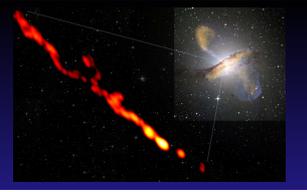




Fermi and Jansky 2011
TALK Abstracts



F-GAMMA program - review and recent findings: Unification and physical interpretation of the radio spectra variability patterns in Fermi blazars and jet emission from NLSy1s

Emmanouil Angelakis L. Fuhrmann, I. Nestoras, R. Schmidt, C. M. Fromm, J. A. Zensus, N. Marchili, T. P. Krichbaum (Max-Planck-Institut für Radioastronomie), H. Ungerechts, A. Sievers, D. Riquelme (Instituto de Radio Astronomía Milimétrica (IRAM)), M. Perucho-Pla (Departament d'Astronomia i Astrofísica. Universitat de València)

F-GAMMA program - review and recent findings: Unification and physical interpretation of the radio spectra variability patterns in Fermi blazars and jet emission from NLSy1s

The F-GAMMA program aims at understanding the physics at work in AGNs via a multi-frequency monitoring approach. A number of roughly 65 Fermi-GST detectable blazars are being monitored monthly since January 2007 at radio wavelengths. The core program relies on the 100-m Effelsberg telescope operating at 8 frequencies between 2.6 and 43 GHz, the 30-m IRAM telescope observing at 86, 145 and 240 GHz and the APEX 12-m telescope at 345 GHz. For the targeted sources the LAT instrument onboard Fermi-GST provides gamma-ray light curves sampled daily. Recently the program has further expanded with the participation of the Korean VLBI network, the Abastumani optical observatory and the Skinakas observatory for optical polarimetry.

Here we will discuss:

A. A review of all participating facilities and the main characteristics of the program (sources sample, frequency coverage, sampling etc.). The recent developments in optical coverage (in total power and polarization) will also be discussed.

B. We show that, on the basis of their variability pattern, the observed quasi-simultaneous broadband spectra can be classified to merely 5 classes. The variability for the first 4 is clearly dominated by spectral-evolution while sources of the last class vary self-similarly with almost no apparent shift of the peak frequency. It is shown that the former classes can be attributed to exactly the same two-component system made of (a) a quiescent optically thin spectrum and (b) a superposed flaring event; whereas the latter class must be interpreted in terms of a completely different mechanism. The apparent differences among the classes are explained in terms of a redshift modulus and an intrinsic-source/flare parameters modulus.

Numerical simulations we have conducted show that a shock-in-jet model can very well describe the observed behavior. On the other hand, it is shown that the ability of the shock-in-jet to reproduce the behavior of sources that cover a broad spectrum of intrinsic properties indicates its universality.

It is concluded that only two mechanisms seem to be producing variability. None of the almost 90 sources used for this study show a switch of class indicating that the variability mechanism is either (a) a finger-print of the source, or (b) that the parameters it may depend on vary at timescales far longer than the monitoring period of almost 4 years.

C. Finally, we discuss recent findings of the program such as red-shift bias free correlation between radio and gamma-ray flux density. Furthermore, recently it has been found that besides the blazars and the radio galaxies, that have traditionally been thought to be the gamma-ray emitting AGNs, Narrow Line Seyfert 1 galaxies also show gamma-ray emission. Within the F-GAMMA program radio jet emission has been detected from 3 such sources challenging the belief that jets are associated with elliptical galaxies. The results of their monitoring will be discussed.

The gamma-ray blazar B0208-512, a multi-wavelength investigation

Jay Blanchard (School of Mathematics & Physics, University of Tasmania, Australia), Jim Lovell (School of Mathematics & Physics, University of Tasmania, Australia), Roopesh Ojha (NASA Goddard Space Flight Center, USA), Matthias Kadler (University of Wurzburg, Germany), Roberto Nesci (University La Sapienza, Italy), Philip Edwards (CSIRO Astronomy and Space Science, ATNF, Australia), Michael Dutka (Catholic University, USA), Tapio Pursimo (Nordic Optical Telescope, Santa Cruz de La Palma, Spain), John Dickey (School of Mathematics & Physics, University of Tasmania, Australia)

PKS B0208-512 is a blazar at a redshift of 1.0. VLBI observations show a strong core and a one sided jet. It was detected by the ROSAT all sky survey as an X-ray source and as a gamma-ray source by EGRET. Since the launch of Fermi, PKS B0208-512 has shown flaring behaviour in the gamma-ray band on at least three separate occasions. VLBI and radio light-curve monitoring observations of PKS B0208-512 is being conducted as part of the TANAMI program. Single-dish flux-density monitoring data obtained with the 30m Ceduna telescope date back to 2004 and show strong flaring behaviour in the radio band as well. Additional radio observations have been made using the Australia Telescope Compact Array and the source has been monitored in the optical band by the REM telescope. Archival X-ray and UV data have been obtained from the Swift satellite and its evolving parsec scale structure is being monitored with VLBI observations using the TANAMI array. We present the results of these multiwavelength observations and discuss the implications they have for the origin and nature of high energy emission from this blazar. In particular, we investigate the non simultaneous nature of the flaring at different frequencies.

Modeling broadband spectra and variability of blazars

Markus Böttcher (Astrophysical Institute, Department of Physics and Astronomy, Ohio University, Athens, OH 45701, USA)

In this talk I will present a review of the current state-of-the-art of models for the broadband spectral energy distributions and variability of blazars. Both leptonic and hadronic models for blazar emission will be considered, with special attention to possible diagnostics to distinguish between those two classes of models. I will highlight areas of future progress to be made with continued Fermi as well as future CTA observations.

A Diagnostic for Determining the Location of the GeV Emission in powerful blazars

Amanda Dotson (University of Maryland Baltimore County), Markos Georganopoulos (University of Maryland Baltimore County, NASA/GSFC), Demosthenes Kazanas (NASA/GSFC), Eric Perlmutter (Florida Institute of Technology)

A central issue currently debated in the literature is how far from the black hole is the ~ 1 Fermi observed GeV emission of powerful blazars emitted. Here we present a clear diagnostic tool for testing whether the GeV emission site is located within the sub-pc broad emission line (BLR) region or further out in the few pc scale molecular torus environment. Within the BLR the scattering takes place at the onset of the Klein-Nishina regime, causing the electron cooling time to become practically energy independent and as a result, the variation of high-energy emission is expected to be achromatic. Contrarily, if the blazar is outside the BLR, the expected GeV variability is energy-dependent and with amplitude increasing with energy. We demonstrate this using time-dependent numerical simulations of blazar variability. The proposed work holds the promise of settling this important issue.

The ANTARES neutrino telescope

Thomas Eberl (Erlangen Centre for Astroparticle Physics, Erwin-Rommel-Str. 1, D-91058 Erlangen) for the ANTARES collaboration

The ANTARES deep-sea neutrino telescope currently is the largest neutrino detector in the Northern Hemisphere. The instrument consists of a three-dimensional array of 885 photomultiplier tubes, arranged in 12 lines anchored at a depth of 2500m in the Mediterranean Sea, 40km offshore from Toulon (France). An additional instrumented line is used for environmental monitoring and for R&D towards acoustic neutrino detection. The photomultiplier tubes detect the Cherenkov radiation of charged secondary particles produced by high-energy neutrinos interacting in or around the detector. Charged-current interactions of muon neutrinos is the reaction channel of central interest. The trajectories of the resulting muons are reconstructed with high precision, revealing the direction of the incoming neutrinos. ANTARES is taking data with its full 12 line configuration since May 2008, and has been operated before in a 5 and 10 line setup for more than a year. The calibration, performance and long-term stability of the detector will be discussed. Studies have been underway to search for neutrino point sources in the ANTARES data since 2007. Results from these studies and the sensitivity of the telescope will be discussed.

Before Fermi met Jansky

Phil Edwards (CSIRO Astronomy & Space Science)

Radio monitoring of gamma-ray emitting AGN in the EGRET era will be reviewed and key findings summarised, and efforts underway to continue, and improve upon, these studies in the Fermi era described.

Blazar observations above 100 GeV with VERITAS

Manel Errando (Barnard College/Columbia University) on behalf of the VERITAS collaboration

The VERITAS array of 12-m atmospheric-Cherenkov telescopes in southern Arizona is one of the world's most sensitive detectors of VHE ($E > 100$ GeV) gamma rays. There are 50 extragalactic sources which are known to emit VHE photons, including blazars, radio galaxies, and starburst galaxies. Blazar observations are one of the VERITAS Collaboration's Key Science Projects. More than 400 hours per year are devoted to this program and 100 blazars have already been observed with the array, in most cases with the deepest-ever VHE exposure. These observations have resulted in 21 detections, including 10 VHE discoveries, all of them with supporting multiwavelength observations. Recent highlights from VERITAS extragalactic observation program and the collaboration's long-term blazar observation strategy will be presented.

A Physical Model for the Revised Blazar Sequence

Justin Finke (US Naval Research Laboratory) and Charles Dermer (US Naval Research Laboratory)

The blazar sequence is reflected in a plot of the peak luminosity versus peak frequency of the synchrotron component of blazars. This diagram has been considered one of the fundamental pieces of evidence for the existence of a continuous sequence that includes low-power BL Lacertae objects through high-power flat spectrum radio quasars. Recently, Some authors (e.g., Meyer et al.) have shown that this plot displays an "L" or "V" shape that was not apparent in earlier representations of the blazar sequence. We find that this shape can be reproduced by a simple model where the external radiation field increases with increasing injection power of jet electrons. This leads to greater cooling of the electrons, which moves the synchrotron peak to lower frequencies. For more powerful injection,

the electron cooling Lorentz factor becomes less than the minimum injected electron Lorentz factor, causing the peak frequency to become nearly independent of the jet power. The difference in viewing angles of different blazars can explain the scatter in the sequence.

Study of cm/mm-band radio and gamma-ray correlated variability in Fermi bright blazars

Lars Fuhrmann (MPIfR), S. Larsson (Stockholm Univ.), J. Chiang (Stanford Univ.), E. Angelakis (MPIfR), I. Nestoras (MPIfR) on behalf of the F-GAMMA and Fermi/LAT collaborations

We present preliminary results of a study focusing on the possible connection between radio and gamma-ray flares/activity periods in the lightcurves of about 50 Fermi-GST detected blazars. For this purpose, the long-term cm/mm radio data obtained within the F-GAMMA program are combined with monthly sampled long-term LAT gamma-ray lightcurves starting in 2008. A detailed statistical cross-band analysis is presented together with more direct methods (e.g. light curve parameters, simultaneous flux-flux evolution) to find significant correlations, and extract parameters like delays, relative timing/onsets of events etc. Possible differences between different source types and possible correlations with other parameters (e.g. spectral types, luminosity, SED peaks) are also explored.

Exploring the FRI/FRII radio dichotomy with the Fermi satellite

Paola Grandi (INAF/IASF-Bologna, Italy) on behalf of the Fermi Collaboration

We review the high energy properties of Misaligned AGNs associated with gamma-ray sources detected by Fermi in 24 months of survey. Most of them are nearby low power radio galaxies (i.e. FRIs) which probably have structured jets. On the contrary, high power radio sources (i.e. FRIIs) with GeV emission are rare. The small number of FRIIs does not seem to be related to their higher redshifts. We suggest that beaming/jet structural differences are responsible for the detection rate discrepancy observed between FRIs and FRIIs.

The Implications of Second-order SSC for the Gamma-ray Spectra of Blazars

Adam Higuera (UMBC, University of Michigan-Ann Arbor), Markos Georganopoulos (UMBC, NASA/GSFC), Eric Perlman (FIT), Demos Kazanas (NASA/GSFC)

Current observations suggest that the Gamma-ray emission of blazars may take place several pc from the central black hole, where the anticipated energy density of external photons is low. In this case, the dominant Gamma-ray emission mechanism is Synchrotron-self Compton (SSC).

Here, we investigate the importance of second-order SSC (SSC2), a process in which SSC photons are upscattered by the same population of relativistic electrons that produced the synchrotron and SSC emission. We study the case in which the maximum electron energy is independent of the physical conditions in the source and the more physically motivated case where the physical conditions in the source affect the maximum energy achieved by particle acceleration.

We show that SSC2 is a viable, and possibly dominant spectral component that naturally produces superquadratic variations of the GeV emission relative to those observed in the synchrotron component. We also show that the rarely seen cubic variations, if interpreted as SSC2 emission, impose significant lower limits (Lorentz factors >100) on the emitting plasma.

Faraday Rotation in the MOJAVE blazar jets

Talvikki Hovatta (Caltech and Purdue University), Matthew L. Lister (Purdue University), Margo F. Aller (University of Michigan), Hugh D. Aller (University of Michigan), Daniel C. Homan (Denison University), Yuri Y. Kovalev (Astro Space Center of Lebedev Physical Institute & MPIfR), Alexander B. Pushkarev (Pulkovo Observatory & Crimean Astrophysical Observatory), Tuomas Savolainen (MPIfR)

We have conducted a survey of Faraday rotation in a sample of 191 compact radio-loud AGNs as part of the MOJAVE (Monitoring of Jets in Active galactic nuclei with VLBA Experiments) project. The observations were carried out with the VLBA at 8.1, 8.4, 12.1 and 15.3 GHz over 12 epochs in 2006. We detect sufficiently strong linear polarization in 159 out of 211 observations to calculate the rotation measure values, resulting in a large enough sample for statistical analysis of the Faraday rotation in blazars. We will present an overview of the results from this large survey and show examples of individual sources. We find the cores of the AGNs to have higher rotation measures than the jets and also indications that the rotation measures in quasars are larger than in BL Lac objects. Additionally, we performed detailed simulations to find a reliable way to estimate the significance of transverse rotation measure gradients, thought to be a signature of large scale helical magnetic fields. We find a significant transverse rotation measure gradient in four quasars (3C 273, 3C 454.3, CTA 102 and 4C 39.25) and indications of gradients in four others. In 3C 273 and 3C 454.3 the gradient could be consistent with a helical field while in 4C 39.25 it could be due to interaction with the intergalactic medium. In CTA 102 we need more detailed observations to confirm the gradient and its origin. 117 of our sources are included in the 2FGL catalog and we detect rotation measure values in 111 out of 129 maps. Of the 74 sources that are not in the 2FGL catalog we detect RM in 48 out of 82 maps. The median RM values of the 2FGL sources do not differ significantly from the non-LAT-detected sources although it is interesting that three of the four sources with significant rotation measure gradients are sources that have shown large gamma-ray flares.

Parsec-Scale Jet Behavior of the Quasar 3C454.3 during the High Gamma-Ray States in 2009 and 2010

Svetlana Jorstad, A.P. Marscher (Boston U., USA), P.S. Smith (Steward Obs., USA), V.M. Larionov (St. Petersburg U., Russia), I. Agudo, (IAA, Granada, Spain), and M. Gurwell (CfA, USA)

We analyze total and polarized intensity images of the quasar 3C454.3 obtained monthly with the VLBA at 43 GHz within the ongoing Boston U. monitoring program of gamma-ray blazars started in June 2007. These data are supplemented by VLBA observations performed during intense campaigns of 2 week duration when the quasar was observed 3-4 times per campaign. We find a strong increase of activity in the parsec-scale jet of the quasar during high gamma-ray states in Autumn 2009 and Autumn 2010. We detect new superluminal knots associated with both events and compare their kinematic parameters. We analyze optical photometric and polarimetric data along with X-ray light curves collected over the periods of the *gamma-ray* outbursts and outline similarities and differences in variations across wavelengths. We discuss the locations in the jet where high gamma-ray fluxes occur.

This research was supported in part by NASA grants NNX08AV65G, NNX08AV61G, NNX09AT99G, and NNX09AU10G, and NSF grant AST-0907893. The VLBA is an instrument of the National Radio Astronomy Observatory, a facility of the NSF, operated under cooperative agreement by Associated Universities, Inc.

AGN Unification and the Gamma-Ray Spectra of Fermi Blazars

Demosthenes Kazanas (NASA/GSFC), Keigo Fukumura (NASA/GSFC-CRESST), Markos Georganopoulos (UMBC), Sean Scully (JMU), Floyd Stecker (NASA/GSFC)

The recent Fermi LAT-driven multiwavelength blazar studies have indicated that that in many objects the observed *gamma*-rays require, besides the synchrotron photons, also an additional contribution to the Compton process by photons external to that of the moving plasma (External Compton – EC). This additional photon component has been attributed to emission by the clouds of the AGN Broad Line Region (BLR). However, in many cases the gamma ray emission takes place at distances larger than that of the traditionally considered BLR size. We propose that the external photons needed to account for the blazar gamma-ray spectra are supplied by MHD winds off the AGN accretion disks with radial density profiles $n(r) \propto 1/r$. These winds span several (5-6) decades in radius and it has been proposed that these actually are the "molecular torii" invoked in AGN unification. Winds with this specific density dependence were employed successfully to account for the Seyfert Warm Absorber X-ray properties and their infrared and far-infrared spectra. We show how these same winds can affect the blazar gamma-ray emission and their influence on shaping the so called "blazar sequence".

Statistical analysis of multiwavelength light curves

Stefan Larsson (Stockholm University)

Since its launch in 2008 the Fermi Large Area Telescope provides regular monitoring of a large sample of gamma-ray sources on time scales from hours to years. Together with observations at other wavelengths it is now possible to study variability and correlation properties in a much more systematic and detailed way than ever before. I will describe some of the statistical methods and tools that have been, or can be, used to characterize variability and to study the relation between multiwavelength light curves. Effects and limitations due to time sampling, measurement noise, non-stationarity etc will be illustrated and discussed.

The (sub-)mm and gamma-ray connection in northern blazars

Jonathan Leon-Tavares (Metsahovi Radio Observatory), E. Valtaoja (Tuorla Observatory), A. Lahteenmaki (Metsahovi Radio Observatory), M. Tornikoski (Metsahovi Radio Observatory)

Thanks to the co-existence of Planck and Fermi satellites, we explore the connection between the (sub-)mm and gamma-ray emission in a sample of northern blazars. First, based on the results from Planck Collaboration et al. (2011) we explore emerging trends between the mm/submm spectral shapes and gamma-ray brightness. Second, using a sample of 45 northern extragalactic radio sources, Leon-Tavares et al. (2011) have presented evidence that the most intense gamma-ray flares are produced in the same disturbances that produce the mm outburst. We will discuss these results and their implications to the origin of the gamma-ray emission in blazars.

Leon-Tavares et al. 2011, A&A, 532, 146

Planck Collaboration et al. 2011, A&A accepted, arXiv:1101.2047

Parsec-Scale Radio Properties of Gamma-ray Emitting Blazars

Justin Linford (UNM), Gregory B. Taylor (UNM), Roger W. Romani (Stanford), Joseph F. Helmboldt (NRL), Anthony C.S. Readhead (Caltech), Rodrigo Reeves (Caltech), Joseph L. Richards (Caltech)

The parsec-scale radio properties of blazars detected by the Large Area Telescope (LAT) on board the Fermi Gamma-ray Space Telescope have been investigated using observations with the Very Long Baseline Array (VLBA). Comparisons between LAT and non-LAT detected samples were made using

both archival and contemporaneous data. In total, 244 sources were used in the LAT-detected sample. This very large, radio flux-limited sample of active galactic nuclei (AGN) provides insights into the mechanism that produces strong gamma-ray emission. It has been found that LAT-detected BL Lac objects are very similar to the non-LAT BL Lac objects in most properties, although LAT BL Lac objects may have longer jets. The LAT flat spectrum radio quasars (FSRQs) are significantly different from non-LAT FSRQs and are likely extreme members of the FSRQ population. Archival radio data indicated that there was no significant correlation between radio flux density and gamma-ray flux, especially at lower flux levels. However, contemporaneous observations showed a strong correlation. Most of the differences between the LAT and non-LAT populations are related to the cores of the sources, indicating that the gamma-ray emission may originate near the base of the jets (i.e., within a few pc of the central engine). There is some indication that LAT-detected sources may have larger jet opening angles than the non-LAT sources. Strong core polarization is significantly more common among the LAT sources, suggesting that gamma-ray emission is related to strong, uniform magnetic fields at the base of the jets of the blazars. Observations of sources in two epochs indicate that core fractional polarization was higher when the objects were detected by the LAT. Included in our sample are several non-blazar AGN such as 3C84, M82, and NGC 6251.

Gamma-ray and parsec-scale jet properties of a complete sample of blazars from the MOJAVE program

Matthew Lister (Purdue University) on behalf of the LAT and MOJAVE collaborations

We investigate the Fermi LAT gamma-ray and 15 GHz VLBA radio properties of a joint gamma-ray and radio-selected sample of AGNs obtained during the first 11 months of the Fermi mission (2008 Aug 4 - 2009 Jul 5). Our sample contains the brightest 173 AGNs in these bands above declination -30 during this period, and thus probes the full range of gamma-ray loudness (gamma-ray to radio band luminosity ratio) in the bright blazar population. The latter quantity spans at least four orders of magnitude, reflecting a wide range of spectral energy distribution (SED) parameters in the bright blazar population. The BL Lac objects, however, display a linear correlation of increasing gamma-ray loudness with synchrotron SED peak frequency, suggesting a universal SED shape for objects of this class. The synchrotron self-Compton model is favored for the gamma-ray emission in these BL Lacs over external seed photon models, since the latter predict a dependence of Compton dominance on Doppler factor that would destroy any observed synchrotron SED peak - gamma-ray loudness correlation. The high-synchrotron peaked (HSP) BL Lac objects are distinguished by lower than average radio core brightness temperatures, and none display large radio modulation indices or high linear core polarization levels. No equivalent trends are seen for the flat-spectrum radio quasars (FSRQ) in our sample. Given the association of such properties with relativistic beaming, we suggest that the HSP BL Lacs have generally lower Doppler factors than the lower-synchrotron peaked BL Lacs or FSRQs in our sample.

The Second Catalog of AGNs detected by the Fermi-LAT

Benoit Lott (CENBG, France) on behalf of the Fermi-LAT collaboration

The properties of the AGNs detected by the Fermi-LAT after 2 years of operation and composing the 2LAC catalog will be reviewed.

Relation between Events in the Millimeter-wave Core and Gamma-ray Outbursts in Blazars

Alan Marscher and S.G. Jorstad (Boston U.)

We report results from our program of monitoring 33 gamma-ray detected blazars with the VLBA at 43 GHz. Comparison of the epochs when new superluminal knots pass through the mm-wave core with times when gamma-ray flares observed by the Fermi LAT occur reveals a number of cases when the events are simultaneous within the uncertainties. However, in other blazars the core brightens at mm wavelengths during a gamma-ray flare, but no bright new knot is apparent. In addition, some gamma-ray flares occur before passage of a knot through the core. A fraction of the blazars in our sample show little or no relation between mm-wave and gamma-ray events. The gamma-ray emission therefore appears to occur in multiple sites in different blazars, and sometimes within a given object. This conclusion has important implications regarding the inference of the physical conditions under which high-energy emission occurs in the relativistic jets of blazars.

This research was supported in part by NASA grants NNX08AV65G, NNX08AV61G, NNX09AT99G, NNX09AU10G, NNX10AO59G, and NNX11AQ03G, and by NSF grant AST-0907893.

OVRO 40m blazar monitoring program: Understanding the relationship between 15 GHz radio variability properties and gamma-ray activity in blazars

Walter Max-Moerbeck, J.L. Richards, V. Pavlidou, T. Hovatta, O.G. King, T.J. Pearson, A.C.S. Readhead, R. Reeves, M.C. Shepherd (California Institute of Technology, Pasadena, CA, USA)

A large sample of known and likely gamma-ray blazars has been monitored twice per week since late 2007 at 15 GHz with the Owens Valley Radio Observatory (OVRO) 40-meter Telescope. The sample contains about 1600 sources, including the initial sample of all the 1158 sources above declination -20 degrees from the Candidate Gamma-Ray Blazar Survey (CGRaBS) plus all the blazars associated with Fermi-LAT detections as released in the Fermi source catalogs. Using statistical likelihood analyses, we compare the variability amplitude for various sub-populations within our sample. These include comparisons of gamma-ray-loud versus quiet objects, BL Lac objects versus flat-spectrum radio quasars, and a study of the variability amplitude trend with redshift. To learn about the location of the gamma-ray emission region we study the significance of peaks in the radio/gamma-ray cross-correlation using Monte Carlo simulations. First results for 52 sources with data from both the high-confidence Fermi Large Area Telescope Bright AGN Sample and the first 2 years of our monitoring program show that only 7 show significant cross-correlations at the 3-sigma level. An extension of this to a larger sample and longer light curves is underway and preliminary results are presented. We also describe KuPol, the new digital Ku-band receiver being constructed for the 40-meter telescope. This new receiver will provide total intensity and linear polarization measurements over the 12-18 GHz band, with 16 MHz spectral resolution. The polarization data will provide important clues about the magnetic field configuration in the radio emission region.

Breaking the Blazar Sequence: A new view of Radio Loud AGN Unification

Eileen Meyer (Rice University), Fossati, Giovanni (Rice University), Georganopoulos, Markos (University of Maryland, Baltimore County), Lister, Matthew L. (Purdue University)

In recent work, we have identified two sub-populations of radio-loud AGN which appear to be distinguished by jet structure, where low-efficiency accreting systems produce 'weak' jets which decelerate

more rapidly than the 'strong' jets of black holes accreting near the Eddington limit. The two classes are comprised of: (1) The weak jet sources, corresponding to FR I radio galaxies, having a decelerating or spine-sheath jet with velocity gradients, and (2) The strong jet sources, having fast, collimated jets, and typically displaying strong emission lines. The dichotomy in the v_p - L_p plane can be understood as a "broken power sequence" in which jets exist on one branch or the other based on the particular accretion mode (Georganopoulos 2011). We suggest that the intrinsic kinetic power (as measured by low-frequency, isotropic radio emission), the orientation, and the accretion rate of the SMBH system are the the fundamental axes needed for unification of radio-loud AGN by studying a well-characterized sample of several hundred Fermi-detected jets. Finally, we present very recent findings that the most powerful strong jets produce gamma-rays by external Compton rather than SSC emission, placing the dissipation region in these strong jets at a radius inside the BLR and/or molecular torus (Meyer 2011).

The TANAMI Program: Southern-Hemisphere AGN on (Sub-)Parsec Scales

Cornelia Müller (Remeis Observatory & ECAP, JMU Würzburg), **Matthias Kadler** (JMU Würzburg), **Roopesh Ojha** (GSFC), **Joern Wilms** (Remeis Observatory & ECAP) on behalf of the TANAMI team

The TANAMI VLBI monitoring program provides bi-monthly, dual-frequency, milliarcsecond monitoring of AGN in the southern third of the sky using the Australian Long Baseline Array (LBA) and associated telescopes in Antarctica, Chile, New Zealand and South Africa. Supporting programs provide multiwavelength coverage of *Fermi*/LAT sources, in order to construct simultaneous broadband SEDs, as well as rapid follow-up of high energy flares. After a brief description of this program and its current status we will present some results including those from the highest resolution image of an AGN (the nearby radio galaxy Centaurus A) ever made.

With the first epoch TANAMI dual-frequency images at an angular resolution of about 0.7×0.4 mas we constructed the best resolved spectral index map of the sub-parsec scale jet-counterjet system of Cen A. We can identify multiple possible sites as the origin of γ -ray emission detected by the *Fermi*/LAT. The multi-epoch analysis based on the first four 8.4 GHz observations reveals a very complex kinematical behaviour when tracking individual components of lightday-scale size.

Radio-to-Gamma Ray Monitoring of Mkn 421 and Mkn 501: Source Variability

Nina Nowak (MPI für Physik, 80805 Munich, Germany), **D. Paneque** (MPI für Physik, 80805 Munich, Germany), **U. Barres de Almeida** (MPI fuer Physik, 80805 Munich, Germany), **N. Strah**(Technische Universität Dortmund, 44221 Dortmund, Germany), **D. Tesaro** (Universita di Siena and INFN Pisa, 53100 Siena, Italy)

We present first results from simultaneous multifrequency observations of the high-synchrotron-peaked BL Lac objects Mrk 421 and Mrk 501 during 4.5 months in 2009. This is part of a multi-year and multi-instrument programme including VLBA, F-GAMMA, GASP-WEBT, Swift, RXTE, Fermi-LAT, MAGIC, VERITAS and many other collaborations and instruments. This extensive radio to TeV data set provides unprecedented temporal and energy coverage of the two sources during a phase of low activity. The SEDs of both objects are very similar and can be described by a standard one-zone synchrotron self-Compton model. In this talk we will report on the multifrequency lightcurves, variability and correlations, and will evaluate these results in the framework of commonly used emission models.

High-resolution monitoring of parsec-scale jets in the Fermi era

Eduardo Ros (Universitat de València, Spain & Max-Planck-Institut für Radioastronomie, Germany)

I will review the present observational efforts to study parsec-scale radio jets in active galactic nuclei by means of very-long-baseline interferometry (VLBI) as related to the new window to the Universe opened by Fermi. I will describe the goals and achievements of those radio studies, which aim to probe the emission properties, morphological changes and related kinematics, magnetic fields from the linear and circular polarization, etc., and I will put those in the context of the radio–gamma-ray connection.

Spectropolarimetric Properties of the Giant Radio Lobes of Centaurus A

Shane O’Sullivan, Ilana Feain, Naomi McClure-Griffiths, Tim Cornwell, Ron Ekers, Ettore Carretti (CSIRO Astronomy and Space Science, ATNF, Sydney)

We present a new study of the polarization and Faraday rotation measure (RM) properties of the giant lobes (projected linear scale: 500 kpc) of our nearest radio galaxy, Centaurus A. Our analysis is based on spectropolarimetric observations with the Australia Telescope Compact Array (ATCA) and the Parkes 64 m single dish at 1.4 GHz. The proximity of Centaurus A provides us with the ultimate laboratory for studying the physical processes that form these giant lobes and the particle acceleration that illuminates the structure. We describe several new, previously undiscovered features amongst the complex filamentary structures seen throughout the lobes. We also discuss our results in the context of the recent detection of gamma-ray emission from the giant lobes with the Fermi satellite and the implications for the magnetic field strength and particle density in the lobes.

A simplified view of blazars: why BL Lacertae is actually a quasar in disguise

Paolo Padovani (ESO), P. Giommi, G. Polenta, S. Turriziani, V. D’Elia (ASDC), S. Piranomonte (INAF)

We propose a scenario where blazars are classified as flat-spectrum radio quasars (FSRQs), BL Lacs, low synchrotron, or high synchrotron peaked objects according to a varying mix of the Doppler boosted radiation from the jet, the emission from the accretion disk, the broad line region, and the light from the host galaxy. We test this new approach, which builds upon unified schemes, using extensive Monte Carlo simulations and show that it can provide simple answers to a number of long-standing issues including, amongst others, the different cosmological evolution of BL Lacs selected in the radio and X-ray bands, the larger synchrotron peak frequency (ν_{peak}) values observed in BL Lacs, the fact that high synchrotron peaked blazars are always of the BL Lac type, and the existence of FSRQ/BL Lac transition objects. Objects so far classified as BL Lacs on the basis of their observed weak, or undetectable, emission lines are of two physically different classes: intrinsically weak lined objects, more common in X-ray selected samples, and heavily diluted broad lined sources, more frequent in radio selected samples, which explains some of the confusion in the literature. We also show that strong selection effects are the main cause of the diversity observed in radio and X-ray samples, and that the correlation between luminosity and ν_{peak} , that led to the proposal of the “blazar sequence”, is also a selection effect.

Cherenkov and Jansky: Our Understanding of AGN at the Highest Energies

Jeremy S. Perkins (UMBC/CRESST/GSFC) on behalf of the VERITAS and Fermi/LAT Collaborations

The radio galaxy M87 has been the subject of some of the most successful radio and gamma-ray multiwavelength campaigns. These campaigns have included many of the major ground and space based gamma-ray telescopes and span decades of energy. The size and proximity (16 Mpc) of M87 makes it a unique laboratory for the study of AGN jet substructure and the morphology of non-thermal emission processes. A recent flare in 2010, observed at very high energies ($E > 100$ GeV) with VERITAS, triggered the most recent campaign. Results from this campaign will be presented along with a review of past campaigns.

Parsec-scale study of Fermi sources

Leonid Petrov (ADNET Systems/NASA GSFC), Yury Kovalev (ASC Lebedev, MPIfR)

It was established that over 60% of the Galactic plane have associations with relatively bright compact extragalactic radio sources detected in all-sky VLBI surveys. In order to eliminate sampling bias, we observed with VLBA+GBT radio weak AGN associations of Fermi detections with no prior knowledge on their parsec-scale properties and got almost 100% determined flux densities from parsec scales, compactness and other characteristics of observed sources and used the full Fermi-VLBI sample to perform population analysis of blazars. We derived VLBI positions of all Fermi associations with a sub-mas accuracy level and evaluated random and systematic position errors of the 2FGL catalogue.

Synchrotron Emission from VHE Gamma-Ray Induced Pair Cascades in AGN Environment

Parisa Roustazadeh and Markus Böttcher (Ohio University, Athens, OH 45701)

The discovery of very-high-energy (VHE, $E > 100$ GeV) gamma-ray emission from intermediate- and low-frequency peaked blazars suggests that gamma-gamma absorption and pair cascading might occur in those objects. We demonstrate that Compton emission from VHE gamma-ray induced pair cascades, deflected by moderate magnetic fields, can explain the Fermi fluxes and spectra of the radio galaxies Cen A and NGC 1275. We demonstrate that the magnetic field can not be determined from a fit of the cascade emission to the gamma-ray spectrum alone, and the degeneracy can only be lifted if the synchrotron emission from the cascades is observed as well. We point out that the cascade synchrotron emission may produce spectral features reminiscent of the big blue bump observed in the spectral energy distributions of several blazars, and apply this idea to 3C 279.

When Fermi met Jansky... - A summary of the Bonn meeting

Tuomas Savolainen (Max-Planck-Institut für Radioastronomie)

The previous meeting on radio - gamma-ray connection in active galactic nuclei, appropriately named "Fermi meets Jansky", was organized in Bonn last year. In this talk I will attempt to summarize the scientific content of the "Fermi meets Jansky" workshop and to give a (subjective) review of its highlights. In order to set the stage for today's meeting, I will also give an account of the major open questions that were debated in Bonn.

Imaging at Both Ends of the Spectrum: the Long Wavelength Array and Fermi

Greg Taylor (UNM) on behalf of the LWA Collaboration

The Long Wavelength Array (LWA) will be a new multi-purpose radio telescope operating in the frequency range 10-88 MHz. Scientific programs include pulsars, supernova remnants, general transient searches, radio recombination lines, solar and Jupiter bursts, investigations into the "dark ages" using redshifted hydrogen, and ionospheric phenomena. Upon completion, LWA will consist of 53 phased array "stations" distributed across a region over 400 km in diameter. Each station consists of 256 pairs of dipole-type antennas whose signals are formed into beams, with outputs transported to a central location for high-resolution aperture synthesis imaging. The resulting image sensitivity is estimated to be a few mJy (5sigma, 8 MHz, 2 polarizations, 1 h, zenith) from 20-80 MHz; with angular resolution of a few arcseconds. Additional information is online at <http://lwa.unm.edu>. Partners in the LWA project include LANL, JPL, NRAO, NRL, UNM, NMT, and Virginia Tech.

The full LWA will be a powerful instrument for the study of particle acceleration mechanisms in AGN. Even with the recently completed first station of the LWA, called "LWA1", we can begin spectral studies of AGN radio lobes. These can be combined with Fermi observations. Furthermore we have an ongoing project to observe Crab Giant Pulses in concert with Fermi. In addition to these pointed studies, the LWA1 images the sky down to declination -30 degrees daily. This is quite complimentary to Fermi's daily images of the sky.

The X-ray view of FR-I and FR-II radio galaxies detected by Fermi-LAT

Eleonora Torresi, Paola Grandi (INAF/IASF-Bologna, Italy)

We study the X-ray properties of FRI and FRII radio galaxies having a Fermi-LAT counterpart, and belonging to well-studied radio catalogs, i.e. 3CR, 3CRR, 2Jy and Molonglo samples. There is evidence that the LAT instrument preferentially detects FRIs. The discrepancy between FRI and FRII gamma detection rates does not seem to be related to FRII's larger distances. Different jet properties might be a more reliable interpretation and X-rays represent a very useful tool to explore this possibility. Indeed, they allow to investigate the nuclear region, where the jet is produced, and the environment, where it propagates. High-resolution X-ray images provide information on the extended (kpc scale) warm/hot gas, if present, and moderate energy resolution spectra can be used to verify the presence (absence) of signatures witnessing efficient (inefficient) accretion disks (for example the iron K α line).

Some considerations on the last flare of 3C 454.3

Valerio Vittorini (INAF-IASF Roma & Univ. Roma "Tor Vergata", Rome, Italy) on behalf of AGILE Team collaboration

We review the last giant flare of 3C 454. The monthly light curves on different bands show an intriguing behaviour: in particular, optical and gamma-ray bands appear not univocally correlated, arguing for a complex mechanism in the production of the flare.

Recent MAGIC observations of active galactic nuclei: Studies in the decisive $E > 50$ GeV region

Robert Wagner (Max-Planck-Institut für Physik, Munich, Germany) for the MAGIC Collaboration

MAGIC, a stereoscopic imaging air Cherenkov telescope system with two 17-m diameter reflectors, is sensitive to gamma-rays from some ten GeV (the lowest energy threshold of such telescope systems) up to some TeV, which enables the study of gamma-ray emission right above the energy regime to which Fermi-LAT is sensitive. In this energy region, source-intrinsic high-energy cutoffs due to, e.g., Klein-Nishina suppression, but also absorption of gamma-rays by the extragalactic background light (EBL) take place and make it an energy window of utmost importance for AGN studies. We report on recent AGN observations that have been performed with the MAGIC telescopes, emphasizing multi-wavelength observations; studies of non-blazar type AGN; and studies of particularly distant blazars with $z > 0.4$ (3C 279, PKS 1222+21), in which particularly the observed fast variability challenges conventional particle acceleration models and the observed extension of their spectra supports a low EBL density.

AGN physics with the Cherenkov Telescope Array

Andreas Zech for the CTA collaboration (LUTH, Observatoire de Paris, CNRS, Université Paris Diderot, 5 Place Jules Janssen, 92190 Meudon, France)

The Cherenkov Telescope Array (CTA), currently in its preparatory phase, will be the first open observatory for very high energy gamma rays. The international consortium behind CTA aims to build two large arrays of Cherenkov telescopes in the Northern and Southern hemispheres with a performance that will be significantly improved compared to the current generation of arrays, such as H.E.S.S., MAGIC and VERITAS. Its increased sensitivity and energy range will give CTA access to a large population of AGNs not yet detected at very high energies and provide much greater details on known TeV sources. While the low end of the CTA energy coverage will close the current gap with the Fermi band, its high energy coverage, up to 100 TeV, will open a new window on the sky, help us understand the intrinsic shape of the hardest blazar spectra and further constrain the distribution of the extragalactic background light.