THE 1st LHAASO SYMPOSIUM

Sunday, 28 May 2023 - Friday, 2 June 2023

Tianfu Cosmic Ray Research Centre

Book of Abstracts

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Corresponding Author: gabici@apc.in2p3.fr

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Moring Session II / **6**

CR Spectra below knees-DAMPE

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Summary:

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Exploring the Emission Mechanisms of Mrk 180 with long term X-ray and Gamma-ray data

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Markarian (Mrk) 180 is a BL Lacertae (BL Lac) object located at a redshift of 0.045 and a potential candidate for high-energy cosmic ray acceleration.
We have analyzed the Fermi-LAT gamma-ray data of Mrk 180 collected over a period of 12.8 years. We have also analyzed Swift X-ray, ultraviolet & optical, and XMM-Newton X-ray data to construct the multi-wavelength SED. The SED has been modelled with one-zone pure leptonic and lepto-hadronic scenarios to explain the underlying physics of multi-wavelength emission. We have done a comparative study between these pure leptonic and lepto-hadronic models. Moreover, an earlier

study has associated Mrk 180 with the Telescope Array (TA) hotspot of UHECRs at E>57 EeV motivates us to check whether ultrahigh energy protons
and iron nuclei can reach the earth from Mrk 180. In this poster, I shall give an overview of our work on this source.

Summary:

Afternnon Session II / 8

Jitter Mechanism as a Kind of Coherent Radiation: GRB 221009A beyond 10 TeV

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The emission of GRB 221009A beyond 10 TeV has been detected by LHAASO. We suggest jitter radiation as a possible explanation for the TeV emission of this energetic GRB. We first present a short review on both synchrotron mechanism and jitter mechanism. We then present the kinetic turbulence that can work on the small length scale. In our scenario, the jitter radiation field is linked to the perturbation field, and the perturbation field is dominated by the kinetic turbulence. The jitter radiation can reach the TeV energy band when we consider either electron cooling or Landau damping. We further suggest that the jitter radiation in the very high-energy band is coherent, and the observational flux of GRB 221009A in the TeV energy band can be reproduced by the the coherent jitter mechanism. In addition, the coherent jitter radiation is expected to have wide applications in the high-energy astrophysical research field.

Summary:

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High-energy Morphologies of Supernova Remnants

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It is considered that supernova remnant (SNRs) is one of the most possible accelerators of Galactic Cosmic Rays (CRs). For the high-energy observation of SNRs, there are a huge debate about the radiation mechanism and the physical processes. Whether SNRs are the efficiently hadronic accelerators is still a question. The Large High Altitude Air Shower Observatory (LHAASO) is the first great science instruments in CR field independently built by our Chinese with an unprecedented sensitivity above 30 TeV and a wide spectrum range to do the research about the morphologies of SNR candidates. Base on the multiwavelength observations of SNR, the morphologies of LHAASO sources associated with SNRs are studied by means of the numerical simulation of SNR evolution. This will help to understand the SNR high-energy particle acceleration and radiation processes.

Summary:

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The Radio Knots within SNR Cassiopeia A and Turbulence around Geminga TeV halo

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The study on the dynamic evolution of young supernova remnants (SNRs) is an important way to understand the density structure of the progenitor ' s circumstellar medium. We have reported the acceleration or deceleration,
proper motion, and brightness changes of 260 compact radio features in the second-youngest known SNR Cas A at 5 GHz based on the Very Large Array data of five epochs from 1987 to 2004. The radio expansion center is located
at α(1950) = 23h21m9 7 ± 0 29, δ(1950) = +58°32′25 2 ± 2 2. Three-quarters of the compact knots aredecelerating; this suggests that there are significant density fluctuations in the stellar winds of the remnant ' s progenitor. We have verified that the acceleration or deceleration of compact knots is not related with the distribution of brightness. The brightening, fading, disappearing, or new appearing of compact radio features in Cas A suggests that the magnetic field in the remnant is changing rapidly.

Summary:

Afternnon Session II / 11

Probing the Glashow resonance and beyond with ultrahigh energy neutrino telescopes

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The standard model (SM) of particle physics predicts the resonant scattering of electron anti-neutrinos off the electron target, as first pointed out by Sheldon Glashow. The Glashow resonance is the only feasible way now to distinguish between neutrinos and antineutrinos at ultrahigh energies. Recently, a candidate event with an energy deposition of around 6.05 PeV has been confirmed by the IceCube Observatory. Such an event arises very likely from the Glashow resonance and can provide us valuable information about the source of cosmic rays and ultrahigh energy neutrinos. I will first talk about the implications of this Glashow resonance candidate to cosmic neutrino sources, incorporating both the atomic Doppler broadening effect and initial state radiation while calculating the cross section. Then, I move on to discussing the prospect of upcoming neutrino telescopes. In particular, the potential of mountain-valley telescopes for the Glashow resonance will be emphasized. Finally, I will discuss exotic resonances arising from new physics beyond the SM.

Summary:

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A long-duration gamma-ray burst with a peculiar origin

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It is generally believed that long-duration gamma-ray bursts (GRBs) are associated with massive star core-collapse, whereas short-duration GRBs are associated with mergers of compact star binaries. However, growing observations have suggested that oddball GRBs do exist, and multiple criteria (prompt emission properties, supernova/kilonova associations, and host galaxy properties) rather than burst duration only are needed to classify GRBs physically. A previously reported long-duration burst, GRB 060614, could be viewed as a short GRB with extended emission if it were observed at a larger distance and was associated with a kilonova-like feature. As a result, it belongs to the Type-I (compact star merger) GRB category and is likely of the binary neutron star merger origin. Here we report a peculiar long-duration gamma-ray burst, GRB 211211A, whose prompt emission properties in many aspects differ from all known Type-I GRBs, yet its multi-band observations suggest a non-massive-star origin. In particular, significant excess emission in both optical and near-infrared wavelengths has been discovered, which resembles kilonova emission as observed in some Type-I GRBs. These observations point towards a new progenitor type of GRBs. A scenario invoking a white dwarf-neutron star merger with a post-merger magnetar engine provides a self-consistent interpretation for all the observations, including prompt gamma-rays, early X-ray afterglow, as well as the engine-fed kilonova emission.

Summary:

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TeV emission surrounding the high galactic latitude pulsar J1740+1000: a possible pulsar halo or a TeV source from the tail of bow shock

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We report the discovery of an unidentified point-like very-high-energy (VHE) gamma-ray source around the PSR J1740+1000 named LHAASO J1740+0948.
Its significance is 12σ (5.4σ) above $25\mathrm{TeV}$ ($100\mathrm{TeV}$) and the best-fit position is $(\mathrm{R.A.}, \mathrm{decl}) = (265.01 \pm 0.03, 9.79 \pm 0.04)$. The energy spectrum can be described by a single power-law function with an index of -3.15 ± 0.17. PSR J1740+1000 is a middle-aged (114 kyr) pulsar with a long X-ray tail. This means that TeV radiation may come from (1) high energy electrons escaping from the pulsar/PWN and scattering the interstellar radiation field, i.e, pulsar halo. But the TeV source and PSR J1740+1000 position offsets are difficult to interpret; (2) upscattering of CMB photons by the ultrarelativistic particles from the PWN tail. We speculate the particles were re-accelerated at the tail of the bow shock.

Summary:

Afternnon Session II / 14

The Einstein Probe Mission

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Einstein Probe (EP) is an upcoming space mission dedicated to the detection and characterization of high-energy transients. It will carry one wide-field lobster-eye X-ray telescope to monitor the soft X-ray sky in 0.5-4 keV with a 3600 square-degree FoV, and a narrow-field X-ray telescope in 0.3-10 keV for deep follow-up observations and precise source locating. Transient alerts can be issued quickly to trigger follow-up observations at multi-wavelengths. Aiming for launch by the end of 2023, EP is a mission of the Chinese Academy of Sciences with the participation of ESA and MPE. This talk will introduce the latest status of the EP mission, and present the prospects of EP in the high-energy transient and multi-messenger astrophysics. Recent results from the EP-WXT pathfinder (also known as LEIA) launched in July 2022 will also be presented.

Summary:

Afternoon session I / 15

First-principle simulations of cosmic-ray transport in the self-confinement regime

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Cosmic-rays (CRs) have been recognized to play an important role in the galactic ecosystem through CR feedback. The key underlying microphysics lie in the CR gyro-resonant instabilities, which trigger the growth of Alfv' en waves that lead to energy and momentum exchange between the CRs and the background plasmas, as well as CR self-confinement. I will present simulations of the CR gyro-resonant instabilities using the magnetohydrodynamic-particle-in-cell (MHD-PIC) method in a variety of simulation settings. By designing a streaming box and an expanding box framework, our simulations achieve the steady-state balance between wave growth and damping, as well as between driving CR streaming/anisotropy and isotropization via wave scattering. It allows us to measure the CR transport coefficients from first principles as a function of background environment, which will offer reliable subgrid prescriptions for macroscopic studies of CR feedback and transport.

Summary:

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Explaining the Hardening Structures of Helium Spectrum and Boron to Carbon Ratio through Different Propagation Models

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Recently, a series of high-precision measurements by various experiments have revealed a hardening trend in the spectra of cosmic ray nuclei and the boron-to-carbon (B/C) ratio at around 200 GV. These anomalous structures have important implications for our understanding of the origin and propagation of Galactic cosmic rays (GCRs). We investigate several propagation models and verify

that an extension of the traditional propagation model taking into account spatially dependent propagation and secondary particle acceleration provides a more accurate description of the latest B/C ratio and the Helium flux data measured by DAMPE, CALET, and AMS-02.

Summary:

Morning Session I / **17**

LHAASO Experiment (General+ first catalog)

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Summary:

Morning Session I / **18**

Galactic Cosmic Rays - Accelearion and propagation

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online

Morning Session I / **19**

CTA and complementarity of techniques

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Summary:

Moring Session II / **20**

Stellar Clusters/SNR and Cosmic Rays

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Summary:

Moring Session II / **21**

LHAASO –SNRs

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Moring Session II / **22**

LHAASO - Stellar Clusters

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Summary:

Afternoon session I / **23**

Turbulent magnetic fields: detections, and implications on CRs

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Afternoon session I / **24**

To be confirmed

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Afternoon session I / **26**

Start Clusters as gamma-ray sources

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In the last decade several Young Star Clusters have been associated to diffuse gamma-ray sources both in the GeV and TeV energy ranges. The origin of such emission is still debated, however hadronic processes due to interaction between gas and locally accelerated cosmic rays seems to be favored at least in some cases. The acceleration mechanism is probably related to powerful stellar winds emitted by the most massive stars in the clusters. I will present a model based on acceleration at the termination shock of those winds, showing how the predicted gamma-ray emission agrees with the one observed from the Cygnus OB association. Moreover, using the same model I will present the total contribution to the diffuse Galactic gamma-sky due to clusters which are too dim to be resolved as single sources by present gamma-ray telescopes.

Afternnon Session II / **28**

The Milky Way Imaging Scroll Painting (MWISP) Survey Project: New Molecular Line Data along the Northern Galactic Plane

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Molecular clouds are the cold and dense part (n ≥ 10^2 cm-3) of hierarchical interstellar medium concentrated toward the Galactic disk. A number of wide-field surveys in molecular lines have been made to investigate the gas distribution and physical processes. Significant progresses have

been made over the last 50 years. However, further improvement of our understanding of interstellar molecular gas was hampered by sensitivity, sky coverage, spatial resolution, velocity coverage, spectral or velocity resolution, and line tracers. The Milky Way Imaging Scroll Painting (MWISP) project was initiated to map the northern galactic plane in 12CO/13CO/C18O J=1-0 lines using the Superconducting Spectroscopic Array Receiver (SSAR), a sideband-separation superconducting SIS focal plane array receiver system at the 13.7m millimeter-wave radio telescope of Purple Mountain Observatory Qinghai Station. An area of 2400 degˆ2 within L=10˜250 deg, B=+/-5 deg was fully covered in its first phase by 11 observing seasons over the period of 2011-2021. MWISP survey is characteristic of high sensitivity, wide sky coverage, and most importantly, multi-line tracers for the first time of its kind. In this talk, I will introduce the general features of the survey, presenting the large-scale CO data and images of molecular emission, examples of discoveries and statistics, followed by illustration of Galactic targets or areas which may be of potential interests to the study of high-energy gamma-rays and cosmic-ray phenomena.

Summary:

Afternnon Session II / 30

Update on ASTRI: Technology and science using wide-field aplanatic IACT telescopes

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The ASTRI program was launched 10 years ago with the goal of developing small-sized dual-mirror aplanatic wide-field IACT telescopes as a precursor to the array of small-sized telescopes (SSTs) for the Cherenkov Telescope Array (CTA) observatory's southern site. The program initially received support from INAF and MUR (the Italian Ministry for Universities and Research), but it later gained support from other international partners such as the University of Sao Paulo/FAPESP, Nort-West University/South Africa, IAC, FGG, and Université de Geneve at different stages of the project. The program's first significant achievement was the development of the end-to-end ASTRI-Horn prototype and its installation at the INAF site of Serra La Nave. The prototype featured an innovative compact camera based on SiPM sensors and proved the dual-mirror Schwarzschild-Couder optical configuration as an aplanatic system while detecting the Crab Nebula in gamma rays. The telescope underwent major refurbishment and is now used to observe the volcano's bright gamma-ray sources, cosmic rays, and muon radiography studies. Meanwhile, the ASTRI mini-array is being implemented in Tenerife to study the gamma-ray sky in the 1-100 TeV energy band with unprecedented angular resolution (3 arcmin), which complements LHAAZO perfectly. This talk discusses the project's current status, scientific goals, and expectations.

Afternnon Session II / 31

ASTRI Optical design

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ASTRI is a 4 m class Imaging Atmospheric Cherenkov Telescope (IACT) devoted to the observation of gamma sources in the TeV emission band. The telescope implements an innovative optical design based on the dual-mirror Schwartzchild –Couder (SC) configuration. The SC configuration was proposed at the beginning of 1900 as an aplanatic configuration capable of reducing off-axis angular resolution degradation and hence enhancing the field of view. ASTRI was inaugurated in 2014 and is the first telescope realized in SC configuration. The optical performance of ASTRI is perfectly matching the TeV band IACT requirements with an angular resolution <0.2° across the field of view of about ˜10°.

ASTRI was then adopted as a baseline for the Cherenkov Telescope Array Small Size telescopes and is going to be implemented in 9 replicas at the ASTRI Mini Array, a TeV band Cherenkov Observatory realized by the Italian Institute for Astrophysics at the Tenerife site.

Summary:

Morning Session I / **32**

LHAASO results on PWNe and Pulsar Halos

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Morning Session I / **33**

Binaries seen in Gamma ray

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Summary:

Moring Session II / **34**

Galactic Cosmic Rays- general review

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Moring Session II / **36**

CR Spectra in the knee region

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Summary:

Afternoon session I / **37**

LHAASO PWN tail: PSR J1740+1000

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Afternoon session I / **38**

LHAASO Millisecond pulsar PWN: J0218+4232

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Afternoon session I / **39**

LHAASO Geminga spectrum and morphology

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Afternoon session I / **40**

How do pulsars generate extended VHE sources? A PWN tale

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Currently, the bulk of Galactic VHE sources are associated with isolated, rotation powered neutron stars (i.e. pulsars). However, how pulsars produce such sources is poorly understood. Answering this question requires understanding the evolution of the pulsar wind nebulae (PWN) produced by the neutron star – where particles are believed to be accelerated to the required PeV energies and then injected into their surroundings. In this presentation, I will discuss a simple one-zone model for such sources, and how the application of this model to PWNe in different stages of their evolution can be used to understand the origin of the highest energy sources in the Milky Way.

Summary:

Afternoon session I / **41**

Spatially resolved TeV emission from the jets of the microquasar SS 433

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The microquasar system SS 433 provides a unique opportunity to study mildly relativistic collimated jets in our own Galaxy. From its core, a binary system hosting a stellar-mass black hole, two persistent, semi-relativistic jets are launched, almost perpendicular to the line of sight. X-ray observations reveal that these jets extend out to around 100 pc on either side of the central system, terminating at the radio structure W50. The jets of SS 433 were recently reported to be a source of TeV gamma-rays by the HAWC collaboration. I will report the results of deep observations of this system with the H.E.S.S. array of telescopes, resulting in the first detection of the system by an Imaging Atmospheric Cherenkov Telescope array.

To fully exploit the capabilities of the H.E.S.S. observations, a new approach to background rejection was deployed, which I will briefly describe. It is based on the detection of Cherenkov light from muons by large Imaging Atmospheric Cherenkov Telescopes (IACTs), such as the telescope located at the center of the H.E.S.S. array. The application of this technique leads to a factor four reduction in background above several tens of TeV in the H.E.S.S. stereoscopic analysis.

The superior energy and angular resolution of the H.E.S.S. array compared to HAWC allow for a

detailed study of the morphology and spectral energy distribution of the gamma-ray emission in the jets, including a measurement of the physical extension of the emission and of the spectra of the jets out to tens of TeV. This measurements are put in the context of the multi-wavelength emission from the jets to constrain the properties of the high energy particle population responsible for the emission.

Afternnon Session II / **42**

Diffuse gamma-ray and neutrino background from Milky Way Galaxy

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Recently LHAASO measured diffuse gamma-ray background from Milky Way in inner and outer Galaxy. In this talk I' ll discuss how combining this information with Fermi LAT gamma-ray, IceCube neutrino and cosmic ray data we can constrain models
of cosmic ray propagation in Galaxy.

Summary:

Afternnon Session II / **43**

Nuclear and electron cascades induced by UHECRs

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Afternnon Session II / **44**

Particle acceleration and multi-messenger radiation from extra-galactic outflows

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Winds and outflows are ubiquitous at several scales throughout the Cosmos.They often develop a bubble structure characterized by strong shocks and turbulence where high-energy particles can be efficiently produced.
I will present a model in which diffusive shock acceleration is a
key process to energize particles in such astrophysical winds.
I will show some model applications in the context of starburst galaxies and active galactic nuclei and I will discuss the associated multi-messenger implications in terms of high-energy photons, neutrinos and escaping cosmic rays.

Afternnon Session II / **45**

Cosmic rays and diffuse gamma-ray emission from the Milky Way

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Summary:

Morning Session I / **46**

LHAASO - Cosmic Rays

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Summary:

Morning Session I / **47**

LHAASO Diffuse: Qiang Yuan

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Morning Session I / **48**

Extragalactic Cosmic Rays

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Online

Moring Session II / **49**

GRBs and their Afterglows

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Moring Session II / **50**

LHAASO - Extragalactic (GRB afterglows and AGN)

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Summary:

Moring Session II / **51**

Gamma Ray Emitting AGN

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Summary:

Afternoon session I / **52**

to be comfirmed

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Afternoon session I / **53**

measurements of mean logarithmic mass of cosmic rays near the knee region by LHAASO

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Afternoon session I / **54**

LHAASO AGN: NGC 1275 and Mrk 421

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Summary:

Afternoon session I / **55**

Galactic black holes as PeVatrons

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Afternnon Session II / **56**

to be comfirmed

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Afternnon Session II / **57**

multi-messenger approach of searching for PeVatrons and UHECR sources

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Afternnon Session II / **58**

LHAASO Dark matter: Dwarf Spheroidal Galaxies

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Afternnon Session II / **59**

LHAASO Updating with WCDA for LHAASO J2108+5157 or LHAASO J0341+5258

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Morning Session I / **60**

LHAASO - Fundamental Physics (DM, LIV, etc.)

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Morning Session I / **61**

Gravitaion waves and GRBs

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Moring Session II / **62**

Fermi - summary of the Fermi Results

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Moring Session II / **63**

Low Energy Neutrinos

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Summary:

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Interpretation of the light curve of gamma-ray emission from the 2021 outburst of the recurrent nova RS Ophiuchi

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Nova outbursts take place in binary star systems comprising a white dwarf and either a low-mass Sun-like star (classical novae) or, a red giant. GeV gamma-ray emission has been detected from a dozen classical novae and from one nova in a symbiotic system (V407 Cyg) by Fermi-LAT. For classical novae, gamma-ray emission is generally thought to be related to internal shocks formed as fast outflow collides with the slow outflow. However, for V407 Cyg, the origin of the gamma-ray emission has been debated, as both an internal shock and an external shock resulting from the collision between the nova ejecta and the ambient wind of the giant companion, and were suggested to explain the gamma-ray data. Recently, bright GeV and TeV gamma-ray emission has been detected from a nova in symbiotic system, RS Ophiuchi, during its 2021 outburst, which shows a remarkably smooth power-law decay in time up to about one month after the outburst. We show that this temporal decay behavior can be interpreted as arising from an adiabatic external shock expanding in the red giant wind. In this interpretation, the gamma rays are produced by shock-accelerated protons interacting with the dense wind through the hadronic process. We also derive the scaling relations for the decay slopes for both adiabatic and radiative nova shocks in the self-similar deceleration phase.

Summary:

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Choked jets in expanding envelope as the origin of the neutrino emission associated with Tidal Disruption Events

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Three tidal disruption event (TDE) candidates (AT2019dsg, AT2019fdr, AT2019aalc) have been found to be coincident with high energy astrophysical neutrinos in multi-messenger follow-ups. Recent studies suggest the presence of a quasi-spherical, optically thick envelope around the supermassive black holes in TDEs, resulted from stellar debris after the disruption. The envelope may expand outwardly with a velocity of $\sim 10^4\,\mathrm{km}^{-1}$, as indicated by the emission line widths. We study whether the neutrino signal can be explained by choked relativistic jets inside the expanding envelope. While powerful jets, such as that in Swift J1644+57, can successfully break out from the envelope, those with relatively weak power could be choked by the envelope. Choked jets can still accelerate cosmic rays and produce high-energy neutrinos via interaction with the thermal photons in the envelope. We explore the parameter space of the jets that can produce detectable neutrino flux while being choked in the expanding envelope.
We find that the cumulative neutrino numbers of AT2019fdr and AT2019aalc are consistent with the expected range imposed by observations, while the allowed parameter space for AT2019dsg is small.

The neutrino time delay relative to the optical peak time of TDEs can be explained as the jet propagation time in the envelope before being choked. The discovery of TDE-associated neutrino events may suggest that jets might have been commonly formed in TDEs, as expected from super-Eddington accretion, but most of them are too weak to break out of the expanding envelopes.

Summary:

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Indication of an X-ray halo associated with HESS J1809-193: Implication for its gamma-ray origin and Prospect for LHAASO

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HESS J1809-193 is an extended TeV γ-ray source and the origin of its γ-ray emission remains ambiguous. Pulsar wind nebula (PWN) of PSR J1809-1917 laying inside the extended γ-ray emission is a possible candidate. Powered by the central pulsar, ultrarelativistic electrons in PWN can produce radio to X-ray emission through synchrotron and γ-ray emission by inverse Compton (IC) scattering. To check whether this PWN is the counterpart of HESS J1809-193, we analyzed Chandra X-ray radial intensity profile and the spectral index profile of this PWN. We then adopt a one-zone isotropic diffusion model to fit the keV and the TeV data. We find diffuse nonthermal X-ray emission extending beyond PWN, which is likely an X-ray halo radiated by escaping electron/positron pairs from the PWN. A relatively strong magnetic field of ~ 20 μG is required to explain the spatial evolution of the X-ray spectrum (i.e., the significant softening of the spectrum with increasing distance from the pulsar), which, however, would suppress the IC radiation of pairs. Our result implies that a hadronic component may be needed to explain HESS J1809-193.

Summary:

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Detection of Diffuse γ-Ray Emission toward a Massive Star-forming Region Hosting Wolf–Rayet Stars

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Isotopic and elemental abundances seen in Galactic cosmic rays (GCRs) imply that ~20% of the cosmic-ray (CR) nuclei are probably synthesized by massive Wolf–Rayet (W-R) stars. Massive star clusters hosting W-R- and OBtype stars have been proposed as potential GCR accelerators for decades, in particular via diffusive shock acceleration at wind termination shocks. Here we report the analysis of Fermi Large Area Telescope data toward the direction of Masgomas-6a, a young massive star cluster candidate hosting two W-R stars. We detect an extended γ-ray source with a test statistic = 183 in the vicinity of Masgomas-6a, spatially coincident with two unassociated Fermi 4FGL sources. We also present the CO observational results of molecular clouds in this region, using the data from the Milky Way Imaging Scroll Painting project. The γ-ray emission intensity correlates well with the distribution of molecular gas at the distance of Masgomas-6a, indicating that these γ-rays may be produced by CRs accelerated by massive stars in Masgomas-6a. At the distance of 3.9 kpc of Masgomas-6a, the luminosity of the extended source is (1.81 ± 0.02) × 1035 erg s−1. With a kinetic luminosity of ~1037 erg s−1 in the stellar winds, the W-R stars are capable of powering the

γ-ray emission via neutral pion decay resulted from CR proton–proton interactions. The size of the GeV source and the energetic requirement suggests a CR diffusion coefficient smaller than that in the Galactic interstellar medium, indicating a strong suppression of CR diffusion in the molecular cloud.

Summary:

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Constraints on the pair injection of pulsar halos: Implications from the Galactic diffuse multi-TeV gamma-ray emission

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Diffuse gamma-ray emission (DGE) has been discovered over the Galactic disk in the energy range from sub-GeV to sub-PeV. While it is believed to be dominated by the pionic emission of cosmic ray hadrons via interactions with interstellar medium, unresolved gamma-ray sources may also be potential contributors. TeV gamma-ray halos around middle-aged pulsars have been proposed as such sources. Their contribution to DGE, however, highly depends on the injection rate of electrons and the injection spectral shape, which are not well determined based on current observations. The measured fluxes of DGE can thus provide constraints on the injection of the pulsar halo population in turn. We estimate the contribution of pulsar halos to DGE based on the Australia Telescope National Facility pulsar samples with taking into account the off-beam pulsars. The recent measurement on DGE by Tibet ASγ and an early measurement by Multiple Institution Los Alamos Gamma Ray Observatory (MILAGRO) are used to constrain the pair injection parameters of the pulsar halo population. Our result may be used to distinguish different models for pulsar halos.

Summary:

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Constrain the ISM density in the G106.3+2.7 cavity

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We constrain the density of the interstellar medium (ISM) around the hadronic PeVatron candidate, supernova remnant (SNR) G106.3+2.7, based on X-ray and γ-ray observations. The purpose of this investigation is to understand the influence of the gaseous environment on this SNR as a proton PeVatron candidate. By modelling the self-regulated propagation of the CRs injected from the SNR, we calculate the γ-ray emission of CRs via the hadronuclear interactions with the molecular cloud and the ISM, and use the measured γ-ray flux to constrain the ISM density around the SNR. Our results support the picture that the SNR is expanding into a low-density cavity of $n < 0.05\,\mathrm{cm}^{-3}$, enabling the SNR to be a potential proton PeVatron despite that it is not in the very early phase.

Summary:

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An attempt to analyse the GRB 221009A using Fermi-GBM data

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We analyzed the notable GRB 221009A using Fermi-GBM data, a gamma-ray burst lasting 600 seconds. The event is divided into three distinct phases: the Precursor, Main, and Tail. The Main phase is further subdivided into Main-1 and Main-2 subphases. During the Main-1 phase, we observed an evolution of the low-energy spectral index, with the index shifting from greater than -2/3 to less than -2/3. We hypothesize that synchrotron radiation occurs first, followed by inverse Compton scattering. However, the Main-2 and Tail phases present a challenge as classical models fail to provide adequate fits. This suggests that these two stages may not represent typical gamma-ray burst prompt emissions and necessitate the development of new models for explanation. Our findings contribute to the understanding of the complex processes during GRB 221009A and emphasize the need for further research in this area.

Summary:

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Constraints on the intergalactic magnetic field strength from gamma-ray observations of GRB 221009A

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TeV gamma-ray sources can be used to constrain the Intergalactic Magnetic Fields (IGMF), which provides an important clue on the origin of the seed field in early university. TeV photons from very-high-energy (VHE) transient sources such as Gamma-ray burst (GRB) are absorbed on Extragalactic Background Light (EBL), and then create eˆ+eˆ- pairs that will radiate delayed, secondary GeV photons by interacting with Cosmic Microwave Background (CMB) photons. Characteristics of the observable cascade gamma-ray signal are sensitive to the strength and structure of the IGMF. There has been a debate on whether GRB 190114C, the first GRB with bright TeV photons, can constrain the IGMF. Recently, LHAASO detected the brightest-of-all-time GRB 221009A, which has much larger energy in TeV band and the spectrum extends to energy above 10 TeV, providing an unprecedented chance to studying the cascade emission. By comparing it with the flux limit obtained from Fermi-LAT observations, we infer a limit of > 10ˆ{-18.5} Guass for IGMF. For the 397 GeV photon arrived at 0.4 day after GBM trigger time, we find that the probability that it results from the cascade process is only 0.8%.

Summary:

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Particle Diffusion and Acceleration in Magnetorotational Instability

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Hot accretion flows contain collisionless plasmas under turbulence generated by the magnetorotational instability (MRI), which can be potential source of particle acceleration. We conduct unstratified shearing-box magnetohydrodynamic (MHD) simulations of the MRI turbulence with net vertical magnetic flux, with and without explicit dissipation, and inject relativistic test particles in simulation snapshots. The results are analyzed by applying the Fokker-Planck equation to particle momentum evolution. We find that the particle momentum diffusion coefficient scales as 𝐷(𝑝) ∝ 𝑝, for lower-energy particles, and shear acceleration takes over when particle gyro-radius 𝑟𝑔 ≳ 0.1𝐻. There also appear to be an anomalous direct acceleration/deceleration, likely associated with the intermittency in the MRI turbulence, and is affected by the turbulence Prandtl number. We also discuss the potential of accelerating PeV cosmic-rays in hot accretion flows around supermassive black holes.

Summary:

74

Gamma pta with 5@5

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In this work we investigate the potential of Pulsar time array study using imaging air Cherenkov telescopes (IACTs). We simulated the detected photons from pulsars using the response of hypothetical low threshold IACTs taking into account of the cosmic ray (CR) backgrounds and timing profile. We then analyzed the timing property of the simulated data in analog to the PTA studies using Fermi LAT data. We found that , thanks to the higher photon statistics of IACTs , the PTA using IACTs can improve significantly the performance compared with the PTA using Fermi LAT data.

Summary:

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Constraints on Models of Gamma-ray Bursts with Observations of Fermi on Bright GRBs

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Gamma-ray bursts (GRBs) are widely suggested as potential sources of ultrahigh-energy cosmic rays (UHECRs). The kinetic energy of the jets dissipates, leading to the acceleration of protons or nuclei which interact with the intense radiation field of GRBs via the photomeson and Bethe-Heitler processes. These processes initiate a series of electromagnetic cascades, giving rise to a broadband

emission up to GeV-TeV gamma-ray regime. The expected gamma-ray flux from cascades depends on properties of the GRB jet, such as the dissipation radius, the bulk Lorentz factor, and the baryon loading factor. Therefore, observations of Fermi-LAT can impose constraints on these important parameters. In this work, we calculate the cascade emissions from some bright GRBs, compare the expected fluxes with the measurements of Fermi-LAT on these GRBs, and obtain allowable ranges of aforementioned parameters. We find that the brighter the GRB is, the more stringent constraint for the baryon loading factor will be obtained. For the brightest GRBs, such as GRB 221009A and 130427A, the baryon loading factor can be limited to be smaller than unity for a large ranges of dissipation radius and bulk Lorentz factor, which are much more stringent than the stacking limits based on GRB neutrino measurements. The obtained constraints from gamma rays disfavor GRBs as the main sources of UHECRs if the constraints can be generalized to all GRBs. Our results also shed some lights on the jet composition and the jet-launching mechanism.

Summary:

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A hard spectrum diffuse gamma-ray component associated with HII gas in the Galactic plane

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We analyzed 12-year Fermi Large Area Telescope gamma-ray data in the inner Galaxy centered at (l=30 degree, b=0 degree) and (l=330 degree, b=0 degree). We found significant hardening of the spectrum of the diffuse gamma-ray emission in these regions as previously reported. We further deduced that the diffuse gamma rays can be divided into two components from the likelihood analysis. One component is associated with the total gas column density and reveals a soft spectrum, while the other is associated with the HII gas and presents a hard spectrum. Assuming the diffuse gamma-ray emissions are mainly produced through the interaction between cosmic rays (CRs) and the ambient gas, these two components are produced by the CR populations with spectral indices of 2.8 (”soft”) and 2.3 (”hard”), respectively. We argue that the hard CR population may come from the vicinity of the CR accelerators. The soft CR population has a similar spectral shape and density as measured in the solar neighborhood, which implies a uniform CR “sea” with a similar density and spectral shape in the Galaxy.

Summary:

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Prospect of detecting X-ray haloes around middle-aged pulsars with eROSITA

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The detection of extended TeV gamma-ray emission (dubbed 'TeV haloes') around Geminga and Monogem pulsars by High Altitude Water Cherenkov collaboration implies that the halo-like morphologies around middle-aged pulsars may be common. The gamma-ray emission above 10 TeV is thought to arise from inverse Compton scattering of relativistic electrons/positrons in the pulsar haloes off cosmic microwave background photons. In the meanwhile, these electrons and positrons can produce X-ray synchrotron emission in the interstellar magnetic field, resulting in a diffuse emission in the X-ray band (namely X-ray haloes). Here, we study the prospect of detecting X-ray haloes with extended Roentgen Survey with an Imaging Telescope Array (eROSITA) from 10 middle-aged pulsars with characteristic age τ_c larger than tens of thousands of years in the Australia Telescope National Facility pulsar catalogue. Assuming a benchmark value (i.e. B = 3 μG) for the magnetic field, most of the X-ray haloes are found to be bright enough to be detected by eROSITA in the energy range of 0.5–2 keV with a 20 ks targeted survey. Among these pulsar haloes, four are detectable in the ongoing 4-yr eROSITA all-sky survey. Thanks to the large grasp in the soft X-ray band, eROSITA is expected to be able to measure the surface brightness profiles of the X-ray haloes from sub-pc up to tens of pc scales, which can be used to constrain the magnetic field and the diffusion coefficient in the pulsar haloes.

Summary:

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Modelling the X-Ray Emission from the Magnetar Wind Nebula around Swift J1834.9-0846

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The extended X-ray emission around Swift J1834.9-0846 observed with XMM-Newton was recently identified to be the first magnetar wind nebula. The high X-ray efficiency of this nebula indicated that it may not be predominately powered by rotational energy of magnetar, but its internal magnetic energy released during burst activities. Similar to the case of rotation-powered pulsar, the energetic particle outflow injected from the magnetar propagates downstream of the termination shock and produces non-thermal radiations through interactions with the interstellar medium. The observed photon index softening towards the outer nebula was attributed to the cooling of relativistic electrons, which could provide useful information about particle transport in this nebula. In this work, we reanalyzed the XMM-Newton observations taken in 2014, and then developed a spatially dependent model to simulate the X-ray emission from the magnetar wind nebula. The fitting results favor the magnetic origin of the magnetar wind nebula. We also found that the observations could be well explained by the model without particle diffusion, indicating advection dominates particle transport in this nebula.

Summary:

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Prospects for LACT observation of gamma ray sources in LHAASO catalog

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Being an important supplement of LHAASO observatory, Large Array of Cherenkov Telescope (LACT) is designed to study the morphology and spectrum of ultra-high energy gamma ray sources observed by LHAASO experiment. Due to the strong sky survey ability for gamma ray sources of LHAASO and the high angular resolution of LACT, the combination of the two experiments will observe the gamma ray sources with unprecedented precision. In this poster, we will give prospects of LACT observation for the gamma ray sources in LHAASO catalog. The LACT telescopes only can operated in night. Furthermore, they can not be run in the summer because of the frequently rain. The calculation of observed periods for the sources is very complicated. Therefore, we will describe the calculation of observed periods for each sources in detail and give the results. In addition, taking the energy spectrum of gamma ray sources from LHAASO and considering the effective areas of LACT at different zenith, we will prospect the events that LACT can observed in one year. Based on above study, we will give the preliminary observation plan of LACT for the sources in LHAASO catalog.

Summary:

81

Fermi-LAT detection of extended gamma-ray emission in the vicinity of SNR G045.7−00.4: evidence for escaping cosmic rays interacting with the surrounding molecular clouds

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We present the analysis of Fermi Large Area Telecope (LAT) data of the gamma-ray emission in the vicinity of a radio supernova remnant (SNR), G045.7−00.4. To study the origin of the gamma-ray emission, we also make use of the CO survey data of Milky Way Imaging Scroll Painting to study the massive molecular gas complex that surrounds the SNR. The whole size of the GeV emission is significantly larger than that of the radio morphology. Above 3 GeV, the GeV emission is resolved into two sources: one is spatially consistent with the position of the SNR with a size comparable to that of the radio emission, and the other is located outside of the western boundary of the SNR and spatially coincident with the densest region of the surrounding molecular cloud. We suggest that the GeV emission of the western source may arise from cosmic rays (CRs) which have escaped the SNR and illuminated the surrounding molecular cloud. We find that the gamma-ray spectra of the western source can be consistently explained by this scenario with a total energy of $\sim 10^{50}\mathrm{erg}$ in escaping CRs assuming the escape is isotropic.

Summary:

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Ultra-High-Energy Cosmic-Ray Outburst from GRB 221009A

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We study accelerations, energy loss and the escape of cosmic rays in GRB 221009A, and suggest that GRB 221009A is an ultra-high-energy(UHE) cosmic ray source with ability of accelerating protons to $> 10^{20}$ eV. It is difficult for UHE protons to escape from the source and the host galaxy, while neutrons at the energies of tens of EeV, produced in the process of $p + \gamma \rightarrow n + \pi^+$, are able to escape from the source as well as the host galaxy without suffering from the serious magnetic field deflection and then decay into protons in the inter-galactic space. After entering the Milky Way, protons will be deflected by the Galactic magnetic field, and will arrive at Earth with a time delay. We make predictions on the possible future observation on the UHECRs from GRB 221009A by cosmic ray detectors, such as PAO, TA×4 and GRAND.

Summary:

Afternoon session I / 83

Particles and radiation from supernova remnants

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Unveiling the origin of the cosmic-ray (CR) flux observed at Earth remains among the main challenges in the field of astroparcle physics. The Galactic CR component is believed to be produced bysupernova remnants (SNRs) as a result of diffusive shock acceleration, though the acvity of this class of sources in the knee region is yet to be proven. In this context, the process through which accelerated particles escape from their sources affects both the spectral and morphological radiave signatures from these sources as well as the formation of the CR spectrum. As a result, the gammaray emission strongly depends on the level of diffusion experienced by the parcles at the accelerator, that can hence be constrained observationally together with the maximum energy of particles achieved, as I will discuss in this contribution.

Summary:

Afternnon Session II / 84

Early TeV Gamma-Ray Afterglow of GRBs

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LHAASO and/or CTA will increase the detected samples of TeV afterglows of GRBs in the near future, which is essential to revealing jet magnetization, particle acceleration, and magnetic field amplification. The emission from the reverse shock largely depends on the magnetization of the jets.
On the other hand, X-ray afterglows frequently show a shallow decaying emission in their first few thousand seconds. Possible models for the shallow decay phase are continuous energy injection, late catch-up of lately launched ejecta, the evolution of microscopic parameters, thin wind profile of the circumstellar medium, and so on.
Depending on the models, the TeV emission of the early afterglow will show different behaviors. We show model calculations of multi-wavelength lightcurves based on our time-dependent simulation code. The detection of early TeV afterglows will provide a clue to distinguishing the models of the shallow decay phase.

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Diffuse gamma-ray emission around the massive star forming region of Carina Nebula Complex

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We report the Fermi Large Area Telescope (Fermi-LAT) detection of gamma-ray emission toward the massive star forming region of Carina Nebula Complex (CNC). The GeV gamma-ray emission can be resolved into three different components. The GeV gamma-ray emission from the central point source is considered to originate from η Car. We further found the diffuse GeV gamma-ray emission around the CNC which can be modelled by two Gaussian discs with radii of 0.4 degree (region A) and 0.75 degree (region B), respectively. The GeV gamma–ray emission from both regions A and B have good spatial consistency with the derived molecular gas in projection on the sky. The GeV gamma-ray emission of region A reveals a characteristic spectral shape of the pion-decay process, which indicates that the gamma-rays are produced by the interactions of hadronic cosmic rays with ambient gas. The gamma-rays spectrum of region B has a hard photon index of 2.12 ± 0.02, which is similar to other young massive star clusters (YMCs). We argue that the diffuse GeV gamma-ray emission in regions A and B likely originate from the interaction of accelerated protons in clusters with the ambient gas.

Summary:

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The prediction of using LHAASO's cosmic-ray electron measurements to constrain decaying heavy dark matter

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LHAASO is an instrument designed for detecting cosmic rays (CRs) and gamma rays at TeV to PeV energies. The decays of heavy dark matter particles in the Galactic halo may produce high-energy electrons that can be detected by LHAASO. The main background for the LHAASO's CR electron measurements is the hadron residuals due to mis-identification of the particle species. In this paper, we estimate the LHAASO's electron background using the known all-particle CR spectrum and the hadron rejection efficiency of LHAASO. With the estimated background, we predict the capability of LHAASO to constrain DM decay lifetime at 95% confidence level for various channels. We find that, if neglecting systematic uncertainties, the CR electron measurement by LHAASO can improve the current best results by up to one order of magnitude for DM masses between 100–1000 TeV. However, indirect measurements of CR electrons by ground-based experiments suffer from sizeable systematic uncertainties. With the systematic uncertainties included in the calculation, the projected constraints will be largely weakened. So for using the CR electron observation of LHAASO to constrain the DM parameters, the key point is whether the systematic error can be effectively reduced.

Summary:

Poster time / **88**

Performance and Layout Schemes of LACT Project

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The Large Array of Imaging Atmospheric Cherenkov Telescopes (LACT) is a next-generation IACT array planned to be constructed on the LHAASO sites. With its exceptional angular resolution, it enables precise localization of gamma rays. Moreover, being built on the LHAASO sites, it benefits from remarkable gamma/proton separation capabilities. In this poster, we present some performance results of LACT projects and illustrate two proposed layout schemes for its implementation.

Summary: