Poster presentations accepted for HEPRO IV

Banasinski, Piotr

Interpretation of the emission stages of radio galaxy NGC 1275 with the optically thick homogeneous SSC model

The gamma-ray spectrum observed from the radio galaxy NGC 1275 by Fermi and MAGIC telescopes shows two emission stages. The GeV flux is larger during the period Aug. 2010- Feb. 2011 and lower during Oct. 2009 - Feb. 2010. On the other hand, the ~100 GeV flux seems to behave in the opposite way. We interpret this emission feature as due to the internal absorption effects within the emission region in which relativistic electrons produce gamma-rays by scattering the synchrotron radiation (i.e. optically thick SSC model).

Bucciantini, Niccolo

Equilibrium Models for Magnetized Neutron Stars in General Relativity

Neutron stars can be characterized by very strong magnetic fields. The magnetar paradigm for AXPs and SGRs, requires field in excess of 1e14G, and the recently proposed millisecond-magnetar model for GRBs advocates the possibility of even higher magnetic fields ~1e16G. Strong magnetic fields are supposed to originated during mergers, and to strongly influence both the electromagnetic and gravitational wave signals. A strong magnetic field is supposed to induce deformations in a NS that in principle might give rise to gravitational wave emission in the case of rapid rotators. Modeling the role and effects of strong magnetic fields is thus necessary to properly constrain the properties of NSs. We present here numerical models of magnetized NS derived in the so called XCFC approximation, and new publicly available code XNS to compute magnetized configuration for NSs. Results are shown for purely toroidal, purely poloidal configurations as well as for mixed case, usually referred as twisted torus.

Bucciantini, Niccolo

Mean field dynamo in thick disks around Kerr black holes: high-order axisymmetric simulations

Accretion on compact objects is commonly retained the most plausible mechanism to power up a list of astrophysical systems (AGNs, GRBs, X-Ray Binaries, etc. . .) due mostly to the high efficiency in converting energy (up to 40%) compared to processes like nuclear fusion (less than 1%). Ordered magnetic fields are a fundamental ingredient in all accretion processes, especially for their role in the generation of magneto-rotational instabilities and relativistic jets, but unfortunately their origin is poorly understood. We present here the first resistive GRMHD simulation in kinematic regime of a magnetized thick disk orbiting around a Kerr black hole, with a mean field dynamo mechanism that can continuously provide the amplification of the magnetic field within the disk.

Hawkes, Jarryd

Investigation of dense gas towards relativistic outflow sources

We probe the gaseous emission towards the objects Circinus X-1 (Cir X-1), a low-mass X-ray binary (XRB) with highly relativistic jets, and Westerlund 2, a young and energetic stellar cluster. The Westerlund 2 cluster is located towards interesting arc- and jet-like features seen in Nanten 12CO(J=1-0) data, which may be an indication of relativistic particle acceleration in the region and could have a common origin with coincident TeV source HESS J1023-575 (Fukui et al. 2009). We have mapped both regions with the Mopra radio telescope, in 7 mm and 12 mm wavebands, looking for evidence of disrupted/dense gas caused by the interaction between high energy outflows and the ISM. Towards Westerlund 2, peaks in CS(J=1-0) emission indicate high density gas towards the middle of the arc and the endpoint of the jet; and radio recombination line emission is seen overlapping the coincident HII region RCW49, providing possible insights into the origin of TeV emission in the region. Towards Cir X-1, 12CO(J=1-0) Nanten data reveals three molecular clouds that lie in the region of the XRB and nearby supernova remnant G321.9-0.3, while our Mopra results show extended CS(J=1-0) emission overlapping one of these clouds. Gas parameters for each cloud are presented here.

Kafexhiu, Ervin

Gamma-ray radiation of an ADAF accretion disk

Very hot accretion flows such as ADAF can reach very high temperatures and are able to initiate nuclear reactions. We solve the accretion disk chemical evolution and gamma-rays emissivity for some given accretion parameters and initial chemical composition. We use ADAF model, and a nuclear network which takes into account all relevant nuclear reactions. Depending on the accretion parameters and the initial chemical composition of ADAF model, we find that neutrons mass fraction abundance can reach values $X_n \sim 0.2$. A 10-M_{sun}-black hole with ADAF can give nuclear lines luminosities $L_N \sim 10^{34}$ erg/s. The luminosities in π^0-production for ADAF can be as high as $L_\pi \sim 10^{35}$ erg/s.

Ma, Renyi
The Large-scale Magnetic Fields of Slim Disks
Narrow-line Seyfert 1 galaxies (NLS1s) are well known for the high accretion rates, at which the disks are probably slim. Recent observations on the radio-loud NLS1s, and especially the discovery of gamma-ray loud NLS1s by Fermi, show the existence of relativistic jets. Considering the importance of the large-scale magnetic field in powering jets, the fields of slim disks are studied. From the equations of accretion, in which the effects of magnetic fields are included, we find the transonic solution. The strength of the field and its effects on the dynamics of slim disk are discussed.

Menzler, Ulf
The influence of plasma effects in pair beams on the cascade emission of blazars
TeV gamma-rays form distant blazar produce collimated electron-positron beams in the cosmic voids via photon-photon pair-production with the extra galactic background light. The energy distribution function is sharply peaked. Inverse-Compton scattering of these relativistic particles with the cosmic microwave background leads to still energetic photons. An electromagnetic cascade evolves leading to extended GeV radiation. Implying that the pairs are deflected before scattering, the non-detection of these radiation has lead to lower limits on the extra galactic magnetic field strength. We show with fully analytical treatment that plasma instabilities, causing a plateauing of the electron beam energy distribution, lead to much lower predictions of the GeV flux than before putting the current lower limits of the EGMF strength into question.

Millas, Dimitrios
Solutions of the wind equation in relativistic magnetized jets
We study the bulk acceleration in relativistic axisymmetric magnetized outflows, by solving the momentum equation along the flow, the so-called wind equation. The solutions for the bulk Lorentz factor depend on the geometry of the field/streamlines through the 'bunching function' S=r^2 B_p/A, where r is the cylindrical distance, B_p the poloidal magnetic field, and A the magnetic flux function. We investigate the general characteristics of the S function and how its choice affects the acceleration. In our study, various fast rise and slow decay examples are selected for S, with a global maximum near the fast magnetosonic critical point, as required from the regularity condition. For each case we determine the terminal Lorentz factor gamma_f and the acceleration efficiency gamma_f/mu, where mu is the total energy to mass flux ratio (which equals the maximum possible Lorentz factor of the outflow). With proper choices of S we can achieve efficiencies greater than 50%. Last, we examine the shape of the field/streamlines with respect to the choice of the S function. The results of this work, depending on the choices of mu, can be applied to relativistic GRB or AGN jets.

Mochol, Iwona
High-energy radiation from electromagnetic precursors of pulsar wind shocks
Strong waves can be launched in pulsar winds as extended precursors to the termination shocks. In certain conditions, a significant fraction of the Poynting flux carried by the wave can be converted to the high energy photons. In gamma-ray binaries IC scattering of an external photon field can result in an additional bright component, which could explain the outstanding GeV flare in the system B1259-63. We predict a low energy counterpart due to synchro-Compton emission.

Moldon, Javier
Evolution of the radio outflow in LS 5039
Gamma-ray binaries allow us to study physical processes such as particle acceleration up to TeV energies as well as very high energy gamma-ray emission and absorption with changing geometrical configurations on a periodic basis. These sources produce outflows of radio-emitting particles whose structure can be imaged with very long baseline interferometry (VLBI). We observed the gamma-ray binary LS 5039 with the VLBA at 5 GHz during five consecutive days. We present the observed radio morphological changes, which show a periodic orbital modulation. Multifrequency and multi-epoch VLBI observations conducted during the last decate confirm that the morphological periodicity is stable on timescales of years. Using a simple model we show that the observed behaviour is compatible with the presence of a young non-accreting pulsar with an outflow behind it.

Nishikawa, Kenichi
Current-Driven Kink Instability in Magnetically Dominated Rotating Relativistic Jet
We have investigated the influence of jet rotation and differential motion on the linear and nonlinear development of the current-driven (CD) kink instability of force-free helical magnetic equilibria via three-dimensional relativistic magnetohydrodynamic simulations. In this study, we follow the temporal development

within a periodic computational box. Displacement of the initial helical magnetic field leads to the growth of the CD kink instability. We find that, in accordance with the linear stability theory, the development of the instability depends on the lateral distribution of the poloidal magnetic field. If the poloidal field significantly decreases outward from the axis, then the initial small perturbations grow strongly, and if multiple wavelengths are excited, then nonlinear interaction eventually disrupts the initial cylindrical configuration. When the profile of the poloidal field is shallow, the instability develops slowly and eventually saturates. We briefly discuss implications of our findings for Poynting-dominated jets.

Paredes-Fortuny, Xavier
Optical photometric monitoring of LS I +61 303
Four gamma-ray binaries, namely PSR B1259-63, HESS J0632+057, HD 215227 and LS I +61 303, contain compact objects orbiting around massive Be stars. The nature of the compact object is only known in the case of PSR B1259-63, but the other systems could also contain young non-accreting pulsars with relativistic winds. Around periastron passage the compact objects should produce significant changes in the structure of the Be discs due to gravitational forces and eventually by ram pressure from the putative pulsar wind. Indeed, variability in the Halpha emission line has been detected in all these systems, and optical periodic variability has been detected in two of them. However, there is lack of a systematic monitoring with accurate photometry, which could be used to constrain the shape of the disc during the periastron passage. This information is important to build accurate physical models to explain the broadband spectral energy distribution of these sources. Here we present an ongoing program to monitor the optical photometry of gamma-ray binaries and show preliminary results for the case of LS I +61 303.

Petropoulou, Maria
Neutrino and UHECR spectra from Mrk 421 at a low state
We present the neutrino and UHECR spectra obtained from a detailed fitting of the spectral energy distribution (SED) of Mrk 421 at a preflare state (March 2001) using two variations of the lepto-hadronic model. In particular, the low-energy component (optical up to X-rays) of the SED is fitted by synchrotron emission of primary electrons in both models, while the high-energy one (GeV up to TeV gamma-rays) is synchrotron emission attributed either to ultra-high energy protons (Proton synchrotron model; LHs) or to secondary electrons produced by the decay of charged pions (Photopion model; LHπ). In the LHπ case we find that the produced neutrino spectra are sharply peaked at $E_{\nu}~30$ PeV with a peak flux slightly below the IC-40 sensitivity limit for Mrk 421. In the LHs model, on the other hand, the neutrino spectra fall well outside the PeV energy range, but the calculated $E~30$ EeV - UHECR flux at earth is close to that observed by Hires I, Telescope Array and Pierre Auger experiments.

Reynoso, Matias
On the production of high energy neutrinos in the internal shocks of gamma-ray bursts
We present preliminary results of a model with two zones in order to study the production of high energy neutrinos in internal shocks at the prompt phase of gamma-ray bursts (GRB). We consider an acceleration zone, where protons are injected and accelerated, being subject to synchrotron, proton-proton, and proton-gamma cooling. We also assume that they can escape from this zone at a certain rate. The produced pions and the decaying muons are also subject to energy loss and gain processes within the acceleration zone, and the escaping ones are re-injected in a second zone where acceleration no longer operates. In a steady state approximation, we compute the neutrino output expected from both of these zones using typical GRB parameters, and integrate in the redshift to obtain a diffuse neutrino flux which can be different from the expected within one-zone models.

Sobczak, Tomasz
Short Gamma-ray Flares in Jets of FSRQs: The Case of PKS 1222+21
We consider the injection of electrons close to the base of the jet in small reconnection regions and their propagation along the toroidal magnetic field in the jet. These electrons comptonize soft radiation from the broad line region (BLR) producing short gamma-ray flares as observed in FSRQs. Such scenario is applied to describe the short gamma-ray flares observed from distant quasars such as PKS 1222+21.

Tchernin, Celine
Neutrino signal from extended Galactic sources in IceCube
The Galactic Plane is the brightest source of gamma rays in the sky. It should be also (one of the) brightest very-high-energy neutrino sources, if a neutrino flux comparable to the gamma-ray flux is produced by the cosmic ray interactions with the gas in the interstellar medium. We calculate the normalization and slope of the neutrino spectrum from different regions of the Galactic plane, based on the observed spectral characteristics of the pion decay gamma-ray diffuse emission observed by the Fermi/LAT telescope. We

compare the neutrino flux calculated in this way with the sensitivity of IceCube for the detection of extended sources. Assuming a binned extended source analysis method, we find that the only possible evidence for neutrino emission for sources located in the Northern hemisphere is from the Cygnus region after 20 years of exposure. For other parts of the Galactic Plane even a 20 year exposure with IceCube is not sufficient for the detection. We also find that a neutrino detector with characteristics equivalent to IceCube, but placed at the Northern Hemisphere (such as KM3NeT), would detect several isolated neutrino sources in the Galactic Plane within just five year exposure at a 5 sigma level. These isolated sources of ~TeV neutrinos would unambiguously localize sources of cosmic rays which operated over the last 10 thousand years in the Galaxy.

Voisin, Fabien

Molecular gas towards HESS J1825-137

The pulsar wind nebula (PWN) HESS\,J1825$-$137 is one of the brightest TeV PWN and its morphology is influenced by molecular gas towards its northern edge. In order to better understand the composition and dynamics of this cloud we have considered CO(1-0) data from the Nanten survey and recently taken 7mm/ 12mm CS(1-0) and NH3 data using the Mopra telescope to probe the denser gas. Our results reveal extended CS(1-0) and clumpy NH3 in the northern cloud, which is 25-30 pc away from the pulsar PSRJ1826-1334 that powers HESS J1825-137. Our additional detections of recombination lines H 62_{α}, H65_{α} and methanol line CH$_{3}$OH(I) suggests the presence of massive star formation inside the molecular cloud. Our poster summarises these results and further investigates the velocity dispersion of the gas, searching for potential influences from the pulsar and progenitor supernova remnant. This will aid our understanding of the evolution of this PWN and enable a search for cosmic-ray induced gamma-rays in the region.