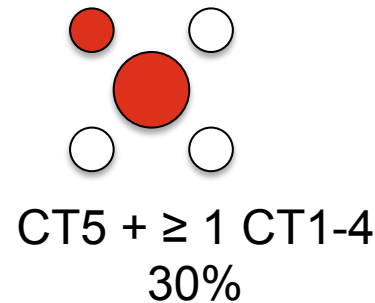
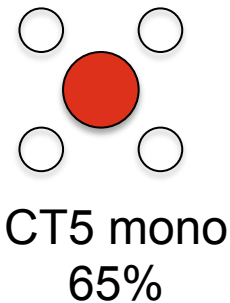
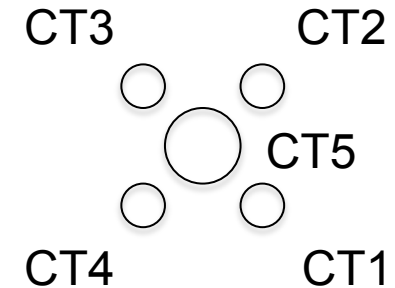
H.E.S.S. I Highlights: A selection

- Diffuse emission
 - after subtraction of sources
- Galactic center
 - (Aion Viana ID282)
- Extreme SNR
 - HESS J1640: The brightest (Stefan Ohm, ID115)
 - G349.7+0.2: The farthest
- Population studies
 - Pulsar wind nebulae population
 - AGN limits
- many more



H.E.S.S. II

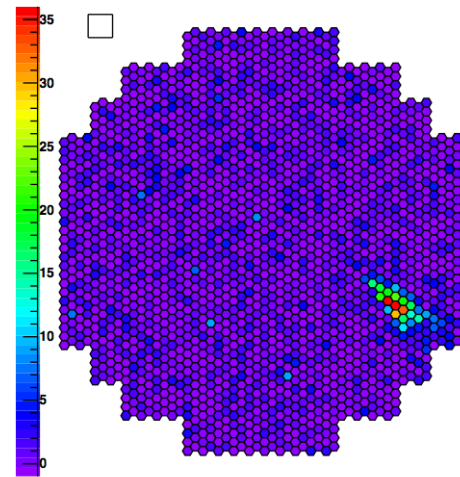
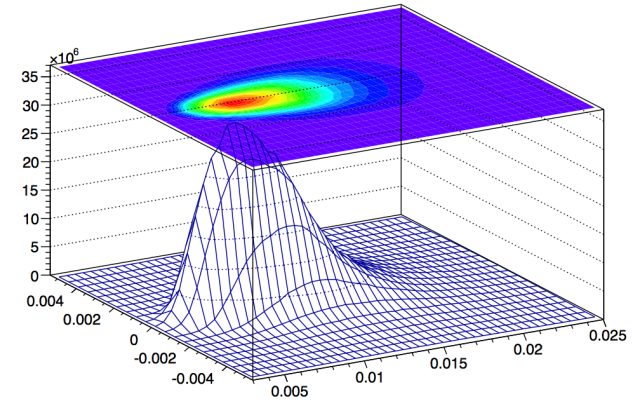
- Operation of the first mixed system of Cherenkov telescopes
- Trigger
 - all configurations simultaneously



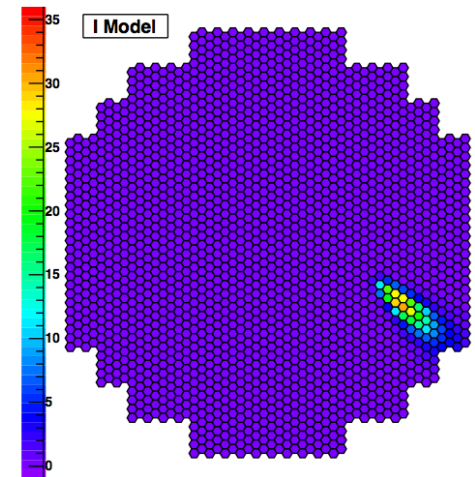
- Analysis
 - **CT5 mono: presented here**
 - full H.E.S.S. array analysis under study

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, ID215

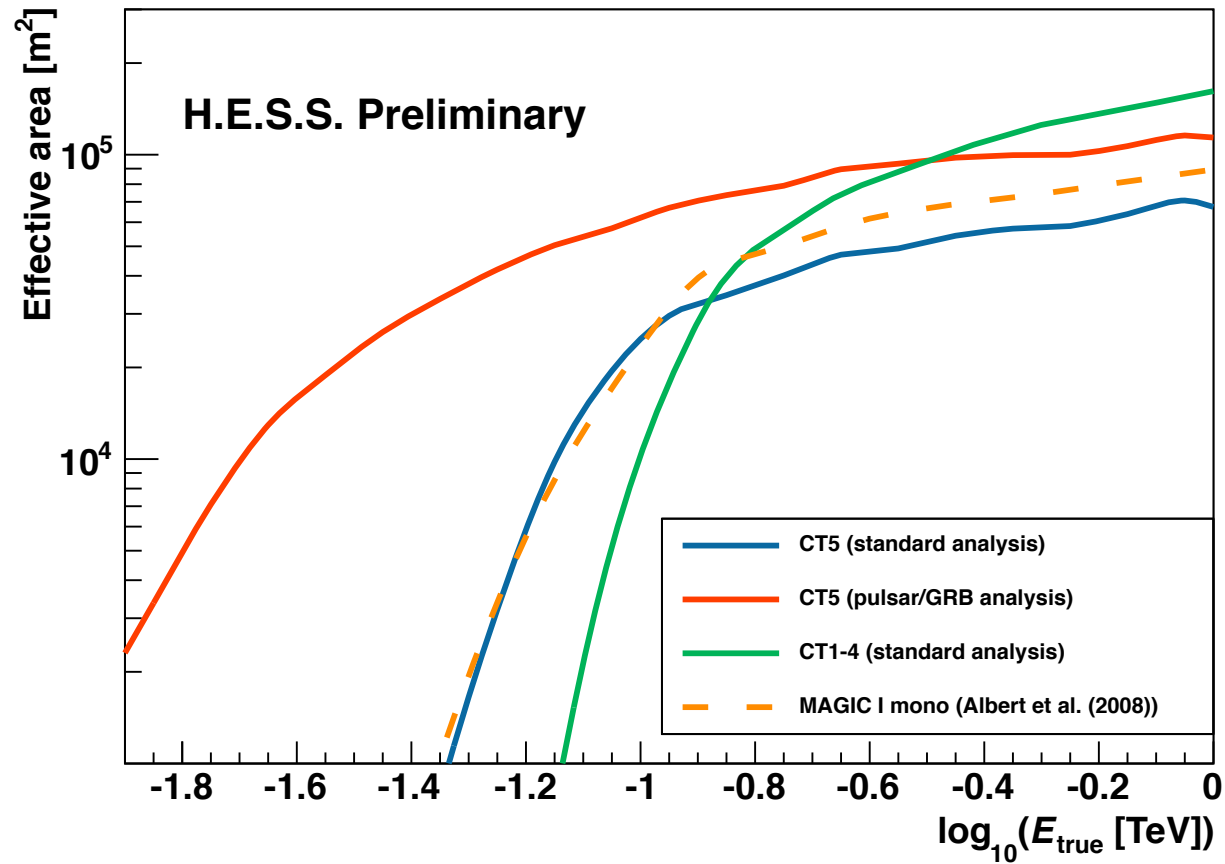


camera event



fit

Collection area

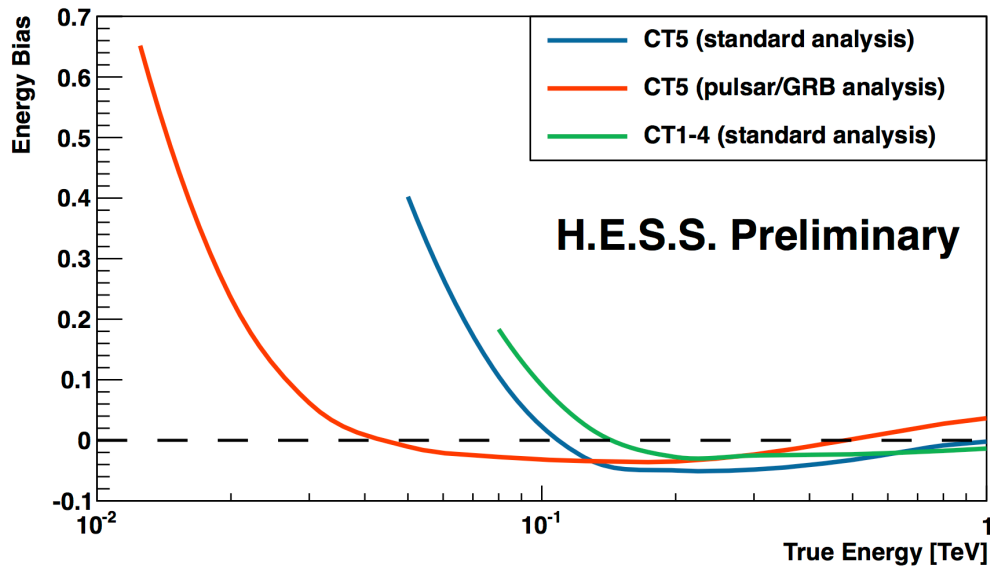


- Systematics at low energies under study

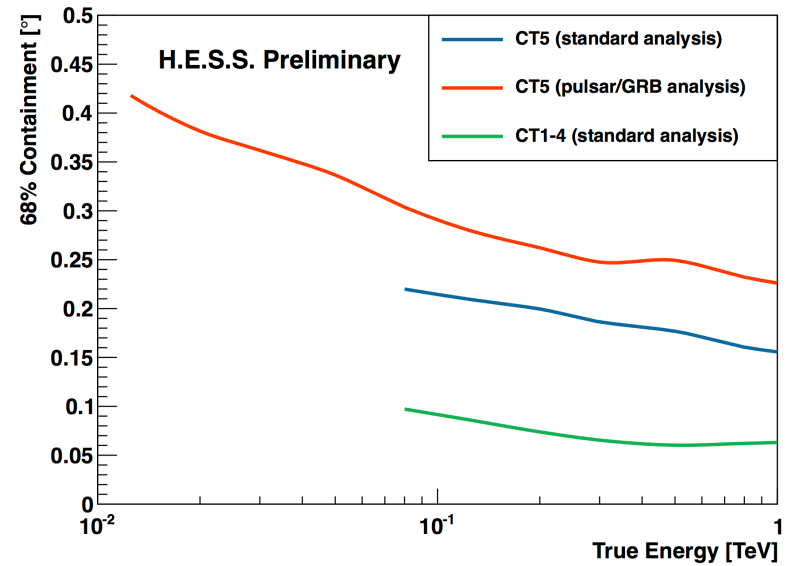
Energy and angular resolution

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

Energy bias

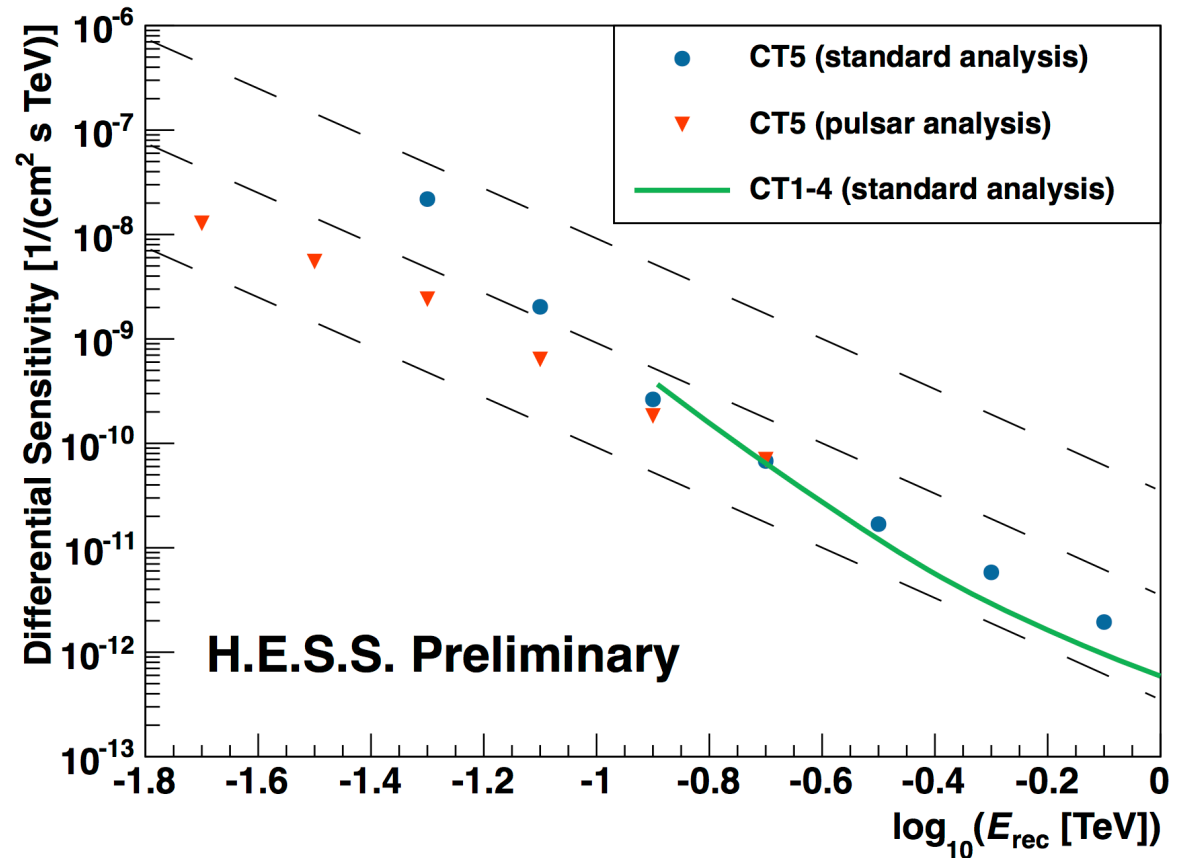


Angular resolution

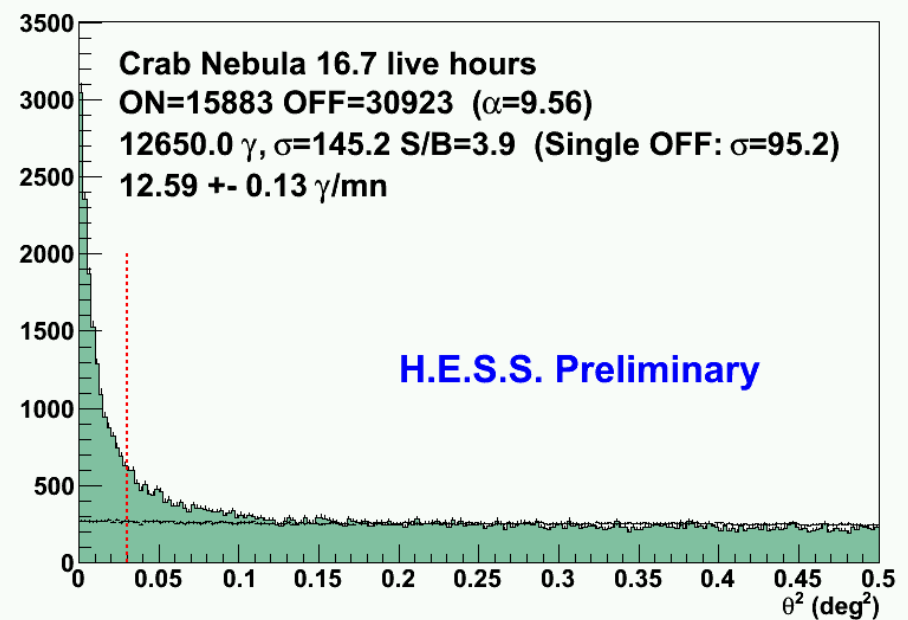
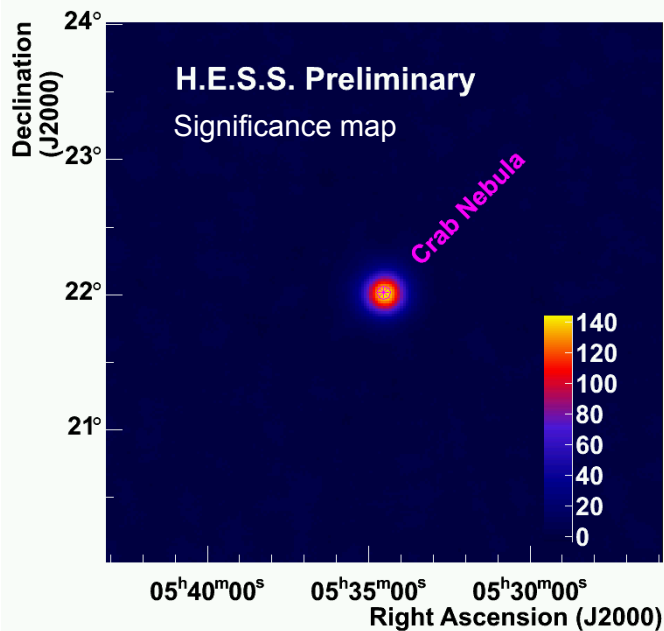


Sensitivity

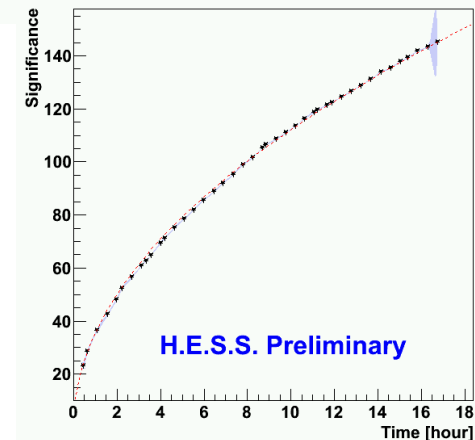
- Standard analysis
 - 5σ in 100 h
 - 5% background systematics
- Pulsar analysis
 - 5σ in 100 h
 - no background systematics



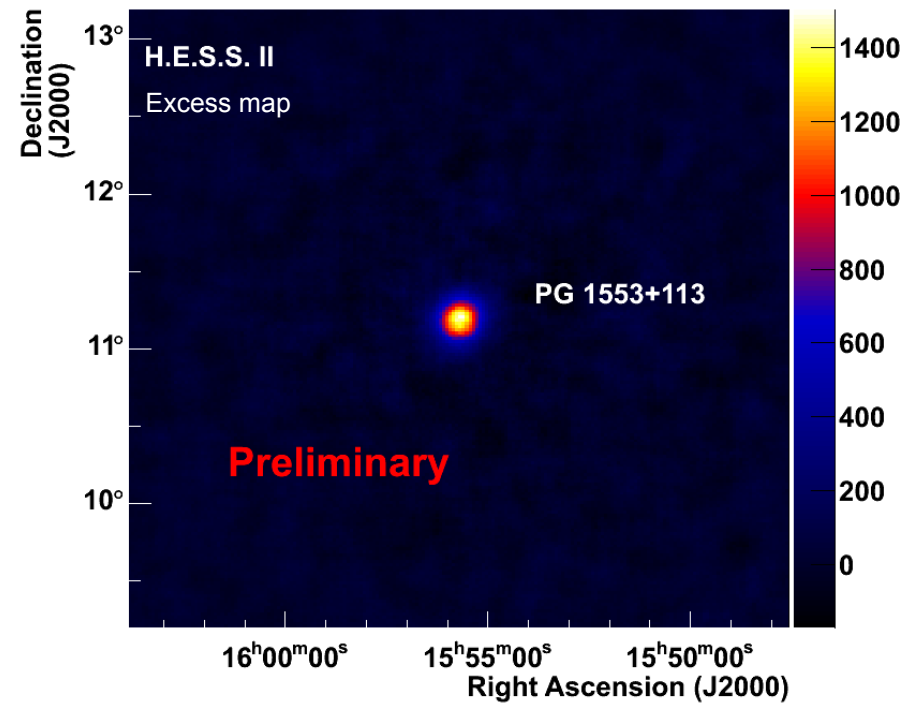
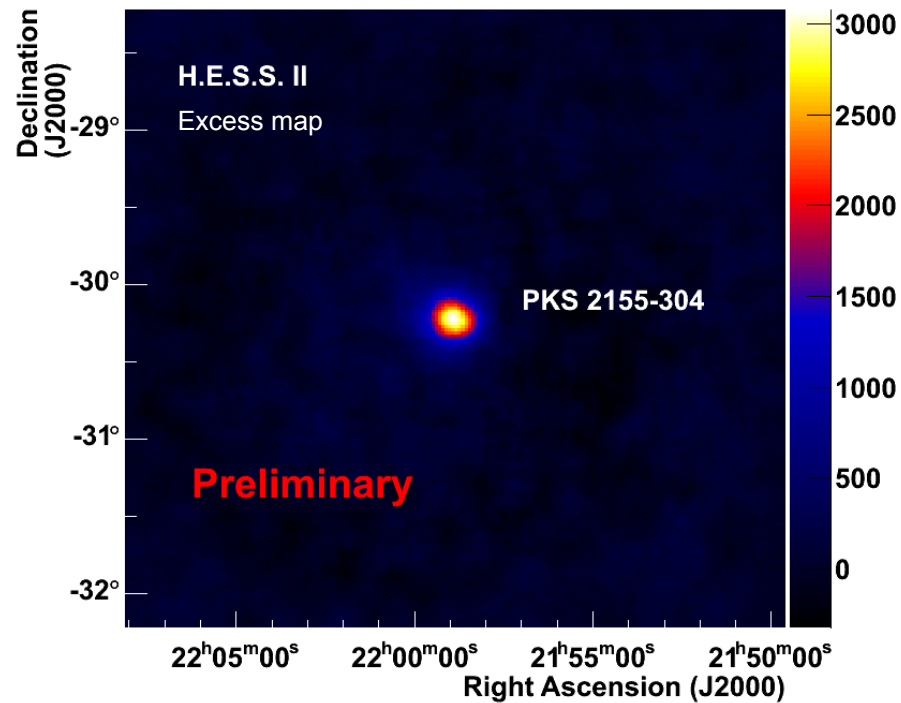
The Crab with CT5



- $\langle \text{zenith} \rangle = 48$ deg
- Standard analysis
 - photon rate = 12.6 ± 0.1 γ /mn
 - MC expectation = 13 γ /mn



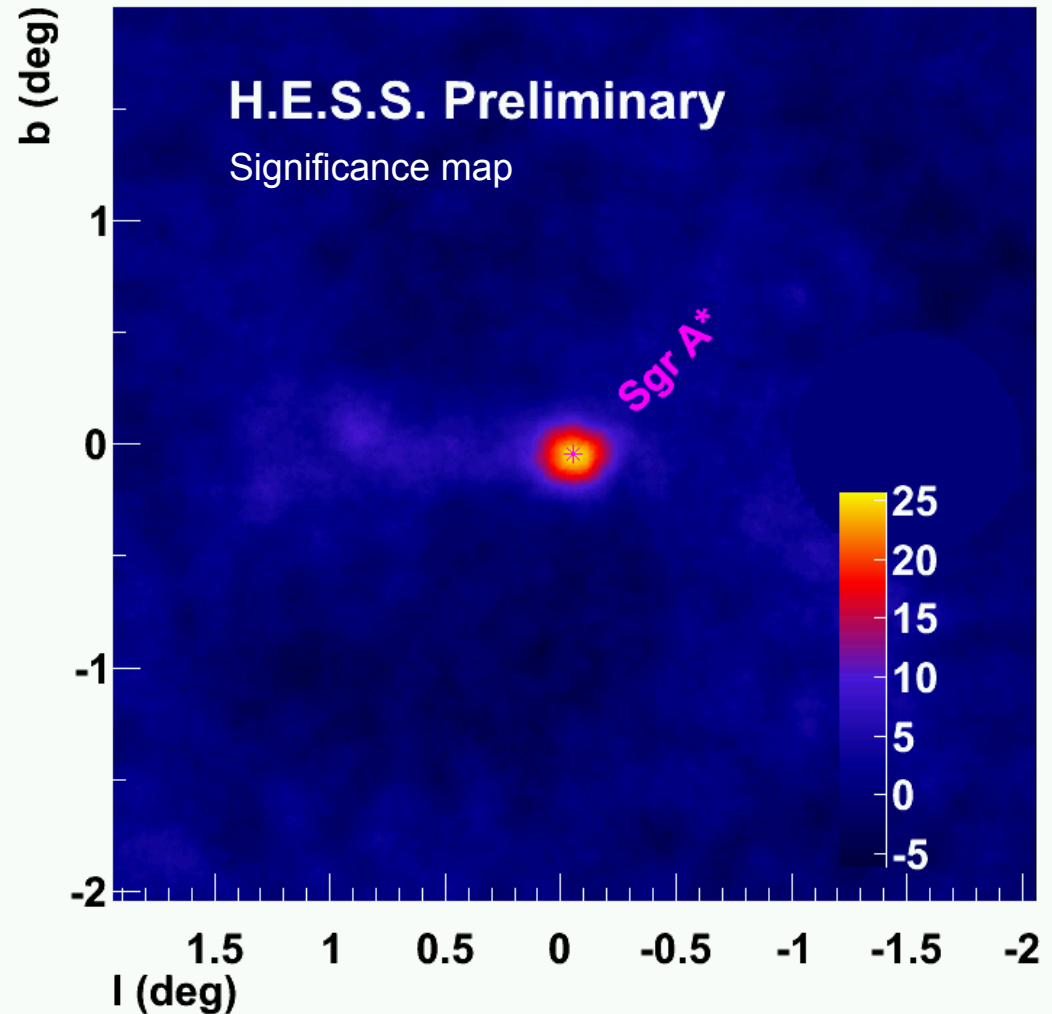
AGN seen with CT5



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

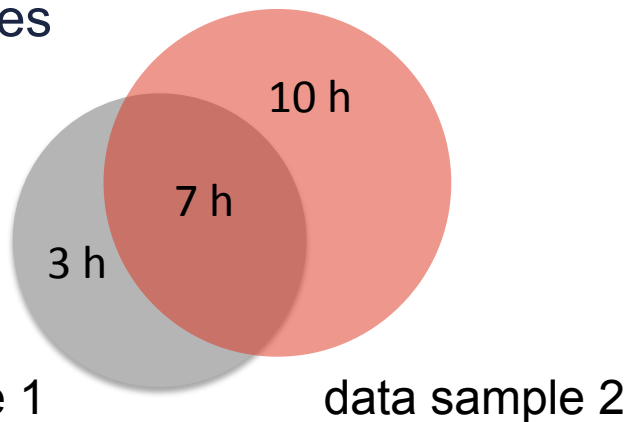
The Galactic Centre with CT5

- The Galactic Centre is one of the most complicated regions
- Observation and analysis
 - Life time 68.8 h
 - Signal with 25σ
 - extended emission
- Background needs to be further studied

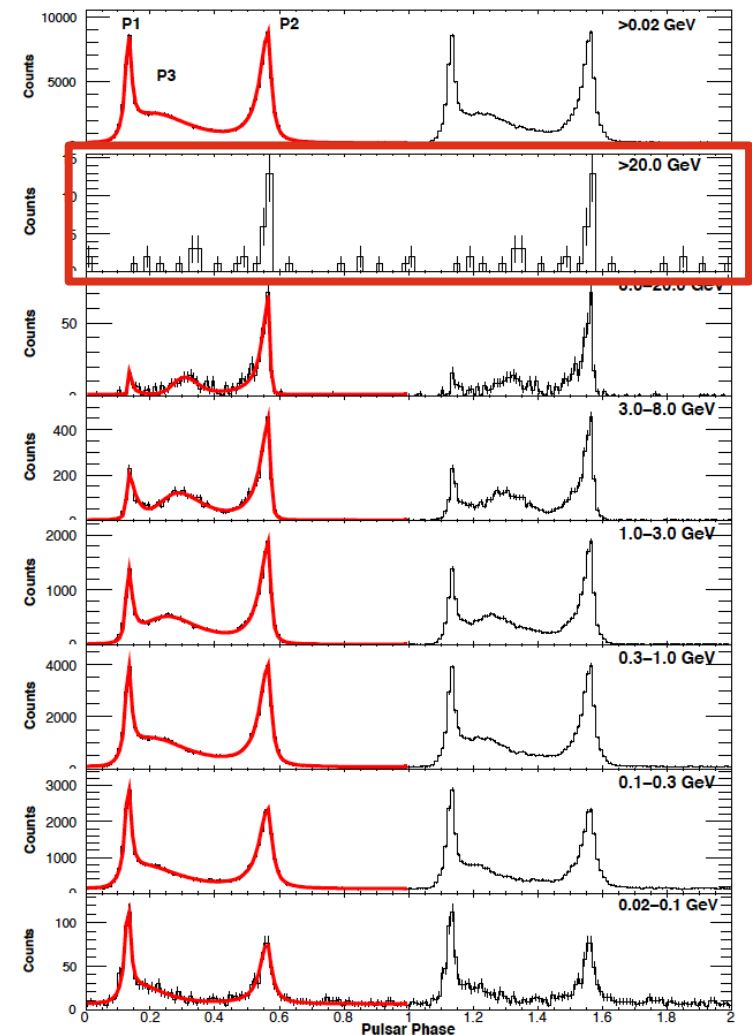


The Vela pulsar

- Observation
 - lifetime 20 h
 - $\langle \text{zenith angle} \rangle$ 27 deg – 35 deg
- PSR analysis
 - optimized cuts for low energies
- Data samples

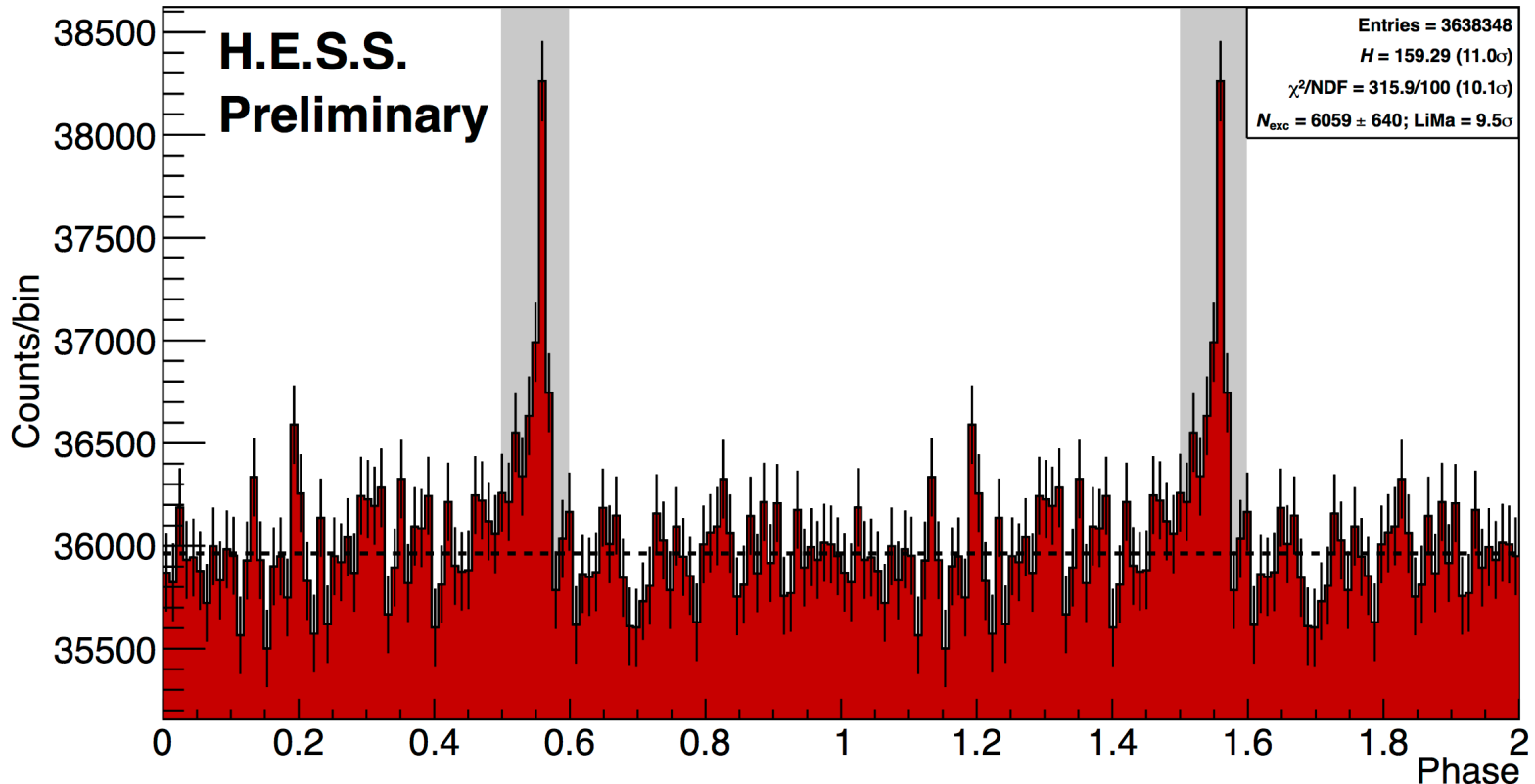


Fermi-LAT, arXiv:1002.4050



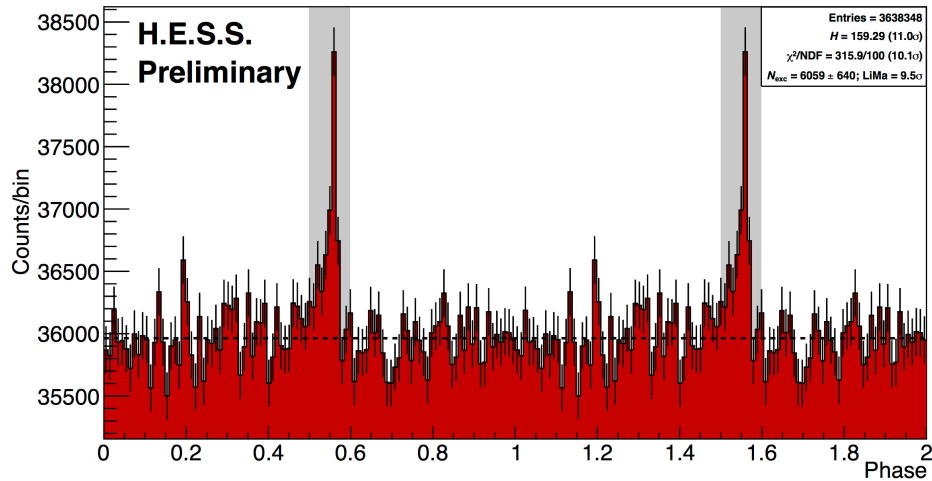
The Vela pulsar seen with CT5

data sample 2

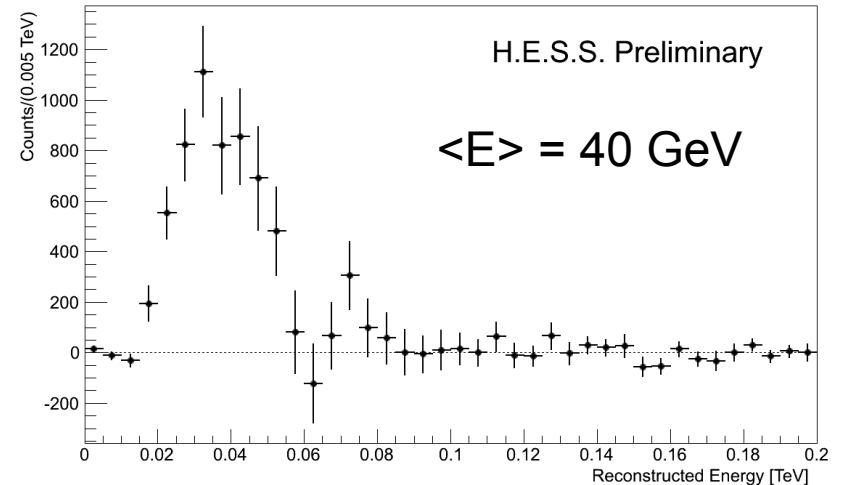


- a priori significance = 8σ (data sample 2 – data sample 1 (10h))
- $N_{\text{excess}} = 6059 \pm 640$

The Vela pulsar seen with CT5



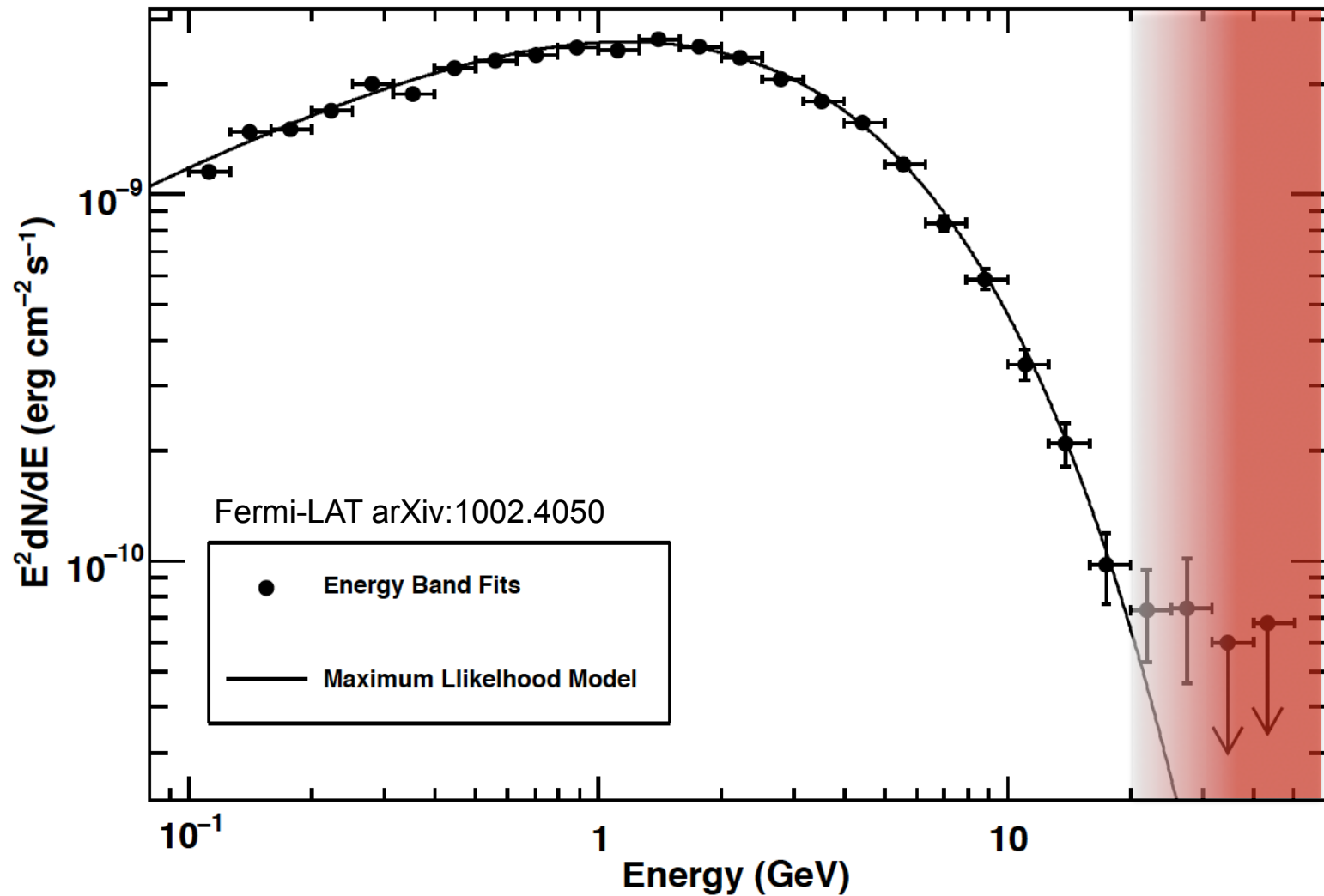
Energy distribution



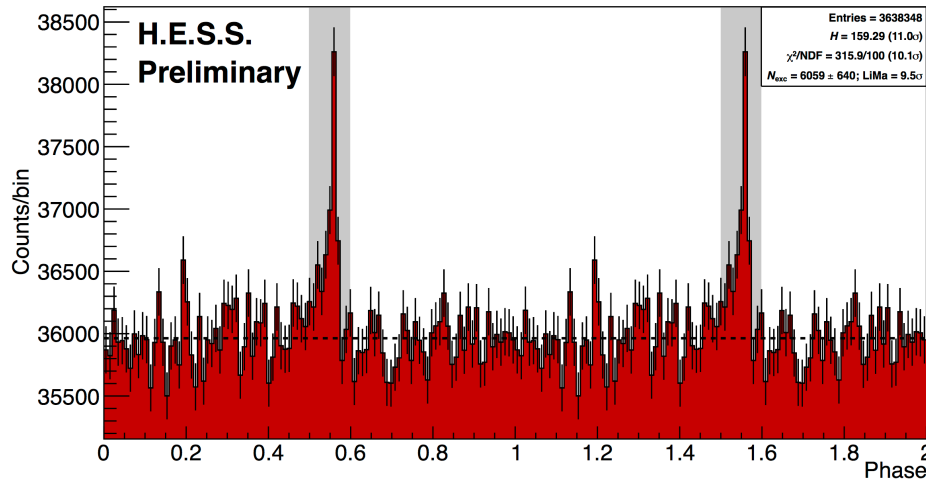
- Pulsar physics (not only Vela)
 - what is the spectrum above 20 GeV?
 - constraining the cut-off?

The Vela pulsar spectrum

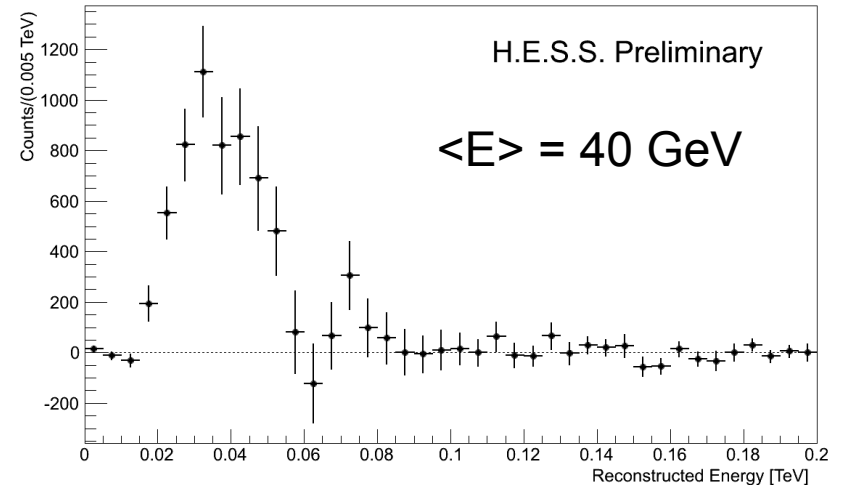
H.E.S.S. II



The Vela pulsar seen with CT5



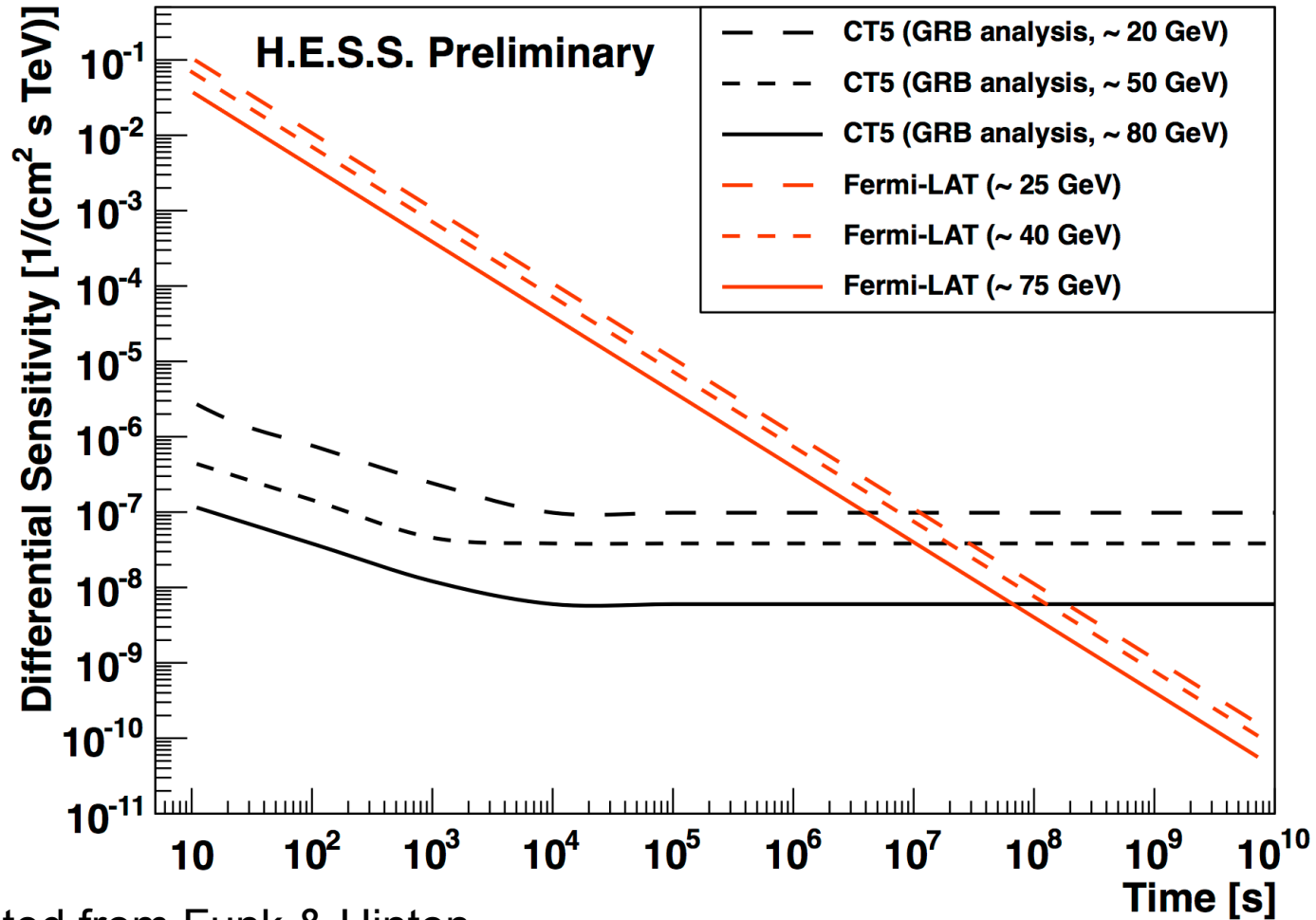
Energy distribution



■ For H.E.S.S. II

- calibration source at the threshold in standard observation mode
- well prepared for GRB search

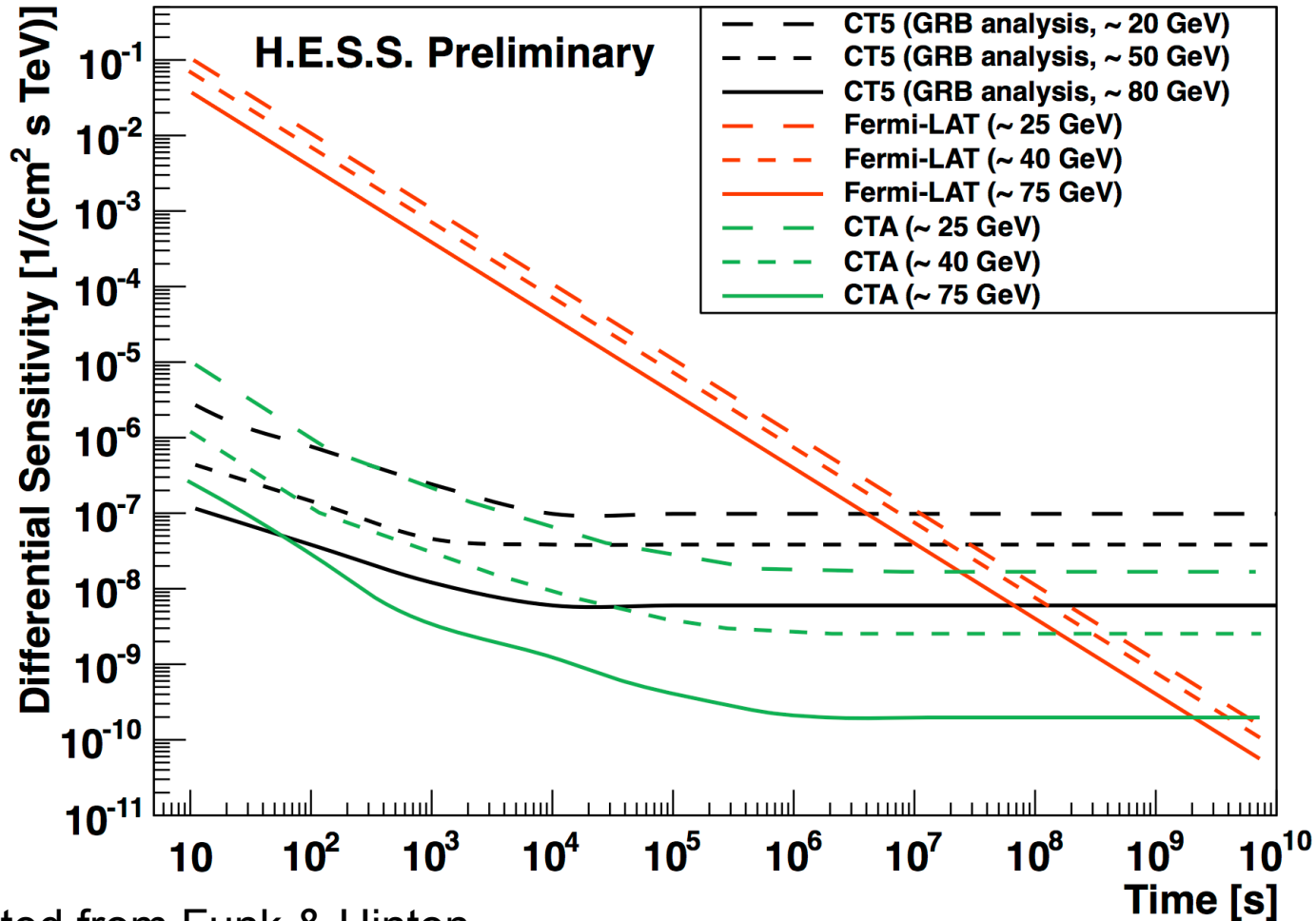
Transients with H.E.S.S. II



adapted from Funk & Hinton



Transients with H.E.S.S. II



adapted from Funk & Hinton



Summary

- H.E.S.S. II is
 - continuing to contribute to our understanding of the high-energy Universe
 - measuring point sources and extended sources
 - filling the gap between Fermi-LAT and IACTs
- Exciting times ahead