36th International Cosmic Ray Conference

PoS(ICRC2019)747

Towards a 3D likelihood analysis in VHE γ-ray astronomy: the case of H.E.S.S.

L. Mohrmann[1]*, K. Nakashima[1], A. Specovius[1], D. Tiziani[1], S. Funk[1], C. van Eldik[1], S. Ohm[2]†

[1] Erlangen Centre for Astroparticle Physics, Erwin-Rommel-Str. 1, 91058 Erlangen, Germany

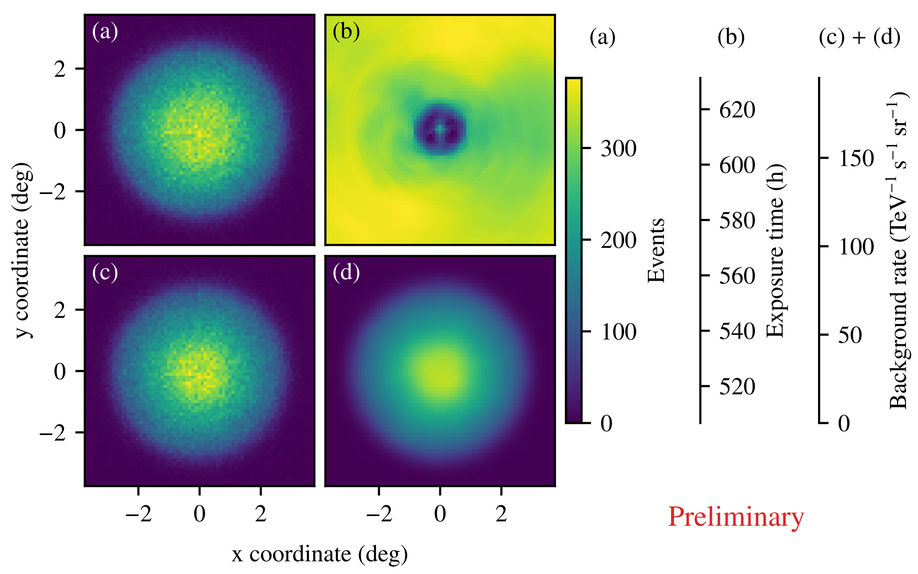
[2] DESY, Platanenallee 6, 15738 Zeuthen, Germany

* Contact: lars.mohrmann@fau.de † Presenter

Construction of a model for the residual cosmic-ray background

- Description of cosmic-ray background is key element in Imaging Atmospheric Cherenkov Telescope (IACT) data analysis
  → accurate background model is pre-requisite for 3D likelihood analysis
- Construct model based on archival H.E.S.S. data taken off the Galactic plane (≈ 3240 hours of data)
- Central idea: Average rate in field-of-view coordinate system

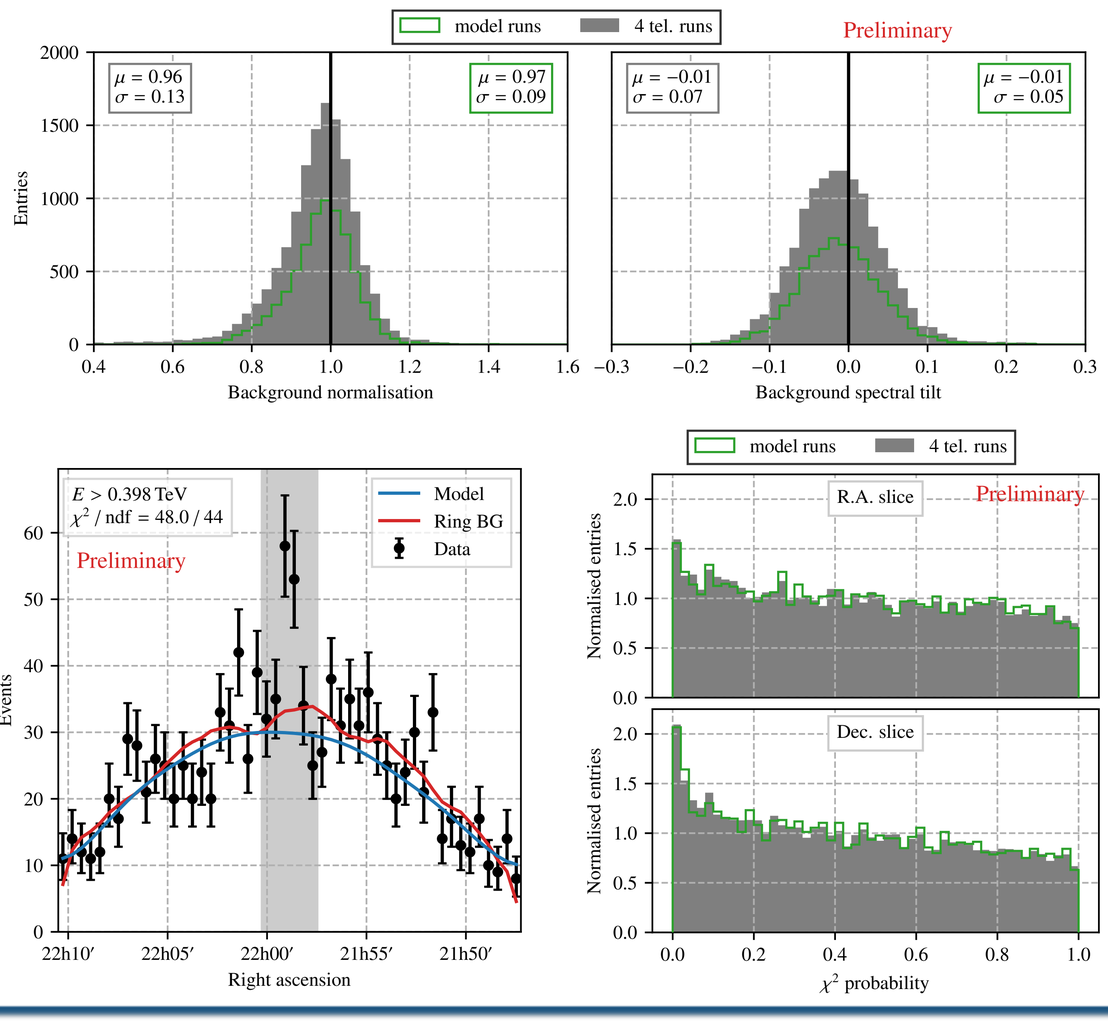
Construction



a) Sum of recorded events, excluding events around γ-ray sources
b) Exposure time per pixel, corrected for exclusion regions
c) Background event rate (per time, energy & solid angle)
d) Background event rate (smoothed)

Validation

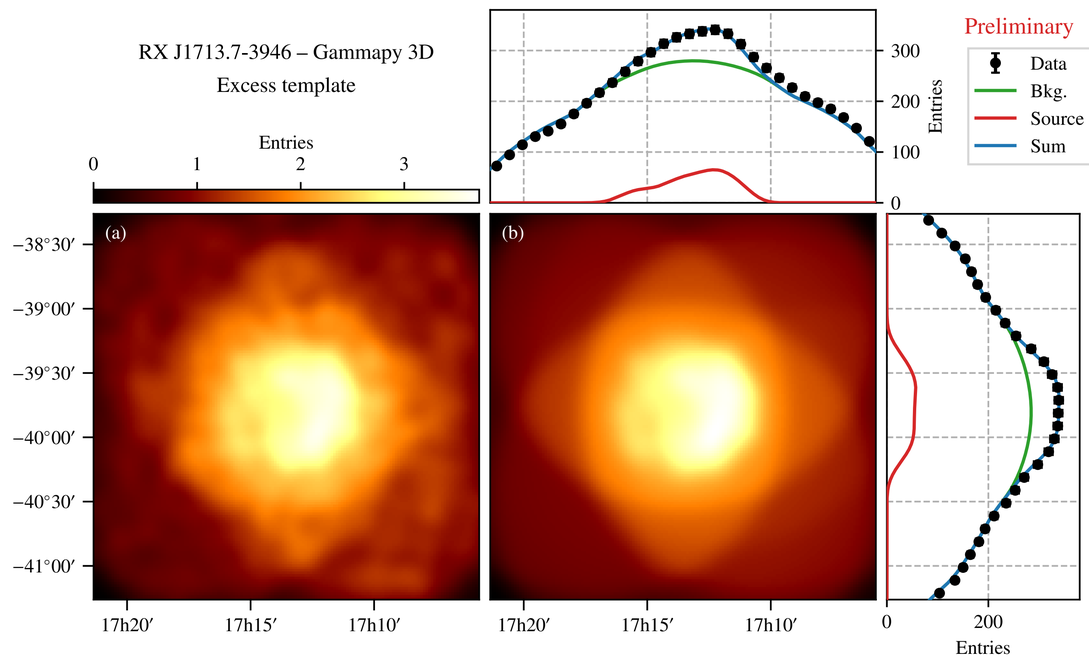
- Fit model normalisation and "spectral tilt" for all 4-telescope observations
  → can be well recovered
- Perform χ^2 test along slices of R.A. and Dec.
  → distribution almost flat (expectation for perfect model)

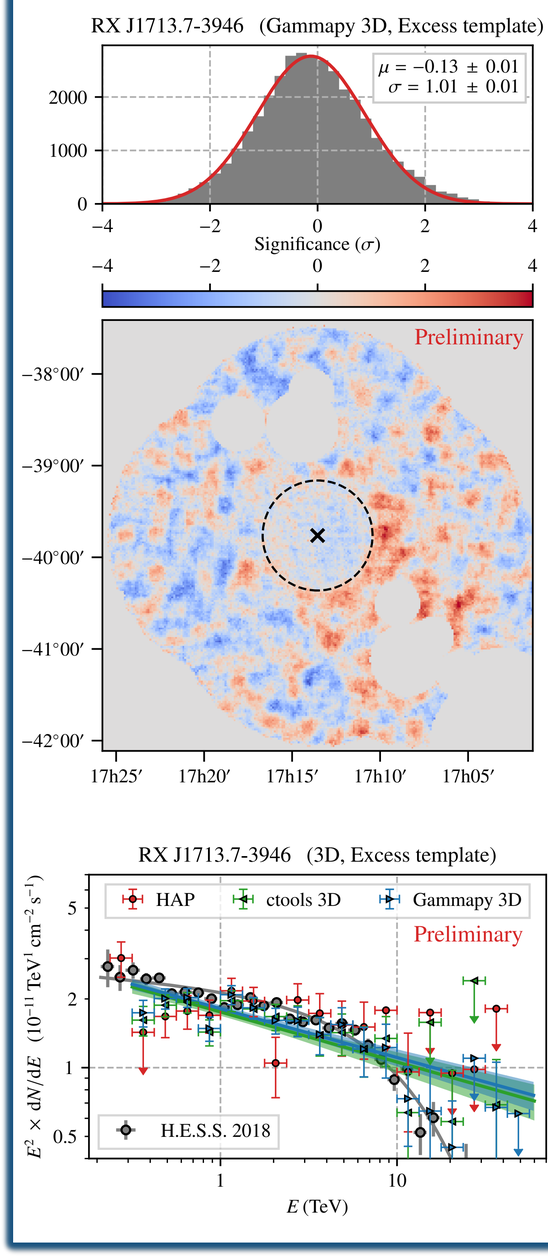


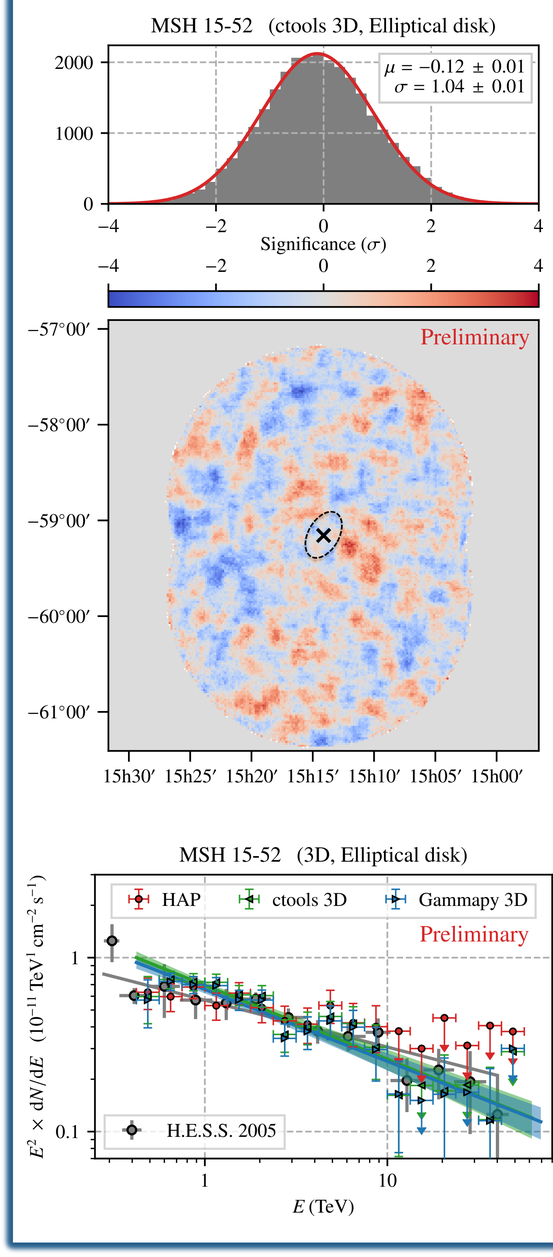
Application of a 3D likelihood analysis to public H.E.S.S. data

- Fit spectro-morphological (3D) model templates to observed data
  → extract source morphology & spectrum simultaneously
  → obtain complete description of observed field of view
- Apply analysis to public H.E.S.S. test data set[1]
  → use open-source tools *ctools*[2] and *Gammapy*[3]
- Results agree well with standard methods

RX J1713.7-3946







[1] [arXiv:1810.04516] [2] http://cta.irap.omp.eu/ctools [3] https://gammapy.org