T 57: Gamma Astronomy I

Time: Wednesday 16:15–18:15 Location: VG 3.101

T 57.1 Wed 16:15 VG 3.101

MAGIC Moments from more than 20 Years of Operation — •Daniela Dorner[1] and MAGIC Collaboration[2] — [1]Universität Würzburg, Deutschland — [2]www.magic.mpp.mpg.de

The Major Atmospheric Gamma-ray Imaging Cherenkov Telescope (MAGIC) started its operation more than 20 years ago. Driven by innovative spirit and an international group of inspired scientists, the two 17-m telescopes located at the Canary Island of La Palma deliver cutting-edge science at energies above 50 GeV. Not only a variety of compelling gamma-ray physics cases are prominent in the science program, but also new fields like intensity interferometry are explored, and a collaboration with the large-size-telescope (LST) of the Cherenkov Telescope Array Observatory (CTAO) has been started. The presentation summarizes highlights from the past two decades, recent results and future prospects.

T 57.2 Wed 16:30 VG 3.101

Longterm Variability Study of the Crab Nebula with the MAGIC Telescopes — Felix Wersig and •Cyrus Walther — TU Dortmund, Germany

As the brightest steady source in the sky at very high energies, the Crab Nebula is often used for the calibration of instruments in gamma astronomy. Since 2011 multiple flares at energies > 100 MeV have been observed by AGILE and Fermi-LAT. We investigate variability at very high energies using data spanning a time period of 10 years from the MAGIC telescopes. Non-periodic variability can manifests in three ways: flares, flux increase/decrease on long-timescales or as an additional fluctuation on top of the statistical fluctuations expected in the flux. To investigate those types of variability, different tests are implemented.The presence of flares is investigated with a Bayesian Blocks algorithm, changes of the flux on long time-scales are investigated with a likelihood ratio test and the fractional variation is introduced as test statistic for a model independent test for fluctuations in the data.

T 57.3 Wed 16:45 VG 3.101

Consistent long-term analysis of VHE blazars using autoMAGIC — •Cyrus Walther and Felix Wersig — TU Dortmund University

Through the Cherenkov light emitted by particles originating from primary gamma rays interacting with the atmosphere, Imaging Atmospheric Cherenkov Telescopes (IACTs) such as MAGIC observe TeV-emitting astrophysical sources since 2003. After 20 years, this allows now for long-term analyses. While the development of consistent multi-year analysis requires a significant time commitment and is prone to bias if performed manually period by period, a database-driven software could fix those issues. An automatic analysis dubbed autoMAGIC has been developed to automatize the analysis of data from the MAGIC telescopes. In this approach, we aim to utilize autoMAGIC to perform long-term analyses of gamma-ray emitting blazars and aim to develop long-term light curves for selected blazars

T 57.4 Wed 17:00 VG 3.101

Revealing FACTs about the Harder-when-Brighter Behaviour of Mrk 421 in an Unbiased Long-Term Study — •Daniela Dorner[1], Bernd Schleicher[2], and FACT Collaboration[3] — [1]Universität Würzburg, Deutschland — [2]ETH Zürich — [3]www.fact-project.org

Featuring two peaks in their spectral energy distribution, blazars exhibit a strong variability both in X-rays and very-high-energy gamma rays. Many studies find a harder-when-brighter behaviour of the spectral index in correlation with the flux.

Within the FACT monitoring program, the blazar Mrk 421 has been observed for more than 3200 hours at TeV energies. Thanks to the unbiased observing strategy, the data sample is ideally suited for systematic long-term studies. Owing to the stable photosensors that allow for observations during bright moon and the automatic and remote operation, the 10-year data sample covers more than 1100 nights.

Results from an unprecedented study of Mrk 421 are presented, focussing on the correlation of the spectral index with the flux at very high energies and probing the often observed hard-when-brighter behaviour.

T 57.5 Wed 17:15 VG 3.101

Towards Searching for Photons with Energies beyond the PeV Range from Galactic PeVatrons — •Chiara Papior, Marcus Niechciol, and Markus Risse — Experimentelle Astroteilchenphysik, Center for Particle Physics Siegen, Universität Siegen

Recently, photons of cosmic origin with energies in the PeV range have been measured by several gamma-ray observatories. Such energetic photons are potentially produced during the acceleration of charged particles in so-called PeVatrons which are widely assumed to be the sources of a large part of galactic cosmic rays. The LHAASO and HAWC observatories published catalogs of gamma-ray sources including sources with energy spectra without visible cutoffs up to the PeV range. Several of those sources have been selected and their spectra have been extrapolated up to the ultra-high-energy (UHE, here beyond 10 PeV) regime. It has been evaluated if (and under which conditions) giant air-shower observatories, for example the Pierre Auger Observatory, could contribute to testing the UHE luminosity of such PeV γ-sources. The expected fluxes and the required discrimination power to distinguish between photon- and hadron-initiated air showers will be presented. The impact of possible propagation effects is investigated as well.

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T 57.6 Wed 17:30 VG 3.101

Enabling ground-based one giga electronvolt gamma ray astronomy — •Sebastian Achim Mueller — Max Planck Institute for Nuclear Physics, Heidelberg, Germany

Timing the variable gamma ray emission from mergers, bursts, recurring novas, flaring jets, clocking pulsars, and many more is key to constrain physical models. For good timing on account of high rates, we would ideally collect the abundant low energetic 1GeV gamma rays, for which the universe is still transparent up to high red shifts, in large areas. Satellites collect low energetic gamma rays but only in desk sized areas. Cherenkov telescopes have multi soccer field sized collecting areas but only detect the rare high energetic gamma rays above several 10GeV. We propose a ground-based instrument that detects 1GeV gamma rays in a large area and hence achieves huge gamma ray detection rates: the Cherenkov plenoscope. With a groundbreaking optics, the plenoscope enables for the first time the high-resolution imaging of low energy gamma ray air showers using a huge (71m) mirror. The plenoscope can tolerate deformations and misalignments of its mirror and camera, what reduces its cost compared to a telescope. We will introduce the plenoscope's optics and demonstrate its capabilities. By simulating a possible design we will briefly discuss the consequences for future ground based gamma ray astronomy.

T 57.7 Wed 17:45 VG 3.101

Bayesian approach to signal estimation in gamma-ray astronomy with Gammapy — •Matheus Genaro Dantas Xavier, Rodrigo Guedes Lang, Tim Unbehaun, and Stefan Funk — Erlangen Centre for Astroparticle Physics (ECAP), Friedrich-Alexander-Universität Erlangen-Nürnberg

Gamma-ray observations from Imaging Atmospheric Cherenkov Telescopes, such as H.E.S.S., are overwhelmingly dominated by a background of cosmic rays. To properly estimate the strength of the observed signal, gamma-hadron separation methods are used in conjunction to background estimation techniques, where selection cuts remove the majority of background events (inevitably loosing a fraction of the unknown signal). We are interested in applying and extending a Bayesian method to perform signal estimation - the BASiL method from D'Amico et al. (2021) - to H.E.S.S. data, in both 1-dimensional (data binned in energy) and 3-dimensional (data binned in energy and spatial coordinates) analyses. This approach utilizes all available information after event reconstruction and the probability distributions associated to gamma- and hadron-like events without selection cuts. In the Bayesian framework, the posterior probability of the signal is obtained, from which credible intervals can be computed and the probability of two competing hypotheses (source or non-source) can be assessed through the Bayes factor. From simulated data, improved precision in signal reconstruction is achieved, while flux points are obtained from a modified version of Gammapy, revealing that fluxes can

be measured even in highly background-dominated datasets.

T 57.8 Wed 18:00 VG 3.101

Impact of the three-dimensional Galactic gas distribution on the modeling of the diffuse gamma-ray flux* — •Yannick Schmidt[1,2], Julien Dörner[1,2], Jonas Hellrung[1,2], and Julia Becker Tjus[1,2,3] — [1]Theoretical Physics IV, Plasma Astroparticle Physics, Faculty of Physics and Astronomy, Ruhr-University Bochum, 44780 Bochum, Germany — [2]Ruhr Astroparticle and Plasma Physics Center (RAPP Center), Germany — [3]Department of Space, Earth and Environment, Chalmers University of Technology, 412 96 Gothenburg, Sweden

The high-energy γ-ray sky is predominantly shaped by diffuse emissions arising from non-thermal processes, such as inverse Compton scattering, Bremsstrahlung, and the decay of neutral pions. Simulations of these emissions serve as valuable tools to constrain models of the Galactic cosmic-ray population, providing insights into their origin and propagation through the interstellar medium (ISM). The accuracy of these simulations is highly dependent on the spatial distribution of the interstellar gas. To date, many models rely on a 2D cylindrically symmetric geometry, which imposes significant limitations in terms of physical realism. In this work, we investigate the impact of explicit three-dimensional distributions for the neutral gas components of the ISM on π^0-production. This is achieved by integrating the local emissivity along the line of sight, as implemented in the HERMES software framework. The resulting γ-ray emissions are subsequently analysed and compared with those obtained using traditional two-dimensional ring models for the gas distribution. * supported by SFB1491