

Detection of J2019+368: a case study of very-large-zenith angle observations with H.E.S.S.

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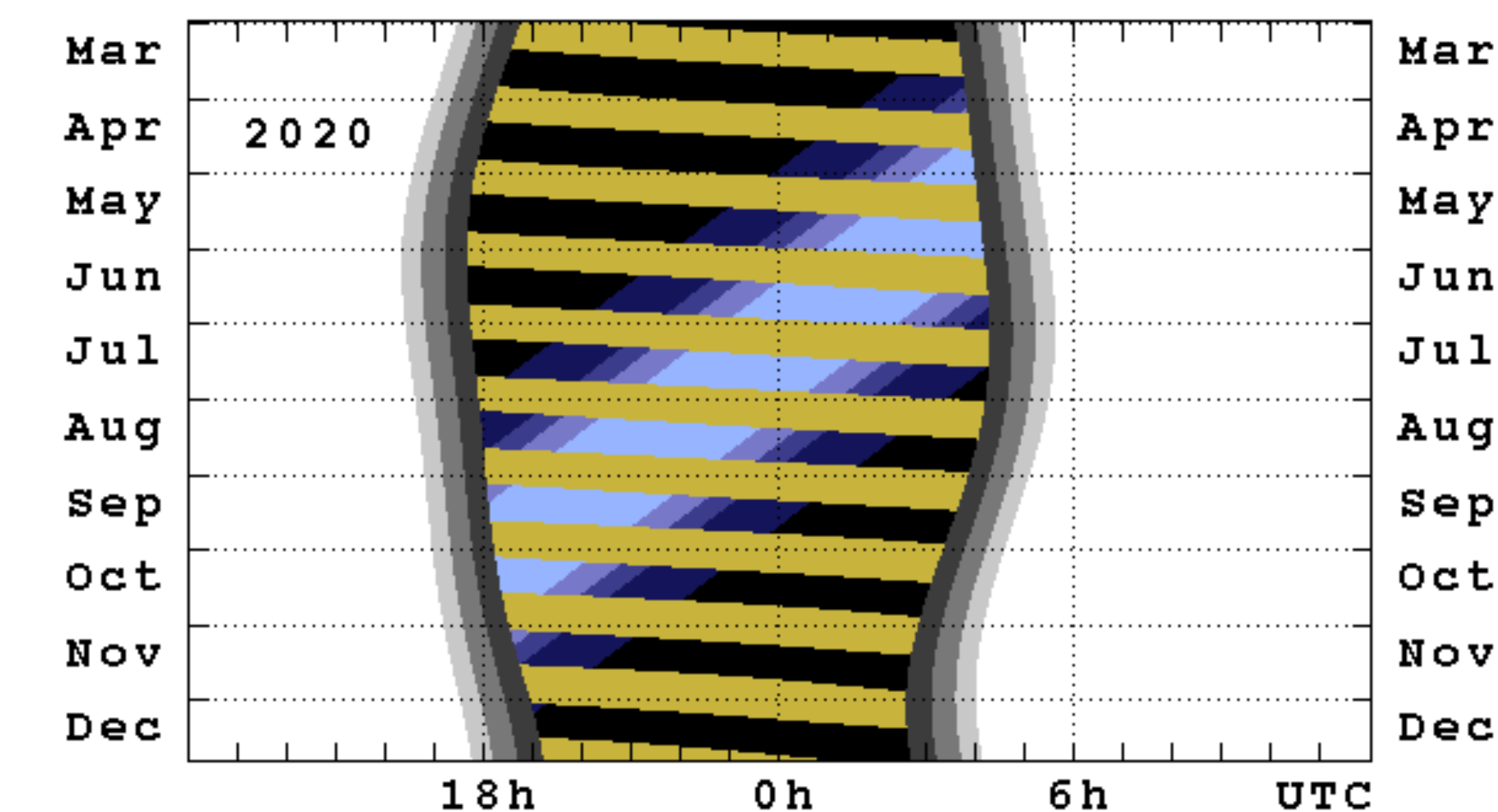
Very Large Zenith Angle (VLZA) observations

- Successfully established technique for IACTs
- Extending observation time for transients
- Extending energy range for Pevatron candidates
- Cosmic-ray and air-shower physics

J2019+368

- PeVatron candidate located in Cygnus region
- Detected by VERITAS and HAWC
- Complex morphology with emission reaching 100 TeV
- Visible by H.E.S.S. only under zenith angles >60°

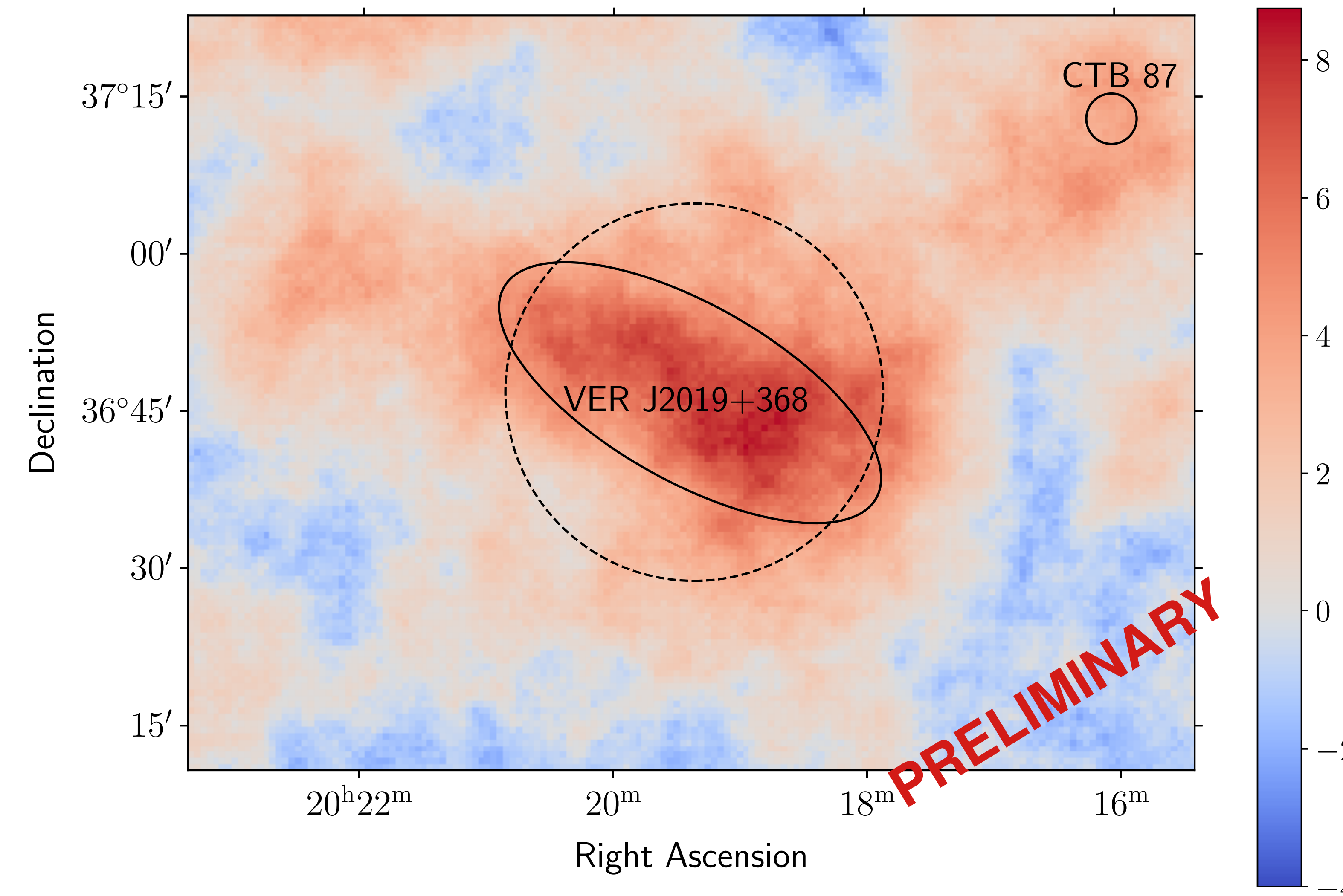
Visibility of J2019+368 at H.E.S.S.



RA: 20:20:10 Dec: 36:50:44
Gal.long.: 74:58 Gal.lat.: 0:21
Altitude: 0 15 20 25
Geo.long.: 16:30.0 lat.: -23:16.3

H.E.S.S. has taken about 50 h of observations
with average zenith angle of 61.3° in 2020

Significance map (0.14° oversampling)



Analysis configuration

Telescopes: CT1, CT2, CT3, CT4 (CT5 is not included)

Main pipeline: Model++

(de Naurois, M., & Rolland, L. 2009, *Aph*, 32, 231)

Cross-check pipeline: HAP

(Parsons, R. D., & Hinton, J. A. 2014, *Aph*, 56, 26)

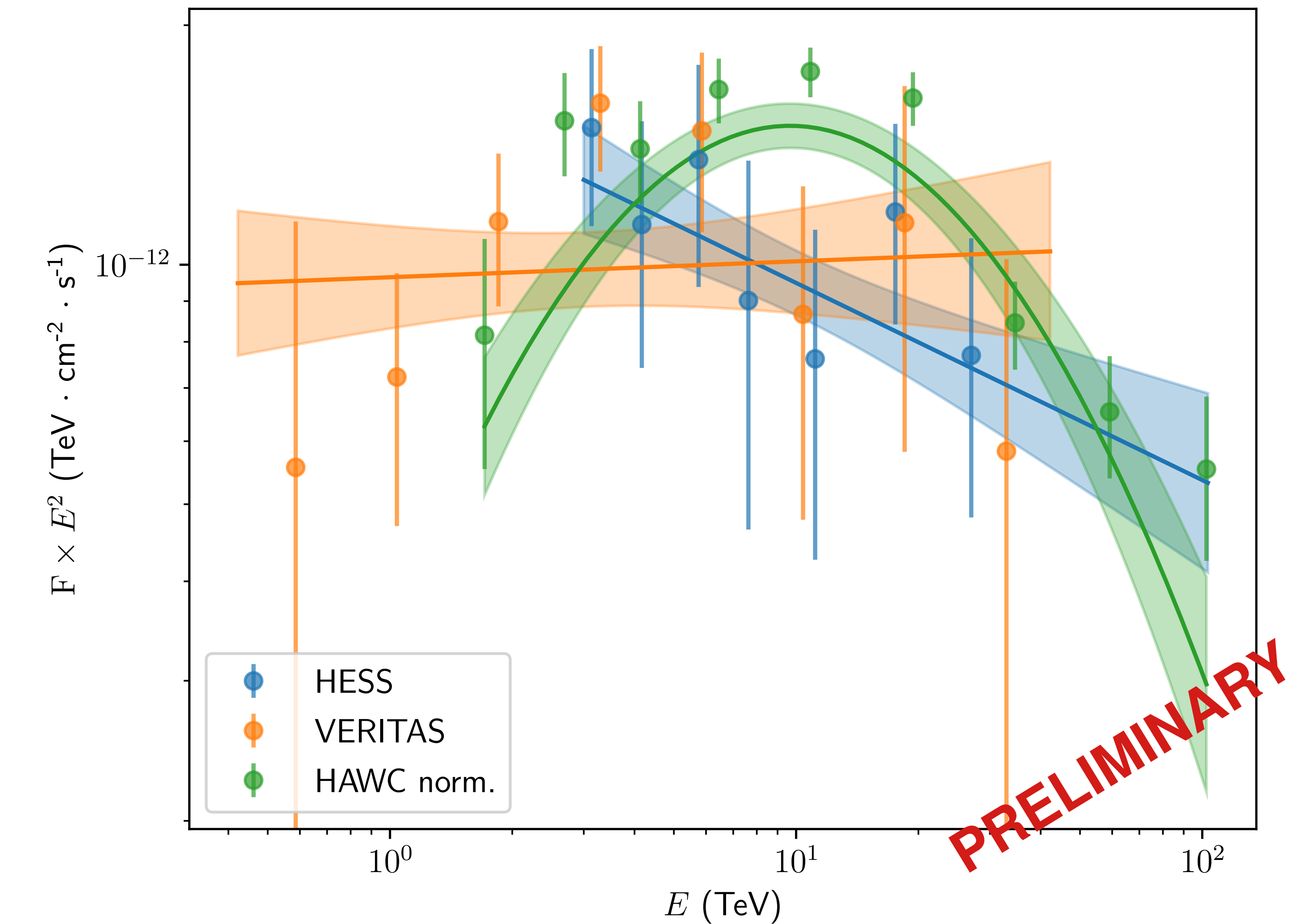
Exclusion region: 0.8° around center of source

Background methods: RingBg (for map) and ReflectedBg (for spectrum)

(Berge, D., Funk, S., & Hinton, J. 2007, *A&A*, 466, 1219)

The H.E.S.S. spectra is extracted from region of 0.30° similar to one in
VERITAS (*Astrophys.J.* 861 (2018) 2, 134) and
HAWC (*Astrophys.J.* 911 (2021) 2, 143) papers, when HAWC is normalized
by factor 2.71. We will take the exact region on 0.23° in next publication

Spectra comparison



Obtained results

The J2019+368 source was firmly detected with high significance (>5 sigma)
featuring the extension similar to one obtained by VERITAS.

Significance map shows the morphology reconstructed by VERITAS
(solid ellipse), SNR CTB 87 and spectra extraction region (dashed circle).

For the spectra reconstruction we have chosen a safe threshold of 3 TeV,
since in this study we did not apply additional atmospheric corrections for VLZA.

We have studied different quality cuts and found that the spectra could be extended
up to 100 TeV, however, further investigations and observations should be taken.



Acknowledgments:

<https://www.mpi-hd.mpg.de/hfm/HESS/pages/publications/auxiliary/HESS-Acknowledgements-2021.html>

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