

7th International Fermi Symposium

Sunday, 15 October 2017 - Friday, 20 October 2017

Congress Center Garmisch-Partenkirchen

Programme

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Sunday 15 October 2017

Welcome Reception (18:00-20:00)

-Conveners: LOC

Monday 16 October 2017

Opening Session (08:25-10:30)

Opening

-Conveners: Elizabeth Hays

time [id] title

08:30	[245] Opening <i>Presenter: HAYS, Elizabeth</i>
08:35	[252] Welcome by NASA HQ <i>Presenter: IMMMLER, Stefan</i>
08:45	[253] Remembering Neil Gehrels <i>Presenter: NOUSEK, John</i>
09:05	[254] Remembering Nanni Bignami <i>Presenter: TAVANI, Marco</i>
09:25	[255] Status of Fermi <i>Presenter: HAYS, Elizabeth</i>
09:55	[256] 10 yrs AGILE <i>Presenter: TAVANI, Marco</i>

Break (10:30-11:00)

Pulsars I (11:00-12:30)

-Conveners: Robin Corbet

time [id] title

11:00	[108] Pulsars: implications from Fermi LAT observations and future prospects <i>Presenter: GUILLEMOT, Lucas</i> Gamma-ray observations with the Fermi Large Area Telescope (LAT) have revealed significant pulsations from more than 200 young and recycled, millisecond pulsars. These observations have demonstrated that pulsars are by far the largest source class in the Galactic plane at GeV energies, and more gamma-ray pulsars are still being revealed by the LAT. In this talk I will give an overview of the main results from Fermi LAT pulsar observations, and from studies of unassociated LAT sources likely to contain pulsars. I will discuss some of the implications of these results in terms of population statistics and high-energy pulsar emission properties.
11:30	[76] Order parameters for the high-energy spectra of pulsars <i>Presenter: TORRES, Diego</i> From the hundreds of gamma-ray pulsars known, only a handful show non-thermal X-ray pulsations. Instead, nine objects pulse in non-thermal X-rays but lack a counterpart at higher energies. What order parameters describe the spectral variety, making the pulsars GeV and/or X-ray bright? Can observations in only one portion of the spectra predict detectability in the other? Can we expect a population of MeV-peaking pulsars? We normally fit observational spectra just with phenomenological functions (a power law with a cutoff in gamma-rays, or a log parabola from X-rays up). Here we shall present the results of a relatively simple physical model for the magnetospheric emission of pulsars above 1 keV, with which we start tackling these questions. It is based on synchro-curvature emission, and includes 1D time-dependent particle propagation. The model seems to contain the basic ingredients needed to describe all observed spectra well: With just four physical parameters, we can fit gamma/X-ray pulsar spectra along seven orders of magnitude, providing an interpretation for the appearance of sub-exponential cutoffs at high energies, or the flattening of the X-ray spectra at soft energies.

11:45	<p>[184] The first detection of a pulsar with the Atacama Large Millimetre Array <i>Presenter: RUDAK, Bronislaw</i></p> <p>We used the Atacama Large Millimetre Array (ALMA) to observe the Vela pulsar (PSR B0833-45), one of the very few pulsars observed in radio and from the mid-infrared up to the very high-energy gamma-rays. We detected Vela at frequencies of 97.5, 145, 233, 343.5 GHz and found that its energy density spectrum follows a power-law. The ALMA fluxes correspond to high brightness temperatures suggesting that this emission is due to a coherent radiative process. This is, therefore, the first indication of coherent emission reaching the submillimetre regime in pulsars. Moreover, we identified an extended structure, preliminarily detected in ground-based observations. We support its interpretation as a counter-jet protruding from the pulsar.</p>
12:00	<p>[219] Understanding the Pulsar High Energy Emission: Macroscopic and Kinetic Models vs. Fermi Data <i>Presenter: KALAPOTHARAKOS, Constantinos</i></p> <p>I will show that Fermi data provide crucial information that guides us to yield meaningful constraints on the macroscopic parameters of our global dissipative pulsar magnetosphere models. Our FIDO (Force-Free Inside, Dissipative Outside) models indicate that the dissipative regions lie outside the light cylinder near the equatorial current sheet. Our models reproduce the light-curve phenomenology while a detailed comparison of the model spectral properties with those observed by Fermi reveals the dependence of the macroscopic conductivity parameter on the spin-down power. We further exploit these important results by building self-consistent 3D global kinetic particle-in-cell (PIC) models, which, eventually, provide the dependence of the macroscopic parameter behavior (e.g. conductivity) on the microphysical properties (e.g. particle multiplicities). Our PIC models provide field structures and particle distributions that are not only consistent with each other but also able to reproduce a broad range of the observed gamma-ray phenomenology (light curves and spectral properties) of both young and millisecond pulsars. The convergent results of our macroscopic and kinetic models and their agreement with the Fermi data provide a unique insight into the understanding of the physical mechanisms behind the high-energy emission in pulsar magnetospheres.</p>
12:15	<p>[162] MeV Pulsars: Modeling Spectra and Polarization <i>Presenter: HARDING, Alice</i></p> <p>A sub-population of energetic rotation-powered pulsars show high fluxes of pulsed non-thermal hard X-ray emission. While this 'MeV pulsar' population includes some radio-loud pulsars like the Crab and PSR B1509-58, a significant number have no detected radio or GeV emission, a mystery since gamma-ray emission is a common characteristic of pulsars with high spin-down power. The All-Sky Medium-Energy Gamma-Ray Observatory (AMEGO), as well as e-Astrogam, plan to detect emission and polarization in the MeV band and may shed light on the MeV pulsars. We present a model for the spectrum and polarization of MeV pulsars where the X-ray emission comes from electron-positron pairs radiating in the outer magnetosphere and current sheet. This model predicts that the peak of the SED increases with surface magnetic field strength if the pairs are produced in polar cap cascades. For small inclination angles, viewing at large angles to the rotation axis can miss both the radio pulse and the GeV pulse from particles accelerating near the current sheet. Characterizing the emission and geometry of MeV pulsars can thus provide clues to the source of pairs and acceleration in the magnetosphere.</p>

Catered Lunch (12:30-14:00)

Active Galactic Nuclei: I - GaPa-2-1 - Konzertsaal (14:00-16:00)

-Conveners: Elisabetta Cavazzuti

time [id] title

14:00	<p>[190] The Gamma-Ray Lobes of Centaurus A <i>Presenter: MAGILL, Jeff</i></p> <p>The broadband emission from the lobes of radio galaxy Centaurus A (Cen A) has been widely considered to be produced via a simple leptonic model, i.e., synchrotron and inverse-Compton scattering. More recently, gamma-ray data from the Fermi Large Area Telescope (LAT) has hinted at a spatial mismatch with the radio and microwave images of the Cen A lobes, challenging the simple leptonic scenario. We present a morphological analysis of the Cen A lobes, confirming this phenomenon and providing a full 9 year Pass 8 LAT gamma-ray image of the lobes. In light of this analysis, we offer alternative production scenarios which may account for the observed mismatch.</p>
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14:15	<p>[193] VLBI and gamma-ray studies of TANAMI radio galaxies <i>Presenter: ANGIONI, Roberto</i></p> <p>The γ-ray sky is strongly dominated by blazars, i.e. AGN with relativistic jets oriented closely with our line of sight. Radio galaxies are their misaligned counterparts, and make up about ~ 1-2% of all AGN observed by *Fermi*-LAT. Nonetheless, they provide us with a view of AGN jets which is less biased by Doppler boosting effects, and allow us to test jet production and emission models in light of the unified scheme of radio-loud AGN. The combination of γ-ray data and high-resolution Very Long Baseline Interferometry (VLBI) studies is a powerful tool in order to investigate these objects. We present selected results of an ongoing study focused on the radio galaxies in the southern-hemisphere VLBI (and multi-wavelength) monitoring program TANAMI.</p>
14:30	<p>[82] RoboPol: the optical polarisation of gamma-ray-loud and gamma-ray-quiet blazars <i>Presenter: ANGELAKIS, Emmanouil</i></p> <p>The RoboPol program has been monitoring an unbiased sample of blazars since 2013 with a cadence of less than a few days. The main drive has been to quantify their optical polarisation properties, understand its variability and gain insight in the mechanisms producing the smooth and long rotations of the polarisation angle, in a systematic and unbiased way. Here we focus on the magnitude of polarisation. We present average R-band optopolarimetric data, as well as variability parameters, from the first and second RoboPol observing season. We show that gamma-ray-loud blazars are systematically more polarised than gamma-ray-quiet ones. We however do not find any evidence that this discrepancy is related to the redshift distribution, rest-frame R-band luminosity density, or the source classification. Furthermore, we find that median polarisation fraction drops with the synchrotron-peak-frequency and so is the randomness of the polarisation angle distribution. We propose a scenario which mediates efficient particle acceleration in shocks and increases the helical B-field component immediately downstream of the shock.</p>
14:45	<p>[11] High-resolution polarization imaging of the Fermi blazars <i>Presenter: RANI, Bindu</i></p> <p>Ever since the revolutionary discovery by the Fermi mission that active galactic nuclei (AGN) produce copious amounts of high-energy emission, its origin has remained elusive. Using high-frequency radio interferometry (VLBI) polarization imaging, we could probe the magnetic field topology of the compact high-energy emission regions in blazars. A case study for blazar 3C 279 reveals presence of multiple gamma-ray emission regions. The observed anti-correlation between gamma-ray flux and percentage polarization at optical bands challenges the current high-energy emission models. High-energy polarization observations will be crucial in better understanding the high-energy dissipation mechanisms. I will briefly describe the polarization capabilities of the AMEGO (All-sky Medium Energy Gamma-ray Observatory) mission.</p>
15:00	<p>[19] SALT ToO spectropolarimetry observations of blazars and self-consistent SED and spectropolarimetry modeling of blazars <i>Presenter: BOETTCHER, Markus</i></p> <p>We report on recent results from a target-of-opportunity programme to obtain spectropolarimetry observations of flaring gamma-ray blazars with the Southern African Large Telescope (SALT). In tandem with this observational program, we develop a leptonic blazar model for a self-consistent representation of SEDs and optical (SALT) spectropolarimetry. Such modeling provides an accurate estimate of the degree of order of the magnetic field in the emission region as well as thermal contributions (from the host galaxy and the accretion disk) to the SED, thus putting strong constraints on the physical parameters of the gamma-ray emitting regions.</p>
15:15	<p>[98] Gamma-rays in the radio galaxy 3C 84: A complex situation <i>Presenter: RANI, Bindu</i></p> <p>3C 84 is unique in that it is one of the few non-blazar AGN that is detected at ultra high energies (including MAGIC in addition to Fermi/LAT). The source itself has been increasing in flux density at both radio and Gamma-rays since approximately 2005 with VLBI observations showing that this rising emission is associated with a slowly moving component south of the jet-launching (C1) region, commonly known as "C3". Recent analysis of multi-wavelength Korean VLBI Network data has suggested multiple locations of Gamma-rays within 3C 84. In addition to the slowly rising trend in C3, smaller scale rapid variation of radio and Gamma-ray fluxes are associated with the C1 region, but that the correlations observed are due to random processes. We then applied wavelet analysis using the WISE package to the kinematics of 3C 84 from 2010 until now. We find that a large flare beginning in early 2015 and currently decaying is apparently due to the emission of a new component from the C3 region. Additionally, there appears to be evidence for helical trajectories with Gamma-ray flaring being possibly associated with when the helical path passes through our line-of-sight.</p>

15:30	<p>[39] Magnetospheric Gamma-Ray Emission in AGN <i>Presenter: RIEGER, Frank</i></p> <p>Radio Galaxies have emerged as unique gamma-ray emitting source class on the extragalactic sky. With their jets believed to misaligned such that Doppler boosting effects become moderate, they allow for new insights into the nuclear source region. I will report on new results for M87 and discuss implications of recent findings for Centaurus A. The relevance of a magnetospheric gamma-ray contribution in radio galaxies will be highlighted and general constraints will be derived to assess its plausibility for a given source.</p>
15:45	<p>[208] Constraints on proton synchrotron origin of VHE gamma-rays from the extended jet of AP Librae <i>Presenter: Dr. GUPTA, Nayantara</i></p> <p>The multi-wavelength photon spectrum from the BL Lac object AP Librae extends from radio to TeV gamma rays. The X-ray to very high energy gamma ray emission from the extended jet of this source has been modeled earlier with inverse Compton (IC) scattering of relativistic electrons off the CMB photons. The IC/CMB model requires the kpc scale extended jet to be highly collimated with bulk Lorentz factor close to 10. Here we discuss the possibility of proton synchrotron origin of X-rays and gamma-rays from the extended jet with bulk Lorentz factor 3. This scenario requires extreme energy of protons 3.98×10^{21} eV and high magnetic field 1 mG of the extended jet with jet power $\sim 5 \times 10^{48}$ ergs/sec in particles and magnetic field (which is more than 100 times the Eddington's luminosity of AP Librae) to explain the very high energy gamma ray emission. Moreover, we have shown that X-ray emission from the extended jets of 3C 273 and PKS 0637-752 could be possible by proton synchrotron emission with jet powers comparable to their Eddington's luminosities.</p>

Pulsars: Pulsars II - GaPa-1-1 - Olympiasaal (14:00-16:00)

-Conveners: Bronislaw Rudak

time [jd] title

14:00	<p>[122] The Search for Millisecond Pulsars <i>Presenter: CLARK, Colin</i></p> <p>Millisecond pulsars (MSPs) are old pulsars which have been spun-up to incredible rotation rates by the accretion of matter from an orbiting companion star. Their extreme properties and long-term stability make them valuable objects for a wide variety of fundamental astrophysics. In recent years, the rate of new MSP discoveries has increased dramatically, owing in large part to the "treasure trove" of pulsar-like sources detected within the LAT data. In fact, more than a quarter of all known MSPs were discovered in searches targeting unidentified Fermi-LAT sources. In this talk, I will describe the various contributions that Fermi has made to the MSP search effort, including the latest results from blind searches for gamma-ray pulsations from unknown pulsars. I will also discuss the prospects for future discoveries in these areas, and the implications of Fermi's observations for the Galactic MSP population.</p>
14:30	<p>[117] On the highest energy emission from millisecond pulsars <i>Presenter: Dr. SAZ PARKINSON, Pablo</i></p> <p>Fermi has detected over 200 pulsars above 100 MeV. In a previous work, using 3 years of LAT data (1FHL catalog) we reported that 28 of these pulsars show emission above 10 GeV; only three of these, however, were millisecond pulsars. The recently-released Third Catalog of Hard Fermi-LAT Sources (3FHL) contains over 1500 sources showing emission above 10 GeV, 17 of which are associated with gamma-ray millisecond pulsars. Using three times as much data as in our previous study (1FHL), we report on a systematic analysis of these 17 pulsars to determine the highest energy (pulsed) emission from millisecond pulsars and discuss the best possible candidates for follow-up observations with ground based TeV instruments (HESS, MAGIC, VERITAS, and the upcoming CTA).</p>
14:45	<p>[204] Hunting for the missing spiders <i>Presenter: KONG, Albert</i></p> <p>With a growing number of gamma-ray emitting millisecond pulsars (MSPs) discovered by Fermi and by combining multi-wavelength observing facilities, it is now possible to study their properties as a population. One of the successes is the discovery of gamma-ray emitting compact MSP binaries known as black-widow and redback systems and this opens a new window to study pulsars and their evolution. I will discuss how multi-wavelength observations reveal a new population of compact MSP binaries that provides new insight into MSP's emission mechanisms and the physics of compact objects. In particular, I will summarize some recent results of our optical and hard X-ray observing campaigns of gamma-ray emitting black-widows and redbacks, and will also discuss the implications to their evolution.</p>

15:00	<p>[66] Inductive spikes from the Crab Nebula <i>Presenter: KIRK, John</i></p> <p>A new theory of the gamma-ray flares from the Crab Nebula is presented, in which the trigger is a sudden drop in the mass-loading of the pulsar wind. The current required to maintain wave activity in the wind is then carried by very few particles of high Lorentz factor. On impacting the Nebula, these particles produce a tightly beamed, high luminosity burst of hard gamma-rays, which reproduces the spectrum, variability timescale and power of the most intense flares. Similar flares potentially contribute to the gamma-ray emission from other powerful pulsars, such as J0537-\$-6910 and B0540-\$-69.</p>
15:15	<p>[79] HAWC TeV gamma-ray observations of two extended nebulae surrounding Geminga and PSR B0656+14 constrain the origin of the local positron flux <i>Presenter: LÓPEZ-COTO, Ruben</i></p> <p>Cosmic-ray positrons are charged antiparticles that strike Earth's atmosphere isotropically. At energies below several GeV they are produced by cosmic-ray protons interacting with nearby interstellar matter. At higher energies, an unexpected and unexplained excess above the proton-induced background has been detected by several satellites, including PAMELA, AMS-02 and Fermi. Due to energy losses in interstellar magnetic and radiation fields, the highest-energy positrons observed must have originated in our immediate Galactic neighborhood. This excess has been theorized to be originated from nearby astrophysical sources, dark matter, or new modes of cosmic-ray secondary production. Amongst the astrophysical sources, pulsars as Geminga and PSR B0656+14 have been proposed to be contributors to this excess. The HAWC Gamma-Ray Observatory reported the discovery of TeV gamma-ray emission extending several degrees around the positions of Geminga and PSR B0656+14 pulsars. Using the morphological and spectral measurements of these two VHE gamma-ray sources, we determine the diffusion coefficient of electrons escaping them and their contribution to the positron flux measured at Earth. For this assumption of isotropic diffusion, we find that neither of these sources make an appreciable contribution to the locally measured positron flux.</p>
15:30	<p>[114] Observing and modeling the gamma-ray emission from pulsar/pulsar wind nebula complex PSR J0205+6449/3C 58 <i>Presenter: LI, JIAN</i></p> <p>We present the results of the analysis of 8 years of Fermi-LAT data of the pulsar/pulsar wind nebula complex PSRJ0205+6449/3C 58. Using a contemporaneous ephemeris, we carried out a detailed analysis of PSRJ0205+6449 both during its off-peak and on-peak phase intervals. 3C 58 is significantly detected during the off-peak phase interval. Hints for a possible flare from 3C 58 are identified. We show that the spectral energy distribution at high energies is the same disregarding the phases considered, and thus that this part of the spectrum is most likely dominated by the nebula radiation. We present results of theoretical models of the nebula and the magnetospheric emission that confirm this interpretation.</p>
15:45	<p>[119] An Einstein@home blind search for gamma-ray pulsars <i>Presenter: WU, Jason</i></p> <p>We present the results of the analysis of 13 gamma-ray pulsars discovered in the Einstein@Home blind search survey using Fermi Large Area Telescope (LAT) Pass 8 data. The 13 new gamma-ray pulsars were discovered by searching 118 unassociated LAT sources from the third LAT source catalog (3FGL), selected using the Gaussian Mixture Model (GMM) machine learning algorithm on the basis of their gamma-ray emission properties being suggestive of pulsar magnetospheric emission. The new gamma-ray pulsars have pulse profiles and spectral properties similar to those of previously-detected young gamma-ray pulsars. Follow-up radio observations have revealed faint radio pulsations from two of the newly-discovered pulsars, and enabled us to derive upper limits on the radio emission from the others, demonstrating that they are likely radio-quiet gamma-ray pulsars. We also present results from modeling the gamma-ray pulse profiles and radio profiles, if available, using different geometric emission models of pulsars.</p>

Coffee Break (16:00-16:30)

Active Galactic Nuclei: II - GaPa-2-1 - Konzertsaal (16:30-18:00)

-Conveners: Elisabetta Cavazzuti

time [id] title

16:30	<p>[153] The Third Catalog of Hard Fermi-LAT Sources (3FHL) <i>Presenter: THOMPSON, David</i></p> <p>The Third Catalog of Hard Fermi-LAT Sources (3FHL), based on the first 7 years of LAT data using the Pass 8 event-level analysis, contains 1556 sources in the 10 GeV--2 TeV energy range. The sensitivity and angular resolution are improved by factors of 3 and 2 relative to the previous LAT catalog in this energy range (1FHL). Most 3FHL sources (79%) are extragalactic, including 16 sources located at very high redshift ($z > 2$), while 9% are Galactic and 12% are unassociated (or associated with sources of unknown nature). The catalog includes 214 new gamma-ray sources. The substantial increase in the number of photons (more than 4 times the number in 1FHL and 10 times that of 2FHL) also allows us to characterize spectral curvature for 32 sources and flux variability for 163 of them. The 3FHL catalog provides an excellent opportunity to relate observations from space to those accessible from the ground (e.g. H.E.S.S., MAGIC, VERITAS, HAWC, and in the near future the Cherenkov Telescope Array).</p>
16:45	<p>[203] Preliminary results from the fourth catalog of AGN Detected by the Fermi-LAT <i>Presenter: GASPARRINI, Dario</i></p> <p>Preliminary results of the fourth catalog of active galactic nuclei (AGNs, 4LAC) detected in gamma rays by the Fermi Large Area Telescope (LAT) in seven years of scientific operation are presented. This catalog will be similar to the previously released third LAT AGN catalog (3LAC). The 4LAC includes approximately 2500 gamma-ray sources located at high Galactic latitudes ($b > 10^\circ$) that are detected with a test statistic (TS) greater than 25 and are statistically associated with AGNs. The 4LAC contains many new objects, and most of them are of unknown type and lack spectroscopic information of sufficient quality to determine the strength of their emission lines. Various gamma-ray properties and their correlations are presented and discussed for the different blazar classes. The trends observed in previous catalogs are confirmed. We will present some of the novelties arising in the 4LAC.</p>
17:00	<p>[132] MAGIC observations of extreme blazars: Toward clarifying the blazar sequence <i>Presenter: Mr. FALLAH RAMAZANI, Vandad</i></p> <p>Extreme blazars (EHLs) are mostly characterized by a synchrotron peak located at energies > 1 keV, and by the hardness of the spectrum in the high-energy (HE, $E > 100$ MeV) range. So far, only a handful of these objects have been detected at very-high energies (VHE, $E > 100$ GeV) by Imaging Atmospheric Cherenkov Telescopes. Moreover, multi-wavelength observations of some of these blazars (like 1ES 0229+200) have provided evidence of a VHE gamma-ray emission extending to several TeV, which is difficult to explain naturally with standard, one-zone synchrotron self-Compton models for BL Lac objects. Furthermore, their GeV-TeV spectra also shed new light on the blazar sequence.</p> <p>Since 2010, nine EHLs have been observed in different observing multi-wavelength campaigns of the MAGIC telescopes, aiming to increase the number of known EHL TeV-emitters. Three sources have been clearly detected at TeV energies by the MAGIC telescopes. In this contribution, I will present the results of the multi-wavelength campaigns. In particular, the GeV-TeV behaviour of these sources will be presented and compared to the known EHL prototype (1ES 0229+200).</p>
17:15	<p>[95] Gamma-ray Blazars at the Dawn of the Universe <i>Presenter: Dr. PALIYA, Vaidehi Sharan</i></p> <p>A broadband study of $z > 3$ blazars enables us to understand the evolution of the properties of relativistic jets over cosmic time. It has been found in many studies that such high z blazars host $>$ billion solar mass black holes and thus shed a new light on the supermassive black hole formation in the early Universe. Here, we report the first gamma-ray detection of blazars beyond $z = 3.1$ using the sensitive Pass 8 dataset of Fermi-LAT. These objects are found to host extremely massive black holes at their centers, confirmed both from optical spectroscopy and accretion disk modeling. Further details of the results, including multi-wavelength follow up studies from NuSTAR and XMM-Newton, will be presented within the framework of the disk-jet connection in powerful jetted AGNs. We will also summarize the prospects of hunting these cosmic monsters with the All-Sky Medium Energy Gamma-ray Observatory (AMEGO), a probe concept study for the next NASA decadal survey. In the 200 keV to 10 GeV band, AMEGO will detect these objects by the hundreds and will provide crucial insight about the emission mechanisms powering the relativistic jets of the most powerful blazars in the Universe.</p>

17:30	<p>[145] On the radio and GeV-TeV gamma-ray emission connection in Fermi blazars. <i>Presenter: LICO, Rocco</i></p> <p>The Fermi-LAT revealed that blazars dominate the census of the gamma-ray sky, and a significant correlation was found between radio and gamma-ray emission in the 0.1-100 GeV energy range. However, the possible connection between radio and very high energy (VHE, $E > 0.1$ TeV) emission still remains elusive, owing to the lack of a homogeneous VHE sky coverage.</p> <p>With this work we aim to quantify and assess the significance of a possible connection between the radio emission on parsec scale measured by the very long baseline interferometry and GeV-TeV gamma-ray emission in blazars, which is a central issue for understanding the blazar physics. We use two large and unbiased AGN samples extracted from the 1FHL and 2FHL catalogs, and for comparison, we perform the same analysis by using the 3FGL 0.1-300 GeV gamma-ray energy flux.</p> <p>Overall, the radio and gamma-ray emission above 10 GeV turns out to be uncorrelated for all the blazar sub-classes with the exception of high synchrotron peaked objects. Conversely, when 0.1-300 GeV gamma-ray energies are considered, a strong and significant correlation is found for all of the blazar sub-classes.</p>
17:45	<p>[62] MCMC estimation of SED model parameters using multi- wavelength data of the blazar Mrk 421 <i>Presenter: YAMADA, Yurika</i></p> <p>The spectral energy distributions (SEDs) of blazars are dominated by synchrotron and inverse Compton radiation. The origin of blazar variability can be investigated from the time variation of the SEDs. However, it is difficult to estimate the optimal model parameters of SEDs and their uncertainties because some parameters are strongly correlated and the standard method may be trapped by local solutions. In this study, we applied a Markov chain Monte Carlo method (MCMC) to this problem. Our experiments using artificial data demonstrate that at least one prior probability is required to uniquely determine the solution. We used simultaneous observations of Mrk 421 with Fermi-LAT, Swift-XRT, and the 1.5-m optical telescope, Kanata from 2009 to 2011 reported in Itoh et al. (2015). We succeeded in estimating the optimal parameters and their uncertainties by using the prior probability of the time-scale and Doppler factor. As a result, we found that the break energy of electron energy distribution is proportional to X-ray flux and the normalization of electron distribution is inversely proportional. These correlations suggest that the X-ray variations were caused by the fluctuations of the break energy rather than the number of electrons.</p>

Central Galaxy - GaPa-1-1 - Olympiasaal (16:30-18:00)

-Conveners: Nir Shaviv

time [jd] title

16:30	<p>[182] Galactic center GeV excess: status and interpretations <i>Presenter: MALYSHEV, Dmitry</i></p> <p>The Galactic center (GC) is one of the most important regions to search for a gamma-ray signal from a possible annihilation of dark matter due to its proximity and high dark matter density. In the past years, several groups have reported an excess of gamma rays in the Fermi-LAT data with an approximately spherical morphology around the GC. In this talk I will review the current observational status of the excess, the difficulties in the gamma-ray analysis near the GC, and possible interpretations, such as an additional source of cosmic rays, a population of millisecond pulsars, and dark matter annihilation. I will discuss how one can distinguish these possibilities with future observations.</p>
17:00	<p>[243] Modeling the Galactic Center Gamma-Ray Excess <i>Presenter: LINDEN, Tim</i></p> <p>Over the last seven years, Fermi-LAT observations have convincingly found an excess in gamma-ray emission emanating from the center of the Milky Way galaxy. The excess has three definitive properties: (1) it has a hard spectrum that peaks at an energy of ~ 2 GeV, (2) it extends from within 0.1 degrees to more than 10 degrees from Sgr A* with a three-dimensional intensity that falls roughly as r^{-2}, (3) it is approximately spherically symmetric. Several models for this excess have been formulated, including the collective emission from a population of individually dim gamma-ray pulsars, outbursts of cosmic-ray electrons from the central molecular zone, or potentially even dark matter annihilation. In this talk, I will discuss the arguments for and against each model, focusing specifically on constraints from multi-wavelength observations. Additionally, I will discuss the future observations that are critical for understanding the origin of the gamma-ray excess.</p>

17:30 [25] Is the Galactic Centre Excess due to the X-shaped stellar over-density in the Galactic bulge?

Presenter: GORDON, Chris

An anomalous excess emission has been found in Fermi-LAT data covering the centre of the Galaxy. We report on an analysis that exploits hydrodynamical modelling to register the position of interstellar gas associated with diffuse Galactic gamma-ray emission. Our analysis reveals that the excess gamma rays' morphology is statistically well described by the X-shaped stellar over-density in the Galactic bulge and the nuclear stellar bulge. Given the non-spherical nature of these over-densities, we argue that the GCE is not a dark matter phenomenon but may rather be associated with the stellar population of the bulge and the nuclear bulge.

17:45 [209] Monitoring the Galactic Center with MAGIC for more than 5 years

Presenter: Dr. FRUCK, Christian

The Galactic Center (GC) region with its rich and dense astrophysical environment and a 4 million solar mass black hole (BH) at its center has always been one of the primary targets for observations with gamma-ray instruments.

MAGIC has been observing the GC within a multi-year monitoring campaign since the first reports about the G2 fly-by in 2012. These observations have been carried out at large zenith angles, leading to a higher energy threshold but also to increased sensitivity at multi-TeV energies.

I will present the results of the multi-year monitoring program of SgrA* with the MAGIC telescopes during the time period around and after the pericentre passage of the G2 object, where MAGIC did not detect any unusual variability, similar to what has been reported for other wavelengths. A detailed morphology study of the region, a significant by-product of the monitoring that became possible due to the availability of new Fermi tools inspired software for MAGIC data, allows us to revisit the properties of the GC diffuse emission that recently lead H.E.S.S. to claim the existence of a PeV cosmic ray source located at SgrA.

Tuesday 17 October 2017

Transients and Gamma-Ray Bursts I: Gravitational Waves (08:30-10:30)

-Conveners: John Kirk

time [id] title

08:30	[148] Gravitational Wave Astronomy with Advanced LIGO/Virgo <i>Presenter: NITZ, Alexander</i> Observation of gravitational-waves from compact binary mergers with Advanced LIGO have opened up the field of gravitational-wave astronomy. We'll discuss results from the recent observing run of LIGO/Virgo and prospects for the future.
09:00	[179] GBM results in the GW Era <i>Presenter: BURNS, Eric</i> We talk about the released results from the searches of GBM data for electromagnetic counterparts to gravitational waves.
09:30	[80] INTEGRAL follow-up of the gravitational wave events <i>Presenter: SAVCHENKO, Volodymyr</i> We use observations of the INTERNATIONAL Gamma-Ray Astrophysics Laboratory (INTEGRAL) to search for gamma-ray and hard X-ray emission associated with the gravitational wave events discovered during the first and the second scientific runs of Advanced LIGO and Advanced Virgo. The highly eccentric orbit of INTEGRAL ensures high duty cycle, long-term stable background, and unobstructed view of nearly the entire sky. This enables us to use a combination of INTEGRAL instruments (SPI-ACS, IBIS/Veto, and IBIS) to search for a hard X-ray electromagnetic signal in the full high-probability sky region for almost every single LIGO trigger. The fraction of the energy promptly released in gamma-rays in 75 keV - 2 MeV energy range in the direction of the observer is constrained to be less than one millionth of the gravitational wave energy, in the majority of the localization region. Moreover, in the case of LVT151012 INTEGRAL high-energy imaging instruments, IBIS, SPI, and JEM-X, provided the unique opportunity to search also for long-lasting electromagnetic counterparts of this event over 3 decades in energy, from 5 keV to 8 MeV.
09:45	[176] Follow-up of Gravitational Wave Events with the Fermi-LAT. Current Status and Prospects for the Future <i>Presenter: OMODEI, Nicola</i> As the first detections of Gravitational Waves (GW) from the coalescence of compact objects were announced by LIGO and Virgo, a new era for astronomy began. Searches for electromagnetic (EM) counterparts of GW events are of fundamental importance, as their success will increase the confidence in the GW detection and will help characterize the system parameters. The Fermi Gamma-ray Space Telescope is the most capable observatory to simultaneously observe a large fraction of the sky from 10 keV to more than 300 GeV, providing the unique capability of rapidly covering the entire probability region from a LIGO candidate. In this talk, I will present the strategy for follow-up observations of GW events with the Fermi Large Area Telescope (LAT), focusing on the results from the first science runs O1/O2. I will also discuss the prospects for detections of GW in coincidence with a gamma-ray signal from the Fermi Gamma-ray Burst Monitor (GBM) and the LAT, likely from a short Gamma-Ray Burst (sGRB) arising from the merger of two neutron stars.

10:00	<p>[96] Off-axis short GRBs from structured jets as counterparts to GW events <i>Presenter: KATHIRGAMARAJU, Adithan</i></p> <p>Binary neutron star mergers are considered to be the most favorable sources that produce electromagnetic (EM) signals associated with gravitational waves (GWs). They are also the likely progenitors of short duration gamma-ray bursts (GRBs). The brief gamma-ray emission (the “prompt” GRB emission) is produced by ultra-relativistic jets, as a result, this emission is strongly beamed over a small solid angle along the jet. It is estimated to be a decade or more before a short GRB jet within the LIGO volume points along our line of sight. For this reason, the study of the prompt signal as an EM counterpart to GW events has been largely ignored. We argue that for a realistic jet model, one whose luminosity and Lorentz factor vary smoothly with angle, the prompt signal can be detected for a significantly broader range of viewing angles. This can lead to a new type of EM counterpart, an “off-axis” short GRB. Our estimates and simulations show, that with the aid of the temporal coincidence from a LIGO trigger, it is feasible to detect these prompt signals with a detector such as *Fermi*, even if the observer is substantially misaligned with respect to the jet.</p>
10:15	<p>[270] Analysing the light curve and spectra of the first detected kilonova <i>Presenter: JERKSTRAND, Anders</i></p> <p>AT2017gfo is the first clearly detected kilonova, with comprehensive photometry and spectroscopy in the optical and NIR. I discuss this unique dataset in the context of previously published models and show fitting results using newly developed ones. I discuss inferred constraints on ejecta mass and composition in relation to simulations of neutron star mergers and theories for the origin of the r-process elements.</p>

Break (10:30-11:00)

Stellar sources (galactic and extragalactic) I: Binaries (11:00-12:30)

-Conveners: Olaf Reimer

time [jd] title

11:00	<p>[85] Recent multi-wavelength studies of gamma-ray binary hosting Be star <i>Presenter: TAKATA, Jumpei</i></p> <p>The gamma-ray binary is composed of the compact object (pulsar/black hole) and high mass OB star, and is gamma-ray loud object. In this talk, I will focus on recent theoretical and observational studies for the gamma-ray binary hosting Be star.</p> <p>For PSR B1259-63/LS 2883, the origin of flare-like GeV emission after the second disk passage is puzzling, and it may be interpreted as a consequence of the inverse-Compton process of the pulsar wind scattering off the soft photon from the accretion disk around the pulsar. For HESSJ0632+057, the recent optical/X-ray studies indicate a shorter orbital period and a smaller eccentricity than those reported in previous. Phase positions of the observed X-ray flare and dip are modified by new orbital parameters. PSR J2032+4127/MT91 213 is the candidate of the gamma-ray binary with a orbit period ~50 years. The X-ray flux from this system rapidly increases with flare-like activities, as the pulsar approaches to the periastron in late 2017/early 2018. I will also report new feature of the super orbital modulation of LS I +61°\circ303 using ~8 years Fermi-LAT data.</p>
11:30	<p>[49] Fermi acceleration under control: η Carinae <i>Presenter: BALBO, Matteo</i></p> <p>The η Carinae binary system hosts a massive stars featuring the highest known mass-loss rate. The two colliding winds dissipate mechanical energy in the shock, accelerating particles up to relativistic energies, and producing high-energy γ-rays. We analysed Fermi LAT data over two full orbital periods, comparing them with the predictions of particle acceleration in hydrodynamic simulations. We detected two distinct emission components: a low-energy component cutting off below 10 GeV, with short-term variability at periastron; an high-energy component varying by a factor 4, but differently during the two periastrons. This suggest a modification of the wind density in the inner wind collision zone, confirmed also in X-ray. Observations match the prediction of the particle in cell simulations. CTA and e-Astrogam could help to understand/constrain acceleration physics in more extreme conditions than in SNR.</p>

11:45	<p>[240] Gamma ray emission from Cyg X-3 and Cyg X-1 <i>Presenter: ZDZIARSKI, Andrzej</i></p> <p>We studied gamma-ray emission from Cyg X-3 and Cyg X-1 with the LAT. With the currently improved calibration and background determination, we studied spectra and variability of Cyg X-3 in its soft, intermediate and hard states and during bright flares. We measured detailed spectra for all of the states except for finding upper limits only in the hard state, in spite of strong radio emission correlated with X-rays in that state. We also measured the orbital modulation to a much greater precision than before. We modelled the spectra and the modulation in terms of jet models and found strong constraints on the location of the bulk of the emission (at a distance along the jet comparable to the separation). The gamma-ray emission is strongly correlated with the radio, which allows us to measure the time lag.</p> <p>In the case of Cyg X-1, we determined a detailed LAT spectrum in the hard/intermediate state and found a significant soft excess below 60 MeV. Also, while we found no soft-state emission above 100 MeV, we found a significant flux below it. In both cases, the soft excesses connect to the previously measured MeV tails.</p>
12:00	<p>[128] Towards the emerging source class of γ-ray emitting colliding-wind binary systems <i>Presenter: REITBERGER, Klaus</i></p> <p>Recently published results using seven years of *Fermi*-LAT data shed new light on the still puzzling source class of particle-accelerating colliding-wind binary (CWB) systems.</p> <p>While the claimed association of the system γ^2 Velorum (WR 11) with a high-energy γ-ray source contrasts the exclusivity of η Carinae as the hitherto only detected γ-ray emitter of that sort, the low upper limits obtained for WR 140 strengthen the question why this system with all its similarities to the γ-ray bright η Carinae remains still unseen.</p> <p>We use three-dimensional magneto-hydrodynamic modeling (MHD) to investigate the structure and conditions of the wind-collision region (WCR) in these three systems, including the important effect of radiative braking in the stellar winds. A transport equation is then solved throughout the computational domain to study the propagation of relativistic electrons and protons. The resulting distributions of particles are subsequently used to compute nonthermal photon emission components.</p> <p>With the above procedure, we obtained first model results that can account for the weak detection of γ^2 Velorum, the strong detection of η Carinae, and the non-detection of WR 140 in a similar computational setup.</p>
12:15	<p>[103] The population of gamma-ray binaries <i>Presenter: DUBUS, Guillaume</i></p> <p>Gamma-ray binaries, whose spectral energy distribution peaks above 1 MeV, are rare objects thought to be composed of a pulsar in orbit around a massive star. How many gamma-ray binaries are there in the Galaxy ? What are the prospects for detecting them ? We have carried out mock gamma-ray surveys of synthetic populations of gamma-ray binaries to answer these questions.</p>

Catered Lunch (12:30-14:00)

Transients and Gamma-Ray Bursts II: Gamma-Ray Bursts - GaPa-2-1 - Konzertsaal (14:00-15:45)

-Conveners: Markus Boettcher

time [id] title

14:00	<p>[27] Emission from accelerating jets in gamma-ray bursts: Radiation dominated flows with increasing mass outflow rates <i>Presenter: RYDE, Felix</i></p> <p>We study the narrowest spectra expected from GRBs. We present an analytical function for the spectrum that is emitted from the photosphere of a radiation-dominated flow that is under acceleration. We also present numerical spectra from photospheres occurring during the transition into the coasting phase of the flow. Using these spectral models, we reanalyse Fermi observations of GRB100507 and GRB101219, which both have been reported to have very narrow spectra. The bursts can be fitted by the spectral models: For GRB101219 the spectrum is consistent with the photosphere occurring below or close to the saturation radius, while for GRB100507 the photosphere position relative to the saturation radius can be determined as a function of time. In the latter case, we find that the photosphere initially occurs in the acceleration phase and thereafter transitions into the coasting phase. We also find that this transition occurs at the same time as the change in observed cooling behaviour: the temperature is close to constant before the break and decays after. We argue that such a transition can be explained by an increasing mass outflow rate. Both analysed bursts thus give strong evidence that the jets are initially radiation dominated.</p>
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14:15	<p>[230] GRB Locations and Spectra with the BALROG <i>Presenter: BURGESS, J. Michael</i></p> <p>In the era of multi-messenger astronomy, all-sky surveys of transient events serve an important role to provide detection and location information to follow-up instruments. The Fermi-GBM serves as the dominant gamma-ray transient detector with coverage of the entire unocculted sky. We introduce a new method to improve both the precision and accuracy of the Fermi-GBM's ability to locate gamma-ray transients. The method been shown to improve the previously reported systematics of the official localization method. I will discuss the issues with localization, how the method attempts to overcome them, and the still existing problems that must be overcome to provide accurate and precise localizations. These efforts are vital for gravitational wave follow-up. Additionally, I will discuss the impact of our localization method on observed GRB spectra and argue that we still have a long path to fully understanding the spectra before making accurate physical inferences about them.</p>
14:30	<p>[196] Exploring the low-energy domain of LAT-detected GRBs id 18440 <i>Presenter: BISSALDI, Elisabetta</i></p> <p>In preparation for the Second LAT Gamma-Ray Burst (GRB) catalog, we explore the use of the LAT low-energy (LLE) data selection to detect bursts with gamma-ray energy below 100 MeV. Here we present the sample of GRBs that are detected at these energies through a Bayesian Block analysis of all Fermi Gamma-ray Burst Monitor (GBM) triggers collected in 8 years of Fermi mission. In particular, we compare the temporal characteristics of this sample of GRBs with those of the brightest bursts detected above 1 MeV by the GBM. Finally, we examine the properties of a subset of events which are not detected above 100 MeV (LLE-only GRBs).</p>
14:45	<p>[200] The Bright and the Slow - GRBs 100724B and 160509A with high-energy cutoffs at < 100MeV <i>Presenter: VIANELLO, Giacomo</i></p> <p>We analyze the prompt emission of two of the brightest Gamma-Ray Bursts (GRBs) observed by Fermi at MeV energies but surprisingly faint at > 100 MeV energies. Time-resolved spectroscopy reveals a sharp high-energy cutoff. We first characterize phenomenologically the cutoff and its time evolution. We then fit the data to two models where the high-energy cutoff arises from intrinsic opacity to pair production within the source. Alternative explanations for the cutoff, such as an intrinsic cutoff in the emitting electron energy distribution, appear to be less natural. Both models provide a good fit to the data with very reasonable physical parameters, providing a direct estimate of bulk Lorentz factors on the lower end of what is generally observed in Fermi GRBs. Surprisingly, their lower cutoff energies E_c compared to other Fermi-LAT GRBs arise not predominantly from the lower Lorentz factors, but also at a comparable level from differences in variability time, luminosity, and high-energy photon index. Finally, particularly low E_c values may prevent detection by Fermi-LAT, thus introducing a bias in the Fermi-LAT GRB sample against GRBs with low Lorentz factors or variability times.</p>
15:00	<p>[229] Magnetic versus baryonic jets for gamma-ray bursts. <i>Presenter: BEGUE, Damien</i></p> <p>The magnetization of gamma-ray burst jets is one of the most important unanswered questions to-date, as it would help to constrain the progenitor, the emission mechanism(s) and the central engine of GRBs. In my talk, I explain how observables can set constraints on models of magnetized jets in the framework of photospheric emission.</p>
15:15	<p>[74] Constraints on microphysical parameters of GRBs using HAWC <i>Presenter: DICHIARA, Simone</i></p> <p>The physical mechanism at the origin of gamma-ray bursts (GRBs) is far from being completely understood. Describing their emission up to very high energies (GeV-TeV) is one of the most challenging and important tasks needed to unveil the physics of these peculiar events. Using data collected by the HAWC gamma-ray observatory, we search for TeV emission coming from a sample of GRBs detected by Fermi and Swift between December 2014 and May 2017. We derive upper limits derived over different time intervals and use them to constrain the microphysical parameters and the bulk Lorentz factor under the assumption of the external shock model scenario. We present the results of this analysis discussing possible interpretations.</p>

15:30	<p>[23] Clustering of gamma-ray burst types in the $\{it Fermi\}$-GBM catalogue: evidence for photosphere and synchrotron emissions during the prompt phase</p> <p><i>Presenter: ACUNER, Zeynep</i></p> <p>Many different physical processes have been suggested to explain the prompt gamma-ray emission in gamma-ray bursts (GRBs). Although there are examples of both bursts with photospheric and synchrotron emission origins, these distinct spectral appearances have not been generalized to large samples of GRBs. Here, we search for signatures of the different emission mechanisms in the full $\{it Fermi\}$ Gamma-ray Space Telescope/GBM catalogue. We use Gaussian Mixture Models to cluster bursts according to their parameters from the Band function (α, β, and E_{peak}) as well as their fluence and T_{90}. We find five distinct clusters. We further argue that these clusters can be divided into bursts of photospheric origin (2/3 of all bursts, divided into 3 clusters) and bursts of synchrotron origin (1/3 of all bursts, divided into 2 clusters). For instance, the cluster that contains predominantly short bursts is consistent of photospheric emission origin. We discuss several reasons that can determine which cluster a burst belongs to: jet dissipation pattern and/or the jet content, or viewing angle.</p>
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Stellar sources (galactic and extragalactic) II - GaPa-1-1 - Olympiasaal (14:00-15:45)

-Conveners: Andrzej Zdziarski

time [id] title

14:00	<p>[101] The Gamma-ray Binary in the LMC: Implications for Populations and Further Discoveries</p> <p><i>Presenter: CORBET, Robin</i></p> <p>Gamma-ray binaries, systems containing interacting compact objects whose radiative output is dominated by gamma-ray emission, are evolutionary precursors of high-mass X-ray binaries, and tens of these objects had been predicted to exist in our Galaxy. We have been searching for new members of this class via the detection of periodic modulation of LAT light curves, with extensive multi-wavelength followup. After our early discovery of 1FGL J1018.6-5856, no additional source had been found until our identification of LMC P3 as another binary, the first gamma-ray binary outside the Milky Way. We present our search techniques, illustrated by the LMC P3 discovery, discuss the implications for the population of gamma-ray binaries and possible future discoveries, and describe our continued observations of the known binaries to better understand their properties and astrophysics.</p>
14:30	<p>[93] The Monster Next Door: Fermi-LAT observations of Supernova Remnant N132D in the Large Magellanic Cloud</p> <p><i>Presenter: CASTRO, Daniel</i></p> <p>Supernova remnant (SNR) N132D, located in the Large Magellanic Cloud, represents a unique opportunity for the study of gamma-ray emission from shock-accelerated cosmic rays (CRs) in another galaxy since it stands as the first and only extra-galactic SNR detected in gamma-rays. N132D is one of the brightest SNRs in the local Universe in the X-ray, infrared and radio bands, and it has also been detected in TeV energy gamma-rays. N132D's apparent interaction with a giant molecular cloud strongly favors the scenario where the gamma-ray emission results from CR hadrons interacting with dense ambient media. We report on the detection of N132D with the Fermi-LAT, and by characterizing its emission in the MeV-GeV band, as well as constraining the non-thermal contribution to the X-ray spectrum using Chandra observations, we build a very complete picture of the properties of the system and its progenitor, ultimately helping us better understand CR acceleration in SNRs.</p>
14:45	<p>[134] Detection of SN 1006 and HESS J1731-347 with Fermi-LAT: a complete view of shell-type TeV SNRs</p> <p><i>Presenter: LEMOINE-GOUMARD, Marianne</i></p> <p>SNRs are considered to be the main sites in the Milky Way for producing cosmic rays with energies up to a few 10^{15} eV. Among them, shell-like SNRs exhibit a morphology spatially coincident with the shock front of the SNR and are of great interest in the context of particle acceleration. Their common characteristics are a young age, a large angular size and TeV emission highly correlated with X-ray synchrotron emission.</p> <p>I will report the GeV gamma-ray detections of the shell-type SNRs HESS J1731-347 and SN 1006 using 8 years of Fermi-LAT Pass 8 data. Overall, the hard spectra of these SNRs suggest a common scenario in which the bulk of the gamma-ray emission is produced by inverse Compton scattering of high energy electrons. However, this does not rule out efficient hadron acceleration in these TeV shells and the spectral slope asymmetry visible in the case of SN 1006 might be a first evidence in this respect. These results will be compared with the 3 other TeV shell-type SNRs providing a first complete census of this class of source at gamma-ray energies.</p>

15:00	<p>[60] Fermi Large Area Telescope observations of supernova remnants Kes 73 and Kes 79 <i>Presenter: YEUNG, Paul Kin-Hang</i></p> <p>The supernova remnants Kes 73 and Kes 79 can deposit a large amount of energy to their surroundings and are potentially responsible for particle acceleration. Using the data taken with the Fermi Large Area Telescope (LAT), we confirmed the presence of extended sources which are spatially associated with these two supernova remnants. Kes 73 shows intense emission from 100 MeV to >100 GeV, and its LAT spectrum can be decoupled into two components. According to the young age of the Kes 73 system, the observed <10 GeV flux is too high for the supernova remnant to account for, while the supernova remnant is reasonably responsible for the hard spectrum above 10 GeV. In the LAT spectrum of Kes 79, we discovered a genuine turnover (a sharp peak) at a photon energy of 290 ± 26 MeV, above which the spectrum follows a power-law with a photon index of 2.63 ± 0.05. This peak is consistent with the scenario of proton-proton collision. The molecular clouds illuminated by hadronic cosmic-rays from Kes 79 is preferably dominating the γ-rays observed in this field.</p>
15:15	<p>[183] Disentangling hadronic from leptonic emission in the composite SNR G326.3-1.8 <i>Presenter: DEVIN, Justine</i></p> <p>Supernova remnants (SNRs), pulsar wind nebulae (PWNe) and pulsars are the usual suspects to accelerate the bulk of cosmic rays in our Galaxy. In those objects the gamma-ray emission allows us to probe the population of high-energy particles and in particular the population of accelerated hadrons radiating through the pion-decay mechanism. In case of composite SNRs, both the SNR shell and the PWN are sometimes bright enough to be observed in the same source. However, understanding the nature of the gamma-ray emission in such objects can be challenging for sources of small angular extent. Previous studies of the composite SNR G326.3-1.8 (radius=0.3°) revealed bright and extended gamma-ray emission but its origin remained uncertain.</p> <p>With the recent Pass8 Fermi-LAT data that provide an increased acceptance and angular resolution, we investigate the morphology of this source to disentangle the PWN from the SNR contributions. In particular, we take advantage of the new possibility to filter events based on their angular reconstruction quality (PSF types). We also report a spectral analysis and derive some physical properties using one-zone models for the SNR spectrum.</p>
15:30	<p>[159] Thermal X-ray studies on escaping of accelerated protons from SNR shocks <i>Presenter: Mr. SUZUKI, Hiromasa</i></p> <p>A number of middle-aged SNRs with molecular clouds (MCs) emit GeV gamma-rays originating from accelerated protons. About half of GeV SNRs also have recombining plasma (RP; the plasma with ionization temperatures that are higher than electron temperatures), implying rapid cooling of the electrons. These facts indicate thermal plasma can be the key to understand the escaping process of accelerated protons from SNR shocks.</p> <p>We have made thermal X-ray study of the GeV SNR HB 21. HB 21 is interacting with MCs and the faintest in GeV band among GeV SNRs. We discovered a strong radiative recombination continuum of Si from the center of the remnant, which is the direct evidence of RP (electron temperature of 0.16 ± 0.01 keV and recombination timescale of $(2.8 \pm 0.5) \times 10^{11}$ s cm^{-3}).</p> <p>The estimated RP age (~ 100 kyr) is the longest among GeV SNRs with RP.</p> <p>Systematic study of GeV SNRs shows a strong correlation between RP age and photon index in the GeV band. It supports the following scenario; interaction with MCs makes a magnetic field partially weaker and protons escape, simultaneously cooling down the SNR plasma to be recombining.</p>

Coffee Break (15:45-16:15)

Transients and Gamma-Ray Bursts III: Radio Transients and Novae - GaPa-2-1 - Konzertsaal (16:15-18:00)

-Conveners: Guillaume Dubus

time [id] title

16:15	<p>[113] Radio Transients - implications for Fermi and future prospects <i>Presenter: ROWLINSON, Antonia</i></p> <p>With the recent arrival of the next generation of sensitive radio telescopes, we have been making rapid progress towards constraining the transient population at radio frequencies on a wide range of timescales. First, I will outline the current developments in blind searches; including the discovery of the first transient sources at low-frequencies by LOFAR and MWA, fast radio bursts, and results from whole visible sky radio transient monitors. I will describe efforts to produce transient alerts in near real-time to enable other facilities to follow-up radio transients and how we can utilise our blind surveys to place constraints on Fermi transient sources. In the second part of this talk, I will give the highlights of targeted transient searches using low frequency radio telescopes. Over the past few years, a number of radio telescopes have been automated enabling a rapid response mode for transient follow-up. I will outline the various rapid response capabilities and what we can learn by triggering on Fermi transients. Looking ahead to the future, I will outline prospects with facilities such as the SKA.</p>
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16:45	<p>[210] Fast Radio Bursts - implications for Fermi and future prospects <i>Presenter: CALEB, Manisha</i></p> <p>Radio astronomy is currently exploring an intriguing new phase space that probes the dynamic Universe on timescales of milliseconds. Recent development of sensitive, high time resolution instruments has enabled the discovery of millisecond duration fast radio bursts (FRBs). The FRB class encompasses a number of single pulses, each unique in its own way, hindering a consensus for their origin. The key to demystifying FRBs lies in discovering many of them in realtime in order to identify commonalities. Despite rigorous follow-up at radio and other wavelengths, with the exception of the FRB discovered by the Arecibo telescope, none of the other FRBs have been seen to repeat suggesting the possibility of there existing two independent classes of FRBs with two classes of possible progenitors. In my talk I will present an overview of the FRB population and their implications for Fermi and the future prospects of the field.</p>
17:15	<p>[149] Probing mass ejection in nova outbursts using gamma-rays <i>Presenter: Dr. MARTIN, Pierrick</i></p> <p>Thanks to the Fermi Large Area Telescope (LAT), novae have been established as a new class of particle accelerators and gamma-ray emitters, with 9 objects detected as transient GeV sources so far. A possible origin for this non-thermal emission is internal shocks in the nova ejecta, resulting from the interaction of a fast wind radiatively-driven by nuclear burning on the white dwarf with material ejected in the initial runaway stage of the outburst. We present a model for the dynamics of such internal shocks and for the associated diffusive shock acceleration and high-energy emission. Non-thermal proton and electron spectra are calculated by solving a time-dependent transport equation for particle injection, acceleration, losses, and escape from the shock region. Predicted spectra and lightcurves are fitted to observations of the first 6 novae detected by the LAT to derive the properties of the nova outbursts. From these results, we discuss the potential of gamma-rays for probing the mechanism of mass ejection in novae in conjunction with diagnostics of the thermal emission.</p>
17:30	<p>[35] Gamma-ray Novae: Rare or Nearby? <i>Presenter: MORRIS, Paul</i></p> <p>Classical Novae were revealed as a surprise source of gamma-rays in Fermi LAT observations. During the first 8 years since the LAT was launched, 6 novae in total have been detected to > 5 sigma in gamma-rays, in contrast to the 69 discovered optically in the same period. We attempt to resolve this discrepancy by assuming all novae are gamma-ray emitters, with peak one-day fluxes consistent to those observed. To determine optical parameters, the spatial distribution and magnitudes of bulge and disc novae in M31 are scaled to the Milky Way. We approximate Galactic reddening using a double exponential disc with vertical and radial scale heights of $r_d = 5$ kpc and $z_d = 0.2$ kpc, and demonstrate that even such a rudimentary model can easily reproduce the observed fraction of gamma-ray novae, implying that these apparently rare sources are in fact nearby and not intrinsically rare. We conclude that classical novae with $m_R < 12$ and within ~ 8 kpc are likely to be discovered in gamma-rays using the Fermi LAT.</p>
17:45	<p>[83] Classical Novae in the Age of Fermi <i>Presenter: LINFORD, Justin</i></p> <p>One of the great surprises from the Fermi Gamma-ray Space Telescope is the discovery that classical novae are sources of GeV gamma-ray emission. Despite the low velocities (\simfew thousand km/s) and low masses ($\sim 10^{-5}$ solar masses) of their ejecta, these explosions still manage to produce populations of relativistic particles. The ENova team studies classical novae at all available wavelengths. Here, we present new discoveries from our observations with the Karl G. Jansky Very Large Array (VLA), the Hubble Space Telescope (HST), Swift, Chandra, NuSTAR, and (of course) Fermi. Fermi and optical monitoring uncover correlation between the optical and gamma-ray light curves, indicating the optical light is reprocessed emission from shocks and favoring the hadronic model for gamma-ray emission. Swift and VLA monitoring reveal evidence for multiple shocks in some novae. HST and VLA imaging point to a misalignment between optical and radio structures in at least one nova. NuSTAR observations provide new information about the hard X-ray regime, beginning to fill in the previously un-observable gap between Swift/Chandra and Fermi. Exciting new projects are underway or planned on all of these instruments.</p>

Stellar sources (galactic and extragalactic) III - GaPa-1-1 - Olympiasaal (16:15-18:00)

-Conveners: Martin Pohl

time [id] title

16:15	<p>[177] New Extended GeV Sources in the Galactic Plane Found using 6 years of Fermi-LAT Pass 8 data <i>Presenter: GRONDIN, Marie-Hélène</i></p> <p>Spatially resolving pulsar wind nebulae (PWNe) and supernova remnants (SNRs) at GeV energies enables accurate representation of spectra, aids identification of multiwavelength counterparts, and probes possible substructure within the gamma-ray sources. Using 6 years of Fermi-LAT Pass 8 data above 10 GeV, we searched for spatially extended sources near the Galactic plane. The improved angular resolution and photon acceptance of the Pass 8 event reconstruction significantly aids in characterizing source extension and assessing spectral and morphological properties, a key consideration for studies of PWNe and SNRs in the gamma-ray band. Selecting photons above 10 GeV strikes a balance between keeping photon statistics high and diffuse gamma-ray emission low, and also carries the benefit of a near constancy with energy of the point spread function of the LAT. More than 30 significantly extended sources are detected, more than a dozen of which are resolved at GeV energies for the first time.</p>
16:30	<p>[147] Resolving the Crab Nebula in TeV gamma-rays with H.E.S.S. <i>Presenter: HOLLER, Markus</i></p> <p>Although the Crab Nebula is one of the best-studied astrophysical sources, its extension in gamma-rays remained unknown until now. Measuring the size of the Crab Nebula in very high energy (VHE) gamma-rays provides important input on understanding the physics of this quite unusual pulsar wind nebula. The suspected extension is well below the angular resolution of Imaging Atmospheric Cherenkov Telescopes, which makes a good understanding of the instrument point spread function (PSF) indispensable. The PSF depends strongly on the observation and instrument conditions, demanding time-dependent simulations of these. Utilising such simulations, the point-source resolvability in VHE gamma-ray astronomy has now been pushed to a new level by H.E.S.S., allowing to probe source extensions well below one arcminute scale. This enables us to reveal the extension of the Crab Nebula in VHE gamma-rays for the first time. Assuming a Gaussian source shape, we obtain a width of 52".</p>
16:45	<p>[78] On the origin of gamma-ray emission toward SNR CTB 37A with Fermi-LAT <i>Presenter: ABDOLLAHI, Soheila</i></p> <p>Supernova remnants (SNRs) are believed to be one of the major sources of Galactic cosmic rays. SNR CTB 37A is known to interact with several dense molecular clouds as traced by OH 1720 MHz maser. Radio and X-ray observations of the SNR confirm a mixed-morphology classification of the remnant. The TeV γ-ray source HESS J1714-385 is positionally coincident with the SNR, though it is still not clear whether the TeV γ-ray emission originates in the SNR or in a plausible pulsar wind nebula (PWN). In the present work, we use 8 years of Pass 8 Fermi-LAT data, with high capability to resolve γ-ray sources, to perform morphological and spectral studies of the γ-ray emission toward CTB 37A from 200 MeV to 200 GeV. The best fit of the source extension is obtained for a Gaussian model of 68% containment radius $0.18^\circ \pm 0.02^\circ$. We also discuss several possible theoretical models to explain the broadband spectrum and to elucidate the nature of the high-energy γ-ray emission toward CTB 37A.</p>
17:00	<p>[6] Similarity of γ-ray spectrum in middle aged supernova remnants interacting with molecular clouds: what can we learn? <i>Presenter: TANG, Xiaping</i></p> <p>We compare the γ-ray spectrum available in literature from middle aged supernova remnants (SNRs) interacting with molecular clouds (MCs). We demonstrate the similarity in the shape of γ-ray spectra and then clarify a few points about the π^0-decay signatures claimed in a few SNRs. Next, we discuss the escaping scenario and direct interaction scenario, which have been proposed to interpret the observed γ-ray emission. We show that the similarity presented in γ-ray spectra is inconsistent with the prediction from escaping scenario statistically. It may imply that the widely used free escape boundary is not a good prescription to study escaping CRs and illuminated MCs. In the direct interaction scenario involving re-acceleration of pre-existing CRs, the similarity in γ-ray spectra can be understood as a reflection of almost uniform CR background in our Galaxy. However, the model suggests a transition in seed particles for diffusive shock acceleration during the SNR evolution. Whether such transition indeed exists and how does it affect SNRs' contribution to Galactic CRs have to be investigated by future observation and theoretical modeling. In the end, we discuss the contribution of SNRs to the Galactic diffuse γ-ray emission.</p>
17:15	<p>[97] Diffusive shock acceleration in the young supernova remnant G1.9+0.3 <i>Presenter: BROSE, Robert</i></p> <p>The very young Supernova remnant G1.9+0.3 is an interesting target for next generation gamma-ray observatories. So far the remnant is only detected in the radio and the X-ray bands but its young age and inferred shock speed of 14,000km/s should make it an efficient particle accelerator.</p> <p>We carry out spherical symmetric 1-D simulations where we simultaneously solve the transport equations for the cosmic rays and the hydrodynamical flow using the PATRON code. With our test-particle simulations we are able to reproduce the observed radio and x-ray spectra together with the radio and x-ray profiles in the east-west direction and the observed radio-flux increase of about 1.2%/yr.</p>

17:30 [142] A New Gamma-Ray Source in the Vicinity of the Galactic Supernova Remnant G306.3–0.9*Presenter: ERGIN, Tulun*

A new extended gamma-ray source, which was named as 'SourceA', in the southwest of Galactic supernova remnant (SNR) G306.3–0.9 was detected with a significance of $\sim 13\sigma$ at the location of R.A.(J2000) = 199.47 deg \pm 0.07 deg and decl.(J2000) = -63.93 deg \pm 0.07 deg using about 9 years of Fermi–LAT data. Showing the properties and detectability levels of non-TeV pulsar wind nebulae (PWNe), SourceA might be a PWN. In order to investigate this unidentified gamma-ray source in multi-wavelengths, we performed Swift observations of SourceA. In this presentation we will summarize the published gamma-ray results, report on the Swift observations, and show our preliminary results of the gamma-ray variability analysis of SourceA.

Wednesday 18 October 2017

GeV to TeV (08:30-10:30)

-Conveners: **Andy Strong**

time [id] title

08:30	[180] Gamma-ray astronomy across 6 decades of energy: synergy between Fermi, IACTs, and HAWC observatories <i>Presenter: HUI, Michelle</i> Gamma-ray astronomy currently has an unprecedented sensitivity with instruments covering 6 decades of energy from 100MeV to 100TeV. The surveying capability at complementary energies between Fermi and HAWC allows extensive coverage for transients and flares. Very extended emissions are also being revealed within our Galaxy from nearby pulsar wind nebulae and star-forming regions. Using these HAWC and Fermi discoveries as targets, the finer resolution of imaging telescopes can begin to deconvolve the morphology of complex regions and follow up on sources found in previously unsurveyed regions with deeper exposures. With all these instruments in operation, the gamma-ray field is well-poised for multi-wavelength and multi-messenger astronomy.
09:00	[217] H.E.S.S. highlights <i>Presenter: PUEHLHOFER, Gerd</i> H.E.S.S. highlights The H.E.S.S. collaboration continues to run an array of meanwhile five Imaging Atmospheric Cherenkov Telescopes to observe the Southern sky in TeV gamma-rays. In this presentation, I will review recent highlight results obtained with H.E.S.S., including the corresponding multiwavelength perspective and future prospects.
09:30	[89] Highlights of VERITAS observations of extragalactic objects <i>Presenter: POHL, Martin</i> VERITAS is one of the world's most sensitive detectors of astrophysical VHE ($E > 100$ GeV) gamma rays, and nearly 5000 hours of observations have been targeted on active galactic nuclei (AGN) and other extragalactic objects. These studies of blazars, radio galaxies, and starburst galaxies have resulted in 37 detections, in most cases accompanied by contemporaneous, broadband observations, which enable detailed studies of the underlying physical processes. Recent highlights from the VERITAS observation program of extragalactic sources will be presented, including studies of the extragalactic background light and reports on the sources OJ287, BL Lacertae, and 1ES 1959+650.
09:45	[224] Recent Galactic Science Results from VERITAS on Pulsar Searches, PSR J2032+4127, and HAWC Follow-Ups <i>Presenter: RICHARDS, Gregory</i> VERITAS is a ground-based imaging atmospheric Cherenkov telescope array sensitive to very high energy (VHE, $E > 100$ GeV) gamma rays. VERITAS has detected VHE gamma-ray emission from nearly 60 astrophysical sources of varied source classes. One of the primary areas of research of VERITAS is the study of galactic particle accelerators, and among the classes of galactic objects investigated are pulsars, binary systems, and pulsar wind nebulae. In this contribution, recent results from VERITAS on the three aforementioned source classes will be presented, including: results from a search for pulsed emission from 14 young pulsars appearing in archival VERITAS data; observations of the binary system PSR J2032+4127/MT91 213, which is quickly approaching its periastron passage set to occur in November 2017; and follow-up observations of new VHE gamma-ray sources detected by the HAWC observatory. These VERITAS observations will provide insight into the particle acceleration and radiation mechanisms at work in these galactic objects.
10:00	[202] Improved IGMF limits from Fermi and MAGIC observations of 1ES 0229+200 <i>Presenter: Dr. VOVK, Ievgen</i> The existence of the Intergalactic Magnetic Field (IGMF) in the voids of the Large Scale Structure provides a unique opportunity to infer the information about the evolution of the Universe in the early times. Currently, the most promising way to measure this field is through the IGMF-induced halos around the distant, gamma-ray loud AGNs. Among these 1ES 0229+200 remains the most suitable, given its hard GeV spectrum and absence of strong variability on the yearly time scales. In what follows, we present the results of 4 years of MAGIC observations of 1ES 0229+200, combined with the 9 year of the Fermi/LAT data, aimed to detect the degree-scale IGMF-induced halo around this source in the GeV-TeV energy range. Though no halo is detected, these observations allow us to derive a lower bound on the IGMF strength (in the large correlation length limit) at the level of 10^{-14} G - combining both the morphological and spectral information on the halo. We further discuss the implications of this bound for the existing IGMF models.

10:15	<p>[215] Evidence for cosmic ray escape: the GeV to TeV morphology of the γ-Cygni SNR with MAGIC and Fermi-LAT</p> <p><i>Presenter: Mr. STRZYS, Marcel C.</i></p> <p>Until today the supernova remnant (SNR) paradigm provides the most plausible hypothesis for the origin of galactic cosmic rays. In contrast to the acceleration process, the way how cosmic rays are released into the interstellar medium is not well understood yet, partially due to the lack of observational signatures. Such a signature could be provided by gamma-rays produced in the interaction of escaping particles with the material surrounding the SNR.</p> <p>The middle-aged (~7000 years old) γ-Cygni SNR (G78.2+2.1) situated in the dense Cygnus region may be in the right evolutionary phase to study the leakage of cosmic rays into the ISM. The high-energy observations by VERITAS and Fermi-LAT revealed a complex, energy-dependent morphology of the SNR in the GeV-TeV band, different from that observed in X-rays.</p> <p>We present recent, deeper observations of the γ-Cygni region with the MAGIC telescopes. Combined with 8 years of Fermi-LAT data, we find clear evidences for the release of cosmic rays at northern part of the SNR shell. We further discuss these results in the context of the current understanding of cosmic ray escape scenarios.</p>
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Break (10:30-11:00)

Analysis techniques: Methods (11:00-12:30)

-Conveners: J. Michael Burgess

time [id] title

11:00	<p>[127] Information field theory for gamma ray astronomy</p> <p><i>Presenter: ENSSLIN, Torsten</i></p> <p>Imaging, the process of converting data into images, is in general an ill-posed problem that requires regularization by additional information. Information field theory (IFT) provides a consistent framework to fuse measurement data and abstract knowledge on signal fields into an optimal image by using field theoretical methods in Bayesian inference. Here, the IFT based D^3PO algorithm will be introduced, and its application to Fermi and RXTE data presented. The future vision of a Unified Bayesian Imaging toolKIT (UBIK) for multi-dimensional and multi-instrumental imaging and the first steps towards it will be presented.</p>
11:30	<p>[170] Searches for Angular Extension in High-Latitude Fermi-LAT Sources</p> <p><i>Presenter: CAPUTO, Regina</i></p> <p>We report on the Fermi High-Latitude Extended Source Catalog (FHES), a systematic search for spatial extension of gamma-ray sources reported in the Fermi Large Area Telescope (LAT) 3FGL and 3FHL catalogs at Galactic latitudes $b > 5$ degrees. While the majority of high-latitude LAT sources are extragalactic blazars that appear point-like within the LAT angular resolution, there are several physics scenarios that predict the existence of populations of spatially extended sources. If dark matter consists of weakly interacting massive particles, the annihilation or decay of these particles in subhalos of the Milky Way would appear as a population of unassociated gamma-ray sources with finite angular extent. Gamma-ray emission from blazars could also be extended (so-called pair halos) due to the deflection of electron-positron pairs in the intergalactic magnetic field (IGMF). Measurement of pair halos would constrain the strength and coherence length scale of the IGMF. We report on new extended source candidates and their associations found in the FHES as well as limits on the IGMF based on the non-observation of the cascade.</p>
11:45	<p>[150] A new way of searching for transients: the ADWO method and its results</p> <p><i>Presenter: BAGOLY, Zsolt</i></p> <p>With the detection of gravitational wave emissions from merging compact objects, it is now more important than ever to effectively mine the data-set of gamma-satellites for non-triggered, short-duration transients. Hence we developed a new method called the Automatized Detector Weight Optimization (ADWO), applicable for space-borne detectors such as Fermi's GBM and RHESSI's ACS. Provided that the trigger time of an astrophysical event is well known (as in the case of a gravitational wave detection) but the detector response matrix is uncertain, ADWO combines the data of all detectors and energy channels to provide the best signal-to-noise ratio. We used ADWO to successfully identify any potential electromagnetic counterpart of gravitational wave events, as well as to detect previously un-triggered short-duration GRBs in the data-sets.</p>

12:00 [70] Time Domain Astronomy with Fermi GBM in the Multi-messenger Era*Presenter: WILSON-HODGE, Colleen*

As the Multi-Messenger era begins with detections of gravitational waves with LIGO and neutrinos with IceCube, Fermi GBM provides context observations of gamma-ray transients between 8 keV and 40 MeV. GBM has a wide field of view, high uptime, and both in-orbit triggering and high time resolution continuous data enabling offline searches for weaker transients. GBM detects numerous GRBs, SGRs, X-ray bursters, solar flares and TGFs. Longer timescale transients, predominantly in our galaxy so far, are detected using the Earth occultation technique and epoch-folding for periodic sources. The GBM team has developed two ground-based searches to enhance detections of faint transients, especially short GRBs. The targeted search uses the time and location of an event detected with another instrument to coherently search the GBM data, increasing the sensitivity to a transient. The untargeted search agnostically searches the GBM data for all directions and times to find weaker transients. This search finds ~80 short GRBs per year, in addition to the 40 per year triggered on-orbit. With its large field of view, high duty cycle and increasingly sophisticated detection methods, Fermi GBM is expected to have a major role in the Multi-Messenger era.

12:15 [227] An Overview of the GBM Targeted Search For Sub-threshold Emission Associated with LIGO/Virgo Detections*Presenter: KOCEVSKI, Daniel*

The Fermi Gamma-ray Space Telescope's Gamma-ray Burst Monitor (GBM) is currently the most prolific detector of Gamma-ray Bursts (GRBs), including short-duration GRBs (sGRBs). Recently the detection rate of sGRBs has been increased dramatically through the use of ground-based searches to analyze untriggered GBM continuous time tagged event (CTTE) data. Motivated by the possibility that sGRBs are caused by compact binary mergers that also produce gravitational waves, the GBM team has developed a method to search CTTE data for transient events in temporal coincidence with a LIGO/Virgo compact binary coalescence trigger. This targeted search operates by looking for a coherent signal in all 14 GBM detectors over a variety of timescales by using spectral templates which are convolved with the GBM detector responses. I will review recent improvements to the targeted search pipeline and discuss its enhanced capabilities at detecting sub-threshold transient signals associated with LIGO/Virgo triggers. I will also discuss the role of the targeted search in finding a possible GBM counterpart to GW150914 and will compare that signal to other known astrophysical transients that can be recovered from the untriggered GBM data using this method.

Catered Lunch (12:30-13:30)**Free Afternoon - Social Program (13:30-18:30)****Conference Dinner: Bayernhalle (18:30-21:30)**

Thursday 19 October 2017

Galactic Diffuse & CR propagation: Galactic Diffuse Emission (08:30-10:30)

-Conveners: Isabelle Grenier

time [id] title

08:30	<p>[135] Cosmic rays and the diffuse gamma-ray emission <i>Presenter: DONATO, Fiorenza</i> We discuss the impact that the charged cosmic rays have on the determination of the gamma-ray diffuse galactic emission. We review the implications deriving from present data and outline some future prospects for data and models.</p>
09:00	<p>[235] Development of the Galactic Diffuse Emission Model for the LAT 4FGL Catalog Analysis <i>Presenter: DIGEL, Seth</i> In support of analysis for the Large Area Telescope 4FGL source catalog (see invited contribution by Jean Ballet) we are developing a new model for the Galactic diffuse emission, fit to the same 8-year Pass 8 data set, spanning 50 MeV--1 TeV. Relative to the 4-year Pass 7 model developed for the 3FGL catalog, the new model includes updated distributions of interstellar atomic and molecular hydrogen, including gas not traced by spectral line surveys, and more degrees of freedom in the fitting. We are testing new templates, including for unresolved Galactic sources, and as for the 4-year model iteratively including un-modeled extended residuals, e.g., the Fermi bubbles. The goal is for the 8-year model to have reduced systematic uncertainties. In fitting the observations we also include updated models for the emission of the Moon and quiet Sun, spectral models for the isotropic extragalactic emission, and take into account the anisotropic distribution of residual charged particles that are more prominent with the larger instrumental acceptance of Pass 8. We also consider a preliminary 4FGL source list. We will present details of the new model components and its comparison to the data.</p>
09:15	<p>[186] Cosmic rays, gas, and dust in local clouds <i>Presenter: REMY, Quentin</i> The recent progress in HI, CO, dust, and gamma-ray observations provides excellent opportunities to probe the properties of the interstellar medium (ISM) at a resolution of a few parsecs inside nearby clouds and to search for biases in the different gas tracers.</p> <p>The nearby clouds in Galactic anti-center and Chamaleon regions have been studied using jointly the gamma-ray observations of Fermi Large Area Telescope, and the dust optical depth inferred from Planck and IRAS observations.</p> <p>We have quantified the potential variations in cosmic-ray density and dust properties per gas nucleon across the different gas phases and different clouds, and we have measured the CO-to-H2 conversion factor, XCO, in different environments. We also mapped the gas not seen, or poorly traced, by HI, free-free, and 12CO emissions, namely (i) the opaque HI and diffuse H2 present in the Dark Neutral Medium at the atomic-molecular transition, and (ii) the dense H2 to be added where 12CO lines saturate.</p> <p>We will present these results and show how the precise modelling of the ISM we have performed helps to improve the modelling of diffuse Galactic gamma-ray emission.</p>
09:30	<p>[140] Diffuse X-ray emission from Loop I: Additional evidence of past activity of Galactic Center and relation to Fermi Bubbles <i>Presenter: AKITA, Masahiro</i> The Fermi-LAT discovered giant structures that are barely visible in the EGRET era. The most striking feature is the so-called Fermi bubbles, extending above and below the Galactic center. In addition, Fermi-LAT detected diffuse gamma-ray emissions associated with Loop I. The northern-most part of Loop I is the brightest arm, known as the North Polar Spur (NPS), and is even clearly visible in the ROSAT X-ray sky map. In previous works, we reported on the X-ray observations of the NPS and Galactic halo with the Suzaku and Swift satellites. All the results suggest that the NPS is a giant structure in the Galactic Center (GC) and is heated by the expansion of the Fermi Bubbles with a velocity of $V_{\text{exp}} \sim 300$ km/s; however, the origin of the X-ray and gamma-ray emissions associated with Loop I is completely unknown. To shed new light on the past activity of the GC, we analyzed all the archival X-ray data pointing toward Loop I with the Suzaku satellite. We argue, for the first time, that the soft gamma-ray spectra of Loop I may be due to π^0 decay.</p>

09:45	<p>[198] Spiral Arm Signatures in Fermi-LAT's spectral index map <i>Presenter: SHAVIV, Nir</i></p> <p>Standard cosmic ray (CR) propagation models that assume neither a time-independent source distribution nor a location-independent diffusion cannot give rise to spatially dependent CR (and hence γ-ray) spectral slopes. Yet, recent observations by Fermi-LAT exhibit a hardening of the γ-ray spectrum between the Sagittarius and Carina tangents, and a further hardening at a few degrees above and below the Galactic plane. Here, we study a model in which the distribution of CR sources is concentrated in the galactic spiral arms, and in particular, that these arms are dynamic. The model has been successful in explaining secondary to primary ratios (e.g., B/C, sub-iron/iron, positrons) as well as long term variations in the CR flux over geological time scales. We find unique signatures that agree with the Fermi-LAT observations and also provides a physical explanation to the difference between the local CR spectral slope and the CR slope inferred from the average γ-ray spectrum.</p>
10:00	<p>[112] High-energy Gamma Rays from the Milky Way: 3D Interstellar Emission Models with GALPROP <i>Presenter: PORTER, Troy</i></p> <p>High-energy gamma rays of interstellar origin are produced by the interaction of cosmic-ray (CR) particles with the diffuse gas and radiation fields in the Galaxy. The main features of this emission are well understood and are reproduced by existing CR propagation models employing a 2D galactocentric cylindrical symmetric geometry. However, the high-quality data from instruments like the Fermi Large Area Telescope reveal significant deviations from the 2D model predictions on few to tens of degree scales, indicating that the details of the Galactic spiral structure should be included and thus require 3D spatial modelling. In this contribution the high-energy interstellar emissions from the Galaxy are calculated using the latest release of the GALPROP code for the first time employing full 3D spatial models for the CR source, interstellar gas, and interstellar radiation field (ISRF) densities. The interstellar emission models that include arms and bulges for the CR source and ISRF densities provide plausible physical interpretations for features found in the residual maps from high-energy gamma-ray data analysis. The 3D models provide a more realistic basis for interpreting the non-thermal interstellar emissions toward the inner Galaxy and about the Galactic centre.</p>
10:15	<p>[111] Constraining the emission of cosmic electrons from supernova remnants with flux, dipole anisotropy and radio data <i>Presenter: MANCONI, Silvia</i></p> <p>In this contribution we present an interpretation of the most recent data on cosmic-ray electron and positron (CRE) fluxes (from Fermi-LAT, HESS, CALET and AMS-02), with a special focus on the electron contribution from supernova remnants (SNRs). For the first time, we consider together the constraints coming from CRE flux up to 20 TeV, as well as Fermi-LAT dipole upper limits and radio measurements of individual nearby SNRs. We show how CRE data up to 20 TeV can constrain the energy cutoff of the electron emission from a smooth distribution of SNRs in the Galaxy. Also, we explore the consequences of the recent Fermi-LAT measurement of the dipole anisotropy, studying in particular the total emission energy in electrons and spectral index of Vela YZ and the Cygnus Loop SNRs. Finally, we make use of the full radio spectrum of nearby SNRs to constrain their electron injection spectrum. Our results show how the combination of constraints from different observables shed light on the interpretation of present CRE data.</p>

Break (10:30-11:00)

Extragalactic diffuse & EBL (11:00-12:30)

-Conveners: Seth Digel

time [id] title

11:00	<p>[130] Cosmic rays, particle acceleration, and Fermi constraints on star and galaxy formation <i>Presenter: PFROMMER, Christoph</i></p> <p>Understanding the physics of galaxy formation is an outstanding problem in modern astrophysics. Recent cosmological simulations have demonstrated that feedback by star formation, supernovae and active galactic nuclei appears to be critical in obtaining realistic disk galaxies and to slow down star formation to the small observed rates. However the particular physical processes underlying these feedback processes still remain elusive. In particular, these simulations neglected magnetic fields and relativistic particle populations (so-called cosmic rays). Those are known to provide a pressure support comparable to the thermal gas in our Galaxy and couple dynamically and thermally to the gas, which seriously questions their neglect. After introducing the underlying physical concepts, I will present our recent efforts to model cosmic ray physics in galaxy formation. I will demonstrate that cosmic rays play a decisive role on all scales relevant for the formation of galaxies, from individual supernova remnants up to scales relevant for entire galaxies. Finally, I will discuss the non-thermal radio and gamma-ray emission of Milky-Way like galaxies and how the Fermi space telescope can be used to infer properties relevant for galaxy formation.</p>
11:30	<p>[187] Radio and Gamma-Ray Constraints on the Wind, Magnetic Field, and Cosmic Rays along the minor axis of the starburst M82 <i>Presenter: BUCKMAN, Benjamin</i></p> <p>Cosmic rays can be probed by their non-thermal emission in the radio and in gamma-ray bands. One-zone models of cosmic rays have been used to match the integrated emission of starburst galaxies. We construct multi-dimensional models of the local starburst M82 using cosmic ray propagation code GALPROP. Using the integrated gamma-ray and radio spectra, along with the vertical distribution of radio emission along the minor axis, we constrain the gas density, magnetic field strength, and cosmic ray population. We show that the wind velocity and diffusion coefficient can be constrained by the morphology of the radio halo. We discuss the interplay between gas density, magnetic field, and outflow velocity and how they effect the emission. We comment on the energetics of cosmic ray species in the system. We provide direct constraints on the dynamical importance of cosmic rays in driving the outflow of the galaxy.</p>
11:45	<p>[216] X-ray to gamma-ray virial shock signal from the Coma cluster <i>Presenter: KESHET, Uri</i></p> <p>Following evidence for an east-west elongated virial ring around the Coma galaxy cluster in ~ 220 GeV VERITAS data, we search for corresponding signatures in > 1 GeV γ-rays from Fermi-LAT, and in soft, ~ 0.1 keV X-rays from ROSAT. For the ring elongation and orientation inferred from VERITAS, we find a 3.4σ LAT excess, and a $> 5\sigma$ modelled signature in the ROSAT R1+R2 bands; both signals are maximized at approximately the expected ring parameters.</p> <p>The intensities of the ROSAT, Fermi, and VERITAS signals are consistent with the virial shock depositing $\sim 0.3\%$ of its energy over a Hubble time in a nearly flat, $p = -dN/dE \sim 2.2$ spectrum of relativistic electrons.</p> <p>The steep angular profiles of the LAT and ROSAT signals suggest preferential accretion in the plane of the sky, as indicated by the distribution of neighboring large-scale structure.</p> <p>The X-ray signal gauges the compression of cosmic-ray electrons as they are advected deeper into the cluster.</p>
12:00	<p>[116] The Extragalactic Background Light in the Fermi Era <i>Presenter: AJELLO, Marco</i></p> <p>The extragalactic background light (EBL), from ultra-violet to infrared, that encodes the emission from all stars, galaxies and actively accreting black holes in the observable Universe is critically important to probe models of star formation and galaxy evolution, but remains at present poorly constrained. The Large Area Telescope (LAT), on board Fermi, produced an unprecedented measurement (relying on 750 blazars and the first 9 years of Pass 8 data) of the EBL optical depth at 12 different epochs from redshift 0 up to a redshift of 3. In this talk, we will present the measurement and how it constrains the EBL energy density and its evolution with cosmic time. We will also discuss how this paves the road to the first point-source-independent determinations of the star-formation history of the Universe.</p>
12:15	<p>[100] Measuring the Cosmic Star Formation Rate Density with Fermi-LAT <i>Presenter: FINKE, Justin</i></p> <p>The extragalactic background light (EBL) in the ultraviolet through optical absorbs gamma rays detectable by Fermi-LAT. We used the absorbed gamma-ray spectra of blazars to make the newest measurements of the EBL absorption optical depth. We fit these measurements with an EBL model that allows the cosmic star formation rate density (CSFRD) to vary, thus making the first accurate point-source-independent measurement of the CSFRD; that is, a measurement of the CSFRD using only gamma rays detected by the LAT. This provides strong constraints on the CSFRD at $z > \sim 5$, with implications for Population III star formation.</p>

Catered Lunch (12:30-14:00)

Active Galactic Nuclei: III - GaPa-2-1 - Konzertsaal (14:00-16:00)

-Conveners: Eduardo Ros

time [id] title

14:00	[192] The remarkable gamma-ray flaring activity of CTA 102 as seen by the Fermi-LAT <i>Presenter: BUSON, Sara</i> In late 2016, the Fermi Large Area Telescope (LAT) observed a dramatic increase in the gamma-ray activity from the blazar CTA 102. The enhanced state was monitored throughout the whole electromagnetic spectrum and persisted for several weeks, reaching daily gamma-ray fluxes (0.1-100 GeV) as high as 10^{-5} ph cm ⁻² s ⁻¹ . We present the analysis of these flares and discuss their characteristics in the context of extreme blazar flares previously observed by the LAT.
14:15	[206] Detection of intra-day variability in FSRQ CTA 102 during high state <i>Presenter: SHUKLA, Amit</i> The flux variability of blazars can shed light on the innermost region of jets well beyond the imaging capabilities of present generation telescopes in any part of the electromagnetic spectrum. The FSRQ, CTA 102 ($z \sim 1$) started showing activity in gamma-rays during 2016 with a few very bright flares. The detection of intra-day variability above 100 MeV using Fermi-LAT during these flares allows to constrain the gamma-ray emission region in CTA 102. The inferred compactness of the emission region suggests, an origin of the gamma-rays close to the central engine and a low pair-creation opacity of the broad-line emission region, or a hadronic emission scenario outside of BLR region.
14:30	[156] Unravelling the complex behaviour of our closest very-high-energy gamma-ray blazars, Mrk421 and Mrk501 <i>Presenter: PANEQUE, David</i> Because of their brightness and proximity ($z=0.03$), Mrk421 and Mrk501 are among the very-high-energy (>100 GeV) gamma-ray objects that can be studied with the greatest level of detail, and consequently they are excellent astrophysical high-energy physics laboratories to study the nature of blazars. Motivated by the extensive temporal exposure of Fermi-LAT, since 2008, there has been an unprecedentedly long and dense monitoring of the radio to very-high-energy gamma-ray emission from these two archetypical TeV blazars. In this conference, I will report some highlight results obtained from these multiwavelength campaigns. Despite some differences in the variability patterns of these two sources, there are also a number of similarities that support a broadband emission dominated by leptonic scenarios, as well as indications for in situ electron acceleration in multiple compact regions. I will also show the presence of different flavors of flaring activity and discuss the complexity in the temporal evolution of their broadband emission, which demonstrates the importance of performing a continuous monitoring over multi-year timescales to fully characterise the dynamics of blazars.
14:45	[77] The FSRQ PKS 1510-089: The Gamma-ray–Synchrotron Connection <i>Presenter: JANKOWSKY, Felix</i> The flat spectrum radio quasar (FSRQ) PKS 1510-089 ($z=0.361$) is known for its complex multi-wavelength behaviour. Since 2015, it has been very active across the entire electromagnetic spectrum. This has led to joint observation campaigns including Fermi-LAT, Cherenkov telescopes and several instrument covering the synchrotron branch. Observations resulted in a range of remarkable measurements, including rapid flares above 200 GeV – peaking at more than 30 times long-term average – and unprecedented optical flares peaking in R-band at 13.6 magnitudes – almost 6 times long-term average. The comparison of the different instrument's results also show that different events follow different spectral evolution within the gamma-ray band and display different relationships to the synchrotron emission. We discuss the effect of pair-absorption on flares originating at different distances from the core and conclude that absorption in the BLR is not the sole reason for the broad-band diversity.
15:00	[73] Orphan γ-ray Flares and Stationary Sheaths of Blazar Jets <i>Presenter: Dr. MACDONALD, Nicholas</i> Many γ -ray flares within blazars are highly correlated with flares detected at longer wavelengths; however, a small subset appears to occur in isolation. These orphan γ -ray flares challenge models of blazar variability. We have developed the 'Ring of Fire' model to explain the origin of these orphan flares. In this model, electrons contained within a blob of plasma moving relativistically along the jet spine inverse-Compton scatter synchrotron photons emanating off of a ring of shocked sheath plasma that enshrouds the jet spine. As the blob propagates through the ring, the scattering of the ring photons by the blob electrons creates an orphan γ -ray flare. This model has been successfully applied to modeling an orphan γ -ray flare in the blazar PKS 1510-089. To further support the plausibility of this model, we have created a stacked radio map of PKS 1510-089 that exhibits a prominent polarimetric signature of a sheath of plasma surrounding the spine of the jet. We have since extended our modeling and stacking techniques to a larger sample of blazars: 3C 273, 4C 71.01, 3C 279, 1055+018, CTA 102, and 3C 345, most of which exhibit orphan γ -ray flares.

15:15	<p>[18] Long-Term Study of the Light Curve of PKS 1510-089 in GeV energies <i>Presenter: PRINCE, RAJ</i></p> <p>We have analyzed data from the flat-spectrum radio quasars PKS 1510-089 collected over a period of eight years from 2008 August to 2016 December with the *Fermi*-LAT. We have identified several flares of this highly variable source, studied their temporal and spectral properties in detail, and compared with previous works on flares of PKS 1510-089. Five major flares and few sub-flares have been identified in our study. The fastest variability time is found to be 1.30 ± 0.18 hr and the minimum size of the emission region is found to be 4.85×10^{15} cm. In most of the flares, the spectral energy distribution are better fitted with a log-parabolic distribution compared to a simple power law or a power law with exponential cutoffs. This has strong physics implications regarding the nature of the high-energy gamma-ray emission region.</p>
15:30	<p>[126] Blazar Radio and Optical Survey (BROS): A New Catalog of Blazar Candidates <i>Presenter: Dr. TANAKA, Yasuyuki</i></p> <p>By using deep radio source catalogs currently available, we present a new blazar candidate catalog, BROS, which includes 56314 sources located at declination $\delta > -40^\circ$ and outside the Galactic Plane ($b > 10^\circ$). We picked up flat-spectrum radio sources of $\alpha > -0.5$ (α is defined as $F_{\nu} \propto \nu^\alpha$) from 0.15 GHz TGSS and 1.4 GHz NVSS catalogs. Then, we identified their optical counterparts by cross-matching with the Pan-STARRS1 data. Color-color and color-magnitude plots for the selected flat-spectrum radio sources clearly showed two populations, "quasar-like" and "elliptical-galaxy-like" sequences. We emphasize that the latter population emerged for the first time and is missed by previous CRATES catalog because of the higher radio flux threshold. This BROS catalog is useful to search for counterparts of Fermi extragalactic un-ID objects as well as PeV neutrinos detected by IceCube. We also emphasize that this BROS catalog includes nearby ($z \leq 0.3$) BL Lac objects, a fraction of which would be TeV emitters and detectable by future Cherenkov Telescope Array. We will soon make this catalog available once published.</p>
15:45	<p>[129] THE ORIGINS OF THE GAMMA-RAY FLUX VARIATION OF NGC1275 ANALYZED WITH 8-YEAR FERMI-LAT OBSERVATION <i>Presenter: TANADA, Kazuhisa</i></p> <p>We present an analysis of 8 years of Fermi-LAT γ-ray data obtained for NGC 1275. By examining the changes in its flux and spectral shape over the entire dataset, we found that its spectral behavior changed around 2011 February. The γ-ray spectra at the early times evolves largely at high energies, while the photon indices were unchanged in the latter despite rather large flux variations. To explain these observations, we suggest the flux changes in the early times were caused by injection of high-energy electrons into the jet, while later, the γ-ray flares were caused by a changing Doppler factor. To demonstrate the viability of these scenarios, we fit the broad-band spectral energy distribution data with a one-zone synchrotron self-Compton (SSC) model for flaring and quiescent intervals before and after 2011 February. To explain the γ-ray spectral behavior, the maximum electron Lorentz factor would have changed from $\gamma_{\max} = 2.5 \times 10^5$ (quiescence) to $\gamma_{\max} = 3.5 \times 10^5$ (flare) in the early times, while a modest change in the Doppler factor from $\delta = 2.7$ to $\delta = 3.6$ adequately fits the quiescent and flaring state γ-ray spectra in the later times.</p>

Extragalactic diffuse & EBL II - GaPa-1-1 - Olympiasaal (14:00-16:00)

-Conveners: Seth Digel

time [id] title

14:00	<p>[163] Exploring the full information content of the extragalactic gamma-ray sky maps <i>Presenter: CUOCO, Alessandro</i></p> <p>The main tools typically used to investigate the nature of the extragalactic gamma-ray background (EGB) are its energy spectrum and population studies of resolved point sources. However, a larger amount of information is contained in the full gamma-ray maps, and this can be exploited to further push the study of the EGB. This information can be encoded into different observables like the auto-correlation, the pixel statistics and the cross-correlation. In the talk I will review these complementary observables, the current status, measurements, and the constraints on the EGB derived from them, with some emphasis on the cross-correlation with galaxy catalogs.</p>
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14:30	<p>[190] Measuring the Galaxy Luminosity Density out to $z \sim 6$ with Fermi-LAT <i>Presenter: HELGASON, Kari</i></p> <p>The Extragalactic Background Light (EBL) absorbs gamma-rays ($\gamma \rightarrow e^-e^+$) and leaves a characteristic imprint in the spectra of high energy blazars. Utilizing the new Fermi-LAT measurement of the gamma-ray optical depth at $0 < z < 3$, we reconstruct the detailed build-up of the EBL over cosmic time in a model-independent way. We use an MCMC approach to determine the instantaneous luminosity density of galaxy populations from the UV to the near-IR out to $z \sim 6$. This allows us to constrain both the cosmic star formation rate density and the build-up of stellar mass over 90% of cosmic time. We also present limits on the amount light from faint undetected galaxies during the epoch of reionization.</p>
14:45	<p>[157] The Density of Blazars above 100 MeV and the Origin of the Extragalactic Gamma-ray Background <i>Presenter: MARCOTULLI, Lea</i></p> <p>Relying on the first 104 months of Fermi-LAT Pass 8 data, using detailed Monte Carlo simulations, we obtained the most sensitive measurement of the source count distribution of blazars above 100 MeV. The result shows, with high statistical significance, the presence of a break in the distribution at low fluxes. From this, we provide a precise measurement of the contribution of blazars to the extragalactic gamma-ray background (EGB). Furthermore, we confirm that they can not account for the total EGB, therefore, another source class is required to explain the remaining component. In this talk, we will present this new measurement and discuss alternatives for the origin of the missing EGB component.</p>
15:00	<p>[211] Extragalactic Background Light Measurements from a Combined Likelihood Analysis of Blazars Detected with the MAGIC Telescopes <i>Presenter: DOMINGUEZ, Alberto</i></p> <p>Recent results on the Extragalactic Background Light (EBL) intensity obtained from a combined likelihood analysis of blazar spectra detected by the MAGIC telescopes are reported. The EBL is the optical-infrared diffuse background light accumulated during galaxy evolution, directly and/or reprocessed by dust, which provides unique information about the history of galaxy formation. The low energy photons from the EBL may interact with very high energy (VHE, $E > 100$ GeV) photons from blazars. This interaction between the EBL and the gamma-ray photons leaves an energy-dependent imprint of the EBL on the VHE gamma-ray spectra of the blazars. Therefore, the study of their spectra can be used to constrain the EBL density at different wavelengths and its evolution in time. In the last few years the MAGIC telescopes obtained accurate measurements of the spectra of 12 blazars in the redshift range from $z=0.03$ to $z=0.944$ for over 300 hours of observation. This allows us to extend the redshift coverage and improve upon previous constraints on EBL, which turn out to be compatible with state-of-the-art models. We conclude that these new measurements are limited by systematic uncertainties.</p>
15:15	<p>[213] Study of the anisotropy of the unresolved gamma-ray background <i>Presenter: NEGRO, Michela</i></p> <p>The Extragalactic gamma-ray Emission (EGB) is constituted by two essential parts: resolved gamma-ray sources, point-like or extended, and an isotropic component. Once the formers have been excluded (masked or subtracted), what remains is the latter component, called Unresolved Gamma-Ray Background (UGRB), which, at a deeper level, is not truly isotropic and includes contribution from unresolved populations of sources. Expanding the UGRB sky map into spherical harmonics gives a powerful mean to study the intensity fluctuations even at the smallest scales, which can give clues about what this component is made of.</p> <p>In this analysis we study the UGRB anisotropy signal with 8 years of Fermi-LAT Pass 8 data. An energy-dependent mask has been built to cover each resolved source in addition to a region around the Galactic plane. Preliminary results are compatible with at least two classes of point-like sources contributing the UGRB emission.</p>
15:30	<p>[161] Updated Fermi-LAT Constraints on the Extragalactic Background Light <i>Presenter: ARMSTRONG, Thomas</i></p> <p>The extragalactic background light (EBL) is a fundamental cosmological observable of our universe, allowing insight into the history of star formation within our universe. Extending between 0.1 - 1000 μm, it is the UV to near-IR that is of interest in high and very high energy astronomy, where EBL photons interact via pair production to leave a visible imprint in the spectra of distant AGN. Multiple studies have been carried out using ground-based Cherenkov telescopes, which can observe the spectra of relatively nearby AGN to provide limits on the density of the EBL. These however do not reveal a great amount of detail concerning the evolution of the EBL with time, and therefore the star formation rate. The Fermi-LAT instrument, with its long exposure of the extragalactic sky, holds an extensive sample of AGN extending out to large redshifts ($z < 2.56$) and has been used by the Fermi-LAT collaboration to study the EBL. Here we further that study by combining a sample of 259 AGN, carefully modelling their spectral energy distributions and determine a redshift-dependent EBL correction factors to a range of models, taking into account the temporal and spectral variability of sources.</p>

15:45	<p>[94] Deriving the contribution of point sources to the Extragalactic gamma-ray background with efficiency corrections and photon statistics</p> <p><i>Presenter: DI MAURO, MATTIA</i></p> <p>The Fermi-LAT has confirmed and measured with unprecedented precision the extragalactic gamma-ray background (EGB), which is the sum of the flux of cataloged sources and the Isotropic diffuse gamma-ray background (IGRB). The IGRB is a highly-isotropic component on angular scales larger than 1 degree and whose composition is thought to be dominated by unresolved sources, i.e., sources that are not individually detected by the LAT.</p> <p>We investigate the origin of the EGB using for the first time two complementary techniques: 1) a source-detection efficiency correction method and 2) an analysis of pixel photon count statistics with the 1-point probability distribution function (1pPDF). With the first method, using realistic Monte Carlo simulations of the gamma-ray sky, we calculate the efficiency of the LAT to detect point sources and this enables us to find the intrinsic source count distribution at photon fluxes. The source count distribution derived with this method is then compared to the one found with the 1pPDF method. The results obtained with these two methods are independent from extrapolation of fluxes below the sensitivity of the LAT and provide a precise estimation of the contribution of blazars to the Fermi EGB.</p>
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Coffee Break (16:00-16:30)

Analysis techniques II: Catalogs - GaPa-1-1 - Olympiasaal (16:30-18:00)

-Conveners: David Paneque

time [id] title

16:30	<p>[53] Improving the Fermi LAT source catalog and interstellar emission model</p> <p><i>Presenter: BALLEST, Jean</i></p> <p>The current Fermi-LAT source catalog (3FGL: 3033 sources above 100 MeV) and interstellar emission model were based on four years of Pass 7 data. The more recent 3FHL catalog was restricted to energies larger than 10 GeV. The next full LAT source catalog (4FGL) will be based on 8 years of Pass 8 data. With this much larger statistics, below a few GeV the source detection and characterization is increasingly limited by imperfect knowledge of the interstellar emission, which dominates the gamma-ray sky. This effect is particularly strong near the Galactic plane, but is important up to a few 100 MeV over the entire sky.</p> <p>On one side, we are working to improve the interstellar emission model. Besides the more precise LAT data, this benefits from external input, particularly recent all-sky HI surveys and the Planck dust map. On the other side, we are down-weighting pixels with many counts in the maximum likelihood fitting in order to account (approximately) for systematics in the source detection statistic and in the parameter uncertainties. I will describe those efforts and present an early version of the 4FGL catalog. More specialized catalogs (AGN, pulsars) will follow.</p>
17:00	<p>[67] The second catalog of flaring gamma-ray sources (2FAV): observing astrophysical accelerators in real time</p> <p><i>Presenter: BUEHLER, Rolf</i></p> <p>Particle acceleration to relativistic energies is common in the Universe. A wealth of astrophysical accelerators have been identified over the past decades using gamma-ray observations. Particularly interesting are time variable sources, where the acceleration and radiation processes can be observed over time. Recently, the LAT collaboration has published a second catalog of flaring gamma-ray sources (2FAV). The catalog is based on 7.4 years of observations, during which 518 flaring sources were detected on weekly time scales. Out of these, 77 had not been seen in gamma-rays before. In addition, the catalog pipeline is used to analyse LAT data in real time. The results are made public on an interactive web page. In this presentation, I will review the different classes of variable gamma-ray sources based on the 2FAV and give an outlook on future developments.</p>
17:15	<p>[124] Effects of Biases of the Interstellar Emission Models on Point Source Finding and Characterization with the Fermi-LAT</p> <p><i>Presenter: CHARLES, Eric</i></p> <p>In this contribution we present studies to quantify the effects of possible biases in diffuse emission models for LAT data on point-source finding and spectral parameter extraction. In particular, 1) we examine differences in source lists obtained in a 40 degree by 40 degree region around the Galactic center (GC region) using different interstellar emission models (IEMs), 2) examine the goodness-of-fit of models of the GC region that include the IEMs as well as discrete sources, 3) use a likelihood weighting scheme to include systematic uncertainties of the IEMs in the point-source fitting. We find that almost all of the differences away from the Galactic plane ($b > 5$ degrees) are attributable to the effect of the source-detection threshold in combination with small differences in the IEMs. On the other hand, along the Galactic plane, we find that biases in the IEMs can result in clusters of spurious sources in regions where the IEMs significantly under-predict the data as well as in groups of missed sources in regions where the IEMs over-predict the data. However, we find that these effects are well mitigated by the likelihood weighting scheme.</p>

17:30	<p>[88] The First Catalog of Low Energy Fermi-LAT sources <i>Presenter: PRINCIPE, Giacomo</i></p> <p>Previous analyses of point sources in the gamma-ray range were done only below 30 MeV (COMPTEL) or above 100 MeV (*Fermi*-Large Area Telescope, EGRET). Below 30 MeV, the imaging Compton telescope (COMPTEL) onboard NASA's Compton Gamma-Ray Observatory detected 26 steady sources in the energy range from 0.70 to 30 MeV. At high energy, the LAT, on board the *Fermi* satellite, detects more than three thousands sources between 100 MeV and 300 GeV (3FGL). Since the *Fermi*-LAT detects gamma rays down to 20 MeV, we create a list of sources detected in the energy range between 30 MeV and 100 MeV, using PGWave, a background independent tool that makes use of a wavelet-based method. This closes a gap of point source analysis between the COMPTEL catalog and the *Fermi*-LAT and EGRET catalogs. We present the *Fermi*-LAT low energy catalog (1FLE) of sources detected in the 30 MeV - 100 MeV range, based on 8 years and 9 months of *Fermi*-LAT data.</p>
17:45	<p>[68] Calorimeter-less gamma-ray telescopes: Optimal measurement of charged particle momentum from multiple scattering by Bayesian analysis of filtering innovations. <i>Presenter: BERNARD, Denis</i></p> <p>Novel gamma-ray telescope schemes are under development so as to bridge the 0.1-100 MeV sensitivity gap of gamma-ray astronomy (Compton, pair creation), (silicon wafer stacks, emulsions, gas detectors). The lower average density with respect, e.g. to the tungsten/silicon active target of the Fermi-LAT makes square-meter effective area telescopes voluminous objects, for which the photon energy measurement by conventional means (calorimeter, magnetic spectrometer, transition radiation detector) is a challenge for the mass budget.</p> <p>We present an optimal measurement of track momentum by the multiple measurement of the angular deflections induced by multiple scattering in the active target itself, using a Bayesian analysis of the filtering innovations of a series of Kalman filters applied to the track.</p> <p>For a Silicon-wafer-stack telescope, the method yields meaningful results up to a couple of GeV/c. (Eq. (58) and Fig. 10 of Nuclear Inst. and Methods in Physics Research, A 867 (2017) 182, arXiv:1706.05863)</p>

Dark Matter - GaPa-2-1 - Konzertsaal (16:30-18:00)

-Conveners: Alessandro Cuoco

time [id] title

16:30	<p>[191] Indirect Axion and Axionlike Particle Searches at Gamma-Ray Energies <i>Presenter: MEYER, Manuel</i></p> <p>Axions and axionlike particles (ALPs) are dark-matter candidates that occur in a variety of extensions of the Standard Model. They couple to photons in the presence of electromagnetic fields, making them potentially detectable. Due to the ubiquitous presence of magnetic fields in the Universe, astrophysical sources are particularly well suited to search for traces of these particles.</p> <p>I will give an overview over axion and ALP searches at gamma-ray energies. In particular, I will present constraints on the photon-ALP coupling derived from Fermi Large Area Telescope observations of the NGC 1275, the central galaxy of the Perseus cluster. The bounds are the strongest to date in the ALP mass range between 0.5 and 20 neV and surpass the sensitivity of future dedicated laboratory experiments. Further, I will give an outlook on future ALP searches using core-collapse supernovae and future gamma-ray instruments such as the Cherenkov Telescope Array and satellite missions.</p>
17:00	<p>[144] Dark matter theory: implications and future prospects for Fermi <i>Presenter: SCOTT, Pat</i></p> <p>I will review the implications of Fermi data for theories of the identity of dark matter, and their combination with data from other complementary probes. I will also preview some of the prospects for probing such models with future data.</p>

17:30 [92] Probing the nature of dark matter with gamma rays: what we learned from the LAT and prospects for the CTA

Presenter: ZAHARIJAS, Gabrijela

High-energy gamma rays are one of the most promising tools to constrain or reveal the nature of dark matter, in particular the Weakly Interacting Massive Particles (WIMP) models. The Cherenkov Telescope Array (CTA) is well into its pre-construction phase and will soon probe the high energy gamma ray sky in the ~ 50 GeV - 100 TeV energy range, probing a parameter space of heavier dark matter (above ~ 100 GeV), with unprecedented sensitivity.

One of the main targets for searches for signals of dark matter annihilation or decay is the centre of our Galaxy. Due to the its lower energy threshold and significantly larger effective area when compared to the current generation of ground based Cherenkov telescopes, the CTA is expected to be sensitive to diffuse astrophysical emission also present in that region. In this talk we report the status of the collaboration effort to, based on the astrophysical emission observed with the LAT at lower energies, study the impact of extended astrophysical emission backgrounds on dark matter search and to suggest the promising data analysis and observational strategies for the upcoming CTA data.

17:45 [138] Limits on Dark Matter annihilation signal from dwarf galaxies with prior-free astrophysical factors

Presenter: CHIAPPO, Andrea

Dwarf spheroidal galaxies (dSphs) are considered promising targets for indirect Dark Matter (DM) identification. The (mostly frequentist) analyses of gamma-ray photons originating from dSphs have allowed to set stringent limits on the DM self-annihilation cross-section. Conventional search strategies rely on quantifying the abundance of DM, by calculating the so-called *J-factor*. This quantity can be estimated from the kinematic properties of the stellar population of dSphs by means of Bayesian methods, which introduce significant systematic uncertainties due to the inevitable influence of priors. Here we describe a fully frequentist method for deriving J-factors and their uncertainties, which improves upon previous studies by making the statistical treatment of J more consistent with most gamma-ray analyses. Validation is performed using the simulation suite released by *Gaia Challenge*, showing that the method possesses good statistical properties. We apply the technique on a kinematic sample from 20 dSphs. We also implement our likelihoods of J to derive new upper limits on the DM annihilation cross-section. The new limits and the implications of these findings for DM searches are discussed.

Friday 20 October 2017

Neutrino-Gamma connection & The Sun (08:30-10:30)

-Conveners: Elena Orlando

time [id] title

08:30	[207] Fermi Large Area Telescope observations of the Sun: The first ten years <i>Presenter: PESCE-ROLLINS, Melissa</i> The Fermi Large Area Telescope (LAT) observations of the active Sun provide the largest sample of detected solar flares with emission greater than 30 MeV to date. These include detections of impulsive and sustained emission, extending up to ~20 hours in the case of the 2012 March 7 X-class flares. Of particular interest is the first detection of >100 MeV gamma-ray emission from three solar flares whose positions behind the limb were confirmed by the STEREO spacecrafts. The LAT data provides a new observational channel that, when combined with observations from across the electromagnetic spectrum, provide a unique opportunity to diagnose the mechanisms of high-energy emission and particle acceleration in solar flares. We will present an overview of these observations including the emission of the Sun in its quiescent state and discuss how these observations provide constraints on different emission mechanisms.
09:00	[29] Search for GeV neutrinos associated with solar flares with IceCube <i>Presenter: DE WASSEIGE, Gwenhaël</i> Solar flare neutrinos from the decay of mesons produced in collisions of accelerated ions from the solar atmosphere are expected with energies of O(MeV-GeV). The study of such neutrinos, combined with existing gamma-ray observations by Fermi-LAT, would provide a novel window to the underlying physics of the acceleration process. The IceCube Neutrino Observatory may be sensitive to solar flare neutrinos and therefore provides a possibility to measure the signal or establish more stringent upper limits on the solar flare neutrino flux. Results from a new approach to search dedicated to low energy neutrinos coming from transient events will be presented. It combines a time profile analysis and an optimized selection of solar flare events based on Fermi-LAT observations, significantly lowering the energy threshold of IceCube, which was initially designed to detect neutrinos with energies above O(100 GeV) and above.
09:15	[81] Origin of cosmic neutrinos in the Fermi context <i>Presenter: WINTER, Walter</i> I discuss the results of IceCube's astrophysical neutrino observations in the context of Fermi data. Examples are constraints on the contribution to the observed diffuse neutrino flux from AGNs and GRBs from stacking analyses using catalogues, and generic conclusions about the neutrino production mechanism from Fermi's extragalactic diffuse flux measurements. I will also point out theoretical implications and future prospects.
09:45	[17] A minimal model for extragalactic cosmic rays and neutrinos <i>Presenter: KACHELRIESS, Michael</i> I discuss attempts to explain in a unified way the experimental data on ultrahigh energy neutrinos and cosmic rays, using a single source class and obeying data on cosmic ray composition and limits on the extragalactic diffuse gamma-ray background.
10:00	[31] Gamma-ray Limits on Neutrino Lines from Dark Matter Annihilation <i>Presenter: QUEIROZ, Farinaldo</i> Monochromatic neutrinos from dark matter annihilations are always produced in association with a gamma-ray spectrum generated by electroweak bremsstrahlung. Consequently, these neutrino lines can be searched for not only with neutrino detectors but also indirectly with gamma-ray telescopes. Here, we derive limits on the dark matter annihilation cross section into neutrinos based on recent Fermi-LAT and HESS data. We find that, for dark matter masses above 200 GeV, gamma-ray data actually set the most stringent constraints on neutrino lines from dark matter annihilation and, therefore, an upper bound on the dark matter total annihilation cross section. In addition, we point out that gamma-ray telescopes, unlike neutrino detectors, have the potential to distinguish the flavor of the final state neutrino. Our results indicate that we have already entered into a new era where gamma-ray telescopes are more sensitive than neutrino detectors to neutrino lines from dark matter annihilation.

10:15	<p>[102] On the Detection Potential of Short Blazar Flares for Current Neutrino Telescopes <i>Presenter: Mr. KRETER, Michael</i></p> <p>High-confidence associations of individual neutrinos with individual blazars could be achieved via spatially and temporally coincident detections of photons and high-energy neutrinos (>100 TeV) from short blazar flares. It has been suggested that the current IceCube neutrino detector is sufficiently sensitive to detect neutrinos from such short flares.</p> <p>We want to test this prediction by calculating the expected number of neutrinos produced in the IceCube detector for the 50 brightest short blazar flares in the sky.</p> <p>The two blazars 3C 279 and PKS 1510–089 alone account for the 27 highest-ranked flares, while the 50 best-ranked flares are produced by a group of only seven different sources.</p> <p>We find that the fluence of most individual blazar flares is far too small to yield a substantial Poisson probability for the detection of one or more neutrinos with IceCube.</p> <p>The integrated fluence of the 50 highest-ranked flares yields only about 50 % of Poisson probability for the detection of a single high-energy neutrino. For the most spectacular short blazar flares, however, Poisson probabilities of up to ~ 2 % are calculated, so that the possibility of associated neutrino detections in future data unblindings of IceCube and KM3NeT seems reasonable.</p>
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Break (10:30-11:00)

Future gamma-ray satellite missions (11:00-12:15)

-Conveners: Marco Ajello

time [id] title

11:00	<p>[185] The Path from COSI to COSI-X <i>Presenter: ZOGLAUER, Andreas</i></p> <p>COSI, the Compton Spectrometer and Imager, is a balloon-borne gamma-ray telescope (0.2-5 MeV) utilizing high-purity Germanium double-sided strip detectors. In spring 2016, COSI had a very successful 46-day balloon flight from Wanaka, New Zealand, utilizing NASA's new super-pressure balloon platform, taking COSI 1.5 times around the world. During the flight, COSI observed gamma-ray bursts, compact objects, the Galactic 511-keV annihilation emission, Galactic nucleosynthesis, and relativistic electron precipitation events.</p> <p>In summer 2017, an upgraded version of COSI called COSI-X was selected for a Phase A study as a mission of opportunity under NASA's Explorer program. COSI-X will feature more detectors with higher position resolution, an updated read-out system, and an improved anti-coincidence system, which will all together lead to significantly improved angular resolution, more resolved Compton events, higher effective area, better background rejection, and an overall higher instrument sensitivity. The first of three proposed balloon flights is planned for 2021-2023.</p> <p>In the presentation, we will show the latest analysis results from COSI and detail the path forward from COSI to COSI-X.</p>
11:15	<p>[71] Polarimetry and high angular resolution gamma-ray observations in the MeV regime using a novel detector concept <i>Presenter: HORAN, Deirdre</i></p> <p>We have demonstrated, for the first time, that the polarisation of gamma rays in the 1-75 MeV regime can be measured using a novel detection technique, namely tracking the gamma-ray conversion pairs using a gaseous TPC. HARPO (the hermetic argon polarimeter) is, to date, the only instrument to have successfully carried out this measurement. Having demonstrated that a TPC can be used to detect and measure the polarisation of MeV gamma rays, we have begun a new, larger study with the goal of flying a TPC on a balloon to validate its performance in a background-dominated environment. We will describe the mission concept for this gamma-ray polarimeter and also the science that can be addressed both with this demonstrator and with an ultimate, satellite-based instrument.</p>
11:30	<p>[237] All-Sky Medium Energy Gamma-ray Observatory (AMEGO) - A discovery mission for the MeV gamma-ray band <i>Presenter: PERKINS, Jeremy</i></p> <p>The MeV domain is one of the most underexplored windows on the Universe. From astrophysical jets and extreme physics of compact objects to a large population of unidentified objects, fundamental astrophysics questions can be addressed by a mission that opens a window into the MeV range. AMEGO is a wide-field gamma-ray telescope with sensitivity from ~200 keV to >10 GeV. AMEGO provides three new capabilities in MeV astrophysics: sensitive continuum spectral studies, polarization measurements, and nuclear line spectroscopy. AMEGO will consist of four hardware subsystems: a double-sided silicon strip tracker with analog readout, a segmented CZT calorimeter, a segmented CsI calorimeter and a plastic scintillator anticoincidence detector, and will operate primarily in an all-sky survey mode. In this presentation we will describe the AMEGO mission concept and scientific performance.</p>

11:45	<p>[155] Viability of a nano-satellite Compton space telescope <i>Presenter: BERLATO, Francesco</i></p> <p>Since the end of the COMPTEL mission, almost 20 years ago, there haven't been any new space telescopes able to improve the observations in the electromagnetic energy region above 1 MeV. This energy band, where Compton scattering is the dominating interaction with matter, is of fundamental importance for the understanding of the emission mechanisms in several astrophysical source types.</p> <p>Through GEANT 4 simulations, we explore the viability of future observations by means of a nano-satellite Compton telescope. In particular, we aim to achieve COMPTEL's sensitivity level near 1 MeV.</p> <p>Low costs and ability to be relatively quickly developed and launched would allow a short-term solution for the lack of new observations in the MeV region, before any large mission takes over.</p>
12:00	<p>[167] Monitoring of gamma-ray burst with a fleet of nanosatellites <i>Presenter: OHNO, Masanori</i></p> <p>With gamma-ray burst (GRB) observations by Swift, Fermi, and HETE-2 and their follow-up observations at other wavelengths, we have made substantial progress in the understanding of their progenitors, physical properties of ultra-relativistic jets, and the emission mechanisms. However, our understanding short GRBs in particular, remains incomplete. New observational probes such as detections of gravitational wave counterparts will provide important new constraints.</p> <p>We will present the current status of a feasibility study for a fleet of nano-satellites to perform an all sky monitoring and timing based localisation of GRBs. The fleet of about dozen satellites of the CubeSat standard, equipped with scintillator based soft gamma-ray detectors and GPS receivers for time synchronisation, will measure the time difference between the arrival of the gamma-ray signal at the different satellites. Based on the precise timing and the in-orbit positions of the satellites, the location of the source in the sky will be determined by triangulation. The satellites will downlink data about the detected GRBs within minutes, enabling rapid follow-up observations at other wavelengths and providing an opportunity to detect the electromagnetic counterparts of gravitational waves (GW).</p>

Concluding Remarks (12:15-12:30)

-Conveners: Julie McEnery

time [jd] title

12:15	<p>[257] Concluding Remarks <i>Presenter: MCENERY, Julie</i></p>
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Pulsars / 158

Blind Search Methods for Binary Gamma-ray Pulsars

Author(s): Lars Nieder^{None}Co-author(s): Colin Clark¹¹ *Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Hannover*

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Gamma-ray observations by the *Fermi* Large Area Telescope have been used very successfully in the last 9 years to detect more than 200 gamma-ray pulsars. 60 of these have been found by directly searching for pulsations in the gamma-ray data, but only one binary MSP has been found this way. Pulsars in binaries are often difficult to detect in radio data because of large eclipses, and some binary MSPs may even be radio quiet. For those, a gamma-ray blind search might be the only possibility for detection. While searches for isolated pulsars up to kilohertz frequencies are already computationally very challenging, blind searches for binary gamma-ray pulsars are simply infeasible without further knowledge of their orbital parameters. I will present methods with which we can conduct searches for candidate binary gamma-ray pulsars for which orbital constraints are known from optical observations of a likely companion star. I will also highlight some example sources where these methods have been used. Additionally, some redback MSPs can be more easily timed in gamma rays than with radio observations; I will also explain how these new methods can be used to do so.

Pulsars / 65

Differences between radio-loud and radio-quiet gamma-ray pulsars as revealed by Fermi

Author(s): Chung Yue Hui¹Co-author(s): Jumpei Takata²¹ *Chungnam National University*² *Huazhong University of Science and Technology*

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We have performed a statistical analysis to compare the populations of radio-quiet gamma-ray pulsars and non-recycled radio-loud gamma-ray pulsars. We found a number of physical properties of these two populations are different such as the magnetic field at the light cylinder, the gamma-ray to x-ray flux ratio, and their gamma-ray spectral curvature. Such differences can shed light on the acceleration mechanism in the pulsar magnetosphere.

Pulsars / 64

Mode Change of the gamma-ray pulsar, PSR J2021+4026

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Pulsars are very rapidly spinning and highly-magnetized neutron stars. The glitch of pulsar refer to the changes in the spin frequency and spin down rate. It can be caused by a sudden release of the stress built up in the solid crust of the star or pinned vortices in the superfluid interior. In our study, we analyse the ~ eight years Fermi data of PSR J2021+4026, one famous glitching pulsar. PSR J2021+4026 is the first variable gamma-ray pulsar observed by Fermi and the first pulsar that shows a significant change in the gamma-ray flux and pulse profile at the glitch (October 16 2011). After three years for a high spin-down rate and a low gamma-ray state, we find that the spin-down rate and gamma-ray flux gradually returned to pre-glitch values and phase-resolved spectra and the pulse profiles after the relaxation are also consistent with those before the glitch. The result indicate that the glitch triggered a mode change in the global magnetosphere. PSR J2021+4026 serve as an example to show the process of the mode change.

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Multiwavelength modeling of the Vela pulsar pulses - from Optical light to VHE gamma-rays

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The pulsed radiation from PSR B0833-45 (Vela) has a phased-averaged spectral energy distribution of an apparently simple structure across a wide energy range. However, in narrow energy bands the pulses reveal astonishing complexity of the directional pattern of the radiation. We present the results of a 3D modeling of the Vela radiation properties in the outer-gap scenario. We show how the synchrotron emission as well as the inverse Compton scattering (ICS) of soft photons by secondary e^\pm -pairs in its magnetic and non-magnetic regimes reproduces qualitatively, and in some cases quantitatively, the observed energy-dependent pulses of Vela. Moreover, we present how ICS of soft synchrotron photons by primary particles can form a pulsed spectral component in the VHE domain. The flux of this component should be of interest to the Cherenkov Telescope Array.

Active Galactic Nuclei / 61

Blazar Variability from Plasmoids in Relativistic ReconnectionIan Christie¹¹ *Purdue University***Corresponding Author(s):** ichristi@purdue.edu

The gamma-ray, short timescale variability in blazars (\sim minutes to hours), which has been recently detected in GeV gamma-rays by Fermi-LAT, challenges existing blazar emission models. An excellent candidate for describing such events is the relativistic magnetic reconnection model, in which energy is transferred to compact regions, denoted as plasmoids, characterized by high Doppler-boosting and fast motions within the blazar jet. Recent 2D particle-in-cell (PIC) simulations have been able to fully capture the evolution and dynamics of these plasmoids that contain high-energy particles and magnetic fields in rough energy equipartition. By coupling PIC results with our radiative transfer model, we may track the temporal evolution of both the electron and photon distributions within each plasmoid, while taking into account the variable Doppler boosting due to the accelerated motion of the plasmoids. Here, I will present the cumulative light curves from a chain of plasmoids formed in the reconnection layer of a blazar jet. I will also present the resulting power-spectral densities and discuss their dependence upon various model parameters and plasmoid sizes while making a direct comparison to blazar observations.

Active Galactic Nuclei / 228

Blazar light curve periodicity debate: the radio-band, optical and X-ray variability of OJ 287Stefano Ciprini¹¹ *ASI Space Science Data Center, Rome, Italy & INFN***Corresponding Author(s):** stefano.ciprini.asdc@gmail.com

The proper understanding of blazar and other AGN flux variability at the various energy bands is one of the most important goals of multifrequency astrophysics. In this frame a peculiar and controversial phenomenology is the periodicity, claimed mostly in radio or optical flux light curves of a restricted group of blazars. Significance estimates are uncertain and the evidence for temporal periodic trends in galaxy-sized systems like blazars is much weaker than it is for X-ray binary star-size systems and microquasars within our Galaxy. Long-term multi-year light curves usually suffer from irregular sampling and large, seasonal, data gaps, affecting the results of time series analysis. A representative case study with multifrequency radio-optical-X-ray data is presented, namely the BL Lac object OJ 287. The ubiquitous role in astrophysical and earth science data of the so called red-noise in time-series data sets is also highlighted.

Active Galactic Nuclei / 125

Disk-Jet Connection in Active Supermassive Black Holes in the Standard Accretion Disk Regime**Author(s):** Yoshiyuki Inoue¹**Co-author(s):** Yasuyuki Tanaka²¹ *ISAS/JAXA*² *Hiroshima***Corresponding Author(s):** yinoue@astro.isas.jaxa.jp

Previous gamma-ray blazar studies revealed that the jet production efficiency is about 1. Here, we studied the disk-jet connection in active supermassive black holes by investigating the properties of optical and radio emissions of radio-loud quasars. We found that the jet powers correlate with the bolometric disk luminosities as $\log P_{jet} = 0.96 \log L_{disk} + 0.79$. This suggests the jet production efficiency of about 0.011, implying low black hole spin parameters and/or low magnetic flux for radio-loud quasars. This result contradicts previous jet power studies based on gamma-ray blazars. We

will discuss the cause of this discrepancy and discuss possible uncertainties in jet power evaluation. This work is published as Inoue et al. 2017, ApJ, 840, 12.

Active Galactic Nuclei / 51

MHD Accretion Disk Winds and the Fermi Blazar Phenomenology

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We show that MHD accretion disk winds, launched across the entire disk extent, invoked as the tori of AGN unification, are instrumental in determining the blazar SEDs. In fact they can account for the correlation between the Fermi γ -ray slope and the frequency of the Synchrotron peak emission, ν_{pk}^S , the unique blazar correlation obtained by Fermi (or between ν_{pk}^S and the blazar Compton dominance). This they achieve with a single free parameter, \dot{m} , the wind mass flux normalized to that of Eddington ($\dot{m} = \dot{M}/\dot{M}_{Edd}$). FSRQs are blazars with $\dot{m} > 1/\Gamma^2$, while BL Lacs are those with $\dot{m} < 1/\Gamma^2$ (Γ is the blazar jet Lorentz factor). Assuming line emission from recombination of the wind plasma, one can then relate also the blazar γ -ray properties to their line emission, as is customary. With this model, the Fermi blazar phenomenology is condensed mainly to a single global accretion flow parameter, indicating the possibility of a deeper understanding of their underlying physics.

Active Galactic Nuclei / 188

Modeling Multiwavelength Blazar Spectra using a Particle Transport Equation

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Blazars are luminous extragalactic sources across the entire electromagnetic spectrum, but the spectral formation mechanisms in these sources are not well understood. We have developed a new theoretical model for simulating blazar spectra in which we numerically integrate the electron transport equation to generate the electron number distribution with respect to energy. Our transport model considers shock acceleration, adiabatic expansion, stochastic acceleration due to MHD waves, Bohm diffusive particle escape, synchrotron radiation, and Compton radiation. We implement the full Compton cross-section for electron interactions with photons from dust and 26 lines from the broad line region, each considered individually, without additional free parameters. We use the solution for the electron distribution to calculate multi-wavelength SED spectra for 3C 279. This new, self-consistent model provides an unprecedented view into the jet physics at play in this source, especially the relative strength of the shock and stochastic acceleration components and location of the emitting region. We show that our new Compton + synchrotron blazar model is the first to successfully fit the Fermi-LAT gamma-ray data for this source based on a self-consistent, first-principles physical calculation.

Active Galactic Nuclei / 160

Multi-wavelength observations of flaring blazars with ATOM and Fermi-LAT

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The Automatic Telescope for Optical Monitoring is a 75cm optical telescope located at the H.E.S.S. site in Namibia. Since 2005, it monitors around 250 gamma-ray emitting AGN and has observed numerous blazar flares in several colour bands with multiple measurements during any given night. We will present recent flaring events together with corresponding multi-wavelength data including Fermi-LAT, and examine possible correlations between energy bands.

Active Galactic Nuclei / 218

On the Underlying Particles in the Jet of 3C 279

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Recent high-energy missions have allowed keeping watch over blazars in flaring states, which provide deep insights into the engine powered by supermassive black holes. However, having a quasar caught in a very bright flaring state is not easy requiring long surveys. Therefore, the observation of such flaring events represents a goldmine for theoretical studies. Such a flaring event was captured by the INTEGRAL mission in June 2015 while performing its today's deepest extragalactic survey when it caught the prominent blazar 3C 279 in its brightest flare ever recorded at gamma rays. The flare was simultaneously recorded by the Fermi-LAT mission, by the Swift mission, by the INTEGRAL mission and by observations ranging from UV, through optical to the near-IR bands. The derived snapshot of this broad spectral energy distribution of the flare has been modeled in the context of a one-zone radiation transfer leptonic and lepto-hadronic models constraining the single emission components. We discuss results and challenges faced by trying to reconcile these observations and theory. Also we show how the recently published VHE data from H.E.S.S. of the same flare tie in with our lepto-hadronic model.

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Optical Study of Bright FERMI/LAT Blazars

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From 1997 we are monitoring of about 70 blazars in BVRI bands using ST6 and Apogee cameras attached to 70-cm meniscus telescope of Abastumani Observatory. During nearly twenty years over 300000 images have been obtained as a result over 3000 nights observations. Most dense coverage of selected FERMI/LAT brightest sources have been undertaken after launch of FERMI satellite in 2008. We present optical light curves of these most well sampled sources.

Active Galactic Nuclei / 7

Optical polarization as a method for the association of unidentified gamma-ray blazars

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Active galactic nuclei (AGN) are one of the largest class of gamma-ray sources with blazars accounting for the vast majority of the AGN associations. Despite the advancements in angular resolution and localization Fermi has offered, roughly half of the detected sources are still unassociated with a lower-energy counterpart. We propose a new method for the association of gamma-ray loud blazars by using as a discriminant their optically polarized emission. We introduce a blazar ranking parameter in order to distinguish between suitable candidates and theoretically benchmark our method. We found that for high galactic latitudes the vast majority of blazars will have higher polarization

than the background interstellar polarization at the 5σ level. We apply our method to observations taken with the RoboPol polarimeter at the Skinakas Observatory.

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Optical polarization rotation in Fermi blazars: results from RoboPol

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Since 2013 the RoboPol collaboration has been monitoring optical (R-band) polarization in a sample of Fermi-detected blazars, using the RoboPol polarimeter on the 1.3m telescope at Skinakas Observatory, Greece. A number of events have been detected in which the optical polarization angle (EVPA) rotates continuously, sometimes through hundreds of degrees, and some of these events are associated with gamma-ray flares. Although several models have been proposed, the physical processes behind the EVPA rotations and their connection with the gamma-ray emission remain unclear. We have now accumulated enough data to analyse a statistically complete sample of 65 blazars in which we have detected more than 40 EVPA rotations. While some of the rotations could be the result of a stochastic process (random walk), we find that many rotations are physically linked with gamma-ray flares, with an average time delay consistent with zero. The amplitudes of the rotations are anticorrelated with the amplitudes of the gamma-ray flares. Presented on behalf of the RoboPol collaboration.

Active Galactic Nuclei / 141

Secondary particle yields from photomeson production in BLR radiation fields of blazars

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Gamma-ray and neutrino production in hadronic models of blazars is most commonly initiated by photomeson production of a relativistic hadron component moving as a spatially localized region (emission region; ‘blob’) with relativistic speed along the blazar’s jet axis and interacting with photons of a low energy radiation field in its vicinity. Target photon fields externally to the emission region, such as the radiation from the broad-line region (BLR) or the omnipresent CMB, appear as beamed anisotropic radiation fields in the co-moving frame of the blob.

In this work we use the gyro-phase averaged interaction rate for hadronic proton-photon interactions in such anisotropic target radiation fields and modify the SOPHIA code to calculate the corresponding yields of all secondaries. In particular we present predictions for the neutrino yields from photomeson production in the BLR line radiation field of blazars taking into account its anisotropy in the blob frame.

Active Galactic Nuclei / 154

The Fermi LAT Very Important Project (VIP) List for Active Galactic Nuclei

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Based on nine years of Fermi LAT observations, we have identified 30 projects for Active Galactic Nuclei (AGN) that appear to provide strong prospects for significant scientific advances. This Very

Important Project (VIP) AGN list includes those AGNs that have good multiwavelength coverage, are regularly detected by the Fermi LAT, and offer scientifically interesting timing or spectral properties. Each project has one or more LAT scientists identified who are actively monitoring the source. They will be regularly updating the LAT results for these VIP AGNs, working together with multi-wavelength observers and theorists to maximize the scientific return during the coming years of the Fermi mission.

Active Galactic Nuclei / 105

The X/ γ -ray correlation in NGC 4945 and the nature of its γ -ray source

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We report hints for the correlation between the X-ray and γ -ray emission in the nearby galaxy NGC 4945, which harbors both an active galactic nucleus and a nuclear starburst region. We have divided Fermi/LAT observations of NGC 4945 into two datasets, comprising events detected during the low (L) and high (H) level of X-ray emission from the active nucleus of this galaxy, determined using the Swift/BAT light curve. Both datasets contain an equal amount of 3.8 years of LAT data and NGC 4945 is detected with a similar statistical significance of $\sim 15\sigma$ in L and 14σ in H. However, the slope of the γ -ray spectrum hardens with increase of the X-ray flux, with the photon index $\Gamma = 2.47 \pm 0.07$ in L and 2.11 ± 0.08 in H. The change is confirmed by systematic variation of the spectral energy distribution as well as a substantial reversal of the γ -ray signal in significance maps for low and high γ -ray energies. The X/ γ -ray correlation indicates that the γ -ray production is dominated by the active nucleus rather than by cosmic rays interacting with the interstellar medium.

Active Galactic Nuclei / 146

Tracing the fundamental jet properties in the gamma-ray active blazar 2013+370

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The compact radio source 2013+370 is a not yet well-studied blazar which is located close to the galactic plane ($b = 1.2^\circ$) at a redshift of $z = 0.859$. We performed Very Long Baseline Interferometry (VLBI) monitoring observations at 15, 43, 86 GHz, which reveal the source kinematics on sub-parsec scales. The VLBI data are then combined with flux density variability measurements using the Sub-millimeter Array (SMA) and the Fermi Large Area Telescope (Fermi-LAT) during the period 2003-2017. We search for possible correlations between the jet kinematics and the gamma-ray activity using a cross-correlation analysis. Here we present and discuss our findings.

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X-ray and GeV gamma-ray variability of the radio galaxy NGC 1275

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In this paper, we will present the analysis of Suzaku/XIS, Swift/XRT, and Fermi-LAT data. We analyzed Suzaku/XIS data (taken from the year 2006 to 2015) and Fermi-LAT data (taken from the year

2008 to 2015) of the gamma-ray emitting radio galaxy NGC 1275. Correlated brightening of the nucleus in both the X-ray and GeV gamma-ray energy bands was found for the period 2013–2015. This is the first evidence of correlated variability between these two bands for NGC 1275. We also analyzed Swift/XRT data and found that the X-ray flux increased over several days in 2010. The GeV gamma-ray band also showed a higher flux with a harder spectrum during the 2010 flare. Simultaneous X-ray and GeV gamma-ray flux increase in the flare could be explained by the shock-in-jet scenario. On the other hand, a long-term gradual brightening of radio, X-ray, and GeV gamma-ray flux with a larger gamma-ray amplitude could have an origin other than internal shocks and some of these possibilities are discussed.

Central Galaxy / 63

Millisecond Pulsar Interpretation of the Galactic Center Gamma-ray Excess

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Over the past few years, a number of groups using data from the LAT instrument have identified excess gamma-ray flux toward the inner regions of the Galactic Center (GC). One leading interpretation of the observed excess is the emission of gamma-rays from a large number of millisecond pulsars (MSPs), with a distribution that is strongly peaked toward the GC. This hypothesis can be put to test by carrying out a sensitive search for MSPs from this region of the Galaxy. To date a number of pulsar searches in the direction of the GC have been carried, so far without a detection of the expected MSP population, most likely due to extreme pulse broadening, which adversely affects the sensitivity of radio searches. We have recently developed a sensitive pulsar search capability at the Deep Space Network's 70-m dish in Canberra, Australia. This instrument, operating at high frequencies, is expected to significantly reduce the effects of pulse broadening. We will provide an overview of the recent work on the MSP interpretation of the gamma-ray excess, review previous pulsar searches, describe the new capability in Canberra, and will present some early results.

Transients and Gamma-Ray Bursts II / 47**A Unified Model for GRB Prompt Emission from Optical to Gamma-Rays: Exploring GRBs as Standard Candles**Sylvain Guiriec¹¹ *George Washington University / NASA Goddard Space Flight Center***Corresponding Author(s):** sylvain.guiriec@gmail.com

The Band function traditionally used for Gamma Ray Burst (GRB) often fails to fit prompt emission spectra. Our model composed of three separate components provides an excellent description of the spectro-temporal prompt emission: a thermal-like and two non-thermal components. For the first time, analysis of GRBs with correlated optical and gamma-ray prompt emission show that our new model describes very accurately the whole broadband spectrum from the optical regime to higher energy gamma-rays. In addition, this model enables a new luminosity-hardness relation showing that GRBs may be standard candles. If statistically confirmed, this relation will be used to (i) constrain the mechanisms powering GRB jets, (ii) estimate GRB distances, (iii) probe the early Universe, and (iv) constrain the cosmological parameters. I will present this unified model using analysis of GRBs detected with various observatories and instruments such as Fermi, CGRO/BATSE and the combination of the three instruments on board Swift and Suzaku/WAM. I will discuss here the striking similarities of GRB spectral shapes, whose components inform on the nature of the prompt emission, as well as the possible universality of the proposed luminosity-hardness relation in the context of our new model.

Transients and Gamma-Ray Bursts I / 233**AN EXTERNAL SHOCK ORIGIN OF GRB 141028A****Author(s):** J. Michael Burgess¹**Co-author(s):** Damien Begue²¹ *Max-Planck-Institut für extraterrestrische Physik*² *Max-Planck Institute for extraterrestrial Physics***Corresponding Author(s):** jburgess@mpe.mpg.de

The prompt emission of the long, smooth, and single-pulsed gamma-ray burst, GRB 141028A, is analyzed under the guise of an external shock model. First, we fit the γ -ray spectrum with a two-component photon model, namely, synchrotron+blackbody, and then fit the recovered evolution of the synchrotron νF_ν peak to an analytic model derived considering the emission of a relativistic blast wave expanding into an external medium. The prediction of the model for the νF_ν peak evolution matches well with the observations. We observe the blast wave transitioning into the deceleration phase. Furthermore, we assume the expansion of the blast wave to be nearly adiabatic, motivated by the low magnetic field deduced from the observations. This allows us to recover within an order of magnitude the flux density at the νF_ν peak. Under this scenario, we argue that the distinction between prompt and afterglow emission is superfluous as both early-time emission and late-time emission emanate from the same source. While the external shock model is clearly not a universal solution, this analysis opens the possibility that at least some fraction of GRBs can be explained by an external shock origin of their prompt phase.

Transients and Gamma-Ray Bursts I / 174**An Investigation on the GRB Peak Energy and Low-Energy Spectral Slope**Hoi-Fung Yu¹¹ *KTH Royal Institute of Technology***Corresponding Author(s):** dy@kth.se

There is no conclusive model for the emission mechanism for Gamma-Ray Bursts (GRBs). The conventional synchrotron emission models have been shown to present difficulties in explaining the

hard low-energy spectral slopes (e.g., Preece et al. 1998) and the sharp peak curvature (e.g., Yu et al. 2015) in the observed time-resolved spectra. On the contrary, thermal emission from the photosphere (whether or not re-processed by sub-photospheric dissipation, which results in a broadened Planck function) provides a natural explanation for most of the narrow time-resolved spectra (e.g., Ryde 2004; Pe'er & Ryde 2011). The peak energy and low-energy spectral slope of some GRB spectra are shown to exhibit correlation (Burgess, Ryde, & Yu 2015). We investigate such behaviour by performing time-resolved spectral analysis using Bayesian techniques (Giacomo et al. 2015) and compare the results to various emission models including the thermal emission models.

Transients and Gamma-Ray Bursts I / 239

Fermi LAT discovery and Swift X-ray follow-up of a new gamma-ray and X-ray variable source Fermi J1544-0649

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The Fermi LAT discovered recently a new flaring/transient GeV gamma-ray source, Fermi J1544-0649 (Swift J154419.7-064915), obtaining prompt and follow-up monitor Swift observations. Curiously a new bright X-ray source counterpart of the LAT source was observed to be coincident with an apparent optical transient, ASASSN-17gs/AT2017egv with a potential host galaxy 2MASX J15441967-0649156/NVSS J154419-064913. This transient high-energy source was subsequently detected by Swift, MAXI and optical telescopes. The persistent flat-spectrum radio emission could indicate a newly discovered high-energy peaked, bright X-ray BL Lac object, for the enhanced X-ray and hard-spectrum gamma-ray emission although the weak absorption observed in the optical spectrum would be difficult to explain, leaving some chances for a more exotic origin.

Transients and Gamma-Ray Bursts I / 221

Gamma-ray bursts closure relation in high-energy emission.

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The fireball model, a standard Gamma-ray bursts (GRBs) model, predicts the evolution of the spectral (β) and temporal (α) properties of GRB afterglows. We have studied the relationship between α and β , so called ‘‘Closure relation’’, with GRBs detected by Fermi Large Area Telescope (LAT). From the analyses of the >100 MeV temporally extended emission, we have calculated the spectral index and the exponent of the temporal decay. Depending on several conditions such as electron spectral index, electron cooling condition and surrounding environment, we derived a series of closure relations, and classified the GRB samples into the best match relation. Within GRB samples classified into the same closure relation, we have found several interesting correlations.

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GeV–TeV Lightcurve of GRB Afterglow

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We numerically simulate the gamma-ray burst (GRB) afterglow emission with a one-zone time-dependent code. The temporal evolutions of the decelerating shocked shell and energy distributions of electrons and photons are consistently calculated. The photon spectrum and light curves for an observer are obtained taking into account the relativistic propagation of the shocked shell and the curvature of the emission surface. Our results show that even if the emission mechanism is switching from synchrotron to synchrotron self-Compton, the gamma-ray light curves can be a smooth power law, which agrees with the observed light curve and the late detection of a 32 GeV photon in GRB 130427A.

Transients and Gamma-Ray Bursts I / 231

Is Spectral Width a Reliable Measure of GRB Emission Physics?

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The spectral width and sharpness of unfolded, observed GRB spectra have been presented as a new tool to infer physical properties about GRB emission via spectral fitting of empirical models. Following the tradition of the 'line-of-death', the spectral width has been used to rule out synchrotron emission in a majority of GRBs. This claim is investigated via examination of both cataloged GRB spectra as well as reanalyzed spectra leading to the introduction of another empirical characterization of the spectra: the data width. This new auxiliary quantity is a direct measure of the folded data's width. Examination of the distribution of data widths suggests that a large fraction of GRBs can be consistent with synchrotron emission. To assess this prediction, a sample of peak-flux GRB spectra are fit with an idealized, physical synchrotron model. It is found that many spectra can be adequately fit by this model even when the width measures would reject it. Thus, the results advocate for fitting a physical model to be the sole tool for testing that model.

Transients and Gamma-Ray Bursts I / 214

MAGIC observation of the short nearby GRB160821B

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Many of the properties of Gamma Ray Bursts (GRBs) remain poorly understood, particularly for short GRBs with durations less than ~ 2 sec. Fermi/LAT has shown that some GRBs emit at high-energy (100 MeV - ~ 100 GeV) gamma-rays with a hard (index of < 2) spectrum. Atmospheric Cherenkov Telescopes (IACTs) could provide information on the possible emission at very-high-energy (VHE, > 100 GeV) gamma-rays. In particular MAGIC telescopes were designed to explore this particular physics case. Although no firm detection has been reported so far, the MAGIC Collaboration reported a hint of a VHE gamma-ray emissions from the short, very nearby ($z=0.16$) GRB 160821B. Even if it is only a hint, this creates doubts on the the standard expectations for gamma-ray emissions from GRBs: low energy (~ 30 GeV) over a short period ($< \sim 100$ s). Moreover GRB 160821B showed a clear extended emission in the X-ray band, which can be generated by a ms pulsar after a NS-NS or NS-BH merger. In this contribution we will briefly report on the hint of the signal and on possible interpretations of the data assuming that the hint is real.

Transients and Gamma-Ray Bursts II / 33

Multimessenger Transients Observations by Lomonosov Mission

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Transients study is one of the main goals of Lomonosov space mission. Multimessenger observations of transients is likely the best way to arrive to new insights of their nature. In this respect Lomonosov satellite is the space mission where the multi-wave length observations of GRBs and TGFs are realized in real time without necessity of instruments re-orientation after monitor's trigger. Mission payload include GRB monitor, wide and narrow field optical detectors, as well as UFFO instrumental suite, that is consisting of X-ray imaging telescope UBAT and UV slewing mirror telescope SMT. Combination of instruments on-board Lomonosov permit simultaneous GRB and TGFs observations in gamma and optical emission at different time scales of event evolution, including obtaining optical light curves of prompt emission for GRBs, as well as of precursors. The GRB and TGFs detections and catalogues will be presented in this talk. Some of transient events, for which information was detected at different wave bands, are discussed in more detail.

Transients and Gamma-Ray Bursts I / 168

New results in apply of the machine-z method

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Gamma-ray bursts (GRBs) are the most energetic transients in the far Universe. Several thousands of GRBs have been observed so far but we could measure the distance of only a few hundreds. We studied the parameters of GRBs with available spectroscopic redshift in order to be able to estimate the redshift of those GRBs without a measured redshift. To calculate their distances we applied two machine-learning estimator methods: random forest regressor and XGBoost. For the process we used selected gamma, x-ray and ultraviolet parameters from the the Swift GRB catalog, in which 328 GRBs had measured spectroscopic redshift. We found a significantly higher correlation between the measured and estimated redshift, we have improved the correlation in multiple steps from 0.57 (published by Ukwatta et al., 2016) to 0.67. It seems that both the random forest and the XGBOOST methods give similarly high correlation and for further improvements additional redshift measurements are required.

Transients and Gamma-Ray Bursts I / 238

Nine Years of Fermi LAT Flare Advocate Monitoring

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The Fermi Flare Advocate (also known as Gamma-ray Sky Watcher) service provides for a quick look and review of the gamma-ray sky observed daily by the Fermi Large Area Telescope (LAT) through on-duty LAT Flare Advocates and high level software pipelines like the LAT Automatic Science Processing (ASP) and the Fermi All-sky Variability Analysis (FAVA). The FA-GSW service provides alerts and communicates to the external scientific community potentially new gamma-ray sources, interesting transients and flares, for example through the Fermi multiwavelength mailing list, Astronomer's Telegrams and Gamma-ray Coordinates Network notes. From July 2008 to September 2017 more than 400 ATels and 120 GCNs have been published by the Fermi LAT Collaboration. Target of opportunity observing programs to other satellites and telescopes have been triggered by Flare Advocates based on gamma-ray flares from blazars and other kinds of sources. Some statistics and a summary of results from the service are presented.

Transients and Gamma-Ray Bursts I / 118

On the Connection of Gamma-Ray Bursts and X-Ray Flashes

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Classification of gamma-ray bursts (GRBs) into groups has been intensively studied by various statistical tests since 1998. It has been suggested that next to the groups of short/hard and long/soft GRBs there could be another class of intermediate durations. For the Swift/BAT database Veres et al. 2010 (*ApJ*, 725, 1955) it was found that the intermediate-duration bursts might be related to X-ray flashes (XRFs). On the other hand, Ripa and Meszaros 2016 (*Ap&SS*, 361, 370) and Ripa et al. 2012 (*ApJ*, 756, 44) found that the intermediate-duration GRBs in the RHESSI database are spectrally too hard to be given by XRFs. Also, in the BATSE database the intermediate-duration GRBs can be only partly populated by XRFs. The key ideas of the Ripa and Meszaros 2016 (*Ap&SS*, 361, 370) article are summarized in this poster.

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Spectral classification and variation of Fermi GRBs

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The Fermi GBM catalog contains general physical quantities of the observed objects and also estimated parameters (peak energy, spectral indices, intensity) from four fitted spectral models (Band, smoothly broken power law, Comptonized, power law) for the peak flux and the fluence. We studied the nature of the errors of the peak flux, the fluence, and duration parameters. We have found a linear correlation between the logarithm of the measured quantities and their error bars. We interpret our results as an indication, that the peak flux, fluence and duration follow a Poissonic distribution.

Transients and Gamma-Ray Bursts II / 115

Testing Isotropic Universe via Properties of Gamma-Ray Bursts Detected by Fermi / GBM

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The sky distribution of Gamma-Ray Bursts (GRBs) has been intensively studied for more than two decades. Most of these studies, test the isotropy of GRBs based on the sky number density distribution. We propose a new method which inspects the isotropy of the properties of GRBs such as their duration, fluences and peak fluxes at various energy bands and different time scales. The method was applied on the Fermi / Gamma-ray Burst Monitor data. We found a relatively significant feature near the Galactic coordinates approximately $l = 30$ deg, $b = 15$ deg and radius $r = 20 - 40$ deg with the inferred probability for the occurrence of such signal (in a random isotropic sample) to be less than a percent. However, more comprehensive analysis using different statistical tests and different samples show that the detected feature can be due to statistical fluctuations. Investigations on the updated Fermi / GBM sample as well as on the data sets of other instruments can clarify on the issue.

Transients and Gamma-Ray Bursts I / 199

The 2nd LAT GRB Catalog

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High-energy emission from Gamma-Ray Bursts is a powerful probe for extreme physics in these highly relativistic sources. Despite the advancements prompted by observations from the Fermi Large Area Telescope and the Fermi Gamma-Ray Burst Monitor, as well as other observatories, many questions remain open, especially on radiative processes and mechanisms. We present here the most extensive search for GRBs at high energies performed so far, featuring a detection efficiency more than 50% better than previous works, and returning more than 130 detections. With this sample size, much larger than the 35 detections presented in the first Fermi/LAT GRB catalog, we are able to assess the characteristics of the population of GRBs at high energy with unprecedented sensitivity. We will review the preliminary results of this work, as well as their interpretation.

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The Fermi GBM Gamma-Ray Burst, Spectroscopy and Time-Resolved Spectral Catalogs: The first eight years

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The next set of Fermi GBM Gamma-Ray Burst Catalogs, currently under preparation, will cover 8 years of Fermi data taking.

The 4th GBM GRB catalog (von Kienlin et al., 2018) will provide information on the most important observables of the GBM detected GRBs, like location, main characteristics of the prompt emission, duration, peak flux and fluence.

The 3rd GBM Spectroscopy Catalog (Poolakkil et al., 2018) is intended to complement the 4th GBM GRB Catalog by providing spectral information to go with the fluence and peak flux values of each burst. The catalog consists of fits to time-integrated and peak flux spectra for four spectral models each.

Finally, the time-resolved spectral analysis of GBM brightest bursts will be summarized in the 2nd Time-Resolved Spectral Catalog (Bissaldi et al., 2018). It will provide high temporal and spectral resolution fits, as well as the corresponding distributions of parameters, together with the statistics of the parameter populations and possible correlations.

These catalogs will be an official product of the Fermi GBM Science Team, and the data files containing the complete results will be available from the High-Energy Astrophysics Science Archive Research Center (HEASARC).

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The Konus-Wind catalog of gamma-ray bursts with known redshifts. I. Bursts detected in the triggered mode.

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In this catalog, we present the results of a systematic study of 150 gamma-ray bursts (GRBs) with reliable redshift estimates detected in the triggered mode of the Konus-Wind (KW) experiment. The sample covers the period from 1997 February to 2016 June and represents the largest set of cosmological GRBs studied to date over a broad energy band. We provide the burst durations, the spectral lags, the results of spectral fits with two model functions, the total energy fluences, and the peak energy fluxes, the rest-frame, isotropic-equivalent energy and peak luminosity, the collimation-corrected

values of the energetics for 32 GRBs with reasonably-constrained jet breaks. We consider the behavior of the rest-frame GRB parameters in the hardness-duration and hardness-intensity planes, and confirm the 'Amati' and 'Yonetoku' relations for Type II GRBs. The correction for the jet collimation does not improve these correlations for the KW sample. We discuss the influence of instrumental selection effects on the GRB parameter distributions and estimate the KW GRB detection horizon. Accounting for the instrumental bias, we estimate the KW GRB luminosity evolution, luminosity and isotropic-energy functions, and the evolution of the GRB formation rate.

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The Rest-Frame Golenetskii Correlation via a Hierarchical Bayesian Analysis

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Gamma-ray bursts (GRBs) are characterised by a strong correlation between the instantaneous luminosity and the spectral peak energy within a burst. This correlation, which is known as the hardness-intensity correlation or the Golenetskii correlation, not only holds important clues to the physics of GRBs but is thought to have the potential to determine redshifts of bursts. In this paper, I use a hierarchical Bayesian model to study the universality of the rest-frame Golenetskii correlation and in particular, I assess its use as a redshift estimator for GRBs. I find that using a power-law prescription of the correlation, the power-law indices cluster near a common value, but have a broader variance than previously reported ($\sim 1-2$). Furthermore, I find evidence that there is spread in intrinsic rest-frame correlation normalizations for the GRBs in our sample ($\sim 1051 - 1053 \text{ erg s}^{-1}$). This points towards variable physical settings of the emission (magnetic field strength, number of emitting electrons, photospheric radius, viewing angle, etc.). Subsequently, these results eliminate the Golenetskii correlation as a useful tool for redshift determination and hence a cosmological probe.

Stellar sources (galactic and extragalactic) I / 234**Combined approach to VHE gamma-ray astronomy at the TAIGA observatory**Evgeny Postnikov¹¹ *Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University***Corresponding Author(s):** evgeny.post@gmail.com

The TAIGA experiment is aiming to address important tasks in ground-based gamma-ray astronomy at energies from a few TeV – to several PeV. TAIGA combines almost all the techniques for gamma-ray air shower detection. First, an array of the imaging air Cherenkov telescopes is planned (three telescopes located at the distance of 800m in 2019). Second, an array of the wide angle Cherenkov timing detectors (currently 28 detector stations; up to 120 for covering 1km² area in 2018). Finally, the array of muon detectors, currently of ~200m² size, is planned to increase up to an area of 3000m² to cover 1km² total.

The shower parameters are estimated by the data of the wide angle Cherenkov timing detectors, whereas gamma-ray induced showers are selected by the image data of the telescopes in combination with the timing array as well as with the muon array data.

The low investments together with the high sensitivity (2.5×10^{-13} TeV/(cm²sec) for 300h of local sources observation at 100TeV, 1km² array) make this pioneering approach very attractive for exploring the galactic PeVatrons.

The status and perspectives of the project as well as the first results of the prototype stage are reported.

Stellar sources (galactic and extragalactic) I / 143**Detection of an Unidentified Extended Gamma-ray Source Close to the Galactic Supernova Remnant 3C 400.2**Tulun Ergin¹¹ *TUBITAK Space Technologies Research Institute***Corresponding Author(s):** tulu.kiz@gmail.com

A new extended gamma-ray source (named as PS J1934.5+1845) was detected with a significance of ~13 σ at a location of 1.83 degrees away from the radio location of the Galactic supernova remnant 3C 400.2 using about 9 years of Fermi-LAT data. The 68% containment radius of PS J1934.5+1845's extension was found to be 0.61 degrees and PS J1934.5+1845 is showing a power-law type spectrum with a spectral index of 2.38. In this presentation we will summarize the gamma-ray analysis methods and report on the analysis results related to the extension and spectrum of PS J1934.5+1845. We will also give preliminary results on the variability analysis and modeling of the spectrum of PS J1934.5+1845 in order to better understand its nature.

Stellar sources (galactic and extragalactic) I / 104**Effect of viscosity on propagation of MHD waves in astrophysical plasma**Alemayehu Cherkos¹¹ *Addis Ababa University, Institute of Geophysics Space Science and Astronomy***Corresponding Author(s):** alexye7@gmail.com

We determine the general dispersion relation for the propagation of magnetohydrodynamic (MHD) waves in an astrophysical plasma by considering the effect of viscosity with an anisotropic pressure tensor. Basic MHD equations have been derived and linearized by the method of perturbation to

develop the general form of the dispersion relation equation. Our result indicates that an astrophysical plasma with an anisotropic pressure tensor is stable in the presence of viscosity and a strong magnetic field at considerable wavelength.

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Fermi-LAT Studies of Globular Clusters.

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We analyse 32 Galactic globular clusters (GC) using 8 years of Pass 8 Fermi-LAT data in the range 60 MeV - 300 GeV with the analysis down to lower energy being performed for the first time. We confirm prior detections and refine their spectral energy distributions (SED). Using a phenomenological approach, we investigate the possible emission mechanisms responsible for the observed gamma-ray properties.

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LMC P3: An Extreme Particle Accelerator

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Persistent gamma-ray emission dominates the radiative output of gamma-ray binaries, which are thought to be the evolutionary precursors to X-ray binaries. Often, this is attributed to particle acceleration in the shock from the winds of an optical companion and rapidly spinning pulsar or inverse Compton scattering of UV photons in the relativistic jet of an accreting compact object. We present XMM-Newton and NuSTAR observations of the newly discovered gamma-ray binary LMC P3 during inferior conjunction, X-ray maximum and X-ray minimum of its 10.3 day orbit. Currently the only gamma-ray binary found outside the Milky Way, LMC P3 is significantly more luminous than similar binary systems at all energy bandpasses. This extreme behavior could possibly be driven by a large spin-down power from the suspected pulsar, as well as a higher UV photon seed density of the O5 III star, but the details of the high energy emission region remain perplexing. We probe the geometry and physical conditions of the high-energy emission region and investigate the nature of the compact object.

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Non-linear combined MHD- Monte Carlo simulations of proton acceleration in colliding wind binaries

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In colliding-wind binary (CWB) systems, the supersonic winds of two stars collide, forming a wind-collision region (WCR) delimited by two shocks. Such systems are expected to produce a nonthermal distribution of energetic particles via diffusive shock acceleration (DSA) at the collisionless shocks. Interacting with the environment, relativistic electrons and/or protons are in turn expected to produce γ -rays. Test-particle Monte Carlo simulations suggest that the energy put into nonthermal protons is non-negligible. Their backreaction on the shock itself therefore has to be taken into account. We perform Monte Carlo simulations of particle acceleration, obtaining the background from MHD simulations of an archetypal CWB system. We further take into account the feedback of the accelerated protons on the local shock structure, where the particles are injected. Global changes

to the system are neglected here. Our approach allows the injection efficiency of DSA in the considered system be obtained from the simulations in a locally self-consistent way, thus contributing to improve γ -ray flux predictions for CWB systems. We present the results of our simulations, including injection efficiencies at different positions along the shocks of the WCR, and spectral energy distributions of the accelerated particles.

Stellar sources (galactic and extragalactic) I / 87

Reexamining the gamma-ray properties of globular clusters

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We have re-examined the properties of gamma-ray emitting globular clusters with the data obtained by Fermi LAT in the past nine years. In particular, we have investigated the role of metallicity in determining the size of millisecond pulsar populations in globular cluster.

GeV to TeV / 84

Probing high-energy acceleration processes in S5 0716+714 using combined Fermi-LAT and MAGIC observations

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The blazar S5 0716+714 underwent an impressive outburst in January 2015, being detected by many instruments spanning from radio to very high energy (VHE, $E > 100\text{ GeV}$). The multi-wavelength dataset collected made possible a deep study of the broadband Spectral Energy Distribution (SED), which typically in blazars is described by two components: the low-energy one, in case of S50716+714 peaked between 10^{14} - 10^{15} Hz, attributed to synchrotron emission from relativistic electrons in the jet, and the high-energy component, generated by inverse-Compton (IC) up-scattering of soft synchrotron photons of the same electrons. VHE data have been collected simultaneously, from Fermi-LAT and MAGIC respectively, allowing the possibility to study the whole high energy part of the broadband SED in an unprecedented high state. In this contribution we will report on the broadband activity of the source during its strongest outburst ever detected so far, focusing on the GeV-TeV connection, described by the multi-wavelength light curves and the SED in the frame of a two-zone modeling.

GeV to TeV / 133

Ten years of H.E.S.S. I extra galactic observations revisited

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In the past decade, the H.E.S.S. (High Energy Stereoscopic System) experiment has significantly contributed to the field of ground-based gamma-ray astronomy. In particular, during the first phase of the experiment from 2004 to 2013, the extra galactic observation program led to the discovery of more than 20 sources of VHE gamma-rays. During this observation program, some regions of the sky were also observed without leading to a detection. About 6.5% of the extra galactic sky was observed and it is now possible to re-analyse these data with the most up-to-date analysis techniques in an uniform way. This allows for population studies, variability studies, transient searches in the observed regions and robust comparison with the latest Fermi-LAT catalogs. In this contribution, the re-analysis of these ~2700 hours of observation will be presented, together with the data products that are intended to be released to the scientific community.

GeV to TeV / 75

Unprecedented temporal analysis of the gamma-ray blazar 1ES 1215+303 Fermi-LAT and VERITAS light curves spanning ten years

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We present here the results of the analysis of the gamma-ray blazar, 1ES 1215+303, over a 10-year period, from 2008 to 2017, measured at high energies (HE; $200\text{ MeV} < E < 100\text{ GeV}$) by the Fermi Large Area Telescope (LAT) and at very high energies (VHE; $E > 100\text{ GeV}$) by Fermi-LAT and VERITAS. This is the longest temporal study of this high-frequency-peaked BL Lac object at gamma-ray energies. The spectrum follows a log-parabola over this time period, and its HE and VHE spectra are well-connected. Its flux is sufficiently strong at HE to allow us to bin the Fermi-LAT data in 3-day intervals, enabling us to investigate the time evolution of the flux in unprecedented detail. Several flaring

episodes were detected and evidence for an overall trend of increasing flux over the span of the 10 years was observed. These light curves, in addition to the spectra, will be presented. This unique data set will help us to advance our understanding of the underlying physical processes in blazar jets.

Analysis techniques / 99**A novel model for gamma-ray source classification using automatic feature selection****Author(s):** Alex P. Leung¹**Co-author(s):** Chung Yue Hui²¹ *Macau University of Science and Technology*² *Chungnam National University***Corresponding Author(s):** huichungyue@gmail.com

With fast growing data collected by the Fermi Large Area Telescope as a big data problem, manual classification has become an impossible task for astronomers. In this paper, we propose a novel framework using machine learning techniques with automatic feature selection algorithms for gamma-ray object classification. We automate parameter tuning rather than manual tuning used in some previous work. We found that using the Random Forest (RF) algorithm for feature selection can result in a better classification performance. Optimal results can be obtained for classifying AGNs/pulsars (accuracy > 98%) and young pulsars/millisecond pulsars (accuracy > 95%) by using the boosted logistic regression algorithm and RF as the classifier respectively. In comparison with the previous work by Saz Parkinson et al. (2016), our scheme leads to an improved performance.

Analysis techniques / 59**COMPTEL Reloaded: a heritage MeV data project**Werner Collmar¹¹ *MPE Garching***Corresponding Author(s):** wec@mpe.mpg.de

The double-Compton telescope COMPTEL flew on the NASA Compton Gamma Ray Observatory (CGRO) satellite from 1991 to 2000, and is still the basis of most knowledge of the 1-30 MeV sky. Pending new missions like eAstrogam, for the next decade COMPTEL will still be a major resource for MeV gamma rays. A long-term effort to exploit heritage COMPTEL data is underway at MPE and MPA Garching. The full 9-year COMPTEL mission covered the entire sky. Several new developments are in progress for COMPTEL: the COMPTEL data analysis system was partly ported to Linux, new event processing techniques improve the background rejection, and new energy ranges are defined to avoid background lines. Time-of-flight background rejection has been improved using intra-detector resolution instead of just per detector, and this is combined with pulse-shape discrimination in a 2D analysis. A new source catalogue will be generated with the new event processing. The maximum-entropy skymapping method for COMPTEL has been updated to use current state-of-the-art convolution on the sphere and the HealPix sky projection and the method has been adapted to modern hardware. New skymaps based on these developments will be presented.

Analysis techniques / 181**Finding untriggered gamma-ray transients in the Fermi GBM data****Author(s):** Michelle Hui¹**Co-author(s):** Michael Briggs²¹ *NASA/MSFC*² *University of Alabama in Huntsville***Corresponding Author(s):** cmhui.astro@gmail.com

The all-sky monitoring capability of Fermi GBM makes it ideal for finding transients. Fermi GBM triggers on events such as gamma-ray bursts, soft gamma-ray repeaters, X-ray bursters, solar flares, and terrestrial gamma-ray flashes. A previous systematic search in offline data for X-ray bursts has uncovered untriggered gamma-ray bursts, and currently there is a dedicated offline search pipeline

looking for weak transients overlooked by the onboard trigger conditions. The untargeted search looks for significant background-subtracted signals in two or more detectors at various timescales in the continuous data, detecting ~80 additional short GRB candidates per year. Since July 2017, these candidates have been published in GCN under Fermi-GBM Subthreshold transients notices, accompanied by localization maps and lightcurves. At present only short GRB candidates are published, expansion to long GRBs and other transient types are forthcoming.

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Image Reconstruction Utilizing the High-Dimensional Data Space of Future Gamma-ray Telescopes

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Advanced gamma-ray telescopes such as COSI, AMEGO, and eAstroGam measure many more parameters of the observed gamma rays than before, especially in the Compton regime. The measured energies and scatter directions (gamma ray and recoil electron), the detector geometry, the distance between interactions, and multiple Compton interactions all influence the response. For example, a matrix which adequately describes COSI's response would consist of 11 dimensions at a minimum. This makes full response simulations impossible, especially when considering the high resolution of modern Compton telescopes. Using a simplified binned imaging approach by e.g. reducing the response space to COMPTEL's original 5 dimensions, would give superior background and flux estimates, but sacrifices sensitivity. On the other side, utilizing a list-mode approach would give superior sensitivity, but the absolute flux and background determination becomes impossible. In the presentation we will show a way out of this dilemma, by introducing a hybrid imaging approach which combines the background estimation and flux determination capabilities of binned-mode imaging with the excellent sensitivity of list-mode imaging and apply it to COSI.

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The Fermi Large Area Telescope: 9 years of on-orbit performance

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The Fermi Large Area Telescope has been successfully operating in low Earth orbit almost continuously since its initial turn-on on 24 June 2008, for over 9 years. We present details of the current performance of the LAT detector and data acquisition sub-systems, together with long-term trends of key performance measures, and assess the expected performance in continued future operation. We also discuss the current and future status of the ground-based control, monitoring and data processing for the LAT.

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The Multi-Mission Maximum Likelihood framework (3ML)

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The age of multi-wavelength and multi-messenger astronomy has arrived and with it, new tools are needed to analyze data from multiple instruments properly and with ease. The Multi-Mission Maximum Likelihood framework (3ML) provides this functionality via the novel use of instrument plugins which allow for every instrument's unique data to be treated independently with an appropriate likelihood. Under the 3ML framework, users can design plugins that handle instrument specific data routines transparently in the background. When multiple instruments are used together, their independent likelihoods are treated under a common minimization or Bayesian sampling framework. 3ML provides a multitude of minimization algorithm for maximum likelihood estimation (MLE) as well as several popular Bayesian posterior samplers. The entire framework is provided via a modern Python interface providing the user with a modern and easily transportable analysis framework well suited for modern astronomy. New models can be added easily. It is also possible to perform time-energy modeling. We present the framework and its main functionalities.

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The first VEGAS-free, exact, 5D, polarized photon-to-e+e-pair conversion event generator

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Current pair-conversion event generators, e.g. in *geant4*, don't sample the five-dimensional differential crosssection (5D DCS), but a product of 1D DCSs. Most of them use high-energy and/or small angle approximations. Also the e+ and e- polar angles are generated independently so energy-momentum is not conserved. None of them can simulate the conversion of polarized photons correctly (*Astropart.Phys.*88 (2017) 60).

I have written a generator that is sampling exactly the 5D Bethe-Heitler DCS [*NIM A* 729 (2013) 765]. I use the VEGAS method: at a given energy, for a given target nucleus, after a 5D grid has been optimized, the DCS is tabulated, something that needs several seconds. Then I can generate zillions of conversions quickly at that energy and for that target. The polarization properties were characterized in *Astropart.Phys.*88 (2017) 30, especially at low energy where most of the statistics is for cosmic sources.

I have developed a VEGAS-free version that allows the fast generation of the conversion of a photon of a given energy on a given target, with the same other properties as for the VEGAS-based generator.

Galactic Diffuse & CR propagation / 41**Evidence for GeV Cosmic Rays from White Dwarfs in the Local Cosmic Ray Spectra and in the Gamma-ray Emissivity of the Inner Galaxy**Tune Kamae¹¹ *SLAC and University of Tokyo***Corresponding Author(s):** kamae@slac.stanford.edu

Observations in the hard X-ray band found that electrons are accelerated in two magnetic white dwarfs. Protons are found to be accelerated to GeV in the novae by Fermi. These prompted us to analyze the cosmic ray (CR) spectra of electrons, protons, and heavier nuclei observed near Earth including the spectra deduced from the observed hard X-ray and gamma ray spectra. We fit the CR spectra at the heliopause using two templates for each species: one representing the CRs from WDs/novae accumulated in the local bubble and the other representing the CRs in the Galaxy. The CR spectra deduced from the hard X-ray and gamma ray spectra are refitted so that the sums of the local and Galactic reproduce the CR spectra at the heliopause. We find one local template and one Galactic template fit all nuclear CR spectra at heliopause and that the hardening of the nuclear CRs is interpreted as due to the roll-down of the CR contributions from WDs/novae at around a few 100 GeV. The GeV hump in the gamma ray emissivity found in the inner Galaxy in the Fermi-LAT emissivity analysis is attributed to the CRs from WDs. .

Galactic Diffuse & CR propagation / 195**Fermi-LAT study of the ISM in Chamaeleon region using the Planck thermal dust optical depth**Katsuhiko Hayashi¹¹ *Nagoya University***Corresponding Author(s):** khayashi@phys.nagoya-u.ac.jp

Diffuse gamma-ray emission from local molecular clouds is a powerful probe of the local interstellar gas and cosmic rays. Most of previous LAT studies of the molecular cloud regions assumed that the gamma-ray emitting interstellar gas is decomposed into three components: atomic hydrogen, molecular hydrogen and some excess gas not traced by standard HI and CO surveys. In each phase, uniform gas and dust properties are assumed. In this study, we examine the Chamaeleon molecular cloud region with a different approach, using total gas column density (NH) models based on the dust optical depth at 353 GHz (τ_{353}) obtained from the Planck dust emission model. The relation between NH and dust optical depth in local molecular clouds exhibits a deviation from a simple linear relation (e.g., Roy et al. 2013 and Planck Collaboration XXVIII, 2015), possibly due to evolution of dust grains in cores of clouds. In fitting gamma-ray data with several NH models, including both linear and non-linear relations with τ_{353} , we found that a non-linear relation of τ_{353} proportional to the ~ 1.3 -th power of NH gives the best fit, which may indicate dust evolution in the local molecular cloud complex.

Galactic Diffuse & CR propagation / 178**Galactic Diffuse Gamma-Ray Emission From 3D Cosmic-Ray Transport Models**Ralf Kisssmann¹¹ *Leopold Franzens Universität Innsbruck***Corresponding Author(s):** ralf.kisssmann@uibk.ac.at

The PICARD code for the numerical solution of the Galactic cosmic-ray propagation problem allows for high resolution 3D models that can acknowledge localised structures within our Galaxy. Using PICARD, we address the impact of different transport physics processes on the flux and distribution

of diffuse Galactic gamma rays: we investigate models with a cosmic-ray source distribution aligned with different arrangements of the Galactic spiral arms, under consideration of a recently updated interstellar radiation field model, and those assuming anisotropic cosmic-ray diffusion governed by an improved Galactic magnetic field model. The choice of changing the different transport parameters is most readily visible in the inverse-Compton channel, which shows features not present in commonly-used axisymmetric transport models.

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Interstellar Cosmic Rays from Multifrequency Observations of the Interstellar Emission

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Cosmic Rays propagate in the Milky Way and interact with the interstellar medium and magnetic fields. These interactions produce emission that spans the electromagnetic spectrum and is a crucial tool for understanding intensities and spectra of cosmic rays in different regions. Hence observations of this interstellar emission complement information from cosmic ray measurements.

We present updates on the study of cosmic ray properties by combining multifrequency observations of the local interstellar emission with latest accurate cosmic ray direct measurements and propagation models. We also make predictions for e-ASTROGAM and AMEGO, proposed gamma-ray missions with a special focus at the MeV energy range.

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Measurement of the Cosmic-ray Proton Spectrum with the Fermi Large Area Telescope

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We present the measurement of the cosmic-ray proton spectrum between 54 GeV and 9.5 TeV using 7 years of Pass 8 flight data from the Fermi Large Area Telescope (LAT). We developed a dedicated proton event selection with a maximum acceptance of 0.25 m² sr at 1 TeV. Our analysis yields a large dataset for a spectral measurement with a statistical uncertainty under 1% up to 1 TeV and residual contamination less than 5% from all other cosmic-ray species. We estimate the systematic uncertainties by testing different event selections and different hadronic interaction models for the GEANT4 Monte-Carlo simulations, and we found that they are an order of magnitude larger than the statistical uncertainty. The event selection and spectral measurement of the proton analysis create the opportunity for additional proton analyses with the LAT, such as a dedicated proton anisotropy search.

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New 3D models of interstellar gas and their impact on high-energy interstellar emission.

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The interstellar gas is a key component for understanding cosmic-ray (CR) physics as it is the target for the generation of secondary CR particles and the high-energy interstellar emission. Observations of the spectra and abundances of these secondary particles are used to decipher the propagation history of CRs and to decode possible signatures of new physics. Until now, most calculations of CR propagation have used 2D cylindrically symmetric models for the distribution of the interstellar gas. This is partly due to the inevitable difficulties in determination of the 3D gas distributions. We present a method for determination of the 3D distribution of interstellar gas and our preliminary results. We discuss the effect these new 3D models may have on the analysis and interpretation of CR propagation and high-energy interstellar emissions.

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Signatures of a Local Cosmic Ray Source

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We suggest that the local supernova which deposited Fe-60 isotopes on the Earth 2-3 million years ago contributes also to the locally observed cosmic ray flux. We show that the contribution of this “local source” explains the positron and antiproton fluxes and why their spectral shape agrees with the proton flux. At the same time, this local source component explains the difference in the slopes of the spectra of cosmic ray nuclei. We discuss the resulting signature in the Boron-to-Carbon (primary-to-secondary cosmic rays) ratio and in the anisotropy of the total cosmic ray flux.

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Study of cosmic-rays in the Orion-Eridanus superbubble

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The Orion-Eridanus superbubble, formed from the winds and the explosions of Orion’s massive stars, could be a cosmic-ray acceleration site. Inside the superbubble, the large level of MHD turbulence and the core-collapse supernovae have created a turbulent medium which effect on cosmic rays can be probed comparing their flux and spectrum in the superbubble to the average in nearby interstellar clouds.

To study cosmic rays in the superbubble, we first rely on Fermi LAT data. Eight years of data and gamma rays above 100 MeV have been used. We are particularly interested in gamma rays resulting from the decay of neutral pions produced by the interaction of cosmic rays with interstellar gas. Hence, knowing both gas distribution and gamma-ray emission allows to obtain the cosmic-ray flux. This requires to model the interstellar emission using multiwavelength tracers for the gas column densities in the different phases (atomic, molecular, ionized) of the superbubble.

First results show that the emissivity spectrum differs from the local measurement by less than 30%. We will discuss systematic uncertainties on this measurement and on the previous local estimates to compare the diffusion properties of CRs in and out of the superbubble.

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Study of the Interstellar Medium and Cosmic-rays in Local HI Clouds

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High-energy cosmic-ray (CR) protons and electrons interact with the interstellar gas or the interstellar radiation field and produce diffuse gamma rays. Since the interstellar medium (ISM) is transparent to these high-energy photons, GeV gamma rays are a powerful probe to study the ISM and Galactic CRs. Indeed, a significant amount of gas not traced properly by standard radio line surveys ("dark gas") was revealed by CGRO-EGRET and has been confirmed by Fermi-LAT. In those studies, dust observations were used to construct a template of the dark gas. Yet, the procedure to convert dust observations into the distribution of the total gas column density (N_{Htot}) has not been established yet. In this contribution, we report a new study of the ISM and CRs in nearby high-latitude HI clouds in the third quadrant. We used Fermi-LAT data, HI4PI survey data, and Planck dust thermal emission model. In analyzing gamma-ray data using dust as a gas tracer, we examined possible dependence of the ratio of N_{Htot} to dust emission on dust temperature, and possible non-linearity between N_{Htot} and dust opacity. We will present details of the data analysis and preliminary results.

Extragalactic diffuse & EBL / 169**Characterization of the Local Universe via cross-correlations**Simone Ammazzalorso¹¹ *University of Torino & INFN***Corresponding Author(s):** simone.ammazzalorso@gmail.com

The aim of our work is to explore the Extra-galactic Unresolved Diffuse Emission of the Local Universe, cross-correlating Fermi LAT Pass8 data with the 2MPZ galaxy catalog. The main idea behind the work is to use magnitude measurement in B and K band as a tracer respectively of star formation and mass amount, and to isolate the presence of AGNs in the 2MPZ catalog with available AGNs catalogs. The determination of the cross-correlation of the gamma-rays data with the various galaxy subsets allows the decomposition of the different contributions to the Angular Power Spectrum, possibly leaving room for a Dark Matter component. We present the latest preliminary results of our analysis.

Extragalactic diffuse & EBL / 86**Detection of virial shocks in stacked Fermi-LAT clusters****Author(s):** Ido Reiss¹**Co-author(s):** Uri Keshet¹¹ *Ben Gurion University***Corresponding Author(s):** reissi@post.bgu.ac.il

In the hierarchical paradigm of structure formation, galaxy clusters are the largest objects ever to virialize. They are thought to grow by accreting mass through large scale, strong virial shocks. Such a collisionless shock is expected to accelerate relativistic electrons, thus generating a spectrally flat leptonic virial ring. However attempts to detect virial rings have all failed, leaving the shock paradigm unconfirmed. Here we identify a virial γ -ray signal by stacking Fermi-LAT data for 112 clusters, enhancing the ring sensitivity by rescaling clusters to their virial radii and utilizing the anticipated spectrum. In addition to a central unresolved, hard signal (detected at the nominal 5.8σ confidence level), probably dominated by active galactic nuclei, we identify (5.9σ) a bright, spectrally flat γ -ray ring at the expected shock position. It corresponds to $\sim 0.6\%$ (with an uncertainty factor ~ 2) thermal energy deposition in relativistic electrons over a Hubble time. This result validates the shock paradigm, calibrates its parameters, and indicates that the cumulative emission from such shocks significantly contributes to the diffuse extragalactic γ -ray and radio backgrounds.

Extragalactic diffuse & EBL / 45**Latest Observations of M31 with the Fermi Large Area Telescope**Xian Hou¹¹ *YNAO, China***Corresponding Author(s):** xhou@ynao.ac.cn

The Fermi Large Area Telescope (LAT) has opened the way for comparative studies of cosmic-ray populations and high-energy sources in the Milky Way (MW) and in other external star-forming galaxies. Using more than 7 yr of LAT Pass 8 data in the energy range 0.1-100 GeV, M31 is detected at nearly 10 sigma and is observed to be extended at 4 sigma. Its spectrum is consistent with a power law and its spatial distribution is consistent with a uniform brightness disk over the plane of the sky and no offset from the center of M31. The emission appears confined to the inner regions of the galaxy and does not fill the disk of the galaxy. The non-correlation with regions rich in gas or star-formation activity suggests that the emission is not interstellar in origin, unless the energetic particles radiating in gamma rays do not originate in recent star formation. Alternative interpretations include a population of unresolved millisecond pulsars in the galaxy center or dark matter annihilation or decay, similar to what has been proposed to account for the Galactic center excess found in LAT observations of the MW.

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Fermi LAT limit on evaporation of individual primordial black holes

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Primordial black holes (PBH) with masses below approximately 10^{15} g are expected to emit gamma rays with energies above a few tens of MeV via Hawking radiation. Previous searches for PBH evaporation signal have focused on either short timescale bursts of TeV photons corresponding to last moments of PBH lifetime or the contribution of PBHs to the isotropic gamma-ray emission. We show that, in case of individual PBHs, the Fermi LAT is most sensitive to PBHs with temperatures near 16 GeV, which can be detected out to a distance of about 0.03 pc. These PBHs have lifetimes of a few years and would appear as potentially moving point sources. We develop a new algorithm to detect the proper motion of a gamma-ray point source (PS) and apply it to unassociated PS in the third Fermi-LAT source catalog (3FGL). None of unassociated PS that have spectra consistent with PBH evaporation show significant proper motion. The derived 99% confidence limit on PBH evaporation rate in the vicinity of the Earth is similar to the limits obtained with ground-based gamma-ray observatories.

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Indirect dark matter searches with H.E.S.S. towards the Galactic Center and nearby dwarf galaxies

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Weakly interacting massive particles (WIMPs) are one of the most promising dark matter (DM) candidates. The self-annihilation of WIMPs today into Standard Model particles could include very-high-energy (VHE, $E > 100$ GeV) gamma-rays in the final state that can be detected by ground-based Cherenkov telescopes such as the High Energy Stereoscopic System (H.E.S.S.). VHE gamma-ray observations focus towards regions in the sky expected to harbor a large DM density. Among them are the inner Galactic halo and the nearby dwarf spheroidal galaxies satellites of the Milky Way. Data accumulated over 10 years (2004-2014) of observations with H.E.S.S. on these targets have been used to seek for continuum and line signatures of DM annihilation. Thanks to improved photon statistics and a 2-dimensional maximum likelihood analysis technique, new more stringent constraints have been set on the annihilation cross section in the energy range 300 GeV - 70 TeV towards the inner Galactic halo. Latest results will be shown including the search for monoenergetic gamma-ray line searches towards the Galactic Center and nearby dwarf galaxies.

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M31 gamma ray emission - a closer look at different explanations

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A new measurement of a spatially extended gamma-ray signal from the center of M31 was published recently, reporting that the emission broadly resembles the so-called Galactic center excess of the Milky Way (Ackermann et al. 2017, arXiv:1702.08602). In this talk we discuss the possibilities that the signal originates from a population of millisecond pulsars, or alternatively the annihilation of

dark matter particles. As an astrophysical interpretation in terms of millisecond pulsars appears viable, we derive upper limits on the annihilation cross section in the $b\bar{b}/\tau\tau$ channel of Weakly Interacting Massive Particles (WIMPs) in a mass range from 1 GeV to 10 TeV, taking into consideration different dark matter density profiles and including the effect of substructure and adiabatic contraction.

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Realistic estimation for the detectability of dark matter subhalos with Fermi-LAT catalogs

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Numerical simulations of structure formation have recorded a remarkable progress in the recent years, thanks to the inclusion of baryonic physics effects. I will present a recent analysis [1] of the sensitivity of Fermi-LAT to detect a subhalo population, built on the results of an hydrodynamical simulation of Milky Way-sized galaxies. The aim is to investigate the effect of baryonic physics on gamma-ray observables.

The detectability of dark matter subhalos is based on the 3FGL and 2FHL Fermi-LAT source catalogs. I will show how the flux sensitivity threshold strongly depends on the particle dark matter mass, and, more mildly, also on its annihilation channel and the observation latitude, and derive predictions for the number of dark matter subhalos that should be found among Fermi-LAT unassociated sources.

A null number of detectable subhalos in the Fermi-LAT 3FGL catalog would imply upper limits on the dark matter annihilation cross section compatible with the limits coming from dwarf spheroidal galaxies. Finally, I will present results for extended subhalos.

[1] F. Calore, V. De Romeri, M. Di Mauro, F. Donato, and F. Marinacci. To appear in PRD [arXiv:1611.03503]

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Sensitivity of the Cherenkov Telescope Array to the Detection of a Dark Matter Signal in comparison to Direct Detection and Collider Experiments

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The search for gamma-ray signals from annihilating cold dark matter (DM) constitutes a complementary approach for DM searches at the LHC and direct detection experiments. The most prominent instruments suited for searches at gamma-ray energies are the Fermi Large Area Telescope and Imaging Atmospheric Cherenkov Telescopes (IACTs). The current generation of IACTs will soon be superseded with the Cherenkov Telescope Array (CTA), which will have a point source sensitivity an order of magnitude better than currently operating IACTs and cover a broader energy range between 20 GeV and 300 TeV. Using effective field theory and simplified models to calculate the gamma-ray spectra resulting from DM annihilation, we compare the prospects to constrain such models with CTA observations of the Galactic center with current and future measurements at the LHC and direct detection experiments. For DM annihilations that are neither velocity nor helicity suppressed, CTA will be able to probe DM models out of reach of the LHC, and, if DM couples to standard fermions via a pseudo-scalar particle, beyond the limits of current direct detection experiments. Only a combined effort of all experimental techniques will make a comprehensive search over the DM parameter space possible.

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Spectral modulation of Galactic Gamma-ray sources due to photon-ALPs mixing in Galactic magnetic field

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Axion like particles (ALPs) are fundamental pseudo scalar particles with properties similar to Axions that have been invoked to solve the strong CP problem in Quantum Chromodynamics. ALPs can oscillate into photons and vice versa in the presence of an external magnetic field. This oscillation of Photon and ALPs could have important implications for astronomical observations, i.e. a characteristic energy dependent attenuation in Gamma ray spectra for astrophysical sources. Here we have revisited the opportunity to search Photon-ALPs coupling in the disappearance channel. We use nine years of Fermi Pass 8 data of a selection of Galactic Gamma-ray source candidates and study the modulation in the spectra in accordance with Photon-ALPs mixing and estimate best fit values of the parameters i.e. Photon-ALPs coupling constant ($g_{\alpha\gamma}$) and ALPs mass (m_a). For the magnetic field we assume large scale galactic magnetic field models based on Faraday rotation measurements.

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Spotting imprints of dark matter in the extragalactic Fermi sky with photon counts statistics

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The dissection of the extragalactic gamma-ray background (EGB) into point sources and diffuse components is a valuable tool to search for new physics such as dark matter. In the recent past, it has been shown that statistical analysis methods can excel the sensitivity of classic source detection approaches. In this contribution, we analyze the eight-year Fermi-LAT data between 1 and 10 GeV by considering 1-point photon counts statistics. We aim at resolving the population of extragalactic point sources and decomposing the diffuse component into Galactic foreground emission and isotropic diffuse background emission. For the first time, the analysis is employed to incorporate a potential contribution from annihilating dark matter (DM), investigating the sensitivity reach of 1-point photon counts statistics for the DM thermally-averaged self-annihilation cross section. We find that the sensitivity of 1-point statistics is highly competitive to upper limits recently obtained with other indirect detection methods.

Neutrino-Gamma connection & The Sun / 121**The Quiet Sun in Gamma Rays: Modeling of the CR Electrons in the Inner Heliosphere****Author(s):** Elena Orlando¹**Co-author(s):** Silvia Raino²; Nicola Giglietto²¹ *Stanford University*² *INFN Bari***Corresponding Author(s):** eorlando@stanford.edu

The Sun in its quiescent state is a known gamma-ray source. The solar emission is produced by Cosmic Rays (CRs) penetrating the inner heliosphere and interacting with the solar atmosphere and optical photons. The solar emission is characterized by two spatially and spectrally distinct components: (i) the disk emission due to hadronic CR cascades in the solar atmosphere, and (ii) the spatially extended inverse Compton (IC) emission due to CR electrons scattering on the solar photons. The intensity of both components anti-correlates with the solar activity being the brightest during solar minima. Observations of the two components at various solar activities allow to gain information on CRs very close to the Sun and on CR propagation in the heliosphere. After the first observation of its gamma-ray emission in the EGRET archival data, Fermi-LAT is separating the two emission components with higher significance, allowing to precisely study the CR in the inner heliosphere. We present updates of the models of the IC emission based on recent CR measurements for various levels of solar activity, and we make predictions for e-ASTROGAM and AMEGO, proposed low-energy gamma-ray missions.

Earth to Heliosphere / 212**Time evolution and study of the two emission components from the Quiescent Sun in 9 years of Fermi-LAT data**Silvia Raino¹¹ *Dipartimento di Fisica, Universita' di Bari & INFN Bari***Corresponding Author(s):** silvia.raino@ba.infn.it

The high energy gamma-ray emission from the Sun is due to the interactions of cosmic ray (CR) protons and electrons with matter and photons in the solar environment. Such interactions lead to two component gamma-ray emission: a point-like emission due to the nuclear interactions of CR protons and nuclei in the solar surface and a spatially extended emission due to the inverse Compton (IC) scattering of CR electrons off solar photons in the whole heliosphere. The observation of these two solar emission components may give useful information about the evolution of the solar cycle by probing two different CR components (proton and electrons) in regions not directly accessible by direct observations. We present the results of the observations of the Sun with Fermi-LAT in the first 9 years on orbit. The significantly larger photon statistics and the improved processing performance allow us to explore and distinguish both components of the emission in greater details and study their evolution in time showing the variations of the emission between the maximum and the minimum of the current solar cycle 24.

Future gamma-ray satellite missions / 173**All-sky Medium Energy Gamma-ray Observatory (AMEGO): Simulations of the Instrument performance****Author(s):** Regina Caputo¹**Co-author(s):** Judith Racusin²¹ *UMD/NASA/GSFC*² *NASA/GSFC***Corresponding Author(s):** regina.caputo@nasa.gov

The gamma-ray energy range from several hundred keV to a hundred MeV has remained largely unexplored since the observations by instruments on the Compton Gamma-Ray Observatory (1991-2000) and on INTEGRAL (since 2002). This energy range is particularly challenging because it is firmly in the Compton-dominated regime where the interaction cross section is minimized. Accurate measurements are critical for answering a broad range of astrophysical questions. To address these questions, we are developing AMEGO: All-sky Medium Energy Gamma-ray Observatory, to investigate the energy range from 200 keV to >10 GeV with good energy and angular resolution and with sensitivity approaching a factor of 20-50 better than previous measurements. This instrument will be capable of measuring both Compton-scattering events at lower energies and pair-production events at higher energies. To achieve these ambitious goals Monte Carlo (MC) simulations will play a crucial role guiding the design of AMEGO. I will present an overview of the AMEGO simulation campaign using the MEGALib framework, as well as the initial results for effective area and angular resolution, as well as sensitivity projections.

Future gamma-ray satellite missions / 236**BurstCube: A CubeSat for Gravitational Wave Counterparts****Author(s):** Jeremy Perkins¹ ; Judith Racusin¹**Co-author(s):** Julie McEnery¹ ; Regina Caputo² ; Daniel Kocevski³ ; David Morris⁴ ; Michelle Hui³ ; Colleen Wilson-Hodge³¹ *NASA/GSFC*² *UMD/NASA/GSFC*³ *NASA/MSFC*⁴ *UVI***Corresponding Author(s):** jeremy.s.perkins@nasa.gov

We present BurstCube, a novel CubeSat that will detect and localize Gamma-ray Bursts (GRBs). BurstCube will detect long GRBs, attributed to the collapse of massive stars, short GRBs (sGRBs), resulting from binary neutron star mergers, as well as other gamma-ray transients in the energy range 10-1000 keV. sGRBs are of particular interest because they are predicted to be the counterparts of gravitational wave (GW) sources soon to be detectable by LIGO/Virgo. BurstCube contains 4 CsI scintillators coupled with arrays of compact low-power Silicon photomultipliers (SiPMs) on a 6U Dellinger bus, a flagship modular platform platform that is easily modifiable for a variety of 6U CubeSat architectures. BurstCube will complement existing facilities such as Swift and Fermi in the short term, and provide a means for GRB detection, localization, and characterization in the interim time before the next generation future gamma-ray mission flies, as well as space-qualify SiPMs and test technologies for future use on larger gamma-ray missions. The ultimate configuration of BurstCube is to have a set of ~10 BurstCubes to provide all-sky coverage to GRBs for substantially lower cost than a full-scale mission.

Future gamma-ray satellite missions / 222**Development and Testing of the AMEGO Silicon Tracker System**Sean Griffin¹

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The All-sky Medium Energy Gamma-ray Observatory (AMEGO) is a probe-class mission in consideration for the 2020 decadal review designed to operate at energies from ~ 200 keV to > 10 GeV. Operating a detector in this energy regime is challenging due to the crossover in the interaction cross-section for Compton scattering and pair production. AMEGO is made of four major subsystems: a plastic anticoincidence detector for rejecting cosmic-ray events, a silicon tracker for measuring the energies of Compton scattered electrons and pair-production products, a CZT calorimeter for measuring the energy and location of Compton scattered photons, and a CsI calorimeter for measuring the energy of the pair-production products at high energies. The tracker comprises layers of dual-sided silicon strip detectors which provide energy and localization information for Compton scattering and pair-production events. A prototype tracker system is under development at GSFC; in this contribution we provide details on the verification, packaging, and testing of the prototype tracker, as well as present plans for the development of the front-end electronics, beam tests, and a balloon flight.

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Exploring the particle nature of dark matter with the All-sky Medium Energy Gamma-ray Observatory (AMEGO)

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The era of precision cosmology has revealed that $\sim 80\%$ of the matter in the universe is dark matter. Two leading candidates, motivated by both particle and astrophysics, are Weakly Interacting Massive Particles (WIMPs) and Weakly Interacting Sub-eV Particles (WISPs) like axions and axionlike particles. Both WIMPs and WISPs have distinct gamma-ray signatures. Thus far, there are no conclusive detections; however, there is an intriguing excess of gamma rays associated with Galactic center (GCE) that could be explained with WIMP annihilation. The angular resolution of the Fermi Large Area Telescope (LAT) at lower energies makes source selection challenging and the true nature of the detected signal remains unknown. WISP searches using, e.g. supernova explosions, spectra of blazars, or strongly magnetized environments, would also greatly benefit from increased angular and energy resolution, as well as from polarization measurements. To address these, we are developing AMEGO, the All-sky Medium Energy Gamma-ray Observatory. This instrument has a projected energy and angular resolution that will increase sensitivity by a factor of 20-50 over previous instruments. This will allow us to explore new areas of dark matter parameter space and provide unprecedented access to its particle nature.

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Gamma-ray Burst and Gravitational Wave Counterpart Prospects in the MeV Band with AMEGO

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The All-sky Medium Energy Gamma-ray Observatory (AMEGO) Probe mission concept is uniquely suited to address open questions in Gamma-ray Burst (GRB) science including the search for counterparts to gravitational-wave events. AMEGO is a wide field of view instrument (~ 60 deg radius) with a broad energy range (~ 200 keV to >10 GeV) and excellent continuum sensitivity. The sensitivity improvement will allow for probes of GRB emission mechanisms and jet composition in ways

that have not been accessible with previous instruments. Potential for polarization measurement may also have profound impacts on the understanding of GRB mechanisms. AMEGO will also be an excellent facility for the search for gravitational wave counterparts to binary mergers including at least one neutron star, which are thought to produce short duration GRBs. This poster will describe how the AMEGO will advance these fields.

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Pulsar Wind Nebulae in AMEGO

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Pulsar wind nebula can emit across much of the electromagnetic spectrum as exemplified by one of the most extreme examples, the Crab Nebula, where the gamma-ray band provides access to emission from the highest energy particles in the nebula. The rapid flares observed peaking close to ~ 1 GeV violate the expected synchrotron cutoff and imply that regions in the Crab Nebula accelerate electrons to \sim PeV energy. The Crab is distinctive in being a nearby, young nebula with a particularly strong magnetic field. Other young nebulae have synchrotron peaks that are expected to cut off at lower energy, in the MeV band, above the reach of hard X-ray telescopes and below that accessible to the Fermi-LAT. In this contribution on behalf of the AMEGO team, we will consider the ability of a medium-energy instrument, such as the All-sky Medium Energy Gamma-ray Observatory (AMEGO), to probe the maximum accelerated particle populations in young pulsar wind nebulae and potential variability in their spectra above the synchrotron peak. We will also explore the ability of an instrument like AMEGO to monitor flares and variability in the Crab Nebula below the energies observed by LAT.

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The MERGER-event Gamma-Ray (MERGR) Telescope

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We describe the MERger-event Gamma-Ray (MERGR) Telescope intended for deployment by ~ 2021 . MERGR will cover from 20 keV to 2 MeV with a wide field of view (6 sr) using nineteen gamma-ray detectors arranged on a section of a sphere. The telescope will work as a standalone system or as part of a network of sensors, to increase by $\sim 50\%$ the current sky coverage to detect short Gamma-Ray Burst (SGRB) counterparts to neutron-star binary mergers within the ~ 200 Mpc horizon of gravitational wave detectors in the early 2020's. Inflight software will provide realtime burst detections with mean localization uncertainties of 6° for a photon fluence of 5 ph/cm^2 (the mean fluence of Fermi-GBM SGRBs) and $<3^\circ$ for the brightest $\sim 5\%$ of SGRBs to enable rapid multi-wavelength follow-up to identify a host galaxy and its redshift. To minimize cost and time to first light, MERGR is directly derived from demonstrators designed and built at NRL for the DoD Space Test Program (STP). We argue that the deployment of a network that provides all-sky coverage for SGRB detection is of immediate urgency to the multi-messenger astrophysics community.