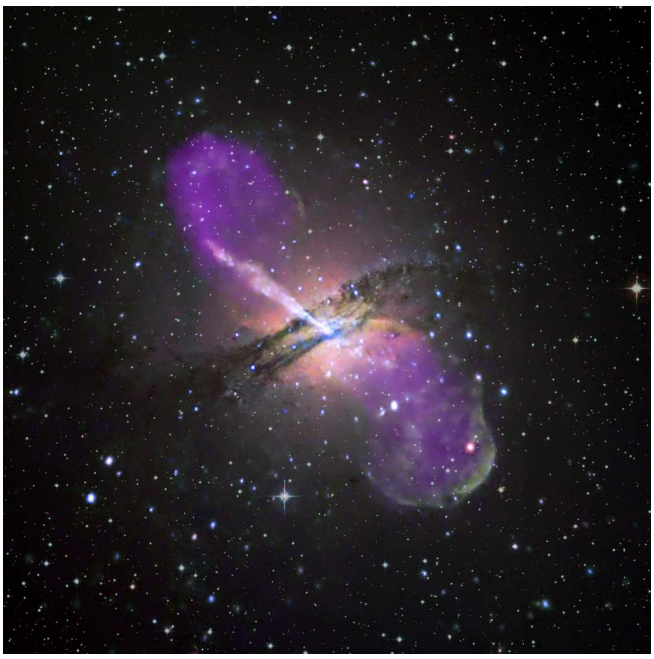
High Energy Phenomena in Relativistic Outflows II



Program & abstracts






Buenos Aires, Argentina, October 26-30, 2009

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Program

Monday 26

08:00 Registration opens
08:45 - 09:00 Welcome

Morning Session: Jets - basic issues and physical processes

09:00 - 09:45 Invited review 1: Jets: open problems and challenges (A. Königl)
09:45 - 10:30 Invited review 2: Recent progress in particle acceleration theory (L. Drury)

10:30 - 11:00 *Coffee break*

11:00 - 11:30 Invited talk 1: The jet/disk connection in black holes: phenomenology (I. F. Mirabel)
11:30 - 12:00 Invited talk 2: The jet/disk connection: theoretical aspects - GRMHD simulations of ultrarelativistic jets (J. McKinney)
12:00 - 12:30 Invited talk 3: Radiative processes in jets (G. S. Vila)

12:30 - 15:00 *Lunch break*

Afternoon Session

15:00 - 15:20 Contributed talk 1: K. Nalewajko
15:20 - 15:40 Contributed talk 2: K-I. Nishikawa
15:40 - 16:00 Contributed talk 3: J. L. Gómez
16:00 - 16:20 Contributed talk 4: G. Matt

16:20 - 17:00 *Coffee break*

17:00 - 17:20 Contributed talk 5: L. J. Pellizza
17:20 - 17:40 Contributed talk 6: O. Porth
17:40 - 18:00 Contributed talk 7: R. Moll
18:00 - 18:20 Contributed talk 8: J. Niemiec

19:30 Welcome cocktail at Tango Porteño

20:15 Dinner with Tango Show (voucher required)

Tuesday 27

09:00 - 09:45 Invited review: Jets on all scales (A. Levinson)

Morning Session: I. Multiwavelength jet emission

09:45 - 10:15 Invited talk 1: Multiwavelength aspects of relativistic jets in AGNs (L. Stawarz)
10:15 - 10:45 Invited talk 2: Synchrotron and IC jet emission in quasars (Y. Uchiyama)

10:45 - 11:30 *Coffee break*

II. Galactic jets and outflows

11:30 - 12:30 Invited talk 3: MHD processes at the jet base (E. de Gouveia Dal Pino)
12:30 - 13:00 Invited talk 4: Microquasar jet models (D. Khangulyan)

13:00 - 15:00 *Lunch break*

Afternoon Session: New observational results

15:00 - 15:20 Contributed talk 1 (VERITAS presentation - T. Weekes)
15:20 - 15:40 Contributed talk 2 (HESS presentation - U. Barres de Almeida)
15:40 - 16:00 Contributed talk 3 (MAGIC presentation - J. Rico)
16:00 - 16:20 Contributed talk 4 (AGILE presentation - M. Tavani)
16:20 - 16:40 Contributed talk 5 (Auger presentation - D. Harari)
16:40 - 17:00 Contributed talk 6 (IceCube presentation - R. Abbasi)

17:00 - 17:30 *Coffee break*

Galactic jets and outflows (cont.)

17:30 - 17:50 Contributed talk 7: V. Bosch-Ramon
17:50 - 18:10 Contributed talk 8: A. Smith
18:10 - 18:30 Contributed talk 9: H. Marshall

Wednesday 28

9:00 Departure for the Excursion Day

Conference "Asado" (Banquet) at an "Estancia" in the countryside (Pampa). Country activities

19:00 Arrival at the hotels

Thursday 29

09:00 - 09:45 Invited review: Blandford-Znajek mechanism and relativistic jets (S. Komissarov)

Morning Session: I. Jet formation and interactions

09:45 - 10:15 Invited talk 1: Magnetic acceleration of relativistic jets (R. Narayan)

10:15 - 10:45 Invited talk 2: Physical conditions near accreting black holes (C. Reynolds)

10:45 - 11:30 Coffee break

11:30 - 12:00 Invited talk 3: Non-thermal processes in black hole coronae (J. Poutanen)

12:00 - 12:30 Invited talk 4: Can multiband observations constrain explanations for knotty jets? (D. E. Harris)

II. Relativistic pulsar winds

12:30 - 13:00 Invited talk 5: Pulsars and pulsar wind nebulae (J. Arons)

13:00 - 15:00 *Lunch break*

Afternoon Session

15:00 - 15:20 Contributed talk 1: G. Bisnovatyi-Kogan

15:20 - 15:40 Contributed talk 2: J. Malzac

15:40 - 16:00 Contributed talk 3: J. Rodriguez

16:00 - 16:20 Contributed talk 4: M. Perucho Pla

16:20 - 17:00 *Coffee break*

17:00 - 17:20 Contributed talk 5: Y. Mizuno

17:20 - 17:40 Contributed talk 6: M. Del Santo

17:40 - 18:00 Contributed talk 7: Z. Meliani

18:00 - 18:20 Contributed talk 8: N. Globus

Friday 30

09:00 - 09:45 Invited review: New insights into gamma-ray AGNs from the Fermi-LAT (B. Lott)

Morning Session: I. AGNs

09:45 - 10.15 Invited talk 1: Gamma-rays from AGNs (F. Tavecchio)

10:15 - 10:45 Invited talk 2: Ten years of TeV gamma-ray observations of M87 (M. Beilicke)

10:45 - 11:30 *Coffee break*

II. GRBs

11:30 - 12:00 Invited talk 3: Overview of GRBs (A. Pozanenko)

12:30 - 13:00 Invited talk 4: GRBs: recent observational results (N. Gehrels)

13:00 - 13:30 Invited talk 5: Recent progress in GRB theory (B. Zhang)

13:30 - 15:00 *Lunch break*

Afternoon Session

15:00 - 15:20 Contributed talk 1: H. Ito

15:20 - 15:40 Contributed talk 2: L. Costamante

15:40 - 16:00 Contributed talk 3: F. Massaro

16:00 - 16:20 Contributed talk 4: J. H. Fan

16:20 - 17:00 *Coffee break*

17:00 - 17:20 Contributed talk 5: M. Böttcher

17:20 - 17:40 Contributed talk 6: D. Schwartz

17:40 - 18:00 Contributed talk 7: M. Weidinger

18:00 - 18:20 Contributed talk 8: E. Troja

18:20 Farewell

Invited contributions

Pulsars and pulsar wind nebulae

J. Arons
University of California, USA

Pulsars transmit their rotational energy to the outside would via relativistic MHD winds. I describe some recent developments in the physics of those winds, with particular attention to the decay of their magnetic fields in the regions between the light cylinders and the surrounding pulsar wind nebulae. I address both the acceleration of the flow and possible radiative signatures, as the magnetic energy decays. I suggest that part of the energy goes into accelerating a relativtsic beam in each wind's current sheet as a "runaway" phenomenon in the electric filed supported by the anomalous resistivity in the sheet. I also discuss some related issues in the dynamics of the current sheet separating the closed and open field regions within pulsars' magnetospheres, and relate these dissipative structures to pulsed gamma ray emission.

Ten years of TeV gamma-ray observations of M 87

M. Beilicke
Washington University in St. Louis, USA

The giant radio galaxy M 87 is located at a distance of ~ 16 Mpc and harbours a supermassive black hole in its center. The structure of its relativistic plasma jet is resolved at radio, optical and X-ray wavelengths. M 87 belongs to the class of active galactic nuclei (AGN) and is one of the few extragalactic TeV gamma-ray sources not belonging to the class of blazars. This makes it a unique laboratory to study jet physics and the corresponding emission processes at very high energies (VHE; $E > 100$ GeV). During the last 10 years M 87 has been regularly detected by several experiments at VHE. The current status as well as the prospects of future simultaneous multi-wavelength observations are discussed.

MHD processes at the jet base

E. de Gouveia Dal Pino
Universidade de São Paulo, Brazil

One of the fundamental properties of astrophysical magnetic fields is their ability to change their topology through magnetic reconnection and in doing so, to release magnetic energy, sometimes violently. In this talk, we will discuss the role of magnetic reconnection and associated heating and particle acceleration in jet/disk accretion systems, namely young stellar objects (YSOs), microquasars, and active galactic nuclei (AGNs). In the case of microquasars and AGNs, violent reconnection episodes between the magnetic field lines of the inner disk region and those that are anchored into the black hole are able to heat the coronal/disk gas and accelerate the plasma to relativistic velocities through a diffusive first-order Fermi-like process within the reconnection site that will produce intermittent relativistic ejections or plasmons. The resulting power-law electron distribution is compatible with the synchrotron radio spectrum observed during the outbursts of these sources. A diagram of the magnetic energy rate released by violent reconnection as a function of the black hole (BH) mass spanning 9 orders of magnitude shows that the magnetic reconnection power is more than sufficient to explain the observed radio luminosities of the outbursts, from microquasars to low luminous

AGNs. In addition, the magnetic reconnection events cause the heating of the coronal gas which can be conducted back to the disk to enhance its thermal soft X-ray emission as observed during outbursts in microquasars. The decay of the hard X-ray emission after a radio flare could also be explained in this model due to the escape of relativistic electrons with the evolving jet outburst. In the case of YSOs, a similar magnetic configuration can be reached that can produce the observed X-ray flares in some sources and provide the heating at the jet launching base. Fully 3D MHD-particle-in-cell simulations of turbulent reconnection and particle acceleration will be also presented.

Recent progress in particle acceleration theory

L. Drury
Dublin Institute for Advanced Studies, Ireland

In this review I will survey the current state of particle acceleration theory as applied to astrophysical systems with relativistic outflows. Although certainly not the only mechanism for particle acceleration, discussion tends to be dominated by diffusive shock acceleration because this is the best understood process, at least for non-relativistic shocks. The exciting new development here is the growing appreciation and understanding of magnetic field amplification. In the relativistic regime shock acceleration is much less secure, but here also recent PIC simulations offer interesting insights and hope for progress in the near future.

GRBs: recent observational results

N. Gehrels
NASA/GSFC, USA

We are in an exciting period of discovery for gamma-ray bursts. The Swift observatory is detecting 100 bursts per year, providing arcsecond localizations and sensitive observations of the prompt and afterglow emission. The Fermi observatory is observing 250 bursts per year with its medium-energy GRB instrument and about 10 bursts per year with its high-energy LAT instrument. In addition, rapid-response telescopes on the ground are providing new capabilities to study optical emission during the prompt phase and spectral signatures of the host galaxies. The combined data set is enabling great advances in our understanding of GRBs including afterglow physics, short burst origin, and high energy emission. This talk will highlight recent findings.

Can multiband observations constrain explanations for knotty jets?

D. E. Harris
Smithsonian Astrophysical Observatory, USA

One can imagine a number of mechanisms that could be the cause of brighter/fainter segments of jets. In a sense, jets might be easier to understand if they were featureless. However we observe a wide variety of structures which we call “knots”. By considering the ramifications of the various scenarios for the creation of knots, we determine which ones or which classes are favored by the currently available multiwavelength data.

Microquasar jet models

D. Khangulyan
Max-Planck-Institut für Kernphysik, Germany

I will discuss properties of binary systems as very high energy (VHE) emitters. In particular, I will consider the implications of the most recent observations in gamma- and X-ray energy bands. Discussing different scenarios for gamma-ray production in such sources, I will the mostly focus on the formation of non-thermal emission in relativistic outflows, which are natural components of microquasars and binary pulsar systems.

Blandford-Znajek mechanism and relativistic jets

S. Komissarov
University of Leeds, UK

In this talk I will summarise our recent results on the possible role of the Blandford-Znajek mechanism in the production of relativistic jets of long gamma ray bursts. In addition to the results of general relativistic MHD simulations, which have allowed to clarify particular aspects of the launch of black hole jets in the collapsar scenario, I will also discuss the possibility of explaining the "shallow decay phase" in the afterglows of LGRBs discovered by the Swift observatory. Finally, I will explore the intrinsic properties and the unusual observational signatures of the relativistic jets from the supercollapsars of the very first stars in the early Universe ($z \sim 20$), which are expected to be very massive.

Jets – open problems and challenges

A. Königl
University of Chicago, USA

Relativistic jets are believed to be powered by the rotational energy of compact objects (black holes or neutron stars) or of their associated accretion disks, which is tapped through a magnetic field that threads the source. This talk will review our current understanding of the acceleration and collimation of such outflows —with emphasis on recent developments— and will proceed to discuss the key open questions on this subject. The discussion will address both purely theoretical issues and the confrontation between theory and observations. Among the topics that will be considered are: the appropriate theoretical framework for modeling relativistic outflows (magnetodynamics or magnetohydrodynamics?), ideal-MHD vs. dissipative systems, the effect of the ambient radiation field, unique predictions of the magnetic acceleration model and their potential manifestations in GRB and AGN jets, dynamical stability properties, the origin of the high-energy emission and of the apparent variability of such jets, single vs. multi-component outflows, and common traits in relativistic jets from disparate astronomical objects (including their relation to the accretion flow).

Jets on all scales

A. Levinson
Tel Aviv University, Israel

I will present a comparison study of jets on all scales. The scaling of conditions in the central engine and of jet properties with the controlling parameters: black hole mass and spin, accretion rate and strength of magnetic field on the horizon, will be discussed. Environmental effects on jet propagation, collimation and dissipation in different systems will also be considered.

New insights into gamma-ray AGNs from the Fermi-LAT

B. Lott
CENBG/IN2P3/CNRS, France

Thanks to its unprecedented sensitivity, large field of view and sky survey operating mode, the Fermi Gamma-ray Space Telescope has opened a new era in extragalactic gamma-ray astronomy. In the first year of science operations the Fermi/LAT has detected several hundreds blazars and a few radiogalaxies, which can be studied with unprecedented accuracy. In this talk, I will review the general properties of these sources and highlight the results of MW studies carried out on bright sources.

GRMHD Simulations of ultrarelativistic jets

J. McKinney
Stanford University, USA

I will discuss how ultrarelativistic jets are produced in GRB and AGN systems as understood from jet theory, accretion disk theory, and general relativistic MHD simulations.

The jet/disk connection in black holes: phenomenology

F. Mirabel
SAp-CEA, France & IAFE, Argentina

I will review the observational evidences for the connection between instabilities in accretion disks and the production of powerful relativistic jets in the three astrophysical manifestations of black holes in the universe: active galactic nuclei, stellar black hole binaries (microquasars), and gamma-ray-bursts.

Magnetic acceleration of relativistic jets

R. Narayan
Harvard-Smithsonian Center for Astrophysics, USA

We describe numerical simulations of magnetized relativistic jets, focusing in particular on the efficiency with which Poynting flux is converted to bulk kinetic energy of the outflowing gas. We show that efficient conversion occurs only for certain geometries. We also discuss the stability of jets to the kink mode.

Non-thermal processes in black hole coronae

J. Poutanen
University of Oulu, Finland

The origin of dramatically different electron distributions responsible for Comptonization in black hole X-ray binaries (BHBs) in their various states is discussed. We solve the coupled kinetic equations for photons and electron-positron pairs without approximations on the relevant cross-sections accounting for Compton scattering, synchrotron radiation, pair production and Coulomb collisions. In the absence of external soft photons, the pairs are efficiently thermalized by synchrotron self-absorption and Coulomb scattering even for pure nonthermal electron injection. The resulting quasi-thermal synchrotron self-Compton spectra have very stable slopes and electron temperatures similar to the hard states of BHBs. The hard spectral slopes observed in the X-rays, the cutoff at 100 keV, and the MeV tail together require low magnetic fields ruling out the magnetic dissipation mechanism. The motion of the accretion disk toward the black hole results in larger Compton cooling and lower equilibrium electron temperature. Our self-consistent simulations show that in this case the distributions of pairs and photons attain a power-law-dominated shape similar to what is observed in the soft state. The electron distribution in the Cyg X-1 soft state might require a strong magnetic field, being consistent with the magnetically dominated corona.

Overview of GRBs

A. Pozanenko
Space Research Institute (IKI), Russia

Review of cosmic gamma-ray bursts will be presented focusing on phenomenological properties, models and unresolved puzzles of the exciting phenomenon. We discuss variability properties of light curves in both gamma-ray domain and optic, supernovae connection and host galaxy statistics. Special attention is devoted to the prompt emission of GRB which is a clue to understanding central machine of gamma-bursts. Particular attention will be given to short duration gamma-ray bursts and possible new class of very short bursts. We also present most interesting results obtained with GRB-follow up network of CIS observatories covering 8 time zones.

Physical conditions near accreting black holes

C. Reynolds
University of Maryland, USA

All energetic phenomena associated with black holes, including large scale relativistic outflows, are fundamentally driven by processes occurring close to the event horizon. In recent years, new observational capabilities (especially sensitive X-ray spectroscopy) have given us unprecedented constraints on the physical conditions close to accreting black holes including (1) the physical properties of the inner accretion flow, (2) the physics of accretion disk winds, and (3) the role of gravitomagnetic forces (associated with black hole spin). I will summarize the current constraints provided by these observations. Drawing motivation from these observations, I will then proceed to discuss the behaviour of large-scale magnetic fields close to the black hole, and speculate upon the ingredients required for the formation of powerful relativistic jets.

Multiwavelength aspects of relativistic jets in AGN

L. Stawarz
KIPAC, Stanford University, USA

I will review the most recent observational results regarding multiwavelength emission of extragalactic large-scale jets. I will attempt to identify the most relevant radiative processes involved. Next I will emphasize the resulting constrains on the energy dissipation and particle acceleration processes taking place thereby, as well as on the global structure of relativistic outflows in active galaxies. In particular, I will address a role of shocks and magnetic turbulence in energizing jet particles to ultrarelativistic energies. Brief comparison with the multiwavelength properties of small-scale (blazar) jets will be given.

Gamma-rays from AGNs

F. Tavecchio
INAF – Osservatorio Astronomico di Brera, Italy

I review the current knowledge of the high-energy emission from AGNs, with particular emphasis on the clues from the new observations of Fermi and Cherenkov telescopes of blazars and radiogalaxies. I discuss the main models advanced to account for the observed properties of the gamma-ray emission in these sources.

Synchrotron and IC jet emission in quasars

Y. Uchiyama
SLAC, Stanford University, USA

The origin of the X-ray emission from large-scale quasar jets has been the subject of active debate. Synchrotron and inverse-Compton (IC) models of the X-ray emission have very different implications to the jet physics on large scales and particle acceleration inside the jet. We present recent multiwavelength observations of quasar jets on large scales and discuss the

radiation mechanism responsible for the quasar extended jets. Particular emphasis will be placed on new calculations of polarization properties of external IC emission. Using the same formalism, we also discuss how future X-ray polarization measurements of "small-scale" emission in high luminosity quasar jets can be used to infer physical conditions of the relativistic jets.

Radiative processes in jets

G. S. Vila
Instituto Argentino de Radioastronomía, Argentina

Relativistic jets and collimated outflows are ubiquitous phenomena in astrophysical settings, from young stellar objects up to active galactic nuclei (AGNs). The observed emission from some of these jets can cover the whole electromagnetic spectrum, from radio to gamma-rays. The relevant features of the spectral energy distributions depend on the nature of the source and on the characteristics of the surrounding environment. In this talk, I shall review the main physical processes that command the interactions between populations of relativistic particles locally accelerated in the jets, with matter, radiation and magnetic fields. Special attention will be given to the conditions that lead to the dominance of the different radiative mechanisms. Examples from various types of sources will be used to illustrate these effects.

Recent progress in GRB theory

B. Zhang
University of Nevada Las Vegas, USA

The recent Fermi observation of GRB 080916C suggests that at least for this burst, the bright thermal emission associated with a hot fireball is missing, which suggests that the outflow has to be Poynting flux dominated. I will critically review the existing GRB prompt emission models (both the baryonic fireball internal shock model and the electromagnetic model), and discuss the recent progress of developing a new GRB prompt emission model in the Poynting-flux-dominated regime, namely, the internal collision-induced magnetic reconnection and turbulence (ICMRT) model.

Invited reports on new observational results

Large scale cosmic rays anisotropy as observed with IceCube

R. Abbasi
University of Wisconsin-Madison, USA

IceCube is a neutrino observatory located at the geographical South Pole. In two years the km^3 detector is expected to be complete. At the moment, data are being taken with 59 deployed strings, when completed it will be comprised of 80-strings plus 6 additional strings for the low energy array Deep Core. The strings are deployed in the deep ice between 1,450 and 2,450 meters depth, each string containing 60 optical sensors. During the year of 2007-2008 data were collected with 22 deployed strings. In this talk I will present some of the current scientific results of these data including the search reporting the measurement of 0.06% of large scale anisotropy. The data used in the large scale anisotropy analysis contain ~ 4.3 billion downward going muon events with a median energy per nucleon of $\sim 14\,\mathrm{TeV}$ and a median angular resolution of 3 degrees. The energy dependence of this anisotropy at median energies of 12 TeV and 126 TeV is also presented in this work. The observed anisotropy has an unknown origin and we will discuss various possible explanations. Studies of the anisotropy could further enhance the understanding of the structure of the Galactic magnetic field and possible cosmic ray sources.

Results from H.E.S.S. observations of relativistic sources

U. Barres de Almeida
University of Durham, UK

The High Energy Stereoscopic System (H.E.S.S.) is a southern hemisphere array of four Atmospheric Cherenkov telescopes observing the sky in the very high energy gamma-ray range (VHE; $> 100\,\mathrm{GeV}$). VHE observations are an invaluable tool to study the acceleration and propagation of energetic particles in many astrophysical systems where relativistic outflows are the main drivers of the emission, such as AGNs, GRBs and galactic binary systems. In this talk we will review the main results of H.E.S.S. observations of these objects, presenting the general picture that emerges from them. We will also comment on some prospects for future investigations with H.E.S.S.-II, to start operation next year.

Search for nearby extragalactic sources of the highest energy cosmic rays

D. Harari
Centro Atómico Bariloche / Pierre Auger Collaboration, Argentina

The Pierre Auger Observatory has measured that the flux of cosmic rays is strongly suppressed above $4 \times 10^{19}\,\mathrm{eV}$. This is consistent with the prediction that cosmic rays with larger energies can only arrive from nearby sources since they must surmount the losses caused by propagation through the cosmic microwave background. The Observatory has also found evidence that the inhomogeneous distribution of nearby extragalactic matter imprints its anisotropy upon the arrival directions of cosmic rays with energy above $6 \times 10^{19}\,\mathrm{eV}$. Correlations are observed with the positions of active galactic nuclei within 100 Mpc, and with other

distributions of local extragalactic objects. An excess of events is observed from a region of the sky close to the location of the radio source Cen A. Current measurements do not identify neither individual sources nor a specific class of sites of origin. We review these results and discuss the perspectives that similar studies with future data, complemented with further measurements of composition of the cosmic rays, may identify their astrophysical sources.

Results from the observations with MAGIC

J. Rico
ICREA/IFAE, Spain

MAGIC is a single-dish Cherenkov telescope located on La Palma (Spain), hence with an optimal view on the Northern sky. Sensitive to the 30 GeV – 30 TeV energy band, it is nowadays the only ground-based instrument being able to measure high-energy gamma-rays below 100 GeV. With the operation in coincidence with MACIC-II, starting in Fall 2009, the sensitivity will improve by a factor ~ 2. We review the experimental results obtained by MAGIC on the very-high-energy emission from astrophysical objects such as pulsars, pulsar wind nebulae, binary systems, active galactic nuclei, and gamma-ray bursts.

AGILE presentation

M. Tavani
INAF - Istituto di Astrofisica Spaziale e Fisica Cosmica (IASF), Roma, Italy

(Not available.)

VERITAS: status report

T. C. Weekes
Harvard-Smithsonian Center for Astrophysics, USA

The advent of advanced systems of atmospheric Cherenkov imaging telescope arrays has opened the extreme universe to observations with high sensitivity. Somewhat surprisingly, the ground-based techniques match, or exceed, the sensitivity of space telescopes at lower energies and hence provide complementary observations to the AGILE and Fermi missions. VERITAS (the Very Energetic Radiation Imaging Telescope Array System) in southern Arizona is one such system; it was commissioned in 2007. It consists of four telescopes of 12 m aperture and cameras with 499 pixels and is located in southern Arizona. The array was completed on-time and within budget and has satisfied or exceeded all technical specifications. VERITAS is now one of the most sensitive very high energy gamma-ray observatories in operation. Results of observations on known and newly discovered sources will be presented. It is now apparent that the emission of very high energy gamma rays is ubiquitous with the existence of nearly 100 sources, both galactic and extragalactic, established. TeV gamma-ray astronomy promises to be a fertile new discipline in high energy astrophysics.

Oral contributions

The unique object SS 433: Monte-Carlo modeling of the X-ray spectrum

G. S. Bisnovatyi-Kogan, Yu. M. Krivosheyev
IKI RAS Space Research Institute, Russia

SS433 is a peculiar massive X-ray binary system with precessing relativistic jets. X-ray spectrum of SS 433 was obtained by observations on RXTE, XMM, INTEGRAL. Monte-Carlo simulations had been used to calculate the hard X-ray ($E > 3\,\mathrm{keV}$) spectrum, in the model, containing accretion disk with a corona, and subrelativistic jets. Elementary processes include bremstrahlung and comptonization of the radiation in the hot corona. Comparison with the experiment allowed to estimate physical parameters of SS 433.

What are the radio outflows in gamma-ray binaries?

V. Bosch-Ramon
Universitat de Barcelona, Spain

Gamma-ray binaries can be characterized by a powerful accelerator in the vicinity of a massive star. The production of relativistic particles and very high-energy photons in an emitter embedded by a strong stellar wind should eventually lead to pumping of relativistic leptons, and probably also protons, into the rich and complex stellar environment. This takes place through gamma-ray absorption and pair creation in the stellar photon field, or particle escape from the accelerator/emitter. In this talk, we show that the radiation associated to this phenomenon is relevant for spectral, temporal, and morphological studies. In particular, we focus on the expected radio emission, which could be detected and marginally resolved by the present instrumentation. The complex medium, and insufficient angular resolution, can lead to quite unusual morphologies for the radio emitting structures.

Modeling of non-traditional TeV blazars

M. Böttcher
Ohio University, USA

For more than a decade, the only blazars detected at very high gamma-ray energies were of the high frequency peaked BL Lac (HBL) class. Recent observations by the current, third generation Atmospheric Cherenkov Telescope facilities, in particular HESS, MAGIC, and VERITAS, have extended the TeV blazar class to intermediate BL Lac objects (IBLs: W Comae, 3C66A, PKS 1424+240), low-frequency peaked BL Lacs (LBLs: BL Lacertae), and even a flat-spectrum radio quasar (FSRQ: 3C279). In this talk, I summarize results of modeling simultaneous spectral energy distributions of these non-traditional TeV blazars in the framework of leptonic and hadronic models. It appears that these new results challenge the traditional view of TeV blazars as being consistent with one-zone synchrotron-self-Compton models. While IBLs and LBLs seem consistent with leptonic models including an external (infrared) radiation field, the VHE gamma-ray detection of 3C279 severely challenges all versions of leptonic blazar jet models.

On the location of the blazar-zone in Fermi blazars

L. Costamante
HEPL/KIPAC, Stanford University, USA

The location of the highly variable and gamma-ray emitting region in blazars (so-called "blazar zone") is still quite uncertain. Usual blazar scenarios locate it inside the broad line region in FSRQ, so to produce gamma-rays through Comptonization of UV photons, while other scenarios locate it at large distances, where Comptonization of IR photons from dust dominate. BLR photons however should typically imprint an absorption feature in the gamma-ray spectra above ~ 10 GeV (due to gamma-gamma absorption), and the different distances could yield different variability properties. The Fermi-LAT instrument is now providing a large time and energy coverage (100 MeV - 100 GeV) for many objects, at much improved sensitivity. I will discuss the insights on the blazar-zone location that recent data are providing, from both variability and spectral properties.

High-energy view of black-hole candidates with INTEGRAL

M. Del Santo
INAF/IASF-Roma, Italy

Black-hole candidates are fundamental sources where we can study accretion on a compact object. It is observed that systems with high mass companion, i.e. Cyg X-1, are all persistent, while low mass X-ray binaries can be either transient or persistent. In this framework, BHC show a big amount of different spectral behaviours and transitions. RossiXTE and BeppoSAX have opened a new era for our comprehension of these systems up to 100 keV. Thanks to INTEGRAL we have now a new view of the emission of BHCs at higher energies. An additional component above 200 keV has been observed in few systems, both transient and persistent, during either hard/intermediate or low/hard states. The nature of this hard-tail is still debated, as also in the high/soft states. This component is usually attributed to the presence of a small fraction of non-thermal electrons in hot-Comptonising plasma, or alternatively, it is thermal and the result of spatial/temporal variations in the plasma parameters. I will review results concerning the high energy emission of BHCs, and present INTEGRAL spectral analysis of three BHCs with different behaviour, namely Cyg X-1 (persistent), GX 339-4 (LMXB transient) and 1E 1740.7−2942 (LMXB persistent). Finally, I will present preliminary results on the application of a new model (see Malzac & Belmont 2009) explaining the hard X-ray spectral shape observed in the low/hard state of Cyg X-1. The main idea is that in presence of a magnetic field the electron distribution can be thermalized by the syncroton self-absorption.

Variability of blazars

J. Fan
Guangzhou University, China

Variability is one of the characteristics of blazars. The rapid variability is superposed on the long term variations. In this work, the variability on different time scales, such as intra-day (IDV), short-term (STV), and long-term (LTV) variations are presented for some sources. We also present our own observations of some selected objects (3C 273, 4C 29.45, OJ 287), for which combined with the historical data, periodicity analysis is performed. Binary black hole system parameter is determined for OJ 287.

A collimation criterion for relativistic jets

N. Globus
LUTH, Observatoire de Paris-Meudon, France

I will present a semi-analytical model of MHD jet in Kerr metrics, in the context of steady axisymmetric outflows of a relativistic ideal MHD fluid emitted by a rotating black hole. The meridional self-similar model is a good assumption to describe outflows close to the polar axis. Such models have already been developed in the classical case by Sauty et al. and also extended to the Schwarzschild metric by Meliani et al. In these models, the study of the total energy variation from field line to field line gives a simple criterion for the collimation of jets. We have been able to generalize the same study to the Kerr metric to find that the rotation of the black hole increases the effect of magnetic self-collimation.

Helical magnetic fields and jet formation: the case of 3C 120

J. L. Gómez
Instituto de Astrofísica de Andalucía (CSIC), Spain

Helical magnetic fields may play an important role in the formation and collimation of relativistic jets. It is possible to search for such helical magnetic fields by looking for Faraday rotation gradients across the jet. Towards this aim we present a thorough study of the jet in the radio galaxy 3C 120, consisting of 32 monthly polarimetric 15, 22, and 43 GHz VLBA observations. The observations reveal a systematic presence of gradients in Faraday rotation and degree of polarization across the jet. These can be explained by the presence of a helical magnetic field in a two-fluid jet model, consisting of an inner emitting jet and a sheath containing nonrelativistic electrons. These results, together with those obtained from other sources, are discussed in the context of the jet formation and collimation processes.

Non-thermal emissions from shocked shells driven by powerful AGN jets

H. Ito
University of Tokyo, Japan

Jets in active galactic nuclei (AGN) drive a strong shock into ambient medium, and the shocked medium forms a thin shell. As in the case of other astrophysical shocks, these shells are expected to offer a site for particle acceleration. In this study, we explore the evolution of synchrotron and inverse Compoton (IC) emissions from accelerated electrons within the shell focusing on the powerful sources which reside luminous AGN in their cores. We show that dominant radiative output is provided by the IC scattering of AGN related photon fields when the source size is small. As the source becomes larger, synchrotron emissions dominate over the IC emissions since the photon fields become dilute. We also show that the GeV - TeV gamma-rays produced via the IC scattering can be detected by Fermi and modern Cherenkov telescopes such as MAGIC and HESS.

Jet and disc coupling in Cygnus X-1

J. Malzac
CESR (CNRS/Université Toulouse), France

Cygnus X-1 is probably the best studied black hole in the universe, this wealth of accurate data may be used to constrain the models of black hole accretion and ejection. I show that the current estimates for the jet power of Cygnus X-1 set a lower limit on the jet bulk velocity. These estimates also imply that the X-ray emission does not arise in the jet, as was proposed by several authors. Yet the jet could contribute at higher energy and be responsible for the emission reported at TeV energies by MAGIC. Regarding the X-ray emitting corona, it is well known that the temperature and optical depth of the Comptonizing electrons can be measured using spectroscopy in the 1 keV - 1 MeV energy band. I will show that other physical parameters of the corona, such as the strength of magnetic field, or the temperature of the ions can be constrained as well. In the prototypical source Cynus X-1, the results appear to challenge current accretion models.

Shock heating by the SS 433 relativistic jets

H. Marshall
MIT Kavli Institute, USA

We examine the hypothesis that the X-ray emission from the SS 433 jets results from shock heating by relativistic jets. The main body of evidence comes from high resolution X-ray spectra using the Chandra HETGS. The X-ray spectra show many signatures of shock heating, by analogy to other systems where lower velocity shocks are involved. From density and temperature estimates from the X-ray spectra, the X-ray emission must originate very close to these shocks and the hot gas is advected downstream, cooling significantly via radiative and adiabatic losses. Comparing spectra taken during primary eclipse, it is clear that only the highest temperature portion of the X-ray emitting regions are blocked, placing an additional constraint on the location of the shocks. By relating contemporaneous X-ray and optical observations, we demonstrate that the optical emission originates much further downstream, past the point where the jet starts to clump.

X-ray spectral analyses of the M 87 jet

F. Massaro
Harvard-Smithsonian Astrophysical Observatory, USA

We present X-ray spectral analyses of the jet in the giant radio galaxy M 87. We derive spectral parameters of the X-ray emission between the radio knots from the various long observations in the Chandra archive. In addition we use the 60 monitoring observations (5 ks each, spanning the last 7 years) to evaluate the X-ray spectral variability of the three brightest knots, HST-1, D, and A. This project is one component of a broader investigation of the spectral energy distribution for all parts of the entire jet. The work at SAO was supported by NASA grants GO8-9116X and GO9-0108X.

High energy phenomena studied with X-ray polarimetry

G. Matt
University Roma Tre, Italy

So far, there is only one polarimetry measurement in X-rays - the Crab Nebula. This is due to the limited sensitivity of traditional techniques. Now, the situation is changing due to the combination of large effective area telescopes with new kind of detectors —like the photoelectric polarimeters—.
In this contribution I will highlight the main scientific motivations for X-ray polarimetry —studies of jets in AGN and microquasars and of Pulsar Wind Nebulae being particularly prominent among them— and discuss the observational perspectives, from national programs to the International X-ray Observatory (IXO).

Decelerating relativistic two-component jets

Z. Meliani
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Transverse stratification is a common intrinsic feature of astrophysical jets. There is growing evidence that jets in radio galaxies consist of a fast low density outflow at the jet axis, surrounded by a slower, denser, extended jet. The inner and outer jet components then have a different origin and launching mechanism, making their effective inertia, magnetization, associated energy flux and angular momentum content different as well. Their interface will develop differential rotation, where disruptions may occur. We will present the investigation in 2.5D and 3D of the stability of rotating, two-component relativistic outflows typical for jets in radio galaxies. For this purpose, we parametrically explore the long term evolution of radially stratified jets numerically. We include cases with magnetized jet components, covering hydro and magnetohydrodynamic models. With grid-adaptive relativistic magnetohydrodynamic simulations, augmented with approximate linear stability analysis, we revisit the interaction between the two jet components. We study the influence of dynamically important magnetic fields, with varying contributions of the inner component jet to the total kinetic energy flux of the jet, on their non-linear azimuthal stability. We demonstrate that two-component jets with high kinetic energy flux, and an inner jet effective inertia which is higher than the outer jet effective inertia are subject to the development of a relativistically enhanced, rotation-induced Rayleigh-Taylor type instability. This instability plays a major role in decelerating the inner jet and the overall jet decollimation. This novel deceleration scenario can partly explain the radio source dichotomy, relating it directly to the efficiency of the central engine in launching the inner jet component. The FR II/FR I transition could then occur when the relative kinetic energy flux of the inner to the outer jet grows beyond a certain treshold.

Magnetohydrodynamic effects in relativistic ejecta

Y. Mizuno
CSPAR/UAH, USA

We study the problem of the deceleration of an arbitrarily magnetized relativistic ejecta in a static unmagnetized medium and its connection to the physics of gamma-ray bursts (GRBs). By computing exact solutions of the Riemann problem describing this scenario, we find that

with the same initial Lorentz factor, the reverse shock becomes progressively weaker with increasing magnetization parameter σ (the Poynting-to-kinetic flux ratio). The reverse shock becomes a rarefaction wave when σ exceeds a critical value defined by the balance between magnetic pressure in the ejecta and thermal pressure in the forward shock. In the rarefaction wave regime, the rarefied region is accelerated to a Lorentz factor that is significantly larger than initial value due to the strong magnetic pressure in the ejecta. We discuss the implications for models of GRBs.

Simulations of kink instabilities and jets from small-scale fields

R. Moll
MPA Garching, Germany

Rotating magnetic fields may drive jets in a variety of circumstances. In the first part of my talk, I will present numerical simulations in which jets are generated by twisting a large-scale magnetic field and develop kink instabilities. The conditions which regulate the growth of the instabilities are examined and the impact of instability-induced magnetic dissipation on the jet's dynamical properties is explored. In the second part of my talk, I will present simulations in which the footpoints of small-scale magnetic arcades are put into rotation to form a magnetic jet in an initially unmagnetized medium. It is shown how the effectiveness of such flows depends on the rotation rate, the strength and the geometry of the field.

Polarization swings from emission regions propagating on curved trajectories

K. Nalewajko
Nicolaus Copernicus Astronomical Center, Poland

We present a systematic study of polarization behaviour resulting from emission regions moving with relativistic speeds in astrophysical jets. When the trajectory of the emitting region is curved, it can produce, depending on the observer's orientation, a gradual swing of the polarization angle, simultaneously with a characteristic variation of polarization degree and enhancement of total flux due to changing Doppler factor. We show how simulated light curves depend on parameters of this trajectory. Our results can be applied to constrain physical parameters of blazar jets from optical polarization monitoring.

Aperiodic magnetic turbulence generated by streaming cosmic rays

J. Niemiec
Institute of Nuclear Physics PAN, Poland

Magnetic-field generation by cosmic rays (CRs) streaming through an electron-ion plasma along a homogeneous magnetic field is investigated with high-resolution particle-in-cell simulations. We present results for the case, in which CRs represent a relativistic hot population drifting with nonrelativistic velocity relative to the ambient plasma, and also for relativistic CR ion beams. The studies test predictions of a strong amplification of short-wavelength modes of magnetic turbulence upstream of nonrelativistic and relativistic parallel shocks associated with supernova remnants, jets of active galactic nuclei, and gamma-ray bursts.

Representing CRs as a constant external current, i.e. excluding a backreaction of the magnetic turbulence on CR particles, we observe non-resonant parallel modes with wavelength and growth rate as predicted by analytic calculations. In this unrealistic setup the magnetic field is amplified to amplitudes far exceeding the homogeneous field, in agreement with recent MHD and PIC simulations. However, if all particles are fully modeled, the backreaction on CRs leads to a moderate field amplification only. Furthermore, if CRs constitute the relativistic beam, the backreaction also leads to filamentation of the ambient plasma and the beam, which in turn influences the properties of the magnetic turbulence. We find good agreement in properties of the turbulence observed in our simulations compared with the dispersion relation calculated for linear waves with arbitrary orientation of a wavevector. In both cases studied, the upstream medium becomes turbulent in the nonlinear stage, with significant spatial fluctuations in density and velocity, the latter in particular leading to moderate upstream heating; such fluctuations will also have a strong influence on the shock structure. We also demonstrate that the aperiodic turbulence generated by the CR beam can provide efficient particle scattering with a rate compatible with Bohm diffusion. (Stroman, Pohl, Niemiec, 2009, in preparation; Niemiec, Pohl, Bret, Stroman, 2009, in preparation)

Simulation of relativistic shocks and associated radiation from turbulent magnetic fields

K-I. Nishikawa
NSSTC/UAH, USA

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

Electromagnetic cascades in presence of magnetic fields

L. J. Pellizza[1], M. Orellana[2], & G. E. Romero[3]
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(2) Universidad de Valparaiso, Chile & FCAG-UNLP, Argentina
(3) IAR - CONICET & FCAG - UNLP, Argentina

Modelling the high-energy electromagnetic spectra of different astrophysical systems showing relativistic outflows is a crucial task to understand the nature of these systems, and the mechanisms at work within them. The gamma-ray propagation in them cannot be reduced to a simple absorption effect, as both internal and external absorption produce energetic secondary

particles, which in some cases give rise to electromagnetic cascades. Moreover, the presence of magnetic fields makes the problem more complex, as charged particles are deflected and lose energy due to synchrotron radiation. Previous works deal with this problem using simplifying hypotheses, such as the instantaneous isotropisation of the momenta of charged particles, whose domain of validity is unclear.
In this work, we present a numerical code for computing electromagnetic cascades in the presence of arbitrary magnetic fields, by combining usual Monte Carlo schemes with molecular dynamics techniques. The code accounts for both the tridimensional nature of the problem and the energy losses due to synchrotron radiation, and is versatile enough to simulate a wide variety of astrophysical systems. As examples of the performance of the code, we present our first results on the spectra produced by electromagnetic cascades in high-mass X-ray binaries with a magnetized neutron star, for different values of the magnetic field.

On the interaction of microquasar jets with stellar winds

M. Perucho Pla
Departament d'Astronomia i Astrofísica, Universitat de València, Spain

In this talk, we will present the first three-dimensional simulations of the evolution of a microquasar jet inside the binary-star system. Our aim is to study the interaction of these jets with the stellar wind from a massive companion and the possible locations of high-energy emission. We have simulated two jets with different initial power in order to give a hint on the minimum power that the jet should have in order to escape the system and become visible in the large scales. In the setup, we include a lateral wind with typical properties filling the grid through which the jet evolves. We show that jets should have powers of the order of 10^{36} erg/s or more in order not to be destroyed by the lateral wind from the companion massive star. The long term evolution of the jet with the highest initial power results in different regions where high energy emission could be produced. We review these results, which represent the more realistic approximation to this stage of evolution of microquasar jets so far.

Relativistic jet collimation and acceleration

O. Porth
MPIA Heidelberg, Germany

We investigate the acceleration and collimation of relativistic MHD jets applying time-dependent special relativistic MHD simulations which also include gravity (in a Newtonian approximation). In our model, the jet is launched as a slow disk wind from a Keplerian accretion disk — thus prescribing a realistic disk-boundary condition absent in previous studies. Due to the scale-free nature of the formulation, our results can be applied to AGN as well as to microquasars. Our main results from a large parameter-study are:
1. Our time-dependent simulations usually result in a large-scale steady-state jet which is driven from the disk magnetic field.
2. The decollimating effect of the electric field wins over the magnetic pinch — resulting in broader jets.
3. The conversion of disk Poynting flux into jet kinetic energy is effective up to equipartition, resulting in moderate $\Gamma < 6$.

Is the corona the source of ejected material in microquasars?

J. Rodriguez
CEA Saclay, France

Microquasar outbursts are characterized by spectral state transitions. The transitions between states characterised by a hard spectrum and those characterised by a soft spectrum are of particular interest. Besides drastic spectral and timing changes, these transition often show discrete ejections detectable in the radio domain. The mechanisms giving birth to the ejections, the links with accretion and the exact nature of the ejected material are still largely unknown. We present systematic X-ray spectral analysis prior to the ejection in several microquasars, and show that, in each case, the properties of the corona drastically evolve, while that of the disc remain roughly constant. We conclude that in these sources part of the corona is ejected at the spectral transition.

Chandra imaging of PKS 0920−397: Physical modelling of a straight jet

D. Schwartz
Smithsonian Astrophysical Observatory (SAO), USA

We present a study of PKS 0920−397 using our 42 ks Chandra observation in conjunction with our ATCA 20 GHz image, 4.5 and 8 μm Spitzer/IRAC images, and HST/ACS F814W and F475W images. We investigate the hypothesis that the jet X-ray emission is due to inverse Compton scattering on the cosmic microwave background (CMB), of relativistic electrons from the same population which gives rise to the radio emission. To calculate parameters intrinsic to the source, one must finesse the fact that we do not know the true angle of the jet to our line of sight. Typical assumptions have been that the Doppler factor equals the Lorentz factor, or that the bulk Lorentz factor takes some fixed numerical value. While giving useful estimates, either assumption is manifestly unphysical. We try different constraints to determine the jet quantities. It is plausible that the kinetic flux be constant along the jet, prior to a terminal hotspot or lobe, and with minimal bending of the jet. Alternatively, because PKS 0920−397 appears straight in projection on the sky, we might assume the jet maintains a constant angle to our line of sight. Either approach gives bulk Lorentz factors of 6 to 8, with kinetic energy flux of order 10^{46} erg s^{-1}, and with the jet at an angle 2 to 4 degrees from our line of sight.

VERITAS observations of microquasars

A. Smith
Argonne National Laboratory, USA

After 3 years of observations, the VERITAS Cherenkov telescope array has accrued a significant amount of time on galactic objects thought to be TeV emitters. Among these are microquasar systems such as Cygnus X-1, Cygnus X-3, SS 433, and the microquasar candidate LS I +61 303. We present the results of VERITAS observations of these targets, focusing specifically on LS I +61 303. VERITAS has now compiled over 120 hours of observations on this target showing it to be a strongly variable gamma-ray emitter. We review the last three

years of VERITAS observations on this source as well as data taken contemporaneously in X-ray wavelengths by RXTE and Swift, and GeV observations with Fermi. While the fundamental nature of the source is still under debate, the most recent observations taken by VERITAS and Fermi indicate that TeV photon absorption may play as prominent a role as particle acceleration in the system.

Compact objects collisions

E. Troja
NASA/GSFC/ORAU, USA

A number of independent observations suggest the presence of prolonged activity from GRB central engines, and what is even more surprising is that this evidence is present in short duration GRBs. The longstanding merger model for short bursts does not naturally account for such late time activity. We explore an alternative possibility involving the collision of two compact objects rather than their merger via gravitational waves. We performed high-resolution hydrodynamical calculations of compact object collisions, and studied the outcome of the encounter for a wide range of stellar masses and impact parameters. We will present our preliminary results, and discuss them in the context of GRB central engines. Possible mechanisms for producing X-ray flares and the extended emission observed in some short GRBs are also discussed.

Modelling the variability of blazar jets – a two zone SSC model

M. Weidinger
ITPA University of Würzburg, Germany

Here a fully self-consistent extension to the SSC model with particle acceleration due to shock and stochastic acceleration (Fermi-I and Fermi-II processes respectively) in a twozone-SSC model is presented. In contrast to onezone SSC models the model parameters arise from the jet's microphysics and the electron spectrum is evolving directly from diffusion and shock acceleration cutting the number of parameters down to three. Thus justifying the powerlaw electron spectra often used in SSC models to explain the observed spectral energy distribution (SED) from blazars. The Cranck-Nicholson scheme and Godunov's method are combined to solve the time evolution of the electron's kinetic equation. Due to that the implemented model is not only able to explain observed SEDs but also the highly variable lightcurves as observed e.g. from PKS2155 by the H.E.S.S. telescope. In this talk results concerning the flare of PKS2155 in 2003, the steady state SED of PKS2155 and Mkn501 are shown and the impact on SSC models is explained.

Poster contributions

The origin of the strong flares in PKS 2155−304

Z. Abraham
IAG/USP, Brazil

PKS 2155−304 is one of the few blazars with detected high TeV emission. It presents some epochs of high variability at all wavelengths, as in 2006 when a strongest TeV flare was detected, as well as intraday variability at optical wavelengths, both in total and polarized flux. At other epochs, on the other hand, no intraday variability is observed. We analyze the existing multiwavelength data and conclude that the observed behavior is compatible with the occurrence and evolution of shocks in the inner region of a relativistic jet, like those that form the superluminal components of quasars and which explains the short timescale variations, superimposed to variations of the direction of the jet relative to the line of sight, which would be responsible for the long timescale variations and the strong TeV flares, which would occur when this angle reaches its minimum value.

The 3 mm polarization properties of optical and gamma-ray classes of blazars

I. Agudo
Instituto de Astrofísica de Andalucía-CSIC, Spain

We will present the results from the first 3 mm polarimetric survey of AGN over a large (146 sources) complete sample strongly dominated by blazars. Our mm observations, performed with the IRAM 30 m Telescope, are favorable to measure the intrinsic linearly polarized emission from AGN, with regard to radio measurements, since the former are not significantly affected by Faraday rotation and depolarization. Consistent with previous findings claiming larger Doppler factors for brighter gamma-ray blazars, such source-class show larger 3 mm luminosity than weaker gamma-ray blazars. The results also show robust evidence that all kinds of AGN, blazars in particular, are twice more linearly polarized at mm wavelengths than at radio wavelengths. This suggests that either the region of the bulk mm emission has a better-ordered magnetic field distribution – thus providing relevant information for magnetic jet formation models –, or that the radio emission is strongly affected by Faraday depolarization. Unlike other VLBI surveys at radio wavelengths, we do not find a clear relation between the 3 mm linear polarization angle and the jet structural position angle of any source class in our sample, implying the markedly non-axisymmetric character of their 3 mm jets.

Time-resolved optical photometry of hard X-ray emitting cataclysmic variables

I. Andruchow
FCAG - UNLP, Argentina

Thanks to the combination of hard X-ray data afforded with the INTEGRAL satellite and optical spectroscopy at various telescopes, a number of new, possibly magnetic, cataclysmic variables (CVs) has been recently discovered. We here report on the preliminary analysis of B-band optical photometry performed with the 2.15 m "Jorge Sahade" telescope at CASLEO (Argentina) on 5 CVs discovered at hard X-rays with INTEGRAL and which show features of a magnetic white dwarf (WD) in their optical spectra. The aim of these observation is to derive the orbital period of these systems and the spin periodicity of their accreting WD.

High-energy emission by jet/cloud interactions in AGNs

A. Araudo
Instituto Argentino de Radioastronomía / FCAG -UNLP, Argentina

Active galactic nuclei (AGN) are extragalactic sources that present continuum and line emission in the whole electromagnetic spectrum. The continuum radiation is produced by an accretion disk and relativistic jets. The emission lines are originated by gas located close to the central super-massive black hole (SMBH). Some of these lines are broad, and would be produced in a small region called broad-line region (BLR). The BLR structure is not well known, although it has been proposed that it is formed by small and dense clouds surrounding the SMBH. In this work, we study the interaction of these clouds with the base of the jet, and compute the produced high-energy emission. We find that the resulting radiation may be significant, and its detection could give important information on the properties of the jet base and BLR of AGNs. In particular, jet/cloud interactions could provide an explanation for the TeV radiation detected from Centaurus A and give information on its obscured central regions. Also, this phenomenon may be behind the variable emission detected in M87.

Magnetorotational instability with Hall effect in a one-dimensional model

C. Bejarano, & D. Gómez
IAFE (CONICET / UBA), & Depto. de Física (FCEN-UBA), Argentina

Accretion disks are formed by matter containing a significant amount of angular momentum being gravitationally attracted by compact objects. These very interesting astrophysical flows are a powerful mechanism of conversion of gravitational energy into kinetic energy and radiation, and take place in a variety of objects. Theoretical models of accretion require the generation of small-scale turbulence to enhance the effective viscosity of the flow. Within the framework of magnetohydrodynamics, the Hall effect might become important both in fully ionized low density plasmas and in cold plasmas with a low ionization fraction. In this talk we analyze the potential relevance of the Hall effect in the magnetorotational instability and present preliminary results from a one-dimensional toy model.

Radio Observation of PKS 2155−304

P. P. Bonetti Beaklini
IAG/USP, Brazil

We report observations at 1.3 cm, obtained with the Itapetinga radome enclosed 14 m radiotelescope, localized in Atibaia, Brazil, of the TeV BL Lac object PKS 2155−304. They were obtained simultaneously with the Fermi and HESS telescopes during the September 2008 campaign, and with optical and polarimetric observations obtained at Pico dos Dias Observatory, Brazil. A good correlation was obtained for the variability at all frequencies, which shows that they have common origin.

Gamma-ray emission from SS 433 and its interaction with the W50 nebula

P. Bordas
Universitat de Barcelona, Spain

We investigate the production of gamma-rays in the inner regions of SS 433 and in its interaction with the W50 nebula. We estimate the VHE emission that can be generated within the jets at the borders of the central binary system. We also apply a theoretical model of the jet/medium interaction to SS 433/W50. We compare the predicted radiative outputs to recent observations of SS 433 at TeV energies, as well as to multiwavelength observations of the SS 433/W50 interaction zones. We derive new constraints of the physical properties of this system and we discuss further observation strategies of the source in the GeV-TeV energy range.

H 1743−322 as seen by INTEGRAL, Swift and RXTE

F. Capitanio
IASF-Roma INAF, Italy

H 1743−322 has been assumed as a typical example of transient BH binary, even if the presence of a BH in this system has still not been dynamically proved, timing and spectral analysis and the detection of relativistic jets strongly support this thesis.
On March 2003 H 1743−322, after about 25 years, was detected in outburst by INTEGRAL satellite. This outburst was quite bright reaching more than 1 Crab in the 1-12 keV energy range. After this bright outburst the source presented other 5 fainter outbursts.
We review here the high energy behaviour of this microquasar during the different outbursts as seen by INTEGRAL, Swift and RXTE with special attention to the last results concerning the 2008 and 2009 outbursts: in particular we present the spectral and temporal behaviour of the October 2008 "failed outburst" compared with the "standard behaviour" of the January 2008 and June 2009 outbursts. We also present some preliminary results of NIR observations performed with ESO telescope in June 2009.

Polarimetry and the high-energy emission mechanisms in quasar jets. The case of PKS 1136−135

M. Cara
Florida Institute of Technology, USA

The emission mechanisms in extragalactic jets include synchrotron and various inverse-Compton processes. At low (radio through infrared) energies, it is widely agreed that synchrotron emission dominates in both low-power (FR I) and high-power (FR II and quasar) jets, because of the power-law nature of the spectra observed and high polarizations. However, at higher energies, the emission mechanism for high-power jets at kpc scales is hotly debated. Two mechanisms have been proposed: either inverse-Compton of cosmic microwave background photons or synchrotron emission from a second, high-energy population of electrons. Here we discuss optical polarimetry as a method for diagnosing the mechanism for the high-energy emission in quasar jets, as well as revealing the jet's three-dimensional energetic and magnetic field structure. We then discuss high-energy emission mechanisms for powerful jets in the light of the HST polarimetry of PKS 1136−135.

High-energy emission and absorption in Cygnus X-1

M. V. del Valle
IAR/FCAG-UNLP, Argentina

The high-mass microquasar Cygnus X-1 has been detected during a flaring state at very high energies, $E > 200$ GeV (Albert et al. 2007). The observation was performed by the Atmospheric Cherenkov Telescope MAGIC. It constitutes the first experimental evidence of very high-energy emission produced by a Galactic stellar-mass black hole. The observed signal occurred in coincidence with an X-ray flare.
The gamma flare took place when the compact object was located behind the companion star. In this configuration the absorption of gamma photons produced by photon-photon annihilation with the stellar photons is expected to be maximum. This suggests that the emission has been originated far above the compact object. The energy spectrum is well fitted by a relatively soft power law.
In this work we present a model of absorption and emission of high energy gamma-rays. We present detailed calculations of the gamma-ray opacity due to pair creation and estabish constrains on the emitting region. We propose that the high energy excess is the result of the interaction between the jet and a very massive clump from the stellar wind.

The relationship among HBLs, LBLs, and FSRQs

J. Fan
Guangzhou University, China

In this work, we revisited the relationship for the subclasses of blazars (highly peaked BL Lacertae objects – HBLs, lowly peaked BL Lacertae objects – LBLs, and flat spectrum radio quasars – FSRQs) based on a sample of blazars. We found that the relationship FSRQs-LBLs-HBLs is clear in their bolometric luminosity, emission line luminosity and the accretion ratio with $V_{\rm FSRQs} > V_{\rm LBLs} > V_{\rm HBLs}$. However, there is no clear difference amongst their central black hole masses. The bolometric luminosity is closely correlated with the emission line luminosity. In addition, we also found that the central black hole masses are marginally anti-correlated with the core-dominance parameter, which perhaps suggests that the jets originated from more massive black holes have larger bulk velocities.

Constraints on theoretical models of UHE diffuse neutrino fluxes with the Pierre Auger Observatory

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Universidad de Buenos Aires, Argentina

The Pierre Auger Observatory is sensitive to ultra high energy neutrinos ($E > 0.1\,\mathrm{EeV}$) of all flavours. These produce, via charged or neutral current interactions, extended down-going atmospheric showers which are measured by the surface array of water Cherenkov detectors. In addition, earth-skimming τ neutrinos give rise to up-going showers if the emerging τ decays close to the surface. Large angle neutrino induced deep showers can be identified from the

dominating background of hadronic events by the broad time structure of the signals they produce in the Cherenkov detectors. Using data collected from Jan 04 to Feb 09 we obtain competitive limits on the ultra high energy diffuse cosmic neutrino flux. We analyze the constraints they place on theoretical production models and discuss the rejection sensitivity that the Pierre Auger Observatory can attain within the next decade.

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

T. Hovatta
Purdue University, USA

We have compared the milliarcsecond jet polarization properties of the Fermi LAT-detected and non-detected sources in the complete flux-density-limited (MOJAVE-1) sample of highly beamed AGN. Of the 135 MOJAVE sources, 34 were detected by the LAT during its first 3 months of operation. We find that the unresolved core components of the LAT-detected jets have significantly higher polarization levels at 15 GHz. This complements our previous findings that these LAT sources have higher apparent jet speeds, brightness temperatures, and are preferentially found in higher activity states. Our Doppler factor measurements from the MOJAVE and Metsahovi monitoring programs indicated that gamma-ray bright blazar jets may be oriented within a preferential range of jet rest-frame viewing angles. Here we discuss the possibility that the core polarization level differences between LAT-detected and non-detected sources could be understood in this same framework. This work is supported under NASA Fermi Grant NNX08AV67G.

Anomalous resistivity-enabled disk formation in magnetized cloud cores

R. Krasnopolsky
Academia Sinica, Taiwan

Accretion disks are needed by most jet launching mechanisms. However, disk formation in star-forming cloud cores is hindered by excessive magnetic braking. Previous work indicates that braking torques can suppress the formation of rotationally supported disks, both in the ideal MHD limit and in the presence of ambipolar diffusion (for the expected magnetization levels and typical rates of cosmic ray ionization).
Our recent simulations show that Ohmic dissipation can in principle enable disk formation. We follow for 30,000 years the collapse of a rotating, magnetized envelope onto a central mass, using a range of values of resistivity. For the smaller resistivities in the range, magnetic braking still prevents disk formation. A Keplerian disk appears for η of order of $\sim 10^{19}\,\mathrm{cm^2\,s^{-1}}$, an anomalous resistivity much larger than the classical microscopic value. We explore the dependence of this resistivity value on core magnetization.

Relativistic jets and radiation bursts from collapsing stars

V. Kryvdyk
Taras Shevchenko National University of Kyiv, Ukraine

The formation of relativistic jets and the generation of radiation bursts in the stellar magnetosphere by gravitational collapse are considered. These jets are formed in the polar caps of collapsing stars magnetospheres, when the stellar magnetic field increases during collapse and the charged particles will be accelerated. These jets will generate the non-thermal radiation. The analysis of particle dynamics and its emission in the stellar magnetosphere under collapse show that the stars on the stage of gravitational collapse must by powerful sources of the relativistic jets and the non-thermal radiation. The radiation flux grows with decreasing stellar radius and can be observed in the form of radiation burst in wide band wave, from radio to gamma-rays. These bursts radiation can be observed as gamma- and X- rays bursts.

Local-Galactic gamma-ray bursts

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During the 1980s, the GRBs hitting Earth some 4-times per day were thought to come from nearby Galactic neutron stars, emitted after clumpy accretion. This interpretation has shifted towards cosmological distances, based on their almost isotropic arrival directions, their large redshifts (between 0 and 8), their occasional seeming host galaxies, and their occasional SN-like afterglow lightcurves and optical spectra. In my talk, I shall point out a large number (> 20) of inconsistencies of this cosmological interpretation, which are partially based on the huge implied energetics (some 10^{16} times Eddington) of both their prompt and afterglow emissions, partially on superluminal behaviour, and partially on other clashes with fundamental physical constraints. I shall then show that the dying-pulsar population of our Galaxy —often interpreted as magnetars— has all the necessary properties to qualify as their source population. In particular, the large observed redshifts can be understood as transrelativistic centrifugal ejections by nearby magnetars.

The globular cluster GLIMPSE-C01 as a likely counterpart to the unidentified Fermi source 0FGL J1848

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We report the finding of the globular cluster GLIMPSE-C01 inside the 95% confidence error box of the Fermi LAT unidentified gamma-ray source 0FGL J1848.6−0138. This cluster is the only peculiar object consistent within the position uncertainty of the gamma-ray source with a conceivable physical scenario for gamma-ray production. This fact together with the possible Fermi detection of 47 Tuc, a well known globular cluster, provides strong evidence in support of previous theoretical predictions of these objects as high energy gamma-ray sources.

Revealing the nature of new unidentified INTEGRAL sources

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Since its launch on October 2002, the INTEGRAL satellite has revolutionized our knowledge of the hard X-ray sky thanks to its unprecedented imaging capabilities and source detection positional accuracy above 20 keV. Nevertheless, many of the newly-detected sources in the INTEGRAL sky surveys are of unknown nature. However, the combined use of available information at longer wavelengths (mainly soft X-rays and radio) and of optical spectroscopy on the putative counterparts of these new hard X-ray objects allows pinpointing their nature. Continuing our long-standing program running since 2004, here we report the classification, through optical spectroscopy, of unidentified high-energy sources belonging to published INTEGRAL surveys as well as to the forthcoming 4th IBIS survey.

Extended X-ray emission in radio galaxies: the peculiar case of 3C 305

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Extended X-ray structures are common in active galactic nuclei (AGNs). Here we present the first case of a compact steep spectrum (CSS) radio galaxy, 3C 305, in which the X-ray radiation appears to be associated with the optical emission line region, marked by the [O III] 5007. On the basis of a morphological study, performed using the comparison between the X-rays (Chandra), the optical (HST) and the radio (VLA) data, we argue that the high energy emission has a thermal nature. Finally, we discuss the origin of the extended X-ray structure connected with the optical emission line region following two different interpretations: as due to the interaction between matter outflows and shock-heated environment gas, or as due to gas photoionized by nuclear emission.

Simulations and cosmic ray shock acceleration

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Diffusive shock acceleration is invoked to explain non-thermal particle acceleration in supernova remnants, active galactic nuclei jets, gamma-ray bursts and various large scale cosmic structures. Especially, the importance of achieving the highest observed particle energies by such a mechanism in a given astrophysical situation is a recurring theme.
In this contribution the cosmic ray acceleration mechanism by non-relativistic and relativistic shock waves will be reviewed, focusing on simulation and numerical methods applicable to relativistic astrophysical environments. Moreover, results will be briefly discussed regarding Monte Carlo simulation studies of relativistic subluminal and superluminal shocks occurring in active galactic nuclei jets and gamma ray bursts with an emphasis on the acquired diffuse cosmic ray signal at the highest particle energies observed. The consequences of simulation studies of cosmic ray shock acceleration will also be addressed.

Internal shocks in relativistic jets with time-dependent sources

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I present a ballistic description of the formation and propagation of the working surface of a relativistic jet. Using simple laws of conservation of mass and linear momentum at the working surface, one obtains a full description of the working surface flow parametrised by the initial velocity and mass injection rate. This allows to compute analytically the energy release at any time in the working surface. Comparisons of this model with results obtained numerically through a new hydrodynamical code applied to the propagation of a relativistic fluid in one dimension in order to test the limits of the study. Finally, I compare the analytical results with observed light curves of five long gamma ray bursts and show that the model is in very good agreement with observations using simple periodic variations of the injected velocity profiles.

Simulations of dynamics and emission from magnetized GRB afterglows

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The role of magnetic fields in the GRB flow is still controversial, and the study of the afterglow, particularly of its early phases, might provide a probe into the magnetization of the outflow. Using ultrahigh-resolution relativistic MHD simulations, the interaction between radially expanding, magnetized ejecta with the interstellar medium is studied for several degrees of flow magnetization. The influence of the presence of magnetic field on the afterglow structure is examined, particularly regarding the presence of a reverse shock. In addition, synthetic multi-wavelength afterglow light curves are computed, and the effect of flow magnetization on observed radiation is discussed.

Current-driven kink instability in relativistic jets

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We have investigated the development of current-driven (CD) kink instability in relativistic jets via 3D RMHD simulations. In this investigation a static force-free equilibrium helical magnetic configuration is considered in order to study the influence of the initial configuration on the linear and nonlinear evolution of the instability. We found that the initial configuration is strongly distorted but not disrupted by the CD kink instability. The linear growth and nonlinear evolution of the CD kink instability depend moderately on the radial density profile and strongly depend on the magnetic pitch profile. Kink amplitude growth in the nonlinear regime for decreasing magnetic pitch leads to a slender helically twisted column wrapped by magnetic field. On the other hand, kink amplitude growth in the nonlinear regime nearly ceases for increasing magnetic pitch. We also present preliminary results for the effect of velocity shear on the CD kink instability.

The optical/near infrared counterpart of GRS 1758−258

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GRS 1758−258 is one of the two microquasars in the Galactic center, considered as a prototype of this class of objects. Despite years of study, the Galactic origin of this source has not been clearly proven yet due to the absence of an unambiguous optical/infrared counterpart identification. Here we present a revised optical/near infrared astrometry of the field containing GRS 1758−258, which enables us to find a single candidate counterpart coincident with the radio and X-ray position. The observed magnitudes are consistent with a low-mass X-ray binary system. We also report on preliminary results from a spectroscopic follow up of this candidate counterpart carried out with GRANTECAN telescope and the OSIRIS instrument.

Magnetic field amplification and electron acceleration by an oblique shock

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Energetic electromagnetic eruptions observed during the prompt phase of gamma-ray bursts are attributed to synchrotron (jitter) emissions from internal shocks, requiring both strong magnetic fields and highly relativistic electrons. We explore with 1D & 2D relativistic PIC simulations the shock layer created when two plasma clouds collide at a speed $0.9\,c$ in a quasi-parallel magnetic field. The clouds have a density ratio of 10. The ion-electron mass ratio is 250. We find strong plasma filamentation behind the otherwise planar shock front. The transverse magnetic field grows to exceed values expected from shock compression by over an order of magnitude, creating a quasi-perpendicular shock. The powerful magnetic fields convect away from the shock boundary and localized magnetic bubbles form. Both species' relativistic masses close to the shock are comparable. The presence of highly relativistic electrons and strong magnetic fields will give rise to significant synchrotron emission.

Features of relativistic particles produced at high energy nucleus-nucleus collisions

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In order to study some interesting characteristics of particles produced in the collisions of silicon ions with nuclear emulsion targets at beam momentum $4.5\,\mathrm{GeV}/c$ per nucleon, experimental data have been analysed; average multiplicities of gray, black, shower and heavily ionizing particles obtained in this study are compared with their corresponding values obtained for different projectile nuclei. The variations of $D(N_s)$ with $\langle Ns \rangle$, $D(N_c)$ with $\langle N_c \rangle$ and $\langle N_c \rangle$ and $\langle N_s \rangle$ with $\langle N_h \rangle$ have also been investigated. Finally, integral N_h distribution is plotted and fitted with a best-fitting analytical expression.

One zone model for the inner jet emission of Cen A

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We investigate the spectral energy distribution (SED) of Centaurus A resulting from a steady one-zone compact acceleration region, located close to the central black hole, where both leptonic and hadronic relativistic populations arise. We present here results of such a model, where we have considered synchrotron radiation by primary electrons and protons, inverse Compton interactions, and gamma-ray emission originated by the inelastic hadronic interactions between relativistic protons and cold nuclei within the jets. Photo-meson production by relativistic hadrons were also taken into account, as well as the effects of secondary particles injected by all interactions. The internal and external absorption of gamma rays is shown to be of great relevance to shape the observable SED, which was also recently constrained by the results of Fermi and HESS.

The radio cores of the faintest radio quiet AGN

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The accretion-ejection mechanism acting in radio-quiet active galactic nuclei (AGN) is still poorly understood, specifically at lower luminosities where the transition from inactivity to activity occurs. Recently found correlations between the nuclear 2-10 keV X-ray and radio luminosities suggest that the accretion flow and the radio source are strongly coupled even in radio-quiet AGN. We have mapped the sub-parsec scales of the faintest and least luminous nuclei among well known local AGN, going to sub-mJy flux densities and radio luminosities around $10^{19}\,\mathrm{W\,Hz^{-1}}$, revealing an ubiquitous presence of sub-parsec cores and structures. Interestingly, their observational and derived physical parameters display heterogeneous behaviours, not always easy to interpret within a common physical scenario. Here we will discuss our observational results within common physical models.

New sample of *blazars* for SED studies

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In the last years there has been lot of enthusiasm for blazar work. Two approaches are posible: studying individual objects which is only possible for few objects that may not be representative of entire population, and statistical analysis which is bedevilled by selection effects. Nevertheless the statistical approach is promising if one can create a sample with as few biases as possible in order to control selection effects. We create the new carefully selected sample – SENSE (Survey of Extragalactic Nuclear Spectral Energies) – which consists of 160 blazars and it's limited by redshift and core flux density. We want to see if there are systematic trends in the SEDs which are physically based. We also want to study a cosmological evolution of the blazar population. Again control of selection effects is vital here.

Chandra observations of the radio galaxy 3C 445 and the hotspot X-ray emission mechanism

E. Perlman
Florida Institute of Technology, USA

We present new Chandra observations of the radio galaxy 3C 445, centered on its southern radio hotspot. Our observations detect X-ray emission displaced upstream of the radio-optical hotspot. Attempting to reproduce both the observed spectral energy distribution (SED) and the displacement, excludes all one zone models. Modeling of the radio-optical hotspot spectrum suggests that the electron distribution has a low energy cutoff or break approximately at the proton rest mass energy. The X-rays could be due to external Compton scattering of the cosmic microwave background (EC/CMB) coming from the fast (Lorentz factor ~ 4) part of a decelerating flow, but this requires a small angle (< 14 degrees) between the jet velocity and the observer's line of sight. Alternatively, the X-ray emission can be synchrotron from a separate population of electrons. This last interpretation does not require the X-ray emission to be beamed.

Polarization monitoring of the M 87 Jet

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Florida Institute of Technology, USA

We present polarization monitoring of the M 87 jet, obtained during the years 2001-2007. This time period includes the flare of knot HST-1, at a projected distance of 60 pc from the nucleus. Polarimetry can give unique information on jets, in particular the magnetic field configuration in the radiating region. Because of the relatively short lifetime of optical emitting electrons, optical polarization gives direct information on particle acceleration mechanisms. We detect variable polarization both from HST-1 as well as from the nucleus, both of which also varied in flux during the observations. We discuss the correlation between flux and polarization variability, as well as the impact of these observations on interpreting both the massive flare of knot HST-1 and the variability of the core.

Discrete ejections from the microquasar GRS 1915+105: nature and possible ways of acceleration

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The microquasar GRS 1915+150 is an object characterized by an extreme level of variability, on timescales ranging from milliseconds to months. At times, it displays powerful ejections in the form of discrete events, with a recurrence time of a few hours. In order to link accretion and ejection processes, we studied these events using simultaneous X-ray and radio observations over 10 years of activity. Our preliminary results show a strong correlation between X-ray precursors and the amplitude of discrete events, as measured in the radio range. This leads to clues on the nature (shock heated jet, plasmon, ...) of the ejected material, and gives additional constraints on the powering mechanism.

Models for the high-energy emission of Centaurus A

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Centaurus A is the closest active galaxy and presents strong activity over a wide spectral range from radio to very high energy gamma-rays. It is a typical radio-loud Fanaroff-Riley type I galaxy, with jets forming a large angle with the line of sight. It is the second non-blazar AGN discovered at very high energies ($E > 100\,\mathrm{GeV}$). We propose a family of lepto-hadronic models for the high-energy emission assuming that particles can be shock-accelerated at the inner jets of this source. The primary electron and proton distributions are obtained in the acceleration zone taking into account the relevant cooling processes, which are synchrotron emission, inverse Compton upscattering, proton-proton and proton-photon interactions. Considering the effects of internal absorption of gamma-rays, we compare our predictions with current observational data obtained by HESS and Fermi instruments. Additionally, we compute the distribution of secondary pions and muons produced by hadronic interactions. The expected high-energy neutrino signal is calculated and the possibility of detection with KM3NET or similar arrays is discussed.

High-frequency oscillations in short gamma-ray bursts

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During our research of the separate class of gamma-ray bursts, we found events where high-frequency oscillations take place. We were investigating time tagged event data from observations and soft gamma repeaters by the burst and transient source experiment (BATSE). Using the Fourier and wavelet analaysis we obtaind 2 types of spectra for BATSE trigger 00207. The Fourier power spectrum shows 175 Hz oscillation and in the same way the wavelet spectrum reveals a harmonic with Fourier period of 0.006 sec. The coincidence of the results of 2 different methods allows us to draw a conclusion about the precision of the outcomes.

High-energy particle interactions in the inner jet of the radio galaxy M 87

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Recent observations with the High Energy Stereoscopic System (HESS) have revealed strong and variable high-energy gamma-ray emission from the radio galaxy M 87. The origin of such emission is uncertain, but the rapid variability indicates that it should be produced close to the central engine of the source. In this work, a lepto-hadronic one-zone model is applied to the available multiwavelength data of M 87. The different losses for both primary and secondary particles are calculated. Then, the different contributions to the spectral energy distribution through interactions with matter, radiation and magnetic fields are obtained, in good accordance with the observations.

INTEGRAL observations of X-ray bursters

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We present here our latest results on the study of INTEGRAL observations of X-ray bursters.

Long-term evolution of slowly rotating collapsar in special relativistic magnetohydrodynamics

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We present our numerical results of two-dimensional magnetohydrodynamic simulations of the collapse of rotating massive stars in light of the collapsar model of gamma-ray bursts. Pushed by recent evolution calculations of GRB progenitors, we focus on lower angular momentum of the central core than the ones taken mostly in previous studies. By performing special relativistic simulations including both realistic equation of state and neutrino coolings, we follow an unprecedentedly long-term evolution of the slowly rotating collapsars up to 10 s, accompanied by the formation of jets and accretion disks.

The cosmic radio background and AGNs

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The recently characterized Cosmic Radio Background provides a unique perspective in which to study the non-thermal Universe, and, in particular, properties and cosmological evolution of active galaxies and their outflows. Less than 1/4 of the total extragalactic background light in the 10 MHz–10 GHz frequency range can be accounted for by classic jet sources such as radio galaxies or radio-loud quasars. Perhaps surprisingly, the bulk of the cosmic radio intensity has to be produced by radio-quiet AGN and starforming galaxies.
After a brief introduction to the radio background, I will discuss the relative contribution of different classes of extragalactic radio sources. As starforming systems are significant contributors, this requires an evolution in the radio/far-infrared correlation with redshift, which may suggest that AGN activity in "ordinary" galaxies is enhanced at earlier times.

Non-thermal non-jet flares in AGNs

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Metsähovi Radio Observatory, Finland

We discuss the possibility of thermal flares near the compact objects in active galactic nuclei. We study if it is possible that certain flares observed in these sources can be produced in the very centre of the system and not in the jet, prior to the appearance of a new shock or jet element and the flare caused by the more standard shock-in-jet scenario. We test whether

the wind-like expansion of hot plasma originating from a collapsed accretion disk can produce certain observed features in some sources –particularly a double-peaked structure in the lightcurve at certain wavelengths– and propose a few simple tests to possibly rule out the model with more extensive observations of AGN and microquasar flares.

Spectral evolution of the Atoll 4U 1728−34 with RXTE and INTEGRAL: evidence for hard X-ray tail

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We report results on the neutron star low mass X-ray binary 4U 1728−34 during a monitoring campaign with RXTE and INTEGRAL starting on 2006 March up to 2007 June. The relative light curves showed three outbursts with different peak luminosity. During these outbursts the source moves from the *soft* spectral state ("banana") to *hard* spectral state ("island") as evidenced by the hardness-intensity diagram. We perfomed a contemporaneous broad spectral analysis with both satellites (with PCA, HEXTE and IBIS instruments) and compared the different spectral states. In particular the hard spectral states are characterized by a Comptonization model plus a hard X-ray tail extending up to 200 keV, which could be due to a non-thermal emission (maybe connected to radio emission) coming from the source at the lower accretion rate of the island state. While for the black hole candidates the hard X-ray tails are often detected during hard states, this was not the case for Atolls. However in recent years there are evidences of detections of this feature from Atolls showing that the so called disk-jet coupling could be also present for the NS systems. The past radio detection of 4U 1728−34 strengthens this suggestion.

Quiescent thermal emission of neutron stars in LMXBs

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Recently, evidence of a jet formation has been found in some LMXBs (low mass X-ray binaries) (Migliari et al. 2006; Russell et al. 2007). The relation between the accreted plasma pressure and the neutron star (NS) magnetic field pressure seems to be the clue for the formation of the jet. The initial condition for an ejection event be possible is a low magnetic field ($< 10^{7-8}$ G) at the NS surface (Massi & Kaufman-Bernado 2007) but depends on the accretion rate $\dot{M}$.
On other hand, in LMXBs, the recent monitoring of the quiescent thermal emission from NSs after active periods (bursts) opened a new vista on the physics of dense matter (Brown & Cumming 2009). The theoretical modeling of the thermal relaxation of the crust put constraints on the thermal conductivity of the matter depending on the accretion rate and magnetic field assumed. In our work we present numerical simulations of the cooling curves that fit the light curves for two sources (KS 1731−260, MXB 1659−29). We give values of model inputs (magnetic field, accretion mass and thermal conductivity) that match the data. We compare our results with previous constraints found for jet formation and speculate a possible consistent picture for LMXBs.

Pulse characterization from GRBs with known redshift

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In the last few years, individual pulse analysis of GRBs have concluded that properties like spectral lag and spectral characteristic are pulse dependent rather than a whole prompt emission properties. Following the idea that some burst properties are intrinsic to the pulses, and combining Suzaku (50 - 5000 keV) and Swift (15 - 50 keV) observations, we analyze the prompt emission of a sample of long GRBs with known redshift. Aiming to find pulse properties, we calculate the autocorrelation functions, skewness and hardness ratio to determine a possible classification of pulses. Then we continue with the study of the evolution with energy of the pulse parameters thanks to the broad energy band obtained by both satellites simultaneous observations. We emphasize that this type of study can be a clue for the understanding of the radiation mechanism involved in the prompt emission.

Non-thermal radiation from Cygnus X-1 corona

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In this work we study the effects of the injection of a non-thermal particle population in a corona around an accreting black hole. We characterize the corona as a two-temperature hot plasma. We consider both electron and proton interactions with magnetic, photon and matter fields in the corona. Our calculations also include the radiation emitted by secondary particles (pions, muons and electron/positron pairs) in a self-consistent way. Finally, we take into account the effects of photon absorption. To estimate the accuracy of our model we compare its results with data of Cygnus X-1 obtained by the COMPTEL instrument.

X-ray and gamma-ray observations of the inner region of MGRO J2019+37

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In order to better understand the puzzling extended TeV source MGRO J2019+37, we have performed a multiwavelength campaign from radio to X-ray covering most of its extent. Here we present an X-ray mosaic including a new observation and two archival observations performed by the X-ray observatory XMM-Newton. We have also observed the source with the gamma-ray observatory AGILE. We discuss new point like and extended X-ray sources we have found in the field that could help elucidate the physics behind MGRO J2019+37.

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