Cosmic Rays and Neutrinos in the Multi-Messenger Era

Rapport sur les contributions

https://indico.in2p3.fr/e/CRNMME24

ID de Contribution: **1** Type: **Non spécifié**

Registration

lundi 9 décembre 2024 08:30 (30 minutes)

ID de Contribution: **2** Type: **Non spécifié**

Welcome

lundi 9 décembre 2024 09:00 (10 minutes)

Orateur: SEMIKOZ, Dmitri (APC, Paris)

ID de Contribution: **3** Type: **Non spécifié**

Telescope Array results

lundi 9 décembre 2024 09:10 (30 minutes)

Orateur: TSUNESADA, Yoshiki

Classification de Session: UHECRs

ID de Contribution: **4** Type: **Non spécifié**

Auger results

lundi 9 décembre 2024 09:40 (30 minutes)

Affiliation

Orateur: ENGEL, Ralph

Classification de Session: UHECRs

ID de Contribution: **5** Type: **Non spécifié**

New developments in EPOS : toward a global approach from Heavy Ions to Cosmic Rays

lundi 9 décembre 2024 10:30 (30 minutes)

Affiliation

Orateur: PIEROG, Tanguy

Classification de Session: UHECRs

ID de Contribution: **6** Type: **Non spécifié**

QGSJet 3.1

lundi 9 décembre 2024 11:00 (30 minutes)

Orateur: OSTAPCHENKO, Sergey

Classification de Session: UHECRs

ID de Contribution: **7** Type: **Non spécifié**

Discussion UHECR

lundi 9 décembre 2024 11:30 (30 minutes)

Classification de Session: UHECRs

ID de Contribution: **8** Type: **Non spécifié**

GMF I

lundi 9 décembre 2024 13:30 (30 minutes)

Orateur: Prof. HAN

Classification de Session: GMF

ID de Contribution: **9** Type: **Non spécifié**

GMF II

lundi 9 décembre 2024 14:00 (30 minutes)

Orateur: Prof. UNGER, Michael

Classification de Session: GMF

ID de Contribution: **10** Type: **Non spécifié**

GMF III

lundi 9 décembre 2024 14:30 (30 minutes)

Orateur: KOROCHKIN, Alexander (ULB, Bruxelles)

Classification de Session: GMF

ID de Contribution: **11** Type: **Non spécifié**

Does the Local Bubble bias Galactic magnetic field models used to backtrack UHECRs?

lundi 9 décembre 2024 15:00 (30 minutes)

Affiliation

Orateur: PELGRIMS, Vincent

Classification de Session: GMF

ID de Contribution: **12** Type: **Non spécifié**

Discussion GMF

lundi 9 décembre 2024 16:00 (30 minutes)

Classification de Session: GMF2

ID de Contribution: **13** Type: **Non spécifié**

Poster Talks

lundi 9 décembre 2024 17:00 (1h 30m)

Affiliation

Classification de Session: Poster session

ID de Contribution: **14** Type: **Non spécifié**

Wine & cheese poster discussion

lundi 9 décembre 2024 18:00 (2 heures)

Classification de Session: Poster session

ID de Contribution: **15** Type: **Non spécifié**

EGMF1

mardi 10 décembre 2024 09:00 (30 minutes)

Orateur: VAZZA, Franco

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **16** Type: **Non spécifié**

EGMF2

mardi 10 décembre 2024 09:30 (30 minutes)

Orateur: DOLAG, Klaus

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **17** Type: **Non spécifié**

Dipole Anisotopies UHECR

mardi 10 décembre 2024 11:00 (30 minutes)

Affiliation

Orateur: FARRAR, Glennys

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **18** Type: **Non spécifié**

UHECR sources search review

mardi 10 décembre 2024 10:00 (30 minutes)

Orateur: BISTER, Teresa

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **19** Type: **Non spécifié**

Discussion UHECR sources

mardi 10 décembre 2024 11:30 (30 minutes)

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **20** Type: **Non spécifié**

Theory propagation <-> GMF

mardi 10 décembre 2024 14:00 (30 minutes)

Orateur: GIACINTI, Gwenael

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **21** Type: **Non spécifié**

Theory acceleration

mardi 10 décembre 2024 14:30 (30 minutes)

Orateur: COMISSO, Luca

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **22** Type: **Non spécifié**

CR other experiments and IceTop; connection to HE

mardi 10 décembre 2024 15:00 (30 minutes)

Orateur: SOLDIN, Denis

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **23** Type: **Non spécifié**

LHAASO CRs

mardi 10 décembre 2024 16:00 (30 minutes)

Orateur: HE, Huihai

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **25** Type: **Non spécifié**

Galactic diffuse gamma-rays (theory)

mardi 10 décembre 2024 16:30 (30 minutes)

Orateur: NERONOV, Andrii

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **26** Type: **Non spécifié**

Discussion

mardi 10 décembre 2024 17:00 (1 heure)

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **27** Type: **Non spécifié**

Cherenkov telescopes new

mercredi 11 décembre 2024 09:00 (30 minutes)

Orateur: HINTON, Jim

Classification de Session: HE-gamma sources

ID de Contribution: **28** Type: **Non spécifié**

LHAASO gamma-ray review

mercredi 11 décembre 2024 09:30 (30 minutes)

Orateur: CAO, Zhen

Classification de Session: HE-gamma sources

ID de Contribution: **29** Type: **Non spécifié**

Leptonic/PSW nebula

mercredi 11 décembre 2024 10:00 (30 minutes)

Orateur: KHANGULYAN, D.

Classification de Session: HE-gamma sources

ID de Contribution: **30** Type: **Non spécifié**

TeV halos

mercredi 11 décembre 2024 11:00 (30 minutes)

Orateur: LINDEN, T.

Classification de Session: HE-gamma sources

ID de Contribution: **31** Type: **Non spécifié**

SNR acceleration

mercredi 11 décembre 2024 11:30 (30 minutes)

Orateur: VINK, J.

Classification de Session: HE-gamma sources

ID de Contribution: **32** Type: **Non spécifié**

SNR Hadronic PeVatrons observations

mercredi 11 décembre 2024 13:30 (30 minutes)

Orateur: YANG, Ruizhi

Classification de Session: MM

ID de Contribution: **33** Type: **Non spécifié**

Hadronic PeVatrons/Super-bubbles

mercredi 11 décembre 2024 14:00 (30 minutes)

Orateur: VIEU, Thibault

Classification de Session: MM

ID de Contribution: **34** Type: **Non spécifié**

Discussion

mercredi 11 décembre 2024 15:00 (30 minutes)

Classification de Session: MM

ID de Contribution: **35** Type: **Non spécifié**

Poster Talks

mercredi 11 décembre 2024 16:00 (2 heures)

Classification de Session: Poster session

ID de Contribution: **36** Type: **Non spécifié**

Wine & cheese poster discussion

mercredi 11 décembre 2024 18:00 (1h 30m)

Classification de Session: Poster session

ID de Contribution: **37** Type: **Non spécifié**

General update neutrinos

jeudi 12 décembre 2024 09:00 (30 minutes)

Orateur: HALZEN, Francis

Classification de Session: Neutrinos

ID de Contribution: **38** Type: **Non spécifié**

The ANTARES legacy results

jeudi 12 décembre 2024 10:00 (30 minutes)

Orateur: KOUCHNER, Antoine

Classification de Session: Neutrinos

ID de Contribution: **39** Type: **Non spécifié**

Baikal GVD

jeudi 12 décembre 2024 11:00 (30 minutes)

Orateur: DVORNICKY, Rastislav

Classification de Session: Neutrinos

ID de Contribution: **40** Type: **Non spécifié**

KM3NeT from MeV to PeV

jeudi 12 décembre 2024 12:00 (30 minutes)

Orateur: HEIJBOER, Aart

Classification de Session: Neutrinos

ID de Contribution: **41** Type: **Non spécifié**

IceCube from MeV to PeV

jeudi 12 décembre 2024 11:30 (30 minutes)

Orateur: O'SULLIVAN, Erin

Classification de Session: Neutrinos

ID de Contribution: **42** Type: **Non spécifié**

Radio detection of neutrinos

jeudi 12 décembre 2024 14:00 (30 minutes)

Orateur: KOTERA, Kumiko

Classification de Session: Neutrinos

ID de Contribution: **43** Type: **Non spécifié**

Galactic neutrino searches (combined)

jeudi 12 décembre 2024 14:30 (30 minutes)

Orateur: KURAHASHI, Naoko

Classification de Session: Neutrinos

ID de Contribution: **44** Type: **Non spécifié**

High energy astrophysical neutrinos: Open questions and future prospects

jeudi 12 décembre 2024 15:00 (30 minutes)

The main goals of high-energy neutrino astronomy are to identify the sources of high-energy cosmic rays, particularly ultra-high-energy ones, and to provide information on the acceleration process and constraints on models of high-energy astronomical objects. The detection of high-energy astronomical neutrinos demonstrates the potential for achieving these goals. I will discuss what we have learned from current neutrino observations and the prospects for making progress on identifying the sources.

Affiliation

Orateur: WAXMAN, Eli

Classification de Session: Neutrinos

ID de Contribution: **45** Type: **Non spécifié**

Discussion

jeudi 12 décembre 2024 15:30 (30 minutes)

Classification de Session: Neutrinos

ID de Contribution: **46** Type: **Non spécifié**

Real-time astronomy

jeudi 12 décembre 2024 17:00 (30 minutes)

Orateur: SANTANDER, Marcos

Classification de Session: Neutrinos

ID de Contribution: **47** Type: **Non spécifié**

MM in transients

jeudi 12 décembre 2024 16:30 (30 minutes)

Orateur: WINTER, Walter

Classification de Session: Neutrinos

ID de Contribution: **48** Type: **Non spécifié**

High-Energy Multimessenger Emission from Supermassive Black Holes

mercredi 11 décembre 2024 14:30 (30 minutes)

Affiliation

Orateur: MURASE, Kohta

Classification de Session: MM

ID de Contribution: **49** Type: **Non spécifié**

Connection gamma-neutrino-CR

jeudi 12 décembre 2024 17:30 (30 minutes)

Affiliation

Orateur: OIKONOMOU, Foteini

Classification de Session: Neutrinos

ID de Contribution: **50** Type: **Non spécifié**

New physics with neutrino telescopes

jeudi 12 décembre 2024 18:00 (30 minutes)

Orateur: ARGÜELLES, Carlos

Classification de Session: Neutrinos

ID de Contribution: **51** Type: **Non spécifié**

DAMPE: B/C, heavier nuclei, e^++e^-

vendredi 13 décembre 2024 09:00 (30 minutes)

Orateur: ALEMANNO, Francesca

Classification de Session: Low-energy CRs – ”Escape problem”

ID de Contribution: **52** Type: **Non spécifié**

CALET, B/C, heavier nuclei, e^++e^-

vendredi 13 décembre 2024 09:30 (30 minutes)

Orateur: MAESTRO, Paolo

Classification de Session: Low-energy CRs – ”Escape problem”

ID de Contribution: **53** Type: **Non spécifié**

AMS-02: Be9/10, escape times

vendredi 13 décembre 2024 10:00 (30 minutes)

Orateur: OLIVA, Alberto

Classification de Session: Low-energy CRs – ”Escape problem”

ID de Contribution: **54** Type: **Non spécifié**

Interpretation breaks 200GV, 10TV: source/diffusion

vendredi 13 décembre 2024 11:00 (30 minutes)

Orateur: EVOLI, Carmelo

Classification de Session: Low-energy CRs – ”Escape problem”

ID de Contribution: **55** Type: **Non spécifié**

Cosmic ray feedback and magnetic dynamos in galaxy formation

mardi 10 décembre 2024 13:30 (30 minutes)

Affiliation

Orateur: PFROMMER, Christoph

Classification de Session: UHECR / Knee – CRs

ID de Contribution: **56** Type: **Non spécifié**

Discussion

vendredi 13 décembre 2024 12:00 (30 minutes)

Classification de Session: Low-energy CRs – ”Escape problem”

ID de Contribution: **57** Type: **Non spécifié**

Conference summary

vendredi 13 décembre 2024 12:30 (45 minutes)

Orateur: AHARONIAN, Felix

ID de Contribution: **59** Type: **Non spécifié**

Observing Scenarios and Multi-messenger Implications for the International Gravitational-Wave Network during O4 and O5

An advanced LIGO and Virgo's third observing run brought another binary neutron star merger (BNS) and the first neutron-star black hole mergers. While no confirmed kilonovae were identified in conjunction with any of these events, continued improvements of analyses surrounding GW170817 allow us to project constraints on the Hubble Constant (H_0), the Galactic enrichment from r-process nucleosynthesis, and ultra-dense matter possible from forthcoming events. Here, we describe the expected constraints based on the latest expected event rates from the international gravitational-wave network (IGWN) and analyses of GW170817. We show the expected detection rate of gravitational waves and their counterparts, as well as how sensitive potential constraints are to the observed numbers of counterparts. We intend this analysis as support for the community when creating scientifically driven electromagnetic follow-up proposals.

Affiliation

CEA, Irfu

Auteurs principaux: GRAY, Abigail; TOIVONEN, Andrew; PUECHER, Anna; FOLEY, Emily M.; SINGER, Leo P.; COUGHLIN, Michael W.; SRAVAN, Niharika; KUNER, Nina; PANG, Peter T. H.; VANDENBERG, R. Oliver; KIENDREBEOGO, R. Weizmann (CEA, Irfu); KAM, S. Zacharie; ANAND, Shreya; DIETRICH, Tim; AHUMADA, Tomàs; KARAMBELKAR, Viraj

Co-auteur: FARAH, Amanda M.

ID de Contribution: **60** Type: **Non spécifié**

Pulsar RMs observed by FAST and the Galactic magnetic fields

The Five-hundred-meter Aperture Spherical radio Telescope (FAST) is the most sensitive radio telescope for pulsar observations. We make polarimetric measurements for a large number of faint and distant pulsars in the Galactic halo and determined their rotation measures (RM). We also determined a few hundreds of RMs by processing the polarimetric data for newly-discovered pulsars in the project of the Galactic Plane Pulsar Snapshot (GPPS) survey or previously known pulsars without RMs. Through analysis of all available RMs of pulsars and extragalactic sources, we reveal the magnetic field structure in a much larger region in the Galactic halo and disk.

Affiliation

National Astronomical Observatories, Chinese Academy of Sciences

Auteur principal: XU, Jun (National Astronomical Observatories, Chinese Academy of Sciences)

Co-auteur: HAN, JinLin (National Astronomical Observatories, Chinese Academy of Sciences)

Classification de Session: Poster session

ID de Contribution: **61** Type: **Non spécifié**

Gamma-ray signatures of particle acceleration at stellar wind termination shocks up to PeV energies

Young massive stellar clusters have recently brought attention as PeVatrons candidates, to explain the knee of the cosmic ray spectrum and how protons can be accelerated to such energy scale in galactic sources. The new detector LHAASO is the first to probe well the photon detection band >0.1 PeV, that can correspond to multi-PeV hadronic cosmic rays. Thus, it enables the use of its gamma-ray data to constrain the galactic particle acceleration models and parameters, and to identify the contribution from the different categories of galactic accelerators to the observed cosmic ray flux, especially in the PeV domain.

To that extent, we model the escape and the transport of cosmic rays from their accelerator to molecular clouds, where a lot of p-p interactions producing gamma rays occur. We are focusing on the case where the source is a young massive star cluster, hence the particles are accelerated in stellar wind termination shocks before escaping. We try to determine in a semi-analytical approach the parameters needed (distance between cloud and source, time, slope of injection, number of stars, etc) to produce an excess in the gamma-ray flux corresponding to PeV cosmic rays, that could be detectable by LHAASO. This enables to constrain the subspace of the parameter space for which a detectable excess could exist, and therefore constrains the subset of systems (cluster+cloud) that could produce such an excess. Then, the goal is to find such systems and compare predictions of the models for the gamma-ray flux to LHAASO data in order to determine more precisely different acceleration parameters, such as the wind termination shock efficiency or the injection spectrum in the interstellar medium. Another goal is to try to explain some of the dark PeVatrons seen by LHAASO with systems star cluster+cloud.

Affiliation

APC

Auteur principal: INVENTAR, Alexandre (APC Laboratory)

Co-auteur: M. GABICI, Stefano (APC Laboratory)

ID de Contribution: **62** Type: **Non spécifié**

Ultra-high-energy cosmic rays from ultra-fast outflows of active galactic nuclei

We investigate ultra-fast outflows (UFOs) of active galactic nuclei (AGN) as potential sites for the production of the highest-energy cosmic rays, focusing on cosmic-ray nuclei, a previously unexplored aspect. These mildly-relativistic large-scale outflows, with velocities reaching up to half the speed of light, are ubiquitous in AGN. We numerically study the processes that affect the maximum energy of the cosmic rays with 3D CRPropa simulations of the vicinity of the AGN. We then apply our method to 87 observed UFOs. We find that the studied UFOs can accelerate iron nuclei to $\sim 10^{20}$ eV, but only a small fraction of these sources allow the nuclei to escape, owing to photonuclear interactions with the intense photon fields within the AGN. The expected flux suppression limits the viability of UFOs as the sources of the observed ultra-high-energy cosmic-ray nuclei, although an intermittent escape during low emissivity states of the associated AGN may be possible. The vast majority of the investigated outflows mainly allows protons and neutrons, which are either primary or byproducts of photodisintegration, to escape due to a lower number of interactions. We conclude that UFOs can supply the protons below the ankle of the cosmic-ray spectrum, making them intriguing source candidates for this component of the observed flux.

Affiliation

Norwegian University of Science and Technology

Auteur principal: EHLERT, Domenik (Norwegian University of Science and Technology)

Co-auteurs: PERETTI, Enrico (APC); OIKONOMOU, Foteini

ID de Contribution: **63** Type: **Non spécifié**

Cherenkov Telescope Array Observatory sensitivity to heavy Galactic Cosmic Rays

Finding the sources responsible for accelerating Galactic Cosmic-Rays (GCRs) to energies up to PeV remains a challenging research topic. Observations of high-energy gamma-rays by the Cherenkov Telescope Array Observatory (CTAO) would help us to identify these sources, called PeVatrons. These gamma-rays emerge from the interaction of CRs with surrounding matter through the $\pi 0$ process and can be traced in the spectral shape of gamma-rays. Among the galactic sources, Supernova Remnants (SNRs) are considered as potential CR accelerators up to PeV energies due to their large energy budget. Based on the results of the multiwavelength analysis (MWL) of Galactic SNRs (Sharma et al., 2023), RX J1713.7-3946 and HAWC J2227+610 were studied to assess CTAO's sensitivity to observe CRs.
To perform this study, gamma-ray spectra were simulated using Gammapy and Naima for different CR compositions including light CRs (protons) and heavy CRs (CNO, Fe). The radiative model parameters were obtained from the previous MWL study.
The simulations revealed that the sensitivity of CTAO to the spectral shape of gamma-rays, would allow us to distinguish protons from heavy CRs, in case of both sources.

Affiliation

IJCLab

Auteur principal: DUBOS, Coline (IJCLab)

ID de Contribution: **65** Type: **Non spécifié**

A search for neutron fluxes from Galactic candidate sources using data from the Pierre Auger Observatory

Since neutral particles are not deflected by magnetic fields, they are a valuable tool for studying the sources of ultra-high-energy cosmic rays (UHECRs). It is expected that sources of UHECRs will also produce neutrons through nuclear interactions and photo-pion production near the source. Free neutrons undergo beta decay, traveling a typical distance of $9.2 \times (E/1\,\mathrm{EeV})$ kpc. As a result, neutron fluxes in the EeV energy range could potentially be detected from Galactic sources of UHECRs. Using data from the Surface Detector of the Pierre Auger Observatory, the world's largest cosmic ray detector, we search for neutron fluxes from candidate Galactic sources. Since it is not possible to distinguish between air showers caused by protons or neutrons, we would identify neutron fluxes as excess of cosmic ray events around the direction of a candidate source. We compare the observed signal to the expected background contribution to search for such excesses. Our candidate sources include different classes of astrophysical objects, such as pulsars, microquasars, magnetars, and selected γ-ray sources identified by LHAASO. We also consider two single-element target sets: the Galactic center and the Crab Nebula. We analyze observed cosmic ray events with declination between -90° and $+45^\circ$ and energy starting from 0.1 EeV. While we do not detect any significant excess of events indicating a neutron flux from these candidate sources, we establish upper limits for the neutron fluxes.

Affiliation

University of Hamburg

Auteur principal: Dr DE OLIVEIRA FRANCO, Danelise (University of Hamburg)

Co-auteur: FOR THE PIERRE AUGER COLLABORATION

ID de Contribution: **66** Type: **Non spécifié**

Unveiling the hard X-ray emission of NGC 1068, a possible high energy neutrino source

One of the central questions in high-energy astrophysics is the origin of high-energy cosmic rays and neutrinos. The Seyfert 2 Compton-thick AGN NGC 1068 stands out as a promising candidate for high-energy neutrino emission, with a significance level of 4.2. Various models have been proposed to explain the multi-messenger emission associated with this source. X-ray data are crucial for constraining the presence of a potential hadronic component in the electromagnetic spectral energy distribution of AGNs. In this context, we analyzed publicly available data from XMM-Newton, NuSTAR, INTEGRAL-IBIS, INTEGRAL-SPI and Swift-BAT spanning over more than 20 years. The resulting spectra cover the 3–195 keV energy range, allowing us to investigate the presence of a cutoff in the hard X-ray regime and thereby explore its hadronic versus leptonic origin. Our analysis confirms that the spectrum is dominated by Compton reflection processes up to 80 keV, while the hard X-ray component does not show any significant cutoff. We will discuss the implication of these results in the context of the multi-messenger emission of NGC 1068.

Affiliation

AstroParticules et Cosmologie - APC

Auteur principal: FOISSEAU, Antoine (AstroParticules et Cosmologie - APC)

Co-auteurs: COLEIRO, Alexis (APC / Université Paris Diderot); GOLDWURM, Andrea (CEA/IRFU/SAp-Saclay; APC-Paris); LACHAUD, Cyril (APC / Université Paris Cité); CANGEMI, Floriane (UPC/APC)

ID de Contribution: **68** Type: **Non spécifié**

Search for GeV neutrino counterparts associated with high-energy IceCube neutrinos

IceCube has made significant progress in identifying astrophysical sources of high-energy neutrinos. However, the majority of the astrophysical flux remains unexplained, prompting further investigation. To improve our understanding of this flux and its sources, it is important to investigate the presence of a component at lower neutrino energies. To this end, we propose a study that searches for GeV neutrinos associated with neutrino events above 60 TeV of reconstructed energy. Since the specialized event selection sensitive in this range is dominated by atmospheric backgrounds, we focus on a hypothesis of short transient neutrino sources, which would then produce both high-energy and GeV neutrino in time correlation. The classes of astrophysical transients already proposed as GeV neutrino sources such as collapsars serve to motivate the assumed emission time scale. We show the statistical method and sensitivity of this search as well as the data quality checks to be performed.

Affiliation

UCLouvain

Auteurs principaux: RAAB, Christoph (UCLouvain); WILBERTS DEWASSEIGE, Gwenhaël (UCLouvain)

ID de Contribution: **69** Type: **Non spécifié**

High-energy neutrino astrophysics with the KM3NeT telescope

KM3NeT is a neutrino telescope located in the depths of the Mediterranean Sea. It consists of two sites, ARCA (off the Sicilian coast of Capo Passero) dedicated to the study of astrophysical neutrinos and ORCA (off the French coast of Toulon), optimised for GeV - TeV energies.
The two detectors are still under construction and should be completed in the next few years. However, the first detection lines have already been deployed and are collecting exploitable physics data.
I will present the first results with these partial configurations in the context of neutrino and multi-messenger astrophysics. In particular, the contribution will focus on the candidate detection of a very-high-energy neutrino event with the 21-line configuration of the ARCA detector.

Affiliation

UCLouvain

Auteur principal: LAMOUREUX, Mathieu (UCLouvain)

ID de Contribution: **71** Type: **Non spécifié**

Status and prospects of the astrophysical GeV neutrino emission searches with IceCube and KM3NeT

In the last decade, neutrino telescopes have probed astrophysical sources to probe cosmic ray acceleration mechanisms and shine light on properties previously unseen. The main neutrino telescopes nowadays are IceCube in the Antarctic ice and KM3NeT under construction in the Mediterranean Sea. These Cherenkov based neutrino telescopes are specially built for neutrino astronomy at TeV and higher neutrino energies, but that does not mean GeV neutrinos are undetectable. We present that despite high background rates at these lower energies,the large instrumented volume allows for detection of transient astrophysical phenomena for neutrinos at GeV energies. For example the search for neutrinos from the Gamma Ray Burst GRB221009A as well as the follow up of Gravitational waves from Ligo-Virgo-Kagra. There are also ongoing efforts to further improve the sensitivity of GeV neutrinos through machine learning techniques for noise reduction and direction reconstruction, possibly lowering the detector threshold to 100 MeV.

Affiliation

UCLouvain

Auteur principal: WILBERTS DEWASSEIGE, Gwenhaël (UCLouvain)

Co-auteur: KRUISWIJK, Karlijn (UCLouvain)

ID de Contribution: **72** Type: **Non spécifié**

Fast Radio Burst Sources and Neutrinos in the Multi-Messenger Context

Fast Radio Bursts (FRBs) are millisecond-long electromagnetic emissions originating from extra-galactic sources, characterized by unprecedented energies in the radio domain. Their properties are consistent with the hypothesis of turbulent, highly magnetized, and dense media surrounding their sources. These sources are strong candidates for multi-messenger emissions, partly due to the huge energy involved in the bursts. In light of the multi-wavelength observation of the galactic magnetar SGR 1935+2154, which was associated with both a Hard X-ray Burst (XRB) and the FRB 20200428A detected in coincidence, several new models have emerged. Magnetars –young neutron stars with extremely intense magnetic fields –appear to be the most promising objects for FRB emissions. The emission of high-energy neutrinos from magnetars with similar characteristics as SGR 1935+2154 has been investigated, suggesting a potential multi-messenger emission involving a neutrino counterpart alongside the FRB. On this basis, an analysis has been conducted to investigate a neutrino-FRB correlation in the data from the KM3 Neutrino Telescope (KM3NeT) and the radio bursts published online. This analysis covers the wide KM3NeT energy range from GeV to PeV. This work presents the properties of FRB sources and examines neutrino emission models from magnetars in relation with FRB models. Finally, the results of the correlation search conducted in KM3NeT with around 900 days of neutrino data and 250 FRBs is provided, setting a limit on the neutrino fluxes for each FRB source.

Affiliation

Subatech/Nantes

Auteur principal: BRETAUDEAU, Felix

ID de Contribution: **73** Type: **Non spécifié**

Insights from modelling the brightest Fermi-LAT blazar flare

The electromagnetic flare of the flat-spectrum radio quasar (FSRQ) 3C 454.3 in November 2010 was the brightest γ-ray flare ever observed by the *Fermi*-LAT from a blazar. We performed the data analysis of the multiwavelength (from infrared photons to γ rays) quasi-simultaneous 1-day-averaged spectral-energy distributions (SEDs) for seven days of the flare and modelled the observed emission with the AM^3 program for the time-dependent simulation of radiative processes. We show that each of the 1-day averaged SEDs can be well described with a leptonic model producing the observable emission originating from a $\sim 10^{16}$-cm-sized region located beyond the outer radius of the broad-line region (BLR). The emission region (blob) should be a stationary feature in the jet into which the relativistic plasma with a high bulk Lorentz factor ($\Gamma \sim 20 - 40$) is injected. On the contrary, modelling the blob as moving along with the bulk motion of the jet plasma results in an underprediction of the γ-ray flux due to the lack of target photons for the inverse Compton process in the later days of the flare. We demonstrate that the γ-ray data support that the observed emission comes from the electrons with a rather low maximum injection energy $E_e^{\prime \max} \sim 10^9$ eV implying small acceleration efficiency. Assuming protons might be accelerated along with electrons with the same efficiency, we obtain the constraints on the neutrino yield from 3C 454.3.

Affiliation

Department of Physics, Norwegian University of Science and Technology (NTNU)

Auteur principal: PODLESNYI, Egor (NTNU)

Co-auteur: Prof. OIKONOMOU, Foteini (NTNU)

ID de Contribution: **74** Type: **Non spécifié**

Incorporating theoretical blazar models into neutrino stacking analyses with KM3NeT/ARCA

After IceCube's identification of the blazar TXS 0506+056 as the first cosmic neutrino source candidate, blazars have started to be considered among the most promising neutrino source classes. An improvement of the observations is expected thanks to the development of next-generation neutrino telescopes, such as KM3NeT/ARCA. KM3NeT/ARCA is a deep-sea Cherenkov neutrino telescope currently under construction in the Mediterranean Sea. Once completed, it will cover a volume of one cubic kilometer and will be capable of detecting neutrinos with energies ranging from 100 GeV up to multi-PeV. Thanks to its modular design, it is currently operational in a partial detector configuration. This contribution introduces, for the first time, a framework that integrates theoretical blazar models—computed using the LeHa code—into binned likelihood stacking analyses based on KM3NeT/ARCA's data. Modeling proton-photon interactions and the resulting radiative processes requires complex numerical simulations to accurately predict the expected neutrino spectra. In parallel, statistical likelihood methods are being developed to identify a potential neutrino signal above the observed background. By incorporating these theoretical models within the statistical data analysis, the proposed methodology aims to improve the sensitivity of neutrino searches from various blazar sub-classes, enabling a deeper understanding of the link between photon and neutrino emissions from astrophysical sources.

Affiliation

University of Bologna and INFN-BO

Auteur principal: CARENINI, Francesco

Co-auteur: CERRUTI, Matteo (Université de Paris - APC)

ID de Contribution: **75** Type: **Non spécifié**

Neutrino follow-up observations with the High Energy Stereoscopic System (HESS)

Realtime alerts have become a cornerstone of multi-messenger astronomy since the past decade. Electromagnetic (EM) observatories operating in various wavelength-bands regularly follow up alerts issued by other EM facilities and more commonly by the neutrino and gravitational wave (GW) observatories across the world. While the localization of GW wave alerts in the sky is rather large at present, multi-TeV neutrinos have a directional uncertainty of ~ 1 deg., allowing for swift identification of potential counterparts. IceCube sends out these alerts publicly as well as privately to some observatories under MoU. The High Energy Stereoscopic System (HESS), is an Imaging Air Cherenkov Telescope (IACT) sensitive to TeV gamma-rays, located in the Namibian desert. HESS receives alerts from IceCube under MoU for an accumulation of events in a particular sky direction above a certain threshold, as well as the individual track-like events also avalable to the public. Follow-up observations are performed based on the purity of the signal, visibility to HESS, presence of known GeV sources in the error region etc.
In this poster/talk on behalf of HESS, I will shed light on the real-time alert paradigm, in general and specific to HESS, and also share the results of a few important follow-ups performed by HESS in the past.

Affiliation

Laboratoire Astroparticule et Cosmologie (APC), Paris

Auteur principal: SHARMA, Ankur (Laboratoire Astroparticule et Cosmologie (APC), Paris)

ID de Contribution: **76** Type: **Non spécifié**

Tracking the gas distribution in the Galactic Centre using neutrinos

The Central Molecular Zone at the Galactic Centre hosts the most massive and densest molecular clouds in our Galaxy. The mass of the clouds could be inferred from the infrared emission of the dust, or line emissions from tracers like CS and CO, but different methods having different assumptions sometimes yield inconsistent results. We propose that neutrinos can act as a new gas tracer to resolve this problem. Diffuse baryonic media will glow in neutrinos and gamma-rays when bombarded by energetic hadrons. The neutrino brightness is directly proportional to the mass of the cloud, making it an unambiguous tracer of the gas mass. Future neutrino detectors such as P-ONE, KM3NeT, and Baikal-GVD will detect neutrinos from the Galactic Centre with angular resolutions better than 0.1 deg for muon neutrinos above 10 TeV. We discuss how a future measurement of neutrino emissions from the Central Molecular Zone will help pin down the more accurate mass tracers and disentangle the leptonic and hadronic contribution when combined with gamma-ray observations.

Affiliation

Mullard Space Science Laboratory, University College London

Auteur principal: LAI, Paul Chong Wa (University College London, Mullard Space Science Laboratory)

Co-auteurs: CRUDELE, Beatrice (UCL); Dr OWEN, Ellis (Osaka University); OIKONOMOU, Foteini; Prof. WU, Kinwah (MSSL, UCL); Dr AGOSTINI, Matteo (UCL)

ID de Contribution: **77** Type: **Non spécifié**

LHAASO detection of Ultra-high-energy Gamma-Ray Emissions from the Giant Molecular Clouds

Gain Molecular Clouds (GMCs) are massive reservoirs of gas and dust, with masses typically around 10^5 M . GMCs are critical regions for studying Cosmic Ray (CR) interactions and their effects on interstellar medium (ISM). We selected six GMCs, which are at high galactic latitude and in the field of view of LHAASO. These GMCs are within 1 kpc distance from the Sun. By using the data from the LHAASO-WCDA and KM2A, we studied the gamma-ray emissions with energy above TeV from these GMCs. We find an excess emission in the clouds by performing a stacked analysis of GMCs. The derived spectral agreed with the expected gamma-ray flux produced via pp interactions. We also try to give a limits of the CR "knee"by measuring the UHE gamma-ray emission from the GMCs.

Affiliation

University of Science and Technology of China

Auteurs principaux: YU, Yanhong (University of Science and Technology of China); YANG, Ruizhi (USTC)

ID de Contribution: **78** Type: **Non spécifié**

Energy dependence of the knee in the cosmic-ray spectrum across the Milky Way

The all-particle spectrum of cosmic rays measured at Earth has a knee-like feature around 4 PeV. A priori, it is not clear if this is a local feature specific to the Solar neighbourhood in the Milky Way, or if it is a generic property of the Galactic cosmic-ray spectrum. We argue that combining gamma-ray and cosmic-ray data of LHAASO indicates that the knee is a local feature. In order to demonstrate this, we derive a model for the local cosmic-ray spectrum and composition, consistent with the recent LHAASO measurements of the all-particle spectrum and the mean logarithmic mass in the knee region. We calculate the spectrum of diffuse gamma-ray emission based on this model and find that the expected spectral shape of the diffuse gamma-ray flux disagrees with the LHAASO measurements of the diffuse gamma-ray emission in the 10-100 TeV energy range in the inner and outer Galaxy. We determine the break energy in the CR spectrum expected from these gamma-ray data and find it an energy ten times lower than obtained from local measurements.

Affiliation

IAP (Sorbonne University and CNRS)

Auteur principal: PRÉVOTAT, Clément (IAP)

Co-auteurs: NERONOV, Andrii; SEMIKOZ, Dmitri (APC, Paris); KACHELRIESS, Michael (Department of Physics, NTNU); M. KOLDOBSKIY, Sergey (Sodankyl¨a Geophysical Observatory and Space Physics and Astronomy)

ID de Contribution: **79** Type: **Non spécifié**

Monitoring the northern sky and follow-up analysis of the multi-messenger alerts with LHAASO-WCDA

With high duty cycle, wide field of view and high sensitivity, LHAASO-WCDA is a promising facility to monitor very-high-energy transient extra-galactic sources unbiasedly. We developed an real-time monitoring system based on LHAASO-WCDA observations which will send alerts within Half a day at most if there is any detection. In the past one year of operation, the system has detected more then ten flare events from IC 310, 1ES 1959+650, BL Lac, etc., and triggered multi-band follow-up observations including VERITAS, Fermi-LAT, Swift-BAT. At the same time, we are actively following up on multi-band and multi-messenger alerts, including X-ray, GeV, neutrino, etc. In this poster, I will present the preliminary results of the sources detected by the monitoring system and the results of follow-up analysis of neutrino alerts.

Affiliation

Institute of High Energy Physics, Chinese Academy of Sciences

Auteur principal: HU, Shicong (Institute of High Energy Physics, Chinese Academy of Sciences)

Co-auteurs: M. XIANG, Guangman (Shanghai Astronomical Observatory, Chinese Academy of Sciences); Dr ZHA, Min (Institute of High Energy Physics, Chinese Academy of Sciences)

ID de Contribution: **80** Type: **Non spécifié**

J1048+7143: A Supermassive Black Hole Binary Candidate*

Coincident quasi-periodic oscillations are observed in the gamma-ray, optical and radio light curves from the blazer J1048+7143. While in gamma rays and optical, the flares consist of two subflares each, the radio emissions show a Gaussian-like flare structure.

Here, we show that all these flares are consistent with a supermassive binary black hole at the center of this blazar, caused by the spin-orbit coupling of the leading jet.
A jet precession model is presented, with which we successfully predicted the timing of the flare observed between 2022 and 2024. With this model, we constrained the mass ratio of the binary, allowing predictions of when it will merge. Finally, we model the characteristic strain of its expected gravitational wave emission.
*Supported by DFG (MICRO and SFB 1491)

Affiliation

CEA/IRFU/DPHP

Auteur principal: JAROSCHEWSKI, Ilja (CEA/IRFU/DPHP)

Co-auteurs: KUN, Emma (Ruhr University Bochum); BECKER TJUS, Julia (Ruhr University Bochum); BRITZEN, Silke (Max-Panck-Institut für Radioastronomie)

ID de Contribution: **81** Type: **Non spécifié**

Investigating the neutrino signatures of candidate neutrino-emitter blazars

Active galactic nuclei are compelling candidates for astrophysical neutrino sources, as suggested by the detection of a high-energy neutrino positionally consistent with the flaring blazar TXS 0506+056 and evidence of neutrino emission from the nearby Seyfert galaxy NGC 1068. Our recent studies based on the IceCube time-integrated sky maps provided evidence of a statistically significant correlation between blazars and anisotropies in the IceCube neutrino distribution. They highlight a small subset of blazars as promising candidate neutrino point sources. The neutrino emission properties of these blazars remain largely unexplored. While the IceCube collaboration has released a 10-year dataset of track-like events, no public analysis tools were made available to the scientific community. In this contribution, we introduce IceCubePy, an unbinned maximum likelihood framework designed for the analysis of the public data from the IceCube Neutrino Observatory. We present the analysis performance of IceCubePy, showing that they are largely consistent with those published by the IceCube collaboration. We hence demonstrate that the software is mature and reliable for scientific analyses. Finally, we showcase its first application to the study of candidate neutrino-emitter blazars. These initial findings, conducted within the framework of the ERC *MessMapp* project, further support the proposed blazar-neutrino association from both neutrino observations and theoretical perspectives.

Affiliation

University of Würzburg, DESY Zeuthen

Auteur principal: LINCETTO, Massimiliano (University of Würzburg / DESY Zeuthen)

Co-auteurs: AZZOLLINI, Alessandra (University of Würzburg); Mlle BREMER, Annette (University of Würzburg); Dr PROKHOROV, Dmitry (University of Würzburg); M. SANCHEZ ZABALLA, Jose Maria (University of Würzburg / DESY Zeuthen); PFEIFFER, Leonard (University of Würzburg); Dr BOUGHELILBA, Margot (DESY Zeuthen); BUSON, Sara (University of Würzburg / DESY Zeuthen)

ID de Contribution: **82** Type: **Non spécifié**

The environment of pulsar halo progenitors

Since the discovery of TeV halos around the Geminga and B0656+14 pulsars by the HAWC experiment in 2017, many theoretical efforts have been dedicated to understanding this source class. Indeed, assuming that they are probing the environment outside their parent supernova remnant (SNR), the gamma-ray emission hints at a confinement of high energy particles that challenges our current understanding of the CR transport in the average interstellar medium (ISM).
Recent hypotheses, including those proposed by Fang et al. 2020, suggest that such an assumption could be erroneous for middle-aged pulsars. Instead, these pulsars may be located in the downstream of the SNR, where turbulence freshly induced by shock activity significantly alters turbulence conditions.
To settle the issue of the position of the relative position of the pulsar, we propose an evolutionary model which coherently describes the evolution of the SNR as a function of the explosion energy and the ambient gas density and take into account the observed distribution of pulsar kick velocities. These quantities being subject to large variance over the Galaxy, we rely on a Montecarlo approach which gives as a result the probability of a pulsar of a given age to remain behind the SNR.
We also investigate more physically accurate models of pulsars being born in stellar wind bubbles and superbubbles to find the probability of a pulsar being inside a turbulent medium or in the ISM. Finally, considering the pulsar progenitor properties, we give the probability of pulsars of a representative Galactic population being in a turbulent medium as a function of their age.

Affiliation

Auteur principal: BOURGUINAT, Lioni-Moana (GSSI)