The Innermost Regions of Relativistic Jets and Their Magnetic Fields.

Granada (Spain). June 10th-14th, 2013.

Program & Abstracts

Sunday, 9th

20:00 Early registration and welcome cocktail at the Nazaríes Hotel

Monday, 10th

08:00 Registration opens

09:00 - 09:15 Welcome and scope of the meeting, José L. Gómez

Jet formation (Chair: Gabriele Ghisellini)

09:15 - 09:45 "The Role of Magnetic Fields in the Production and Propagation of Relativistic Jets", D. Meier (Review)

09:45 - 10:15 "Relativistic Jet Formation by Spinning Black Holes", A. Tchekhovskoy (Invited)

10:15 - 10:45 "Probing the inner jet of M87; from the jet base to HST-1", K. Hada (I)

10:45 -11:15 Coffee break

11:15 - 11:35 "The firs 2-years in the lifetime of the newly born jet associated to Swift J1644+57", A. J. Castro-Tirado

11:35 - 11:55 "The M87 Jet", M. Nakamura

11:55 - 12:15 "JEDs and SADs in X-ray Binaries", J. Ferreira

12:15 - 12:35 "Polarimetric Observations of the Innermost Regions of Relativistic Jets in X-ray Binaries", D. Russell

12:35 - 12:55 "The force-free magnetosphere of a rotating black hole", I. Contopoulos

---

12:55 - 15:00 Lunch break

Jet dynamics, structure and stability (Chair: José-María Martí)

15:00 - 15:30 "The Role of Macroscopic & Microscopic Instabilities in Relativistic Jets", P. Hardee (R)

15:30 - 16:00 "Jet dynamics and stability", M. Perucho (I)

16:00 - 16:20 "Kink instability in relativistic magnetized jets", N. Vlahakis

---

16:20 - 16:50 Coffee break

16:50 - 17:10 "Radiation from relativistic jets from particle accelerated by shocks, shear-flows, and reconnection", K. Nishikawa

17:10 - 17:30 "Current-Driven Kink Instability in Magnetically Dominated Rotating Relativistic Jet", Y. Mizuno

17:30 - 17:50 "Rayleigh-Taylor and Richtmyer-Meshkov Instabilities in Relativistic Hydrodynamic Jets", J. Matsumoto

17:50 - 18:10 "3 dimensional magneto hydrodynamic jet simulations", J. Staff

Tuesday, 11th

Emission across the electromagnetic spectrum I (Chair: Jose L. Gómez)

09:00 - 09:30 "Multi-waveband Behavior of Blazars", A. Marscher (R)

09:30 - 10:00 "The "Far Distance" Scenario for Gamma-ray Emission in Blazars: A View from the VLBI Observing Perspective", I. Agudo (I)

10:00 - 10:20 "The Gamma-ray Activity of the high-Z Quasar 0836+710", S. Jorstad

10:20 - 10:40 "The radio/gamma-ray connection in Active Galactic Nuclei in the Fermi era", M. Giroletti

---

10:40 -11:10 Coffee break

11:10 - 11:30 "What can we learn from high energy flares in the Fermi sample of FSRQ: from a case study to dozens of objects", L. Pacciani

11:30 - 11:50 "The nature of the IR emission in LLAGN at parsec scales: Does the jet dominate at low luminosities?", J. A. Fernández Ontiveros

11:50 - 12:10 "Jet evolution in Steep Spectrum Radio Quasars. A multiwavelength study", E. Torresi

12:10 - 12:30 "Gamma-Ray variability studies of Misaligned AGN", P. Grandi

12:30 - 12:50 "Probing the Radio Counterpart of Gamma-ray Flaring Region in 3C 84", H. Nagai

12:50 - 13:10 "On the connection between radio and gamma rays. Variability and polarization properties in relativistic jets", M. Orienti

---

13:10 - 15:00 Lunch break

Jets from stellar-mass objects (Chair: Marcello Giroletti)

15:00 - 15:30 "Jets across the black hole mass scale: new insights from X-ray binaries", S. Markoff (R)

15:30 - 16:00 "Relativistic stellar jets: dynamics and non-thermal radiation", V. Bosch-Ramon (I)

16:00 - 16:20 "Search for new stellar sources of gamma-rays", J. Martí

16:20 - 16:50 Coffee break

16:50 - 17:10 "Discovery of synchrotron emission from a YSO jet", C. Carrasco González

17:10 - 17:30 "Spectra and fast multi-wavelength variability of compact jets powered by internal shocks", J. Malzac

17:30 - 17:50 "Doppler-shifted lines revealing baryons in the jets of the X-ray binary 4U 1630-47", S. Migliari

17:50 - 18:10 "Magnetic Field Structure in Relativistic Jets", H. Jermak

Wednesday, 12th

Emission across the electromagnetic spectrum II (Chair: Svetlana Jorstad)

09:00 - 09:30 "Multi-wavelength emission models in blazars", G. Ghisellini (R)

09:30 - 10:00 "Radio-loud AGN unification: Connecting jets and accretion", E. Meyer (I)

10:00 - 10:20 "Leptonic and Hadronic Modeling of Fermi-Detected Blazars", M. Boettcher

10:20 - 10:40 "Constraining the location of gamma-ray emission in Blazar jets", M. Joshi

---

10:40 -11:10 Coffee break

11:10 - 11:30 "An Exceptional Radio Flare in Markarian 421", J. Richards

11:30 - 11:50 "Time dependent photon and neutrino emission from Mkn421 in the context of the one-zone leptohadronic model", A. Mastichiadis

11:50 - 12:10 "Panchromatic Observations of the Nuclei of z<0.5 3CRR Radio Galaxies: Implications for Feeding, Feedback, and Black Hole Spin", D. Evans

12:10 - 12:30 "Relativistic jets in Narrow-Line Seyfert 1 galaxies. New discoveries and open questions", F. D'Ammando

12:30 - 12:50 "The origin and emission mechanism of VHE (>100 GeV) emission from FSRQs", B. Behera

12:50 - 13:10 "Uncovering the physics behind the blazar sequence using a realistic model for jet emission", W. Potter

---

Free afternoon for social activities (visit to Alhambra)

Thursday, 13th

Magnetic fields and jet physics I (Chair: Gabriele Giovannini)

09:00 - 09:30 "Magnetic fields and polarization in AGN jets", J. Wardle (R)

09:30 - 10:00 "Parsec-Scale Polarization and Magnetic Field Characteristics of MOJAVE AGN Jets", M. Lister (I)

10:00 - 10:20 "Magnetic field in the jet of 3C 454.3", M. Zamaninasab

10:20 - 10:40 "Probing the magnetic field of 3C279", S. Kiehlmann

---

10:40 -11:10 Coffee break

11:10 - 11:30 "A sensitive study of the peculiar jet structure HST-1 in M87", C. Casadio

11:30 - 11:50 "Longitudinal and transverse velocity fields in parsec-scale jets", F. Mertens

11:50 - 12:10 "AGN jet physics and observed apparent opening angles", E. Clausen-Brown

12:10 - 12:30 "Intrinsic brightness temperatures of blazar jets at 15 GHz", T. Hovatta

12:30 - 12:50 "Study of High Energy Emission from Relativistic Jets with VERITAS", R. Mukherjee

12:50 - 13:10 "Hadronic Modeling of AGN Variability", M. Weidinger

13:10 - 15:00 Lunch break

Magnetic fields and jet physics II (Chair: John Wardle)

15:00 - 15:30 "Multi-wavelength Polarization Studies of AGN Jets", D. Gabuzda (R)

15:30 - 15:50 "Constraints on Blazar Jet Conditions During Gamma-Ray Flaring from Radiative Transfer Modeling", M. Aller

15:50 - 16:10 "Recollimation Shock and the Fire Hose in BL Lacertae", M. Cohen

16:10 - 16:30 "Broadband radio circular polarization observations of the quasar PKS B2126-158", S. O'Sullivan

16:30 - 17:00 Coffee break

17:00 - 17:20 "A Rotation Measure Gradient on the M87 VLA Jet", J. C. Algaba

17:20 - 17:40 "Multi-frequency study of the TeV blazar Markarian 421 with VLBA observations", R. Lico

17:40 - 18:00 "Studies of Blazar emission using a spatially resolved SSC model", S. Richter

Conference dinner at Palacio de los Cordova

Friday, 14th

AGN Jets (Chair: Markus Böttcher)

09:00 - 09:30 "Space VLB interferometer RadioAstron: early results and future prospects of AGN studies", Y. Kovalev (I)

09:30 - 10:00 "Quasar large scale jets: Fast and powerful or weak and slow, but efficient accelerators?", M. Georganopoulos (I)

10:00 - 10:20 "Poynting flux dissipation in jets", J. Kirk

10:20 - 10:40 "Magnetic field amplification and blazar flares", X. Chen

10:40 -11:10 Coffee break

11:10 - 11:30 "The jet of the LLAGN of M81: Evidence of Precession", A. Alberdi

11:30 - 11:50 "Evidence for internal rotation in the jet of the quasar NRAO150", S. Molina

11:50 - 12:10 "The core shift measurements for two-sided jets affected by free-free absorption using VLBA", T. Haga

12:10 - 12:30 "Astrometric observations of the core position changes in Mrk 421 after the large X-ray flare in 2011", K. Niinuma

12:30 - 12:50 "High-energy signatures of binary supermassive black holes", G. Vila

12:50 - 13:20 Conference summary by Alan P. Marscher

Abstracts book

Review and invited talks

Contributed talks

Review and invited talks

Agudo, Iván

The "Far Distance" Scenario for Gamma-ray Emission in Blazars: A View from the VLBI Observing Perspective. (I)

Since the birth of gamma-ray astronomy, locating the origin of gamma-ray emission has been a fundamental problem for the knowledge of the emission processes involved. Deep and densely time sampled monitoring programs with the Very Long Baseline Array and the Fermi Gamma-ray Space Telescope, together with several other facilities at most of the available spectral ranges (including polarization measurements if possible) are starting to shed light for the case of blazars. A successful observing technique consists on analyzing the timing of multi-waveband variations in the flux and linear polarization, as well as changes in ultra-high resolution VLBI images to associate the particularly bright events at different wavebands. Such association can be robustly demonstrated by probing the statistical significance of the correlation among spectral ranges through Monte Carlo simulations. The location of the high energy emission region is inferred through its relative location with regard to the associated low energy event observed in the VLBI images. In this talk I will present some of the latest results obtained in the wake of our group that locate the GeV emission within the jets of blazars AO 0235+164 and OJ287 at >12 parsec from the central AGN engine, hence supporting the "Far Distance" scenario.

Bosch-Ramon, Valenti

Relativistic stellar jets: dynamics and non-thermal radiation. (I)

Relativistic stellar jets propagate through media with different spatial scales releasing their energy in the form of work and radiation from radio to gamma rays. In this talk I will review several jet-medium interaction scenarios from the point of view of both dynamics and non-thermal radiation, focusing mostly in the high-energy range.

Gabuzda, Denise

Multi-wavelength Polarization Studies of AGN Jets. (R)

Polarization-sensitive VLBI imaging is the only way to obtain information about the projected structure and degree of order of the magnetic fields of AGN jets. The availability of such observations at multiple wavelengths enables in addition mapping of the distribution of Faraday rotation occurring in the immediate vicinity of the AGN and its jet. Since the observed Faraday rotation depends on the line-of-sight magnetic field, this effectively provides a third dimension to our picture of the magnetic field. Overall patterns in the Faraday-rotation distribution can provide information about ordered structure in the magnetic field and/or thermal-electron density in the vicinity of the jet, whereas turbulence or inhomogeneity in the medium surrounding the jet can give rise to patchiness in the Faraday-rotation distribution. Helical or toroidal magnetic fields associated with a jet can give rise to Faraday-rotation gradients across the jet structure due to the systematically changing line-of-sight component of the helical field. Estimation of magnetic-field strengths are difficult and can be model dependent, but reasonably reliable core-region magnetic fields can be derived via analysis of the frequency dependence of the position of the VLBI core. The move toward pixel-based analyses that has occurred over the past 10-15 years has led to the need to improve our understanding of VLBI images and what can and cannot be reliably deduced from them, leading to a number of Monte Carlo and other numerical studies. Recent observational and numerical results concerning multi-wavelength polarization phenomena will be reviewed.

Georganopoulos, Markos

Quasar large scale jets: Fast and powerful or weak and slow, but efficient accelerators?. (I)

The X-ray emission of powerful large scale quasar jets has be attributed to both inverse Compton scattering of cosmic microwave background photons from from ~10-100 MeV electrons in a fast (bulk Lorentz factor ~10-20) and powerful jet (close to or higher than the Eddington luminosity) and synchrotron radiation from a population of 10-100 TeV electrons in a jet that can be slow (bulk Lorentz factor ~1.5-3) and weak (~three orders of magnitude below Eddington). Obviously, these are two very different realities that will impact the host galaxy cluster in very different ways. We present Fermi-based work in the direction of deciding the above issue.

Ghisellini, Gabriele

Multi-wavelength emission models in blazars. (R)

I will discuss the most recent results about blazars, coming mostly from the Fermi and Swift satellites, but also on searches of high-z blazars with the SDSS and FIRST. Then I will present the main properties of blazars as derived by modelling, focusing on the Flat

Spectrum Radio Quasar class. For them the accretion disk emission can be visible, allowing the measurement of the black hole mass and the accretion rate. I will discuss where we stand about the understanding of blazar physics.

Hada, Kazuhiro

Probing the inner jet of M87; from the jet base to HST-1. (I)

Relativistic jets in active galactic nuclei are one of the most energetic phenomena in the Universe. While it is widely accepted that AGN jets are powered by accretion onto the supermassive black hole, the detailed processes of jet formation as well as production of high-energy emission up to TeV gamma-ray still remain as major questions in current astrophysics.
The giant radio galaxy M87 accompanies one of the nearest AGN jets showing intense radiation through radio to TeV gamma-ray. Its proximity and the large mass of the central black hole provide an excellent advantage to probe the sites of jet formation and gamma-ray production. VLBI observations at radio frequencies are a unique tool to resolve such regions directly. In this talk, I will present the latest progress of our study for the innermost part of the M87 jet based on multi-frequency, multi-epoch VLBI observations. We especially focus on the two remarkable regions; the jet base near the black hole and the peculiar jet feature HST-1 at a large distance from the jet base. Physical properties of these features obtained from the observations will be discussed.

Hardee, Philip

The Role of Macroscopic & Microscopic Instabilities in Relativistic Jets. (R)

I first review the work done on Kelvin-Helmholtz and Current Driven Instabilities. These macroscopic MHD instabilities may be responsible for observed larger scale jet structures. In addition, I will review the progress made on two-stream and velocity shear plasma instabilities at smaller scales that can lead to magnetic field generation and particle acceleration. Finally, I will examine the role of these different instabilities on jet spatial scales from the central engine out to a few Kpc and when these different instabilities can be important.

Kovalev, Yuri

Space VLB interferometer RadioAstron: early results and future prospects of AGN studies. (I)

The space element of the ground-space very long baseline (VLB) interferometer RadioAstron is a 10-meter radio telescope Spektr-R which was successfully launched in

2011. It covers four frequency bands from 0.3 to 25 GHz and provides baselines up to 350,000 km. This allows to study space objects with a resolution as high as about 10 microarcseconds. Fringes are found at all four bands of 92, 18, 6, and 1.3 cm. Science observations are ongoing. Early results of the RadioAstron AGN survey at extreme angular resolutions will be presented in the talk. In particular, AGN core emission is successfully detected at interferometer baselines up to 7.6 GLambda (or fringe spacing 27 microarcseconds) which is the current VLBI record. High radio brightness of AGN cores is found significantly above the known inverse-Compton limit. Implications to AGN jet emission models will be discussed. First results of RadioAstron space VLBI imaging of AGN jets will be also presented. Overview of prospects of AGN studies within the open RadioAstron Key Science Program will conclude the talk.

Lister, Matthew

Parsec-Scale Polarization and Magnetic Field Characteristics of MOJAVE AGN Jets. (I)

Since 2002, the MOJAVE program has gathered multi-epoch full VLBA polarization data at 15 GHz on over 300 compact radio jets associated with AGN. Multi-frequency VLBA polarization data (8.1, 8.3, 12, 15 GHz) were also obtained on 191 of these jets in 2006. With this extensive dataset we have examined parsec-scale Faraday rotation, rotation measure gradients, and core shifts in bright blazars. We detected significant transverse rotation measure gradients in four jets, and find statistical differences in the rotation measures, polarization orientations, and magnetic fields of BL Lac jets as compared to quasars. The weak-lined jets tend to have smaller rotation measures, higher fractional jet polarization, electric polarization vectors better aligned with the local jet direction, and weaker magnetic fields in the VLBI core region. We present preliminary results regarding the time evolution of polarization structures within the jets, and their overall connection with kinematic properties of the flow. We also discuss the polarization properties of gamma-ray bright blazars, which appear to correlate strongly with the location of the synchrotron peak in the overall spectral energy energy distribution.

Markoff, Sera

Jets across the black hole mass scale: new insights from X-ray binaries. (R)

Black hole X-ray binaries (BHBs) are fantastic laboratories for studying accretion processes on timescales millions of times shorter than those in supermassive black holes. During a typical outburst, relativistic jets are launched with both steady flow and discrete ejecta, and then ultimately quenched, over the course of weeks to months.In the process, the system traverses a series of accretion states with enough similarities to AGN classifications to motivate a quantitative comparison.I will discuss the latest results on how BHBs are guiding our ideas about jet launching, dynamics and particle acceleration, also relevant for supermassive black hole systems. Beyond considering the mapping of

BHB states to AGN classes, I will also cover some new ideas we are exploring for how to link the accretion inflow conditions to characteristics of the produced outflows.

Marscher, Alan

Multi-waveband Behavior of Blazars. (R)

The author will selectively review the extensive set of comprehensive multi-waveband observations of blazars that has become possible with the availability of the Fermi Gamma Ray Space Telescope. These include light curves from radio to gamma-ray frequencies, linear polarization from radio to optical wavelengths, and spectral energy distributions at different flux states. The combination of cross-frequency correlations, power spectra, timing of the appearance of superluminal knots relative to events in the light curves, and both well-defined and erratic behavior exhibited by blazars is challenging to interpret. Models that incorporate helical magnetic fields in the inner parsec of the jet, and turbulence or shear plus reconnections of magnetic fields on parsec scales, may prove successful, but much work remains to be done.

Meier, David

The Role of Magnetic Fields in the Production and Propagation of Relativistic Jets. (R)

I will review the current understanding of how relativistic jets behave from the point where they are initially launched near the accretion inflow (or black hole) until they are disconnected causally from the central engine and on their way toward creating the extended jet and lobes. There are strong observational and theoretical reasons for believing that many, if not most, jets undergo a very strong (and possibly predictable) constriction of the flow shortly after they become causally disconnected from the acceleration and collimation region. Depending on conditions in this constriction (the exact mechanisms of which are still are poorly understood), the properties of the jet downstream of this feature could be either Poynting-flux-dominated (PFD) or kinetic-flux-dominated (KFD). I suggest that the properties of both compact (VLBI) and extended jets and their lobes should be interpreted in terms of the strength and physical structure of the local jet magnetic field. This paradigm shift could lead to a greater understanding of the role that magnetic fields play, not only in the formation of relativistic jets, but also in the production of portions of the Fanaroff and Riley morphological sequence.

Meyer, Eileen

Radio-loud AGN unification: Connecting jets and accretion. (I)

While only a fraction of Active Galactic Nuclei are observed to host a powerful relativistic jet, a cohesive picture is emerging that radio-loud AGN may represent an important phase in the evolution of galaxies and the growth of the central super-massive black hole. I will review my own recent observational work in radio-loud AGN unification in the context of understanding how and why jets form and their the connection to different kinds of accretion and growing the black hole, along with a brief discussion of possible connections to recent modeling work in jet formation. Starting from the significant observational advances in our understanding of jetted AGN as a population over the last decade thanks to new, more sensitive instruments such as Fermi and Swift as well as all-sky surveys at all frequencies, I will lay out the case for a dichotomy in the jetted AGN population connected to accretion mode onto the black hole. 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 the less collimated, edge-darkened FR Is, with 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 vp-Lp 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 (Georganopolous 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 origin of the IC emission in these strong jets at a radius inside the BLR and/or molecular torus (Meyer 2012).

Perucho, Manel

Jet dynamics and stability. (I)

In my talk, I will review our recent results on the effects of the growth of instabilities on jet structure and evolution of relativistic jets. The analysis of VLBI observations of the jet in 0836+710 shows that theobserved helical structure of the jet responds to a pattern motion,possibly related to a pressure maximum within the jet cross-sectiondriving the helical motion. I will discuss some implications that thisresult has with respect to the long-term evolution of this jet, and moregenerally, regarding the nature of the radio core and the superluminaltransversal motions detected in other extragalactic jets. I will alsopresent results from a detailed study of a strong flare in CTA 102. We have followed the spectral and kinematic evolution of the injected perturbation in the jet and obtained possible evidence for shock-shock interaction, possibly produced by the travelling perturbation and a standing shock within the core region.

Tchekhovskoy, Alexander

Relativistic Jet Formation by Spinning Black Holes. (I)

Recent advances in computer modeling allow us to simulate the production of relativistic jets by accreting black holes in unprecedented detail. For the first time, the simulations allow us to determine the maximum power with which spinning black holes can produce relativistic jets and measure the dependence of this maximum jet power on black hole spin. Further, I will describe the new results on the production of jets by black holes whose rotational axis is tilted relative to the direction of the angular momentum of the infalling material. Finally, I will discuss how these advances improve our ability to probe observationally the physics of the central engine.

Wardle, John

Magnetic fields and polarization in AGN jets. (R)

In the literature there are now a wealth of images of AGN in both linear and circular polarization at milliarcsecond resolution of many sources at multiple epochs and wavelengths. This review will be a broad overview of our current state of knowledge of the polarization properties of AGN jets, and of what we can infer about the structure of their magnetic fields and the distribution of Faraday rotating material (and also what is premature to infer). I will discuss the "value added" by observing in all 4 Stokes parameters coupled with detailed modeling using the full equations of transfer for polarized radiation. This permits the determination of important physical parameters of the jet that are otherwise poorly constrained or unknown. I will mention briefly what might be learned using the new technique of Faraday synthesis, and also the prospects for imaging polarized radiation near supermassive black holes using the Event Horizon Telescope.

Contributed talks

Alberdi, Antxon

The jet of the LLAGN of M81: Evidence of Precession.

Author list: A. Alberdi, I. Marti-Vidal, J. M. Marcaide, A. Brunthaler, M. A. Perez-Torres, J. C. Guirado, E. Ros

We have performed a multi-frequency VLBI campaign of observations of the low-luminosity active galactic nucleus (LLAGN) in the galaxy M81. Thanks to the large amount of data available, we have been able to study with exquisite detail the stability of the AGN in the frame of the host galaxy at different frequencies, the frequency-dependent effects in the jet morphology, together with their time evolution. We have found strong evidence of precession in the jet (i.e. a systematic time evolution in the jet inclination at each frequency) associated with changes in the overall flux density at the different frequencies. We will show our last results.

Algaba Marcos, Juan Carlos

A Rotation Measure Gradient on the M87 VLA Jet.

Author list: Juan Carlos Algaba, Keiichi Asada, Masanori Nakamura

Rotation measures (RMs) have proven to be an excellent tool to study magnetic field structures in AGNs. Here we study RM properties on kiloparsec scales of the M87 jet via stacked multi wavelength polarized VLA observations. Our results show for the first time an indication of the RM gradient transverse to the jet in knot A, and possibly knot C and HST-1. Motivated by the shape of the RM in knots A and B, we discuss that part of it may be a filamentary structure of higher RM due to an external Faraday screen, although we consider this unlikely because i) there is no total intensity counterpart, ii) no feature from external Faraday screen matches this structure and iii) we wouldn't detect the expected offset of the RM in the jet axis from the poloidal component of the magnetic field. The data presented here can be easily explained by a helical magnetic field. By combining this result together with polarization direction plus the U-shape and degree (~60%) of the fractional polarization across the jet, we can fairly conclude the presence of systematically wrapped, possibly helical, magnetic fields tightly wounded in knots A and C, in agreement with an MHD quad shock model. This also indicates a role of magnetic fields in the jet at scales far away (~10^7 Rs) from the central engine.

Aller, Margo

Constraints on Blazar Jet Conditions During Gamma-Ray Flaring from Radiative Transfer Modeling.

Author list: M. F. Aller, P. A. Hughes, H. D. Aller, T. Hovatta

As part of a program to investigate jet flow conditions during GeV gamma-ray flares detected by Fermi, we are using UMRAO multi-frequency, centimeter-band total flux density and linear polarization monitoring observations to constrain radiative transfer models incorporating propagating shocks orientated at an arbitrary angle to the flow direction. We describe the characteristics of the model, illustrate how the data are used to constrain the models, and present results for three program sources with diverse characteristics: PKS 0420-014, OJ 287, and 1156+295. The modeling of the observed spectral behavior yields information on the sense, strength and orientation of the shock (s) producing the radio-band flaring; on the energy distribution of the radiating particles; and on the observer's viewing angle with respect to the jet independent of VLBI data. We present evidence that, while a random component dominates the jet magnetic field, a distinguishing feature of those radio events with an associated gamma-ray flare is the presence of a weak but non-negligible ordered magnetic field component along the jet axis.
This work was supported in part by NASA Fermi GI grants NNX09AU16G, NNX10AP16G, and NNX11AO13G.

Behera, Bagmeet

The origin and emission mechanism of VHE (>100 GeV) emission from FSRQs.

Author list: Bagmeet Behera

Flat Spectrum Radio Quasars, unlike BL Lac objects, are blazars that show prominent line-emission and strong thermal components associated with the accretion disk, the broad-line region (BLR), and/or the dusty torus. The low energy peak in the continuum is from synchrotron emission (of electrons), and the high energy peak is well explained by external-Compton emission. In these models the relativistic electrons in the jet up scatter photons from the thermal photon fields up to GeV energies. Beyond a few tens of GeV such models predict cutoffs due to Klein-Nishina effect and internal absorption via pair production. While >300 FSRQs have been seen with Fermi-LAT (between 100 MeV - 30 GeV) only three have been detected at >∼100 GeV (Very High Energy) with Cherenkov telescopes. The detection of VHE emission constrains the location of the blazar zone based on internal absorption estimates, but challenges the emission models that predict cutoffs. While a number of GeV flaring states (in various FSRQs) have been observed with Cherenkov telescopes only few have resulted in detection of a VHE signal. The broadband emission characteristics and other observables such as apparent velocities in the jets of bright Fermi FSRQs (including the VHE-detected FSRQs) are

studied and put in context to better understand the location and emission mechanism of VHE gamma-ray emitting FSRQS in particular.

Boettcher, Markus

Leptonic and Hadronic Modeling of Fermi-Detected Blazars.

Author list: Markus Boettcher, Anita Reimer

We describe new implementations of leptonic and hadronic models for the broadband emission from relativistic jets in AGN in a temporary steady state. The new model implementations are used to fit snap-shot spectral energy distributions of a representative set of Fermi-LAT detected blazars from the first LAT AGN catalogue. We find that the leptonic model is capable of producing acceptable fits to the SEDs of almost all blazars with reasonable parameters close to equipartition between the magnetic field and the relativistic electron population. If charge neutrality in leptonic models is provided by cold protons, our fits indicate that the kinetic energy carried by the jet should be dominated by protons. We find satisfactory representations of the snapshot SEDs of most blazars in our sample with the hadronic model presented here. However, in the case of two quasars the characteristic break at a few GeV energies can not be well modelled. All of our hadronic model fits require powers in relativistic protons in the range 10^{47} - 10^{49} erg/s.

Carrasco Gonzalez, Carlos

Discovery of synchrotron emission from a YSO jet.

Author list: Carlos Carrasco-Gonzalez, Luis F. Rodriguez, Guillem Anglada, Josep Marti, Jose M. Torrelles, Mayra Osorio

Synchrotron emission is commonly found in relativistic jets from active galactic nuclei (AGNs) and microquasars, but so far its presence in jets from young stellar objects (YSOs) had not been proved. Here, we present the first detection of polarized synchrotron emission arising from the jet of a YSO. We found that the apparent magnetic field, with strength of ~0.2 milligauss, is parallel to the jet axis, and that the polarization degree increases toward the jet edges, as expected for a confining helical magnetic field configuration. These characteristics are similar to those found in AGN jets, hinting at a common origin of all astrophysical jets.

Casadio, Carolina

A sensitive study of the peculiar jet structure HST-1 in M87.

Author list: Carolina Casadio, Jose L. Gómez, Marcello Giroletti, Gabriele Giovannini, M. Perucho, et al.

To obtain a better understanding of the location and mechanisms for the production of the gamma-ray emission in jets of AGN we present a detailed study of the HST-1 structure, 0.8 arcsec downstream the jet of M87, previously identified as a possible candidate for TeV emission. HST-1 shows a very peculiar structure with superluminal as well as possible stationary sub-components, and appears to be located in the transition from a parabolic to a conical jet shape, presumably leading to the formation of a recollimation shock. This scenario is supported by our new RHD simulations in which the interaction of a moving component with a recollimation shock leads to the appearance of a new superluminal component. To discern whether HST-1 is produced by a recollimation shock or some other MHD instability, we present new polarimetric 2.2 and 5 GHz VLBA, as well as 15, 22 and 43 GHz JVLA observations obtained between November 2012 and March 2013.

Castro-Tirado, Alberto J.

The first 2-years in the lifetime of the newly born jet associated to Swift J1644+57.

Author list: A. J. Castro-Tirado, J. L. Gómez, I. Agudo, M. A. Guerrero, M. Bremer, J. M. Winters, J. Gorosabel, S. Guziy, M. Jelinek, J. C. Tello, R. Sánchez-Ramírez, D. Pérez-Ramírez, J. Reyes-Iturbide, I. H. Park, S. Jeong, and A. S. Pozanenko

We describe the evolution of of Swift J1644+57, whose unique X-ray properties have led several groups to interpret its behavior as corresponding to an extraordinary event of tidal disruption of a star by a supermassive black hole in the nucleus of a (z =0.3545) galaxy, as derived by GTC. Multiwavelength observations (optical, millimetre, centimitre) in the last two years are proving to be essential to reveal the long term nature of the emission in this source. In particular, we identify for the first time the properties of a forming relativistic jet.

Chen, Xuhui

Magnetic field amplification and blazar flares.

Author list: Xuhui Chen, Ritaban Chatterjee, Giovanni Fossati, Martin Pohl

Recent multiwavelength observation of PKS0208-512 by SMARTS, Fermi, and Swift revealed that gamma-ray and optical light curves of this FSRQ are highly correlated, but with an exception of one large optical flare having no corresponding gamma-ray activity

or even detection (Chatterjee et al. 2012). On the other hand, recent advances in SNRs observations and plasma simulations both reveal that magnetic field downstream of astrophysical shocks can be largely amplified beyond simple shock compression. These amplifications, along with their associated particle acceleration, can be expected to explain the blazar flares, including the peculiar flare of PKS0208-512. Using our time dependent multizone blazar emission code, we evaluate several scenarios that may represent such phenomena. This code combines Monte Carlo method that tracks the radiative processes including Inverse Compton scattering, and Fokker-Planck equation that follows the cooling and acceleration of particles. It is a comprehensive time dependent code that fully take into account the light travel time effects (LTTEs). In this study, both the changes of the magnetic field and acceleration efficiency are explored as the cause of blazar flares. Under these assumption, Synchrotron Self-Compton (SSC) and External Compton (EC) models produce distinct features that favor the EC model. The optical flares with/without gamma-ray counterparts can be explained by different allocations of energy between the magnetization and particle acceleration, which in turn can be affected by the relative orientation between the magnetic field and the shock front. We will compare the details of the observation and simulation, and highlight what implications this study has on our understanding of relativistic jets.

Clausen-Brown, Eric

AGN jet physics and observed apparent opening angles.

Author list: Eric Clausen-Brown, Tuomas Savolainen, Alexander B. Pushkarev, Yuri Y. Kovalev, Matthew L. Lister

I will present a new method to measure the product of jet Lorentz factor and intrinsic opening angle in flux-limited samples of active galactic nuclei (AGN) jets. This parameter is physically important for jet launching and jet dynamics since it is related to jet sidewise expansion velocity and causality. The measurement is carried out by analyzing the observed distribution of apparent opening angles in very long baseline interferometry (VLBI) flux-limited samples of jets, given some prior knowledge of the AGN radio luminosity function. When applied to the MOJAVE flux-limited sample of radio loud objects, I find the product of jet half-opening angle and Lorentz factor to be 0.1 ± 0.03, which implies that AGN jets are causally connected. In contrast, this parameter is typically two orders of magnitude higher in gamma-ray burst jets, suggesting significant physical differences between AGN jets and GRB jets. I also find evidence that AGN jets viewed very close to the line of sight effectively have smaller intrinsic opening angles than jets viewed more off-axis, which is consistent with Doppler beaming and a velocity field consisting of a fast inner spine and slow outer sheath.

Cohen, Marshall

Recollimation Shock and the Fire Hose in BL Lacertae.

Author list: M. H. Cohen and the MOJAVE BL Lac Team

The MOJAVE group has made 15 GHz images of BL Lacertae at 109 epochs, using VLBA data. A quasi-stationary bright spot (Component7) is usually seen at r~0.26 mas from the core. This component is the counterpart of component A2 seen at 43 GHz (Jorstad et al 2005). Fast components with apparent speeds up to 10c come from or through component 7; several appear every year. We identify component 7 as a recollimation shock and suggest that it might be ejecting components in a manner similar to the strong MHD shock that forms in a super-fast-magnetosonic jet flow and converts it to a trans-magnetosonic flow (Clarke et al 1986, Lind et al 1989). The PA of the inner jet varies irregularly at 15 GHz. Several large swings occurred, with time scale of about 2 years and amplitude up to 25 degrees. In these cases the jet appeared to follow the PA ballistically for two or three mas, with the shift in PA moving downstream as a superluminal pattern, analogous to water streaming from a swinging hose. In 2009 the activity relaxed and in 2010-2012 the jet was stable and showed a mild stationary oscillation with wavelength about 2 mas and amplitude about 0.5 mas. At most epochs the polarization had a longitudinal EVPA, and we suggest that the magnetic field is in the form of a tight helix. If this is the case, the superluminal components might be fast MHD waves or shocks traveling parallel to the central axis.

Contopoulos, Ioannis

The force-free magnetosphere of a rotating black hole.

Author list: Ioannis Contopoulos

We present the structure of the steady-state force-free magnetosphere around a Kerr black hole. The solution depends on the distributions of the magnetic field angular velocity and the poloidal electric current. These are not arbitrary. They are determined self-consistently by requiring that magnetic field lines cross smoothly the two singular surfaces of the problem, the inner `light surface' located inside the ergosphere, and the outer `light surface' which is the generalization of the pulsar light cylinder. We obtain the rate of electromagnetic extraction of energy and confirm the results of Blandford & Znajek (1977). Unless the black hole is surrounded by a thick disk and/or extended disk outflows, the asymptotic solution is very similar to the asymptotic pulsar magnetosphere which has no collimation and no significant plasma acceleration.

D'Ammando, Filippo

Relativistic jets in Narrow-Line Seyfert 1 galaxies. New discoveries and open questions.

Author list: F. D'Ammando, M. Orienti, J. Finke, J. Larsson, M. Giroletti on behalf of the Fermi LAT Collaboration

Before the launch of the Fermi satellite only two classes of AGNs were known to generate relativistic jets and thus emit up to the gamma-ray energy range: blazars and radio galaxies, both hosted in giant elliptical galaxies. The first two years of observations by the Large Area Telescope on board Fermi confirmed that these two are the most numerous classes of identified sources in the extragalactic gamma-ray sky, but the discovery of gamma-ray emission from 5 radio-loud Narrow-Line Seyfert 1 galaxies revealed the presence of a possible emerging third class of AGNs with relativistic jets. A core-jet structure with apparent superluminal motion of the jet components has been observed in radio for some of them. Considering that Narrow-Line Seyfert 1 are typically hosted in spiral galaxy, this finding poses intriguing questions about the nature of these objects, the onset of production of relativistic jets, and the cosmological evolution of radio-loud AGN.
Here, we discuss the radio-to-gamma-rays properties of the gamma-ray emitting Narrow-Line Seyfert 1 galaxies in the context of the blazar scenario and the unification of relativistic jets at different scales, in particular focusing on PKS 1502+036 and the two flaring sources SBS 0846+513 and PMN J0948+0022.

Evans, Daniel

Panchromatic Observations of the Nuclei of z<0.5 3CRR Radio Galaxies: Implications for Feeding, Feedback, and Black Hole Spin.

Author list: Daniel Evans, Mark Birkinshaw, Diana Worrall, David Garofalo, Martin Hardcastle, Judith Croston, Ralph Kraft, Rita Sambruna

We present a radio through X-ray study of the nuclei of 3CRR radio galaxies at z<0.5. This unique data set allows us to answer three key questions about radio-loud AGN: (1) What is the origin of X-ray emission? We show that the X-ray emission from low-excitation radio galaxies is dominated by a parsec-scale jet and shows no evidence for a torus. High excitation radio galaxies, on the other hand, are dominated by luminous accretion disks. (2) How does accretion take place? By estimating the kinetic jet power, we show that Bondi accretion of the hot IGM can power the majority of LERGs, but not the most powerful of these. The Bondi paradigm fails altogether for HERGs. (3) How are jets powered? We next consider models for extracting jet power from rotating black holes. We demonstrate that both the jet power and time evolution of radio-loud AGN fit into a model in which black hole spin varies from retrograde to prograde with respect to the accreting material.

Fernández Ontiveros, Juan Antonio

The nature of the IR emission in LLAGN at parsec scales: Does the jet dominate at low luminosities?.

Author list: J. A. Fernández-Ontiveros, M. A. Prieto, J. A. Acosta-Pulido, S. Markoff, O. González-Martín

The vast majority of AGN belong to the low-luminosity class (LLAGN): they exhibit a low radiation efficiency ($L < 10^{42}$ erg/s; $L/Ledd < 10^{-3}$) and the absence of the big blue bump in their spectrum, a signature of the accretion disk. The study of LLAGN is a complex task due to the contribution of the host galaxy, whose light outshines these faint nuclei. As a consequence, numerical models are usually compared with relatively poorly defined spectral energy distributions (SEDs). For a sample of six prototype nearby LLAGN, a multiwavelength dataset including radio, IR, optical/UV and X-ray measurements with a few tenths of arcsec resolution has been collected. These high-spatial resolution SEDs reveal that: i) the mid-IR bump, indicative of thermal emission from the torus, is missing in LLAGN; ii) the continuum emission of these nuclei is largely described by a self-absorbed synchrotron spectrum, suggesting that jet emission dominates the overall energy output in these objects. The optically thin radiation in the IR-to-UV range is produced in the jet launching region, very close to the central black hole. The very steep slope found in this component -with a spectral index in the 1-3 range- suggests that a large number of LLAGN are powered by young and compact jets with very high radiative losses.

Ferreira, Jonathan

JEDs and SADs in X-ray Binaries.

Author list: Jonathan Ferreira, Pierre-Olivier Petrucci, Quentin Garnier

As proposed in Ferreira et al (2006), the conjecture is made that the innermost regions of accretion discs in XrBs is threaded by a large scale magnetic field of bipolar topology. Such a field is assumed to be near equipartition with the thermal pressure up to an outer transition radius r_J, and much below beyond that radius. A Jet Emitting Disc (hereafter JED) would thus be established below r_J and a Standard Accretion Disc (SAD) beyond. A JED is actually a new class of accretion disc solution with dynamical properties quite different from those of a standard disc. It allows the production of magnetically confined jets that can carry away a sizable fraction of the released accretion power, leading to a missing disc luminosity. Moreover, as for ADAFs, it exhibits three different thermal equilibrium branches at a given radius: two stable (cold and hot) and one intermediate unstable. The hot solution can be naturally associated with the hot X-ray corona generally invoked at the base of the jet in the hard states of microquasars. It will be shown that such a configuration can naturally account for many observational features of microquasars, while providing a possible scenario for their hysteresis. Finally, the power carried by these Blandford & Payne type jets will be compared to that of

Blandford & Znajek type.

Giroletti, Marcello

The radio/gamma-ray connection in Active Galactic Nuclei in the Fermi era.

Author list: M. Giroletti, V. Pavlidou, A. Reimer on behalf of the Fermi-LAT collaboration

We present a detailed statistical analysis of the correlation between radio and gamma-ray emission of the active galactic nuclei (AGNs) detected by Fermi during its first year of operation, with the largest data sets ever used for this purpose. We use both archival interferometric 8.4 GHz data (from the Very Large Array and ATCA, for the full sample of 599 sources) and concurrent single-dish 15 GHz measurements from the Owens Valley Radio Observatory (OVRO, for a sub sample of 199 objects). Our unprecedentedly large sample permits us to assess with high accuracy the statistical significance of the correlation, using a surrogate data method designed to simultaneously account for common-distance bias and the effect of a limited dynamical range in the observed quantities. We find that the statistical significance of a positive correlation between the centimeter radio and the broadband (E > 100 MeV) gamma-ray energy flux is very high for the whole AGN sample, with a probability of $<10^{-7}$ for the correlation appearing by chance. Using the OVRO data, we find that concurrent data improve the significance of the correlation from 1.6×10^{-6} to 9.0×10^{-8}. Our large sample size allows us to study the dependence of correlation strength and significance on specific source types and gamma-ray energy band. We find that the correlation is very significant (chance probability $< 10^{-7}$) for both flat spectrum radio quasars and BL Lac objects separately; a dependence of the correlation strength on the considered gamma-ray energy band is also present, but additional data will be necessary to constrain its significance.

Grandi, Paola

Gamma-Ray variability studies of Misaligned AGN.

Author list: P. Grandi, E. Torresi, A. DeRosa, G. Malaguti, S. Raino

We review the gamma-ray variability properties of AGN with the jet not directly pointing towards us, i.e. Misaligned AGN (MAGN). This class is mainly populated by nearby low power radio galaxies (i.e. FRIs). The high power radio sources (i.e. FRIIs) are indeed rare in the GeV sky. The cause of the different FRI/FRII detection rate is still under debate, although different beaming/jet structural properties could explain the observations. The Fermi-LAT inspection of MAGN light curves collected in 4years of FERMI-LAT survey reveals FRI-FRII different temporal behaviors (confirming a radio galaxy dichotomy) and provides new insights into the location/dimension of the gamma-ray dissipation regions.

Haga, Takafumi

The core shift measurements for two-sided jets affected by Free-Free absorption using VLBA.

Author list: Takafumi Haga, Akihiro Doi, Yasuhiro Murata, Hiroshi Sudou, Seiji Kameno, Kazuhiro Hada, Hiroshi Nagai

A radio core represents the peak of intensity in VLBI images and is located at the base of jets. It appears at different positions depending on frequencies. This is known as "core shift", caused by absorption of the core emission. The position of the central engine in an AGN can be estimated accurately by measuring the core shift with multifrequency and phase-referencing observations. We observed NGC 4261 using the VLBA at seven frequencies. This source is a nearby FR-I type radio galaxy at the distance of 30 Mpc and has prominent two-sided jets. We measured the core shifts in not only approaching side but also counter side of the jets. The positions of core at infinity of frequency in both side indicated to come close asymptotically to the same position, which was separated by 82±16 μas from 43 GHz core position, corresponding to 310±60Rs (Schwarzschild radius). This source also has another feature that there is a region affected by free-free absorption (FFA) in the vicinity of the core and toward the counter jet. Moreover, we also found the same feature in other three sources, 3C 84, Cen A and Cyg A, which are also nearby galaxies with two-sided jets and with an indication of the FFA regions. We measured the core shifts in these sources by using same technique as NGC 4261 in order to study the structure of circumnuclear plasma, to determine the position of the central engine and to test core shifts due to FFA. We will also report these latest results about new observations.

Hovatta, Talvikki

Intrinsic brightness temperatures of blazar jets at 15 GHz.

Author list: T. Hovatta, E. Leitch, K. Wiik, D. Homan, M. Lister, J. Richards, W. Max-Moerbeck, A. Readhead

We have developed a new Bayesian Markov Chain Monte Carlo method to deconvolve light curves of blazars into individual flares, including proper estimation of the fit errors. We use the method to fit 15 GHz light curves obtained within the OVRO 40-m blazar monitoring program where a large number of AGN have been monitored since 2007 in support of the Fermi Gamma-Ray Space Telescope mission. The time scales obtained from the fits are used to calculate the variability brightness temperature of the sources. Additionally, we have calculated brightness temperatures of a sample of these objects using Very Long Baseline Array data from the MOJAVE (Monitoring of Jets in Active Galactic Nuclei with VLBA Experiments) survey. Combining these two data sets enables us to study the intrinsic brightness temperature distribution in these blazars at 15 GHz. I will present the new method and preliminary results of this study.

Jermak, Helen

Magnetic Field Structure in Relativistic Jets

Author list: Carole Mundell, Shiho Kobayashi

Relativistic jets are ubiquitous when considering an accreting black hole. Gamma-ray bursts (GRBs) have highly collimated relativistic jets with high Lorentz factors (100-1000). Magnetic fields are thought to play a key role in collimating and accelerating these powerful short-lived jets but until recently, little was known about them - in contrast to spatially resolved jets of AGN. Early time polarisation measurements provide a unique tool for probing GRB jets when the initial magnetic field properties are still encoded in the fading afterglow light. I will present polarisation detections along with theoretical models to provide new insight into GRB jets and their magnetic field structure.

Jorstad, Svetlana

The Gamma-ray Activity of the high-Z Quasar 0836+710.

Author list: Svetlana Jorstad, Alan Marscher, Paul Smith, Valeri Larionov, and Ivan Agudo

The Fermi LAT detected an increase in gamma-ray activity of the quasar 0836+710 (z=2.17) in Spring 2011 that culminated in a sharp gamma-ray flare at the end of 2011 when the source reached a flux of $1.4e^{-6}$ phot/s/cm^2 at 0.1-200 GeV. We monitor the quasar at optical wavelengths in photometric and polarimetric modes and with the VLBA at 43 GHz. The optical brightness of the quasar increased by ~0.5 mag in R-band and the degree of polarization rose by up to 30% during the highest gamma-ray state. We have identified in the VLBA images a strong, highly polarized component that moves with an apparent speed 20+-2 c. The component emerged from the core in the beginning of the gamma-ray event and reached a flux maximum at the peak of the gamma-ray outburst. We present the results of a correlative analysis of variations at different wavelengths along with the kinematic parameters of the parsec scale jet. We discuss the location of the high gamma-ray emission in the relativistic jet, as well as the emission mechanisms responsible for gamma-ray production.
This research was supported in part by NASA grants NNX10AO59G, NNX10AUG15G, aNNX11AQ03G, and NNX12AO90G.

Joshi, Manasvita

Constraining the location of gamma-ray emission in Blazar jets.

Author list: Manasvita Joshi, A. Marscher, & Markus Boettcher

The location of gamma-ray emission in blazar jets has remained elusive to our understanding of jet emission despite the extensive multiwavelength campaigns and rigorous theoretical efforts to understand the multiwavelength spectra. The synergy between multiwavelength campaigns and VLBA studies has resulted in correlation between majority of gamma-ray events and disturbances propagating down the parsec-scale jet. This implies that the gamma-ray emission might originate beyond the broad line region (BLR), perhaps on scales comparable to the size of the dusty torus. On the other hand, external Compton models in which gamma-ray emission is limited to sites inside the BLR have been used to explain the high-energy emission of many blazars. Thus, comprehending the time-dependent impact of all the three external components of seed photon field, namely the accretion disk, the BLR, and the dusty torus, on the evolution of the spectral energy distribution (SED) can be used as an important tool for connecting the origin of gamma-ray emission of a flare to its multiwavelength properties. Here, we use a multi-zone time-dependent leptonic jet model, with radiation feedback, to address this aspect of blazar jet emission. We let the system evolve to beyond the BLR and within the dusty torus. We explore the effects of varying the contribution of the disk, the BLR, and the dusty torus on the resultant seed photon field and their manifestation on the simulated SED of a typical blazar to gain insight on the location of the gamma-ray emission region.
This is supported by NASA through Fermi grant NNX12AO59G.

Kiehlmann, Sebastian

Probing the magnetic field of 3C279.

Author list: S. Kiehlmann, T. Savolainen on behalf of the Quasar Movie Project team

Magnetic fields play a major role in the launching, acceleration, collimation, and radiation properties of extragalactic jets. The only direct way to observationally access magnetic fields in jets is to measure their polarization imprint on the emitted synchrotron radiation. As part of our Quasar Movie Project, a large, densely-sampled data set, consisting of multi-wavelength photometry (radio to gamma-rays), polarimetry (radio, mm, and optical), and multi-frequency VLBI observations of the gamma-ray bright quasar 3C279, has been collected in 2010-2012. Here we present the results from the polarization monitoring at optical, millimetre and radio wavelengths, and discuss their implications on the structure and magnetic field of the emission zone. 3C279 exhibits strong variation of the optical electric vector positioning angle (EVPA), showing continuous EVPA-rotations larger than 360 degrees in both clockwise and counterclockwise directions. One of the rotations coincides with a gamma-ray flaring period and could be interpreted as a newly ejected emission feature spiraling in the jet and probing a toroidal magnetic field along its streamline. Variations in the polarized

flux are consistent with this. There is also a continuous rotation of the EVPA at mm-wavelengths during the same event, albeit ~4-20 times slower than in optical. Explaining these rotations within one model poses a challenge, and none of the current models can easily explain all the observed behaviour.

Kirk, John

Poynting flux dissipation in jets.

Author list: J. G. Kirk, Takanobu Amano, Iwona Mochol

Relativistic shocks are promising sites for the production of a nonthermal particle population, and, therefore, the nonthermal emission observed from jets. However, if they obey the standard MHD Rankine-Hugoniot jump conditions, they are not effective at dissipating the energy of a relativistic, magnetically dominated jet into particles. A way out of this problem is possible if the incoming magnetic field fluctuates on a sufficiently short timescale. In this case, dissipation can proceed either by driven reconnection in the compressed downstream plasma, or by conversion of the fluctuation modes into a damped superluminal electromagnetic mode in a shock precursor.
I will report recent work on the latter scenario, concerning the stability of these modes, and present two-fluid simulations that explicitly demonstrate mode conversion in a shock precursor. The implications of these results for particle acceleration will be discussed.

Lico, Rocco

Multi-frequency study of the TeV blazar Markarian 421 with VLBA observations.

Author list: R. Lico, M. Giroletti, M. Orienti, G. Giovannini, M. G. Blasi, Y. Y. Kovalev, A. Marscher, S. Jorstad, T. P. Krichbaum, M. A. Perez-Torres, K. V. Sokolovsky, B. G. Piner, W. Cotton, P. G. Edwards, L. Fuhrmann, M. Kino, D. Paneque

Thanks to high resolution radio observations it is possible to obtain a direct imaging of the innermost regions of Active Galactic Nuclei; in particular, it is possible to investigate about the jet's morphology and any proper motions, and the time evolution of physical parameters, such as flux densities and spectral index. In this talk we will present recent results about the nearby (z=0.031) TeV blazar Mrk 421. We analyzed data obtained with the Very Long Baseline Array at twelve epochs (one observation per month from January to December 2011) at 15, 24 and 43 GHz, in the context of a broadband campaign from the radio to gamma-ray. We investigate the inner jet structure on parsec scales through the study of model-fit components for each epoch. At these frequencies the source shows a compact (about 0.13 mas, or 0.08 pc) and bright component, with a one sided jet detected out to about 10 mas. All model-fit components in the jet appear to be almost stationary during our observation period, and the spectral index, in

agreement with other works, it is fairly flat in the core region and steepens along the jet's length. We estimate a different jet velocity for the radio and the high-energy emission regions, such that the respective Doppler factors are delta(r) about 3 and delta (h.e.) about 14. Significant flux density variations have been detected for the core component, with a peak in the flux density on February. A comparison of our radio light curves with the optical light curves, obtained at the Steward Observatory, reveals an increase of the V magnitude and of the fractional polarization in correspondence of the radio peak. A preliminary study of the polarization properties and evolution will be presented.

Malzac, Julien

Spectra and fast multi-wavelength variability of compact jets powered by internal shocks.

Author list: Julien Malzac

The emission of steady compact jets observed in the hard spectral state of X-ray binaries is likely to be powered by internal shocks caused by fluctuations of the outflow velocity. The dynamics of the internal shocks and the resulting spectral energy distribution (SED) of the jet is very sensitive to the shape of the Power Spectral Density (PSD) of the fluctuations of the jet Lorentz factor. I used both Monte-Carlo simulations and semi-analytical methods to investigate this dependence. It turns out that Lorentz factor fluctuations injected at the base of the jet with a flicker noise power spectrum (i.e. $P(f) \sim 1/f$) naturally produce the canonical flat SED observed from radio to IR band in X-ray binary systems in the hard state. This model also predicts a strong, wavelength dependent, variability that resembles the observed one. In particular, strong sub-second variability is predicted in the infrared and optical bands. The complex timing correlations observed between the IR/optical light curves and the X-rays can then be used to probe the accretion/ejection connection on short time-scales.

Martí, Josep

Search for new stellar sources of gamma-rays.

Author list: Josep Martí

We report the present status of our search for gamma-ray binaries,microquasars and new kinds of gamma-ray source associated tostar forming regions in the Galaxy. The search is being carried outusing cross-identification techniques applied to to public databases andarchives. A few promising candidates have been so far identified.These include the emission line star VES 737 and the central cluster of theMonoceros R2 star forming region. The observational data supportingthe proposed associations is presented and discussed.

Mastichiadis, Appostolos

Time dependent photon and neutrino emission from Mkn421 in the context of the one-zone leptohadronic model.

Author list: Apostolos Mastichiadis, Maria Petropoulou, Stavros Dimitrakoudis

We apply a recently developed time-dependent one-zone leptohadronic model to study the emission of the blazar Mkn421. Both processes involving proton-photon interactions, i.e. photopair (Bethe-Heitler) and photopion, have been modeled in great detail using the results of Monte Carlo simulations, like the SOPHIA event generator, in a self-consistent scheme that couples energy losses and secondary injection. We find that TeV gamma-rays can be attributed to synchrotron radiation either from relativistic protons or, alternatively, from secondary leptons produced via photohadronic processes. As a second step we study the variability patterns that each scenario predicts and we find that while the former is more energetically favored, it is the latter that produces, in a more natural way, the usual quadratic behavior between X-rays and TeV gamma-rays. Finally we use the obtained SEDs to calculate in detail the expected neutron and neutrino fluxes that each model predicts and we discuss briefly the consequences of these for the class of TeV blazars as a whole.

Matsumoto, Jin

Rayleigh-Taylor and Richtmyer-Meshkov Instabilities in Relativistic Hydrodynamic Jets.

Author list: Jin Matsumoto and Youhei Masada

We investigate the stability of relativistic jets using three-dimensional hydrodynamic simulations. The propagation of relativistic flow which is continuously injected from the boundary of computational domain into a uniform ambient medium is solved. An intriguing finding in our study is that Rayleigh-Taylor and Richtmyer-Meshkov type instabilities grow at the interface between the jet and ambient medium as a result of spontaneously induced radial oscillating motion. It is powered by in-situ energy conversion between the thermal and bulk kinetic energies. From complementary two-dimensional simulations of transverse structure of the jet, we find the effective inertia ratio of the jet to the surrounding medium determines a threshold for the onset of instabilities. The mixing between light faster jet and slow heavier external matters due to these instabilities causes the deceleration of the jet.

Mertens, Florent

Longitudinal and transverse velocity fields in parsec-scale jets.

Author list: Florent Mertens, Andrei Lobanov

Radio-loud AGN typically manifest powerful realtivistc jets extending up to millions of light years and often showing superluminal motions organized in a complex kinematic pattern. A number of physical models are still competing to explain the jet structure and kinematics revealed by radio images using the VLBI technique. Robust measurements of longitudinal and transverse velocity field in the jets would provide crucial information for these models. This is a difficult task, particularly for transversely resolved jets in objects like 3C273 and M87. To address this task, we have developed a new technique for identifying significant structural details (SSD) of smooth, transversely resolved flows and obtaining a velocity field from cross-correlation of these regions in multi-epoch observations. Detection of individual SSD is performed using the wavelet decomposition and multiscale segmentation of the observed structure. The cross-correlation algorithm combines structural information on different scales of the wavelet decomposition, providing a robust and reliable identification of related SSD in multi-epoch images. The algorithm enables recovering structural evolution on scales down to ~0.25 FWHM of the image PSF. We present here the results from application of this algorithm to obtaining the first detailed transverse velocity fields and studying the kinematic evolution in the parsec-scale jets in 3C273 and M87.

Migliari, Simone

Doppler-shifted lines revealing baryons in the jets of the X-ray binary 4U 1630-47.

Author list: S. Migliari, M. Diaz, J. Miller-Jones, W. Broderic, T. Tzioumis

Accreting black holes are known to power relativistic jets, both in stellar-mass binary systems and at the centres of galaxies. The power carried away by the jets, and hence the feedback they provide to their surroundings, depends strongly on their composition. Jets containing a baryonic component should carry significantly more energy than electron-positron jets. While energetic considerations and circular polarisation measurements have provided conflicting circumstantial evidence for the presence or absence of baryons, the only system in which baryons have been directly detected in the jets is the X-ray binary SS 433. We report the detection of Doppler-shifted X-ray emission lines from the black hole X-ray binary 4U1630-47, coincident with the reappearance of radio emission from the jets of the source. We argue that these lines arise in a jet with velocity 0.66c, thereby establishing the presence of baryons in the jet.

Mizuno, Yosuke

Current-Driven Kink Instability in Magnetically Dominated Rotating Relativistic Jet.

Author list: Yosuke Mizuno, Yuri Lyubarsky, Ken-Ichi Nishikawa, & Philip E. Hardee

We have investigated the influence of jet rotation and differential motion on the linear and nonlinear development of the current-driven (CD) kink instability of force-free helical magnetic equilibria via three-dimensional relativistic magnetohydrodynamic simulations. In this study, we follow the temporal development within a periodic computational box. Displacement of the initial helical magnetic field leads to the growth of the CD kink instability. We find that, in accordance with the linear stability theory, the development of the instability depends on the lateral distribution of the poloidal magnetic field. If the poloidal field significantly decreases outward from the axis, then the initial small perturbations grow strongly, and if multiple wavelengths are excited, then nonlinear interaction eventually disrupts the initial cylindrical configuration. When the profile of the poloidal field is shallow, the instability develops slowly and eventually saturates. We briefly discuss implications of our findings for Poynting-dominated jets.

Molina, Sol N.

Evidence for internal rotation in the jet of the quasar NRAO150.

Author list: Sol N. Molina, Iván Agudo, Jose L. Gómez, Thomas Krichbaum

Multi-epoch extremely-high angular resolution VLBI observations allow to study the innermost regions of AGN jets through which obtain a better understanding of the relationship between the supermassive black hole, accretion disk and jet. Several sources have shown a progressive rotation of the structural position angle in the plane of the sky, being the quasar NRAO150 an extreme case, with a projected counter-clock-wise jet swing of 11 degrees per year when referred to a component assumed to remain stationary (the hypothetical core). We present new multi-epoch 8, 15, 22, and 43 GHZ VLBA, as well as 86 GHz GMVA observations of NRAO150 between 2006 and 2010. On the light of the new data we present an alternative model to the jet swing, in which the jet is viewed face-on and all the detected components trace a helical path around an auto-absorbed (non-detected) core coincident with the apex of the jet cone.

Mukherjee, Reshmi

Study of High Energy Emission from Relativistic Jets with VERITAS.

Author list: Reshmi Mukherjee

VERITAS is an imaging atmospheric Cherenkov observatory located in southern Arizona. VERITAS consists of an array of four 12-m telescopes, and carries out a strong observing

program for Galactic and extragalactic high energy sources at energies above 100 GeV. Observations of astrophysical objects in the TeV band are sensitive probes of highly energetic processes occurring in these sources. In this talk I will present recent results from VERITAS on active galaxies and Galactic gamma-ray binaries, and discuss the results in the context of particle acceleration in jets.

Nagai, Hiroshi

Probing the Radio Counterpart of Gamma-ray Flaring Region in 3C 84.

Author list: Hiroshi Nagai, Monica Orienti, Motoki Kino, Kenta, Suzuki, Keiichi Asada, Akihiro Doi, Gabriele Giovannini, Marcello Giroletti, Jun Kataoka, Filippo D'Ammando,

Takafumi Haga, Makoto Inoue, Anne Lahteenmaki, Merja Tornikoski, Jonathan, Leon-Tavares, Seiji Kameno, Uwe Bach

3C 84 is the bright radio source associated with the radio/elliptical galaxy NGC 1275 in the Perseus cluster. Its proximity (z=0.0176) makes it a unique laboratory to study the jet physics and circumnuclear environment in close vicinity of the super massive black hole at multiwavelengths. This source is particularly important in the context of gamma-ray production in "misaligned" AGN with a moderate beaming, thereby allowing us to study the similarity and difference with the gamma-ray production in highly beamed blazars. By making use of the data by single dish telescopes (Metsahovi and Effelsberg) and VLBI (VERA and VLBA), we have studied a long-term light curve and structural changes in the central sub-pc region. We detected monotonic increase in radio flux density, which is mostly associated with a prominent component C3 ejected after the increase activity in radio band starting in 2005. Although the gamma-ray flaring activities with the timescale of days to weeks were detected by Fermi/LAT twice during our monitoring period, no clear correlation with the radio light curve on this timescale was found. Neither prominent new components nor changes in morphology associated with the gamma-ray flares were confirmed on the VLBI images, a part from the propagation of C3 along the jet. Its apparent speed ranges between 0.1c to 0.5c, which was relatively slower than the typical jet speed observed in typical gamma-ray bright blazars. We will discuss possible scenarios to reconcile jet properties in the radio band and gamma-ray activity.

Nakamura, Masanori

The M87 Jet.

Author list: Masanori Nakamura

M87, the "Rosetta Stone" of relativistic jets, is extensively examined based on our ground/space VLBI observations and MHD jet theories. We summarize properties of the jet and core emissions on 10 - 10^5 r_s scales; observed parabolic streamlines may be as a

consequence of the magnetically driven jet, that is thermally confined by the stratified ISM in the SMBH gravitational potential. We also suggest a frequency depending VLBI core shift in M87 can be explained in the framework of an MHD parabolic jet. ASIAA and SAO are leading the Greenland Telescope (GLT) project to conduct sub-mm VLBI observations towards M87. We briefly introduce the GLT science cases for M87, that include not only imaging the BH shadow, but exploring the origin of the jet and nature of inner accretion flows onto the SMBH inside 10 r_s; our science goals shall play a fundamental role in understanding of the AGN central engine.

Niinuma, Kotaro

Astrometric observations of the core position changes in Mrk 421 after the large X-ray flare in 2011.

Author list: K. Niinuma, M. Kino, A. Doi, S. Koyama, K. Hada, H. Nagai

Mrk 421 is one of the best sources for studying the most compact regions in blazars because of its proximity. Many observations for this source were performed at multi-wavelength. Even though the large Doppler factor of this source has been shown by the high-energy observations as well as other blazars, superluminal knot have not been detected directly by most of previous VLBI observations. However, Niinuma et al. (2012) recently reported the detection of a superluminal inward motion of the jet component in Mrk 421 located at 1.2 milli-arcsec north-west from the core after the largest X-ray flare occurred in 2010 February (Isobe et al. 2010), by conducting quick and dense follow-up observation immediately after the X-ray flare using JVN (Japanese VLBI Network) at 22 GHz. We concluded that one of the plausible explanations for such inward motion is an apparent motion, which was caused by the variation of the centroid of the radio core by the emergence of newly born with a superluminal speed. In order to obtain additional validation that the large flare actually caused the core position changes within a short term, we carried out phase-referencing observations for the large X-ray flare of Mrk 421 occurred in 2011 September 7th (ATel #3637) using VERA (VLBI Exploration of Radio Astrometry; baseline ranging over 1000-2300 km) operated by National Astronomical Observatory of Japan, which is designed to dedicate for the astrometric observation. The total of 13 epochs of VERA observations for the flare were performed between 2011 September 16th and 2012 April 28th (typical interval is bi-week) at 22 GHz. As the result of our dense monitor with VERA, the core position of Mrk 421 showed the continuous variation of ~0.5 milli-arcsec within about 40 days along the jet direction. Although, now we have discussed what caused such large variation of the core at 22 GHz, one of the possible origins is the ejection of bright and short-lived components associated with the flare.

Nishikawa, Ken-Ichi

Radiation from relativistic jets from particle accelerated by shocks, shear-flows, and reconnection.

Author list: K. I. Nishikawa, P. Hardee, Y. Mizuno, I. Dutan, B. Zhang, M. Medvedev, E. J. Choi, K. W. Min, J. Niemiec, A. Nordlund, J. T. Frederiksen, H. Sol, M. Pohl, & D.H. Hartmann

We have investigated shock structure associated with an unmagnetized relativistic jet propagating into an unmagnetized plasma at the microscopic level. Strong magnetic fields are generated in the trailing (jet) shock along with electron acceleration. On small scales relativistic velocity shears between faster and slower moving material can also create strong DC magnetic fields via the kinetic Kelvin-Helmholtz instability (KKHI) and we have studied how the Lorentz factor affects the growth rate of KKHI. We have calculated, self-consistently, the radiation from electrons accelerated in turbulent shock magnetic fields and in the strong magnetic fields generated by KKHI. We find that synthetic spectra depend on the bulk Lorentz factor, the initial electron temperature, and the strength of the generated magnetic fields. The calculated radiation properties begin to provide an understanding of the complex time evolution and/or spectral structure from gamma-ray bursts, relativistic jets, and supernova remnants.

O'Sullivan, Shane

Broadband radio circular polarization observations of the quasar PKS B2126-158.

Author list: Shane O'Sullivan

I will present full-polarization observations of the quasar PKS B2126-158 from 1 to 10 GHz using the Australia Telescope Compact Array. Large fractional circular polarization (m_c) is detected at high significance across the entire band at 128 MHz intervals; which allows us to construct a very robust circular polarization (CP) spectrum. We find m_c is proportional to frequency to the power of +0.6 +/- 0.1 from 1.5 to 6.5 GHz, with a peak of m_c ~ 1% before the spectrum turns over somewhere between 6.5 and 8 GHz, above which m_c goes as frequency to the power of -3.2 +/- 0.3. The frequency dependence of the linear polarization (LP) is well modelled by external Faraday rotation in which large gradients in RM exist on scales much smaller than our resolution. Overall, our results are consistent with the hypothesis of little or no thermal plasma within the jet, with conversion of LP to CP caused by a small amount of Faraday rotation from the low-energy end of the relativistic electron energy spectrum in an electron-proton dominated jet.

Orienti, Monica

On the connection between radio and gamma rays. Variability and polarization properties in relativistic jets.

Author list: Orienti M., D'Ammando F., Giroletti M., on behalf of the Fermi-LAT collaboration, and Dallacasa D., Giovannini G., Venturi T.

Relativistic jets are one of the most powerful manifestations of the release of energy produced around supermassive black holes at the centre of active galactic nuclei (AGN). Their emission is observed across the entire electromagnetic spectrum, from the radio band to gamma rays. Despite decades of efforts, many aspects of the physics of relativistic jets remain elusive. In particular, the location and the mechanisms responsible for the high-energy emission and the connection of the variability at different wavelengths are among the greatest challenges in the study of AGN.
In this presentation I will discuss results on radio sources which underwent strong gamma-ray flaring activities detected by Fermi-LAT. From the comparison of the radio and gamma ray light curves there is evidence that some flares, either in radio or in gamma rays, have not an obvious connection at the other extreme of the electromagnetic spectrum, like in the case of the Narrow Line Seyfert 1 SBS 0846+513. An intriguing aspect pointed out by high resolution radio observations is the change of the polarization properties close in time with some high energy flares. In particular, in PKS 1510-089 and 3C 454.3 a rotation of almost 90 degrees have been observed after strong gamma-ray flares. The swing of the polarization angle may be related either to the propagation of a shock along the jet that order the magnetic field, or a change of the opacity regime.

Pacciani, Luigi

What can we learn from high energy flares in the Fermi sample of FSRQ: from a case study to dozens of objects.

Author list: L. Pacciani, et al.

In 2008 the flat spectrum radio quasar GB6 J1239+0443 (z=1.762), underwent an high activity period at all wavelengths. In particular, at optical-uv wavelengths, the source underwent a flux enhancement of a factor 15-30 in 6 years, and >10 in half a year, showing a transition from accretion disk to synchrotron jet dominated emission. During the flare, Fermi observed a flat gamma-ray spectrum, extended up to 15 GeV, with no statistically-significant absorption from the broad line region (BLR), suggesting that the blazar-zone is located beyond it. We obtained the same findings from the modeling of the broad-band spectral energy distribution for the flaring activity periods, which is well constrained by the multiwavelength data collected, and from the accretion disk luminosity and black hole mass that we estimated from the archival data. Other authors suggested that 4C +21.35, PMN J2345-1555, and 3C 279 underwent high energy flares originating from outside or just bejond the BLR. Here we report the MWL studies on a dozen of FSRQ which we propose radiate gamma-rays far from the central SMBH, and

we will discuss the scenarios originating from this result.

Potter, William

Uncovering the physics behind the blazar sequence using a realistic model for jet emission.

Author list: William J. Potter and Garret Cotter

Blazar spectra are one of the most important windows into the physical processes occurring along jets. The spectrum, composed from the different emitting regions along the jet, allows us to constrain the physical conditions in the jet. I will present my work modelling blazar spectra using an extended inhomogeneous jet model with an accelerating, magnetically dominated parabolic base transitioning to a slowly decelerating conical section motivated by observations, simulations and theory. We set the inner geometry of our multi-zone jet using observations of the jet in M87 which transitions from parabolic to conical at 10^5 Schwarzschild radii. This model is able to reproduce quiescent blazar spectra very well across all wavelengths (including radio observations) for a sample of both BL Lacs and FSRQs. Using this inhomogeneous model we are able to constrain the location at which the synchrotron emission is brightest in these jets from fitting to the optically thick to thin synchrotron break. We find that the radius of the jet at which the synchrotron emission is brightest (where the jet first approaches equipartition) scales approximately linearly with the jet power. In agreement with previous work we find that BL Lacs are low power blazars whereas FSRQs are high power blazars. Together with our simple jet power-radius relation this leads us to a deeper understanding of the physics underlying the blazar sequence.

Richards, Joseph

An Exceptional Radio Flare in Markarian 421.

Author list: Joseph L. Richards, Talvikki Hovatta, Matthew L. Lister, Anthony C. S. Readhead, Walter Max-Moerbeck, Tuomas Savolainen, Marcello Giroletti, Emmanouil Angelakis, Lars Fuhrmann, Hugh D. Aller, Margo Aller

In September 2012, the high-synchrotron-peaked (HSP) blazar Mkn 421 underwent a rapid wideband radio flare, reaching nearly twice the brightest level observed in the cm band in over three decades of monitoring. In response to this event we carried out a five epoch cm- to mm-band multifrequency Very Long Baseline Array (VLBA) campaign to investigate the aftermath of this emission event. Rapid radio variations are unprecedented in this object and are surprising in an HSP BL Lac object. In this flare, the 15 GHz flux density increased with an exponential doubling time of about 9 days, then faded to its prior level at a similar rate. This is comparable with the fastest large-amplitude cm-band radio variability observed in any blazar. Similar flux density increases were detected up to mm bands. This radio flare followed about two months

after a similarly unprecedented GeV gamma-ray flare (reaching a daily E>100 MeV flux of (1.2+/-0.7)x10^{-6} ph cm^{-2} s^{-1}) reported by the Fermi Large Area Telescope (LAT) collaboration, with a simultaneous tentative TeV detection by ARGO-YBJ. A cross-correlation analysis of long-term 15 GHz and LAT gamma-ray light curves finds a statistically significant correlation, suggesting that the gamma-ray emission originates upstream of the radio emission. Preliminary results from our VLBA observations show brightening in the unresolved core region and no evidence for apparent superluminal motions or substantial flux variations downstream.

Richter, Stephan

Studies of Blazar emission using a spatially resolved SSC model.

Author list: Stephan Richter, Felix Spanier

In this talk we will present results obtained with a time dependent, spatially resolved SSC model. In our model, particle acceleration is included via the shock-in-jet approach, where the shock is represented as an inhomogeneity within the emission region. In this way the natural connection to the underlying microphysics is possible. The spectral energy densities (SEDs) are then computed using the full Klein-Nishina inverse Compton cross section. Although steady state SEDs of blazars are well described by this model (as it is usually the case for SSC models), the time variability, e.g. the flare of Markarian 501 on MJD 54952, often can't be explained. This holds, although the light crossing time limit no longer applies, due to the spatial resolution. In fact, the variability timescale usually is determined by the acceleration or cooling mechanism. Furthermore a self consistent connection of various spatial scales is implemented. Hence it is possible to constrain the morphology of the emission region to obtain a consistent picture of high energy emission, radio emission and VLBI radio morphology.

Russell, David

Polarimetric Observations of the Innermost Regions of Relativistic Jets in X-ray Binaries.

Author list: D. M. Russell

Synchrotron emission from the relativistic jets launched close to black holes and neutron stars can be highly linearly polarized, depending on the configuration of the magnetic field. In X-ray binaries, optically thin synchrotron emission from the compact jets resides at infrared--optical wavelengths. We show that the polarimetric signature of their jets is detected in the infrared and is highly variable in some X-ray binaries. This reveals the magnetic geometry in the compact jet, in a region close enough to the black hole that it is influenced by its strong gravity. We conclude that the magnetic field is turbulent and variable near the jet base. We also predict that in some cases, variable

levels of X-ray polarization from synchrotron emission from the jets will be detected from accreting black holes by future spaceborne X-ray polarimeters.

Staff, Jan

3 dimensional magneto hydrodynamic jet simulations.

Author list: Jan Staff

We present the results of four 3 dimensional magneto hydrodynamic jet simulations, with different initial magnetic field configurations. The simulations focus on the innermost regions of the jet. While a Keplerian disk is put on the boundary, we resolve the inner edge of the disk in the simulations, and follow the jet out to 3000 times the inner edge of the disk. We show that depending on the initial magnetic field configuration, a two component jet structure consisting of a thin axial jet surrounded by a cylindrical shaped outer jet may form. In other cases, only the thin axial jet forms.

Torresi, Eleonora

Jet evolution in Steep Spectrum Radio Quasars. A multiwavelength study.

Author list: E. Torresi, P. Grandi, the TANGO team on behalf of the Fermi-LAT collaboration and A. De Rosa

Thanks to the Fermi gamma-ray satellite, it is now confirmed that Misaligned Active Galactic Nuclei (MAGN), i.e. radio galaxies and steep spectrum radio quasars, are a new class of GeV emitters. Similarly to blazars, one of the most intriguing aspects of MAGN is the localization of the high-energy dissipation region (at sub-pc or pc-scale), that turns out to be an important ingredient for theoretical models. In this context, we will discuss the results obtained from a radio to gamma-ray study of the two steep spectrum radio quasars belonging to the MAGN sample, i.e. 3C 207 and 3C 380. Part of these data have been collected within the TANGO (Timing Analysis of Non blazar Gamma-ray Objects) multi frequency project that aims at studying the temporal evolution of MAGN jets. From the gamma-ray variability and the comparison of flaring periods at different wavelengths, the physical size of the high-energy emitting zone and its energetics can be estimated. Possible locations of such region are also discussed.

Vila, Gabriela

High-energy signatures of binary supermassive black holes.

Author list: Gabriela Vila, Daniela Pérez & Gustavo E. Romero

The accretion disk around a supermassive black hole may be strongly perturbed by the presence of a supermassive secondary. Recent studies by Kocsis et al. (2012) have shown that, under certain conditions, the system relaxes to a quasi steady state in which the tidal torque of the secondary black hole fails to open a central gap in the disk, and matter "overflows" across the orbit to accrete onto the primary. The structure of such an accretion disk, however, considerably differs from that predicted by the standard model. In this work we study the radiative properties of a binary system of supermassive black holes, assuming that a relativistic jet is being launched from the primary and that the migration of the secondary across the disk proceeds in the "overflowing" regime. We consider different orientations of the jet with respect to the accretion disk and the line of sight. The modified two-bump radiative spectrum of the disk is calculated accounting for strong gravitational effects in the innermost region. The jet emits non-thermal radiation all along the electromagnetic spectrum by interaction of locally accelerated particles (electrons and protons) with matter, magnetic field, and internal and external radiation fields. In particular, we investigate whether the inverse Compton spectrum of scattered disk photons presents any signature that may disclose the presence of the secondary black hole.

Vlahakis, Nektarios

Kink instability in relativistic magnetized jets.

Author list: N. Vlahakis

Nonaxisymmetric perturbations are potentially very important in magnetized jets and may significantly change their structure. Results of a linear stability analysis will be presented, and the dependence of the growth rate on the jet characteristics, such as its magnetization and magnetic pitch, will be discussed.

Weidinger, Matthias

Hadronic Modeling of AGN Variability.

Author list: Matthias Weidinger, Felix Spanier

The first peak in the typical blazar spectrum, with its two distinct humps, is well explained by doppler-enhanced synchrotron radiation of electrons within the relativistic jet. However, the mechanism responsible for the gamma-ray emission is still under debate. Compton up-scattering of internal (jet) photons works well for many, but - by far

- not for all blazars. Either external radiation fields or non-thermal protons within the jet need to be present to explain the broadband emission of e.g. flat spectrum radio quasars. A self-consistent and time-dependent hybrid emission model is introduced. Depending on the physical parameters within the jet, especially its magnetic field, protons can also be accelerated up to very high energies, making them relevant emitters in the gamma-rays. The full time-dependency of the underlying non-linear kinetic equations, including acceleration and all relevant radiation mechanisms, is solved numerically. Short term variability of blazars can hence be exploited to reveal the relevant emitting processes by identifying typical patterns in the interband light curves. We suggest flaring scenarios for the blazar 1 ES 1011+496, which may be discovered combining observations of Swift, Fermi and Air-Cherenkov telescopes.

Zamaninasab, Mohammad

Magnetic field in the jet of 3C 454.3.

Author list: M. Zamaninasab, T. Savolainen, E. Clausen-Brown, T. Hovatta, M.L. Lister, T. P. Krichbaum, Y. Y. Kovalev, A. B. Pushkarev

I will present compelling evidence that suggest the radio emission from the jet of the quasar 3C 454.3 exhibits multiple signatures of a large-scale, ordered helical magnetic field component at a distance of hundreds of parsecs from the launching point. Our results provide observational support for magnetic jet launching models and indicate the ordered helical field component may remain stable over a large distance down the jet.

Posters

Acosta Pulido, Jose A.

Near infra-red polarimetry of a sample of Blazars. #23

Author list: Jose A. Acosta Pulido, Antonio Preyra, Irene Agulli, Iván Agudo, Jose L. Gómez, Alan P. Marscher, Svetlana G. Jorstad

The polarization variability is one of the most ubiquitous characteristic of the blazars. In order to select the most successful models for jet acceleration and collimation, the analysis of multi wavelengths is necessary (Agudo et al, 2010, Marscher et al, 2008). The commonly observed gamma-ray flares sometimes is associated with optical polarization rotations and other not, which indicates that the paradigm of the innermost regions of the blazar jets should be based on multiple scenarios.
Contrary to the optical measurements, the near infra-red (NIR) polarizations measurements of blazars are less frequent. In this sense, the NIR regime can be essential to understand non correlated behaviour between the optical and radio regimes. In this work, we report NIR polarimetry measurements of a sample of 28 blazars gathered with LIRIS at WHT/La Palma in several runs in 2011. The sample was selected to contain the brightest mm and gamma-ray blazars with typical optical mag. < 18. The majority of the blazars were observed more than one epoch using two filters (J and Ks). We will present preliminary results for the whole sample, including correlations between polarization and photometric measurements.
In addition, we will shortly describe the new capabilities of the camera/spectrograph LIRIS at the WHT, regarding near-IR polarization measurements, as a promising instrument for AGN studies.

Aller, Hugh

Circular Polarization Measurements at Centimeter Wavelengths. #24

Authors list: Hugh D. Aller & Margo F. Aller

The University of Michigan 26-Meter paraboloid was used to monitor the integrated emissions of over a dozen active extragalactic objects at 4.8, 8.0, and 14.5 GHz in all four Stokes parameters for more than a decade. The low level of instrumental polarization in Stokes V (less than 0.1 percent) is verified by repeated observations of galactic HII regions such as M17 and M42. We present light curves and spectra in all 4 Stokes

parameters for the bright QSOs 3C 279, 3C 345, and OV-236, and for the radio galaxy 3C 84. 3C 279 and OV-236 have exhibited V as high as 1% with variability time scales of months to years. The polarity of V has been observed in our source sample to reverse with time, and we have observed simultaneous opposite polarities of V within our frequency range of 5 to 15 GHz. The variability observed includes temporal changes in polarity at a single frequency, frequency-dependent differences in polarity at a single epoch, and long-term ordered changes in amplitude. This research was supported in part by funds from NSF grant AST-0607523.

Araudo, Anabella Teresa

Gamma-ray emission from massive stars interacting with AGN jets. #9

Author list: A. T. Araudo, V. Bosch-Ramon, G. E. Romero.

In the nuclear region of AGNs there is matter in the form of diffuse gas, (BLR) clouds, and stars, making jet medium interactions likely. We study the interaction of massive stars with the AGN jets. We analyze the dependence with the interaction height z of the double bow shock formed around each star interacting with the jets, and also the subsequent non-thermal processes generated at these shocks.

Balokovic, Ivan Mislav

NuSTAR Observations of Blazar Mkn 421 in the 2013 Multi-wavelength Campaign. #28

Author list: Mislav Balokovic, Marco Ajello, Roger Blandford, Steven Boggs, Kristen Boydstun, Finn Christensen, William Craig, Amy Furniss, Paolo Giommi, Charles Hailey, Fiona Harrison, Masaaki Hayashida, Brian Humensky, Yoshiyuki Inoue, Jason Koglin, Gregorz Madejski, David Meier, Thomas Nelson, Patrick Ogle, David Paneque, Matteo Perri, Simonetta Puccetti, Anthony Readhead, Daniel Stern, Gianpiero Tagliaferri, Megan Urry, Ann Wehrle, William Zhang

NuSTAR is the first X-ray telescope in orbit capable of focusing in the hard X-ray band up to 79 keV, enabling it to reach a factor of 100 better sensitivity above 10 keV in comparison to previous missions. We present NuSTAR observations of the famous blazar Mkn 421. Since January 2013, it has been a subject of a 5-month multi-wavelength campaign consisting of 2 to 4 pointings per month, strictly simultaneous with observations with the Veritas and MAGIC TeV telescopes. The aim of the campaign is unprecedented multi-wavelength coverage of the spectral energy distribution (SED) in different states and the characterization of any correlated variability. Mkn 421 was clearly detected up to highest NuSTAR energies with a spectrum that is a gradually steepening power law, with no evidence for the onset of a Compton SED component in the NuSTAR band. Significant variability spanning more than an order of magnitude in

flux was seen during the campaign, and flux changes by a factor of 3 have been observed within a single 12-hour observation. The flux variability was correlated with spectral variations around the synchrotron peak of the SED, which are very well sampled by combining simultaneous NuSTAR and Swift data. The observed softer-when-fainter behavior is consistent with previous soft X-ray observations in same flux range. The unprecedented data quality and the extension of high sensitivity above 10 keV allow for a detailed study of the distribution of radiating particles in the relativistic jet in the context of standard leptonic models.

Beaklini , Pedro Paulo B.

Radio and polarimetric R band observations of 3C279 and PKS 1510-089. #29

Author list: Beaklini P. B. B., Dominici T., Abraham Z.

We present the results of 3 years monitoring (2009-2012) of the quasars 3C279 and 1510-089. The radio observations were made with the Itapetinga Radiotelescope at 7 mm, while the polarimetric R band observations were performed in the Observatório Pico dos Dias, both in Brazil. In 3C279 we detected an increase in the flux density at 7 mm through the years, while the variability of the polarization degree at R band shows the existence of flares in 2009, 2010 and 2011, but only the 2011 flare was simultaneously with a gamma-ray flare detected by Fermi. In 1510-089, we observed an increase in the flux density at 7 mm starting in the second semester of 2011, at the same epoch at which several flares were detected at gamma-rays by Fermi. We interpreted this increase in the radio flux as a superposition of flares, consequence of the ejection of various components in the jet, evidenced by the flares at high energy. At polarimetric R band observations, we detected variability of the rotation angle in 2009, at the same time that the source become brighter at gamma-ray. This behavior can be explained by the formation of a new region of polarized emission. In both sources we detected a correlation between the magnitude in the R band and the polarization degree, however, this correlation is more evident in 1510-089.

Benítez, Erika

Optical Photopolarimetric Monitoring of WComae. #44

Author list: E. Benítez, M. Sorcia, D. Hiriart

In this poster we present our main results of the analysis done to our optical polarization monitoring of W Comae from 2008-2012. Data were obtained with POLIMA, a single-beamed polarizer using the R-band filter, attached to the 84cm telescope at San Pedro Martir Observatory (Mexico). In particular, we found that the IBL WComae shows the presence of two polarized components. One stable and the other variable. The stable component shows a linear polarization degree of ~10%. We observed a rotation of the

position angle larger than 180 degrees during the outburst of 2008. The maximum observed linear polarization for this source is ~21%. A general trend of decreasing brightness during the monitored period was observed. The maximum R-band mag is ~14.25 and the minimum is ~15.68. We will also present estimations of some parameters associated with the relativistic jet of this source, that were derived from our observational data.

Beuchert, Tobias

Polarimetric study of 3C111 with the 100-m Effelsberg Radio Telescope. #51

Author list: Tobias Beuchert, Matthias Kadler, Jörn Wilms, Emmanouil Angelakis, Lars Fuhrmann, Ioannis Myserlis, Ioannis Nestoras, Alex Kraus, Uwe Bach, Eduardo Ros, Christoph Grossberger, Robert Schulz

Studying the variability of polarized AGN jet emission in the radio band is crucial in order to understand the dynamics of moving shocks as well as the structure of the underlying magnetic field. The 100-m Effelsberg telescope is a high quality instrument to study the long-term variability of both total and polarized intensity as well as the electric-vector position angle. Since 2007, the F-GAMMA program has been monitoring the linear polarized emission of 60 blazars at 5 and 10 GHz. Here, we present a method of calibrating polarimetric data as well as F-GAMMA results from the full-Stokes long-term evolution of the radio galaxy 3C111 along with VLBI-polarimetric images from the MOJAVE program.

Capitanio, Fiamma

The behavior of the BHC 4U1630-472 during the 2006-2010 outbursts. #45

Author list: Capitanio F., Campana R., De Cesare G. et al.

4U1630-472 is a recurrent X-ray transient classified as a BHC from its spectral and timing properties. One of the peculiarity of this source is the presence of regular outbursts with a period that spans from 600 until about 700 days. We present here the analysis of the data collected by INTEGRAL and RXTE during three consecutive outbursts. In particular we focus on the differences and similarities of their spectral and timing properties. Moreover we speculate on the nature of the regular outbursts that the source have shown since its discovery in 1969.

Carnerero Martin, Maria Isabel

Optical-gamma correlation in BL Lacertae. #30

Author list: C. M. Raiteri, M. Villata and M. I. Carnerero for the GASP-WEBT collaboration

The GLAST-AGILE Support Program (GASP) of the Whole Earth Blazar Telescope (WEBT; http://www.oato.inaf.it/blazars/webt/) collaboration was started in 2007. The aim was to perform continuous monitoring of selected blazars at low frequencies to compare with the high-energy observations of the gamma-ray satellites. BL Lacertae is one of the sources followed by the GASP and Fermi has provided a continuous gamma-ray light curve since 2008. Here we present an analysis of the optical and gamma-ray flux behaviour of BL Lacertae from 2008 to 2012, including the 2011-2012 outburst. A general correlation is found between the fluxes at the two frequencies. However, the details of the emission behaviour require a more complex explanation than simple co-spatiality of the production sites.

Coronado, Yaxk'in U Kan

A hydrodynamical model for the FERMI-LAT gamma-ray light curve of Blazar PKS 1510-089. #8

Author list: J. I. Cabrera, Y. Coronado, E. Benítez, S. Mendoza, D. Hiriart and M. Sorcia

We present a physical description of the formation and propagation of the working surface inside the relativistic jet of the Blazar PKS 1510-089 is used to model its gamma-ray variability light curve using FERMI-LAT data from 2008 to 2012. The physical model is based on conservation laws of mass and momentum at the working surface as explained by (Mendoza, 2009) . The hydrodynamical description of the working surface is parametrised by the initial velocity and mass injection rate at the base of the jet. We show that periodic variations on the injected velocity profiles are able to account for the observed luminosity. With this, we are able to obtain mass ejection rates of the central engine which are injected at the base of the jet, and oscillation frequencies of the flow, amongst other physical parameters.

Coughlan, Colm

Imaging VLBI polarimetry data from Active Galactic Nuclei using the Maximum Entropy Method. #21

Author list: Colm Coughlan, Denise Gabuzda

Mapping the relativistic jets emanating from AGN requires the use of a deconvolution algorithm to account for the effects of missing visibilities and thermal noise. The CLEAN algorithm is the most commonly used algorithm in VLBI imaging today and is suitable

for imaging polarised data. The Maximum Entropy Method (MEM) is presented as an alternative with some advantages over the CLEAN algorithm, including better spatial resolution and a more rigorous and unbiased approach to deconvolution. We have developed a MEM code suitable for deconvolving VLBI polarimetry data. Monte Carlo results demonstrating the performance of CLEAN and the MEM code on a variety of source types are presented. Real polarimetry (VLBA) data taken at multiple wavelengths are also deconvolved using MEM and the resulting polarisation and Faraday rotation maps presented and discussed.

Cúneo, Virginia

Stellar Mass Black Holes in the Galaxy. #46

Author list: V. A. Cúneo, M. N. Gómez

This contribution presents a stellar mass black holes candidates' catalogue, mainly in our Galaxy, that represents the largest database available in the literature nowadays. We developed a global study of the properties of these objects, in comparison with different types of evolved massive stars, and expose the main results we found. The confirmed candidates, all of them belonging to binary systems, are discussed in a separated and detailed manner. Through the analysis of these results we look for a better understand of final stages in the live of massive stars and their relation to black holes.

Del Santo, Melania

The high-energy spectrum of Cygnus X-1: corona and jet contributions. #47

Author list: Del Santo M., Malzac J., Belmont R., Bouchet L., De Cesare G.

We have analyzed six years of INTEGRAL observations of the BH binary Cygnus X-1. We report on the evolution of the physical parameters of the accretion flow across spectral transitions. In particular, we have used for the first time the new model BELM which gives constraints on the intensity of the magnetic field in the X-ray corona of BH binaries. We have found that in the softer states, the magnetic field is at most of the order of 1E+06 G. In the harder states, if the non-thermal excess observed above a few hundred keV is produced in the same region as the bulk of the thermal Comptonization, the upper limit on the magnetic field is about 1E+05 G. On the other hand, as suggested by the recent polarization measurements, this high-energy excess may be produced in the jet: in this case the constraints on the magnetic field in the hard state are somewhat relaxed and the upper limit rises to 1E+07 G.

Doi, Akihiro

ALMA continuum spectrum of the M87 nucleus. #1

Author list: Akihiro Doi, Kazuhiro Hada, Hiroshi Nagai, Motoki Kino, Mareki Honma, Kazunori Akiyama, Tomoaki Oyama, Yusuke Kono

We report the result of ALMA continuum observations toward the M87 nucleus at thirty-six frequencies (quasi-simultaneously) ranging from 90 GHz to 700 GHz. We found a spectral break at the millimeter regime: a nearly flat spectrum at lower frequencies and a steep spectrum at higher frequencies. The spectral profile may suggest (1) a possible high-frequency end of previously observed core shift of jets and (2) an optically thin line-of-sight to the expected radius of a black hole shadow for a future submm VLBI imaging.

Donnarumma, Immacolata

A new insight into the innermost jet regions: probing extreme jet variability with LOFT. #36

Author list: I. Donnarumma on behalf of the LOFT Consortium

Blazars are highly variable sources over timescales that can be as low as minutes. This is the case of the High Energy Peaked BL Lac objects which show strong variability in X-rays, which highly correlate with that of the TeV emission. The degree of this correlation is still debated, particularly when the flaring activity is followed down to very short time scales. This correlation could challenge the synchrotron-self-Compton scenario in which one relativistic electron population dominates the entire radiative output. We argue that the LOFT Large Area Detector (10 m^2, LAD), thanks to its unprecedented timing capability, should allow to detect the X-ray counterpart (2-50 keV) of the the very fast variability observed at TeV energies, sheding light on the nature of X-TeV connection. We will discuss some test cases (e.g. PKS 2155-304), showing as it would be possible to look for any X-ray variability occurring at very short timescales, ever explored so far. This will put strong constraints on the size and the location of any additional electron population in the multi-zone scenario. Under this perspective, we will analyze the synergies between LOFT and the CTA observatories, planned to operate in the same time frame. Finally, perspectives on the study of FSRQs will be also discussed.

Errando, Manel

Observations of low- and intermediate-frequency-peaked BL Lacs above 100 GeV with VERITAS. #37

Author list: M. Errando, for the VERITAS Collaboration

Most of the ~50 blazars detected to date at very high energies (VHE, E>100 GeV) are high-frequency-peaked BL Lacs (HBLs). Low- and intermediate-frequency-peaked BL Lacs (LBL/IBLs, with synchrotron peak frequencies in the infrared and optical regime) have only been detected by ground-based gamma-ray telescopes on a handful of occasions, typically during flaring states. LBLs and IBLs are generally more powerful, more luminous, and have a richer jet environment compared to HBLs, with the accretion rate being typically proposed as the main driver of these differences. The VERITAS array located in southern Arizona has observed five known VHE LBL/IBLs since 2009: 3C 66A, W Comae, PKS 1424+240, S5 0716+714 and BL Lacertae, with exposures of 5-10 hours/year. The results of four years of observations will be presented, including the first low-state detections of 3C 66A and W Comae; a bright, sub-hour scale VHE flare of BL Lacertae in June 2011, and the detection and characterization of two new IBLs: VER J0521+211 and B2 1215+30. The new observational results will be discussed in the context of characterizing the emission from blazars with powerful jets and the role of photons external to the jet in the production of gamma-ray emission.

Fossati, Giovanni

What is truly the relationship between jet, accretion disk and BLR intensity changes in FSRQs? #39

Author list: G. Fossati

Studies of the relationship between variations in the jet continuum emission and those of broad emission lines (and disk emission) can provide new clues about the structure of the central regions of jetted AGNs and properties of the outflow, such as the location of the active region. Thanks to Fermi and the large multiwavelength coverage that it stimulated (and supported) there are now high quality data for several blazars and this type of investigation is becoming possible and slowly beginning to bear fruit. The interpretation of the correlated (or not) variability requires to look more in depth at the relationship between the various "radiative signals", some of which may be responsible for causing variations in other components, examples being BLR radiation seeding EC in the jet, disk emission increasing BLR power, or jet emission ionizing part of the BLR as recently discussed. Because the jet "blob" moves nearly at the same speed of the "signals", the actual relationships are somewhat at odds with the naive intuition. I will present results of our study of the observational implications/appearance of variations originating in different components and discuss the implications for the interpretation of recent novel observational work.

Giovannini, Gabriele

Exploring the parsec scale properties of BL Lac sources. #10

Author list: G. Giovannini, E. Liuzzo, M. Giroletti, B. Boccardi, S. Tamburri, C. Casadio

BL Lac objects are the most abundant emitters in gamma-ray band. However most of them are relatively low power radio sources even if the presence of relativistic jets is expected from unification models and observed properties. To increase our knowledge on parsec scale properties of BL Lacs we selected a homogeneous sample of BL Lac sources with no constrain on their radio and gamma-ray emission. We present here new VLBA observations at 8 and 22 GHz for this sample and discuss the presence of relativistic jets, in comparison with nuclear properties of radio galaxies. A comparison with gamma-ray properties will be also shortly presented.

Hagen-Thorn, Vladimir

Optical variability of the blazar 3C 454.3 during 2007-2010. #25

Author list: V. A. Hagen-Thorn, V. M. Larionov, A. A. Arkharov, E. I. Hagen-Thorn, D. A. Blinov

The color variability of the blazar 3C 454.3 during 2007-2010 has been studied using the results of multicolor (BVRIJHK) observations carried out in the Astronomical Institute of St.-Petersburg State University and Pulkovo Observatory. The existence of two variable synchrotron sources was found. The first is responsible for the flux variability of small amplitude, the second – for the flares. In each flare the relative SED of variable source was found to be constant but spectral indexes were different in different flares. This fact points to impossibility to explain the global variability only by geometrical reasons.

Hough, David

A Three-decade X-band VLBI Study of 3CR Lobe-dominated Quasar Nuclei. #15

Author list: David Hough

We report X-band VLBI observations of several 3CR lobe-dominated quasar nuclei from 1981 to 2010, mostly obtained with the NRAO VLBA. The goal is to follow flux density outbursts and to fully determine the jet morphology and kinematics on 1-100 pc scales. In 3C207, the core region has flux outbursts at mean intervals of 7 yr; one of these is actually a double outburst from a stationary true core and a "swinging" component 0.5 mas apart. The position angle (PA) of the swinging component varies by 40 degrees, while the PAs of the jet components span 25 degrees. The jet extends to 25 mas. Average

superluminal speeds are about 10c. One component shows apparent acceleration from 7c to 14c at 2-3 mas from the true core, in a jet recollimation zone that redirects the flow toward PA 90 degrees. Individual jet components expand until reaching the recollimation zone. In 3C263 and other objects, some of the same phenomena are seen, including ejection of jet components over a range in PA, superluminal motion, and apparent acceleration, but to a lesser degree. Possible physical interpretations involving beaming, orientation, projection, precession, and magnetic effects will be discussed.

Jermak, Helen

Exploring the magnetic fields of blazar jets using the optical imaging polarimeter RINGO3 on the Liverpool Telescope. #26

Author list: Helen Jermak, Carole Mundell, Kari Nilsson, Elina Lindfors, Ulisses Barres de Almeida, Iain Steele

Blazars are a subclass of active galactic nuclei (AGN) in which the jet is orientated within a small opening angle to the observer's line of sight. To understand the physical processes that underlie the formation, ejection and collimation of these highly relativistic jets, it is important to explore both the energetic periods of the AGN (i.e. flares and outbursts) and also quiescent periods. Magnetic fields are fundamental to the collimation and acceleration of the jet but spatially resolved images of blazar jets cannot be made; measuring the polarisation properties of the emitted radiation therefore provides a powerful source of information about the structured areas of the magnetic field along with the disrupted sections that may give rise to shocks and flares.
I present an ongoing imaging polarisation study with the Liverpool Telescope (LT) of a sample of 16 AGN that have shown high-energy gamma-ray flares, detected with Fermi and MAGIC. The LT is a 2-metre telescope which specialises in rapid-reaction and time variable astronomy and is the world's largest unmanned, fully autonomous optical telescope, robotically observing since 2004. Using the novel RINGO2 polarimeter on the LT, our team's optical imaging polarimetry program monitors blazars both in quiescence and during triggered high-energy flare events. This talk will introduce the sample, the observing techniques, initial results and highlights. I will also describe our next generation, multi-colour rapid response imaging polarimeter - RINGO3 - which provides unique polarisation data in 3 colour bands (covering 400-900 nm) and the contribution of the additional 'skycam' camera that is attached to the Liverpool Telescope and provides independent flux monitoring simultaneous with the RINGO measurements.

Kaufmann, Sarah

Broadband variability of TeV BL Lac objects. #38

Author list: Sarah Kaufmann, Steffan Wagner

BL Lac objects provide a direct view on the high energetic jet and offer the possibility to study the emission processes and the particle acceleration in the jet because of their broad emission range over the whole electromagnetic spectrum up to TeV energies. The variability information gives a direct estimation of the maximum size of the emission region and is hence important for modeling. Under the assumption of the synchrotron Self-Compton model, which is a good description of the spectral energy distribution of BL Lac objects, correlated variability is expected in the different wavebands. We will present the broadband variability of several TeV BL Lac objects and discuss the correlation of the variation in different wavebands (e.g the expected correlation of synchrotron and inverse Compton emission).

Kino, Motoki

Energy densities of magnetic field and relativistic electrons at the innermost region the M87 jet. #2

Author list: M. Kino, F. Takahara, K. Hada, A. Doi

Using the radio flux and angular size of the radio core of the M87 jet measured by VLBA at 43~GHz, we estimate the energy densities of magnetic field and relativistic electrons in the core at 43~GHz by the comparison with one-zone synchrotron self absorption (SSA) model to the observed core. In this talk, we especially discuss (i) angular size dependence of these densities, and (ii) consistencies of derived densities with observed SED.

Kravchenko, Evgeniya

Parsec scale Faraday rotation measures in 20 AGN jets. #13

Author list: Evgeniya Kravchenko, Yuri Y. Kovalev, Kirill Sokolovsky

We present the parsec-scale Faraday rotation measure (RM) properties of 20 active galactic nuclei (AGN), observed with the VLBA simultaneously at nine frequencies from 1.4 to 15.4 GHz in the dual circular polarization mode. This sample represents sources with large apparent frequency-dependent core shifts and bright parsec-scale jets. We produced Faraday RM and Faraday-corrected linear polarization maps.
We discuss the fractional polarization properties and transversal Faraday RM gradients of these AGNs. Combined with the core shift measurements these data allowed us to reconstruct a 3D magnetic field geometry in AGN's radio cores.

Kreikenbohm, Annika

A Multi-Wavelength Study of the RL-NLSy1 Galaxy PKS 2004-447. #31

Author list: A. Kreikenbohm , M. Kadler , J. Wilms , R. Ojha , E. Ros, C. Müller, K. Mannheim, D. Elsässer

The recent detection of variable gamma-ray emission in five radio-loud Narrow Line Seyfert 1 (RL-NLSy1) galaxies demonstrates that these sources carry powerful relativistic jets, similar to blazars and radio galaxies. While radio-quiet NLSy1 sources are known to accrete at a low Eddington rates, RL-NLSy1s show near-Eddington accretion rates along with strong radio- and gamma-ray emission. Since gamma-ray loud RL-NLSy1 show properties of both radio-loud and radio-quiet AGN, they provide excellent laboratories to study the conditions for AGN to ignite powerful relativistic jets. Among the five known sources, PKS 2004-447 (z=0.240) plays a key role, because it shows intriguing optical, X-ray, and radio properties. We conducted a five months multi-wavelength monitoring campaign of PKS 2004-447 in 2012 including two deep XMM-Newton X-ray observations in May and October 2012, connected by monthly Swift observations and TANAMI VLBI observations. Here, we present first results from X-ray spectroscopy and VLBI imaging of the parsec-scale structure.

Kutkin, Alexander

A detailed study of the coreshift effect in the blazar 3C454.3. #3

Author list: A. M. Kutkin, K. V. Sokolovsky, M. M. Lisakov, P. A. Voytsik

We present a detailed study of the opacity-driven shift in the apparent parsec-scale radio core position (the ``coreshift effect``) in the blazar 3C454.3 during its 2008 flare. The effect is investigated using two independent techniques: cross-correlation analysis of single-dish 4.8-37 GHz radio light curves and 4.6-43 GHz VLBI data analysis. The VLBI analysis included uv-plane modeling of the source structure and image-plane cross-correlation to determine alignment between images at different frequencies. Both lightcurve and VLBI data analysis techniques provide consistent results. We estimate the magnetic field strength in the 43 GHz core as of B~0.07 G. Our analysis of time lags and core positions provide the jet velocity estimate of 0.7 mas/yr which is 2-8 times faster than previous VLBI kinematic estimates.

Larionov, Valeri

Prominent outburst of the blazar CTA~102 in 2012. #32

Author list: V. Larionov, S. Jorstad, A. Marscher, D. Blinov, M. Villata, C. Raiteri, I. Agudo, P. Smith, D. Morozova, I. Troitsky

After few years of quiescence, the blazar CTA 102 underwent a large outburst in the fall of 2012. The flare has been traced from gamma-rays to near-infrared, including Fermi and Swift data and polarimetric data from several observatories. An intensive GASP-WEBT collaboration campaign in optical and NIR bands, using previously unpublished archival data, allowed to compare this outburst with the previous activity period of this blazar in early 2000th. We found remarkable similarity between optical and gamma-ray behavior of CTA 102 during the outburst, without any time lag between the two light curves, indicating co-spatiality of the optical- and gamma-radiating regions. A strong harder-when-brighter spectral dependence is seen both in gamma and optical. Polarimetric behavior of CTA 102 during the outburst conforms with the shock-in-jet interpretation.

Lee, Sang-Sung

Monitoring of multi-frequency polarization of gamma-ray bright AGNs. #16

Author list: Sang-Sung Lee, Jun-Hyun Baek, Myoung-Hee Han, Do-Young Byun, Jee-Hye Yang, Bong Won Sohn

We introduce an on-going project for monitoring total flux density, linearly polarized flux, and polarization angle at 22, 43 and 86GHz of Gamma-ray bright AGN (Active Galactic Nuclei) with KVN (Korean VLBI Network) 21-m radio telescopes. The project has been conducted since May 2011 with an effective monitoring cycle of one week, observing four main objects (3C 454.3, BL Lac, 3C 273, and 3C 279). More objects were included in the source list when they had flared in gamma-ray. Especially, we included a compact radio source at the Galactic center, SgrA* since Jan. 2012. In this paper, we report the current status of the project and preliminary results for the monitoring observations.

Lisakov, Mikhail

Multifrequency vlbi follow up study of jets in the blazars 3c273 and 3c279 after strong gamma-ray flares. #14

Author list: Mikhail Lisakov, Yuri Kovalev, Evgeniya Kravchenko

We present results of a five month long VLBA campaign to observe 3C273 and 3C279 between 5 and 43 GHz. This campaign was triggered by and started immediately after a

strong gamma-ray flare detected by Fermi LAT from 3C273 in August 2009. In the same time 3C279 was undergoing a period of a high gamma-ray activity. We have detected flares in the parsec-scale radio cores of both 3C273 and 3C279. Flux density of the cores of both AGN at 43 GHz have increased by a factor of 2-3 within several months, while radio spectra became inverted. An ejection of a new born 43 GHz component in 3C273 is measured to happen about 140 days after the strong gamma-ray flare. A close connection between gamma-ray and parsec-scale radio emission in the blazars is supported. Frequency dependent apparent shift of the core position, evolution of linear polarization structure, Faraday RM and its variability as well as spectral properties are also presented and analyzed. Finally we discuss changes in physical properties which occurred in the apparent jet base during the flare.

Liu, Xiang

Formation and Collimation of jets in AGN revisit with toy models. #7

Author list: Xiang Liu

We study the jet formation and collimation in AGN with toy models, for a supermassive black hole as the central engine, with material accreting onto BH, to forming and collimating a large scale jet, there must be either a bi-polar large scale magnetic field (B) or a geometric thicked accretion disk (maybe ADAF/Bondi accretion). Then we could see three kind of initial/inner jets formation and collimation (IJFC): 1) the IJFC is dominated by the collimated B, 2) the IJFC is dominated by bi-polar chunnels from geometric thick disk, or 3) a fair situation between the two. We will try to investigate the inner jets from a sample of AGN, to see whether they are grouped such as with strong B, or with thick disk, or with both.

Martí, Josep

Searching for new gamma-ray binaries and microquasars: the case of VES 737. #48

Author list: Martí J., Sánchez-Ayaso E., Luque-Escamilla P. L., Sánchez-Sutil J. R.

We present the current status of our search for new galactic gamma-ray binaries and microquasar systems based on a cross-identification algorithm using public archives and databases. In particular, we report about the case of the emission-line star VES 737 located nearly two degrees above the galactic equator. This object is a star with a B9V spectral type interestingly consistent with the X-ray source 2E 0216.9+6248, and the gamma-ray sources EGRc J0225+6240 and 2FGL J0221.4+6257c. The possibility of association between the star and the high energy sources is assessed, and observations with the Karl G. Jansky Very Large Array are also presented.

Menzler, Ulf

The influence of plasma effects in pair cascades on lower limits of the IGMF. #40

Author list: U. Menzler, R. Schlickeiser

Very high energy radiation from cosmological distant blazars is attenuated due to photon-photon pair creation with the extra-galactic background light. Inverse-Compton scattering of these secondary particles with the cosmic microwave background results in either isotropic pair halos around the sources or a beam broadening cascade, depending on the strengths of the intergalactic magnetic field (IGMF). We investigate the influence of, by now unregarded, plasma effects in the pair beams on the expected secondary photon fluxes. This leads to modification of currents estimates of the lower limit of the IGMF strengths.

Morozova, Daria

Multiwavelength observations of 6 BLLac objects in 2008-2012. #33

Author list: D. A. Morozova, I. Agudo, D. A. Blinov, S. G. Jorstad, V. M. Larionov, A. P. Marscher, P. Smith, I. S. Troitskiy

We present results of 4 years of multifrequency observations of 6 Bllac objects (3C 66A,S5 0716+71 ,PKS 0735+17,S4 0954+68,W Com and OT 081) carried out with the Fermi Large Area Telescope (LAT) at gamma-rays , with different ground based telescopes in photometric and polarimetric modes at optical wavelengths, and with the Very Long Baseline Array (VLBA) at 43 GHz. We have analyzed total intensity images of the blazars obtained with the VLBA to study the morphological and kinematic evolution of the pc-scale jets of the sources. For all sources we have compared flux variations in the VLBI core and bright superluminal knots with gamma-ray and optical light curves.The majority of gamma-ray flares coincide with the appearance of a new superluminal knot as well as with a flare in the optical band and in the millimeter-wave core.These results support the conclusion that many gamma-ray and optical flares in blazars originate in the vicinity of the millimeter-wave core or even downstream the jet.

Motter, Juliana Cristina

Cross-entropy: a new method to study jet kinematics. #17

Author list: Juliana C. Motter & Zulema Abraham

VLBI images of blazars are characterized by the presence of jets that have enhanced emission regions and seem to recede from the central core with apparently

superluminal velocities. It is still under discussion if the movement of these jet components is ballistic or not, although it is well established that different components of the same jet may have different velocities. The determination of these velocities depends strongly on the identification of the same components (which are frequently superimposed) at different epochs, and also on a reliable model for their positions. There are many procedures to identify these components, which are in general taken as two-dimensional gaussians. Commonly, these procedures are subjective in the sense that they depend on initial conditions. Recently, Caproni, Monteiro & Abraham (2011) adopted the method Cross-entropy (CE) that allows the fitting of an unlimited number of components and determines their parameters without the need of initial conditions. In this work we used this method to analyze the images of the quasar 3C 279 obtained in 15 GHz by the VLBA between 1995 and 1999. In addition to the stationary core we identified six components that move with ballistic motion and velocities between $0.15 < \mu < 0.25$ mas/yr.

Mueller, Cornelia

The unusual jet morphology of the hard gamma-ray source PMN J1603-4904 revealed by TANAMI. #20

Author list: C. Müller, M. Kadler, R. Ojha, G. B. Taylor, F. Krauß, A. Kreikenbohm, E. Ros, J. Wilms & the TANAMI Team

The TANAMI VLBI monitoring program provides regular, dual-frequency (at 8GHz and 22GHz), milliarcsecond (mas) monitoring of extragalactic jets south of -30 degrees declination using the Australian Long Baseline Array (LBA) and associated telescopes in Antarctica, Chile, New Zealand and South Africa. Supporting programs provide simultaneous multi-wavelength coverage of all sources. Besides a brief description of this program and its current status we will present our latest results on the bright, hard spectrum gamma-ray source PMN J1603-4904. Our VLBI observations reveal an unusual jet structure which has an overall flat to steep spectrum (alpha=-0.4) on mas scales. A classification of PMN J1603-4904 is not straightforward due to its low Galactic latitude, the lack of optical identification, and low multiwavelength variability. We discuss different classification scenarios, which suggest that PMN J1603-4904 is either an atypical blazar or a gamma-ray bright young radio galaxy, and the corresponding implications.

Murphy, Eoin

Monte Carlo Studies of Transverse Faraday Rotation Profiles. #12

Author list: Eoin Murphy and Denise C. Gabuzda

Faraday Rotation measurements are a very important tool for investigating the magnetic (B) fields associated with the relativistic jets of Active Galactic Nuclei (AGN); for example, a toroidal or helical B field component should give rise to a systematic gradient in the observed Faraday rotation across the jet. However, real observed radio images have finite resolution, usually expressed via convolution with a Gaussian beam whose size corresponds to the central lobe of the point source response function. Typical beam sizes for cm-wavelength Very Long Baseline Interferometry (VLBI) observations are often comparable to the observed jet widths, implying intrinsic jet widths appreciably smaller than the beam width. This raises questions about how well resolved a jet must be in the transverse direction in order to reliably detect transverse Faraday-rotation structure. The results of new simulations of Faraday rotation maps designed to directly investigate this question are presented. These simulations clearly demonstrate the possibility of detecting transverse Faraday-rotation structures even when the observed intrinsic jet widths are comparable to a beam width. An analysis of probabilities of observing spurious Faraday Rotation gradients as a result of random noise and finite resolution, which supplement the previous analyses of Hovatta et al. (2012) and Algaba (2013).

Nakamura, Masanori

Greenland Telescope (GLT) Project --- A Direct Confirmation of Black Hole with Sub-millimeter VLBI. #11

Author list: J. C. Algaba, K. Asada, B. Chen, M.-T. Chen, J. Han, P. H. P. Ho, S.-N. Hsieh, T. Huang, M. Inoue, P. Koch, C.-Y. Kuo, P. Martin-Cocher, S. Matsushita, Z. Meyer-Zhao, H. Nishioka, G. Nystrom, N. Pradel, P. Raffin, H.-Y. Shen (ASIAA), and the Greenland Telescope Project Team (CfA, MIT Haystack Observatory, and NRAO)

Direct observation of black holes has not yet been achieved. If we are able to do so, we will access for the first time matter and electromagnetic fields under the extremely strong gravity, which could test Einstein's theory of general relativity. The GLT project is deploying a new sub-millimeter (sub-mm) VLBI station in Greenland. Our primary scientific goal is to image a shadow of the supermassive black hole (SMBH) of six billion solar mases in M87 at the center of the Virgo cluster of galaxies. The expected SMBH shadow size of 40-50 μas requires superbly high angular resolution, suggesting that the sub-mm VLBI would be the only way to obtain the shadow image. The Summit station in Greenland enables us to establish baselines longer than 8,000 km with ALMA in Chile and SMA in Hawaii as well as providing a unique u-v coverage for imaging M87. Our VLBI network will achieve a superior angular resolution of about 20 μas at 350 GHz, corresponding to $\sim$ 2.5 R_s of the SMBH in M87. We have been monitoring the atmospheric opacity at 230 GHz since Aug. 2011; we have confirmed the value on site

during the winter season is comparable to the ALMA site thanks to high altitude of 3,200 m and low temperature of -50°. We will report current status and future plan of the GLT project towards our expected first light on 2015 - 2016.

Petropoulou, Maria

Time-dependent modelling of PKS 2155-304 at a low state: One- or two-zone emission modelling ? #41

Author list: M. Petropoulou and A. Mastichiadis

One-zone radiation models have been widely used in modelling the steady-state multiwavelength (MW) spectra of blazars, having as main goal the determination of the physical conditions in the emitting region, such as the magnetic field strength, the species of radiating particles etc. Then, the results from one-zone stationary modeling are often used as a stepping stone for studying flaring events. Here we show that the application of steady-state one-zone models on intrinsic variable sources, even when these are at a low state, can be misleading. In particular, we apply two time-dependent one-zone models, (i) a synchrotron self-compton (SSC) and (ii) a proton synchrotron, to the simultaneous MW observations of PKS 2155-304. We show that both models succeed in fitting the time-averaged MW spectrum, but they cannot easily (or at all) reproduce the optical, X-ray and gamma-ray light curves, although the flux variability is not significant. Finally, we show that a two-component leptonic model addresses both spectral and light curve observations more successfully, albeit at the expense of more free parameters.

Piner, Glenn

The Parsec-Scale Structure of the Fainter TeV Blazars. #22

Author list: B. Glenn Piner and Philip G. Edwards

We expand our VLBA studies of TeV-detected HBLs by presenting first-epoch VLBA images of eight new TeV blazars, making a total of 21 TeV-detected HBLs in our VLBA monitoring program. The jets in these sources are fundamentally different from the more powerful blazar jets, and they are not well-studied by other VLBA programs. The newly detected TeV blazars tend to be faint in the radio, but all eight of these new sources were successfully detected and imaged at 8 GHz, and all eight had at least one measurable jet component. The peak flux densities of these sources range from 5 to 35 mJy. Statistics from the entire sample of TeV HBLs that we have imaged with the VLBA will be presented and discussed, in the context of relativistic jet models. Although the TeV gamma-ray emission is apparently highly beamed, none of these TeV HBLs has yet shown evidence for extremely high Doppler factors or Lorentz factors in their parsec-scale radio jets.

Racero, Elena

Broadband Long-Term Variability of VHE Blazars: the case of Mrk421. #35

Author list: Elena Racero and Ignacio de la Calle

In recent years, more and more focus has been placed in broadband studies of blazars as a way to understand the mechanisms responsible for the acceleration of ultra-relativistic particles in these objects. The proposed work aims at addressing these questions by studying the long-term lightcurve of TeV Blazars by putting together archive multiwavelength data of a small sample of TeV Blazars. The study will focus on variability studies over different timescales and the dependence of this variability with parameters such as flux and energy.
This work is still in progress, and ultimately, the aim is to provide a systematic study of the variability of Blazars by first applying statistical tools to the case of the TeV Blazar Mrk421, and then by further extending this work to other Blazars in order to infer their physical properties from a statistical context.

Rueda Becerril, Jesús

Numerical study of broadband spectra caused by internal shocks in magnetized relativistic jets of blazars. #6

Author list: Jesús M. Rueda-Becerril, P. Mimica, Miguel A. Aloy and Carmen Aloy

Blazars are a type of radio-loud active galactic nuclei (AGN) whose (relativistic) jets are pointing very close to the line of sight of the observer. In previous studies (Mimica & Aloy 2010, 2012) we have performed a limited parameter study in the context of the internal shocks (IS) model in blazar jets. The focus of the previous work was studying the signature of the magnetization of colliding shells on the light curves and spectra. In the present work we focus on a limited number of different shell magnetization levels, but extend our coverage of the parameter space to include varying parameters such as the jet viewing angle, shell bulk Lorentz factor, and their relative Lorentz factor. The data obtained in these simulations was analyzed in order to find and so categorize the specific effects that different values of each parameter induce on the spectra, and these synthetic observations compared with those from the 2LAC catalog of blazars observed by Fermi.

Sasada, Mahito

4-year optical-infrared photometric and polarimetric behaviors of a gamma-ray blazar 3C 454.3. #18

Author list: Makoto Uemura, Yasushi Fukazawa, Ryosuke Itoh, Koji Kawabata, Michitoshi Yoshida

Relativistic jets are often associated with active galactic nuclei (AGNs). Blazar is a subclass of AGNs whose jet axis is directed close to the line of sight. Blazars are well known to show large-amplitude flux and polarization variations with various timescales because of its relativistic effects. Thus a continuous photometric and plarimetric monitoring of blazars is a promising way to understand the activity of AGN jets. We have performed a multi-color photo-polarimetric monitoring of 45 optical-bright blazars since 2007. 3C 454.3, which is one of the brightest blazars in the gamma-ray sky, is a target of our project. We have made photo-polarimetric monitoring of this object since July 2007. The object showed violent variation in its flux and polarization. In particular, four large-amplitude outbursts in 2007, 2008, 2009 and 2010 are remarkable. In each outburst, we observed a significant rise in the polarization degree. We calculated structure functions of the total and polarized fluxes from the 4-year monitoring data. The typical variation timescale of the total flux is longer than that of the polarized flux. From this result, we suggest that there are a number of emitting regions which have different intrinsic fluxes and polarization vectors in this blazar jet. These nearly independent emitting regions would separetely contribute the observed total and polarized fluxes.

Sawada-Satoh, Satoko

VERA Monitoring of blazer OJ 287. #19

Author list: S. Sawada-Satoh and the GENJI team

OJ 287 is known to show a rapid variability across a wide range of wavelength. Recent gamma-ray monitoring by Fermi revealed the high activity of OJ 287 in 2011 and 2012. We present the VLBI monitoring results of blazer OJ 287 at 22 GHz band using the VERA (VLBI Exploration of Radio Astrometry) in the same time range between 2011 and 2012. This research is a part of the monitoring program GENJI (Gamma-ray Emitting Notable AGN Monitoring by Japanese VLBI), which is a monitoring program of gamma-ray bright AGNs with the VERA. Time interval of the monitoring is typically once or twice per month.

Shahbaz, Tariq

Evidence for quiescent synchrotron emission in the Halo black hole X-ray transient Swift J1357.2-0933. #49

Author list: T. Shahbaz, D. M. Russell, C. Zurita, J. Casares, J. M. Corral Santana, V. S. Dhillon, T. R. Marsh

We present high time-resolution optical and infrared observations of the edge-on black hole X-ray transient Swift J1357.2-0933. Our data taken in 2012 shows the system to be at its pre-outburst magnitude and so the system is in quiescence. In contrast to other X-ray transients, the quiescent light curves of Swift J1357.2-0933 do not show the secondary star's ellipsoidal modulation. The optical and infrared light curves is dominated by variability with an fractional rms of about 20 per cent, much larger than what is observed in other systems. The quiescent ultraviolet to mid-IR spectral energy distribution in quiescence is dominated by a non-thermal component with a power--law index of --1.4, (the broad-band rms SED has a similar index) which arises from optically thin synchrotron emission from a jet; the lack of a peak in the spectral energy distribution rules out advection-dominated models. Using the outburst amplitude--period relation for X-ray transients we further constrain the distance 1.5 to 6.3 kpc. The short orbital period argues for a nuclearly evolved star with an initial mass 1.5 Msun, which has evolved to a 0.17 Msun star. The high Galactic latitude of Swift J1357.2-0933 implies a scale height between 1.2 and 4.8 kpc above the Galactic plane, placing Swift J1357.2-0933 in a sub-class of high-z short-period black hole X-ray transients in the Galactic Halo.

Sorcia, Marco

Long term optical polarization variability of the TeV Blazar 1ES1959+650 analized within the framework of a two-component model. #27

Author list: M. Sorcia, E. Benítez, D. Hiriart, J. M. López, J. I. Cabrera, R. Mújica, J. Heidt, I. Agudo, K. Nilsson and M. Mommert

In this talk we will show our main results obtained through the analysis of optical R-band photopolarimetric variability data obtained from 2008 to 2011 of the TeV blazar 1ES 1959+650. In particular, we found that the source shows a maximum polarization degree of ~12.2% and a presented a preferential position angle of ~153°, with variations of ~10°-50°, that is in agreement with the projected position angle of the parsec scale jet found in radio at 43 GHz. From our analysis of the Stokes parameters, we infer the existence of two optically-thin synchrotron components that contribute to the polarized flux. One of them is stable, with a constant polarization degree of ~4%. We estimated some parameters associated with the the relativistic jet: the magnetic field B~0.06 G, the Doppler factor ~23, the viewing angle ~2.4°, and the size of the emission region ~5.6×10^{17} cm. Our study is consistent with a two-component model that is able to explain the polarimetric variability displayed by this source during our monitoring.

Teixeira, Danilo

No Evidence For Bardeen-Petterson Alignment In Conservative GRMHD Simulation Of Moderately Thin, Tilted Accretion Disk. #5

Author list: Danilo Morales Teixeira, Viacheslav Zhuravlev, P. Chris Fragile, Pavel B. Ivanov

In this work we present our latest numerical simulations of accretion disks that are misaligned (tilted) with respect to the rotation axis of a Kerr black hole. In this work we use a new, fully conservative version of our general relativistic magneto-hydrodynamics (GRMHD) code, coupled with an ad hoc cooling function designed to control the thickness of the disk. Together these allow us to simulate the thinnest tilted accretion disks ever using a GRMHD code. In this way, we are able to probe the regime where the dimensionless stress α and scale height H/r of the disk become comparable. We also introduce the first results that use data extracted from numerical simulations as inputs to the analytic twisted disk model of Zhuravlev & Ivanov. The simulated disk shows no sign of Bardeen-Petterson alignment, consistent with our earlier work, but contrary to common expectations for thin disks. Importantly, we also find that the dimensionless stress resulting from the MRI-generated turbulence in our simulations is not isotropic, also contrary to common assumptions. Finally, we find that the predictions from the Zhuravlev & Ivanov model for the dynamics and stationary configuration of the disk agree quite well with the simulations. The implication is that the parameter space associated with Bardeen-Petterson alignment may be quite small, only including very thin disks H/r << alpha.

Tramacere, Andrea

A panchromatic view of blazars: constraining acceleration and emission processes in relativistic jets using broadband SED fitting. #42

Author list: Andrea Tramacere

We investigate the phenomenological link between the shape of the blazars broadband spectral energy distribution (SED), ranging from the radio up to gamma-ray energies, and the underlying emitting electron distribution. We describe the methodology to use this connection to constrain the emission and acceleration processes acting in relativistic jets. In the first step we use a log-log polynomial fit of the observed SEDs to constrain the parameter space of the synchrotron self-Compton (SSC) and external Compton (EC) leptonic scenario. This allows us to mitigate some of the degeneracies among the model parameters, such as that between the beaming factor and the magnetic field intensity. The analysis of the SED shape allows us also to constrain the shape of the electron distribution. In the second step, the phenomenologically constrained parameters are used as input values for an accurate numerical code reproducing radiative and acceleration processes. The final best-fit parameters, with their confidence

intervals and the goodness-of-fit estimation, are obtained by plugging the numerical code to different minimization algorithms and performing a model fit to the observed data. The whole process has been translated into a fitting/modeling code, that will be publicly distributed. In the present analysis we focus on the case of HBLs objects, investigating the shape of the electron distributions, comparing the best-fit models to self-consistent time-dependent analysis performed in the framework of the stochastic acceleration scenario, finding interesting constraints on the magnetic field intensity, and on the characterization of the flaring vs. equilibrium state.

Troitskiy, Ivan

Multi-wavelength polarization observations of the gamma-ray bright quasar PKS 0420-014. #34

Author list: I. S. Troitskiy, I. Agudo, D. A. Blinov, S. G. Jorstad, V. M. Larionov, A. P. Marscher, D. A. Morozova, P. S. Smith

We analyze total and polarized intensity images of the quasar PKS 0420-014 obtained monthly with the VLBA at 43 GHz during 2008-2012 along with gamma-ray data provided by the Fermi Large Area Telescope and multi-color photometric and polarimetric measurements collected by different optical telescopes. During this period the quasar underwent a number of optical flares which were accompanied by rapid rotation of polarization angle, an increase of activity in gamma-rays, and appearance of new superluminal knots in the parsec-scale jet. We investigate the fine structure of the flares at different wavelengths and in polarized light, and determine kinematic parameters of the knots. We compare rapid evolution of the optical polarization with the polarization of the VLBI core and knots. We interpret the multi-wavelength behavior within a model that places the blazar "dissipation zone" at the millimeter wave core of the parsec-scale jet.

Voytsik, Petr

Apparent frequency dependence shift of ultra-compact AGN cores. #4

Author list: Petr Voytsik, Yuri Kovalev

In VLBI images of extragalactic jets, the apparent position of the compact, bright emitting region at the narrow end of the jet (the core) depends on the observing frequency and is fundamentally determined by absorption in the radio emitting plasma (synchrotron self-absorption) and/or in the material surrounding the flow. This dependency provides a tool to probe absolute geometry and physical conditions in the vicinity of the core. It also must be taken into account in order to achieve the highest accuracy of radio reference frame and tie it accurately to the future optical GAIA frame. However, the widely used jet self-referencing method cannot be applied to highly

compact ICRF objects with weak or no jets. Relative astrometry is the only tool to detect and measure the core shift for them. In order to do so, we used phase-referencing EVN observations to measure the frequency-dependent core shift between 1.4, 2.3, 5, and 8.4 GHz in a sample of eight ultra-compact ICRF objects. First results of this project are presented and discussed.

Vuillaume, Thomas

A stratified jet model for the high energy emission of AGN: influence of the anisotropic Inverse Compton effect. #43

Author list: T. Vuillaume, G. Henri, P-O. Petrucci

It is now granted that the gamma ray emission of AGNs arise predominantly from Inverse Compton scattering of low energy photons by highly relativistic particles in the jet. But the exact source and location of these photons is still a matter of discussion. For BL Lac type objects, the main contribution is probably provided by synchrotron radiation and the high-energy emission is thus dominated by Synchrotron Self Compton (SSC) process. For luminous quasars however, the emission from the accretion disc and the reprocessed components (Broad Lines and molecular torus) is probably significant and can even be dominant. Whereas diffuse component is approximately isotropic, the emission from the accretion disc is highly anisotropic and the effect on Inverse Compton emission can be very important. The leptonic model we have been developing takes into account a multi-zone emission as well as the geometry of the disc and thus the anisotropy of the emission. We illustrate the consequences of anisotropy in the vicinity of the accretion disk on several examples that could be relevant to AGN spectra and variability, and present some fitted spectra.

Yonetoku, Daisuke

Magnetic structure in relativistic jet of Gamma-Ray Bursts by the gamma-ray polarization with IKAROS-GAP. #50

Author list: Daisuke Yonetoku, Toshio Murakami, Shuichi Gunji, Tatehiro Mihara, Kenji Toma, Tomonori Sakashita, Yoshiyuki Morihara, Takuya Takahashi, Noriyuki Toukairin, Hirofumi Fujimoto, Yoshiki Kodama, Kanazawa University, Yamagata University, RIKEN, Osaka University

The Gamma-Ray Burst Polarimeter (GAP) aboard the solar sail IKAROS is the first polarimeter specifically designed to measure the gamma-ray polarization of prompt GRBs. We detected the polarization signals from three bright GRBs with almost above 3 sigma confidence level. For the case of GRB100826A, we also detected the firm change of polarization angle with 3.5 sigma confidence level. In view of gamma-ray polarization measurement, we consider that the magnetic fields may play an important role in the

mechanism of prompt GRB. We suggest the non-axisymmetric (e.g. patchy) structures of the brightness and/or the magnetic fields inside the relativistic jet within the observable angular scale of $Gamma^{-1}$, to explain the observed significant change of polarization angle.