P1 ExtraGalactic

AGN

P1 - 1 **Connection between Gamma-Ray Variations and Disturbances in the Jets of Blazars**

Jorstad, Svetlana G., A.P. Marscher, V.M. Larionov, I. Agudo, P.S. Smith

We present total and polarized intensity images at ultra-high resolution (0.1 milliarcseconds) of a sample of 33 gamma-ray blazars obtained monthly with the Very Long Baseline Array (VLBA) at 43~GHz, starting in Summer 2008 when the Fermi Gamma-Ray Space Telescope began to operate. The VLBA observations determine the flux and polarization of the millimeter-wave core and other components of the jet, as well as the kinematics of bright superluminal knots. We compare the gamma-ray light curves of the blazars, obtained with the Fermi Large Area Telescope, with flux variations in the core and knots, the times when new knots pass through the core, changes in the flux at millimeter, optical, and X-ray wavelengths, and variations in the optical and millimeter-wave polarization. The results of the analysis show that, for a number of the blazars (e.g. AO 0235+164, 3C 279, and PKS 1510-089), strong gamma-ray activity lasting more than a month can include multiple flares with ! different durations and amplitudes on time scales of days or weeks. Such events occur as a new superluminal knot propagates down the inner jet, with the most intense gamma-ray flare occurring as the disturbance interacts with the core.

P1 - 2 **The optical monitoring of the bright gamma-ray blazars by GRT**

Sakamoto, Takanori , D. Donato, N. Gehrels, T. Okajima, C.A. Wallace

We present the optical light curves of 20 bright gamma-ray blazars monitored by Goddard Robotic Telescope (GRT) during the first year of operation. All these sources are monitored by LAT. For all the blazars, we collect the light curves at different wavelengths to investigate possible correlations. We will present the results of blazars which have a good time coverage in the light curves.

P1 - 3 **Radio Band Linear Polarization as a Probe of Gamma-Ray-Flaring Blazar Jets**

Aller, Margo F., Hugh D. Aller, Philip A. Hughes

We describe and present initial results from a Fermi cycle 2 program designed to monitor the centimeter-band linear polarization and total flux density of gamma-ray-flaring blazars using the Michigan 26-m dish. The goal of the program is to identify changes in the magnetic field structure in the radio jet associated with gamma-ray flaring and ultimately to test whether gamma-ray flaring is associated with the onset of shocks. Light curves illustrating variability are shown for sample program sources.

P1 - 4 **Modeling VERITAS IBLs**

Boettcher, Markus ,

I will discuss the implications of the recent discovery of intermediate BL Lac objects (IBLs) by VERITAS, for leptonic models. For this purpose, a brief review of leptonic jet models for blazars will be presented. I will then focus on the appli- cation of these models to the newly discovered IBLs W Comae, 3C66A, and PKS 1424+240. While modeling of the spectral energy distributions of W Comae and 3C66A identifies them as truly intermediate between the classical TeV blazars (high-frequency-peaked BL Lac objects), and quasars, in that they require a moderate amount of external radiation as seed photon field for inverse-Compton scattering to produce the observed gamma-ray emission. The same does not seem to be true for PKS 1424+240. Modeling of the latter object is particularly problematic because of its unknown redshift. I will briefly discuss a redshift constraint based on spectral modeling.

P1 - 5 **Timing signatures of the internal-shock model for blazars**

Boettcher, Markus , C. D. Dermer

A quasi-analytical description of the internal-shock model for blazars has been developed. The underlying simplifications will be briefly discussed. This model allows a quick evaluation of the prevalent spectral and timing features of the internal-shock model for a variety of parameter choices. I will present the results of a general parameter study with emphasis on the signatures of internal shocks in blazar jets on the discrete correlation functions between different wavelength bands, as can be readily calculated from observational data.

P1 - 6 **Coordinated Fermi/Optical Monitoring of Blazars and the Great 2009 September Gamma-ray Flare of 3C 454.3**

Smith, Paul S., E. Montiel, S. Rightley, J. Turner, G.D. Schmidt (UA), B.T. Jannuzi (NOAO/KPNO)

We describe the optical spectropolarimetric monitoring program at Steward Observatory centered around $gamma$-ray-bright blazars and the LAT Monitored Source List planned for Fermi Cycles 2-4. The large number of measurements made during Cycle 1 of the Fermi mission are available to the research community and the data products are summarized (see http://james.as.arizona.edu/simpsmith/Fermi). The optical data include spectropolarimetry at a resolution of sim20~AA, broad-band polarization and flux measurements, and flux-calibrated spectra spanning 4000-7600~AA. These data provide a comprehensive view of the optical variability of an important sample of objects during the Fermi Era. In addition to broad-band flux and linear polarization monitoring, the spectra allow for the tracking of changes to the spectral index of the synchrotron continuum, importance of non-synchrotron emission features, and how and when the polarization varies with wavelength, an important c! lue as to the structure of the emission region and identification of multiple non-thermal components. As an illustration, we present observations of 3C 454.3 obtained in 2009 September during an exceptionally bright $gamma$-ray flare. The blazar was optically bright during the flare, but except for a few short periods, it showed surprisingly low polarization ($P < 5$%). Opportunities exist within the Fermi research community to coordinate with our long-term optical monitoring program toward the goal of maximum scientific value to both the Fermi and associated radio VLBI monitoring of blazars. This work has been made possible by NASA Fermi grant NNX08AV65G.

P1 - 7 **Gamma-ray emission from hot accretion flows**

Niedzwiecki, Andrzej , F.-G. Xie

We discuss the detectability of the gamma-ray emission, induced by proton-proton interactions in hot accretions flows, from nearby AGNs. Interestingly, such a hadronic spectral component can explain the gamma-ray emission observed by Fermi/LAT from Cen A, provided that this object harbors a rapidly rotating black hole.

P1 - 8 **Jet opening angles and gamma-ray brightness of AGN**

Pushkarev, Alexander Dr., Y.Y. Kovalev, M.L. Lister, T. Savolainen

We have investigated the statistical difference in apparent opening angles for parsec-scale active galactic nucleus (AGN) jets detected by the {it Fermi} Large Area Telescope (LAT) during its first three months of operations and those for non-LAT-detected AGN, within the radio-flux limited MOJAVE sample. We used 15.4 GHz VLBA observations of 142 sources from the 2 cm VLBA MOJAVE program. We determined the projected opening angles by analyzing transverse jet profiles from the data in the image plane and applying model fitting technique to the data in the {it (u,v)} plane. Both methods provided comparable estimates. Apparent opening angles of $gamma$-ray bright quasars and BL Lacertae objects are preferentially larger than those of $gamma$-ray weak sources, while distributions of intrinsic opening angles are statistically comparable for these groups of objects. This suggests that the jets in $gamma$-ray bright AGN are pointed at preferentially smaller angles to the line of sight. Intrinsic opening angle and Lorentz factor are found to be inversely proportional, as predicted by standard models of compact relativistic jets.

P1 - 9 **Fermi detected blazars seen by INTEGRAL**

Beckmann, Volker , S. Soldi, C. Ricci

Multiwavelength observations are essential to constrain physical parameters of the blazars observed by Fermi/LAT. Out of the 187 AGN significantly detected in public INTEGRAL data above 20 keV by the imager IBIS/ISGRI, 18 blazars were detected. 11 of these sources allowed significant spectral extraction. They show hard X-ray spectra with an average photon index of 1.55 +- 0.04 with a hard X-ray luminosity of L(20-100 keV) = 1E46 erg/sec. These objects are also included in the Fermi/LAT bright source list, thus allowing to constrain the inverse Compton branch in these cases. Especially for blazars during bright outbursts, as already observed simultaneously by INTEGRAL and Fermi (e.g. 3C 345.3 and Mrk 421), INTEGRAL provides unique spectral coverage up to several hundred keV. We present the spectral energy distributions and discuss the implications based on the combined INTEGRAL and Fermi detections.

P1 - 10 **Optical photometry of X-ray selected BL Lacertae objects since 1997: Black Hole mass - variability amplitude relation for TeV sources**

Kurtanidze, Omar M, Nikolashvili M.G., Kimeridzr G.N. and Sigua L.A.

We present the results of optical monitoring since 1997 of twelve extragalactic X-ray selected BL Lacertae objects identified in the Einstein Slew Survey. Six of them 1ES 0229+200, 1ES 0806+524, 1ES 1011+496, 1ES 1426+428, 1ES 1959+650 and 1ES 2344+514 were later detected at VHE. All these sources have been observed with ST-6 CCD camera attached to the Newtonian focus of the 70-cm meniscus telescope. These data provide optical information on sources that have rarely or never been observed in the optical bands. Variability on long time-scales in R band within 0.10-1.25 magnitude was found for all of the studied sources. The amplitude of variability of these TeV sources is in anticorrelation with their BH masses, so that the sources harboring higher mass Black Holes show lower amplitude of variability.

P1 - 11 **Blazar Jet Emission in the Internal Shock Model Scenario**

Joshi, Manasvita , Markus Boettcher

We use the internal shock model to explore the time-dependent radiation transfer and particle acceleration mechanisms in the inner jet of blazars. We assume a single inelastic collision between a fast and a slow moving plasma shell. The collision results in the formation of a forward and a reverse shock. We consider the instantaneous acceleration of relativistic particles at the two shock fronts, the subsequent radiative cooling of particles, and the resultant self-consistent production of synchrotron and synchrotron self Compton radiation. We apply the multi-zone feedback scheme to incorporate the inhomogeneity in the photon density throughout the emission region. Here, we present the effects of varying relevant parameters on the simulated spectral energy distribution and lightcurves.

P1 - 12 **VERITAS Observations of Radio Galaxies**

Galante, Nicola , VERITAS Collaboration

Radio galaxies are the only non-blazar AGN detected in the VHE (E > 100 GeV) band. These objects enable the investigation of the main substructures of the AGN, in particular the core, the jet and its interaction with the intergalactic environment. Beside the past observation campaigns on radio galaxies performed by VERITAS, the discovery by Fermi of GeV emission from NGC 1275 has triggered a recent observation by VERITAS on this source. Results from the VERITAS observations of radio galaxies and future plans are presented.

P1 - 13 **Radio survey of Fermi LAT bright sources region at declination 32--42 degree**

Kida, Sumiko , T. Tanaka, T. Aoki, K. Asuma, S. Nakagawa, H. Uehara, A. Imai, H. Miyata, H. Akamatsu and T. Daishido

The wide-field survey at 1.4 GHz is carried out by drift scanning in WASEDA NASU Pulsar Observatory. The drift scan survey has been continued almost every day since 2004. The observable declination is 32--42 degrees, and seven Fermi LAT Bright sources (0FGL J0220.9+3607, 0FGL J0320.0+4131, 0FGL J1310.6+3220, 0FGL J1635.2+3809, 0FGL J1641.4+3939, 0FGL J1653.9+3946, 0FGL J1847.8+3223) are within this area. Three sources are galaxies, three sources are QSOs, and one source is a radio source. In our wide - field survey, we were able to obtain data on areas including Fermi sources at a time when these sources were not paid much attention to by other researchers. We report the radio states of 2004--2007 about these sources located in declination 32--42 degree. The flux densities of at least two sources are an increasing tendency from 2004-2005. Both these two sources have not been detected by EGRET and the radio states were steady in 1991--2000. The correlation of the radio detection and the gamma rays detection is reported.

P1 - 14 **Fermi-LAT Observations of the Core of Centaurus A**

Finke, Justin , Fermi Collaboration

The nearby radio galaxy Centaurus A has been detected by the Large Area Telescope (LAT) onboard the Fermi Gamma-Ray Space Telescope. Here we report on the LAT detection of the Cen A core integrated over 10 months. Contamination from the gamma-ray emission of the giant radio lobes has been accounted for and subtracted. The flux level and spectral index observed by the LAT is consistent with that found by EGRET. The core observations are complemented by a variety of contemporaneous and archival data to create a spectral energy distribution (SED). The SED is fit with a single zone synchrotron self-Compton model, which is not able to account for the non-simultaneous very high energy emission observed from Cen A by HESS in 2004--2008. These results have implications for possible emission mechanisms and for blazar/radio galaxy unification.

P1 - 15 **Fermi-Motivated Discovery of Very High Energy Emission from PKS 1424+240 by VERITAS**

Furniss, Amy K, VERITAS and Fermi Large Area Telescope Collaborations

We report on the detection of the very high energy (E $>$ 100 GeV) gamma$-$ray emission from the BL Lacertae object PKS,1424+240 by VERITAS and the study of the spectral energy distribution using additional data from Fermi-LAT and Swift. PKS,1424+240 is the first Fermi-motivated VHE discovery and was observed with VERITAS from February 19th through June 21st of 2009, after being selected from the Fermi Bright Source List as a promising VHE candidate. The observed integral flux above 140 GeV is $(9.9pm3.9)times10^{-12}$ photons cm^{-2}s^{-1} and shows no evidence for variability in the VERITAS data. Contemporaneous multi-wavelength data were obtained with Swift (X-ray & optical/UV), Fermi-LAT (MeV-GeV gamma-ray) and MDM (optical) during the VERITAS observations. The redshift of the object is unknown, with the spectral energy distribution described by a synchrotron self-Compton (SSC) leptonic jet model favoring a redshift of less than 0.4.

P1 - 16 **TANAMI: Milliarcsecond resolution observations of extragalactic gamma-ray sources**

Ojha, Roopesh , M. Kadler and the TANAMI team.

The TANAMI (Tracking AGN with Austral Milliarcsecond Interferometry) and associated programs provide comprehensive radio monitoring of extragalactic gamma-ray sources south of declination -30 degrees. Joint quasi-simultaneous observations between the Fermi Gamma-ray Space Telescope and ground based observatories allow us to discriminate between competing theoretical blazar emission models. High resolution VLBI observations are the only way to spatially resolve the sub-parsec level emission regions where the high-energy radiation originates. The gap from radio to gamma-ray energies is spanned with near simultaneous data from the Swift satellite and ground based optical observatories. We present early results from the TANAMI program in the context of this panchromatic suite of observations.

P1 - 17 **Join Fermi/VERITAS Observations of Mrk 501 during 2008-2009**

Konopelko, Alexander , for the VERITAS collaboration

VERITAS is the high sensitivity instrument of latest generation. It is often used for the short (≤1 hr) AGN monitoring exposures evenly distributed over entire observational season of a source of interest. Each of these exposures is long enough to detect a source at the flux level of about 1 Crab. During 2008-2009 observing season a number of exposures of Mrk 501 with VERITAS revealed variable TeV gamma-ray emission at the level of about 1-2 Crab. Observed TeV emission has never overcome substantially the 2 Crab flux level. A short summary of recent VERITAS results on the Mkn 501 detection, light curve, average low-state and high-state energy spectra will be given at the symposium. Mrk 501 has been detected with Fermi at the >10σ level during the first year of its operation. Contemporary VERITAS and Fermi data samples of Mrk 501 permit detailed spectral measurements. The combined Fermi/VERITAS spectral energy distribution of Mrk 501 along with the spectr! al models will be presented at the symposium.

P1 - 18 **Fermi observations of TeV-selected AGN**

Fegan, Stephen J, on behalf of the Fermi Large Area Telescope Collaboration

We report on observations of TeV-selected AGN made during the first 5.5 months of observations with the Large Area Telescope (LAT) on-board the Fermi Gamma-ray Space Telescope (Fermi). In total, 96 AGN were selected for study, each being either (i) a source detected at TeV energies (28 sources) or (ii) an object that has been studied with TeV instruments and for which an upper-limit has been reported (68 objects). The Fermi observations show clear detections of 38 of these TeV-selected objects, of which 21 are joint GeV-TeV sources and 29 were not in the third EGRET catalog. Most can be described with a power law of spectral index harder than 2.0, with a spectral break generally required to accommodate the TeV measurements. Based on an extrapolation of the Fermi spectrum, we identify sources, not previously detected at TeV energies, which are promising targets for TeV instruments. Evidence for systematic evolution of the gamma-ray spectrum with redshift is presente! d and discussed in the context of interaction with the EBL.

P1 - 19 **Parsec-scale radio emission of jets in Fermi LAT detected AGN**

Kovalev, Yuri Y., MOJAVE collaboration

A comparison of positions from the Fermi LAT 3 months list with positions of VLBI-selected extragalactic jets has yielded bright VLBI counterparts for the majority of Fermi detections. This includes six new associations located within 10 deg from the galactic plane. Further analysis has shown that gamma-ray properties of AGN are closely related to parsec-scale radio emission of their jets. A positive correlation is found between gamma-ray photon flux and parsec-scale radio flux density, measured quasi-simultaneously. Gamma-ray selected AGN appear to have brighter and more compact jets in the radio band, suggesting that they might have higher Doppler factors than other blazars. Correlations found between the temporal radio and gamma-ray variability suggest that the prominent flares in both bands are produced in the parsec-scale jet core regions, typically within an apparent time separation of up to a few months. These results indicate that relativistic beaming of! the parsec-scale jet emission is important in both the low- and high-energy bands.

P1 - 20 **Fermi Observations of the Hard Gamma-ray Blazar PG 1553+113**

Horan, Deirdre , David Sanchez on behalf of the Fermi Large Area Telescope Collaboration

We report the observations of PG 1553+113 with the Fermi Large Area Telescope (LAT). This is the first detailed study of PG 1553+113 in the GeV gamma-ray regime and it allows us to fill a gap of three decades in energy in its spectral energy distribution. We find PG 1553+113 to be a steady source with a hard spectrum that is best fit by a simple power-law in the Fermi energy band. We combine the Fermi data with archival radio, optical, X-ray and very high energy (VHE) gamma-ray data to model its broadband spectral energy distribution and find that a simple, one-zone synchrotron self-Compton model provides a reasonable fit. PG 1553+113 has the softest VHE spectrum of all sources detected in that regime and, one of the hardest spectra measured in the Fermi energy regime. Thus, it has the largest spectral break of any gamma-ray source studied to date, which could be due to the absorption of the intrinsic gamma-ray spectrum by the extragalactic background light (EBL). ! Assuming this to be the case, a particular parameterization of the EBL was used to absorb the power-law spectrum from PG 1553+113 measured with Fermi (200 MeV - 157 GeV) to find the redshift which gave the best fit to the measured VHE data (90 GeV - 1.1 TeV).

P1 - 21 **Spectral properties of Bright Fermi-detected Blazars in the Gamma-ray band**

Escande, Lise , Benoit Lott on behalf the Fermi-Large Area Telescope collaboration

The gamma-ray spectra of bright blazars of the LAT Bright AGN Sample (LBAS) are investigated. Spectral properties (hardness, curvature and variability) established using a data set accumulated over 6 months of operation are presented and discussed for different blazar classes and subclasses: Flat Spectrum Radio Quasars, Low-, Intermediate- and High-frequency peaked BLLacs.

P1 - 22 **The variability of the quasar 3C 273: a radio to gamma-ray view**

Soldi, Simona ,

3C 273 is the brightest quasar in the sky and among the most extensively observed and studied AGN, therefore one of the most suitable targets for a long-term, multi-frequency study. Using radio to gamma-ray data covering up to 40 years of observations, we study the properties of the variability across the 3C 273 spectrum and search for possible connections between the emission at different energies. The amplitude and the maximum time scales of the variations depend strongly on the frequency and show trends that are characteristic of the underlying emission processes. The variability properties of the X-ray band imply the presence of either two separate components (possibly a Seyfert-like and a blazar-like) or at least two parameters with different timing properties to account for the X-ray emission below and above 20 keV. The dominant hard X-ray emission is most probably not due to electrons accelerated by the shock waves in the jet as their variability does not co! rrelate with the flaring millimeter emission, but seems to be associated to long-timescale variations in the optical. This optical component is consistent with being optically thin synchrotron radiation from the base of the jet and the hard X-rays would be produced through inverse Compton processes (SSC and/or EC) by the same electron population. The Fermi monitoring of this source during the first year of operations is a fundamental tool to study the shape and the origin of the gamma-ray emission of 3C 273 and its connection to the X-ray branch of the Compton peak.

P1 - 23 **Extragalactic Jets from the TANAMI Sample as Seen by Fermi/LAT**

Boeck, Moritz , M. Kadler, R. Ojha, G. Tosti, J. Wilms, C. Mueller and the TANAMI and Fermi/LAT Collaborations

Since 2007, the TANAMI program has been monitoring the parsec-scale radio jets of Southern $gamma$-ray bright AGN with VLBI techniques simultaneously with Fermi/LAT monitoring of their $gamma$-ray emission. Here we present the $gamma$ properties of the TANAMI sources based on an analysis of LAT data from the first 11 months of Fermi operations. We compare the radio and $gamma$-ray characteristics of the AGN jets and present upper limits on the $gamma$-ray flux for LAT-undetected TANAMI sources.

P1 - 24 **Monitoring the synchrotron and Compton emission of PKS2155-304: one year of observations with RXTE and Fermi**

Sanchez, David , Berrie Giebels, on behalf of the Fermi Large area collaboration

PKS 2155-304 is a well known GeV and TeV source and one of the brightest blazars in the Fermi sky. We present the result of one year of data taking with Fermi producing the longest light curve on this object. Together with a long time X-ray monitoring program with RXTE, these data give a new picture of the emission mechanisms on long time scales of PKS 2155-304.

P1 - 26 **Fermi-Swift synergetic campaign on the new gamma-ray blazar PKS 1502+106**

Ciprini, Stefano , C. Pagani**, Y. Y. Kovalev**, E. Hoversten**, D. Sanchez* (* on behalf of the Fermi LAT Collaboration) (** on behalf ot the PKS 1502+106 Fermi-Swift multifrequency campaign)

The discovery of gamma-ray emission from PKS 1502+106 by Fermi LAT is reported in conjunction with X-ray observations by Swift and radio-optical data obtained during one of the first successful Fermi multifrequency campaigns. Abstract: The discovery of high-energy gamma-ray emission from the distant blazar PKS 1502+106 by the Large Area Telescope (LAT) onboard the Fermi Gamma-ray Space Telescope is reported. First result on these Fermi LAT observations are presented in conjunction with X-ray observations by Swift and radio-optical data by ground based observatories obtained during a simultaneous multifrequency campaign.

P1 - 27 **Gamma-ray Variability of Bright Fermi LAT Blazars**

Ciprini, Stefano , S. Larsson, S. Cutini, G. Tosti, L. Foschini, B. Lott (on behalf of the Fermi LAT Collaboration)

Some highlights on gamma-ray light curves and gamma-ray variability properties above 300 MeV of blazars from the Fermi LAT Bright AGN Sample and collected during the first eleven months of all sky survey are introduced.

P1 - 28 **VERITAS Observations of Blazars**

Wystan, Benbow R, VERITAS Collaboration

The VERITAS array of 12-m atmospheric-Cherenkov telescopes in southern Arizona began full-scale operations in 2007. It is one of the world's most-sensitive detectors of astrophysical VHE (E$>$100 GeV) gamma rays. Approximately 25 blazars are known to emit VHE photons, and observations of blazars are one of the VERITAS Collaboration's Key Science Projects (KSP). More than 60 of these objects have already been observed with the array, in most cases with the deepest-ever VHE exposure. This contribution will summarize the VERITAS Blazar KSP and its results.

P1 - 29 **Analysis of the Spectral Energy Distributions of Fermi bright blazars**

Cutini, Sara , Paolo Giommi, Nicola Mazziotta, Silvia Rainò e Andrea Tramacere on behalf of Fermi-LAT collaboration

The Large Area Telescope (LAT) is the main instrument on-board the Fermi observatory, successfully launched on June 11 2008. The LAT is a pair conversion telescope presenting a significant improvement in sensitivity over its predecessor EGRET, due to its previously uncovered energy range from 20 MeV to > 300 GeV, to its large field of view and effective area, combined with its excellent timing capabilities. This contribution reports the results of a Spectral Energy Distribution Analysis performed on a sample of 48 LBAS (LAT Bright AGN Sample) blazars observed by the Fermi LAT in its first three months of data taking. Combined data from radio, optical, UV, X-ray and up to TeV energy bands have been combined creating an unprecedented sample of quasi-simultaneous multi-wavelength observations.

P1 - 30 **Multiwavelength observations of the high-frequency-peaked BL Lac object RGB J0710+591**

Fortin, Pascal , Jeremy Perkins

The high-frequency-peaked BL Lac object RGB J0710+591 was discovered at very high energies (E > 100 GeV) by VERITAS. This object was observed for 22.1 hours by VERITAS from December 2008 through March 2009. Contemporaneous optical and X-ray data were obtained from the Michigan-Dartmouth-MIT (MDM) observatory, the Swift Ultra-Violet and Optical Telescope (UVOT), and the Swift X-ray Telescope (XRT). These data were analyzed together with gamma-ray data from the Fermi Large Area Telescope (LAT) covering the same period. Results from modeling the broad-band spectral energy distribution with synchrotron self-Compton (SSC) and external-Compton (EC) models will be presented.

P1 - 31 **Multiwavelength campaign of the gamma-ray flaring source PKS 2052-474**

Chang, Chin-Shin , et al.

The flat-spectrum radio quasar PKS 2052-474 was reported to have increasing optical flux from July to August. On August 9, LAT detected a flare from the source, which reached its active phase in the following two months. To further investigate the physics and mechanism during the flaring state of PKS 2052-474, we arranged a multi-wavelength campaign from radio to gamma-ray to study its spectral energy distribution. The participating facilities include: southern VLBI observations by the TANAMI team, radio flux monitoring with the Ceduna-Hobart observatories, sub-millimeter observations with the APEX telescope, Swift UVOT/XRT/BAT, and the Fermi LAT monitoring. The analysis of the collected data from this campaign will provide physical insights to this flaring source.

P1 - 32 **Intrinsic anisotropy of gamma-ray emission from blazar jets**

Savolainen, Tuomas , D. C. Homan, T. Hovatta, Y. Y. Kovalev, M. L. Lister, and the MOJAVE collaboration

There is both observational evidence and theoretical arguments which strongly suggest that the MeV--GeV $gamma$-rays from active galactic nuclei (AGN) originate in relativistic jets, but the exact mechanism of $gamma$-ray production is poorly understood. Here we report the discovery of a directional dependence of $gamma$-ray emission in the comoving frame of the jet. By combining high-resolution VLBI images and millimeter-wavelength flux density monitoring data of 66 blazars, we have estimated their jet Doppler factors, Lorentz factors, and viewing angles in the observer's frame and in the frame comoving with the jet. The analysis shows that sources detected by the {it Fermi Gamma-ray Space Telescope} have preferentially higher Doppler factors than $gamma$-ray weak sources, and that the $gamma$-rays are emitted into a rather narrow range of angles roughly perpendicular to the jet flow direction in its comoving frame. This intrinsic emission anisotropy indicates either significant direction-dependent photon-photon-absorption or a special emission region geometry, both of which are inconsistent with the simplifying assumptions of the widely used single-zone blazar models.

P1 - 33 **Fermi LAT detection of variability and highest energy gamma-rays from NGC 1275**

Kataoka, Jun , on behalf of Fermi-LAT collaboration

We report a deep look at high-energy gamma-ray emission from NGC 1275, a giant elliptical galaxy lying at the center of Perseus cluster. NGC 1275 was recently discovered with Fermi LAT at a flux about seven times higher than the upper limit of EGRET. This indicates that source must be variable at least on time scales of years to decades, and therefore restricts the fraction of emission that can be produced in extended region of Perseus cluster. After accumulation of one-year all sky survey data, we actually detected significant flux and spectral modulations of this source over a timescale of a few months, suggesting that source emission region is as small as ~0.1 pc scale. Highest energy photon during observation time associated with NGC 1275 was 67.4 GeV, with angular replacement from the nucleus was only 2.4 arcmin. The average flux and power-law photon index, measured between 100 MeV and 50 GeV, are F = (2.19± 0.13)× 10^7 ph (> 100 MeV) cm^-2 s^-1 and Gamma = 2.! 12 ± 0.02, respectively. We discuss intrinsic spectral curvature and possible cutoff of NGC 1275 using the best quality data ever reported.

P1 - 34 **Searching for Very High Energy Flaring States of Blazars in Fermi LAT Data Using Bayesian Blocks**

Chiang, James , Jeff Scargle, on behalf of the Fermi Large Area Telescope Collaboration

Observations of the high-peaked BL Lac objects (HBLs) PKS 2155-304 (by H.E.S.S.) and Mrk 501 (by MAGIC) have shown that very rapid flaring activity is produced by these objects at energies $ga 0.2$ TeV. Even though this emission appears to be connected with epochs of increased X-ray activity, the very short time scales of the flares (sim 5 min) present serious problems for standard synchrotron self-Compton (SSC) emission models. Because observations by ACTs such as H.E.S.S., MAGIC, and VERITAS require dedicated pointed observations, the ubiquity and recurrence rate of these short time scale flares among blazars generally is not known. In the Fermi LAT band, extrapolating reasonable spectral shapes from TeV energies, these flares would appear as a handful of photons with energies $ga 10$ GeV and with arrival times clustered on time scales similar to those seen for highest state epochs of PKS 2155-304 and Mrk 501. The rate of these photons should greatly exceed tha! t of the local diffuse emission, even in regions near the Galactic plane. We present a method for detecting these flares using photon-by-photon exposure-weighting and Bayesian Blocks to reconstruct the light curves on the shortest possible time scales. We verify the method through simulations and present results for HBLs and other blazars using the first year Fermi data. We also discuss a possible trigger mechanism to be implemented in the Fermi-LAT data processing pipeline that may be used to alert ACTs and other observatories of these flaring episodes.

P1 - 35 **Broadband multi-wavelength campaign on PKS2005-489**

Kaufmann, Sarah , S. Wagner, O. Tibolla, F. Volpe, M. Hauser, O. deJager, M. Raue, K. Kosack on behalf of the HESS collaboration and P. Fortin, W. McConville, D. Thompson on behalf of the Fermi/LAT collaboration

The spectral energy distribution (SED) of high-frequency peaked BL Lac objects (HBL) is characterized by two peaks in the UV-X-ray and GeV-TeV regime. An interesting object for analyzing these broadband characteristics is PKS2005-489, which in 2005 shows the softest TeV spectrum ever measured. This year, a multi-wavelength campaign has been conducted with, for the first time, simultaneous observations by HESS (TeV), Fermi (GeV), RXTE (keV), Swift (keV, UV, optical) and ATOM (optical) to cover the two peaks of the SED. During this campaign PKS2005-489 underwent a high state in all wavebands which gives the opportunity to study in detail the emission processes of a high state of this interesting HBL.

P1 - 36 **The relation between radio polarization and gamma-ray emission in AGN jets**

Hovatta, Talvikki , Y. Y. Kovalev, M. L. Lister, A. B. Pushkarev, T. Savolainen, and the MOJAVE collaboration

We have compared the milliarcsecond jet polarization properties of the Fermi LAT-detected and non-detected sources in the complete flux-density-limited (MOJAVE-1) sample of highly beamed AGN. Of the 135 MOJAVE sources, 30 were detected by the LAT during its first 3 months of operation. We find that the unresolved core components of the LAT-detected jets have significantly higher polarization levels at 15 GHz. This complements our previous findings that these LAT sources have higher apparent jet speeds, brightness temperatures, and are preferentially found in higher activity states. Our Doppler factor and apparent speed measurements from the Mets"ahovi and MOJAVE monitoring programs indicated that gamma-ray bright blazar jets may be oriented within a preferential range of jet rest-frame viewing angles. Here we discuss the possibility that the core polarization level differences between LAT-detected and non-detected sources could be understood in this same framework. This work is supported under NASA Fermi Grant NNX08AV67G.

P1 - 37 **Optical Spectroscopy of Fermi LAT Blazars**

Shaw, Michael S, on behalf of the Fermi LAT Collaboration

The Fermi Large Area Telescope (LAT) has detected an unprecedented number of gamma-ray sources. Through a figure of merit procedure, many sources are associated with flat spectrum radio cores, especially at high Galactic latitudes. In order to study the population of these sources, to probe their evolution and to identify targets suitable for further study (e.g. TeV detection or measurements of extragalactic background light attenuation), we must measure redshifts for a large sample. We describe here follow-up optical spectroscopy of blazars associated with LAT catalog sources, determining the source redshift and AGN properties. We present early results on the redshift distribution, and black hole masses of the Fermi blazars.

P1 - 38 **Multi-wavelength Observations of Markarian 501**

Gall, Daniel D, VERITAS Collaboration

The VHE (E > 100 GeV) blazar Markarian 501 has a history of extreme spectral variability and is an excellent laboratory for studying the physical processes within the jets of active galactic nuclei. A short term multi-wavelength study of Markarian 501 was coordinated in March 2009 using the Suzaku X-ray satellite as well as the VERITAS and MAGIC experiments (VHE gamma rays). The results of these simultaneous, quiescent-state observations are combined with public data from the Fermi Gamma-ray Space Telescope and compared to historical observations of the source during an extreme outburst, with the goal of examining the spectral variability, particularly how the spectral energy distribution varies with flux. Studies of possible multi-wavelength correlations, the broad-band spectral energy distribution, and the spectral hardness-intensity correlations during the observations will be presented.

P1 - 39 **Multi-Waveband Variability of Eight Blazars in the First Year of Observations with Fermi**

Chatterjee, Ritaban , Erin W. Bonning, Charles Bailyn, Michelle Buxton (Yale University), Alan P. Marscher, Svetlana G. Jorstad (Boston University), Margo F. Aller, Hugh D. Aller (University of Michigan)

We have analyzed one-year-long light curves of eight blazars in gamma-rays (Fermi), optical-IR (SMARTS), and radio (15 GHz; UMRAO) as well as VLBA images (BU blazar group) at 43 GHz. These eight target objects are chosen based on the availability of relevant data from Fermi, SMARTS, and BU blazar group, which are all public databases. Three of these eight objects (1730-130, 3C 273, and OJ 287) show no significant variability during this time, three others (3C 279, 3C 273, and 3C 454.3) show significant correlated variability in all three wave bands while the other two objects (0235+164, PKS 0528+134) vary significantly in one or more of the lower energy bands but show no variability in gamma-rays. Our analysis include power spectral density, discrete cross-correlation function, and decomposition of the light curves into individual flare(s). Using the results of our analysis we discuss possible location and mechanisms of the time variable emission in these objects.

P1 - 40 **Radio and gamma-properties of the 2cm Survey and MOJAVE samples**

Ros, Eduardo , the MOJAVE collaboration

The 2cm VLBA Survey observed since 1994 a set of over 150 Quasars, BL Lac objects, and radio galaxies, selected to be representative of the compact AGN radio population. This effort was continued as the MOJAVE project, where a statistically complete set of radio sources being monitored was defined. First results on the gamma-radio relationship have been published for those sources. Over 70 prominent AGN are not members of the statistically complete MOJAVE sample, but their radio results can as well be compared with the Fermi/LAT findings. Here we present a study of both sets of sources and their radio-to-gamma properties.

P1 - 41 **The spectral energy distribution of gamma-faint compact radio sources**

Chang, Chin-Shin , et al.

The MOJAVE program has been monitoring over the last years a radio flux-density selected sample of 135 relativistically beamed, flat-spectrum active galactic nuclei. An important fraction of these objects has been detected as well by Fermi/LAT. To understand the divide between gamma activity and quiescence, we selected several of the faintest MOJAVE objects in the gamma-band, and compare the low high-energy emission with the spectral energy distribution provided by the combination of Swift, MOJAVE, Fermi/LAT and other available data. We selected several of the gamma-faint and gamma-quiet MOJAVE objects and compared the LAT results with the spectral energy distribution provided by Swift in the Optical, UV and X-rays, to understand the constrains of their emission at the high-energy bands. This is a part of the analysis being performed at the MOJAVE/Swift program.

P1 - 42 **Revisiting the Blazar Sequence**

Lee, Kuen , S. Thibadeau, H.D. Aller, M.F. Aller, A. Ariel, M. Beilicke, P. Coppi, A. Falcone, H. Krawczynski, A. Lahteenmaki, K. Nilsson, M. Stroh, M. Tornikoski

From observations with EGRET we know that the frequencies at which the low-energy and high-energy components of the spectral energy distributions (SEDs) of blazars peak anti-correlate with their bolometric luminosities. Following the discovery of this anti-correlation, Fossati et al. (1998) and Ghisellini et al. (1998) proposed a simple physical explanation for the anti-correlation in the "blazar sequence", namely that the radiative electron cooling in the more powerful objects accounted for the rather low frequencies of their SED peaks. Except for the most powerful sources, EGRET was only able to make time- and source-averaged statements about the gamma-ray SEDs of blazars. We now re-visit the blazar sequence based on extensive radio (UMRAO, Metsahovi), optical (Tuorla, WIYN), X-ray (Swift), and gamma-ray (Fermi) observations of 26 blazars in 2008 and 2009. The observations deliver broadband spectral energy distributions with unprecedented signal to noise ratio, a! nd allow us to study how well individual sources fit into the blazar sequence. Furthermore, it becomes possible to study how sources move "along" and "perpendicular" to the blazar sequence as they cycle through quiescent and flaring phases. In this contribution, we scrutinize the time resolved blazar SEDs. Using observational tools as broad band cross-correlation analyses, and theoretical tools like snapshot and time-dependent SED modeling, we discuss the implications of the observations for the physical mechanisms which govern the emission properties.

P1 - 43 **Gamma-Ray Properties of Extragalactic Jets from the MOJAVE Sample**

Kadler, Matthias , M. Boeck, G. Tosti, T. Burnett and the LAT and

We discuss the gamma-ray properties of extragalactic jets from the MOJAVE sample. MOJAVE contains a statistically complete VLBI flux-limited subsample of 135 objects, which represent the brightest compact extragalactic jets of the sky. The majority of all sources from the complete MOJAVE sample have been found to be bright gamma-ray emitters by Fermi/LAT. Specifically, gamma-ray emission from all BL Lac objects has been found while about one third of the quasars in the sample remain undetected after 11 months of LAT observations. We will report the distributions of gamma-ray luminosity, photon index and other quantities and will compare gamma-ray bright and gamma-ray faint sources in this complete AGN jet sample.

P1 - 44 **Multiwavelength Observations of Gamma-ray Blazar AO 0235+164**

do Couto e Silva, Eduardo , Luis C. Reyes and Grzegorz Madejski on behalf of the Fermi LAT Collaboration and MW partners

BL Lac object AO 0235+164 (z=0.94) has been one of the most active blazars observed by Fermi LAT since its launch in Summer 2008. In addition to the continuous coverage by Fermi, contemporaneous observations were carried out from radio to gamma-ray frequencies between September and December 2008. In this contribution we summarize the rich multiwavelength data sample collected during the campaign, examine the flux lightcurves measured in the different energy bands, and interpret the resulting spectral energy distribution in the context of well-known blazar emission models.

P1 - 45 **SSC, the End of the Tether**

Alessandro, Paggi , Francesco Massaro, Alfonso Cavaliere

The synchrotron-self Compton (SSC) radiation process provides a close representation of the double-peaked spectral energy distributions in BL Lac Objects. These are marked by pure non-thermal and beamed radiations, highly variable on timescales of days or less, and extending up to extreme (gamma) rays.

P1 - 46 **AGN astrophysics via multi-frequency monitoring of gamma-ray blazars in the Fermi-GST era**

Angelakis, Emmanouil , on behalf of the F-GAMMA team

Several models have been suggested to explain the dramatic behavior of blazars. Although the exact physical processes at play are unclear, the study of the temporal behavior of the SED can shed light on the emission and variability mechanism since different mechanisms predict different variability patterns. Hence, multi-frequency monitoring of blazars is essential in understanding the blazar physics.

P1 - 47 **Connection between gamma-ray and radio activity of blazars from Fermi-LAT and multi-frequency radio cm/mm monitoring with the Effelsberg 100-m and IRAM 30-m telescopes**

Fuhrmann, Lars , on behalf of the Fermi-LAT and F-GAMMA collaborations

Radio cm/mm monitoring of a sample of blazars has been carried out within the F-GAMMA project at multiple frequencies with the Effelsberg 100-m and IRAM 30-m telescopes. A larger sample of blazar candidates from the CGRaBS sample has been observed with the OVRO 40-m telescope. Using these quasi-simultaneous observations we study the connection between the $gamma$-ray behavior of blazars as detected by Fermi-LAT and the cm/mm bands. In particular, comparing the light curves for a large number of sources it is possible to study in detail the relation between the $gamma$-ray and radio activity of LAT $gamma$-ray blazars and its physical implications. Furthermore, we present for the first time the study of a statistically significant cm/mm and $gamma$-ray luminosity correlation. We here show first results using the cm/mm band data obtained with the Effelsberg and IRAM PV telescopes.

P1 - 48 **The Extreme Optical Variability of 4C 38.41**

Miller, H. R., W. Ryle, K. Marshall, J. McFarland, A. Meyers, A. Campbell, J. Eggen, J. Maune, D. Gudkova, J. Noble, J. Wilson and A. Daya

The Fermi blazar, 4C 38.41, was optically monitored from 1994-2009 in order to investigate the structure and time scales of the optical variability. Variations, in the blazar rest frame, of more than a magnitude per day have been observed on several occasions during this monitoring period. Significant variations are reported on timescales ranging from hours to decades. This blazar exhibits some of the most extreme variations detected. These variations provide constraints on the geometry of the source region and the physical processes responsible for these variations.

P1 - 49 **Fermi Large Area Telescope Gamma-Ray Detection of the Radio Galaxy M87**

McConville, William F, C.C. Cheung

We present the high-energy (MeV-GeV) gamma-ray detection of the radio galaxy M87 with the Fermi Large Area Telescope (LAT). The detection of M87 marks the third radio galaxy seen by Fermi in addition to Cen A and Per A. The point-like source, which reached a significance of >10 sigma after 10 months of all-sky survey data, is positionally consistent with the center of M87. Spectral analysis of the source resulted in a >100 MeV flux of 2.5 * 10^-8 ph cm^-2 s^-1, and a photon index of 2.3. Thus no significant flaring of the source is observed on decade timescales when compared to the previous 2 sigma EGRET upper limit of < 2.18 * 10^-8 ph*cm^-2*s^-1. Ten-day light curves using the Fermi data reveal no significant gamma-ray variability over the duration of the LAT observation. Comparison of contemporaneous Chandra and VLBA observations with previous measurements indicate that the source was in a quiescent state during this time. The broadband SED, which uses both the ! contemporaneous VLBA and Chandra observations, is fit with a one-zone synchrotron self-Compton jet model from the electron population producing the radio to x-ray emission in the sub-pc scale core.

P1 - 50 **Results from the observation of extragalactic objects with the MAGIC telescope**

Kranich, Daniel , the MAGIC collaboration

The MAGIC air Cherenkov telescope, located on the Canary island La Palma, has been designed for a low energy trigger threshold (~50 GeV), a fast repositioning time (less than 30s) and is also able to observe in the presence of strong moonlight. MAGIC is therefore very well suited for the observation of fast transient objects like GRBs or flaring AGN. In the past couple of years MAGIC has made significant contributions to VHE gamma-ray astronomy covering well-studied bright Blazars like Mrk 421 and Mrk 501, the radio galaxy M 87 or the distant flat spectrum radio quasar 3C 279. All MAGIC AGN observations have simultaneous coverage in optical through the KVA telescope and, in addition, already three Blazars could be detected at TeV energies following an optical trigger from KVA. MAGIC also took part in several extended MWL campaigns with FERMI this year. Here we present and discuss selected highlights from recent MAGIC observations.

P1 - 51 **The TANAMI Program: Tracking Active Galactic Nuclei with Austral Milliarcsecond Interferometry**

Mueller, Cornelia , M. Kadler, R. Ojha, J. Wilms, M. Boeck and the TANAMI Collaboration

We discuss TANAMI, a VLBI monitoring program to study the structure and dynamics of relativistic jets in active galactic nuclei (AGN). TANAMI is a unique complement to other ongoing VLBI monitoring programs of AGN as it focuses on sources south of -30 degrees declination. The observations are being conducted bimonthly at 8.4GHz and 22GHz with the Australian Long Baseline Array and the trans-oceanic antennas Hartebeesthoek, TIGO and O'Higgins achieving milliarcsecond resolution imaging of the AGN jets' parsec scale structure and variability. We describe the observation strategy and source-selection criteria and present first 22GHz images of Fermi/LAT detected AGN jets.

P1 - 52 **Constraining the magnetic field in the parsec-scale jets of the brightest Fermi blazars with multifrequency VLBI observations**

Sokolovsky, Kirill V, Y.Y. Kovalev, A.P. Lobanov, A.B. Pushkarev, T. Savolainen, M. Kadler

We search for a turnover caused by synchrotron self-absorption in radio spectra of selected bright Fermi blazars by means of dedicated seven frequency (5-43 GHz) VLBA observations during the first year of Fermi operations. This allows us to estimate the magnetic field strength for sources for which the self-absorption turnover was detected or put upper limits on it if the turnover was detected but the emitting region was not spatially resolved. We use a novel approach to reconstruct radio spectra in individual pixels of VLBI images. The results are compared to estimates obtained by a method based on model-fitting bright VLBI components with 2D Gaussian functions. Since gamma-ray emission in blazars is suggested to originate from regions spatially close to the VLBI core, the estimations of the magnetic field strength could be used to constrain SED models.

P1 - 53 **Study of the Classical TeV blazars Mrk421 and Mrk501 with Fermi**

Paneque, David ,

Despite High Peak BL Lacs (HBL) being observed for tens of years, the existing experimental data set is not sufficient to unambigously identify the physical mechanisms responsible for the electromagnetic emission. The Fermi-LAT instrument, which started operation in August 2008, provides "continuous" source coverage with high sensitivity in the band 0.1-100 GeV, which is rather unexplored for HBLs. In particular, the simultaneous observations of HBLs with Fermi-LAT and Imaging Cherenkov Telescopes (IACTs) have the unprecented capability of resolving the complete high energy bump without gaps, which is a very valuable information to reﬁne (or rule out) the currently available theoretical emission models. In the conference I will report on the 1-year Fermi view of two classical TeV HBL sources: Markarian 421 and Markarian 501. In addition, I will also show results from the multi-frequency (radio to TeV) observations performed within the 4.5 months long campaig! ns that we organized on those two objects in 2009. During these campaigns we collected the most complete simultaneous multi-frequency data set from these blazars up to date, which includes, for the first time, the information from the GeV energies measured by Fermi-LAT.

P1 - 54 **Connection between gamma-ray and radio activity of blazars from Fermi-LAT and 15 GHz radio monitoring with the OVRO 40-m telescope**

Max-Moerbeck, Walter , W. Max-Moerbeck on behalf of the Fermi-LAT and F-GAMMA collaborations

A large sample of blazar candidates from the CGRaBS sample has been observed with the OVRO 40 m telescope at 15 GHz. Using these quasi-simultaneous observations we study the connection between the gamma-ray behavior of blazars as detected by Fermi-LAT and the cm band as observed by the F-GAMMA project with the OVRO 40 m telescope. Comparing the light curves for a large number of sources it is possible to study in detail the relation between the gamma and radio activity of LAT gamma-ray blazars. We present first results for correlations between Fermi-LAT and our 15 GHz observations.

P1 - 55 **The Allowed Synchrotron Self Compton Parameter Space for HBLs**

Massaro, Francesco , M. Elvis (Harvard-SAO)

Most $gamma$-ray detected extragalactic sources are Blazars. The subclass of ``high frequency peaked blazars'' (HBLs), have spectral energy distributions (SEDs) with a lower energy peak, probably due to synchrotron emission, in the X-ray band, and have X-ray spectra that are generally curved with a log-parabolic shape. The higher energy peak, most likely due to a Comptonized component, lies in the $gamma$-ray.

P1 - 56 **Extensive optical and NIR monitoring of gamma-ray and mm-wave bright blazars**

Carramiñana, Alberto , L. Carrasco, V. Chavushyan, E. Recillas, I. Pedraza

We established a sample of mm-wave and gamma-ray bright blazars through matching the WMAP catalog with the 3EG catalog, Fermi 0FGL bright source list and individual E>10 GeV photons. Starting on August 2007, we established a dedicated monitoring program with more than 40 nights allocated per semester on the 2.1m telescope at the Observatorio Astrofisico Guillermo Haro, in Cananea, Sonora, Mexico. The program consists of optical photometry (BRVI), low resolution spectroscopy and near infrared JHKs imaging - the later with 2000 data points already reduced. The current study will lead to follow-up and identification programs using optical and NIR facilities, like the 2.1m OAGH telescope, and the Large Millimeter Telescope.

P1 - 57 **Spectrophotometric optical and near infrared characterization of 3C454.3 under the Fermi light**

Carramiñana, Alberto , L. Carrasco, V. Chavushyan, E. Recillas, I. Pedraza

We have performed frequent observations of 3C 454.3, with optical BVRI and near infrared JHKs measurements covering more than 20 epochs in two years. In addition we have obtained optical spectra in the 4000-7000 A band in five epochs. All these measurements are presented and discussed in consideration of the guaranteed contemporaneous Fermi observations.

P1 - 58 **Is Fermi (already) answering our questions on blazar unification scenarios?**

Fossati, Giovanni , Eileen Meyer

Over the last several years we have seen limited progress in our understanding of radio-loud AGNs. While disputed, the general concept of the blazar sequence has remained the leading ``general'' framework for organizing and hopefully understanding the properties of blazars.

P1 - 59 **Optical Monitoring of Blazars by the MITSuME Telescope**

Mori, Yuki A, N.Kawai, M.Yoshida, Y.Yatsu, T.Shimokawabe, H.Nakajima, A.Endou

We are performing automatic optical monitoring of blazars using the MITSuME Telescope, a 50 cm optical telescope equipped with a tricolor camera capable of simultaneous imaging in g', Rc and Ic bands.

P1-239 **On the Power of Jets in Fermi Blazars**

Maraschi, Laura,

The physical properties and specifically the total power carried by the jets for the FERMI blazar sample will be discussed. The analysis is based on detailed one-zone modeling of the blazar SEDs, leading to estimate in a homogeneous way the interesting physical quantities in the dominant emission region within the jet. A significant correlation between the jet power and the luminosity of the accretion disk is found for the FSRQs subsample, suggesting a close relation between the jet power and the accretion power. Assuming that the same relation holds for BL Lacs, the absence/weakness of emission lines and the different shapes of the SEDs for the latter can be simultaneously understood as due to the radiative inefficiency of the accretion flow at low Eddington ratios, consistently with their gamma-ray luminosities and masses. The derived near equality and correlation between jet power and accretion power in FSRQs supports the Blandford Znajek mechanism for the origin of jets.

EBL

P1 - 60 **Modeling the Extragalactic Background Light from Stars and Dust**

Justin, Finke D, Soebur Razzaque, Charles Dermer

The extragalactic background light (EBL) from the far infrared through the visible and extending into the ultraviolet is thought to be dominated by starlight, either through direct emission or through absorption and reradiation by dust. IR/optical photons absorb 10 GeV - multi-TeV gamma-rays from distant sources such as blazars and GRBs and producing electron positron pairs. We present an EBL model of the far-infrared through ultraviolet that consistently takes into account the star formation rate (SFR), and initial mass function (IMF), including main sequence and post-main sequence stars, and self-consistently treats dust absorption and re-radiation. We find our best-fit model combining the Hopkins and Beacom SFR using the Cole et al. parameterization with the Baldry and Glazebrook IMF is shown to agree with available luminosity density data at a variety of redshifts. Our resulting EBL energy density is quite close to the lower limits from galaxy counts and in ! some cases below the lower limits, and agrees fairly well with other recent EBL models shortward of about 5 mum. This model has implications for the absorption of $gamma$-rays detected from high redshift objects by the Fermi-LAT. For those GRBs lacking a redshift, EBL attenuation can be used to place an upper limit based on Fermi GBM and LAT data for the burst.

P1 - 61 **A method for constraining the extragalactic background light with Fermi and TeV observations of blazars**

Georganopoulos, Markos , Justin Finke, Luis Reyes

We propose a method for setting upper limits to the infrared to ultraviolet extragalactic background light (EBL). Our method uses simultaneous {em Fermi}-LAT GeV and ground-based TeV observations of blazars and is based on the assumption that the intrinsic TeV spectral energy distribution (SED) of TeV blazars lies below the extrapolation of the GeV SED from GeV toTeV energies. If this is the case, by extrapolating the Fermi-LAT spectrum, which is practically unattenuated by photon-photon pair production with EBL photons, to TeV energies, a firm upper limit on the intrinsic TeV SED is provided. The ratio of this upper limit on the TeV spectrum to the observed TeV spectrum provides an upper limit to the optical depth for the propagation of the TeV photons due to pair production on the EBL, which in turn sets firm upper limits on the EBL. We demonstrate this method using recent simultaneous observations with {em Fermi}-LAT and TeV atmospheric Cherenkov telescopes of the blazar object PKS 2155-304.

P1 - 62 **Contribution to the Extragalactic Gamma-ray Background from the Cascades of Very-high Energy Gamma Rays from Blazars**

Venters, Tonia M,

As very-high--energy photons propagate through the extragalactic background light (EBL), they interact with the soft photons and initiate electromagnetic cascades of lower energy photons and electrons. The collective intensity of a cosmological population emitting at very-high energies (VHE) will be attenuated at the highest energies through interactions with the EBL and enhanced at lower energies by the resulting cascade. We calculate the cascade radiation created by VHE photons produced by blazars and investigate the effects of cascades on the collective intensity of blazars and the resulting effects on the extragalactic gamma-ray background. We find that cascade radiation greatly enhances the collective intensity from blazars at high energies before turning over due to attenuation. The prominence of the resulting features depends on the blazar gamma-ray luminosity function, spectral index distribution, and the model of the EBL. We additionally calculate the casc! ade radiation from the distinct spectral sub-populations of blazars, BL Lacertae objects (BL Lacs) and flat-spectrum radio quasars (FSRQs), finding that the collective intensity of BL Lacs is considerably more enhanced by cascade radiation than that of the FSRQs. Finally, we discuss the implications that this analysis and upcoming emph{Fermi} observations could have for the nature of the EBL, the evolution of blazars, blazar spectra, and other sources of gamma-ray radiation.

Other Galaxies

P1 - 63 **The mechanism of suppressed dynamical friction in a constant density core of dwarf galaxies**

Inoue, Shigeki Mr.,

The dynamical friction problem is a long-standing dilemma. In dwarf galaxy, dynamical friction is too effective for their globular clusters (hereafter, GCs) to keep their orbital motion. Nonetheless, these GCs do exist even in current dwarfs. However, if dwarf galaxies have a cored dark matter halo which has a constant density region in its center, the dynamical friction is significantly weakened (suppressed dynamical friction). But, the mechanism of the suppressed dynamical friction has not been clarified yet. By means of N-body simulation, I discuss the mechanism of the suppressed dynamical friction.

P1 - 64 **Search for GeV gamma-ray emission from clusters of galaxies studied by TeV telescopes**

Mori, Masaki ,

A cluster of galaxies is a huge system bounded by gravitation, and cosmic rays are thought to be confined in the system, thus it should contain much non-thermal components. Many theories predict significant gamma-ray emission that could be detectable by state-of-the-art gamma-ray telescopes. Some clusters have already been studied by using Fermi gamma-ray space telescope in the GeV band and Cherenkov telescopes in the TeV band, but most clusters are not studied in both energy bands. Here I present results on GeV gamma-ray emission from clusters of galaxies which have been given upper limits by Cherenkov telescopes using Fermi archival data.

P1 - 65 **Models analysis of the VHE detections of the starburst galaxies M82 and NGC 253**

de Cea, Elsa , Diego F. Torres, Ana Y. Rodríguez

In the light of recent results detecting the nearest starburst galaxies M82 and NGC 253 at very high energy (VHE), we present a multi-wavelength model successfully explaining their gamma-ray diffuse emission. The detection of M82 was presented by VERITAS collaboration in the recent ICRC, while the integral flux of the fainter NGC253 has just been published by H.E.S.S. Collaboration. Slight and reasonable variations in the space parameter of already published models can fully account for the VHE emission coming from both galaxies, while agreeing with previous data detected from radio to infrared. We explore these changes and the implications they have for the cosmic-ray distribution in these galaxies.

P1 - 66 **GeV gamma-ray observations of galaxy clusters with the Fermi LAT**

Bechtol, Keith C, On behalf of the Fermi LAT Collaboration

We explore non-thermal properties of galaxy clusters using first year data collected by the Fermi LAT. Our search for gamma rays emanating from galaxy clusters is motivated by the existence of diffuse radio halos and relics around many of these objects suggesting populations of energetic particles confined by intergalactic magnetic fields. Interactions between these cosmic rays, magnetic fields, and intergalactic gas all contribute to the pressure and energy budget of the intergalactic medium. In addition, galaxy clusters may host distinctive particle acceleration processes along large scale structure formation shocks. LAT observations in the GeV energy range can directly assess the hadronic cosmic-ray energy content of galaxy clusters by constraining gamma-ray emission related to neutral pion decay. No galaxy clusters were detected by the LAT during the first year of science operations and consequently flux upper limits will be presented.

P2 Galactic

Galactic Binaries

P2 - 67 **H.E.S.S. VHE gamma-ray observations of the microquasar GRS 1915+105**

Szostek, Anna , Guillaume Dubus

GRS 1915+105 is a very well studied microquasar with a wide variety of temporal and spectral states. Multi-wavelength observations from radio to X-rays have uncovered clear relations between the variability in different bands. GRS 1915+105 is also well-known as a source of superluminal jets moving away from the core with true velocity ge0.9 c. Non-thermal emission from the jets or their termination shock could extend to the VHE gamma-ray domain. GRS 1915+105 was observed with the H.E.S.S. telescope array between 2004 and 2008 for a total of 24 hours. We report on these observations and discuss our findings.

P2 - 68 **X-ray absorption and occultation in gamma-ray binaries.**

Szostek, Anna ,

In the framework of the model where gamma-ray binaries are composed of a pulsar and massive star, the VHE gamma-ray emission is produced as a result of the collision between the relativistic pulsar wind and the wind of the massive star. The shocked winds are also places where the X-ray emission originates. The X-rays emitted from the shock on their way to the observer are absorbed in the stellar wind. In addition, for some configurations, the emitting parts of the shock can be occulted by a massive star. We model the orbital modulation of the X-rays in the colliding winds model and apply it to gamma-ray binaries LS 5039 and LS I+61 303. The results are used to put constraints on the binary parameters.

P2 - 69 **4U 1909+075: a well-hidden pearl**

Fuerst, Felix , Ingo Kreykenbohm, Joern Wilms, Slawomir Suchy, Katja Pottschmidt, Laura Barragan, Peter Kretschmar, and Richard E. Rothschild

We present the first detailed studied of the HMXB 4U 1909+07 with INTEGRAL. The object is not well known, only two studies, based on RXTE data have been published to date. We analyze the pulse period evolution and find that it follows a random walk like pattern, typical for a wind accreting source and confirming the classification as HMXB. The pulse profile shows a strong energy dependence in comparison to RXTE PCA data. It is not only more complex at lower energies but the secondary pulse in the profile vanishes completely at energies above 20 keV. We argue that this is most likely due to different temperatures of the electron plasma above the two magnetic poles. The joint spectrum of INTEGRAL ISGRI, RXTE PCA and HEXTE can be very well simultaneously fitted with standard neutron star spectral models.

P2 - 70 **Hunting for New Gamma-ray Binaries - Technique Development**

Corbet, Robin , Matthew Kerr

There are only a few sources that are definitely known to be gamma-ray binaries. Two of these are listed as associations in the Fermi LAT Bright Source List. We are developing novel techniques to extract high signal-to-noise light curves of all cataloged Fermi sources and to search for periodic variability using appropriately weighted power spectra. The detection of periodic variability would be strong evidence for the detection of a new gamma-ray binary. The LAT's sensitivity provides the potential to open up completely new discovery space for additional binary systems, potentially involving novel astrophysics. We present here demonstrations of the sensitivity gains obtained through the use of these techniques.

P2 - 71 **Study of gamma-ray binaries in the Fermi era.**

Chernyakova, Maria , Andrii Neronov

There are a small but growing number of high mass X-ray binaries that also exhibit MeV--TeV emission. Currently, this category of ``$gamma$-ray loud binaries'' includes only four systems: PSR B1259--63, LS I +61 303, LS 5039, and HESS J0632+057. In this presentation we discuss the temporal and spectral properties of the systems basing on the latest X-ray and gamma-ray (Fermi) observations.

P2 - 72 **Search for Colliding-Wind Induced Gamma-Ray Emission in High-Mass X-Ray Binaries**

Shrader, Chris R, Macomb, D.J.

We describe our ongoing work utilizing the combined databases of the Fermi LAT Swift BAT, and INTEGRAL to search for gamma-ray emission from hard-X-ray selected high-mass X-ray binaries. Of particular interest are the high-amplitude variables including the recently identified Super Giant Fast X-Ray Transients (SFXTs). We are attempting to exploit the high-duty cycle coverage of Swift BAT to construct hard-X-ray light curves, identify periods of activity and/or light curve inflections in our sample objects. We then focus our Fermi LAT data analysis efforts on accordingly on such events. Our motivation is that the currently known gamma-ray emitting X-ray binaries – LSI +61 303 and LS 5039 – are high-mass systems characterized by low-X-ray luminosities (L_x~10^33 ergs/s) comparable to the quiescent luminosities of the SFXTs and which are likely to be wind-wind rather than accretion powered systems. Furthermore, the compact secondary in LSI +61 303 has exhibited magnet! ar-like behavior in a 2008 outburst event documented by Swift. One of the two classes of models for the SFXTs involves magnetically gated accretion. While that avoids the requirement of density fluctuations of 3-4 orders of magnitude necessitated by the competing clumped-wind models, the magnetic fields required are high (upwards of 10^14 G) and the absence of X-ray or radio pulsations remains problematic. On the other hand, there are a number of slow-rotators recently identified with neutron star spin periods upwards of 10^3 s which could represent spun-down magnetars adding further support to this idea. Additionally, the recent Fermi pulsar detections have demonstrated the importance of energy-dependencies in beaming geometries and the viability of gamma-ray studies. We speculate that the mechanism responsible for the gamma-ray emission seen in the two LS sources could be present at a lower level in some of these other binaries, and a combination of deep searches, plus s! horter, epoch-selected studies as well as possible phase-resol! ved sear ches could be revealing.

P2 - 73 **Routine Science Processing of Fermi/LAT data for monitoring X-ray binary systems**

Glanzman, Thomas , R. Dubois, D.L. Flath

The Fermi Gamma-ray Space Telescope normally transmits science data to earth every two orbits (~180 minutes); basic event reconstruction is typically complete 24 hours later. An Automated Science Processing (ASP) task then takes a quick look at all data, recording, for example, blazar activity. This is followed by a number of semi-automated Routine Science Processing (RSP) tasks. One such RSP task monitors pulsars. Another RSP task, and the focus of this work, analyzes and monitors X-ray binary systems, including source detection, spectral analysis, and activity trending for each source. The structure and features of this task, plans for future enhancements, and its application to the LS 1 +61 303 system are described.

P2 - 74 **Accreting pulsars as possible sources of high-energy gamma-rays**

Walter, Roland ,

INTEGRAL has tripled the number of wind fed supergiant High Mass X-ray binaries known in the galaxy. The new systems are either higlhly obscured or transcients. We show that part of these systems could become very high-energy sources if protons are accelerated in the pulsar's magnetosphere.

P2 - 75 **Particle acceleration in eta Carinae**

Walter, Roland , J-C Leyder

If relativistic particle acceleration takes place in colliding-wind binaries, then hard X-rays and gamma-rays are expected through inverse Compton scattering of the copious UV radiation field. INTEGRAL provided hard X-ray images of the Carina region with a much higher spatial resolution than previously available. Based on observations taken far from periastron, a bright source was detected at the position of eta Car up to 100 keV. Two additional nearby hard X-ray sources could also be resolved. This is the first unambiguous detection of eta Car at hard X-rays. There is no other X-ray source in the hard X-ray error circle, bright enough to match the hard X-ray flux.

P2 - 76 **Spectral States of Cygnus X-3**

McCollough, Michael L.,

Cygnus X-3 is a unique microquasar. Its X-ray emission shows a very strong 4.8 hour orbital modulation which is typical for a low-mass X-ray binary. But its mass-donating companion is a Wolf-Rayet star which makes it a high-mass X-ray binary. Also unlike most other X-ray binaries Cygnus X-3 is relatively bright in the radio virtually all of the time (the exceptions being the quenched states). In addition, Cygnus X-3 undergoes giant radio outbursts (up to ~20 Jy) and there is strong evidence of jet-like structures moving away from Cygnus X-3 at 0.3-0.9c.

P2 - 77 **The clumpy wind of Vela X-1**

Fuerst, Felix , Joern Wilms, Ingo Kreykenbohm, Katja Pottschmidt, Manfred Hanke, Richard E. Rothschild, Peter Kretschmar, Dmitry Klochkov, Ruediger Staubert

We investigate the structure of the wind in the binary system Vela~X-1, consisting of a neutron star and the high mass donor star HD 77581, by analyzing the flaring behavior in X-rays. Vela~X-1 shows constant flaring, with some giant flares reaching fluxes of 7.0,Crab above 20,keV for a few hundred seconds, while the average flux is around 300,mCrab. We analyzed all archival textit{INTEGRAL} data, calculating the brightness distribution in the 20--60,keV band. We show that the orbital averaged distribution is closely following a log-normal distribution. We conclude that the accreted mass distribution must also follow a log-normal distribution to explain the flaring behavior. In case the highly structured wind is accreted unperturbed, this would lead to clump masses of the order of 10^{20}--10^{21},g. We can further point out that the recently discovered class of SFXT seems to show the same parameters for the wind further strengthening the link between persistent HMXB like Vela~X-1 and SFXT.

Magnetars

P2 - 78 **October 2008 bursting activity of SGR J1550-5418 as observed by Fermi/GBM**

von Kienlin, Andreas , on behalf of the Fermi/GBM Magnetar team

In early October 2008, SGR J1550-5418 (formerly classified as AXP 1E 1547.0-5408) became active, emitting a series of bursts, which triggered the Gamma ray Burst Monitor (GBM) onboard Fermi 7 times. The active period lasted for 7 days and the source was not detected as a burster again until January 2009. The October 2008 activity was also observed with Swift in the hard X-ray regime. A multitude of un-triggered events were also recorded during this period. SGR J1550-5418 was first detected with the Einstein observatory $sim 30$ years ago (1E 1547.0-5408); recent X-ray and optical observations of the source, however, suggested that it could be a magnetar candidate. Due to the absence of burst emission, the source was originally classified as an Anomalous X-ray Pulsar (AXP). The detection of the two extremely active bursting periods with properties typical of Soft Gamma Repeaters, indicates that the classification of the source as an SGR is more appropriate. We repo! rt here on the timing and spectra of the observations obtained with the Fermi/GBM in October 2008.

P2 - 79 **Suzaku Results on Extremely Hard X-rays from Magnetars**

Enoto, Teruaki , Kazuo Makishima, Nanda Rea, Yujin Nakagawa,Kazuhiro Nakazawa, Takanori Sakamoto, YukikatsuTerada, Masanori Ohno

The Japanese X-ray satellite Suzaku has recently observed an hard X-ray emission from several magnetars, with a power-law spectral decomposition with photon indexes above 10keV of Gamma~ 1. The emission mechanism of this new enigmatic component has not yet been unveiled. Last two years, Suzaku has performed two target-of-opportunity observations of a newly discovered magnetar SGR 0501+4516 and of the transient radio magnetar 1E‾1547.0-5408, both soon after a large X-ray outburst. Suzaku successfully detected extremely hard power-law components with Gamma~0.79 and 1.54 for SGR‾0501+4516 and 1E‾1547.0-5408, respectively, as well as their soft X-ray thermal and non-thermal emissions. Furthermore, combining these results with those found for other members of the class, we found that the ratio of hard over soft X-ray flux of magnetars, seems to negatively (or positively) correlate with their characteristic ages (or magnetic fields). This gives a further hint for unifying SGRs and AXPs into one scheme, directly connected to decay of the magnetic activity in the evolution of magnetars. We report here the Suzaku results for ~10 magnetars, as well as discussing the perspectives for higher energy band observations, such as with Fermi-LAT or other missions.

P2 - 80 **The spectacular X-ray echos of a magnetar burst**

Vianello, Giacomo , Tiengo, A.; Esposito, P.;Mereghetti, S.;

The Anomalous X-ray Pulsar (AXP) 1E 1547.0-5408 reactivated in 2009 January with the emission of dozens of short bursts, observed by Integral/ACS, Fermi/GBM and a lot of other instruments. Follow-up observations with Swift/XRT showed the presence of three expanding rings around the position of the AXP. These rings are due to the scattering, by different layers of interstellar dust, of the radiation emitted by 1E 1547.0-5408 on January 22. Thanks to the exceptional brightness of the X-ray rings, we could carry out a detailed study of their spatial and spectral time evolution, followed with both Swift/XRT and XMM-Newton/EPIC. We have obtained the first measurement of the distance of a Galactic magnetar candidate, and we have derived tight constraints on the properties of the dust responsible for this rare phenomenon.

P2 - 234 **Magnetar in a Frenzy: Fermi/GBM Spectral Analysis of SGR J1550-5418 Bursts**

van der Horst, A.J. , C. Kouveliotou, Y. Kaneko, E. Gogus, on behalf of the GBM Magnetar Team

After the discovery of bursts from Soft Gamma Repeater J1550-5418 in October 2008, the source entered a second very active period on January 22 2009 which lasted for a month. The large peak of activity was on the first day, when the Fermi Gamma-ray Burst Monitor (GBM) detected hundreds of bursts. We present here first results of a detailed spectral study of a sub-sample of these bursts. The combination of the optimal GBM temporal and spectral capabilities has enabled us to study integral and time-resolved spectra in great detail for the first time up to 200 keV.

Pulsars

P2 - 81 **Pulsar high-Energy radiation: A diagnostic tool for magnetic field structure in the magnetosphere**

Wang, Yu , Takata J, Cheng K.S., Bai X. and Spitkovsky A.

Motivated by recent progress of studies on structure of pulsar magnetosphere and results of gamma-ray instruments in high-energy bands, the magnetic field structure in pulsar magnetosphere is investigated with the high-energy emission model and observations. We apply the outer gap accelerator model to the Crab pulsar, and compute the spectra and pulse profiles of the high- energy emissions for the different magnetic field structures. To examine dependency of the emission properties on structure of the magnetosphere, we apply two extreme cases; (1) force- free field and (2) the vacuum dipole field. We find that both phase-averaged spectra calculated with the force-free field and the vacuum field are consistent with the present γ-ray data including very high energy data by Fermi and MAGIC data, implying that the magnetic field structures can not differentiate with the observed phase-averaged spectrum. On the other hand, it is found that the phase-resolved spectra calculated with the force-free field and the vacuum field show different properties each other. Specifically, the present outer gap model predicts that the calculated flux of the phase-resolved spectra at the second peak with the force-free field is about one order smaller than that with the vacuum field. This indicates that the phase-resolved spectra can discriminate the field line structure, for which neither vacuum field nor force-free field is expected. We discuss that a study of phase-resolved spectra with the different magnetic field structures will be an important tool to resolve the mechanism of the high-energy emissions from the pulsars.

P2 - 82 **Pulsar Magnetosphere Geometries and Simulations of High Energy Emission Models**

Watters, Kyle P, Roger Romani

Young pulsars are the dominant class of Fermi-detected objects in the Galactic plane. However, despite years of study, there are still major gaps in our understanding of the emission mechanism of pulsar gamma rays. I will present recent work modeling the geometry of the magnetospheric field and computations of the pulsed emission from these field lines. We consider both the Outer Gap model and the Two-Pole Caustic realization of the Slot Gap model. The resulting pulse profiles are suitable for comparison with high energy (e.g. Fermi LAT) pulse data, and can be used to pin down the location of the active emission zone. Considering individual pulsars and using the constraints supplied by published LAT light curves, we show that the data are already providing useful constraints on the location of the active field lines.

P2 - 83 **On the high energy pulsar population detected by Fermi**

Caliandro, G. Andrea ,

The Large Area Telescope (LAT), Fermi's main instrument, is providing a new view of the local energetic pulsar population. In addition to identifying a pulsar origin of a large fraction of the bright unidentified Galactic EGRET sources, the LAT results provide a great opportunity to study a sizable population of high-energy pulsars. Correlations of their physical properties, such as the trend of the luminosity versus the rotational energy loss rate, help identify global features of the gamma-ray pulsar population. Several lines of evidence, including the light curve and spectral features, suggest that gamma-ray emission from the brightest pulsars arises largely in the outer magnetosphere.

P2 - 84 **Self-consistent modeling of pair cascade in the polar cap of a pulsar**

Timokhin, Andrey ,

Predictions of existing models of the polar cap pair cascades, which assume particle outflow to be unidirectional and stationary, disagree with both observational data and results of numerical models of force-free pulsar magnetosphere. On the other hand, the stability of such stationary models has not been quantitatively studied. Particle acceleration and electron-positron pair production in the polar cap could be essentially non-stationary: time intervals of effective particle acceleration could alternate with intervals when the accelerating electric field is screened by electron-positron pairs created in the cap. To construct a consistent model for particle acceleration in the polar cap and high energy emission produced there we need to know the pattern of particle flow. Possible complexity of the system behavior compels to conduct a numerical experiment where particle acceleration, pair production and variation in the accelerating electric field are modeled self-consistently. In order to do this I developed a hybrid PIC/Monte-Carlo code which incorporates processes relevant for the polar cap of pulsar. Here I report on the first results of such self-consistent modeling. I present evidences for complexity of the particle flow in the cap and discuss implications of the results for a future self-consistent radiopulsar model(s).

P2 - 85 **Constraining pulsar gap models with lightcurve statistical properties and flux properties of a simulated gamma-ray pulsar population**

Pierbattista, Marco , Isabelle A. Grenier, Alice K. Harding, Peter L. Gonthier

The Fermi Gamma-Ray Space Telescope has successfully discovered many gamma-ray pulsars, both as radio-loud objects and radio-quiet or radio-weak pulsars that have been discovered through blind period searches. The latter presumably have gamma-ray beams emanating at high altitudes in the magnetosphere, resulting in little or no overlap with the radio beam. The exponential cut-off of the emission at high energy also points to a medium- or high-altitude origin of the gamma rays. Population synthesis offers the possibility to study two different statistical aspects of the gamma-ray pulsar population: energetics and light curve geometry. The study of luminosity and efficiency behavior with respect to the main intrinsic parameters (age, magnetic field and gap width) offers a good way to constrain the pulsar energetics in the different models in competition (slot gap and outer gap). In parallel, the study of the light curve structures (peak multiplicity, peak position, pe! ak separation and shape distributions) could provide a powerful method of constraining the pulsar beam geometry (position of magnetic and rotational axes respect to the line of sight). We present new simulation results combining energetics and light curve morphologies that we will compare with Fermi pulsar data to probe the origin of the gamma-ray pulsar emission.

P2 - 86 **Population Synthesis of Radio and Gamma-ray Pulsars in the Fermi Era**

Gonthier, Peter L, Erin Nagelkirk, Melanie Stam, and Alice K. Harding

We present results of our pulsar population synthesis of normal pulsars from the Galactic disk using our previously developed computer code. From our studies of observed radio pulsars that have clearly identifiable core and cone components, in which we fit the polarization sweep as well as the pulse profiles in order to constrain the viewing geometry, we develop a model describing the luminosity and ratio of radio core-to-cone peak fluxes. In this model, short period pulsars are more cone-dominated. We explore models of neutron star evolution with and without magnetic field-decay, and with different initial period distributions. We present preliminary results including simulated population statistics that are compared with the observed radio pulsar population. The evolved neutron star populations resulting from this simulation can be used to model distributions of gamma-ray pulsars for comparison to Fermi results. We express our gratitude for the generous support of the Michigan Space Grant Consortium, of the National Science Foundation (REU & RUI) and the NASA Astrophysics Theory and Fundamental Program.

P2 - 87 **Fermi-LAT Observations of the Crab Pulsar and Nebula**

Grondin, Marie-Helene , Marianne Lemoine-Goumard, Francesco Loparco and M.N. Mazziotta on behalf of the Fermi Large Area Telescope Collaboration and the Pulsar Timing Consortium

The Crab Pulsar and Nebula are the remnants of the supernova SN 1054. Previously detected by EGRET, both sources have been extensively observed in the gamma-ray energy band by the Large Area Telescope (LAT) on board the Fermi satellite during its first months of data taking. LAT data have been used to determine the Crab pulsar light curve and spectrum. The precise measurement of the cut-off energy, which could not be determined accurately with EGRET, allows better constraint of the emission models. A complete spectral analysis of the unpulsed gamma-ray emission in the 100 MeV - 300 GeV energy range was also performed. The spectrum of the nebula is well described by the sum of two power-laws corresponding to the falling edge of the synchrotron and the rising edge of the inverse Compton components. The latter nicely connects with the observations from Earth-based telescopes at about 100 GeV, thus providing a direct way to cross-calibrate these instruments. The obtained spectral parameters, combined with the spectrum from other wavelengths, also give direct information about the electron spectrum, magnetic field and others physical parameters of the nebula.

P2 - 88 **PSR J0659+1414 the Musketeer pulsar and PSR J1420-6048 in the Kookaburra complex**

Parent, Damien P, on behalf of the Fermi-LAT Collaboration and the Pulsar Timing Consortium

The Fermi LAT collaboration reports the discovery of the gamma-ray pulsar PSR J0659+1414 at energies $>$ 100 MeV, having been detected with low significance by EGRET. The pulsar is associated with the Monogem ring, a bright diffuse supernova remnant visible in soft X-ray images, and also with a pulsar wind nebula in optical and X-rays. This pulsar, one of the ``Three Musketeers'', is cleary visible at energies above 100 MeV, but not above 1 GeV, showing that its spectrum is extremely soft. The gamma-ray light curve consists of only one gamma-ray peak at ~0.2 in phase, unlike the optical and near-UV light curves showing two peaks. The X-ray profile is more complex, it is a combination of thermal and non-thermal emission. We will discuss the beaming geometry for this pulsar. J1420$-$6048 is located in the Kookaburra complex and within the error circles of the previously unidentified EGRET source 3EG J1420$-$6038. The pulsar is also located 0.4 from a second energetic! pulsar J1418$-$6058 discovered in the LAT data. Actually, the EGRET source has now been resolved into two separate gamma-ray pulsars. We will describe the gamma-ray light curves for these two pulsars and discuss the beaming geometry of J1420$-$6038.

P2 - 89 **Fermi Gamma-Ray Pulsar Diagnostics using their Maximum Emission Energies**

Story, Sarah A, Matthew G. Baring

The Fermi gamma-ray pulsar database is rapidly growing, and already defines an important part of Fermi's early legacy. The sample of over two dozen pulsars provides rich information for the interpretation of young energetic pulsars and old millisecond pulsars. Among the population characteristics already established is the common occurrence of exponential turnovers in the 1-10 GeV range. This paper interprets these turnovers via an exploration of attenuation and emission characteristics as functions of altitude in pulsar magnetospheres. The turnover energies provide lower bounds to the mean emission altitude, using arguments of single-photon pair creation transparency below the turnover. These altitude bounds generally preclude altitudes below around 2-4 stellar radii for the emission region of young pulsars. Interpreting the observed turnovers as being due to radiation-reaction-limited curvature radiation yields altitudinal constraints from curvature radiation slot-gap or outer gap models. These constraints are somewhat sensitive to the choice of the electric potential, providing potential discrimination between outer gap and slot gap acceleration locales. This survey also explores population trends with period and period derivative.

P2 - 90 **High-energy gamma-ray observations of Geminga with the Fermi Large Area Telescope**

Razzano, Massimiliano , Denis Dumora (CENBG) and Fabio Gargano (INFN-Bari)

Geminga is the second brightest persistent source in the gamma-ray sky. We will report on the preliminary results obtained on the analysis of the first year of observations.

P2 - 91 **Gamma-ray Pulsar Light Curves From Force-free Magnetospheres**

Bai, Xuening , Anatoly Spitkovsky

The Fermi LAT has recently discovered dozens of new gamma-ray pulsars, and is destined to revolutionize our knowledge of pulsar science. The gamma-ray pulsar light curves carry important information about pulsar magnetospheric structure, which have commonly been modeled as a vacuum dipole and are subject to uncertainties. We present the first results of pulsar high-energy light curve modeling using the more realistic force-free (FF) field taken from time-dependent FF simulations. We find that the the conventional slot-gap (or two-pole caustic) model fails to produce the general double-peak pulse profile, mainly because the size of the polar cap in the FF magnetosphere is larger. The conventional outer-gap model is capable of producing only one peak under general conditions, because a large fraction of the open field lines does not cross the null charge surface. We propose a novel ``annular gap" model, where the high-energy emission originates from a thin layer insi! de the last open field lines. The emission from this layer generates two large caustics on the sky map, and form near the light cylinder. The origin of the annular gap may be related to the magnetospheric current sheet. We show that most features and statistics from the currently available gamma-ray pulsar light curves can be well reproduced and explained.

P2 - 92 **A Method to Enhance Sensitivity to Pulsations in Fermi LAT Data**

Kerr, Matthew T,

The overlap between the populations of radio-loud and GeV-bright pulsars is one of the key observables in the effort to understand high-energy emission from pulsar magnetospheres. The Pulsar Timing Consortium is timing over 200 high-luminosity pulsars to produce ephemerides with which Fermi LAT photon arrival times may be folded to search for pulsations, and over 25 radio-loud pulsars have been detected so far. However, pulsars clustered along the Galactic plane suffer from the strong diffuse background at low Galactic latitudes, and the pulsed signal may be obscured. We outline here a method for pulsation searches that uses, in addition to the photon time of arrival, its reconstructed energy and position on the sky. The supplemental information helps reject background events and increases sensitivity to pulsations. We report on the application of this method to the first year of LAT data.

P2 - 93 **Very Fine Time-Resolved Spectral Studies of the Vela Pulsar with the Fermi Large Area Telescope**

Johnson, Tyrel J, On Behalf of the Fermi Large Area Telescope Collaboration and the Timing Consortium

The Vela pulsar is one of the most exciting gamma-ray sources and has been at the forefront of high energy pulsar science since the detection of gamma-ray pulsations at the radio period by SAS-2 in 1975. With the unprecedented angular resolution, effective area, field of view, and timing resolution, in the GeV band, of the Large Area Telescope (LAT) on the Fermi Gamma-ray Space Telescope the light curve of the Vela pulsar can be studied in greater detail than ever before. Using a timing solution derived solely from the LAT data, phase aligned with the radio emission, the spectrum of the Vela pulsar has been fit in intervals as small as 0.0016 in phase. Significant variation is seen in the cutoff energy and spectral index across the light curve which seems to correlate with the radius of curvature, strongly supporting curvature radiation as the source of the high energy gamma-rays from the Vela pulsar.

P2 - 94 **Phase-Resolved Spectroscopy of Fermi LAT Blind Search Pulsars**

DeCesar, Megan E, Alice K. Harding, Tyrel J. Johnson

The high sensitivity of the Fermi Large Area Telescope has led to the discovery of sixteen gamma-ray pulsars, found without the aid of radio ephemerides. Most of these blind search pulsars are either radio-faint or radio-quiet, and represent a population with a different set of observational biases than those inherent in radio pulsars. For example, they likely exhibit a broader range of inclinations relative to the magnetic axis, presenting an opportunity to study previously unobserved magnetospheric geometries. We present here energy-dependent light curves and phase-dependent spectral parameters of a selection of the blind search pulsars, and show there is significant variation in the cutoff energy with phase.

P2 - 95 **High-energy observations of pulsars J1057-5226, J1709-4429 and J1952+3252 with the Fermi Large Area Telescope**

Celik, Ozlem , F. Gargano, T.Reposeur; on behalf of Fermi Large Area Collaboration

The Fermi-LAT data have confirmed the pulsed emission from all six high-confidence gamma-ray pulsars previously known from the EGRET observations. We report results obtained with the analysis of 9 months of LAT data for three of these pulsars: J1057-5226, J1709-4429, and J1952+3252.

P2 - 96 **A New Look at Gamma-Pulsars with the LAT Low-Energy Technique**

Burgess, James M, Rob Preece

With the unprecedented sensitivity of the LAT, astrophysical sources such as gamma-ray pulsars can be observed in greater detail than ever before. The LAT, with an advertised observing range of 20-300,000 MeV, has observed several gamma-ray pulsars to date; however, the LAT suffers a steep drop in effective area below 100 MeV due to poor reconstruction of the pair tracks. With this constraint, the low-energy data from the LAT are not viable for public analysis. Such a gap in observations obscures the continuous emission spectrum of gamma-ray pulsars potentially hiding important spectral features. Poor sensitivity in this energy range has historically challenged gamma-ray instruments leaving the territory virtually unexplored in the realm of gamma-ray pulsars. We present a technique to recover the low-energy data through an analysis of unreconstructed photons in the raw data enabling detailed spectral studies of gamma-ray pulsars.

P2 - 97 **A Multi-Wavelength View of Some of the New Gamma-Ray Pulsars**

Roberts, Mallory S.E., Crystal Brogan, Scott Ransom, Paul Ray, Kent Wood, Bryan Gaensler, Jules Halpern, Eric Gotthelf, Fernando Camilo, Maxim Lyutikov, Regis Terrier, Arache Djannati-Atai, Natasha Maddox

The Fermi and AGILE telescopes have detected pulsations from dozens of pulsars, many of which had not been previously known to pulse at other wavelengths. Many are embedded in nebulae which emit from radio to TeV wavelengths. We will present the results of multi-wavelength explorations of these new pulsars. These include the results of radio and X-ray pulse searches, X-ray spectral studies of the pulsars, high resolution radio and X-ray imaging studies of the inner nebulae, and the relationship between the large scale structure of the radio/X-ray nebulae and surrounding infrared and TeV emission. Through these studies, information can be inferred about the dis- tance, geometry,and history of these pulsars.

P2 - 98 **Bayesian Modeling of the Fermi Gamma-ray Pulsar Population**

McLaughlin, Maura A, James Cordes

We discuss a model for the Fermi pulsar population based on a likelihood analysis of Fermi detections and upper limits. We use this to constrain the initial spin period, magnetic field, and beaming fraction distributions and derive a luminosity law for Fermi pulsars. We predict the numbers of Fermi pulsars expected to be detected and the fraction of unidentified sources that are rotation-powered pulsars.

P2 - 99 **Searches for Gamma-Ray Pulsars: Comparisons of EGRET and Fermi Detections**

McLaughlin, Maura A, James Cordes

We describe search algorithms for gamma-ray pulsars and their application to EGRET and Fermi data. We compare the pulse profiles and properties of pulsars discovered in semi-blind searches for pulsars detected after the EGRET mission. We compare the profiles and properties of these EGRET pulsars with their newly measured Fermi profiles and properties. Finally, we describe application of these same methods to Fermi data and the implications for pulsars that are detected after the completion of the Fermi mission.

P2 - 100 **Constraining Pulsar Emission Physics through Radio/Gamma-Ray**

Bilous, Anna , Maura McLaughlin, Vlad Kondratiev, Maxim Lyutikov, Scott Ransom, Ben Stappers, Glen Langston, Mitch Mickaliger, Duncan Lorimer

Giant pulses (GPs) are relatively rare, short (up to mus) bursts of intense radio emission and are clearly a special form of pulsar radio emission. The nature of giant pulses still remains unclear and solving this puzzle may help to understand the elusive pulsar emission mechanism in general. To set the constrain on giant-pulse emission mechanisms, we performed an extensive study of radio GPs together with Fermi data. Our foremost goal was testing whether radio GPs are due to changes in the coherence of the radio emission mechanism, variations in the pair creation rate in the pulsar magnetosphere, or changes in the beaming direction. Besides that, we tested the specific model of GP emission proposed by Lyutikov, in which Crab GPs are generated on closed magnetic field lines near the light cylinder via anomalous cyclotron resonance on the ordinary mode. This model gives a clear prediction that radio GPs should be accompanied by $gamma$-ray photons.

P2 - 101 **The Gamma-Ray Pulsar in the CTA1 Supernova Remnant**

Abdo, Aous, On behalf of the Fermi Large Area Telescope Collaboration

The gamma-ray-only pulsar in CTA1 was the first to be discovered in a blind search with Fermi (Abdo et al. 2008). Here we report a more detailed analysis of the Fermi data including the glitch that we detected in 2009. We present spectral studies of this pulsar as well as energy dependent gamma-ray pulsed light curves and compare the results between the pre- and post-glitch time intervals.

P2 - 238 **Fermi LAT observations of PSR J1836+5925**

Belfiore, Andrea, on behalf of Fermi-LAT collaboration

Blind search analysis of Fermi LAT data has proved the bright EGRET source 3EG J1835+5918 to be a pulsar. PSR J1836+5925 is characterized by a strong baseline emission and a large characteristic age, the lack of a radio counterpart and a position out of the galactic plane. Variability and extension will be discussed. Phase resolved spectral analysis has been performed and will be presented. There is no evidence that the unpulsed component is due to a pulsar wind nebula. The spectrum obtained observing with XMM Newton the X-ray counterpart confirms it to be a Geminga-like nearby neutron star.

SNe & PWNe

P2 - 102 **Fermi-LAT observations of young Supernova remnants**

Funk, Stefan , for the LAT collaboration

Supernova remnants (SNRs) are generally thought to be responsible for the acceleration of Cosmic rays through Shock acceleration. In particular gamma-ray observations of young Supernova remnants can provide detailed insights into particle acceleration in shock waves. Here I will present results on Fermi-LAT observations of young supernova remnants which might help to distinguish between radiating particle populations in these objects.

P2 - 103 **Observation of Supernova Remnant IC 443 with the Fermi Large Area Telescope**

Lee, Herman , Tsuneyoshi Kamae, Diego F. Torres, Ana Y. Rodriguez, Francesco Giordano

We report observation of the supernova remnant IC 443 (G189.1+3.0) with the textit{Fermi Gamma-ray Space Telescope (FGST)} Large Area Telescope (LAT) in the energy band between 200~MeV and 50~GeV. IC~443 is a shell-type supernova remnant located off the outer Galactic plane where high-energy emission has been detected in the X-ray, GeV and TeV gamma-ray bands. Past observations suggest IC~443 has been interacting with surrounding interstellar matter. Proximity between dense shocked molecular clouds and GeV$-$TeV gamma-ray emission regions detected by textit{EGRET}, textit{MAGIC} and textit{VERITAS} strengthens the interpretation that cosmic-ray (CR) particles are accelerated at IC~443. With the high gamma-ray statistics and broad energy coverage provided by the LAT, we accurately characterize the gamma-ray emission produced by the CRs accelerated by IC~443. The emission region is extended in the energy band with $theta _{68} =$ 0.27^circ pm 0.01^circ (stat) ! pm 0.03^circ (sys) for an assumed two-dimensional Gaussian profile and overlaps well with the extended source region of textit{VERITAS}. Its centroid is displaced significantly from the known pulsar wind nebula (PWN) which suggests that the PWN is not a major contributor in the present energy band. The observed spectrum is flat between 200 MeV and sim 5 GeV, breaks at 3$-$5 GeV to a softer power-law spectrum and continues smoothly to the textit{VERITAS} data points. The combined gamma-ray spectrum is reproduced well by decays of neutral pions produced by a broken power-law proton spectrum.

P2 - 104 **Probing runaway protons using the diffuse gamma-ray emission surrounding the young supernova remnant RX J1713-3946**

Jones, David I, Sabrina Casanova, Felix Aharonian

We have investigated the diffusion of runaway protons from the young supernova remnant RX J1713-3946. To do this we have used a realistic density distribution as a function of distance for a $10times10$ square degree region surrounding the SNR provided by the NANTEN II telescope. We use a supernova solution for the escape and diffusion of protons away from the SNR as a function of position, energy and time (i.e., more energetic particles being released first) for a number of different (energy dependent) diffusion coefficients. The protons, having diffused away from the SNR, then interact with the surrounding interstellar medium to produce a flux of $gamma$-rays as a function of position, and energy after $sim1600$~years (the age for the SNR assuming that it is the event in AD393 observed by Chinese astronomers) and what the remnant may look like in 10,000 years time. We then compare this to the $gamma$-ray flux expected from hadronic interactions due to the bac! kground CR-sea (equal to that observed at the top of the Earth's atmosphere) as a function of position.

P2 - 105 **HESS J1507-622: an unique unidentified source off the Galactic Plane**

Tibolla, Omar , O. de Jager, W. Domainko, S. Kaufmann, N. Komin, K. Kosack on behalf of the H.E.S.S. collaboration

Galactic very high energy gamma ray sources in the inner Galaxy H.E.S.S. survey tend to cluster within 1 degree in latitude around the Galactic plane. HESS J1507-622 instead is unique, since it is located at latitude of -3.5 degrees. HESS J1507-622 is slightly extended over the PSF of the instrument and hence its Galactic origin is clear. The search for counterparts in other wavelength regimes (radio, infrared and X-rays) failed to show any obvious counterparts; moreover, given its position off the Galactic plane and hence the absorption almost one order of magnitude lower, it is very surprising to not see any plausible counterparts especially at X-rays wavelengths (by ROSAT, XMM-Newton and Chandra). Its latitude implies that it is either rather close, within about 1 kpc, or is located well off the Galactic plane. And also the models reflect the uniqueness of this object: a leptonic scenario (PWN) would locate HESS J1507-622 at very large distances, while an hadronic scenario (SNR or MC interaction) would survive only if the TeV gamma-ray source would be very close.

P2 - 106 **Latest results on galactic sources obtained with the MAGIC telescope.**

Zanin, Roberta , on behalf of the MAGIC collaboration

The MAGIC telescope is the largest single-dish Imaging Atmospheric Cherenkov Telescope (IACT) with the lowest energy threshold among the current generation of IACTs (as low as 25 GeV with the use of the innovative sum trigger). Therefore, the MAGIC telescope is a perfect instrument to study the galactic sources especially in the context of observations with the satellite observatories Fermi and Agile. This talk will give an overview of the MAGIC results on the galactic sources including the first detection of the Crab pulsar above 25 GeV, detailed observations of binary systems, supernovae remnants and unidentified sources. The impact of the second telescope (MAGIC-II) on future observations of the galactic sources will also be discussed.

P2 - 107 **Fermi-LAT searches for off-pulse gamma-ray emission from pulsars**

Grondin, Marie-Helene , Joshua Lande on behalf of the Fermi Large Area Telescope Collaboration and the Pulsar Timing Consortium

Prior to the Fermi Gamma-ray Space Telescope, only six pulsars and one associated pulsar wind nebula, the Crab Nebula, had been detected in gamma-rays by EGRET. Since then, Fermi has significantly increased the number of detected pulsars in the 100 MeV to 30 GeV energy range. Emission from pulsar wind nebulae and supernova remnants exists near many pulsars, potentially powered by the pulsars themselves. These sources can only be observed in the off-pulse windows because pulsed emission dominates in the rest of the phase interval. A systematic analysis was performed using 11 months of Fermi-LAT data to detect these weak and steady sources. When no significant detection was observed, flux upper limits were derived.

P2 - 108 **LAT Observations of the region of MSH 15-52**

Takeshi, Nakamori , Mari-Helene Grondin, on behalf of Fermi LAT collaboration

MSH 15-52 is a composite supernova remnant associated with the young energetic pulsar PSR B1509-58. The latter powers a bright X-ray and TeV pulsar wind nebula (PWN). EGRET observations of this region ended in a marginal source detection around the pulsar in sub-GeV energies. Using 1 year of survey data with the Large Area Telescope (LAT) onboard Fermi, significant high energy emission positionally coincident with PSR B1509-58 and the nebula is detected. We will report on the results of the spatial and spectral analyses of the gamma-ray emission observed in the region of the PWN MSH 15-52.

P2 - 109 **A Model of the Spectral Evolution of Pulsar Wind Nebulae**

Tanaka, Shuta J, Fumio Takahara

Pulsar Wind Nebulae (PWNe) are observed for a wide frequency range from radio through TeV gamma-rays and provide the information about the properties of the pulsars, pulsar winds and their environments. The number of well-studied PWNe has increased to include many old aged objects. Moreover, some of the recently discovered TeV unidentified sources are considered old PWNe. It is interesting to investigate GeV properties of such old PWNe with Fermi. We study a broad band spectral evolution of PWNe to take into account for the energy injected when they were young and energetic. We adopt a simplified model of the magnetic field evolution inside the uniformly expanding PWN to calculate the spectral evolution, and we solved the evolution of the electron energy distribution function with time dependent injection from the pulsar and the radiative and adiabatic cooling. The model was calibrated by fitting the spectrum to the Crab Nebula at age of a thousand years old. Only a small fraction of the injected energy from the Crab pulsar goes to the magnetic field, consistent with the predictin of the model by Kennel and Coroniti (1984). The spectral evolution of the Crab Nebula calculated in our model shows the ratio of gamma-ray to X-ray flux increases with time, which predicts the existence of a GeV / TeV bright population of old PWNe.

P2 - 110 **The Extended X-ray Nebula of the GeV Pulsar J1420-6048**

Van Etten, Adam , Roger Romani

The vicinity of the unidentified EGRET source 3EG J1420-6038 has undergone extensive study in the search for counterparts, revealing the energetic young pulsar PSR J1420-6048 and its surrounding wind nebula as a likely candidate for at least part of the emission from this bright and extended gamma-ray source. We report on new Suzaku observations of PSR J1420-6048 and its surrounding extended X-ray nebula. The X-ray data, along with with archival radio and VHE data, provide hints to the pulsar birthsite, evolution, and the properties of the ambient medium. We further explore such properties and implications for LAT data analysis by modelling the spectral energy distribution (SED) of the extended nebula.

P2 - 111 **What can the nonlinear shock acceleration theory tell us about the RXJ 1713 gamma ray spectrum in sub-TeV range?**

Malkov, Mikhail , Patrick Diamond

Supernova remnant (SNR) shocks are long thought to be efficient particle accelerators. Cosmic rays drive various instabilities in the shock precursor and so enhanced perturbations evolve nonlinearly into a random array of shocks. Their magnetic patterns change the transport regime of accelerated particles from diffusive at lower momenta to fractionally kinetic at higher momenta. As a result, a spectral break forms, typically at sub-TeV energies. Theoretical studies of these phenomena will be presented along with their spectral signatures in gamma radiation expected from SNRs, such as RXJ 1713.7-3946.

P2 - 112 **Molecular clouds and gamma ray sources in W28**

Kazufumi, Torii , Kesuke Ohishi, Yoshihisa Nakashima, Takeshi Okuda, Hiroaki Yamamoto, Akiko Kawamura, Norikazu MIzuno, Toshikazu Onishi and Yasuo Fukui

We compared the new NANTEN2 molecular data of the CO J=2-1 emission line with HESS TeV gamma-ray distribution in W28. This comparison yields better correlation between CO and gamma-ray in W28 north than in CO 1-0 (Aharonian et al. 2008), providing a further support for the hadronic origin of the gamma-ray emission. We also examined the relationship of molecular clouds in W28 north and south and identified a molecular bridge between them. This suggests a physical linkage between the two regions and that the W28 SNR may be a possible candidate for the origin of cosmic ray protons that interact with the molecular clouds in W28 south. These results support the recent Fermi results (Katagiri et al. 2009, in preparation).

P2 - 113 **A molecular jet and arc toward Westerlund 2**

Fukui, Yasuo , Naoko Furukawa, Akio Ohama, Dame Thomas M, Joanne Dawson, Takeshi Okuda, Hiroaki Yamamoto, Akiko Kawamura, Norikazu MIzuno and Toshikazu Onishi

Westerlund 2 is a super star cluster associated with a TeV and GeV gamma-ray source. We recently reported a discovery of 100 pc scale molecular jet and arc based on NANTEN CO dataset (Furukawa et al. 2009). We here present new higher resolution CO data of J=1-0 and 2-1 transitions as well as results of the analysis of temperature and density. We find temperature is significantly enhanced in dense parts of the jet, suggesting recent heating within 10$^{4-5}$ yrs. We discuss that an anisotropic Supernova explosion or a microquasar jet is a possible candidate for driving and heating of the jet.

P2 - 114 **Supernova Remnant Masers and Gamma-Ray Sources**

Hewitt, John W,

Supernova remnants (SNRs) interacting with molecular clouds are potentially exciting systems in which to detect evidence of cosmic ray acceleration. Large reservoirs of dense gas may act as a target for cosmic rays accelerated by the SNR producing prominent gamma-ray emission at GeV and TeV energies. In many SNRs coincident with gamma-ray sources, the presence of OH(1720 MHz) masers is used to identify interaction with dense gas and to provide a kinematic distance to the system. We demonstrate a clear correlation between these SNR masers and gamma-ray sources. Sensitive VLA observations show extended maser emission tracing the shock interaction. The observed high columns of hydroxyl require a high ionization rate in the post-shock gas. If the associated gamma-ray emission arises from hadronic cosmic rays local to the SNR, the gamma-ray luminosity provides a direct estimate of the local cosmic ray density. We present Fermi LAT observations of SNRs with masers, in wh! ich the cosmic ray ionization rate is measured to be enhanced by one to two orders of magnitude over the local solar value. This may explain the observed correlation between SNR masers and gamma-ray sources.

P2 - 115 **VERITAS Observations of PWNe**

Aliu, Ester , VERITAS Collaboration

Pulsar wind nebulae have proven to be the single most common class of sources of TeV gamma rays in our Galaxy based on observations obtained from the southern hemisphere. We report on a complementary northern survey for TeV nebular emission towards a selection of energetic and/or close pulsars using the VERITAS Cerenkov telescope array located in southern Arizona.

P2 - 116 **Using LIRA (Low-count Image Reconstruction and Analysis) to Explore and Quantify Diffuse Emission Around Bright gamma-ray PWN and Pulsars**

Connors, Alanna , David van Dyk, UCI Statistics; Nathan M. Stein, Harvard Statistics; Vinay Kashyap, Harvard-Smthsonian CfA; Aneta Siemiginowska, Harvard-Smithsonian CfA

We explore using LIRA, our new Low-count Image Reconstruction and Analysis code, on regions of diffuse emission observed by Fermi. LIRA uses a full posterior likelihood (Poisson data, and a sky-model folded through instrument response); plus a Poisson multi-scale structure for any unknown 'model-mis-match'. This allows one to both: 1) {it quantify the goodness of fit} of the low-count image data to the model; and 2) {it put quantitative limits on the amount and shape any `residual'} (which is captured by our multi-scale component). We demonstrate this by looking for and setting limits on pulsar wind nebulae (PWN) around known gamma-ray pulsars; and PWN detected at higher (TeV) energies; such as SNRs W44, W51C, and IC 443. For these, we use "GALPROP" plus the bright-source list as our 'Null' model; and allow the multi-scale model to represent the unknown PWN shape. This R-based code is available from nathanmstein at gmail dot com, or aconnors at eurekabayes dot! com.

P2 - 117 **GeV emission from an evolved shell type supernova remnant**

Terrier, Régis , F. Mattana

Most of the TeV gamma ray shell type supernova remnants are young objects, since the most energetic particles should either escape quickly from the shock or radiate most of their energies in the case of electrons. At lower energies, a population of older remnants interacting with molecular clouds is detected by Fermi. Here we report the detection of spatially resolved GeV emission from an evolved shell type SNR. We discuss the implications in terms of energetic particles content of the remnant and discuss future prospects.

P3 Gamma Ray Bursts

GRB

P3 - 148 **Long-Term Evolution of Slowly Rotating Collapsar in Special Relativistic Magnetohydrodynamics**

Seiji, Harikae , Tomoya Takiwaki, Kei Kotake

We present our numerical results of two-dimensional magnetohydrodynamic (MHD) simulations of the collapse of rotating massive stars in light of the collapsar model of gamma-ray bursts (GRBs). Pushed by recent evolution calculations of GRB progenitors, we focus on lower angular momentum of the central core than the ones taken mostly in previous studies. By performing special relativistic simulations including both realistic equation of state and neutrino coolings, we follow a unprecedentedly long-term evolution of the slowly rotating collapsars up to sim 10 s, accompanied by the formation of jets and accretion disks. Our results show that for the GRB progenitors to function as collapsars, there is a critical initial angular momentum, below which matter is quickly swallowed to the central objects, no accretion disks and no MHD outflows are formed. When larger than the criteria, we find the launch of the MHD jets in the following two ways. For models with stronger i! nitial magnetic fields, the magnetic pressure amplified inside the accretion disk can drive the MHD outflows, which makes the strong magnetic explosions like a 'magnetic tower' (type II). For the models with weaker initial magnetic fields, the magnetic tower stalls first and the subsequent MHD outflows are produced by some eventual inflows of the accreting material from the equator to the polar regions (type I). Regardless of type I or II, the jets can attain only mildly relativistic speeds with the explosion energy less than $10^{49} erg$, which could possibly be related to the X-ray flashes. To obtain stronger neutrino energy depositions in the polar funnel regions heated from the accretion disk, we find that smaller initial angular momentum is favorable. This is because the compression makes the temperature of the disk higher. Due to high opacity for neutrinos inside the disk, we find that the luminosities of nu_e and $bar{nu}_e$ become almost comparable, which is advantageous for making the energy deposition rate larger. We discuss how the energy deposition can be as efficient as the magnetically-driven processes for energetizing jets. Among the computed models, we suggest that the model with the initial angular momentum of $j sim 1.5j_{mathrm{lso}}$ ($j_{mathrm{lso}}$: the angular momentum of the last stable orbit) and with initial magnetic field strength of $sim 10^{10}$ G, provides a most plausible condition for making fireballs for GRBs, because such model is appropriate not only for producing the MHD outflows quickly by the magnetic towers, but also for obtaining the stronger neutrino heating in the evacuated funnel.

P3 - 149 **Bright High-Energy GRBs detected with the Gamma ray Burst Monitor (GBM) on Fermi**

Bissaldi, Elisabetta , On behalf of the Fermi GBM Collaboration

The Fermi/GBM was designed to detect and localize transient events, particularly GRBs, for the Fermi mission. By means of an array of 12 NaI(Tl) (8 keV to 1 MeV) and two BGO (0.2 to 40 MeV) scintillation detectors, the GBM has the capability of performing time-resolved spectroscopy of the burst emission over a very broad energy range.

P3 - 150 **The Swift/BAT Fermi/GBM burst GRB 080928**

Rossi, Andrea , A. Rau, S. Klose, P. Ferrero, S. Schulze, D.A. Kann, J. Greiner, P.M.J. Afonso, T. Krühler, D.H. Hartmann, A. Updike, B. Paciesas, C. W. Akerlof, S. B. Pandey, F. Yuan, A. Panaitescu

GRB 080928, detected by Swift/BAT and also by FERMI/GBM, was a long burst with an initial Lorentz Factor of about 300, with a bumpy early afterglow light characterized by high energy injections, followed by forward shock emission. No GRB host galaxy could be detected down to deep flux limits.

P3 - 151 **Integrating the Fermi Gamma-Ray Burst Monitor into the 3rd Interplanetary Network**

Hurley, Kevin C, V. Connaughton, C. Meegan, A. von Kienlin

We are integrating the Fermi Gamma-Ray Burst Monitor (GBM) into the 3rd Interplanetary Network (IPN) of Gamma-Ray Burst (GRB) detectors. With the GBM, the IPN will comprise 9 detectors. This will 1) assist the Fermi team in understanding and reducing their systematic localization uncertainties, 2) reduce the sizes of the GBM error circles by 1-4 orders of magnitude, 3) facilitate the identification of GRB sources with objects found by ground- and space-based observatories at other wavelengths, from the radio to very high energy gamma-rays, 4) reduce the uncertainties in associating some LAT detections of high energy photons with GBM bursts, and 5) facilitate searches for non-electromagnetic GRB counterparts, particularly neutrinos and gravitational radiation. We will present the statistics of the bursts detected to date, and demonstrate the synergy between the IPN and the GBM localizations.

P3 - 152 **Theoretical modeling and interpretation of a distinct hard spectral component in GRB 090902B detected with Fermi**

Razzaque, Soebur , on behalf of the Fermi GBM and LAT Collaborations

GRB 090902B shows for the first time clear evidence of excess emission both at low energies (below 20 keV) and at high energies (above 100 MeV), which can not be fitted with a Band function alone. These excesses are well-fit by a single hard, photon index -1.9, power-law component suggesting a common origin for both. We discuss various theoretical models which may give rise to such a component and outline a possible scenario which also give rise to a delayed onset of >100 MeV emission.

P3 - 153 **Fermi and Swift observations of the bright GRB 090510, prompt emission and afterglow studies**

Pelassa, Veronique A.-S., on behalf of the Fermi GBM and LAT Collaborations

The bright short-hard GRB 090510 was observed by both {it Swift} and {it Fermi} telescopes. The study of the prompt emission by {it Fermi} revealed an additional high-energy spectral component, the highest lower limit ever on the bulk Lorentz factor in a short GRB jet, and brought the most stringent constraint ever on Lorentz invariance violation models. The fast repoint and follow-up by both telescopes allowed the first multiwavelength study of a GRB afterglow from optical range to several GeV. Studies of the prompt emission and the afterglow are presented.

P3 - 154 **Spectral features of bright Fermi Gamma-Ray Bursts revealed by a new analysis method**

Pelassa, Veronique A.-S., on behalf of the Fermi GBM and LAT Collaborations

{it Fermi} Large Area Telescope (LAT) data analyses based on a sophisticated event reconstruction and sorting are so far restricted to events of measured energy larger than 100 MeV. We propose a way to get the signal from Gamma-Ray Bursts' (GRB) prompt emission between 40 MeV and 100 MeV, which differs from the standard LAT analysis. Filling the former "gap" between Gamma-ray Burst Monitor and LAT observations allows to better constrain the high-energy spectra of GRB. New analyses of bright Fermi GRB and their implications are presented.

P3 - 155 **An up-scattered cocoon emission model of gamma-ray burst high-energy lags**

Toma, Kenji , Xuefeng Wu, Peter Meszaros

The Fermi satellite has been reporting the detailed temporal properties of gamma-ray bursts (GRBs) in an extremely broad spectral range, 8keV - 300GeV, in particular, the unexpected delays of the GeV emission onsets behind the MeV emission of some GRBs. We focus on GRB 080916C, one of the Fermi-GRBs for which the observational analysis is fairly complete at the moment and the data of the delayed high-energy emission is quite extensive, and we show that the behavior of the high-energy emission of this burst can be explained by a model in which the prompt emission consists of two components: one is the MeV component due to the synchrotron-self-Compton radiation of electrons accelerated in the internal shock of the jet and the other is the high-energy component due to up-scattering of the photospheric X-ray emission of the expanding cocoon off the same electrons in the jet. Such an up-scattering effect could be important for other Fermi-GRBs, including short GRBs, as ! well. We discuss some implications and predictions of this model.

P3 - 156 **Prompt optical observations of Fermi-LAT bursts and GRB 090902B.**

Pandey, Shashi Bhushan , Carl Akerlof

Prompt optical observations and their possible correlations to the photon emission at LAT frequencies energies are important towards understanding the physical mechanisms behind these extreme energetic explosions. Prompt response times and large fields of view of the ROTSE-III telescopes are suitable for Fermi bursts with a given smaller error-box for bursts. So far, there are 11 GRBs which have been seen at LAT frequencies with the optical afterglows has been observed detections for 6 cases.

P3 - 157 **Fermi-LAT observations of low-luminous Gamma-Ray Bursts**

Ohno, Masanori , on behalf of the Fermi GBM and LAT Collaborations

We present the analysis results of three Gamma-Ray Bursts (GRBs) detected by the Gamma-ray Burst Monitor (GBM) and the Large Area Telescope (LAT) onboard Fermi: the two long GRB 080825C and GRB 090217, and the first short burst with GeV photons GRB 081024B. The detailed analysis of the temporal and spectral properties of these bursts revealed some diversity at high energies, in spite of the low photon statistics detected in the LAT. The emission from GRB 081024B observed by the LAT above 100 MeV is delayed with respect to the GBM trigger, and significantly extends after the low-energy episode. Some hints for spectral hardening was observed in this burst as well as in GRB 080825C, possibly related to a separate and harder component showing up at late times. Conversely, GRB 090217 does not exhibit any noticeable feature. The low and high-energy episodes are coincident for this burst, and its broad-band spectrum is well reproduced by the common Band shape, which does ! not significantly evolve with time. Together with the other bright LAT detected bursts (e.g. GRB 080916C and GRB 090510), these observations help to classify the GRB properties and give new insight on the acceleration mechanisms responsible for their emission at the highest energies.

P3 - 158 **The Cross-Calibration of Swift-BAT and Fermi-GBM via Correlative Spectral Analysis of GRBs: Status & Preliminary Results**

Stamatikos, Michael , BAT/GBM Inter-Calibration Team

We report on recent inter-calibration studies featuring Swift's Burst Alert Telescope (BAT) and Fermi's Gamma-ray Burst Monitor (GBM) based upon correlated observations of GRBs, via their resultant joint spectral energy fit analysis. Swift's intrinsic multi-wavelength instrumentation and dynamical response complement Fermi's superior energy range. The addition of BAT's spectral response will (i) facilitate in-orbit GBM detector response calibration, (ii) augment Fermi's low energy sensitivity, (iii) enable ground-based follow-up efforts of Fermi GRBs, and (iv) help identify a subset of GRBs discovered via off-line GBM data analysis, for an annual estimate of $sim30$ GRBs. The synergy of BAT and GBM augments previous successful joint spectral fit efforts by enabling the study of peak photon energies (Epeak), while leveraging the over eleven energy decades afforded by Fermi's Large Area Telescope (LAT), in conjunction with Swift's X-Ray (XRT) and Ultraviolet-Optical ! (UVOT) Telescopes, for an unprecedented probe of broad-band spectral and temporal evolution, throughout their contemporaneous orbital tenure over the next decade.

P3 - 159 **High Redshift GRBs**

Zhang, Binbin , Bing Zhang

We have observed 14 bursts with redshift greater than 4. We will report our preliminary results of this high z bursts sample.

P3 - 160 **SWIFT and BATSE bursts' classification**

Bagoly, Zsolt , I. Horvath, L. G. Balazs, P. Veres

Short and long burst groups were identified in the early 90's. Later there were some indications for the existence of an intermediate type of GRBs. Therefore it is worth re-analyzing the durations and their distribution observed by different satellites. In this analysis we are going to use other burst parameters too.

P3 - 161 **Anomalous grouping of some short BATSE GRBs**

Bagoly, Zsolt , L. G. Balazs, P. Veres, A. Meszaros, I. Horvath

The power spectra of the short BATSE bursts were analyzed, focusing on the 64msec lightcurves' tails in the low energy bands. Using MC simulations, 25 GRBs were identified with unusually high harmonic power above 0.03 Hz. The sky distribution of these bursts shows an extraordinarily strong dipole moment with a >98% significance.

P3 - 162 **A search for gravitational lensing effects in Fermi GRB data**

Peter, Veres , Z. Bagoly, I. Horvath, A. Meszaros, L.G. Balazs

As GRBs trace the high-z Universe, there is a non-negligible probability of a lensing effect being imprinted on the lightcurve of the bursts. We propose to search for lensing candidates with a cross-correlation method. We also try to identify 'repeating' bursts, which would be the lensed manifestation of the same event seen days or months apart. We can also infer the mass ranges of the possible lensing objects.

P3 - 163 **How the RHESSI Gamma-Ray Burst Measurements have been Affected by the Annealing Procedure?**

Veres, Peter , J. Ripa, C. Wigger

The performance of the nine RHESSI germanium detectors has been gradually degrading since launch in 2002 because of radiation damage caused by the charged particles of the Earth's radiation belts. To correct this problem, the detectors underwent the procedure called 'annealing' in November 2007. It led to a change in the RHESSI response. We present how this affected Gamma-ray burst measurements, e.g., detected bursts' hardness ratios. We also compare the RHESSI spectral fits with measurements from other instruments.

P3 - 164 **A long and homogeneous optical monitoring of the 'naked-eye' burst GRB 080319B with the Palomar-60 telescope**

Veres, Peter , J. Kelemen, B. Cenko, Z. Bagoly, I. Horvath

GRB 080319B is one of the brightest and most extensively sampled bursts. It has good coverage at many wavelengths. Here we present the optical observations of the Palomar 60 inch telescope, which spans a long time interval after the burst. We augment the optical dataset with freely available Swift BAT and XRT observations reduced by us. We also compare our conclusions with the published parameters from the rich literature about this burst.

P3 - 165 **The Accuracy of GBM GRB Localizations**

Briggs, Michael S, M. S. Briggs, V. Connaughton (UAH/NSSTC) and K. Hurley (UCB) on behalf of the Fermi GBM Collaboration

We report an study of the accuracy of GBM GRB localizations, analyzing three types of localizations: those produced automatically by the GBM Flight Software on board GBM, those produced automatically with ground software in near real time, and localizations produced with human guidance. This work uses a Bayesian analysis that models the distribution of the GBM total location error by comparing GBM locations to more accurate locations obtained with other instruments. Two types of more accurate reference locations are used: small error boxes from Swift, Integral and other instruments, intersecting IPN arcs; and single IPN arcs. We model the GBM total location errors as having systematic errors in addition to the expected statistical errors and use the Bayesian analysis to constrain the systematic errors.

P3 - 166 **Model for the Extended GeV Emission from Gamma Ray Bursts**

Dermer, Charles D, Soebur Razzaque, Justin Finke

One of the most established features of high-energy gamma-ray phenomenology of GRBs, dating back to the EGRET era, is the persistence of > 100 MeV -- GeV emission long after the keV -- MeV emission has declined below background. This behavior is observed with Fermi in both long and short GRBs. The delayed arrival of the synchrotron self-Compton (SSC) component into the GeV band has been proposed to explain this delayed emission, but the expected spectral and temporal SSC behavior is not observed. Instead, we focus on long-lived emission from proton acceleration in an external shock. The early onset of the external shock is indicated in GRBs 080916C, 090510, and 090902B as a consequence of the large bulk Lorentz factors inferred in these GRBs. In this talk, the arguments leading to large Lorentz factors in GRBs, and the inference of early external shock emission are summarized. Hadronic acceleration models with proton synchrotron and photohadronic proceeses are show! n to account for the delayed GeV emission in GRBs.

P3 - 167 **Investigation of the limiting systematic error of the GBM location code**

Pretz, John R, Marc Kippen, Valerie Connaughton, Michael Briggs

The Fermi GBM locates gamma-ray bursts using a chi-squared fit to the responses of the 12 NaI detectors on the instrument. We have used a GEANT4 simulation of the full GBM from the General Response Simulation System (GRESS) to model the response of the instrument to individual GRBs of various spectral parameters and directions. I will report on a study of the limiting systematic error of the Daughter of Locburst (DOL) location-finding code based on this simulation. These studies have suggested ways to improve the underlying tables of the instrument response, and I will report on one such modification which has been demonstrated -- in simulation -- to improve the limiting systematic error of the algorithm by a degree or more.

P3 - 168 **Terrestrial Gamma-ray Flashes (TGFs) Above Thunderstorms**

Fishman, Jerry , - for the GBM TGF Team

Terrestrial gamma-ray flashes (TGFs) are being observed with the Gamma-ray Burst Monitor (GBM) detectors on Fermi about once every four weeks. These intense millisecond flashes of MeV photons have been observed with four space-borne experiments since their initial discovery by the BATSE-CGRO experiment in the early 1990s. TGFs have extremely hard spectra (harder than GRBs) and photons are seen to extend to over 30 MeV. The GBM-Fermi observations have the highest temporal resolution of any previous TGF observations and time-resolved coarse spectra can be derived. These features will be crucial for testing the leading current model of TGF production: relativistic run-away electron cascades formed in the intense electric fields within thunderstorms.

P3 - 169 **VERITAS Observations of Gamma-Ray Bursts**

Aune, Taylor W, The VERITAS Collaboration

To date, the Fermi Gamma-Ray Space Telescope has detected $sim 300$ gamma-ray bursts (GRBs), and more than ten with the Large Area Telescope (LAT). Delayed GeV emission has been detected by the LAT and in the case of GRB,090902B a 33 GeV photon was detected 82 s after T$_0$. This burst was detected at a redshift of 1.822 indicating this photon was emitted at an energy of sim90 GeV. However, due to the relatively small collection area of the LAT, sensitivity to the highest GRB energies may be extremely limited. In many GRB afterglow models, photon energies in the hundreds of GeV or even TeV energy range may be produced. VERITAS is an array of four Imaging Atmospheric Cherenkov Telescopes with maximum sensitivity to gamma rays ranging from 100 GeV to $>$30 TeV. As such, observations by VERITAS of GRB afterglows explore the spectral range above that accessible to Fermi. Characterizing gamma-ray burst emission at the highest energies will significantly impact our understanding of GRB physics and potentially constrain models of the extragalactic background light and theories predicting Lorentz invariance violation. VERITAS has been performing follow-up observations of satellite-detected gamma-ray bursts since 2006. No evidence of emission has yet been found and upper limits on the VHE flux from these bursts are presented here.

P3 - 170 **Search for GeV-TeV emission from GRB 080319B using the Milagro Observatory**

Aune, Taylor W, The Milagro Collaboration

On March 19, 2008 NASA's Swift satellite discovered one of the brightest gamma-ray bursts ever recorded. With a peak visual magnitude of 5.3, GRB,080319B was dubbed the ``naked-eye'' gamma-ray burst, as an observer under dark skies could have seen the burst without the aid of an instrument. Due to the proximity in both time and space to GRB080319A, prompt emission from GRB,080319B was detected in both the optical and $gamma$-ray bands by several wide-field instruments. Follow-up observations spanned 11.5 orders of magnitude in wavelength, making GRB,080319B one of the most well-studied gamma-ray bursts to date. The Milagro observatory was an extended air shower array located near Los Alamos, NM, that operated from January 2000 to May 2008. GRB,080319B was fortuitously located in the field of view of Milagro, and a search for prompt emission in the GeV-TeV energy range is presented here. No evidence for emission is found. The fluence upper limits derived from the Milagro observations are incompatible with the standard single-zone synchrotron self-Compton model of gamma-ray bursts, which predicts a strong second order inverse-Compton peak at tens of GeV in the spectrum of GRB,080319B.

P3 - 171 **Fermi LAT Observations of Short Gamma-Ray Bursts**

Connaughton, Valerie -, on behalf of the Fermi LAT and Fermi GBM Collaborations

In just over one year of observations, the Fermi Large Area Telescope (LAT) has detected eleven gamma-ray bursts (GRBs) at energies above 100 MeV. Short and long bursts are detected in roughly the same proportions by the LAT as at lower energies by the Fermi Gamma-ray Burst Monitor (GBM), with long and short bursts looking similar to each other at LAT energies. Temporal and spectral signatures at high energies suggest a complicated relationship with the lower-energy gamma rays, with emission above 100 MeV often beginning later and being detected for longer than below 1 MeV. A detection in the LAT is sometimes not expected from an extrapolation of the steep power-law indices measured by the GBM in at least some short, bright GRBs. We report here on the ensemble of bright, short GBM GRBs and their corresponding high-energy signal or upper limit to any high-energy emission in the LAT.

P3 - 172 **The Spectral Lag Evolution of Gamma-Ray Bursts Detected by Fermi**

Ukwatta, Tilan N, K. S. Dhuga

Spectral lag is a common feature in Gamma-ray Bursts (GRBs). The lag is defined as the difference in time of arrival of high and low energy photons. Simultaneous observations using both LAT and GBM instruments provide unprecedented spectral and temporal coverage of GRBs, giving us the opportunity to study spectral lag evolution across approximately seven energy decades. We present the results of a study of the dependence of the spectral lag as a function of energy across the GBM-LAT energy range using the cross correlation function method.

P3 - 173 **Collisional heating and photospheric emission in GRBs**

Beloborodov, Andrei M,

There is growing evidence for a photospheric component in GRB emission. In particular, the MeV peak in many GRBs is likely emitted at the jet photosphere (while optical and multi-GeV emission are generated at much larger radii). The spectrum of photospheric emission is controlled by heating at subphotospheric radii. We argue that this heating is due to simple collisional dissipation in the baryonic neutron-proton jet. It is shown to convert about 30 per cent of the jet energy to escaping radiation. Simulations of radiative transfer in collisionally heated jets give the theoretical spectrum of photospheric radiation. Remarkably, it reproduces the Band spectral component in observed GRBs if the jet Lorentz factor exceeds 500: the photospheric spectrum peaks at MeV and extends to GeV with a slope of 2.3-2.5. We also discuss the possibility that additional, non-photospheric emission is caused by the decay of neutrons in the jet. This second emission component is expected to lag the photospheric emission by a few seconds in observer time and may contribute to the prompt optical and multi-GeV emission.

P3 - 174 **Spectral and Temporal Properties of Multiple-spike GRBs**

Yoshida, Atsumasa , Satoshi Sugita for HETE-2 team and Suzaku-WAM team

Based on the data obtained by HETE-2, Suzaku/WAM and Swift/BAT, spectral and temporal properties are studied for 12 multiple-spike GRBs with known redshift using {¥it spike-resolved} analysis. The result is compared with the {it Yonetoku Relation}, and we found that each spike follows the relation over 3.5 orders of magnitude.

P3 - 176 **Search for changes in Gamma-Ray Bursts at different redshifts**

Pizzichini, Graziella , E. Maiorano, F. Munz

We try to find changes in the detected quantities of Gamma-Ray Bursts at different redshifts which could be due to source evolution. We consider only events for which the redshift has been at least tentatively measured.

P3 - 233 **Fine Time-Resolved Spectroscopy of Three Short GRBs Observed with GBM**

Kara, Erin, Sylvain Guiriec, Michael Briggs on behalf of the Fermi GBM Collaboration

We investigate the spectral evolution of the three brightest short gamma-ray bursts observed thus far by GBM (GRB 090227B, GRB090228 and GRB 090510). GBM, with its combination of NaI and BGO detectors, covers a large range of energies up to 40 MeV, and can resolve spectra with timescales as small as a few milliseconds. With the improved capabilities of GBM, it is possible to do fine time-resolved spectroscopy of these short GRBs, revealing that Epeak evolves over a wide range and extends to higher values than previously measured. While the spectral evolutions of the three events are similar to those of long bursts, the results suggest some interesting differences. Moreover, we show that for two of the integrated spectra, the Band Model fit was statistically preferred over the power law with exponential cutoff function, which has previously sufficed to fit short bursts.

P4 Cosmic Rays / Dark Matter

Cosmic Rays

P4 - 118 **Swimming in a high-altitude lake: molecular clouds as a test of the cosmic ray sea level**

Casanova, Sabrina , Jones, D., Aharonian, F., Rowell, G., Fukui, Y., Gabici, S., Kawamura, A., Onishi, T., Torii, K., Yamamoto, H.

It is regularly assumed that the ﬂux of cosmic-rays (CRs) observed at the top of the Earth's atmosphere is representative of the ﬂux in the Galaxy at large. The advent of high sensitivity, high resolution $gamma$-ray astronomy, together with a knowledge of the distribution of the atomic and molecular gas in the Galaxy, as provided by NANTEN, creates a unique opportunity to probe the validity of the assumptions about the ﬂux of CRs we receive at Earth –- i.e., the so-called CR 'sea'. We present a methodology which aims to provide a testbed for current and future γ -ray observatories to explore the CR spectrum at various positions in our Galaxy. In particular, for a 3D distribution of molecular clouds, we estimate the expected GeV to TeV $gamma$-ray signal, which can then be compared against observations. A relative deﬁcit in the observed $gamma$-ray signal would imply that there is a relative surfeit of CRs in the local region.

P4 - 119 **Swimming in a high-altitude lake: molecular clouds as a test of the cosmic ray sea level**

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P4 - 120 **Fermi-LAT study of cosmic-ray gradient in the outer Galaxy**

Mizuno, Tsunefumi , on behalf of the Fermi Large Area Telescope Collaboration

The distribution of cosmic-rays within our Galaxy is a key information to understand their origin and propagation. High energy cosmic-rays interact with the interstellar medium or the interstellar radiation field and produce the diffuse gamma-ray emission (via pion production, electron bremsstrahlung and inverse Compton scattering). This fact enables us to study the Galactic cosmic-rays using high-energy gamma-ray observations. Here we report an analysis of the diffuse gamma-rays in the third quadrant with Fermi-LAT. The region has kinematically well-defined segments of the local arm and Perseus arm, and thus is one of the best regions for the study of cosmic-ray density distribution across the outer Galaxy. Detailed analysis of the Fermi-LAT data will be presented. The comparison with cosmic-ray propagation models will also be discussed.

P4 - 121 **Searches for Cosmic-ray Electron Anisotropies in the Fermi-LAT Data**

Vasileiou, Vlasios , & Nicola Mazziotta on behalf of the Fermi Large Area Telescope Collaboration

The Fermi Large Area Telescope (Fermi-LAT) provides unique high statistics for high-energy cosmic-ray electrons (CRE), with excellent angular resolution. Any anisotropies in the arrival directions of these CRE at energies high enough to avoid heliospheric effects could potentially be a signature of electrons originating in a nearby source (depending on the properties of the Galactic magnetic field between us and the source), and could provide information not only on the source parameters and location but also on the solar and Galactic magnetic-field structures. We present methods to search for small to large scale (ten to several tens of degrees) anisotropies in high-energy CRE events detected by the Fermi-LAT.

P4 - 122 **Methods for Measuring the Cosmic-Ray Proton Spectrum With the Fermi LAT**

Smith, Patrick D, Richard Hughes, Brian Winer, Thomas Wood

The Fermi Gamma-Ray Space Telescope was launched in June 2008 and the onboard Large Area Telescope (LAT) has been collecting data since August of that same year. The LAT is currently being used to study a wide range of science topics in high-energy astrophysics, one of which is the study of high-energy cosmic rays. The LAT has recently demonstrated its ability to measure cosmic-ray electrons, and the Fermi LAT Collaboration has published a measurement of the high-energy cosmic-ray electron spectrum in the 20 GeV to 1 TeV energy range. Some methods for performing a similar analysis to measure the cosmic-ray proton spectrum using the LAT will be presented with emphasis on unfolding the reconstructed proton energy.

P4 - 123 **Identification of Cosmic Ray Protons with the Fermi-LAT**

Monzani, Maria Elena ,

The Fermi Large Area Telescope has been designed and optimized for the detection of gamma rays. However, as the recent results on the electron+positron spectrum demonstrate, we are able to identify and reconstruct signals from charged cosmic-ray particles as well. Some methods for the identification of proton signals in the LAT are being implemented, based on a set of basic cuts and also on a new multivariate analysis framework. I will display the implementation of these methods, as well as the performance of the LAT for detecting and measuring cosmic-ray protons.

P4 - 124 **Extending the Galactic Cosmic Ray electron + positron spectrum measured by the Fermi LAT**

Pesce Rollins, Melissa , On behalf of the Fermi Large Area Telescope Collaboration

Launched on the 11th of June 2008, the Fermi Large Area Telescope (LAT) has made several outstanding scientific contributions to the high energy astrophysics community. One of these contributions was the high statistics measurement of the Galactic Cosmic Ray (GCR) electron + positron spectrum from 20 GeV to 1 TeV. The Fermi satellite is in a nearly circular orbit with an inclination of 25.6 degrees at an altitude of 565 km. Given this orbit it is possible to measure the GCR electrons + positrons down to ~5 GeV. However, this lower limit in energy is highly dependent on the orbital position of the LAT in geomagnetic coordinates due to the rigidity cutoff. In order to measure the spectrum down to these energies it is necessary to sample the population of electrons+ positrons in several different geomagnetic positions. In this poster we present the analysis performed to extend the lower limit in energy of the GCR electron + positron spectrum measured by the Fermi LAT.

P4 - 125 **Anisotropy of multi-TeV Hadronic Cosmic Ray**

Dingus, Brenda L, Milagro Collaboration

The intragalactic magnetic fields of typical strength of a few microGauss randomize the directions of charged cosmic rays. However, large scale anisotropies are possible due to the diffusion of cosmic rays from their origin in the galactic plane, and there are several observations of such an anisotropy at TeV energies. However, Milagro, and more recently ARGO, have observed localized regions of cosmic ray excesses of angular extent approximately 10 degrees. The Milagro observation indicates a harder spectrum from the excess that cuts off at about 10TeV, and a purely hadronic excess is favored over a purely gamma-ray excess with high significance. The Fermi observatory detects hadronic cosmic rays as well as gamma rays and could be used to constrain cosmic ray anisotropies at energies above 100 GeV where solar effects are minimal. Also, constraints on the gamma-ray flux that is coincident with the Milagro excess regions might rule out some origins in which the ! cosmic ray excess is due to a cascade of particles.

P4 - 237 **The Cosmic Rays Electron Spectrum measured by Fermi-LAT: some possible interpretations**

Grasso, Dario , on behalf of Fermi-LAT collaboration

The Fermi Large Area Telescope (LAT) has provided the measurement of the high energy (20 GeV to 1 TeV) cosmic ray electrons plus positrons (CRE) spectrum with unprecedented accuracy. The spectrum shows no prominent features and it is significantly harder than that inferred from several previous experiments. While the reported Fermi-LAT data alone can be interpreted in terms of a single (electron dominated) Galactic component, when combined with other complementary experimental results, specifically the CRE spectrum measured by H.E.S.S., and especially the positron fraction measured by PAMELA, an additional electron and positron component needs to be invoked. We will show that the acceleration electron-positron pairs in Galactic pulsars offer a natural interpretation of all these results. Other possible scenarios including secondary electron and positron production in supernova remnants and dark matter annihilation/decay will be shortly mentioned.

Dark Matter / New Physics

P4 - 126 **Quantum Mechanical Propagators of Photons in Causal Set Theory**

Scargle, Jeffrey D, Slobodan Simic

The Fermi Gamma Ray Space Telescope is able to detect or place upper limits on photon dispersion (a form of Lorentz Invariance Violation) in gamma-ray burst light curves. However, there is an almost complete absence of unambiguous predictions of photon dispersion in existing quantum gravity theories. To address part of this need for explicit theoretical analysis, we have developed a formalism based on Feynman path integrals in the context of causal set theory (one of the many flavors of quantum gravity formalisms). We have obtained an exact formula for the summation of the propagator over all paths from a set of points in the causal set (CS) representing the "source" and to a set of "detector" points in the CS. The latter can be partitioned into "pixels" such that one does not know at which point in the pixel the photon was detected (add amplitudes!), but one does know which in which pixel the photon was detected (add probabilities!). Numerical evaluation of this formula is straightforward, but of course impossible for the monster numbers involved in gamma ray burst studies (Hubble distance / Planck scale), so we are pursuing in parallel some other approaches that may give asymptotic results.

P4 - 127 **Direct CMSSM constraints from Fermi observations of Segue 1**

Scott, Pat , on behalf of the Fermi-LAT Collaboration

The dwarf galaxy Segue 1 is one of the most promising targets for the indirect detection of dark matter. I will explain what constraints 9 months of data on Segue 1 from the Fermi Large Area Telescope (LAT) place upon the Constrained Minimal Supersymmetric Standard Model (CMSSM), with the lightest neutralino as the dark matter particle. The scans which I will describe used nested sampling to explore the CMSSM parameter space, simultaneously fitting other relevant constraints from accelerators and the microwave background. These scans included spectral and spatial fits to the Fermi observations, a full treatment of the instrumental response and its related uncertainty, and detailed background models. I will also show predicted impacts upon the CMSSM parameter space after 5 years of observations, assuming no signal is observed from Segue 1. Results marginally disfavour models with low neutralino masses and high annihilation cross-sections, though virtually all of the! se models are already disfavoured by existing experimental or relic density constraints.

P4 - 128 **PLUMs: Gamma-rays from ultracompact primordial dark matter minihalos**

Scott, Pat , Sofia Sivertsson

Primordially-laid ultracompact minihalos (PLUMs) have recently been proposed as a new class of dark matter structure. PLUMs would be produced by phase transitions in the early Universe, and constitute non-baryonic massive compact halo objects (MACHOs) today. I will examine the prospects for detecting PLUMs in gamma-rays if dark matter consists of self-annihilating particles. I will show present-day fluxes from PLUMs produced in the electroweak and QCD phase transitions in the early universe, and from the electron-positron annihilation epoch. PLUMs produced during the electron-positron epoch should be eminently detectable today, either by the Fermi satellite, current Air Cherenkov telescopes, or even in archival data from EGRET. If they exist within 2 kpc of Earth, PLUMs from the electron-positron epoch should also appear as extended sources to Fermi. PLUMs formed in the QCD phase transition have similar predicted fluxes to the dwarf spheroidal galaxies targeted by ! current indirect searches for dark matter, and might be detectable by future instruments.

P4 - 129 **Quantum metric and oscillatory zero-point energies of high-energy particles**

Takahashi, Yoshiyuki ,

Quantum nature of curved spacetime formula is reconsidered for the oscillatory fluctuation of high-energy particles. The vacuum-average of zero-point energy (analogous to Casimir) suggests a large correction of total gravitating mass of galaxies and clusters. Flux observations of limiting high energy photons and neutrinos can potentially explore the dictating quanta at light-cone and the amount of dark matter.

P4 - 130 **Indirect Search for Dark Matter from the Milky Way Halo with Fermi-LAT**

Sander, Aaron J, Brandon Anderson, Richard Hughes, Robert Johnson, Troy Porter, Jennifer Siegal-Gaskins, Brian Winer, Andrea Albert

One possible explanation for dark matter is the existence of weakly interacting massive particles (WIMPs) which represent an extension to the standard model of particle physics. Our galaxy is expected to reside in a large dark matter halo whose density is peaked toward the galactic center but still has significant density at high galactic latitudes. These WIMPs may manifest themselves through annihilations that produce high-energy gamma rays observable by the Fermi Large Area Telescope (LAT). However, diffuse gamma-ray emissions from cosmic-ray interactions in the galaxy represent a formidable source of background. Using the excellent energy resolution and large effective area of the Fermi LAT, we have performed an indirect search for dark matter annihilations in the galactic halo. The search uses both the spatial distribution and energy spectrum of gamma-rays to attempt to separate dark matter from other astrophysical sources. We will present the current resu! lts and discuss the systematic uncertainties due to diffuse gamma-ray backgrounds.

P4 - 131 **The Search for Dark Matter Galactic Satellites with Fermi-LAT**

Bloom, Elliott D, Ping Wang, on behalf of the Fermi Large Area Telescope collaboration

$Lambda$CDM model computer simulations predict a large number of as yet unobserved dark matter (DM) galactic satellites (DM-GS) in our galaxy. Our work assumes that a significant component of DM is a Weakly Interacting Massive Particle (WIMP) in the 100 GeV mass range. The annihilation or decay of WIMPs results in many high energy gamma rays that can be well measured by the Fermi Large Area Space Telescope (Fermi-LAT). The WIMP produced spectrum from the putative DM-GS are considerably harder than most astrophysical sources, are not power laws, and the emission has no time variability. In addition, the only counterpart would be a collection of associated stars (dwarf galaxy) observed in the optical. This talk will focus on the blind analysis we have performed on 10 months of Fermi-LAT data in our search for DM-GS, which has been developed using the first 3 months of Fermi-LAT data and Monte Carlo simulations. We will present results from this analysis, and briefly! discuss theoretical interpretations.

P4 - 132 **Indirect Search for Dark Matter from the center of the Milky Way with Fermi-LAT**

Vitlae, Vincenzo Dr, Aldo Morselli, for the LAT collaboration

Dark matter as weakly interacting massive particle could annihilate or decay and give rise to high energy gamma-rays. Then an indirect search for Dark Matter is possible by means of the Large Area Telescope on board the FERMI satellite. A relatively large signal is expected from the regions where the Dark Matter is expected to have the greatest density, such as the central region of the Milky Way. This region also hosts many high-energy gamma ray sources, of many different classes. Furthermore diffuse emission due to cosmic ray interaction with interstellar gas and radiation is detected from the same direction. A greatly improved understanding of the gamma ray emission from the Glactic Center region is going to be obtained with the Fermi LAT first-year data. The data along with refined modeling of the diffuse emission and a careful evaluation of the discrete sources will allow new limits to be placed on the mass and annihilation rate of Dark Matter particles.

P4 - 133 **Extragalactic gamma-ray background radiation from dark matter annihilation**

Zavala Franco, Jesus , Volker Springel and Michael Boylan-Kolchin

If dark matter is composed of neutralinos, one of the most exciting prospects for its detection lies in observations of the gamma-ray radiation created in pair annihilations between neutralinos, a process that may contribute significantly to the extragalactic gamma-ray background (EGB) radiation. We here use the high-resolution Millennium-II simulation of cosmic structure formation to produce the first full-sky maps of the expected radiation coming from extragalactic dark matter structures. Our map making procedure takes into account the total gamma-ray luminosity from all haloes and their subhaloes, and includes corrections for unresolved components of the emission as well as an extrapolation to the damping scale limit of neutralinos. Our analysis also includes a proper normalization of the signal according to a specific supersymmetric model based on minimal supergravity. The new simulated maps allow a study of the angular power spectrum of the gamma-ray backgroun! d from dark matter annihilation, which has distinctive features associated with the nature of the annihilation process and may be detectable in forthcoming observations by the recently launched FERMI satellite. Our results are in broad agreement with analytic models for the gamma-ray background, but they also include higher-order correlations not readily accessible in analytic calculations and, in addition, provide detailed spectral information for each pixel. In particular, we find that difference maps at different energies can reveal cosmic large-scale structure at low and intermediate redshifts. If the intrinsic emission spectrum is characterized by an emission peak, cosmological tomography with gamma ray annihilation radiation is in principle possible (arXiv e-print 0908.2428).

P4 - 134 **Fermi-LAT Limits on High Energy Gamma Lines from WIMP Annihilation**

Edmonds, Yvonne V, on behalf of the Fermi LAT Collaboration

The Fermi Large Area Telescope (Fermi LAT) Collaboration Dark Matter and New Physics Working group has developed approaches for the indirect astrophysical detection of dark matter by its annihilation or decay products. Our work is motivated by the hypothesis that a significant component of dark matter is Weakly Interacting Massive Particles (WIMPs). The annihilation of two WIMPs or WIMP decay usually results in the production of many $gamma$ rays that if present, can be well measured in the LAT. There is also the possibility to observe $gamma$ lines from annihilation or decay into $gamma gamma$ and/or $gamma$Z final states. Detection of these high energy $gamma$ lines would give convincing evidence for the existence of WIMPs and a measurement of the WIMP mass. We present 11 month upper limits on $gamma$ lines.

Galactic Diffuse

P4 - 135 **High-latitude Molecular Clouds as Gamma-ray Sources for Fermi**

Ergin, Tulun , Thomas M. Dame

The first large scale Galactic CO survey extending to $|b| > 10$ deg was done by Dame, Hartmann, and Thaddeus (2001) with the 1.2 meter millimeter-wave telescope at the Center for Astrophysics. This unbiased survey has been extended to higher Galactic latitudes with a spacing of 0.25 deg (roughly every other beam-width), where over 200 molecular clouds at $|b| > 10$ deg between the Galactic longitudes of 0 and 230 deg (Dame and Thaddeus, 2004) has been mapped. Here we present results from new CO observations, started in October 2008, which beam-width sample all of the high-latitude clouds uncovered by our unbiased mapping. As of June 2009 approximately 63,277 CO spectra have been obtained toward 205 clouds and mapping of 15 more is ongoing. We expect that all isolated clouds at high-latitudes ($|b|>10$ deg) and at $delta > -15$ deg will be mapped by the same manner by the end of 2009. It has been shown by Torres, Dame, and Digel (2005) that high-latitude CO clo! uds should be detected as gamma-ray sources in the first-year all-sky survey of Fermi depending on their angular size and their column densities. Since the number of such high-latitude clouds is predicted to be around 100, they are expected to be the most numerous high-latitude gamma ray sources after AGN. It is therefore crucial for the diffuse gamma ray emission from these clouds to be well understood and characterized. Additionally, the new survey will be used to investigate the nature and extent of the so-called dark gas proposed by Grenier, Casandjian, and Terrier (2005). The data may also contribute to the Fermi search of dark matter in the Galactic halo, providing molecular column densities toward suspected regions of WIMP annihilation (Baltz, Taylor, and Wai 2007).

P4 - 136 **Fermi measurements of diffuse gamma-ray emission beyond the solar circle: Cassiopeia, Cepheus and the Perseus arm**

Tibaldo, Luigi , on behalf of the Fermi LAT collaboration

We present the analysis of the interstellar gamma-ray emission measured by the Fermi Large Area Telescope (LAT) in the second Galactic quadrant at $100^circ< l < 145^circ$, $-15^circ < b < 30^circ$. This region encompasses the prominent Gould-Belt clouds of Cassiopeia, Cepheus and the Polaris flare, as well as conspicuous clouds at larger distances in the local and Perseus spiral arms, suitable to probe the cosmic-ray densities and interstellar masses beyond the solar circle. We find that the gamma-ray emissivity spectrum of the local gas is consistent with expectations based on the cosmic-ray spectra measured at the Earth. The emissivity decreases from the Gould Belt to the Perseus arm, but the measured gradient is flatter than expectations based on diffusion of cosmic rays from supernova remnant sources with a distribution peaked in the inner Galaxy as suggested by pulsars. The $X_mathrm{CO}=N(H_2)/W_mathrm{CO}$ conversion factor moderately increases by a factor ! $ sim 2$ from the Gould Belt to the Perseus arm. The presence of additional gas not properly traced by HI and CO in the Gould Belt is suggested by the correlation between gamma-ray data and cold dust detected through its thermal emission.

P4 - 137 **HI spin temperature with Fermi-LAT**

Johannesson, Gudlaugur , for the Fermi-LAT collaboration

The diffuse high-energy gamma-ray emission of the Milky Way arises from interactions of cosmic-rays with interstellar gas and light in the Galaxy. The neutral hydrogen (HI) gas component is by far the most massive and broadly distributed component of the interstellar medium. Using the 21-cm emission line from the spin flip transition of atomic hydrogen it is possible to determine the column density of HI if the spin temperature of the emitting gas is known. Studies of diffuse gamma-ray emission have generally relied on the assumption of a fixed, constant spin temperature for all HI in the Milky Way. Unfortunately, observations of HI in absorption against bright background sources has shown it to vary greatly with location in the Milky Way. We will discuss methods for better handling of spin temperatures in the Galactic diffuse emission using the Fermi-LAT data and Galactic diffuse emission modeling along with direct observation of the spin temperature using HI abso! rption.

P4 - 138 **GALPROP modelling of diffuse Galactic emission**

Strong, Andrew W, and the GALPROP team, on behalf of the Fermi Large Area Telescope Collaboration

The quality of data from the Fermi Large Area Telescope on the emission from the Galaxy requires support from a correspondingly detailed physical model. The GALPROP model has been developed over the last decade to make predictions of cosmic-propagation and the resulting interstellar emission for gamma rays and synchrotron radiation. It has been adopted in the Fermi collaboration as the basis for the physical interpretation of the Galactic emission. A new release of GALPROP is planned to correspond to results presented at this Symposium. We describe this release and its new features, and show some comparisons with Fermi data. We will also show multiwavelength spectra of the Galaxy compared with data from a range of experiments.

P4 - 139 **Source population contribution to Galactic 'diffuse' emission**

Strong, Andrew W, on behalf of the Fermi Large Area Telescope Collaboration

The gamma-ray emission from the Galaxy arises from both interstellar processes and compact sources. Only a small fraction of the sources in the Galaxy have been (or will be) detected by the Fermi Large Area Telescope: the most luminous and the nearest ones. At some level the interstellar and source emission become observationally indistinguishable, and explicit modelling is required. The analysis of Galactic 'diffuse' emission with Fermi naturally concentrates on the interstellar component associated with cosmic rays, gas and interstellar radiation fields, but estimates of the contribution from undetected source populations are still essential when comparing models with data. We describe a simple population-synthesis approach which allows a general study to be made without invoking details of the nature of the sources. The model populations are required only to be consistent with constraints from current Fermi source lists. Current best estimates of the contribution from undetected sources will be given. Predictions for the expected residual contribution as the source survey threshold decreases will also be shown. Upper limits will be given on the luminosity function of dim source populations which could contribute to the diffuse emission while remaining undetected.

P4 - 140 **Diffuse Gamma-Ray Observations of the Orion Molecular Clouds**

Akira, Okumura , Tune Kamae, on behalf of the Fermi Large Area Telescope Collaboration

We report on the Fermi/LAT observations of the Orion A and B molecular clouds. Since the GeV gamma-ray emission from molecular clouds is expected to be induced by hadronic and electromagnetic interactions between Galactic cosmic rays and nuclei in the clouds , we are able to study the structure of the clouds independently of other observations such as CO and dust. The clouds in the Orion region form the nearest giant molecular clouds complex and have long been studied in gamma rays and radio because of the large angular extents and their location in the outer Milky Way. The proportionality between $N(mathrm{H}_2)$ and $W(mathrm{CO})$ is found to be different between Orion A and B in our study with Fermi/LAT data. We discuss the relation between gamma-ray, CO, and dust observations.

P4 - 141 **Cosmic rays and magnetic fields constrained by synchrotron and gamma rays**

Orlando, Elena , Strong, A. W.; Moskalenko, I. V.; Porter, T. A.; Johannesson, G.; Digel, S. W.

By combining synchrotron and gamma-ray data we can put better constraints on Galactic cosmic ray electrons and magnetic fields than possible when considering these data separately. The GALPROP code includes 3D magnetic field models, and these can be used to make self-consistent predictions of the synchrotron and gamma-ray sky. We present the current state of this study.

P4 - 142 **High Energy Gamma-Ray Emission Around the North Polar Spur**

Casandjian, Jean-Marc , On behalf of the Fermi Large Area Telescope Collaboration

Loop I is a nearby giant radio loop spanning over 100 degrees and centered on the Sco-Cen OB association. It may correspond to a superbubble formed by the joint action of stellar winds and supernova remnants. ROSAT observations revealed that this region is filled with a hot gas possibly reheated by successive supernova explosions. The brightest feature of Loop I, called the North Polar Spur (NPS), is located in the northern hemisphere at a longitude around 30 degrees and is at a distance of approximately 100 pc from the Sun. This long filament, probably located in the interaction region between Loop I and the Local Bubble, is surrounded by a dense ring of compressed atomic hydrogen in the annular zone of intersection. In case of proton acceleration by Loop I, this hydrogen would be a prime site for neutral pion production. Early searches for high energy gamma rays associated with electrons or protons accelerated by Loop I were performed with COSB and EGRET. But a d! etector with better performance and higher statistics is required to distinguished between the signal from the NPS and broad structures in the Galactic interstellar emission, like the inverse Compton emission from cosmic-ray electrons scattering the interstellar radiation field. We will discuss the excess of gamma-ray observed by the Fermi Large Area Telescope in the region of the NPS and will compare the data with a precise model of the Galactic diffuse emission.

P4 - 143 **The gamma-ray side of Gould Belt clouds: a census of the atomic, molecular, and dark gas mass**

Casandjian, Jean-Marc , On behalf of the Fermi Large Area Telescope Collaboration

The presence of "dark" gas, i.e. normal interstellar gas with a normal dust-to-gas ratio that is not accounted for in the HI and CO surveys, has been proposed to explain the correlated excess of cold dust and of gamma-ray intensity seen around the nearby CO clouds in the EGRET data (Grenier et al., 2005). A large dark-gas mass, ranging from 10% to 500 % of the molecular mass seen in the CO-bright phase, was derived in these clouds at the interface between the atomic and molecular gas. The Large Area Telescope (LAT) aboard the Fermi Gamma-ray Space Telescope has extensively surveyed the Gould Belt clouds, off the Galactic plane, for the past year. The observations confirm the existence of an excess of gamma rays correlated with an excess of dust reddening over the contributions expected from the HI and CO data. The gamma-ray spectral shape is the same for the dark gas as for the atomic and molecular gas, thus confirming the need for additional gas. The superior sens! itivity and angular resolution of the LAT allow a good spatial separation of the three HI, CO, and dark phases to measure their gamma-ray emissivity spectrum independently in different nearby clouds. We will compare the cosmic-ray flux and mass estimates obtained in a sample of Gould Belt clouds and discuss the influence of the uniform spin temperature used to derive the HI column density. The confirmation of the dark gas in the local clouds has important implications for the determination of the CO-to-H2 conversion factor and of the cosmic-ray densities across the Galactic disc.

P4 - 144 **The Diffuse Gamma-Ray Emission Excess from two Galactic Plane Regions at TeV Energies**

Huentemeyer, Petra H, The Milagro Collaboration

Measuring the diffuse gamma-ray emission from our Galaxy provides information on the origin and propagation of Galactic cosmic rays. Previously the EGRET experiment observed a global excess over theoretical predictions based upon direct cosmic ray measurements at Earth and our knowledge of matter and radiation fields throughout our Galaxy. New results from the Fermi telescope, at least in certain galactic mid-latitude regions, did not confirm the GeV excess seen by EGRET. At around 15 TeV, the Milagro experiment reported an enhancement by a factor of eight (in the Cygnus region) and a factor of almost five (in the inner Galaxy) with respect to a standard model of Galactic cosmic ray production and propagation. Possible explanations for the excess observed by Milagro will be reviewed and future perspectives for resolving the discrepancy between model predictions and data will be discussed.

P4-240 **The Fermi Haze: a Gamma-Ray Counterpart to the Microwave Haze**

Finkbeiner , Doug,

Recent Data from the Fermi Gamma-ray Space Telescope shows emission in the inner 30 deg of the Milky Way in excess of that expected for the diffuse pi-0 and bremsstrahlung components. I will argue that the emission is inverse Compton scattered starlight, from a hard electron CR spectrum consistent with that required to make the WMAP microwave haze. These components are morphologically similar and require the same electron spectrum. I will discuss possible sources for this spectrum, including WIMP annihilation.

Sun / Solar System

P4 - 145 **Fermi-LAT observations of the Earth Albedo Gamma-ray emission**

Funk, Stefan , for the LAT collaboration

The interactions between cosmic rays and the earth atmosphere produce high energy photons, which are normally called the earth gamma-ray albedo. For GeV gamma-ray instrument the proximity to the Earth renders the earth the brightest gamma ray source in the sky for Fermi-LAT. Using the Albedo gamma-rays yields unprecedented detailed measurements of the interaction of cosmic rays with the earth atmosphere. Spectral and spatial properties are presented here

P4 - 146 **Fermi Solar Flare Observations**

Dennis, Brian R, Richard Schwartz, Kim Tolbert, Ronald Murphy, Francesco Longo, Gerald Fishman, Michael Briggs, Gerald Share

Our 3-year Fermi GI program is designed to ensure the full realization of the unique scientific potential of Fermi solar-flare observations. We will make the GBM and LAT flare data and our IDL analysis tools readily accessible to the solar community. We will analyze X- and gamma-ray flares, and cross-calibrate GBM with RHESSI and other solar instruments. From these measurements we will obtain information on flare-accelerated electrons and ions that can be compared with results from Solar Energetic Particle events. We propose autonomous solar pointing to optimize the study of long-duration gamma-ray flares with LAT. We will encourage the international solar physics community to carry out joint scientific analysis of Fermi data.

P4 - 147 **Searches for high energy solar flares with Fermi LAT**

IAFRATE, GIULIA , Giulia Iafrate and Francesco Longo on behalf of the Fermi Large Area Telescope Collaboration

The Fermi Large Area Telescope (LAT) has been surveying the sky in gamma rays from 20 MeV to more than 300 GeV since August 2008. The Solar System Science Group of the Fermi team is continuously monitoring the high energy emission from the Sun searching for flare events. Upper limits were derived for all solar flares detected so far by other missions and experiments (RHESSI, Fermi GBM, GOES). Here we present the analysis techniques as well as the details of this search. We also present a detailed comparison of the stacked solar flare emission with the emission of the quiet Sun.

P5 Theory / Catalogs / Instruments / Missions

Astrophysical Theory

P5 - 177 **Simulation of relativistic shocks and associated radiation from turbulent magnetic fields**

Nishikawa, Ken-Ichi , J. Niemiec, B. Zhang, M. Medvedev, P. Hardee, Y. Mizuno, A. Nordlund, J. Frederiksen, H. Sol, M. Pohl, D. H. Hartmann, J. F. Fishman

Plasma instabilities excited in collisionless shocks are responsible for particle acceleration. We have investigated the particle acceleration and shock structure associated with an unmagnetized relativistic electron–positron jet propagating into an unmagnetized electron–positron plasma. Cold jet electrons are thermalized and slowed while the ambient electrons are swept up to create a partially developed hydrodynamic-like shock structure. In the leading shock, electron density increases by a factor of about 3.5 in the simulation frame. Strong electromagnetic fields are generated in the trailing shock and provide an emission site. These magnetic fields contribute to the electron's transverse deflection behind the shock. The ``jitter'' radiation from deflected electrons in turbulent magnetic fields has different properties than synchrotron radiation, which is calculated in a uniform magnetic field. This jitter radiation may be important for understanding the complex! time evolution and/or spectral structure in gamma-ray bursts, relativistic jets in general, and supernova remnants. New spectra based on simulations will be presented.

P5 - 178 **Plasma effect on the lower limit of the quantum gravity mass**

Wu, Xuefeng , Kenji Toma, Peter Meszaros

Delayed multi-GeV photons in GRB 080916C and GRB 090510 detected by Fermi/LAT have been used to constrain the possible linear Lorentz invariance violation, resulting in lower limits on the quantum gravity mass of ~0.1 and > 1.0 Planck mass, respectively. In this talk we will discuss the plasma effect on the lower limit of the quantum gravity mass, especially for the quadratic LIV case. The dispersion caused by plasma effect is opposite to the dispersion by the LIV effect on the photon's velocity. The former results in soft lags while the latter results in hard lags. The cancellation of these two effects happens at a photon energy of a few tens MeV for the quadratic LIV case, which can be tested with current and future GRBs observed by Fermi/LAT.

P5 - 179 **Effects of retro-lensing light curves near a black hole**

Karas, Vladimir , Jiri Horak

We model the light-curves from radiation-driven clouds near an accreting black hole. Taking into account the multiple images due to strong gravitational lensing, we find that sharp spikes can significantly enhance the observed flux. We assume that scattering of ambient light takes place in a cloud that is in radial motion under a combined influence of black hole gravity and the radiation field. The retro-lensed photons give rise to peaks in the observed signal that occur with a characteristic time lag after the direct-image photons. Duration of these features is very short and it is a signature of the photon orbit. We also consider the polarization properties of scattered light.

P5 - 180 **A Generalized Split Monopole Solution for the Blandford-Znajek Mechanism**

Menon, Govind K, Charles Dermer

A recent perturbative solution to the Blandford-Znajek mechanism that is valid for rapidly spinning black holes will be presented. The electromagnetic and matter energy extraction from supermassive black holes for this solution is then considered from an analytic point of view. This solution is of order 1/r^2, and it satisfies the Znajek regularity condition exactly and the event horizon of a Kerr black hole.

P5 - 181 **Neutrino annihilation around spinning black holes**

Zalamea, Ivan , A. M. Beloborodov

A fraction of neutrino emission from GRB accretion disks annihilates above the disk, creating e+- plasma that can drive GRB explosions. We calculate the efficiency of this annihilation using the recent detailed model of hyper-accretion disks around Kerr black holes. Our calculation is fully relativistic and based on a geodesic-tracing method. Besides neutrino-antineutrino annihilation, we include another reaction: creation of e+- pairs by neutrinos in a strong magnetic field. We find that this reaction can dominate e+- creation only for disks with small neutrino luminosities. We find that the net rate of e+- creation around the disk is a well-defined function of (1) accretion rate and (2) spin of the black hole. It is practically independent of the details of neutrino transport in the opaque zone of the disk. The results help identify the accretion disks whose neutrino emission can power GRBs.

P5 - 182 **Is M33 X-7 a Possible Progenitor of a Long Gamma-Ray Burst?**

Fragos, Tassos , Kalogera Vassiliki, Valsecchi Francesca

Black hole X-ray binaries are X-ray luminous binary systems comprising a black hole accreting matter from a companion star. Understanding their origins and future evolution sheds light on the still puzzling physics of black hole formation. M33 X-7 is known to host the second most massive black hole ($15.65rm, M_{odot}$) among the known X-ray binaries, and a $70rm, M_{odot}$ stellar companion in a 3.45 days orbit. The stellar companion is currently at the end of its main sequence and is almost filling its Roche lobe. In $sim 10^5$ years, the companion star will start expanding dramatically as it evolves onto the giant branch, and will overfill its Roche lobe. Due to its mass ratio, the binary will enter a phase of dynamically unstable mass-transfer, also known as common envelope phase. During this phase, the black hole will spiral in the outer layers of the companion star. Under specific conditions, energy can be transferred from the orbit to the common envelope ! leading to a reduction of the binary separation, ejection of the envelope, and spin up of the remaining helium core through tidal interactions. If the common envelope does not lead the system to a merger, then the remaining rapidly spinning massive Helium core is the perfect candidate for a long Gamma-ray burst progenitor. Here, we study the outcome of the CE phase using an innovative method, which assumes nearly-adiabatic ejection of the envelope and takes into account the full internal structure of the companion star.

P5 - 183 **The Jitter Model of Prompt GRB Emission**

Medvedev, Mikhail V, S. Pothapragada, S. Reynolds

The origin of rapid spectral variability and certain spectral correlations of the prompt gamma-ray burst emission remains an intriguing question. We propose a heuristic model of the prompt emission, which involves unique spectral properties of jitter radiation --- the radiation from small-scale magnetic fields generated at a site of strong energy release (e.g., a relativistic collisionless shock in baryonic or pair-dominated ejecta, or a reconnection site in a magnetically-dominated outflow). We show that anisotropy of the jitter radiation pattern and relativistic shell kinematics altogether produce effects commonly observed in time-resolved spectra of the prompt emission, e.g., the softening of the spectrum below the peak energy within individual pulses in the prompt light-curve, the so-called ``tracking'' behavior (correlation of the observed flux with other spectral parameters), the emergence of hard, synchrotron-violating spectra at the beginning of individual ! spikes. We discuss observational predictions of the model and highlight ideas that may help to discriminate baryon/leptin-dominated and magnetically-dominated GRBs.

P5 - 184 **Diffuse GeV emission from the Milky Way halo**

Medvedev, Mikhail V, M. Pohl

What do we know about the Milky Way local environment, within the distances of a couple hundred kpc? Little is really known as of now. As the Milky Way moves toward Virgo cluster at some 200 km/s and is also producing the Galactic wind of a similar speed, it is tempting to make an analogy with our Solar system, with the Sun producing the solar wind and moving through the interstellar medium. We propose a model of the "galactosphere" as an up-scaled analog of our heliosphere, for which accurate computer modeling and in situ data from Voyagers are available. A termination shock and a bow shock are expected to exist under certain conditions of the ambient warm-hot intergalactic medium (WHIM) and the galactic wind. We propose that these shocks, if exist, shall be our local extragalactic sources of cosmic rays (CRs). The CRs interact with the gas in the Milky Way, its halo and with the high velocity clouds shall produce gamma-rays in a few GeV range via pion production! . We estimate the spectrum and strength of the gamma-ray spectrum and its contribution to the north-south asymmetry of GeV background. We argue that the signal is within the observational capabilities of Fermi/LAT.

Catalogs and UnId

P5 - 185 **A search of VHE counterparts of Fermi sources**

Tam, Thomas P.H., Stefan Wagner

VHE gamma-rays have been detected from SNR, pulsars and pulsar wind nebulae, AGN, gamma-ray binaries, molecular clouds, and likely star-forming regions, thanks to the high sensitivity of current IACTs. At lower energies, sources detected using LAT provides a fruitful set of data for understanding how the cosmic accelerators works through the GeV/TeV window. In particular, the much improved angular resolution in both bands compared to previous experiments provides the best positional identification ever obtained for a few tens of sources. This allows detailed studies of individual sources to be carried out. In this paper, spatial coincidences from VHE gamma-ray sources with LAT bright sources are searched for and available GeV and TeV spectra of coincident sources are compared. This helps to identify the nature of a number of LAT sources through their VHE counterparts.

P5 - 186 **Swift/BAT monitoring of Fermi/LAT sources**

Krimm, Hans A, S. Barthelmy, W. Baumgartner, J. Cummings, E. Fenimore, N. Gehrels, C. Markwardt, D. Palmer, T. Sakamoto, G. Skinner, M. Stamatikos, J. Tueller

The Swift Burst Alert Telescope (BAT) hard X-ray transient monitor tracks more than 700 galactic and extra-galactic sources on time scales ranging from a single Swift pointing (approximately 20 minutes) to one day. The monitored sources include all objects from the Fermi LAT bright source list which are either identified or which have a 95% error confidence radius of less than eight arc minutes. We report on the detection statistics of these sources in the BAT monitor both before and after the launch of Fermi.

P5 - 188 **The First Fermi AGN Catalogue**

Healey, Stephen E, the AGN Working Group of the Fermi LAT collaboration

The Third EGRET Catalogue (3EG) and the Fermi LAT Bright AGN Sample (LBAS) showed, and the first year of LAT data confirms, that the extragalactic ($|b| > 10^circ$) $gamma$-ray sky is dominated by blazars and other AGNs. I will briefly describe the methods by which LAT sources are associated with radio AGN counterparts and summarize the general properties of the LAT AGN population (e.g., a census of AGN number counts, the classification of LAT blazars as FSRQs or BL Lacs, the basic $gamma$-ray spectral properties of the catalogue, the redshift distribution of the sample, etc.).

P5 - 189 **New unidentified H.E.S.S. Galactic sources**

Tibolla, Omar , O. de Jager, W. Domainko, S. Kaufmann, R.C.G. Chaves, N. Komin, A. Fiasson, K. Kosack on behalf of the H.E.S.S. collaboration

H.E.S.S. is one of the most sensitive instruments in the very high energy (VHE; > 100 GeV) gamma-ray domain and has revealed many new sources along the Galactic Plane. After the successful first VHE Galactic Plane Survey of 2004, H.E.S.S. has continued and extended that survey in 2005-2008, discovering a number of new sources, many of which are unidentified. Some of the unidentified H.E.S.S. sources have several positional counterparts and hence several different possible scenarios for the origin of the VHE gamma-ray emission; their identification remains unclear. Others have so far no counterparts at any other wavelength. Moreover, the lack of an X-ray counterpart puts serious constraints on emission models. Several newly discovered and still unidentified VHE sources are reported here; particular attention is given to the unidentified sources that have a possible Fermi LAT counterpart at GeV energies.

P5 - 190 **A search for candidate TeV emitters in the high-latitude Fermi unassociated sources**

Fortin, Pascal , Deirdre Horan, Elizabeth Ferrara, on behalf of the Fermi Large Area Telescope Collaboration

We report the results of an analysis to identify candidates for very high energy (VHE; E > 100 GeV) emission from the Fermi high-latitude unassociated sources in the first year catalogue. These are sources with no known counterparts at other wavelengths. Since VHE instruments are pointed instruments with small fields of view and low duty cycles, their observing programs need to be planned carefully to identify the most promising targets for observation. The scientific potential of combined Fermi and VHE observations has already been demonstrated with a number of joint VHE-Fermi papers. The goal of this work is to select the most promising unassociated Fermi sources for joint observations with Fermi and the VHE instruments.

P5 - 191 **Some Candidates for Gamma Ray Observation.**

Kriske, Richard M,

The author suggests some unique targets for Gamma Ray Observation.

P5 - 192 **Correlating the GeV and hard X-ray skies**

Hill, Adam B, On behalf of the Fermi Large Area Telescope Collaboration

The Large Area Telescope on the Fermi Gamma-ray Space Telescope provides unprecedented sensitivity for surveying the high energy energy sky and has detected many sources in its 1st year of operations. The current generation of hard X-ray telescopes have been monitoring and surveying the keV sky for the past seven years providing the most complete catlogs in this energy band. Emission in the Fermi band is dominated by particle acceleration processes including shocks, jets and magnetospheric emission; the hard X-ray sky is dominated by accretion mechanisms. These are two very physically different regimes and consequently those objects which are present in both energy regimes are very interesting to investigate. We present a correlation analysis of the Fermi source population with the hard X-ray survey catalogs of INTEGRAL and Swift.

P5 - 193 **Analysis of the spatial extent of sources in the Fermi-LAT 1 year catalog**

Lande, Joshua J,

A large number of candidate Fermi-LAT source classes, including SNRs, Molecular clouds, PWN, Galaxy clusters and Dark Matter satellites, are expected to show spatially extended emission beyond the instrument's energy-dependent point spread function. For both the identification of these sources as well as for the interpretation of observations of these source classes, information on the angular extents of the emission regions are of tremendous value. The significance of extension was calculated for all of the sources in the Fermi-LAT 1 year catalog. Each of the significantly extended sources was fit as a radially symmetric Gaussian and the extension, localization, and spectral features of each source were calculated.

P5 - 194 **Studies of Fermi sources with a novel image restoration technique**

Hiroyasu, Tajima , Fermi LAT collaboration

We have developed an image restoration technique based on the Richardson-Lucy algorithm optimized for Fermi-LAT image analysis. Our algorithm is original since it utilizes the PSF (point spread function) that is calculated for each event. This is critical for Fermi-LAT image analysis since the PSF depends on the energy and angle of incident gamma-rays and varies by more than one order of magnitude. Fermi-LAT image analysis also faces Poisson noise due to low photon statistics. Our technique incorporates wavelet filtering to minimize such noise effects. We present studies of Fermi sources using this novel image restoration technique for possible identification of extended gamma-ray sources and source confusions.

P5 - 195 **Observations of Soft Gamma-ray Sources >100 keV Using Earth Occultations with GBM**

Cherry, Michael L, C. A. Wilson-Hodge, E. Beklen, P.N. Bhat, M. Briggs, A. Camero-Arranz, G. L. Case, V. Chaplin, V. Connaughton, M. Finger, R.H. Haynes, R. Preece, J. Rodi

The Gamma Ray Burst Monitor (GBM) onboard Fermi is being used to monitor a number of hard x-ray/soft gamma ray sources using the Earth occultation technique. Through the first year of this monitoring program, 6 sources have been detected at energies above 100 keV, with a seventh possibly detected during a flare. Light curves and spectra of these sources are presented using the 8-channel CTIME data.

P5 - 196 **Population Characteristics of Unassociated Fermi Large Area Telescope Sources**

Ferrara, Elizabeth C, I. Grenier, on behalf of the Fermi Large Area Telescope Collaboration

In its first year, the Fermi Large Area Telescope (LAT) has dramatically improved our knowledge of the gamma-ray sky. As a result of the LAT's increased sensitivity and angular resolution over earlier-generation detectors, many previously detected gamma-ray sources (from EGRET and other instruments) have now been identified with objects that belong to known classes of gamma-ray emitters. Such improvements have also significantly expanded the number of detected sources that do not appear to have an association with any known gamma-ray-emitting object type. We use the spectral, spatial, and temporal properties of these unassociated sources, in comparison with LAT sources that have likely associations or are firmly identified, to provide insight into the underlying population(s) that these detections may represent.

P5 - 197 **Observations of Fermi Unidentified High Latitude Sources with XMM-Newton**

Wolff, Michael T., LAT Collaboration

Using the XMM-Newton satellite during July and August 2009 we have observed two fields of unidentified high galactic latitude sources from the initial August 2008 Fermi/LAT source list (AUG0026 at b = -10.9^circ, AUG0070=0FGLJ1231.5-1410 at b = +48.4^circ). The observations consisted of 37 ks for the AUG0026 field broken into two separate observations of roughly equal length, and 26 ks for the AUG0070 field utilizing both the EPIC-pn and MOS cameras. The fields of view of both instruments are approximately 30 arcmin in diameter and thus well matched to the error regions of our Fermi/LAT sources. We characterize the X-ray spectra and fluxes for sources detected by XMM-Newton within the Fermi/LAT error regions of both sources, as well as characterize the temporal properties in the 0.2-10 keV energy band for these sources. We also compare optical and radio source survey results for these fields to the observed X-ray sources.

P5 - 236 **Fermi-INTEGRAL : the odd skies**

Ubertini, Pietro,

We present a crosscheck of the new outstanding appearance of the Fermi high energy gamma-ray sky with the Integral/IBIS soft gamma ray Universe. This comparison shed a new light on high energy emission processes in Blazars, PWN, microQSO and, possibly on a new class of high energy Galactic transient sources.

Instruments / Missions

P5 - 198 **Science Data Monitoring for the Large Area Telescope**

Monzani, Maria Elena ,

The quality of the LAT science data is continuously monitored through a number of web-based tools, to make sure that all the detector subsystem collect data as expected and that the data can be used for physics. We are currently monitoring over a hundred thousand quantities, both at the single-subsystem level and at the overall detector level. Most quantities are checked by an automated alarm system, which can catch problems without human intervention, while a few quantities are inspected every day by duty scientists. The output of the Data Monitoring work includes a set of Data Quality flags, which assess the overall quality of the data and are included in the spacecraft data files provided by the FSSC.

P5 - 199 **Multiwavelength Opportunities and Challenges in the Era of Public Fermi Data**

Thompson, David J, Fermi Large Area Telescope Collaboration

The gamma-ray survey of the sky by the Fermi Gamma-ray Space Telescope offers both opportunities and challenges for multiwavelength and multi-messenger studies. Gamma-ray bursts, pulsars, binary sources, flaring Active Galactic Nuclei, and Galactic transient sources are all phenomena that can best be studied with a wide variety of instruments simultaneously or contemporaneously. Identification of newly-discovered gamma-ray sources is largely a multiwavelength effort. From the gamma-ray side, a principal challenge is the latency from the time of an astrophysical event to the recognition of this event in the data. Obtaining quick and complete multiwavelength coverage of gamma-ray sources can be difficult both in terms of logistics and in terms of generating scientific interest. The Fermi LAT team continues to welcome cooperative efforts aimed at maximizing the scientific return from the mission through multiwavelength studies.

P5 - 200 **Particle Background Effects on Efficiency and Residual Background Contamination of the LAT Diffuse Class Photon Sample**

Charles, Eric A,

We present and use a method to disentangle the effects of particle background fluxes from celestial photons by measuring correlations between observed photon rates and instantaneous particle background rates. We provide estimates of the both the loss of efficiency and the residual contamination of the diffuse class photon sample using 6 months of data over the entire sky over the energy range 100MeV - 10GeV.

P5 - 201 **Measurement of the Fermi-LAT localization performance**

Burnett, Toby , Fermi-LAT collaboration

We present results of a study of the localization capability of Fermi-LAT, using a large set of blazars with precise radio locations. Since the width of the PSF decreases with energy, the performance is typically dominated by a few high energy photons, so it is important to properly characterize the high-energy PSF. Using such data, we have found a need to modify the pre-launch high-energy (greater than a few GeV) PSF derived from extensive Monte Carlo simulations of particle interactions in the LAT; the resulting data-based PSF is shown.

P5 - 202 **Performance of the Fermi Large Area Telescope**

Rando, Riccardo , on behalf of the Fermi LAT collaboration

The current status of the Large Area Telescope (LAT) performance represents the Fermi collaboration's best knowledge of the instrument: calibrations are now based on flight data, and a description of on-orbit effects related to background event rate is included. We summarize the top-level performance of the LAT as it is currently parametrized and distributed for science analysis. From the performance characterization we derive the LAT point source sensitivity as a function of energy and celestial coordinates. A plan for the future developments is also detailed.

P5 - 203 **Fermi LAT Flare Advocate Activity During the First Year of Mission**

Ciprini, Stefano , Gasparrini, Dario (on behalf of the Fermi LAT Collaboration) & on behalf ot the Fermi LAT Flare Advocates)

The Flare Advocate/Gamma-ray Sky Watcher (FA-GSW) activity is part of the Fermi LAT Science Operations aiming to supply a prompt outlook service to the quick-look Automatic Science Processing (ASP) products, and in general to the LAT sky, day by day. The FA-GSW points out potentially interesting seeds for LAT science and the different LAT science groups, while communicating basic and relevant news to the external astrophysical community, in order to increase the rate of multi-frequency observations and follow-ups that could maximize science return. During the first year of the Fermi mission, FA-GSWs discovered, for example, many gamma-ray flares and longer-term brightening from blazars, three unidentified transients near the Galactic plane, discovered the quiet sun emission, compiled 43 Astronomical Telegrams, pointed out possible new sources, and provided starting seeds for about a dozen LAT papers on single sources. Some highlights of these substantial results a! re presented here.

P5 - 204 **Description of the Event Reconstruction for the Fermi Large Area Telescope**

Usher, Tracy , Leon Rochester, Bill Atwood

We present a description of the event reconstruction of the data from the Fermi Large Area Telescope (LAT) . The data consist of the responses of the tracker (TKR), calorimeter (CAL) and anticoincidence-detector (ACD) subsystems of the LAT. For each event, the raw energy measured in the CAL is used to constrain tracks in the TKR, which are then used to refine the energy measurement. In addition, quantities relating the struck ACD tiles to the tracks are computed. In a subsequent step, many of the quantities calculated during the reconstruction are used to separate incident gammas from background and to arrive at the final energy and direction on the sky of the incident particles. The algorithms and implementations were developed pre-launch using simulated data from a detailed Monte Carlo model of the detector and particle sources, both gammas and background.

P5 - 205 **Description of Upgrades to the Event Simulation and Reconstruction for the Fermi Large Area Telescope**

Rochester, Leon S, Tracy Usher, Robert Johnson and Bill Atwood, on behalf of the Fermi LAT Collaboration

The pre-launch event simulation and reconstruction performed beyond expectation, essentially without modification, and made possible the immediate start of science analysis. But the on-orbit data exhibit unanticipated features that necessitate upgrades to both the simulation (essentially done) and the reconstruction (ongoing). The major new effect encountered on-orbit is the presence of "ghosts," that is, remnant detector response to particles passing through the detector before the particle that triggered the event. These ghosts appear primarily in the form of extra tracks and/or energy deposits. As part of this upgrade, we plan to enhance our ability to discriminate against background particles by introducing additional analysis during the reconstruction phase. We present a description of the effect of ghosts, and of the work to deal with them, done and planned, as well as some other ideas for improving the reconstruction.

P5 - 206 **Unfolding spectral analysis of the Fermi-LAT data**

Mazziotta, Mario Nicola, Francesco Loparco (On behalf of the Fermi-LAT collaboration)

The Large Area Telescope (LAT) onboard the Fermi satellite is observing the gamma-ray sky in the very high energy region, above 20MeV. We have developed a method to reconstruct the energy spectra of the gamma rays detected by the Fermi LAT instrument based on a Bayesian unfolding approach, that takes into account the energy dispersion introduced by the instrument resolution. The method has been successfully applied to reconstruct the energy spectra of both steady and pulsating point sources. The analysis technique will be illustrated and the results obtained in some significant test cases will be discussed.

P5 - 207 **A tool for estimating the background of the LAT for transient events**

Vasileiou, Vlasios , on behalf of the Fermi Large Area Telescope Collaboration

The instantaneous rate of LAT background events from a source depends strongly on the geomagnetic coordinates at the location of the spacecraft and the off-axis angle of the source. These dependencies can cause short-term fluctuations of the background rate that can be as large as a factor of two. For long-term observations these fluctuations average out, however for short-term observations (seconds to ~several tens of minutes) these fluctuations are important. A tool that takes into account these effects to accurately estimate the number of LAT background events for any kind of observational conditions (any kind of pointing, any duration, and for any location in the celestial sphere) has been developed. This tool has been already used by the Fermi GBM and LAT collaborations in GRB publications, but has not yet been described in detail. Here we will provide more details on the background-estimation procedure and on the tests performed to verify the tool's results.

P5 - 208 **A Southern Sky Survey with Fermi LAT and ASKAP**

Cameron, Robert A, The Fermi Large Area Telescope Collaboration, the ASKAP VAST Survey Science Team

We present the prospects for a future joint gamma-ray and radio survey of southern hemisphere sources using the Fermi Large Area Telescope (LAT) and the upcoming Australian Square Kilometre Array Pathfinder (ASKAP) radio telescope. ASKAP is a next generation radio telescope designed to perform surveys at GHz frequencies at a much higher survey speed than previous radio telescopes, and is scheduled to start engineering observations in 2011. The survey capabilities of both Fermi LAT and ASKAP are described, and the planned science surveys for ASKAP are summarized. We give some expected details of the Variable and Slow Transient (VAST) survey, which will search for transients on timescales from 5 seconds to years. Some observational properties of faint and transient sources seen at gamma-ray and radio wavelengths are summarized, and prospects and strategies for using ASKAP survey data for LAT source counterpart identification are summarized.

P5 - 209 **Initial Results of New Tomographic Imaging of the Gamma-Ray Sky with BATSE**

Case, Gary L, Michael Cherry, Yuan Zhang, James Ling, Martin Lo, Thomas Shimizu, William Wheaton

We describe an improved method of mapping the gamma-ray sky by applying the Radon Transform to data from BATSE (the Burst And Transient Source Experiment) on NASA's CGRO (Compton Gamma-Ray Observatory) mission. Based on a method similar to that used in medical imaging, we use the relatively sharp ($sim0.2^{circ}$) limb of the Earth to collimate BATSE's eight Large Area Detectors (LADs). Coupling this to the ~51-day precession cycle of the CGRO orbit (with 28.5^{circ} inclination), we can complete a full survey of the sky, localizing point sources to $0.5 - 1^{circ}$ accuracy. This technique also uses a physical model for removing many sources of gamma-ray background, which allows us to image strong gamma-ray sources such as the Crab up to ~2 MeV with only a single precession cycle. We present the concept of the Radon Transform technique as applied to the BATSE data for imaging the gamma-ray sky and show sample images in four broad energy bands (23-98 keV, 98-23! 0 keV, 230-595 keV and 595-1800 keV) centered on the positions of selected sources from the catalog of 130 known sources used in our Enhanced BATSE Occultation Package (EBOP) analysis system. We also discuss the application of image cleaning techniques to pinpoint the location of these known sources. Any new sources discovered during the sky survey will be added to the input catalog for EBOP allowing daily light curves and spectra to be generated. We also discuss the extension of this method to the Fermi GBM occultation project.

P5 - 210 **NuSTAR: The Nuclear Spectroscopic Telescope Array**

Madejski, Grzegorz (Greg) , NuSTAR team

NuSTAR, the Nuclear Spectroscopic Telescope Array, is a recently confirmed Small Explorer (SMEX) NASA mission, scheduled for launch in August 2011. NuSTAR will be the first focusing high energy satellite sensitive in the hard X-ray (6 - 79 keV) band, and will probe the X-ray sky approximately two orders of magnitude more sensitively than currently achievable. NuSTAR will answer fundamental questions about the Universe: How are black holes distributed through the cosmos, and what is their contribution to the Cosmic X-ray Background? How were the heavy elements forged in the explosions of massive stars? What powers the relativistic jets in the most extreme active galaxies? This presentation will discuss the current status of NuSTAR and the baseline, 2-year science program.

P5 - 211 **Early Results from MAXI, an X-ray All-Sky Monitor on the ISS**

Kawai, Nobuyuki , on behalf of the MAXI team

MAXI (Monitor of All-sky X-ray Image) is a Japanese X-ray all-sky monitor mission on the International Space Station (ISS). MAXI will scan almost all the sky every 90 minutes in the 0.5-30 keV band with two narrow fan-beamed (3 deg x 160 deg) fields of view with a high sensitivity. It was installed on the ISS in July 2009, and the science instruments were powered on in August. It is currently in the commissioning phase. The preliminary analysis indicates that GSC achieved about 20--30 mCrab sensitivity in one orbit, which is consistent with the pre-flight estimation. In the first two months of operations with GSC, we have observed transient outbursts from several Galactic sources and two gamma-ray bursts. After a few months of commissioning phase, we plan to start delivering alerts on X-ray transients on various time scales to the world astronomy community to solicit multiwavelength follow-up observations. The targets include GRBs and supernova shock breakout as transient events on short time scales, outbursts of galactic accreting binary sources and AGN as those on longer time scales. By integrating MAXI's scans, we will produce weekly all-sky X-ray maps with milli-Crab sensitivities. The light curves of hundreds of pre-selected sources will be regularly published on the web to contribute to the multiwavelength studies of transient high-energy sources.

P5 - 212 **Status of MAGIC-II**

Moralejo Olaizola, Abelardo moralejo@ifae.es, the MAGIC collaboration

MAGIC, a gamma-ray imaging atmospheric Cherenkov facility composed up to now of a single telescope, has become a stereoscopic system with the inclusion of a second telescope, MAGIC-II. MAGIC operates in the very high energy spectral band (photon energies above 30 GeV). MAGIC-II saw its first light in Spring 2009, and is now approaching the end of its commissioning phase. Whereas from the mechanical point of view MAGIC-II is essentially a clone of the first telescope, it features significant improvements in other aspects, like a more finely pixelized camera and a cheaper, more compact readout system. The operation of the two telescopes in stereoscopic mode is expected to boost the performance of MAGIC, especially in terms of flux sensitivity and energy resolution. Results from the first stereoscopic observations of the Crab Nebula will be presented at the symposium.

P5 - 213 **Cross Calibration of Imaging Air Cherenkov Telescopes with Fermi**

Meyer, Manuel , Dieter Horns

We use an updated model for the synchrotron and inverse Compton emission from a population of high energy electrons to reproduce the measured spectral energy distribution from radio to high energy gamma rays. By comparing the predicted inverse Compton component with recent Fermi measurements of the nebula emission we can determine the average magnetic field in the nebula and derive the underlying electron energy distribution. The model calculation can then be used to cross calibrate the Fermi measurements with ground based air shower measurements. The resulting energy calibration factors are derived and can then be used for combining broad energy measurements taken with Fermi in conjunction with ground based measurements.

P5 - 214 **HX-POL - A Balloon-Borne Hard X-Ray Polarimeter**

Lee, Kuen , A. Garson III, Q. Li, J. Martin, M. Beilicke, P. Dowkontt, E. Wulf, G. De Geronimo, M. G. Baring, H. Krawczynski

We report on the design and estimated performance of a balloon-borne hard X-ray polarimeter called HX-POL. The experiment uses a combination of Si and Cadmium Zinc Telluride detectors to measure the polarization of 50 keV-500 keV X-rays from cosmic sources through the dependence of the angular distribution of Compton scattered photons on the polarization direction. On a one-day balloon flight, HX-POL would allow us to measure the polarization of bright Crab-like sources for polarization degrees well below 10%. On a longer (15-30 day) flight from Australia or Antarctica, HX-POL would be able to measure the polarization of bright sources down to polarization degrees of a few percent. Hard X-ray polarization measurements provide unique venues for the study of particle acceleration processes by compact objects and relativistic outflows. Furthermore, we present results form laboratory tests of the Si and CZT detectors.

P5 - 215 **The CTA project future and perspectives**

VASILEIADIS, Georges , CTA Consortium

Gamma-ray astronomy has emerged as a observational discipline, driven by the HESS,VERITAS,MAGIC and CANGAROO experiments. A large number of VHE gamma-ray sources have been detected, representing different galactic and extragalactic source populations.The detection of very high energy emission from extragalactic sources at large distances has provided insights in the star formation during the history of the universe and in the understanding of active galactic nuclei, while the H.E.S.S survey of the galactic plane has revealed a large number of sources and addresses issues such as the question about the origin of cosmic rays. The CTA project is aiming at building a very powerful multi- functional tool, with an unprecedented sensitivity (improved by one order of magnitude compared to the previous generation experiments) and a superior angular resolution. The current plan for CTA consists of two observatories, one in each Hemisphere, with relatively different energy coverage. We will report on the scientific motivation, design status and expected performances of the CTA project, as well as on its current status.

P5 - 216 **Neutrino Point Source Searches with IceCube**

Baker, Michael F, IceCube Collaboration

The IceCube Neutrino Observatory is a $ km^3 $ detector currently under construction at the geographic South Pole. IceCube will use 4800 optical modules deployed on 80 vertical strings between 1450 and 2450 m under the ice surface to detect and reconstruct high energy neutrino-induced charged leptons. Six additional strings in a dense, deep core are also being deployed to lower the energy threshold. The detection of astrophysical neutrinos can help identify the sources of the highest energy cosmic rays. We are interested in using a multi-messenger approach to search for neutrino sources. Information from high-energy astronomy experiments, such as Fermi, can be used to search for neutrinos in coincidence with high photon flux states, enhancing the potential for source discovery over a time-integrated search. The comprehensive sky coverage of Fermi is particularly interesting for this approach, as candidate sources such as blazars exhibit variability on the timescale! of hours. We will give an overview of searches for neutrino point-sources and outline how we utilize data from Fermi for neutrino flare searches.

P5 - 218 **VERITAS Telescope 1 Relocation: Details and Improvements**

Perkins, Jeremy S, The VERITAS Collaboration

The first VERITAS telescope was installed in 2002-2003 and originally operated as a prototype instrument. The decision to locate the full array at the same site was made subsequently, resulting in an asymmetric array layout. As anticipated, this resulted in less than optimal sensitivity due to the loss in effective area and the increase in background due to local muon initiated triggers. In the summer of 2009, the VERITAS collaboration relocated Telescope 1 to improve the overall array layout. This is expected to provide a ~15% improvement in sensitivity, corresponding to a ~25% reduction in the time required to detect a source. This contribution will detail the specifics of the relocation and the sensitivity improvements.

P5 - 219 **The Science and Design of the AGIS Observatory**

Kieda, David B, j. Buckley, K. Byrum, S. Diegel, G. Drake, A. Falcone, L. Fortson, S. Funk, D. Hanna, B. Humensky, J. Holder, D. Horan, P. Kaaret, N. Karlsson, A. Konopelko, H. Krawczynski, F. Krennrich, G. Maier, R. Mukherjee, R. Ong, N. Otte, J. Quinn, M. Schroedter

The AGIS observatory is a next-generation array of imaging atmospheric Cherenkov telescopes (IACTs) for gamma-ray astronomy between 100GeV and 100 TeV. The AGIS observatory is the next logical step in high energy gamma-ray astronomy, offering improved angular resolution and sensitivity compared to FERMI, and overlapping the high energy end of FERMI's sensitivity band. The baseline AGIS observatory will employ an array of 36 Schwarzschild-Couder IACTs in combination with a highly pixelated (0.05^circ diameter) camera. The instrument is designed to provide millicrab sensitivity over a wide (8^circ diameter) field of view, allowing both deep studies of faint point sources as well as efficient mapping of the Galactic plane and extended sources. In this talk I will describe science drivers behind the AGIS observatory and the design and status of the project.

P5 - 220 **The Advanced Gamma-ray Imaging System (AGIS) - Camera Electronics Development**

Tajima, Hiroyasu, J. Buckley, K. Byrum, G. Drake, A. Falcone, S. Funk, D. Hanna, B. Humensky, J. Holder, D. Horan, N. Karlsson, D. Kieda, A. Konopelko, H. Krawczynski, F. Krennrich, R. Mukherjee, R. Ong, N. Otte, J. Quinn, M. Schroedter, S. Swordy, R. Wagner, S. P. Wakely

AGIS, a next-generation imaging atmospheric Cherenkov telescope (IACT) array, aims to achieve a sensitivity level of about one milliCrab for gamma-ray observations in the energy band of 40 GeV to 100 TeV. Achieving this level of performance will require on the order of 50 telescopes with perhaps as many as 1M total electronics channels. The larger scale of AGIS requires a very different approach from the currently operating IACTs, with lower-cost and lower-power electronics incorporated into camera modules designed for high reliability and easy maintenance. Here we present the concept and development status of the AGIS camera electronics.

P5 - 221 **Science Drivers for the Advanced Gamma-ray Imaging System (AGIS): Galactic Astrophysics**

Digel, Seth W., Stefan Funk, Philip E. Kaaret & Hiro Tajima for the AGIS Collaboration

The Advanced Gamma-ray Imaging System (AGIS), a concept for a next-generation atmospheric Cherenkov telescope array, would provide unprecedented sensitivity and resolution in the energy range >40 GeV, allowing great advances in the understanding of the populations and physics of sources of high-energy gamma rays in the Milky Way. The AGIS concept of 36 Schwarzschild-Couder telescopes with finely pixellated cameras will provide an 8^circ field of view, an effective area of sim1 km^2, per-photon angular resolution better than sim0.06^circ at 1~TeV, and excellent background rejection (Maier et al. 2009). The initial H.E.S.S. survey of the Galactic plane (Aharonian et al. 2006) revealed 14 newly-detected TeV sources, most of which were identified as supernova remnants (SNRs), pulsar wind nebulae (PWNs), or compact-object binaries; 3 of the newly-found sources remain unidentified and further observations have since found other so-called ‘dark accelerators’. ! Colliding-wind systems of massive stars have also been established as Galactic TeV sources (e.g., Aharonian et al. 2007). Extrapolation based on the known source classes and the performance parameters for AGIS indicates that a survey of the Galactic plane with AGIS will reveal hundreds of TeV sources in exquisite detail, for studies of the particle acceleration in specific parts of SNR shock fronts and in colliding wind systems, the relativistic winds that form PWNs, the microquasar phenomenon of X-ray binaries, and investigations into the natures of the dark accelerators. AGIS will be able to study propagation effects on the cosmic rays produced by Galactic sources by detecting the diffuse glow from their interactions in dense interstellar gas. AGIS will complement results now being obtained in the GeV range with the Fermi mission, by providing superior angular resolution and sensitivity to variability on short time scales, and of course by probing energies that Fermi ! cannot reach. In some Galactic sources, TeV observations at e! nergies beyond the Klein-Nishina limit will uniquely probe the proton component at the acceleration sites.

P5 - 222 **Camera Photosensors for the Advanced Gamma-Ray Imaging System (AGIS)**

Williams, David A, Jim Buckley, Karen Byrum, Abe Falcone, Stefan Funk, David Hanna, Brian Humensky, Niklas Karlsson, Dave Kieda, Frank Krennrich, Reshmi Mukherjee, John Quinn, Nepomuk Otte, Martin Schroedter, Simon Swordy, Hiro Tajima, Bob Wagner, Scott Wakely, Amanda Weins

The Advanced Gamma-Ray Imaging System (AGIS) is a concept for the next generation very high energy gamma-ray observatory. Design goals include an order of magnitude better sensitivity, better angular resolution, and a lower energy threshold than existing Cherenkov telescopes. Each telescope is equipped with a camera that detects and records the Cherenkov-light flashes from air showers. The camera is comprised of a pixelated focal plane of blue sensitive and fast (nanosecond) photon detectors that detect the photon signal and convert it into an electrical one. Given the scale of AGIS, the camera must be reliable and cost effective. The Schwartzschild-Couder optical design yields a smaller plate scale than present-day Cherenkov telescopes, enabling the use of more compact, multi-pixel devices, including multianode photomultipliers or Geiger avalanche photodiodes. We present the conceptual design of the focal plane for the camera and results from testing candidate! focal plane sensors.

P5 - 223 **Prospects for Dark Matter Measurements with the Advanced Gamma-Ray Imaging System (AGIS)**

Buckley, James , for the AGIS Collaboration

AGIS, a concept for a future gamma-ray observatory consisting of an array of $sim 36$ atmospheric Cherenkov telescopes, would provide a powerful new tool for determining the nature of dark matter and its role in structure formation in the universe. The advent of more sensitive direct detection experiments, the launch of Fermi and the startup of the LHC make the near future an exciting time for dark matter searches. While other experiments may provide evidence for new particles either produced in accelerators, or detected in our local halo, gamma-ray measurements will provide the only means for mapping the dark matter in the halo of our galaxy and other galaxies. In addition, the spectrum of gamma-rays (either direct annihilation to lines or continuum emission from other annihilation channels) will be imprinted with the mass of the dark matter particle, and the particular annihilation channels providing key measurements needed to identify the dark matter particle. While current gamma-ray instruments fall short of the generic sensitivity required to measure the dark matter signal from any sources other than the (confused) region around the Galactic center, we show that the planned AGIS array will have the angular resolution, energy resolution, low threshold energy and large effective area required to detect emission from dark matter annihilation in Galactic substructure or nearby Dwarf spheroidal galaxies.

P5 - 224 **Implementation and performance of the Fermi LAT level 1 pipeline**

Focke, Warren B,

Fermi Level 1 processing performs digitization, reconstruction, and monitoring. It must handle incomplete and out of order data and recover gracefully from hardware or software failures. It runs on the SLAC pipeline and the general SLAC batch farm. It uses up to 800 processor cores. It has used 125 CPU*years in the first year of data taking. FITS data products are typically delivered to FSSC 2-3 hours after receiving the data (8 hours after the data are acquired). It has processed $1.4times 10^10$ events, $2times10^8$ photons.

P5 - 225 **The Advanced Gamma-ray Imaging System (AGIS): Schwarzschild-Couder (SC) Telescope Mechanical and Optical System Design**

Vassiliev, Vladimir V, V. Vassiliev , T. Arlen, V. Bugaev, J. Buckley, K. Byrum, S. Digel, A. Falcone, S. Fegan, J. Finley, V. Guarino, D. Hanna, P. Kaaret, H. Krawczynski, R. Romani, J. Vandenbroucke, R. Wagner for the AGIS Collaboration

AGIS is a concept for the next-generation ground-based gamma-ray observatory. It will be an array of 36 imaging atmospheric Cherenkov telescopes (IACTs) sensitive in the energy range from 40 GeV to 200 TeV. The required improvements in sensitivity, angular resolution, and reliability of operation relative to the present generation instruments imposes demanding technological and cost requirements on the design of AGIS telescopes. In this submission we outline the status of the development of the optical and mechanical systems for a novel Schwarzschild-Couder two-mirror aplanatic telescope. This design can provide a field of view and angular resolution significantly superior to those offered by the traditional Davies-Cotton optics utilized in present day IACTs. Other benefits of the novel design include isochronous focusing and compatibility with cost-effective, high quantum efficiency image sensors such as multi-anode PMTs, silicon PMTs (SiPMs), or image intensifie! rs.

P5 - 226 **Extragalactic Science with AGIS**

Coppi, Paolo S, J. Buckley, A. Falcone, H. Krawczynski, R. Mukherjee, V. Vassiliev for the AGIS team

The Advanced Gamma-Ray Imaging System (AGIS), a proposed next-generation array of Cherenkov telescopes, provides an unprecedented view of the high energy universe. We discuss how AGIS, with its larger effective area, improved angular resolution, lower threshold, and an order of magnitude increase in sensitivity, impacts the extragalactic science possible in the very high energy domain. To quantify the reach of AGIS, we present simulated source counts, spectra, lightcurves, and images for likely classes of sources (AGN, GRBs, clusters, and star-forming galaxies). With useful sensitivity down to ~30 GeV, AGIS will see many of the sources discovered by Fermi. With its better sensitivity and angular resolution, AGIS then becomes a key instrument for identifying and characterizing Fermi survey sources, the majority of which will have limited Fermi photon statistics and localizations. As an example of this, we show how AGIS could play a key role in unraveling the origi! n of the diffuse extragalactic gamma-ray background. AGIS should also have enough sensitivity to start seeing the cascade radiation surrounding powerful cosmic accelerators. Detection of this radiation provides us several new diagnostics, for the high-energy accelerators themselves as well as for the intergalactic magnetic field and the background radiation fields at optical to infrared wavelength.

P5 - 227 **On the calibration of the energy scale of Cherenkov telescopes with**

Otte, Nepomuk ,

The energy estimation of gamma-rays detected with Imaging Air Shower Cherenkov Telescopes (IACTS) like H.E.S.S., MAGIC, and VERITAS relies solely on Monte Carlo simulations. A calibration of these instruments with a "standard candle" has so far been difficult due to the lack of a source with a spectrum that had been measured by a calibrated instrument. With Fermi LAT it is now possible to measure gamma-ray spectra of a few sources with high precision into the VHE (above 100,GeV) regime , the domain of IACTs. A calibration seems, therefore, to be possible in the near future, which opens up the question on how to do it best. It has been argued that the Crab Nebula is the best source to perform this task, because it is the strongest steady VHE source known, and it has a relatively hard spectrum that extends well into the Fermi energy range. The lack of narrow features in the photon spectrum of the Crab nebula, however, make a precise determination of the absolute ene! rgy scale on the order of or better than 20% difficult. The steep cutoffs observed in the gamma-ray spectra of pulsars above a few GeV, on the other hand, provide a distinct feature that can be used to determine the absolute energy scale in IACTs. However, the measurement of the photon spectrum of a pulsar with an IACT is not an easy task because of the steeply falling spectrum and the steeply rising effective area of IACTs below 100,GeV. Here, I propose a new method to calibrate IACTs that makes use of the energy dependent characteristics seen in the light curves of pulsars. For example the Crab pulsar, the only pulsar detected by an IACT so far, has two pulses of which one pulse is the dominant feature below 1,GeV, whereas the other pulse is the dominant feature above 25,GeV. The energy dependent ratio of the amplitudes of the two pulses provides a measure of the energy that can be used to calibrate IACTs independent from the effective area. The method will be explained on the example of the Crab pulsar between 1 GeV and 60 GeV using publicly available Fermi and MAGIC data.

P5 - 228 **HAWC Sensitivity to GRBs**

Pretz, John R, Andrew Smith, Brenda Dingus

The High Altitude Water Cherenkov experiment (HAWC) is a wide-field, continuously-operating TeV gamma-ray detector being constructed at high-altitude at Sierra Negra, Mexico. HAWC will have unprecedented sensitivity to gamma-rays above 50 GeV across the entire overhead sky, making it the ideal instrument to search for TeV emission from gamma-ray bursts. I will describe the design of the HAWC detector and characterize its performance. Recent Fermi observations have identified a high-energy component to many GRBs with detections of photons of tens of GeV. I will describe the prospects for HAWC to observe GRBs, using the Fermi high-energy detections as a starting point.

P5 - 229 **Development of the HAWC gamma-ray observatory in Sierra Negra**

Carramiñana, Alberto, the HAWC collaboration

The HAWC gamma-ray observatory is starting development in its site at the volc'an Sierra Negra, in central Mexico. Sierra Negra, located in the Parque Nacional Pico de Orizaba, provides a 4100m altitude site with access to 2/3 of the sky and Galactic plane. After obtaining the required environmental permits, an access road has been built as a 1km diversion of the road to the Large Millimeter Telescope. Site development considers improving the road, the installation of power and Internet, preparation of the site for the tank array and implementing water acquisition systems.

P5 - 230 **The Large Aperture GRB Observatory (LAGO)**

Alvarez Ochoa, Cesar Mr, Allard, D.; Asorey, H.; Barros, H.; Bertou, X.; Castillo, M.; Chirinos, J. M.; De Castro, A.; Flores, S.; Gonzalez, J.; and 31 coauthors

The Large Aperture GRB Observatory (LAGO) is looking for the high energy component of Gamma Ray Bursts using the single particle technique in Water Cherenkov Tanks located at 3 high altitude sites : Chacaltaya, Bolivia, 5300 m a.s.l., Pico Espejo, Venezuela, 4750 m a.s.l. and Sierra Negra, Mexico, 4550 m a.s.l . This technique allows smal fluxes of gamma photons in the range from 10 GeV to 1 TeV to be detected by LAGO. In this work we present the current status of LAGO.

P5 - 231 **The CTA Observatory**

Wagner, Robert, Elina Lindfors, Aimo Sillanpää, Stefan Wagner for the CTA Consortium

In recent years ground-based gamma-ray astronomy has experienced a major breakthrough with the impressive astrophysical results obtained mainly by the current generation experiments like CANGAROO, H.E.S.S., MAGIC, MILAGRO and VERITAS. The Cherenkov Telescope Array (CTA) is an initiative to build the next generation ground-based gamma-ray instrument, which is supposed to serve as an observatory to a wide astrophysics community. In this poster we discuss the organisational and operational requirements for operating such a large-scale facility as well as the specific needs of the VHE gamma-ray astronomy. We compare it to other major infrastructures in astrophysics, particle physics and astroparticle physics.

P5 - 232 **Performance of the 1st Prototype of the HAWC Gamma Ray Observatory**

Sandoval, Andres, for the HAWC Collaboration

The HAWC high energy gamma ray observatory will be built at 4100m altitude in volcan Sierra Negra, Mexico consisting of 300 large volume water Cherenkov detectors to measure air showers in the 100 GeV-100 TeV range and discriminate between the primary being a gamma or a charged cosmic ray. To test the basic concept and gain experience in working at that altitude we have setup a first prototype of 3 water Cherenkov detectors. The performance of the array and lessons learnt during this exercise that have impacted the final design will be presented.

P5 - 235 **Fermi data processing pipeline, collaboration data servers and web based data monitoring tools.**

Johnson, Tony S.,

Reconstruction, monitoring and initial science processing (ASP) of Fermi LAT data is controlled by a fully automated processing pipeline running at the SLAC national accelerator laboratory. This pipeline allows complex graphs of parallel data processing tasks to be constructed and executed with manual intervention by operators only required in exceptional circumstances. A suite of web applications allows the state of the processing pipeline to be monitored in real-time, presents the results of data quality monitoring and ASP analysis to scientists, and makes the final data available to collaborating scientists via a set of data servers. These technologies together make it possible for scientist to contribute to the data processing, data monitoring and data analysis from anywhere with a web connection.