News from the African Gamma-ray sky: Highlights from the H.E.S.S. Experiment

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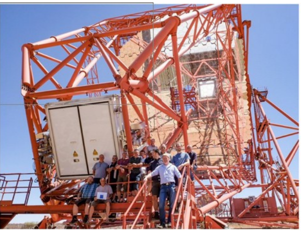
for the H.E.S.S. collaboration

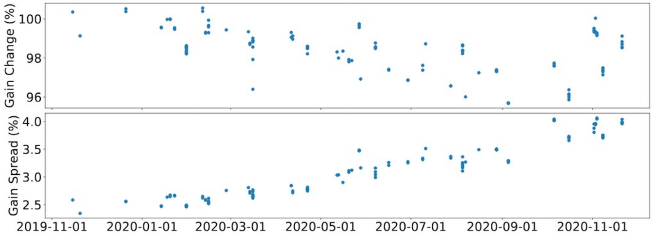
H.E.S.S.

Mixed IACT array, operated in Namibia since 2002/2004/2012.
Four 12m-sized dishes in square array + central 600 m^2 telescope.
Collaboration: 240 scientists, 31 groups, 13 countries, 4 continents.

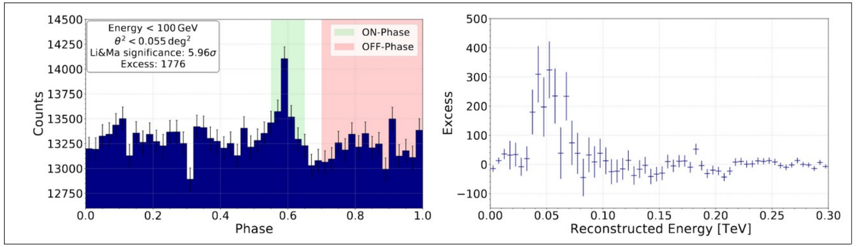
A new camera for the 28m CT5

After 7 years of operation, the initial camera of the the 600 sqm. CT5 telescope was retired and replaced by ‘NamCam’, an advanced prototype of the FlashCam camera developed for MSTs of CTA.

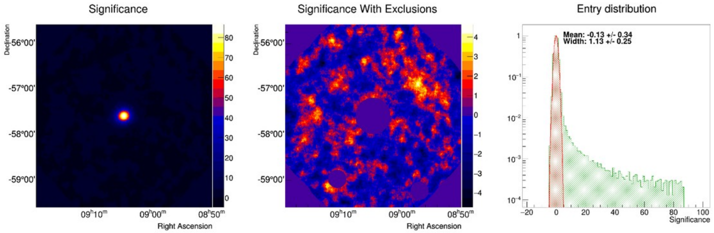




Vela Pulsar



Installation, commissioning and integration to operations went very well. See Baiyang Bi et al. (#960) for camera performance and poster #1369, Pühlhofer et al. for science verification. (PKS 0903-57, ATEL #13632)



Operating H.E.S.S.

H.E.S.S. is the oldest of the current generation IACTs
The first telescope started 2002, the array end of 2003.
After more than 15 years of anticipated operation, the
H.E.S.S. entered an extension phase in October 2019.

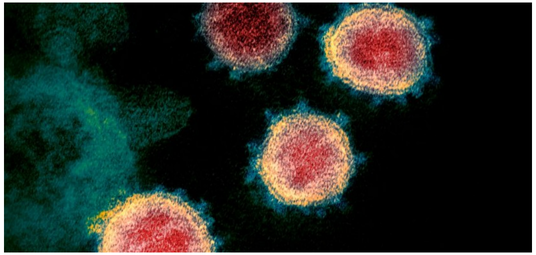
Despite aging hardware, the extension aimed for more reliable operations.
Supported by the new camera for CT5 and an upgrade of the H.E.S.S. DAQ
(see poster #1224, Zhu et al) new online quality control provided high efficiency.

2020: Average telescope efficiency 98%, 5-telescope array efficiency > 95%.
In average weather a record amount of 1180h darktime data were obtained.

Operating in Covid-times

In 2020 we
wanted to see

instead
we got



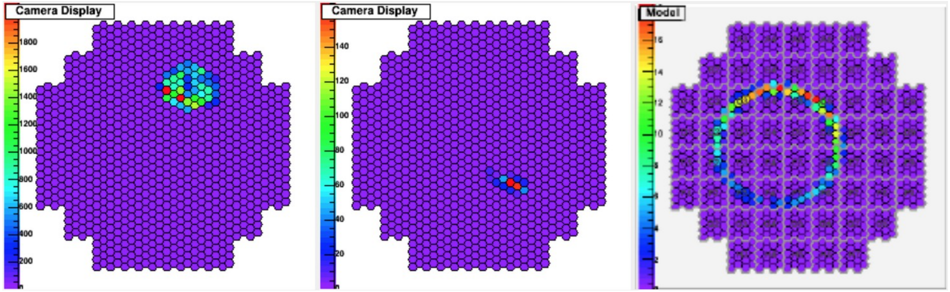
Access to Namibia and the site was limited promptly
Changing mode of operation with local staff
Great support from UNAM & state-exemptions from lockdown
HESS was able to run continuously throughout pandemic
We lost Albert Jahnke, a long-term member of our local crew.

Moving to remote control: Increasing ability of environmental sensors
Control rooms for remote operations set up in DESY Zeuthen.

News from the experiment

Increasing the observing window by observing during moonlight (following MAGIC and VERITAS) and by moving further into twilight. Satisfactory match in analysis of moonlight data with reduced gain.

Exploring UAV-based airborne calibration (see Muller et al., poster #53)



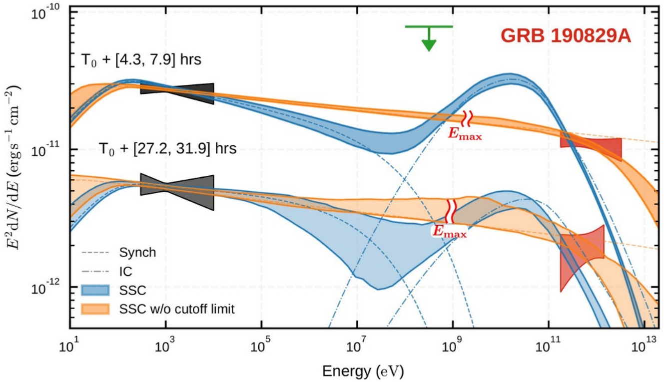
A **Python** package for **gamma-ray** astronomy

Integration of open source analysis tools: Following extensive tests, gammapy was chosen. First papers using gammapy published in 2021.

GRB and other fast ToOs

GRBs have been the highlight in the past 2 years (see # 90)
GRB 180720B, and GRB 190829A, the 1st and 3rd GRB observed > 100 GeV along with GRB 190114C, detected by MAGIC, rewarded a decade-long hunt.

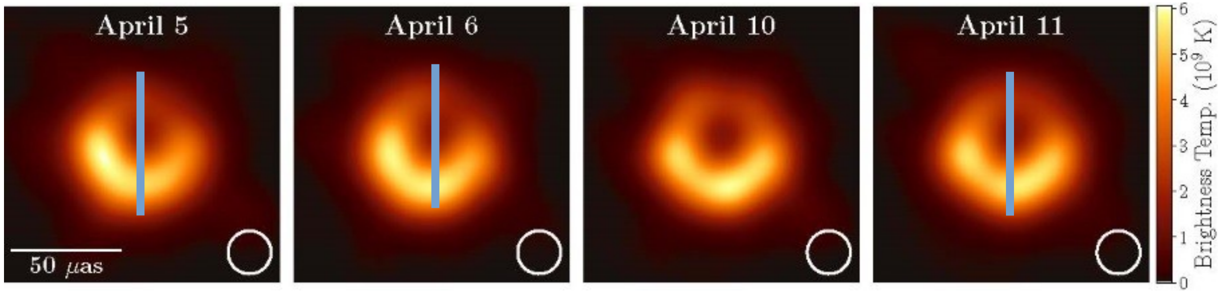
The nearby (z=0.079) GRB 190829A (H.E.S.S. collaboration, Science, 372, 1081, 2021) has been measured up to 3.3 TeV and until 53h after the explosion with remarkable similarities between X-ray and VHE characteristics.

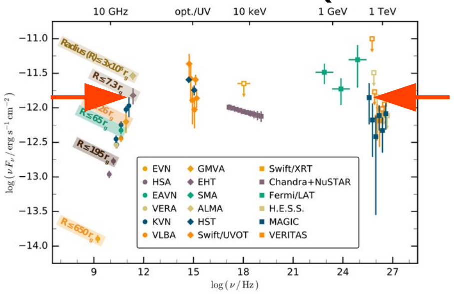


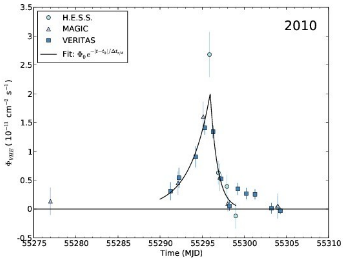
FRBs (#102), GW-sorces (#124) , AGN (#1369), SNe (#436), Neutrinos (#776, 907) have been followed up with interesting upper limits or detections.
Galactic ToOs: Novae, XRBs (CV, HMXB, LMXB, SGR (#102)), and flaring stars.

Monitoring

Multiwavelength monitoring of M87 during EHT observations (MAGIC/VERITAS)





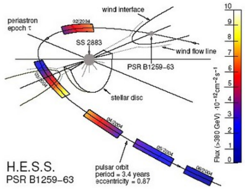


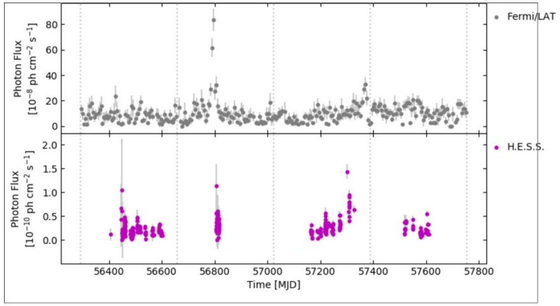
Matching radiation energy densities from same (similar-sized) region?

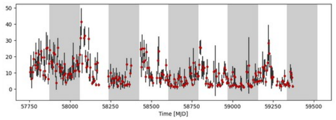
EHT + LAT + HESS + MAGIC + VERITAS + EAVN et al., ApJL, 911, L11 (2021)

Binaries: Secular variability (HESS J 0632+057, HMV submitted, 2021

PSR 1259-63, 2021 periastron, Eta Car 2020 periastron) → winds?





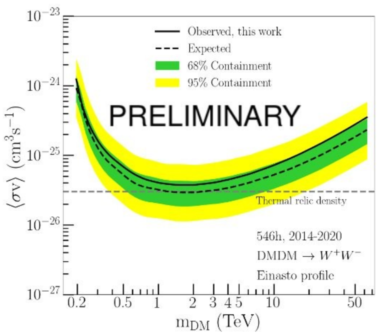


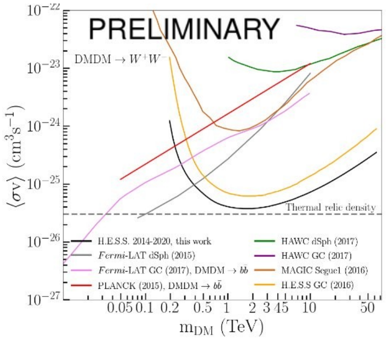
Longterm monitoring of AGN (PKS 2155-304, 2002 - 2021)

A. Wierzcholska et al., HESS. HEPRO VII, 2019

(2013 – 2016), LAT 2017 – 2021 + HESS coverage

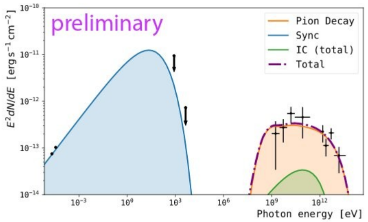
Galactic sources

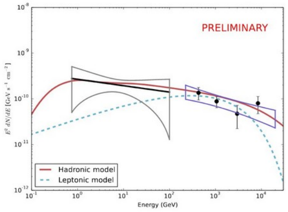




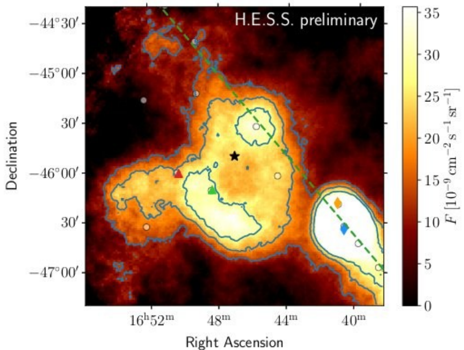
An Inner Galaxy Survey (IGS), yields a more constraining limit on annihilating dark matter (Montanari et al., #279) and a constraining upper limit on VHE emission from the low-|b| part of the Fermi bubbles (#280, Moulin+).

Deep observation of the mature luminous SNR N132D in the LMC (#128, Vink+) suggest hadronic emission. The young and faint SNR Kepler has been studied (Prokhorov et al., # 391).



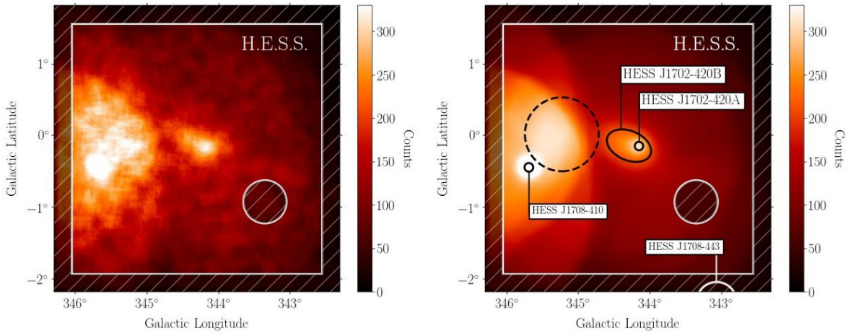


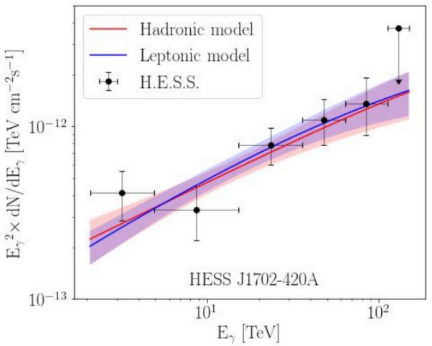
3D-analysis of Westerlund1 reveals Complex energy dependend morphology.

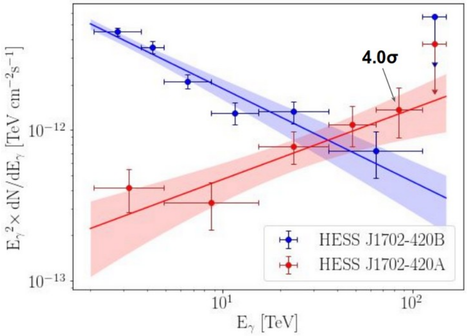


PeVatrons

Progress in the long-standing aim of understanding Galactic PeVatrons:
Further HESS sources are being traced up to 100 TeV (see #287, Giunti et al.)

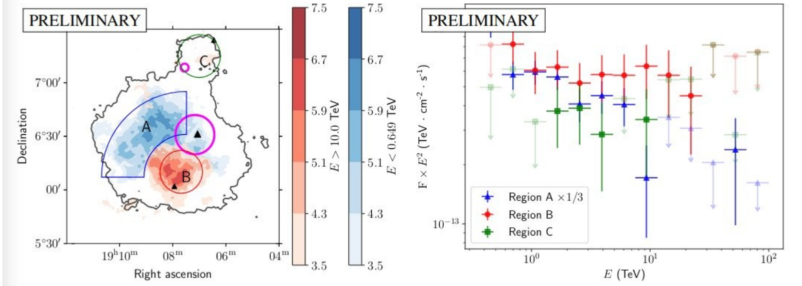






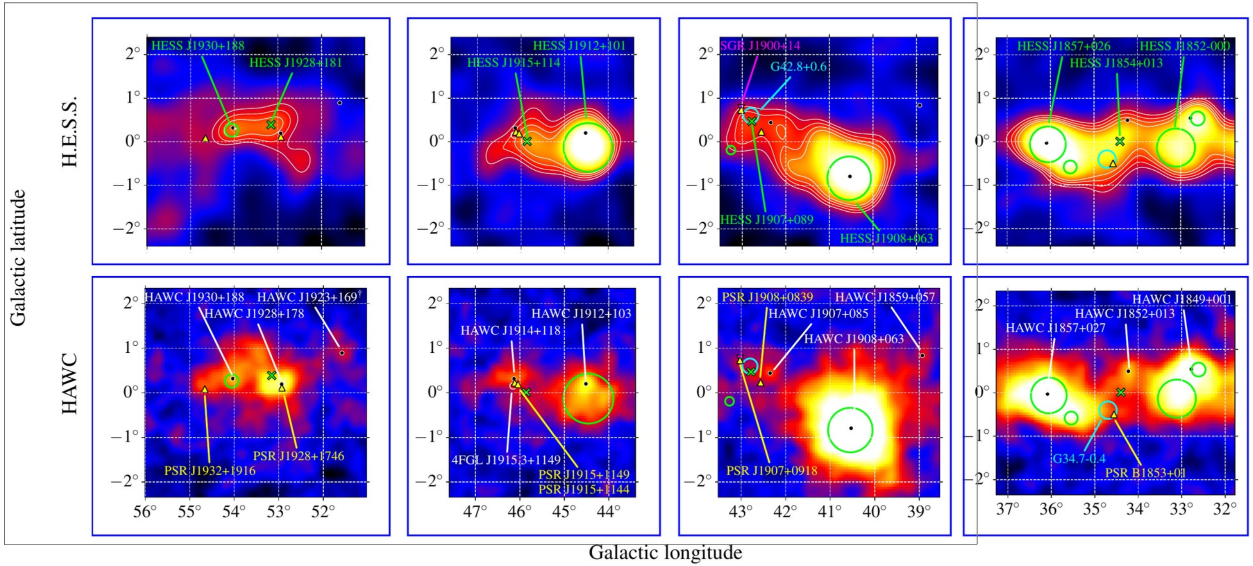
Complex source morphology or superposition. Two (spectrally and morphologically) very different (superposed?) components/sources:
HESS J 1702-420A and HESS J 1702-420B (H.E.S.S. coll.,arXiv:2106.06405)
Need for high resolution in PeVatrons: J1908+063.

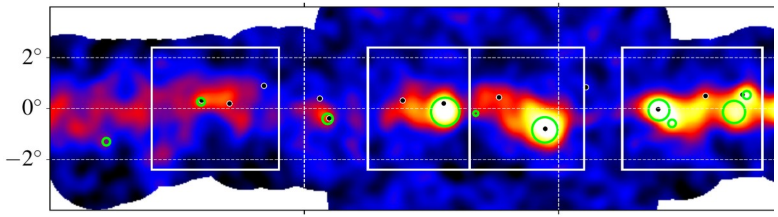
See #140, Kostunin et al.



New Sources in the Galactic Plane

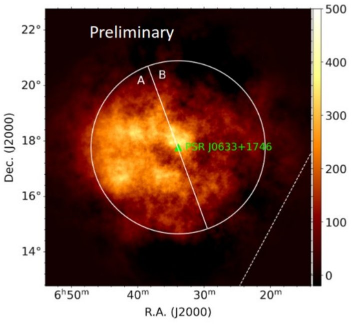
Different revised analyses of the HESS Galactic Plane Survey (GPS), e.g. with wider kernels and fov-background estimates reveal more new faint/extended sources (e.g. HESS-HAWC comparison, arXiv 2107.01425). New sources HESS J 1928+181, HESS J 1915+114, HESS J 1907+089, HESS J 1854+013

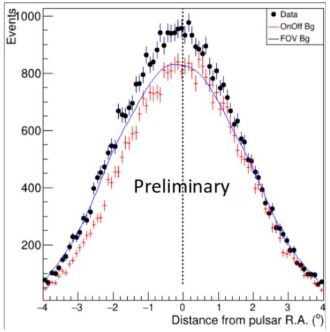




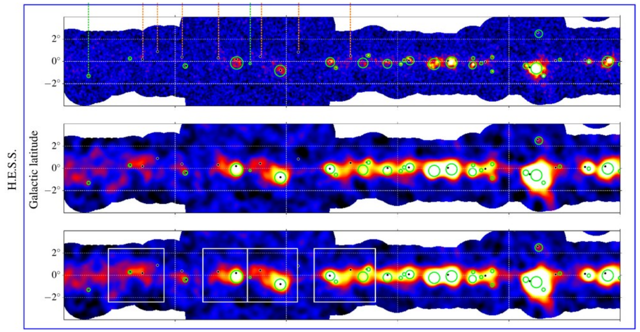
Diffuse Emission

‘Narrow’ FoV instruments (HESS: 15 deg²) can cover a lot of ground using smart analysis, see e.g. Geminga (see #174, A. Mitchell et al.)

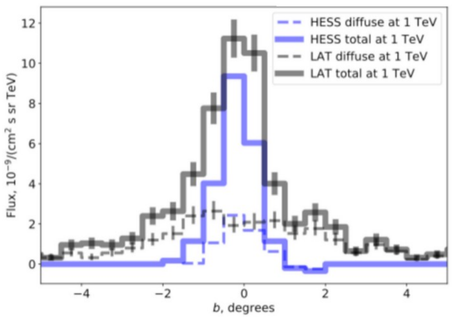




#174, A. Mitchell et al.



HESS collaboration: arXiv 2107.01425



Neronov & Semikoz, 2019

Reanalyses turn out more sources, more source extensions and complex morphology (source confusion?) → studies of diffuse emission face conceptual problem: |b| profiles depend on models of extended diffuse emission.