

Data Life Cycle in very high energy gamma astronomy.



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Introduction

- VHE gamma astronomy is a young interdisciplinary (astronomy×astroparticle) field
1989 – discovery of Crab nebula with Whipple
- There are many useful tools developed for astronomy, e.g. FITS format, WCS axes, etc
- The software for the next-generation telescopes are actively developed under open-source policy

High Energy Stereoscopic System (H.E.S.S.)

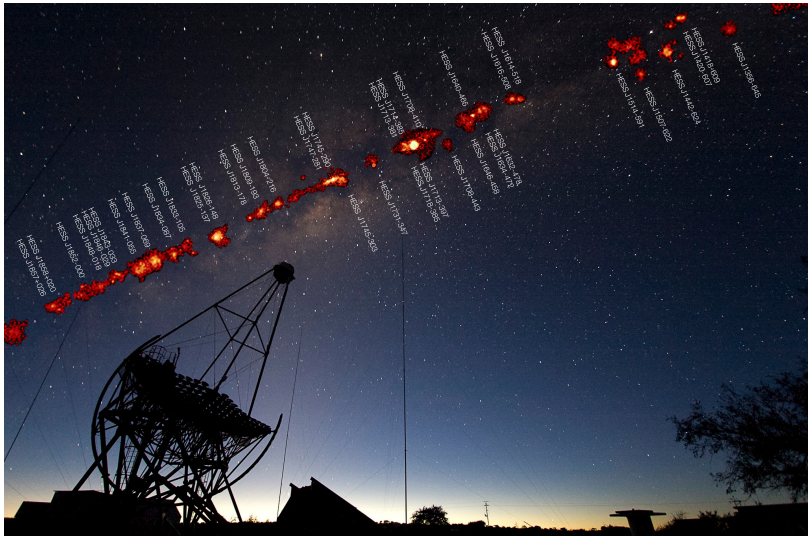


4 telescopes with 12-m reflectors

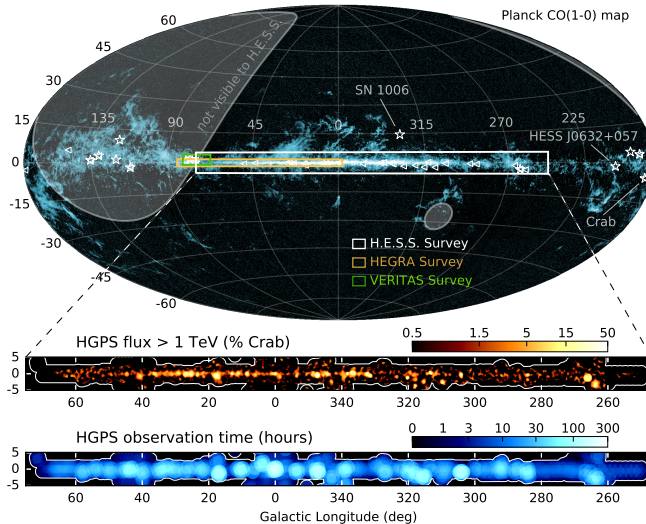
1 telescope with 28-m reflector

$23^{\circ}16'17''$ S $16^{\circ}30'00''$ W, 1800 m a.s.l, Namibia

Galaxy seen by H.E.S.S.

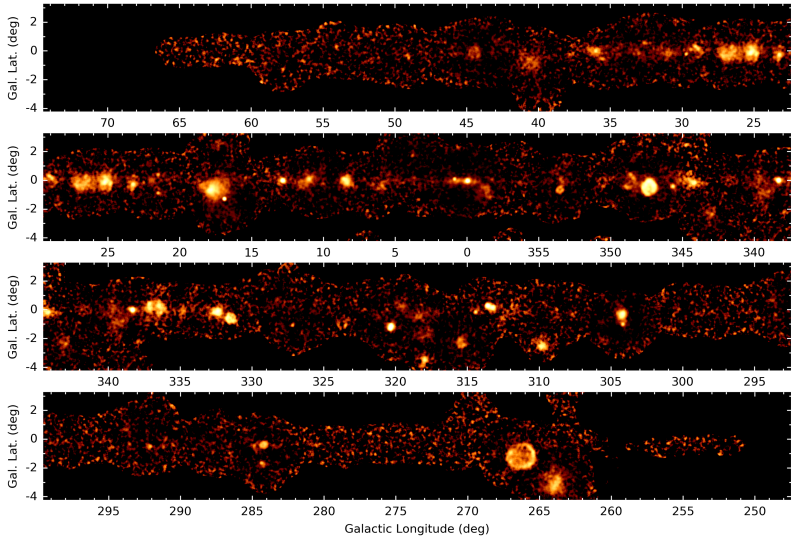


H.E.S.S. Galactic Plane Survey (HGPS)



<https://www.mpi-hd.mpg.de/hfm/HESS/hgps/>

H.E.S.S. Galactic Plane Survey (HGPS)



FITS maps

- Significance
- Flux
- Sensitivities
- Uncertainties
- Upper limits

FITS tables

- Source catalogue

Software

- astropy and gammapy packages
- Special HGPS tutorial:
<https://docs.gammapy.org/dev/notebooks/hgps.html>

H.E.S.S. first public test data release

The data are released in FITS tables and contain following:

Sources

- Crab nebula
- PKS 2155-304
- MSH 15-52
- RX J1713.7-3946
- Off runs

Quantities

- Events
- Good time intervals
- Instrument responses
- Effective area
- Energy dispersion

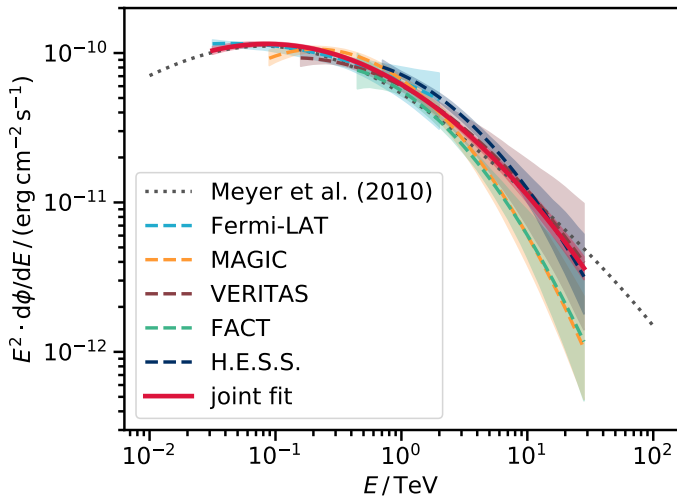
Analysis recommendations and software

<https://gamma-astro-data-formats.readthedocs.io/en/latest/>

gammapy and ctools open-source packages are suggested to use

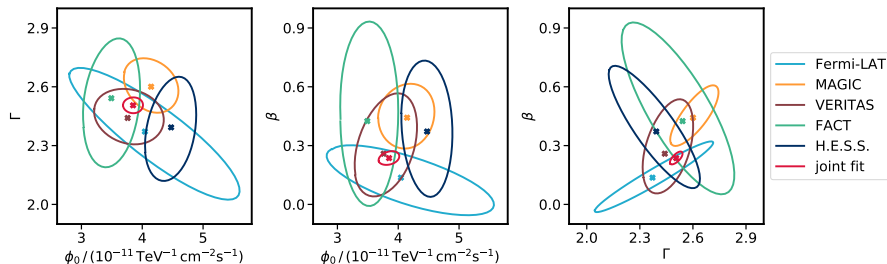
Cross-check of open source analysis software

Global fit of Crab Nebula using gammapy



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$$\frac{d\phi}{dE} = \phi_0 \left(\frac{E}{E_0} \right)^{-\Gamma - \beta \log_{10} \left(\frac{E}{E_0} \right)},$$

arXiv:1903.06621

Conclusion

- H.E.S.S. has shown the efficiency of astroparticle data publication using standard astronomical tools, e.g. FITS data format
- The software packages for the CTA are already open-source, actively developing and testing on existing data and simulations
- There is nothing to invent for TAIGA: just follow the good practice set by H.E.S.S. and CTA and intensively use open-source analysis tools