T 83: Gamma astronomy II

Time: Thursday 16:00–18:35 Location: Th

Group Report T 83.1 Thu 16:00 Th

FACT - Highlights from Unbiased Monitoring at Very High Energies — •Daniela Dorner[1] and Thomas Bretz[2,3] for the FACT-Collaboration — [1]Universität Würzburg, Germany — [2]ETH Zürich, Schweiz — [3]RWTH Aachen, Germany

The First G-APD Cherenkov Telescope (FACT) has been monitoring bright sources at TeV energies for more than eight years, collecting a total of more than 14700 hours of physics data. The duty cycle is maximized and gaps in the light curves are minimized using semiconductor photosensors. In combination with an unbiased observing strategy, this yields an unprecedented data sample and allows for systematic studies of source variability. In addition, many multi-wavelength observations are triggered or carried out in the context of multi-instrument campaigns. Those are crucial to interpret the origin of the TeV gamma-ray emission. The presentation will summarize results from the past years on the blazars Mrk 501, Mrk 421, 1ES 1959+650 and 1ES 2344+514.

T 83.2 Thu 16:20 Th

Variability Analysis of *Fermi*-LAT and FACT blazar light curves — •Sarah Wagner, Daniela Dorner, and Karl Mannheim for the FACT-Collaboration — Julius-Maximilians-Universität Würzburg

Blazars are active galactic nuclei with a relativistic outflow directed closely towards our line of sight showing rapidly variable non-thermal continuum emission. We present a flare analysis of blazar light curves observed with *Fermi*-LAT and FACT in order to better understand the physical processes that give rise to the observed variability. Based on Bayesian blocks and the HOP algorithm, the asymmetries of flux rise and decay time are studied.

T 83.3 Thu 16:35 Th

FACT - Analysis of Flux Distributions of the Blazars Mrk 421 and Mrk 501 — •Laura Eisenberger for the FACT-Collaboration — University of Würzburg

The blazars Mrk 421 and Mrk 501 are the brightest known astrophysical sources at TeV energies. Active Galactic Nuclei (AGN) viewed along the jet axis, known as blazars, show extremely variable gamma-ray emission which so far defies a compelling physical interpretation.

Theoretical models predict non-thermal emission due to particle acceleration at shock waves travelling down an initially relativistic jet. Doppler boosting of the emission from the fastest shocks results in high-amplitude flux states, while the multiple shocks from the decelerated jet further downstream produce an apparently steady baseline emission with weaker Doppler boosting. Studying the shape of flux distributions on time scales from minutes to years and investigating its temporal evolution provides crucial information for testing this scenario.

FACT, the First G-APD Cherenkov Telescope, has been designed for long-term and continuous monitoring in the very-high-energy regime. Here, we present results of our analysis of FACT data acquired during 786 nights (1882 hours in total) for Mrk 421 and 896 nights (1725 hours in total) for Mrk 501.

T 83.4 Thu 16:50 Th

Long-term Studies of the Blazar Mrk 421 in the Multi-Wavelength Context — •Bernd Schleicher for the FACT-Collaboration — University of Würzburg, Institute for Theoretical Physics and Astrophysics

The blazar Mrk 421 is one of the brightest sources in very-high-energy (VHE) gamma rays. The origin of such gamma rays is still under debate but several models predict correlation between different wavelengths. Therefore, regular multi-wavelength (MWL) campaigns have been carried out, since 2009. Based on this extensive data sample, variability is studied on different time scales from minutes to years. At VHE, the source is regularly monitored by MAGIC and FACT. Combining the data from these two telescopes, both the short time scales (excellent sensitivity of MAGIC) and long time scales (dense monitoring by FACT) can be studied in detail. Studying 5.5 years of FACT light curves combined with MWL data show a correlation between VHE and X-ray with a lag < 0.6 days and a correlation between GeV gamma-ray and radio data with a lag of 43 days. A study of two years of data including both MAGIC and FACT in the VHE also shows a significant correlation between X-ray and VHE. The highest variability was found in X-rays and VHE in both studies. The analysis of further MWL observations is ongoing.

T 83.5 Thu 17:05 Th

Detection of new Misaligned Active Galactic Nuclei in the Fermi-LAT Fourth Source Catalog using machine learning techniques — •Luca Deval[1,2], Fiorenza Donato[3], and Mattia Di Mauro[3] — [1]Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Physics Department-Torino University, Turin, Italy — [3]Physics Department, Torino University, and Istituto Nazionale di Fisica Nucleare, Sezione di Torino, Torino,Italy

Active galactic nuclei (AGN) are the most luminous and abundant objects in the gamma-ray sky. AGN with jets misaligned along the line-of-sight (MAGN) appear fainter than the brighter blazars, but are expected more numerous. Fermi Large Area Telescope (LAT) detected 40 MAGN compared to 1943 blazars.

The aim of this study is to identify new MAGN candidates in the blazars of uncertain type (BCUs) listed in the Fermi-LAT 10-years Source Catalog using an artificial neural network (ANN). The statistical tests applied to the trained ANN reveals that a classification with machine learning techniques is feasible with high accuracy and precision. The trained ANN has been applied to the 1120 BCUs which have been classified into 655 BL Lacs and 314 Flat Spectrum Radio Quasars (FSRQs). Among the re-classified BCUs, the possible MAGN candidates have been determined by applying thresholds on the spectral index, variability index and gamma-ray luminosity.

Our results led to 36 possible MAGN candidates, which respect the main physical properties of the 40 MAGN already listed in the Fourth Fermi Catalog.

T 83.6 Thu 17:20 Th

Event classification in Compton-Pair telescopes using Convolutional Networks — •Jan Lommler and Uwe Oberlack — Johannes Gutenberg-Universität Mainz

Low to medium energy gamma rays are shielded by the Earth's atmosphere and cannot be measured with on-ground facilities. Satellite based gamma-ray astronomy relies on Compton scatter and Pair creation as measurement channels. Among the biggest challenges are the poor signal to background ratio due to low signal fluxes from cosmic sources and the high background rates even in the comparatively moderate environment of Low Earth Orbits. An efficient event tagging reduces signal losses by preventing type-mismatching applications of reconstruction algorithms (e.g. performing a Compton reconstruction on a Pair event) and signal pollution (distinguishing events originating from background sources). We explore the feasibility of Deep Convolutional Neural Nets in the context of event classification for Compton-Pair telescopes on the example of the e-ASTROGAM design proposal.

T 83.7 Thu 17:35 Th

Colibri - The coincidence library for real-time inquiry for multi-messenger astrophysics — •Patrick Reichherzer[1,2,3], Fabian Schüssler[3], Julia Tjus[1,2], Anke Yusafzai[4], and Atilla Alkan[3] — [1]Ruhr-University Bochum, Theoretical Physics IV — [2]Ruhr Astroparticle and Plasma Physics (RAPP) Center — [3]Irfu, CEA Paris-Saclay — [4]ECAP, FAU Erlangen-Nuremberg

Flares of known stable astronomical sources and transient sources can occur on different timescales, from only a few seconds to several days. The discovery potential of both serendipitous observations and multi-messenger and multi-wavelength follow-up observations could be maximized with a tool which allows for quickly acquiring an overview over both stable sources and transient events in the relevant phase space. We here present COincidence LIBrary for Real-time Inquiry (Colibri), a comprehensive tool for this task.

Colibri evaluates incoming VOEvent messages of astronomical observations in real time, stores them in the database and filters them by user specified criteria in the context of known sources from various catalogs. Colibri's architecture comprises a RESTful API, a real-time database, a cloud-based alert system and a website as well as apps for iOS and Android as clients for users. The clients provide a graphical representation with a summary of the relevant data to allow for the fast identification of changes in observed sky regions, and for analyses

of those. In this contribution, the key features of Colibri are presented. Current and possible future implementations of Colibri will be discussed.

T 83.8 Thu 17:50 Th

COMCUBE: Exploring the violent Universe with CubeSat Technology — •Jan Lommler for the COMCUBE-Collaboration — Johannes Gutenberg-Universität Mainz

Gamma Ray Bursts are a window into some of the most energetic processes in the Universe. Due to the energy range of the emitted electro-magnetic radiation, measurements have to be performed in space by a network of either dedicated observatories like SWIFT and POLAR or piggy-back detectors mounted on other observatories like Fermi GBM. Most detectors only allow the measurement of the burst's energy-spectrum and time evolution, missing out on polarization of the incident photons.Using Compton scattering as main detection channel, Cubesats offer the opportunity to setup a network of small-scale dedicated detectors at relatively low cost that are able to pinpoint GRBs, measure their spectra and temporal evolution while obtaining polarization information. In this talk we want present the detector concept of COMCUBE and report basic performance estimates.

T 83.9 Thu 18:05 Th

Performance analysis of the Cherenkov telescope HAWC's Eye in a hybrid setup with HAWC — •Florian Rehbein for the HAWC's Eye-Collaboration — Physics Institute III A, RWTH Aachen, Germany

The compact imaging air-Cherenkov telescope HAWC's Eye was developed to operate with the High-Altitude Water Cherenkov Gamma-Ray Observatory (HAWC), which is an extensive air shower array located in the state of Puebla, Mexico. The hybrid observation improves the energy and angular resolution significantly. This approach is very promising not only for the HAWC observatory but also for future experiments such as the Southern Wide-field Gamma-ray Observatory (SWGO). A full detector simulation of multiple HAWC's Eye telescopes in a hybrid setup with HAWC has been set up. A simply hybrid reconstruction with one or more HAWC's Eye telescopes shows an improvement of the angular and energy resolution above 10 TeV.

T 83.10 Thu 18:20 Th

Implications of turbulence dependent diffusion on cosmic ray spectra — •Julien Dörner, Julia Tjus, and Patrick Reichherzer — RAPP-Center at Ruhr University Bochum, Bochum, Germany

The propagtion of cosmic rays can be described by diffusive motion in most galactic enviroments. Therfore, a detailed knowlege of the diffusion tensor is necessary. Recent analyses of the energy dependence of the diffusion tensor show a function of the turbulence level b/B, i.e. $\kappa_i \propto E^{\gamma_i}$ with $\gamma_i = \gamma_i(b/B)$, where $i \in \{\parallel, \perp\}$. (Reichherzer et al, MNRAS 498:5051-5064 (2020))
In this talk we show the implication of this turbulence-dependent diffusion on the radial dependence of the cosmic-ray spectral index and the transition between parallel and perpendicular component. Finally, we interpret the cosmic-ray gradient detected by Fermi in the light of these findings.