# H.E.S.S. Highlights

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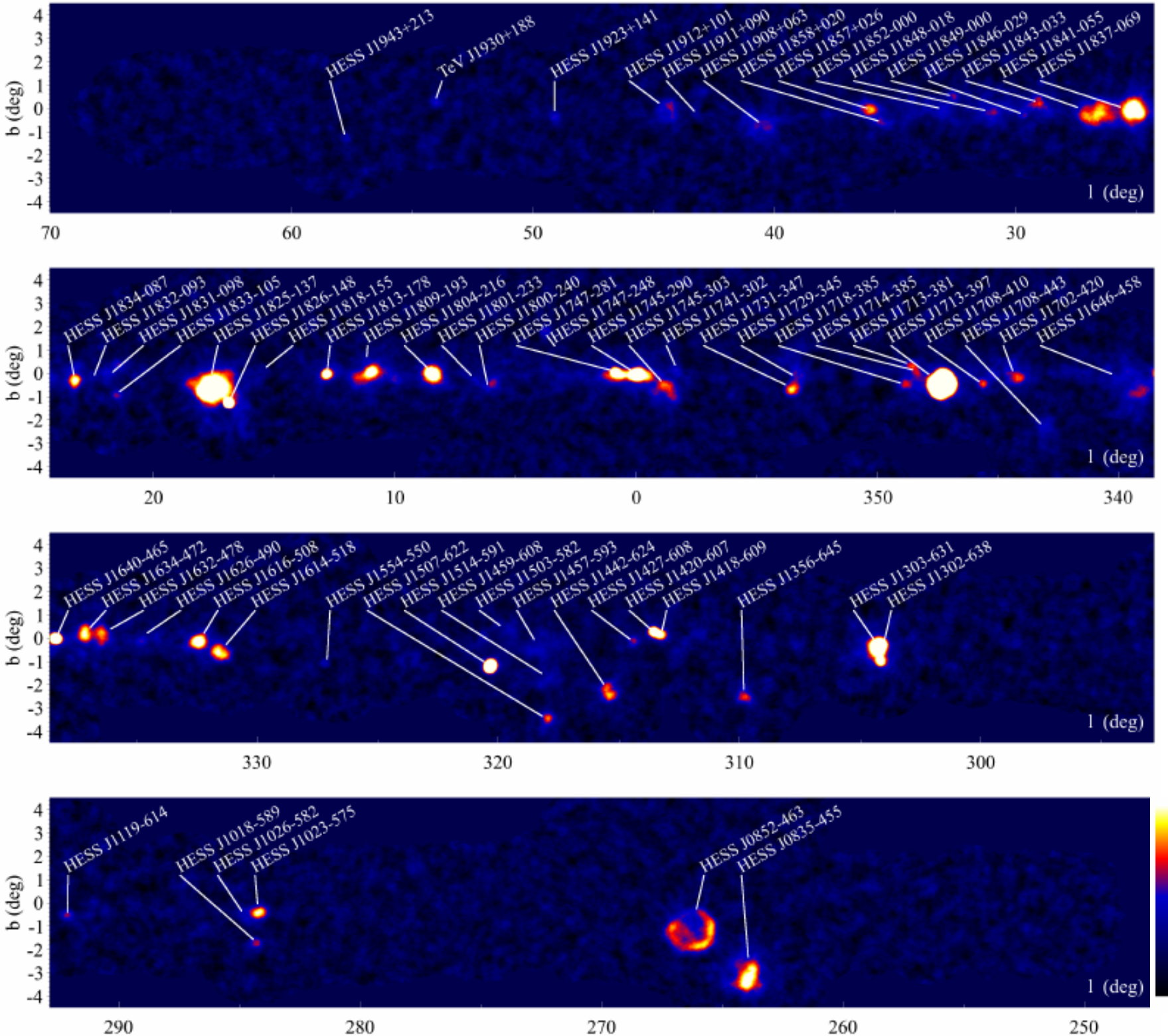
H.E.S.S. Observation Committee, Publication Board

# H.E.S.S. is now a 5-tel *hybrid* array

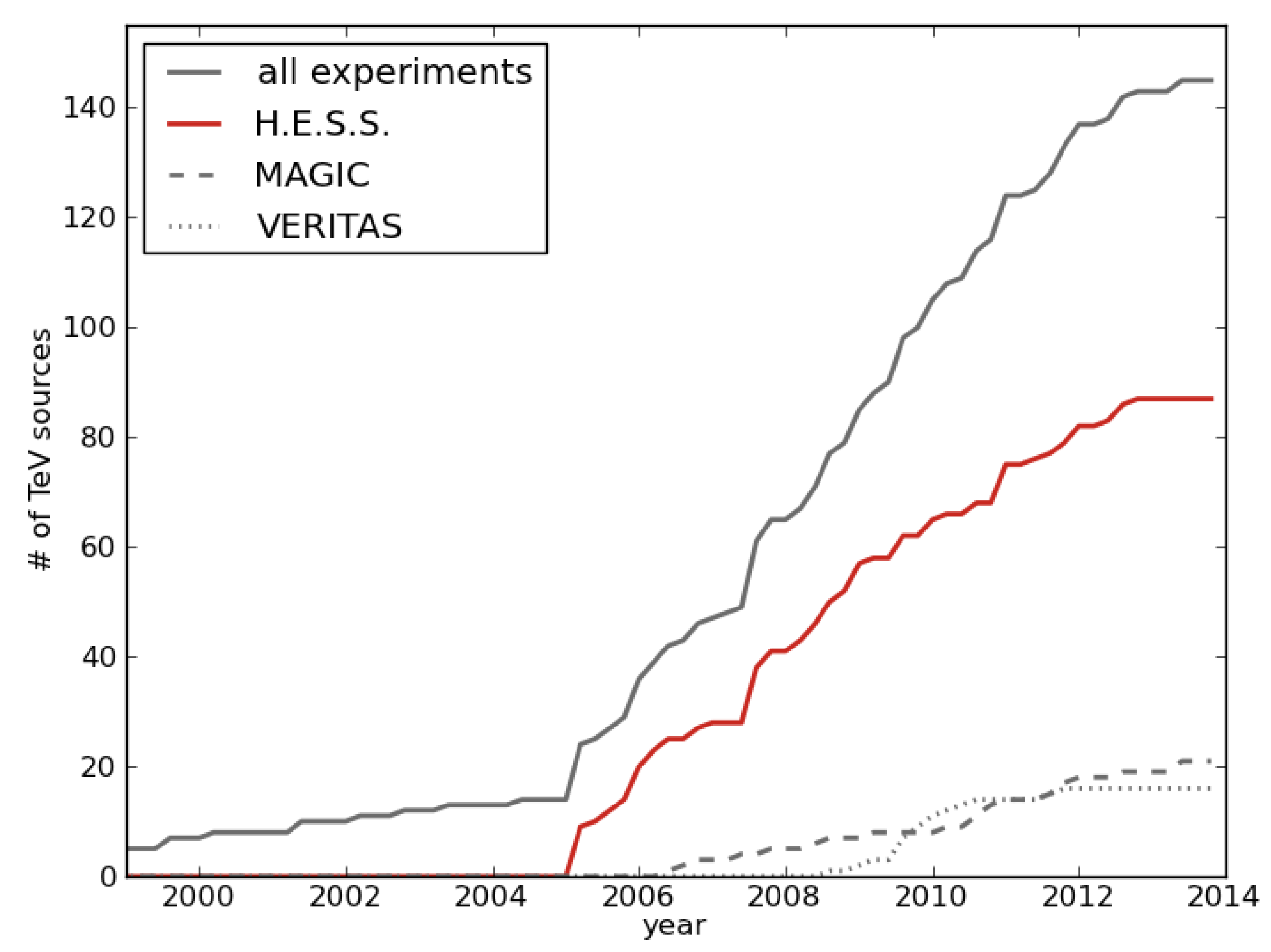
4 12-m IACTs w/ recoated mirrors + 1 28-m IACT

Multiple triggering & targeting schemes available

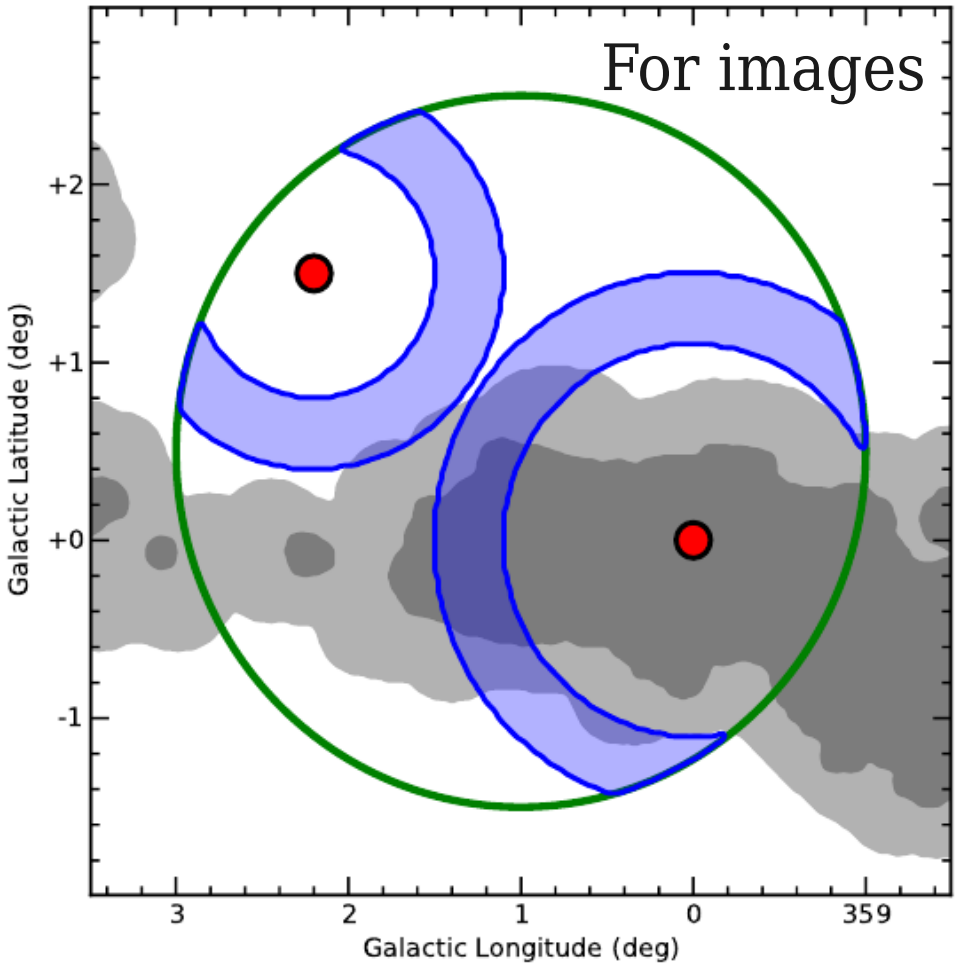
CT5: 2048 PMTs 614 $m^2$ 3.2° FoV $E_{min}$ ~ 30 GeV f = 38 m

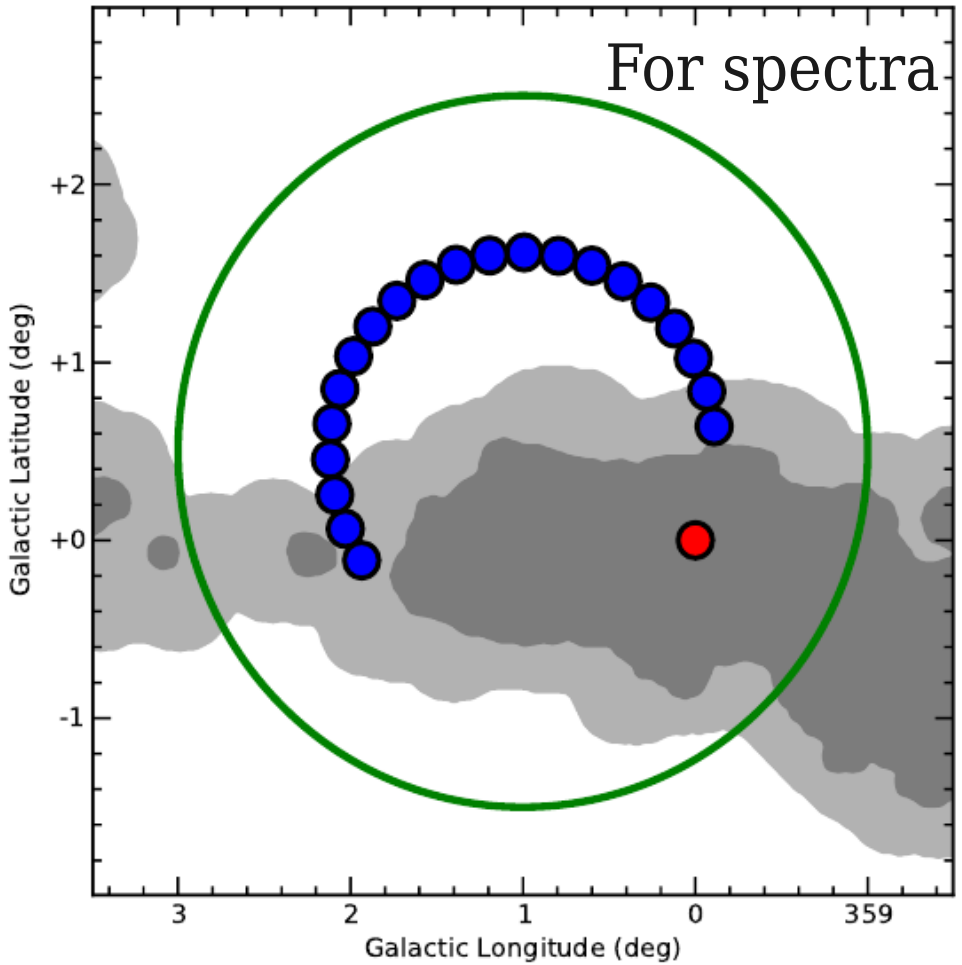



Carrigan, S., Brun, F., Chaves, R.C.G. et al. (H.E.S.S.) 2013

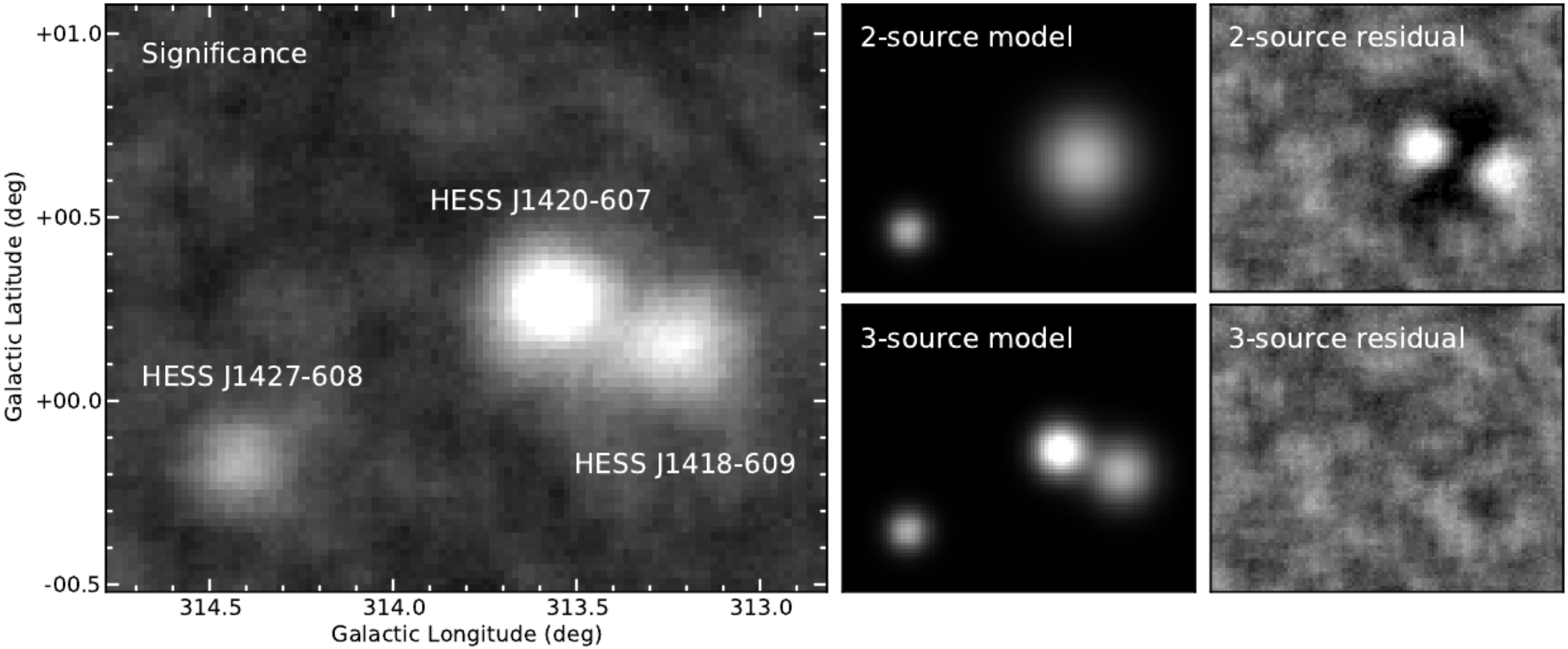

all experiments
H.E.S.S.
MAGIC
VERITAS
# of TeV sources
year
0
20
40
60
80
100
120
140
2000
2002
2004
2006
2008
2010
2012
2014

# Challenges & solutions for analyzing complex source regions



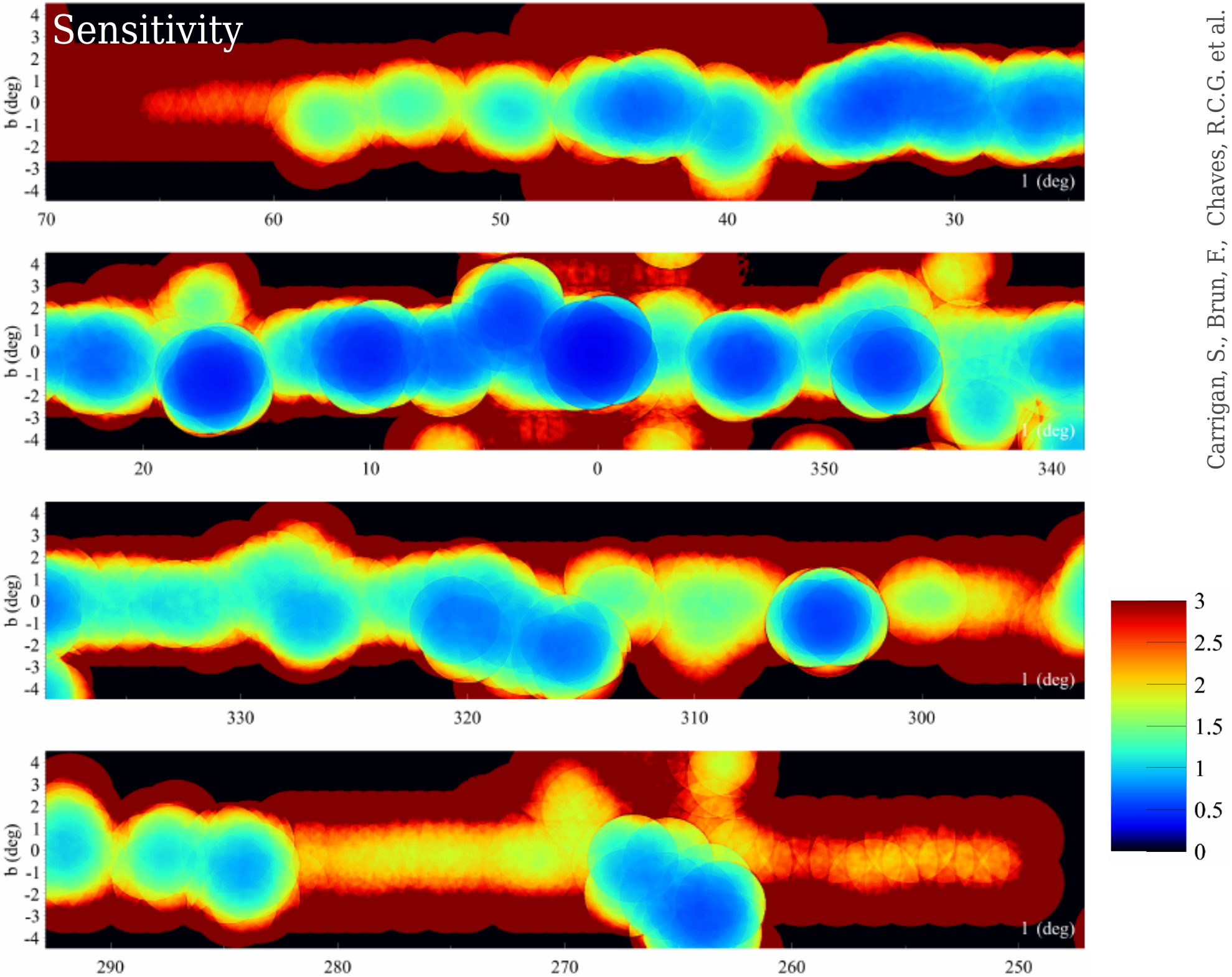




Background estimation with adaptive regions




Automated source extraction with maximum likelihood techniques

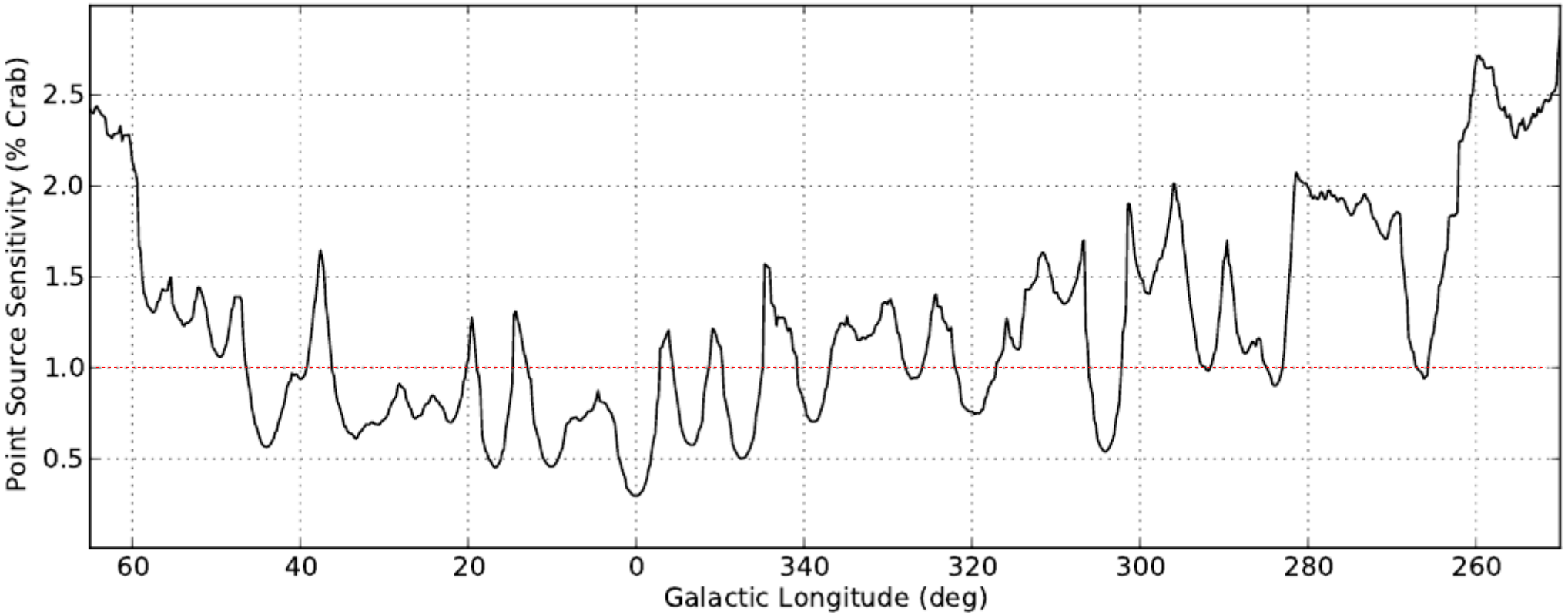
# How complete is the Survey?

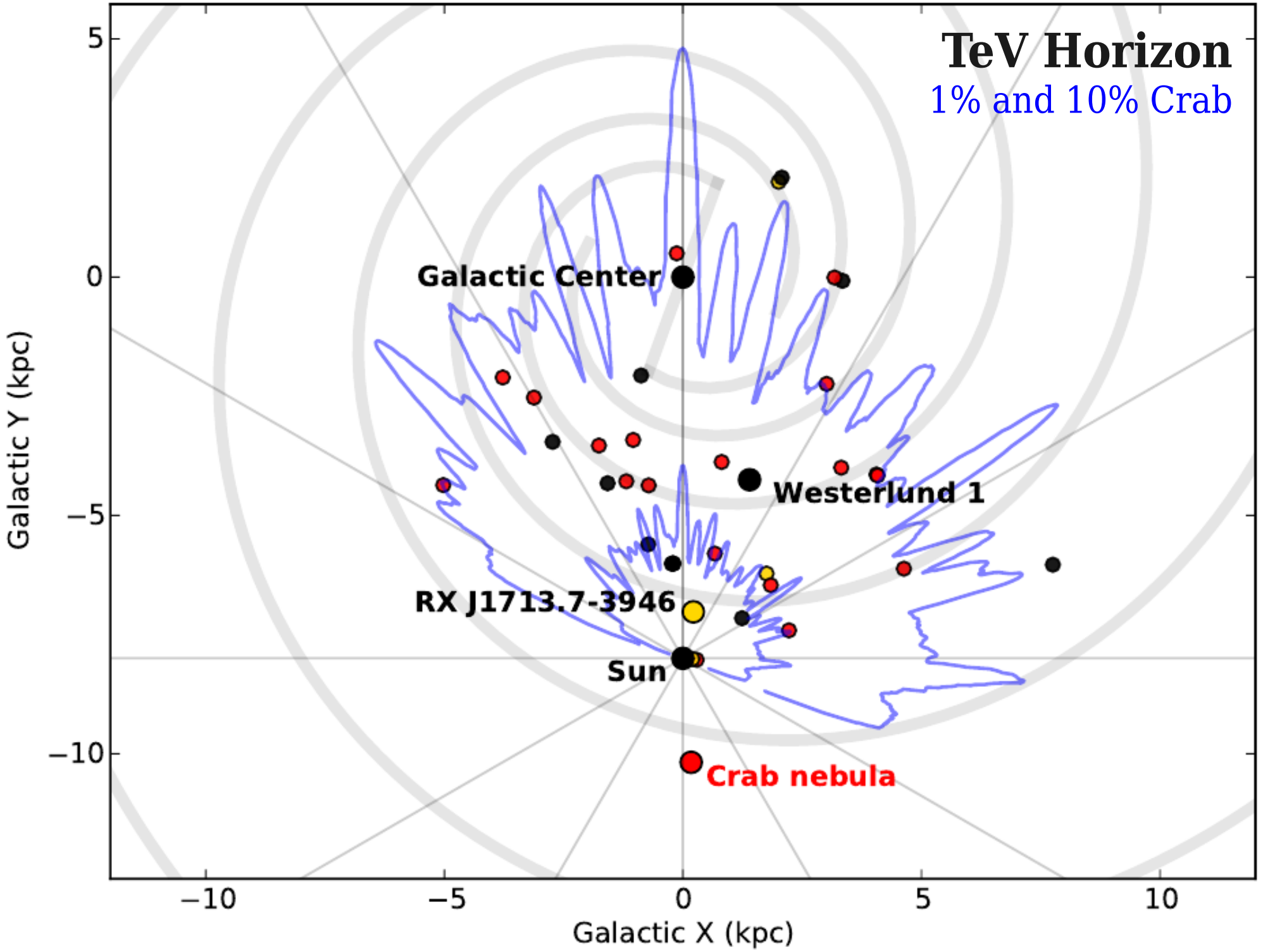


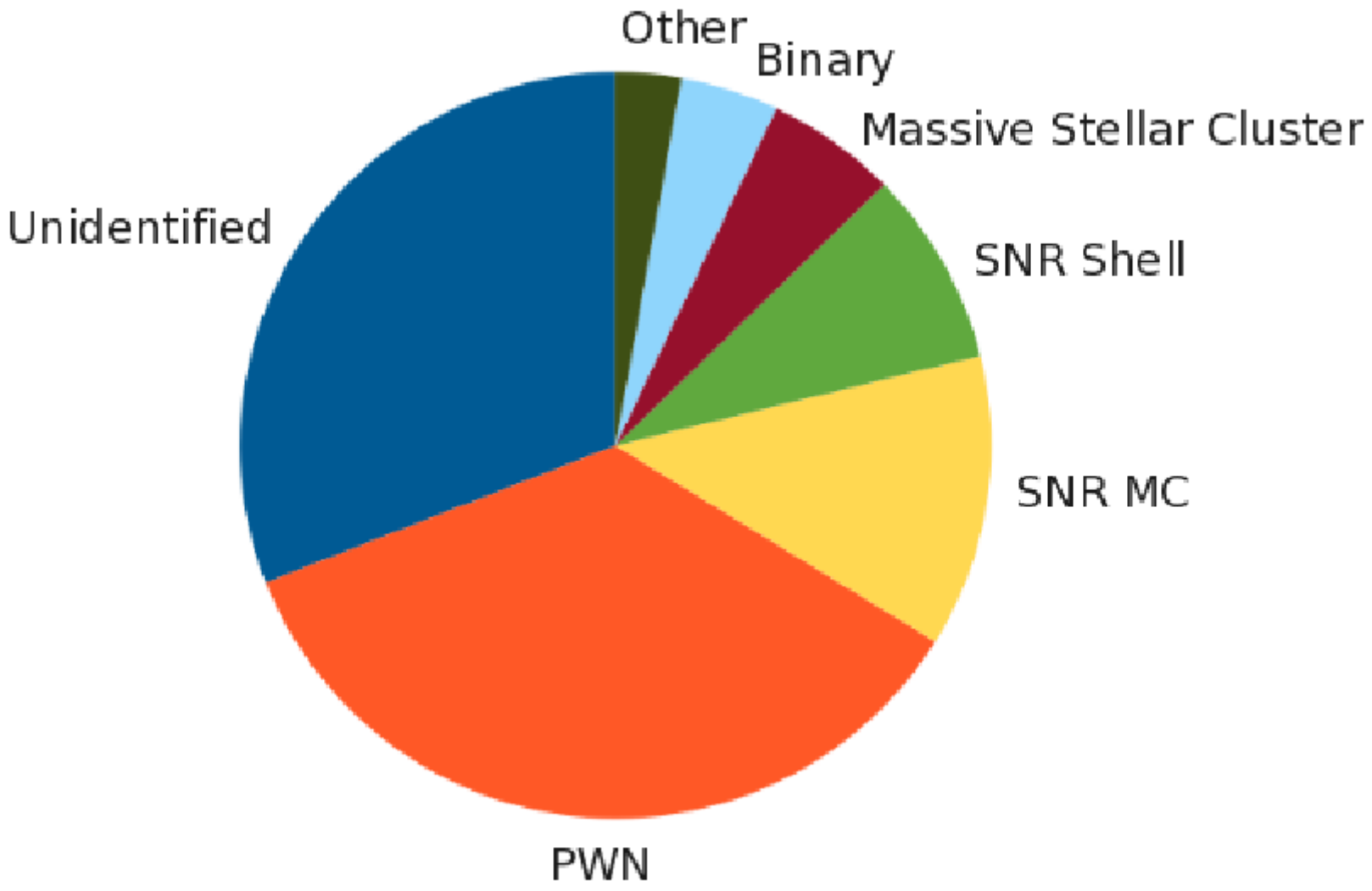

Carrigan, S., Brun, F., Chaves, R.C.G. et al. (H.E.S.S.) 2013

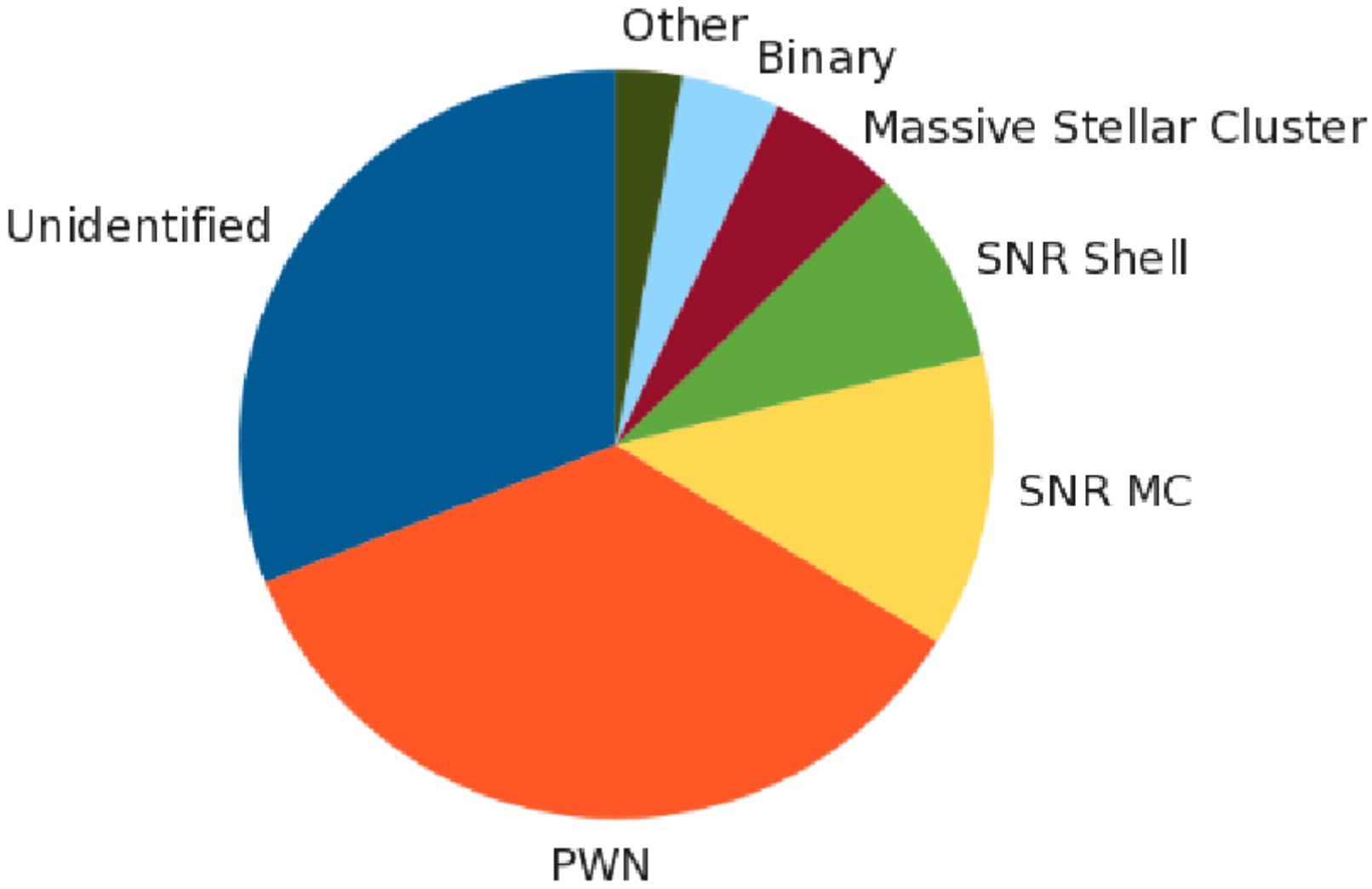
# HGPS Sensitivity along b = -0.3°

for 5-σ detection




TeV Horizon
1% and 10% Crab
Galactic Center
Westerlund 1
RX J1713.7-3946
Sun
Crab nebula
Galactic Y (kpc)
Galactic X (kpc)
5
0
−5
−10
−10
−5
0
5
10


Other
Binary
Massive Stellar Cluster
Unidentified
SNR Shell
SNR MC
PWN




… to be revised with follow-up H.E.S.S-II and MWL observations

# An exceptionally luminous TeV source & proton-accelerating SNR (which you probably haven't heard of yet)

Abramowski et al. (H.E.S.S.) 2014 – MNRAS

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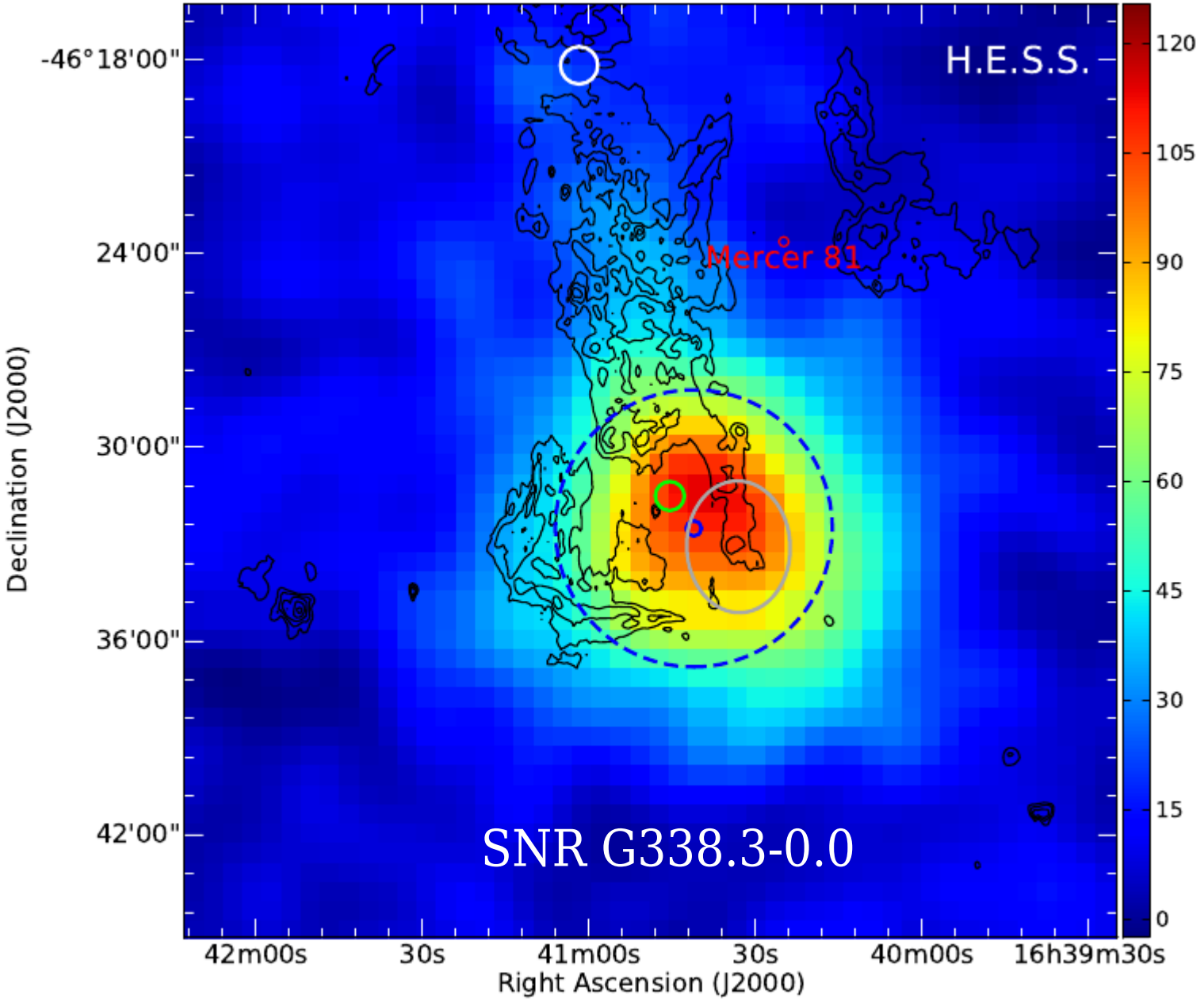
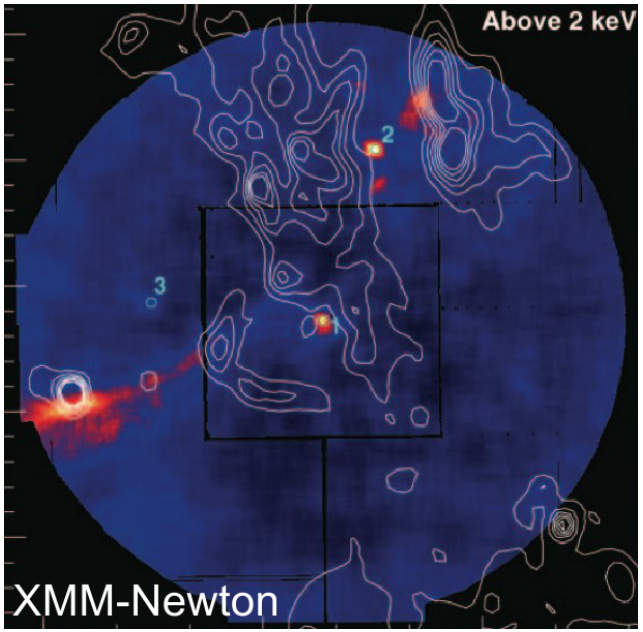
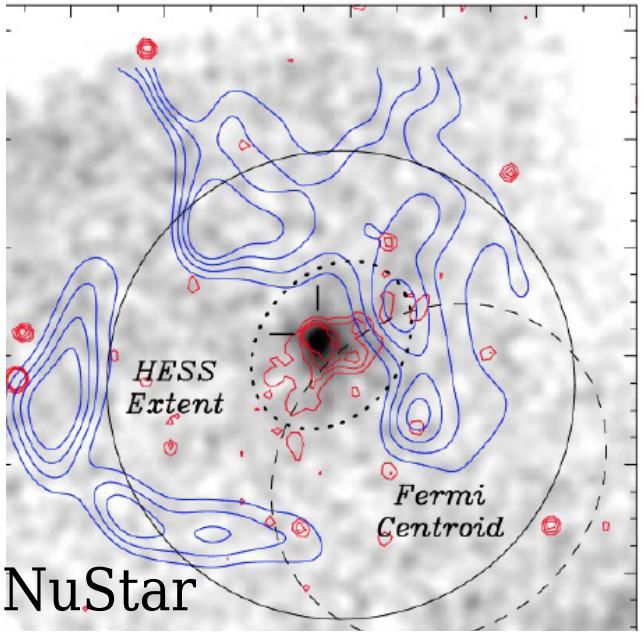
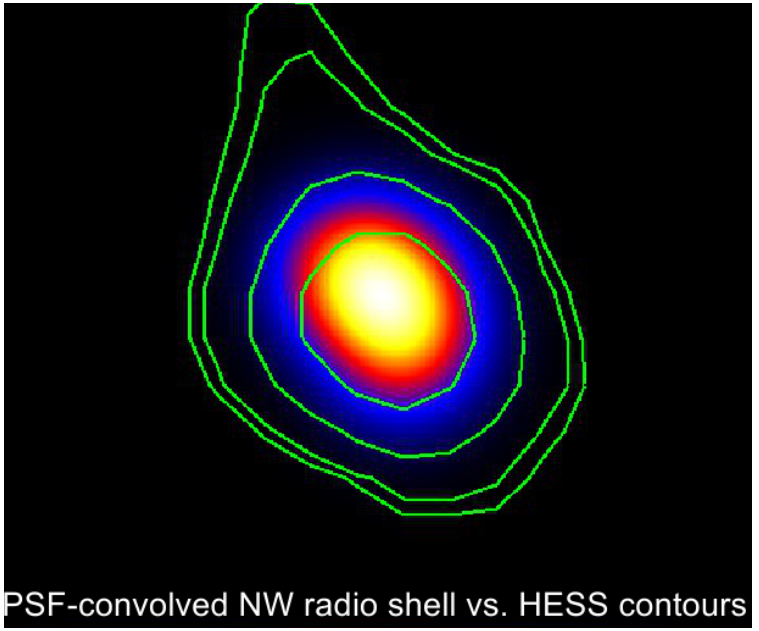


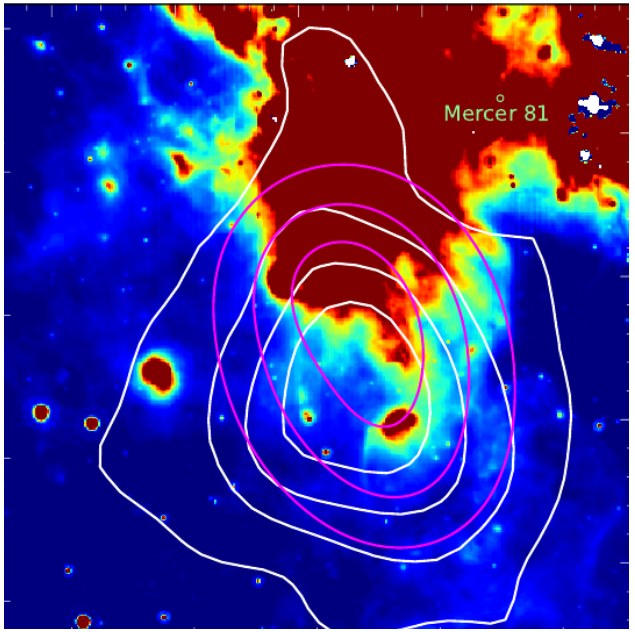

Abramowski et al. (H.E.S.S.) 2014 – MNRAS

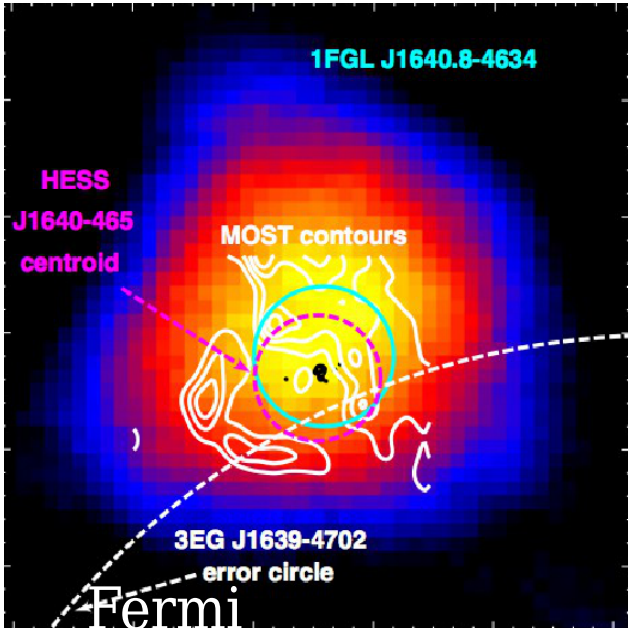
# **Synergies with other wavelengths:** radio, IR, X-rays



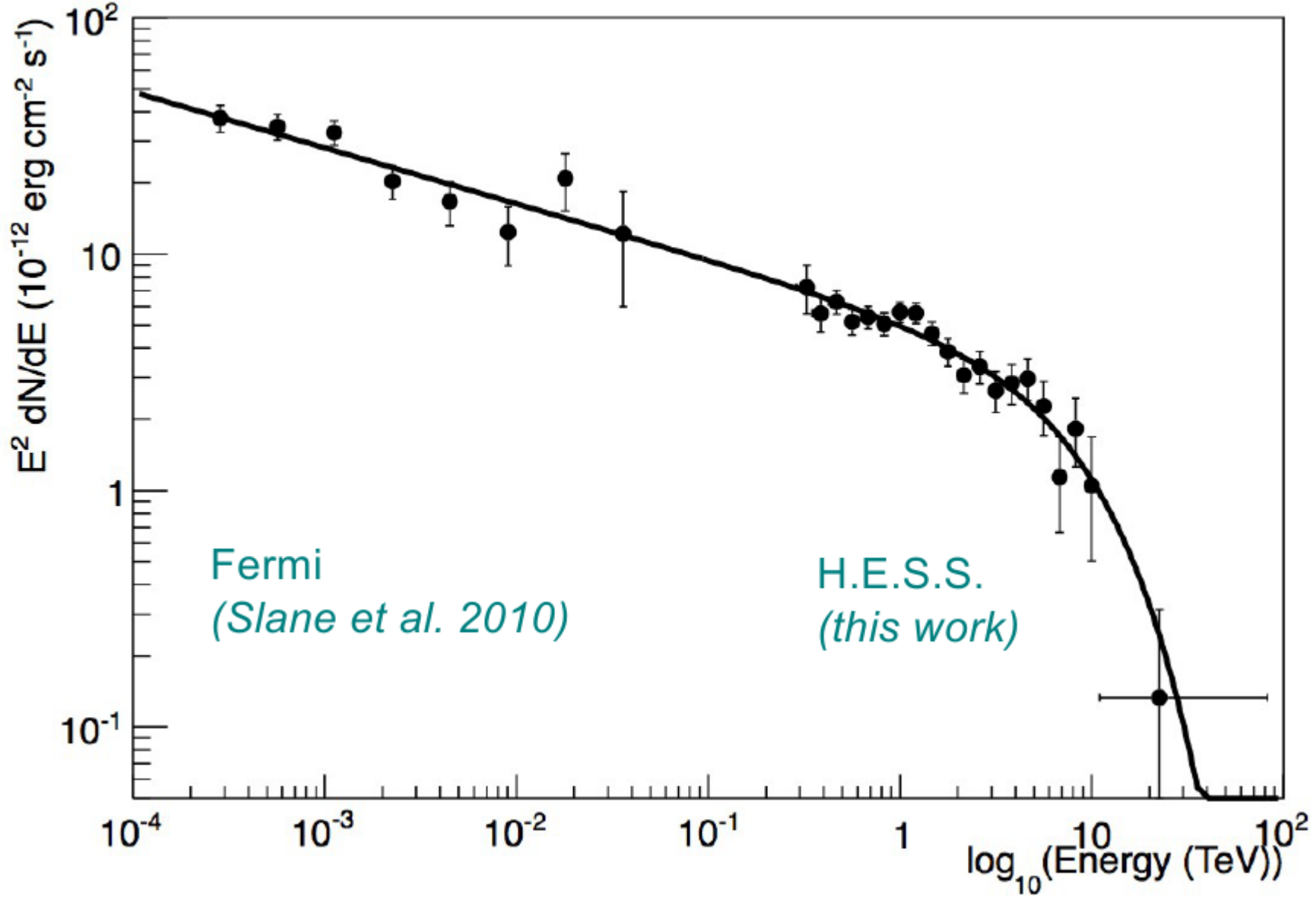




Abramowski et al. (H.E.S.S.) 2014
Adapted from Eger et al. (H.E.S.S.) 2014

**Synergies with other wavelengths:** HE (MeV-GeV) gamma-rays

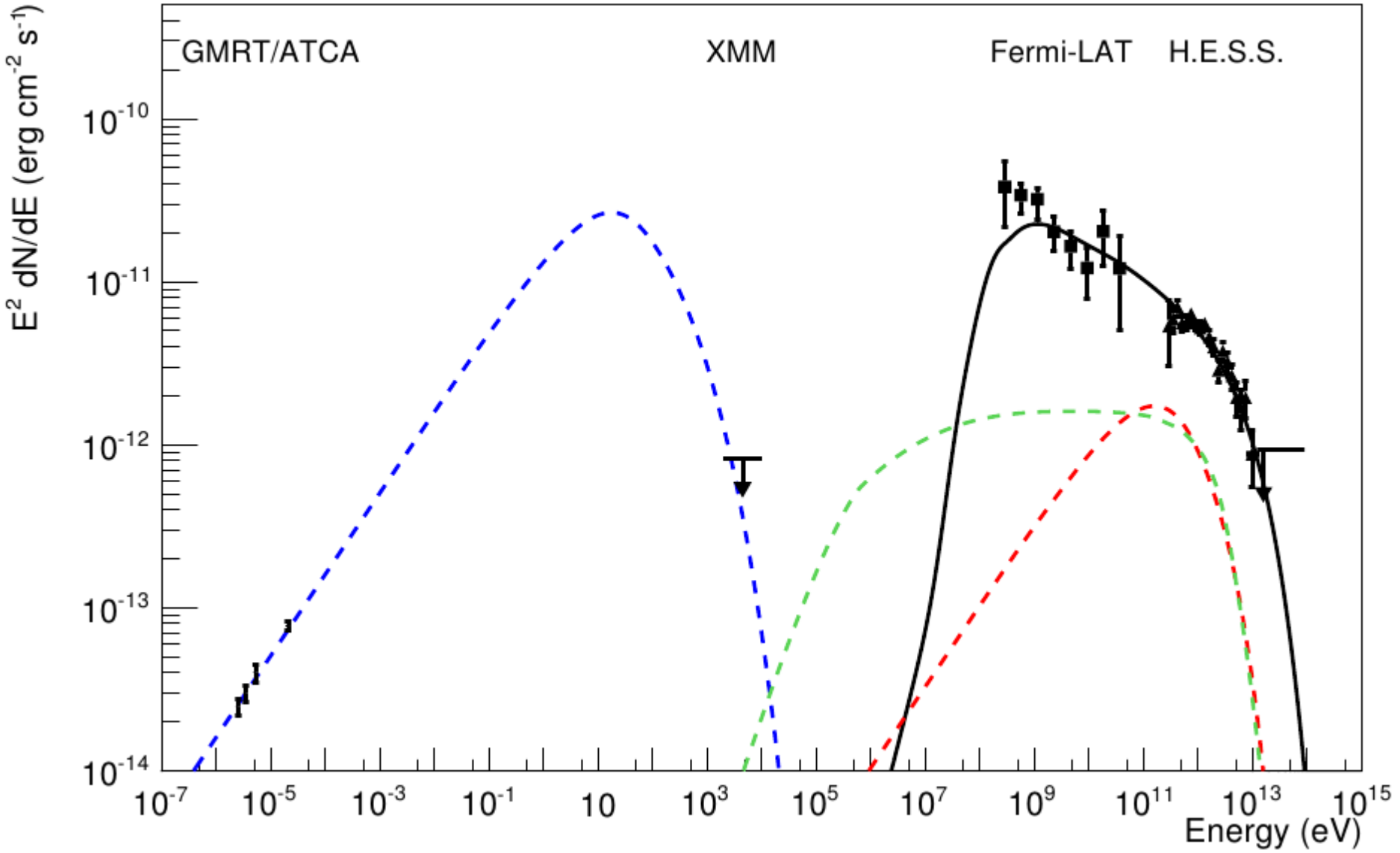
Challenging the previous PWN interpretation




Abramowski et al. (H.E.S.S.) 2014 – MNRAS
Eger et al. (H.E.S.S.) – Moriond

**Synergies with other wavelengths:** HE (MeV-GeV) gamma-rays

Challenging the previous PWN interpretation w/ new hadronic interpration

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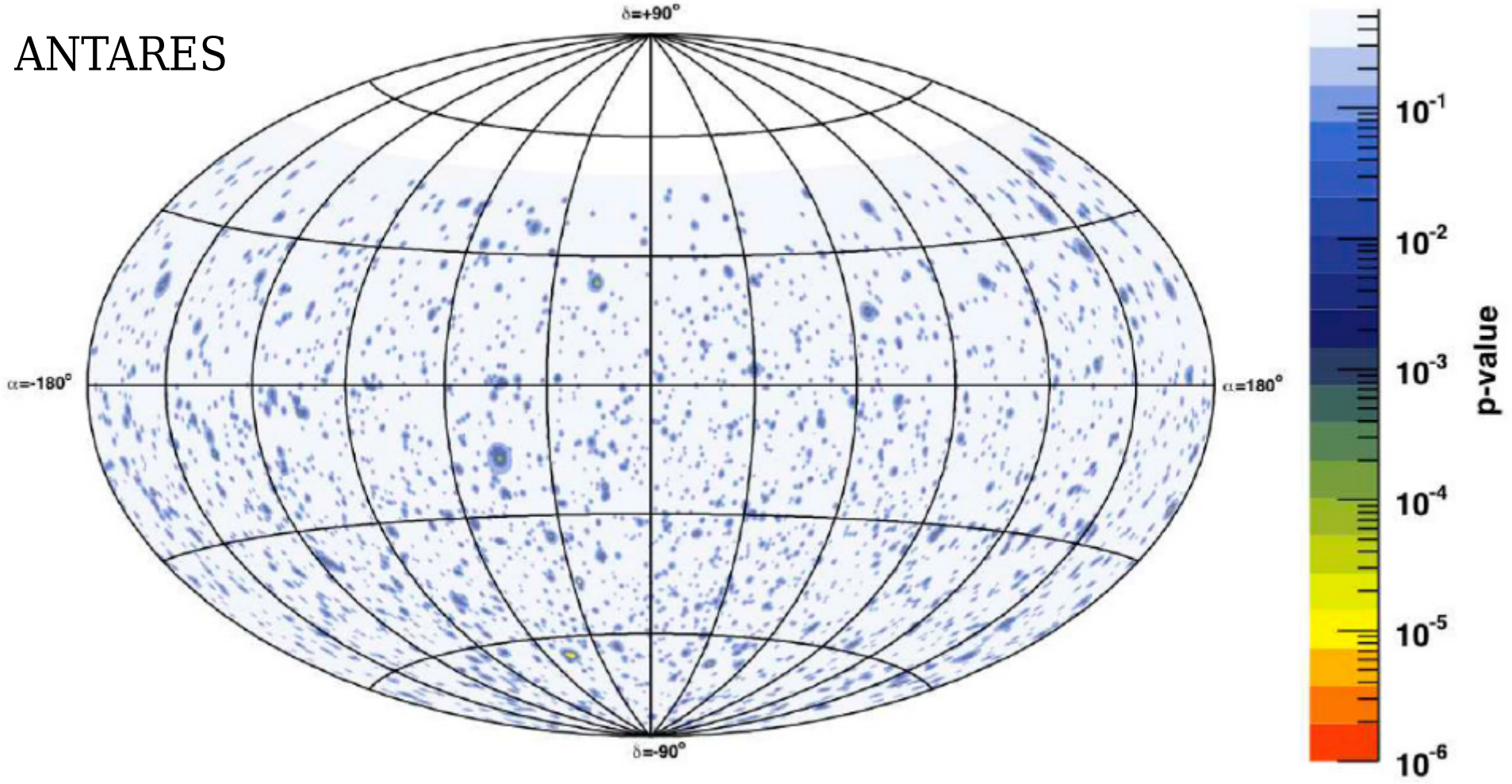

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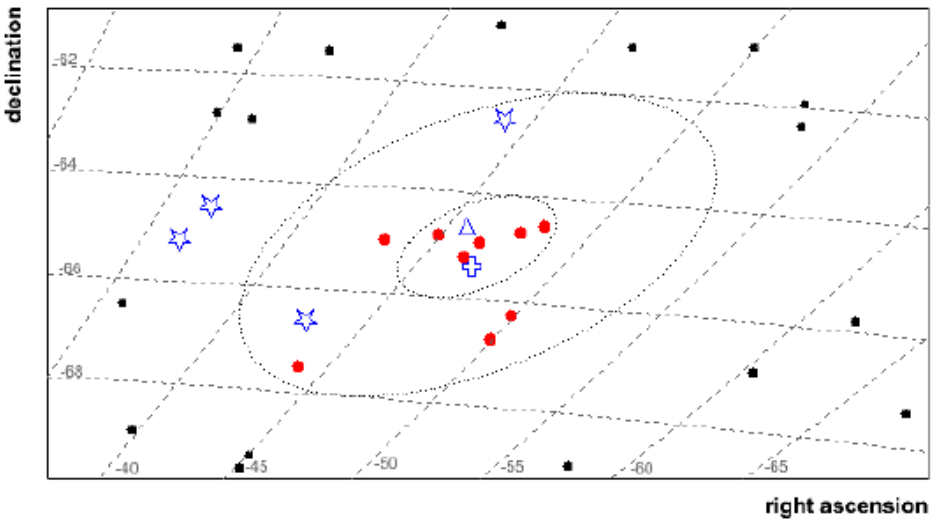
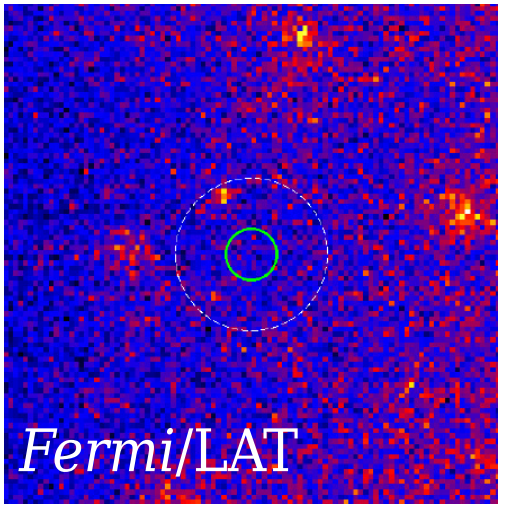
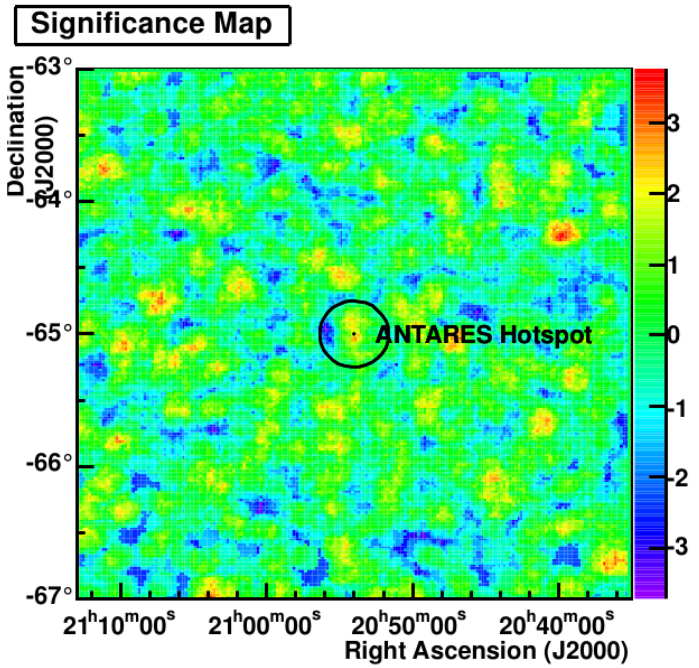
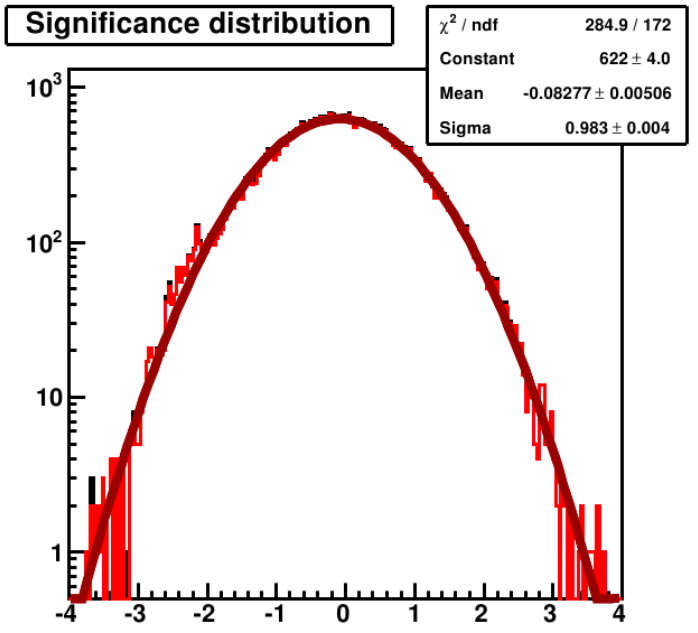



Also performed follow-up observations of IceCube hotspot in 2009




More formal partnerships with multi-messenger community, including ToOs, currently under development

Schüssler, F., Brun, P., Chaves, R.C.G. et al. (H.E.S.S.) 2013

# Towards to the next generation

2010-2012: Mirrors re-coated on all 4 telescopes.
Regained near-original optical efficiency.

2013: H.E.S.S.-II First Light
First hybrid IACT array. First LST.
Access down to ~30 GeV. Increased effective area.
Improved angular resolution.

2014-15: H.E.S.S.-I Electronics Upgrade
Reduce deadtime. Increase robustness.
Greater integration.
Testbed for CTA tech (e.g. NectarCAM).

# H.E.S.S.-II Preview

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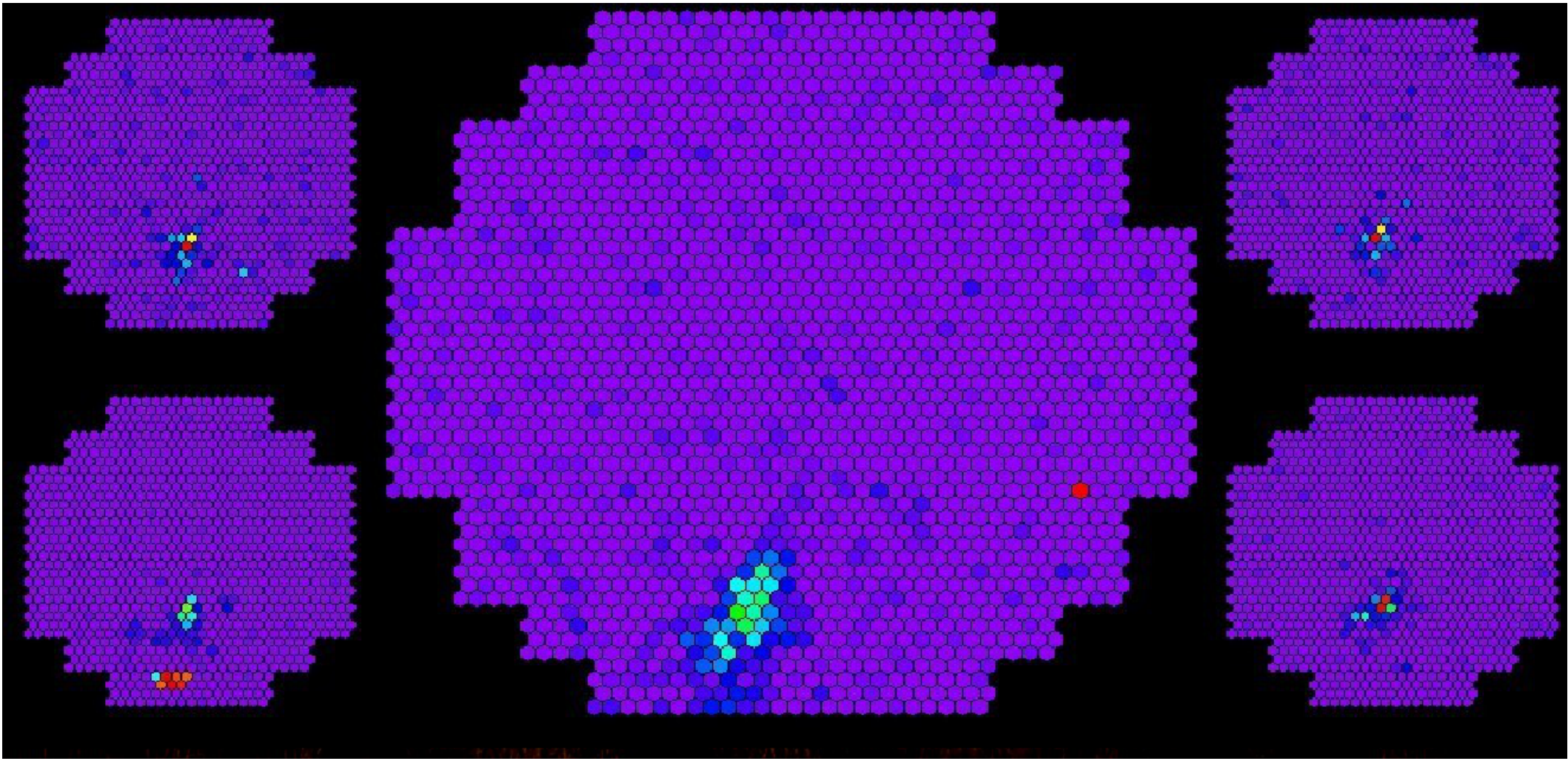

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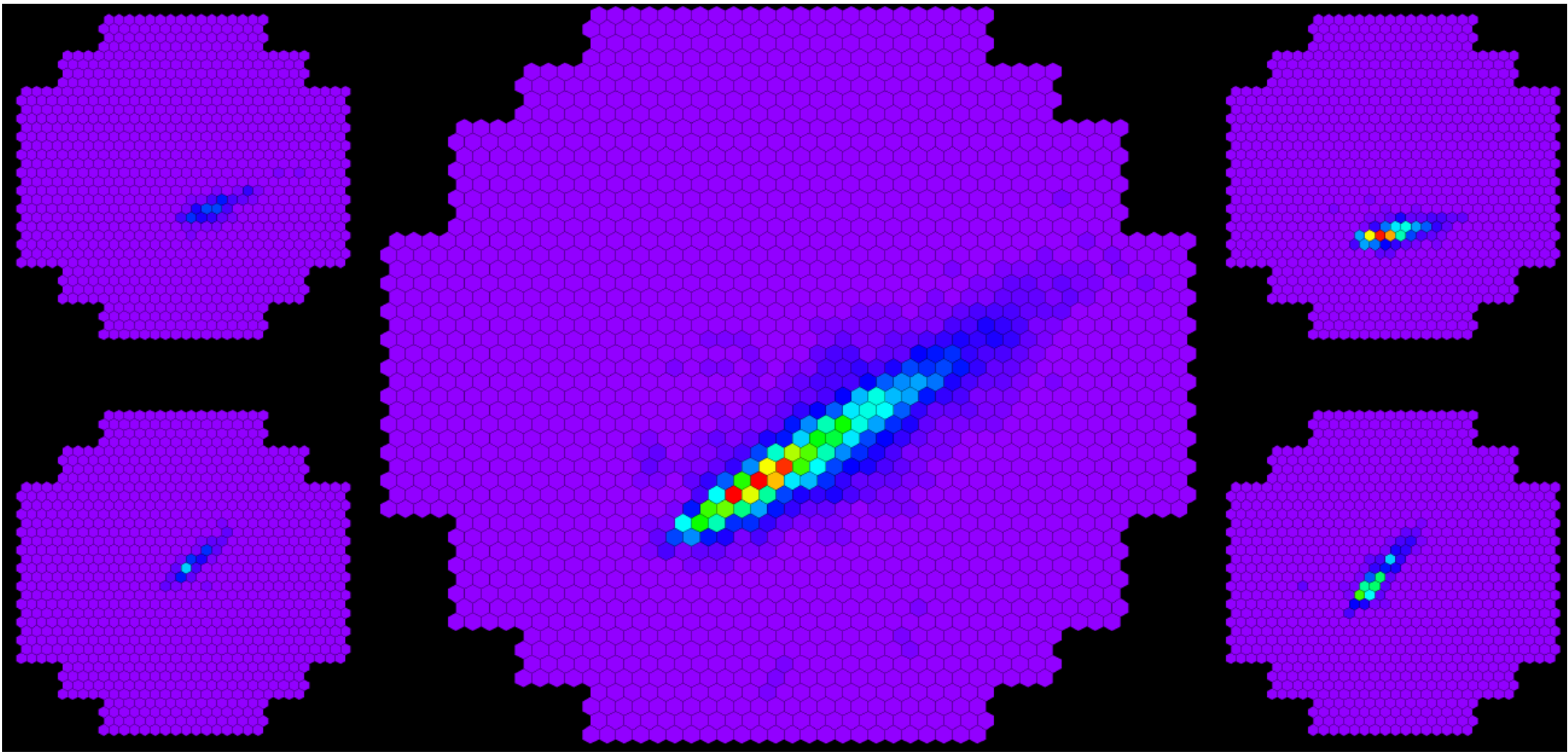
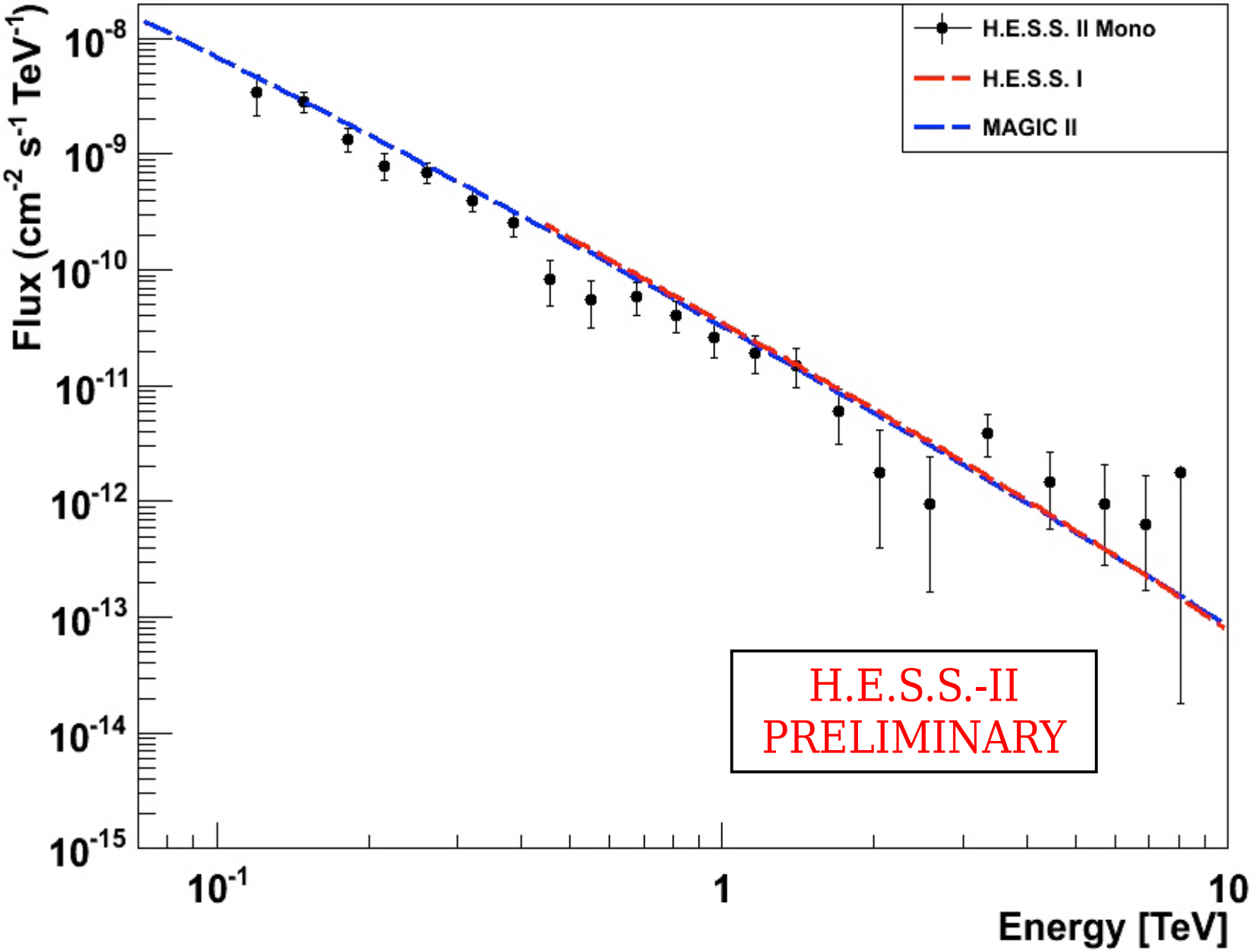


Primary commissioning target for H.E.S.S.-II:

**Crab Nebula**



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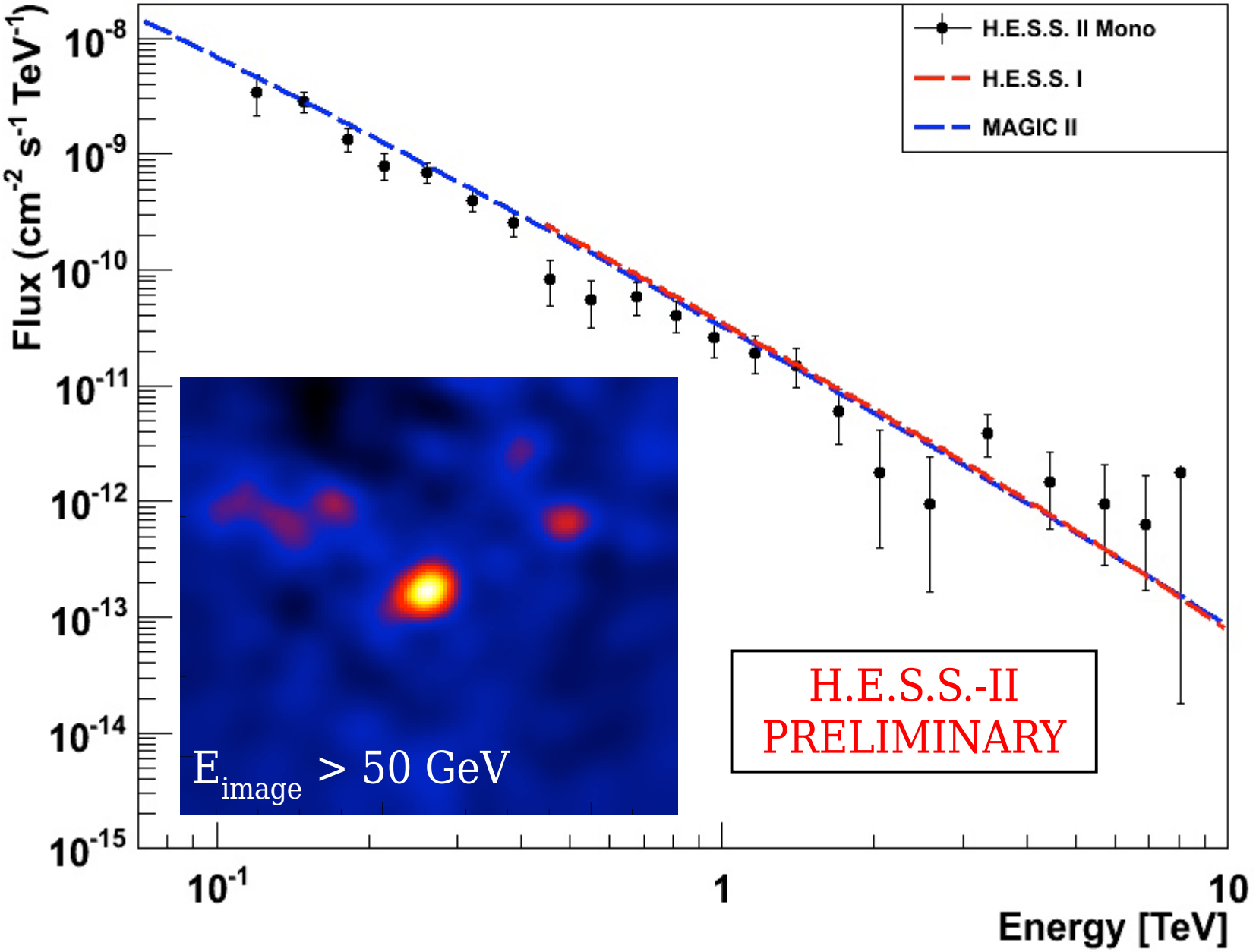

# Conclusions

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Rich dataset continues to deliver new science

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Leveraging MWL observations in each source analysis to
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Since 2010, the H.E.S.S. array has undergone major upgrades.
0) Improved techniques for gamma/hadron separation.
1) Completed mirror refurbishment.
2) Added colossal LST to center of array.
3) Further upgrades (electronics) to be completed by 2015.

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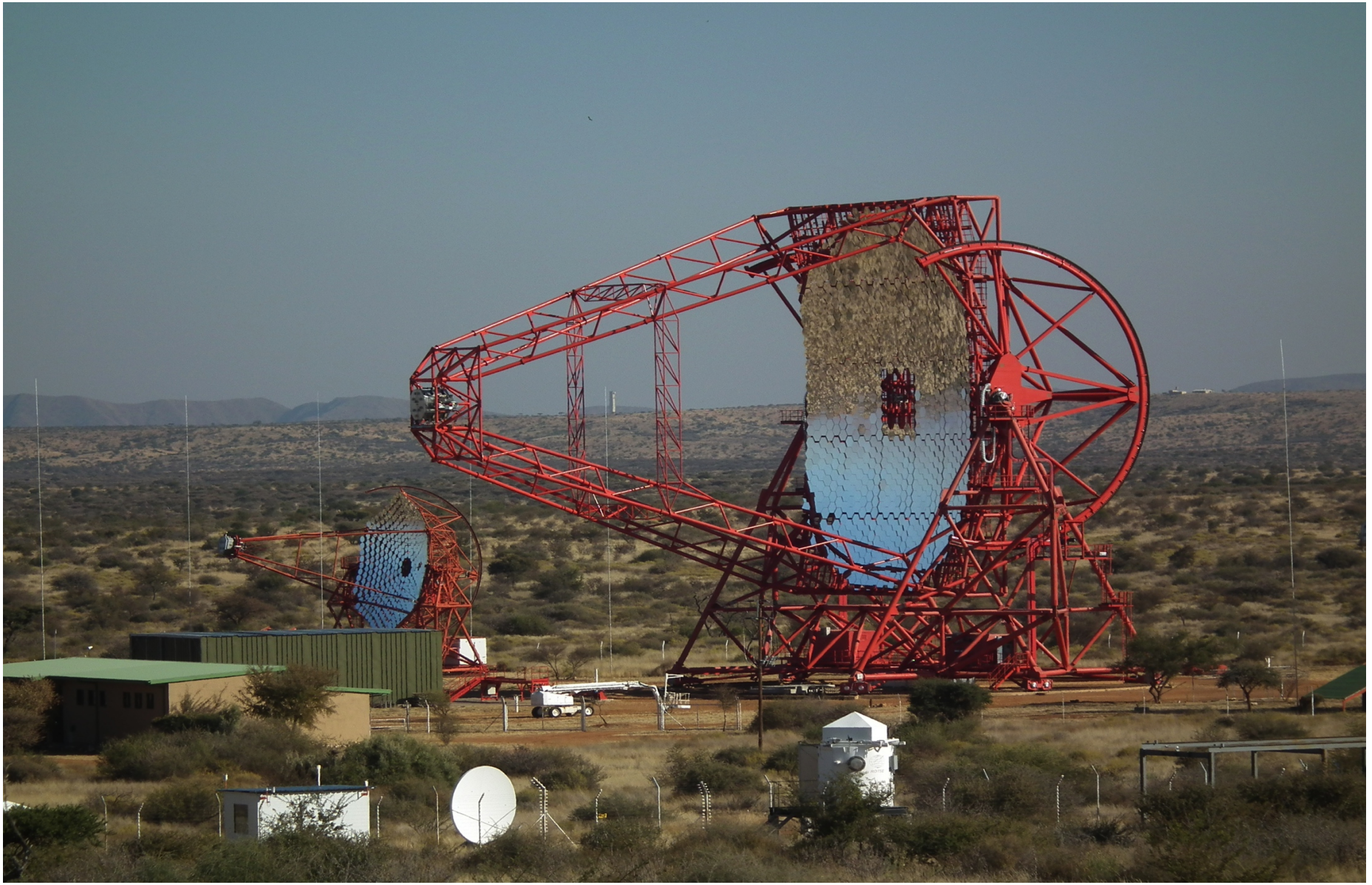
**Building a bridge to the next generation of high-energy ~~experiments~~ observatories.**

# H.E.S.S.-II First Science

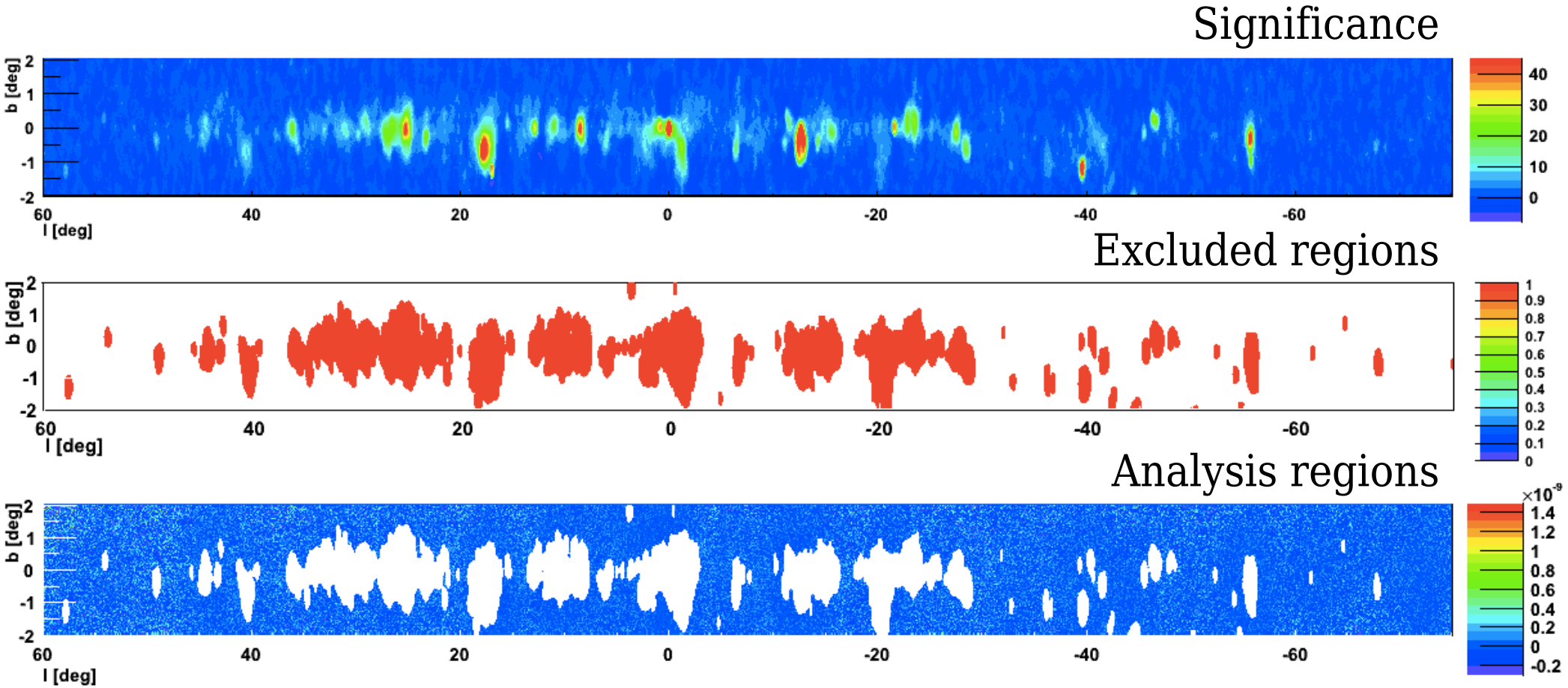
to be released @ TeVPA (23 June)



Investigating Galactic Center, pulsars, GRBs, LIV, binaries, ...

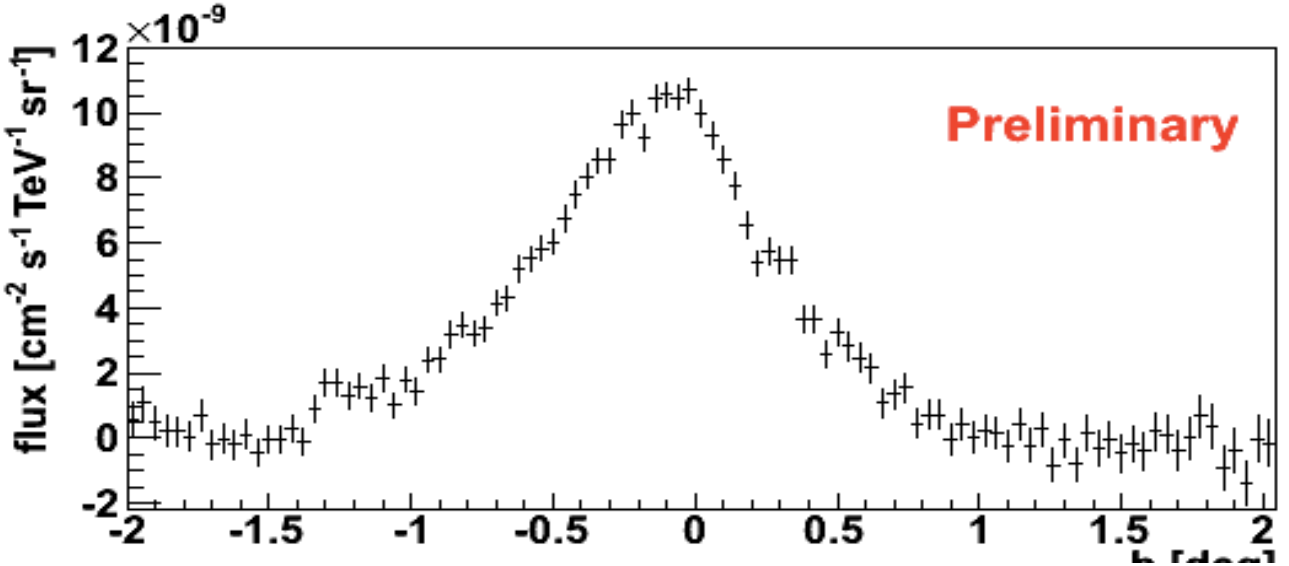
# Backup Slides

# Extracting a clean signal to search for diffuse TeV emission

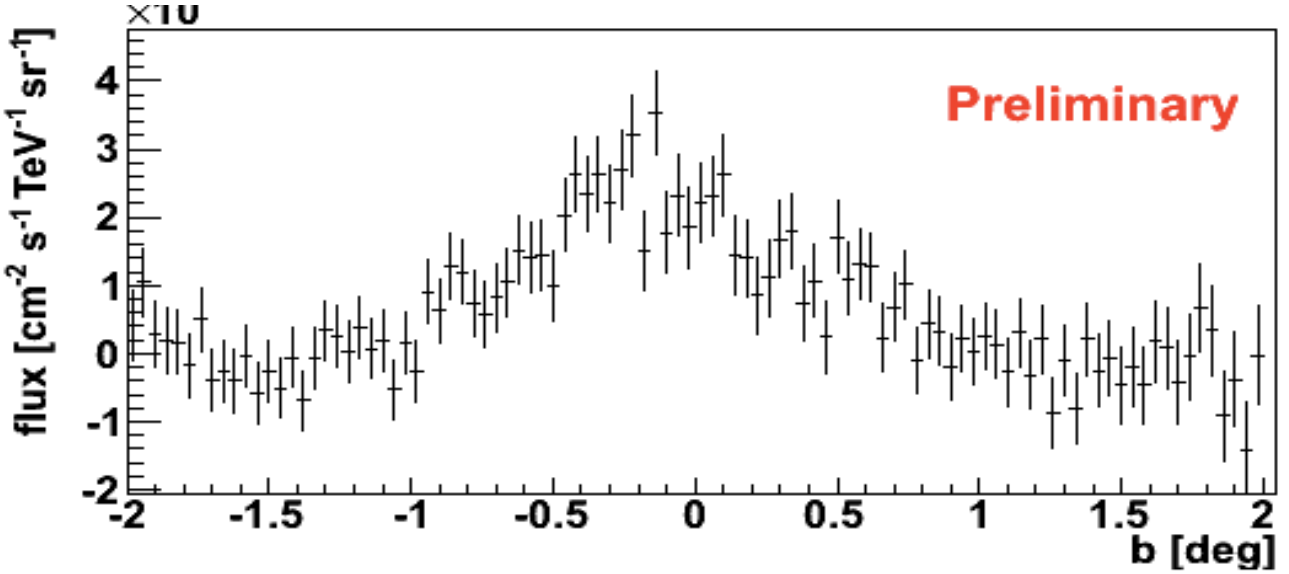


# Extracting a clean signal to search for diffuse TeV emission

Total flux




Diffuse flux



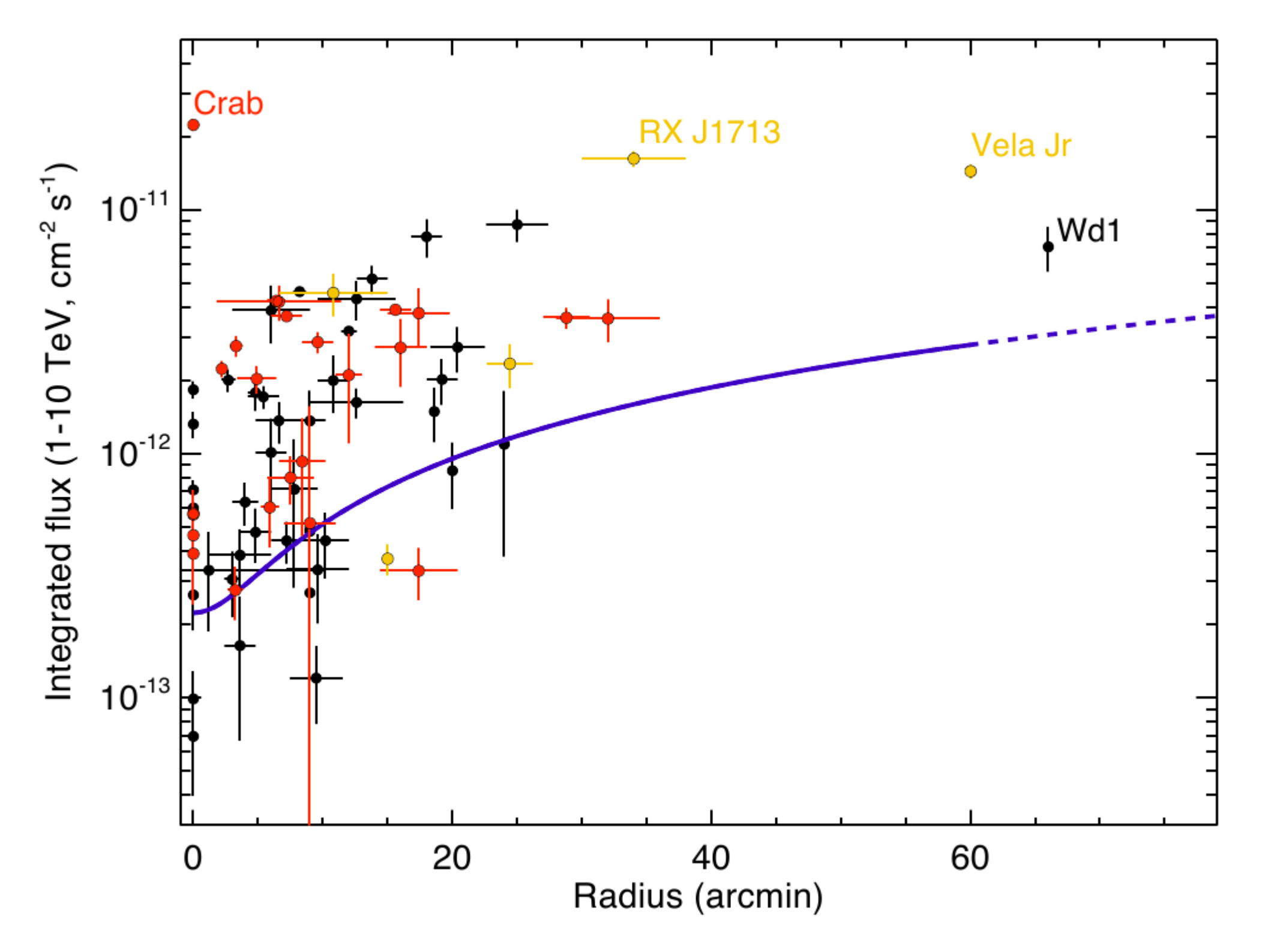
# HESS J1640-465

## Challenges for a PWN scenario

- No visible IC peak in GeV – TeV range:
  a) Very old lepton population, steep injection spectrum;
     - likely multiple emission zones
     - varying magnetic field within emission region
     - Complex spectra expected (i.e. Vela X, Hinton et al. 2011)
  b) Fine-tuned multi-component injection spectrum to mimic powerlaw: i.e. Relativistic Maxwell + powerlaw tail (Slane et al., 2010)

- Overlap of PWN IC emission with SNR shell
  a) Not observed for any other composite SNR so far
  b) Requires relic PWN and old system?

Abramowski et al. (H.E.S.S.) 2014 – MNRAS
Eger et al. (H.E.S.S.) 2014


Crab
RX J1713
Vela Jr
Wd1
$10^{-11}$
$10^{-12}$
$10^{-13}$
Integrated flux (1-10 TeV, cm$^{-2}$ s$^{-1}$)
0
20
40
60
Radius (arcmin)

# GRBs at VHE

Typical re-pointing time < 1 min

Fully automated GCN triggering & observations; highest priority

Currently observing ~5 GRBs/yr

Extended sensitivity down to 50 GeV
(Previously published only E > 400 GeV)