Neutrino production in starburst galaxies

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Understanding the origin of the diffuse flux of high-energy astrophysical neutrinos detected by IceCube has become a challenging issue within present High Energy Astrophysics. In this work, we present a model to explore the potential neutrino production of starburst galaxies (SBG) by considering four different neutrino production zones that can be associated to a typical single SBG. The first zone is the nucleus, where due to the high rate of supernova explosions, a significant amount of protons can be accelerated to high energies and undergo pp interactions with the interstellar medium. The second zone is a cavity that surrounding the nucleus, where particles escaping from it are injected and undergo interactions with the medium. The third zone we consider is the corresponding to the superwind, which is formed by the hot gas that escapes from the nucleus and interacts with the intergalactic medium (IGM) generating shocks. Protons accelerated there can undergo both pp interactions with the ambient matter, and also pγ collisions with photons from the cosmic microwave background (CMB) at different redshifts. The fourth neutrino production zone we consider, is an external one, where we account for the possibility that protons escaping from the whole system interact with the CMB. Finally, adding the neutrino contributions of the four zones, we calculate the diffuse neutrino flux by integration on the redshift range appropriate for SBG.

Bouncing a pNGB dark matter

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In the Standard Model, the introduction of a singlet complex scalar field may give rise to a stable pseudo-Nambu-Goldstone boson (pNGB), a good dark matter candidate with novel features at the phenomenological level, such as the reduction of direct detection signal. In this work we extend this scenario with the inclusion of a second dark matter (DM) component: a fermion singlet. Then, the two DM components interacts with the visible sector through two Higgs-like particles via a Higgs portal. We explore the thermal freeze-out of this scenario, founding a bouncing effect in the yield of pNGB DM, with consequences on indirect detection observables.

Nearby active galactic nuclei and starburst galaxies as sources of the measured UHECRs anisotropy signal

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The Pierre Auger observatory have measured a statistical significant large-scale anisotropy in the arrival direction of ultra-high-energy cosmic rays (UHECR). The large-scale anisotropy signal is a dipolar modulation in the arrival directions of UHECR, whose amplitude increases with energy above 4 EeV. The interpretations of these data favor extragalactic sources of UHECR. Using the CRPropa3 framework, detailed simulations of the arrival directions of UHECR are performed. The dipole signal that can be generated by nearby (<23 Mpc) active galactic nuclei (AGN) and/or starburst galaxies (SBG) was investigated. We consider different injected nuclei (p, He, N, Si, Fe), UHECR luminosity proxies (identical sources, radio luminosity, and gamma-ray luminosity), and extragalactic magnetic field models. The results shows that the nearby AGNs must be dominant to explain the dipole signal in the energy range above 32 EeV. The dipole signal measured above 8 EeV cannot be described by nearby SBG only, neither by nearby AGN only, nor by nearby AGNs and SBGs combined, suggesting the need of an extra source component in this energy range.

Taxonomic Classification of Active Galactic Nuclei

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Active galaxies have a central supermassive black hole that emits outflows and jets of radiation and particles whose energy is high enough to be 100 times stronger than the radiation emitted by all the stars in the galaxy. These regions are called active galactic nuclei (AGN), which, in some cases, interfere with the dynamics of the host galaxy, altering its star formation. Such a phenomenon is called feedback. In this work, we analyze a sample of 62 galaxies observed by MaNGA to determine the ones likely to present a feedback process. The stellar velocity fields and the Hα gas of each galaxy are examined to verify if the rotation is similar since galaxies with different velocity fields are subject to be undergoing feedback. The classifications used in this work are separated into three classes: regular-pattern velocity field (CVPR), irregular-pattern velocity field (CVPI), and counter-rotating velocity field (CVCR), where the first includes galaxies whose velocity fields are similar, and the last two, different velocity fields, either by discontinuous differences (CVPI) or by being in rotations in opposite directions (CVCR). Each galaxy in the sample also has its nuclear and extranuclear regions classified in Seyfert, LINER, composite, or star formation regions. We find this by analyzing the BPT diagram of each galaxy according to the relationships between [OIII]/Hbeta and [NII]/Halpha, [SII]/Halpha and [OI]/Halpha.
Keywords: Astrophysics; AGN, Galaxy, Feedback, BPT Diagram, Kinematic Classification

Non-thermal gamma-ray emission in the Galactic Center region

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The region surrounding the center of our Galaxy is one of the most complex and richest regions studied in high-energy astrophysics harboring a variety of potential sources of high-energy radiation. (1) Among these sources, there is the closest supermassive black hole to Earth, a cosmic Pevatron, dense molecular clouds, strong star-forming activity, multiple supernova remnants, and pulsar wind nebulae, arc-like radio structures, as well as the base of what may be large-scale galactic outflows. This project aims to reconstruct the radiative models that can explain the gamma-ray emission from the Galactic Ridge as seen by gamma-ray telescopes. Our goal is to simulate the gamma-ray flux on earth for different sources (2) and different models for the Central Molecular Zone's geometry.

Study of three Active Galactic Nuclei observed with HAWC

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A significant fraction of the astrophysical gamma ray sources are active galactic nuclei. In this work we present a detailed analysis of the gamma ray spectra in the TeV regime of three of these sources: the radio galaxy M87, as well as the BL Lac objects 1ES 1215 +303 and VER J0521 +211, obtained from the deepest and most updated HAWC data set. We also present fits to their spectral energy distributions, which were constructed with multi-frequency data.

Reconstruction of the AGN luminosity function with gamma-ray telescope

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Here, we present predictions for the reconstruction of the luminosity function (LF) of blazars detected in the TeV energy range by an observatory such as CTA. The LF is a fundamental piece of information to understand the formation and evolution of AGNs as a function of time. We have implemented a code for calculating the posterior probability distribution of blazar (BL Lacs and FSRQ) LF parameters and applied it to synthetic samples of blazars. The samples were generated using a gamma-ray LF tuned to Fermi-LAT sources in the GeV energy range, followed by an extrapolation of the spectra to the TeV region. In the future, we intend to explore the feasibility of constructing a LF from first principles based on the physical properties of the accretion process and formation of the relativistic jet of these AGNs.

Simulation of Cherenkov radiation detectors for the SWGO Observatory

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Gamma rays at ultra high-energies (above 10^{15}eV) arriving from outer space interact with Earth's atmosphere, producing particle showers. The detection of these ultra-high energy gamma rays can give us information about their accelerating astrophysical sources, which can then be mapped in the sky, such as in the recent gamma rays sources identification performed by LHASSO and CTA Observatories. The "Southern Wide-field Gamma-ray Observatory" (SWGO) is an observatory in plannig that proposes to observe regions of the sky that other observatories cannot, such as the Galaxy Center. This is a unique feature of SWGO due to its planned location, as it will be constructed in high altitudes (4.4km) in South America. In this work, I will show the proposal of the SWGO, presenting it's science case in ultra high-energies, and I will describe an analysis to simulate a Portuguese-Brazilian model of Water Cherenkov Detector (WCD), named MERCEDES, and it's interaction with atmosferic showers products. This detector is a proposal of CBPF in collaboration with LIP to SWGO - the Southern Wide-field Gama ray Observatory.

Dark Matter and Cosmic-ray Scattering Indirect Detection

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In the last few decades, a large number of searches have been conducted in order to detect dark matter particles, with the purpose of characterizing these particles and finally defining a proper model to describe them, expanding the current Standard Model of Particle Physics (SM). These searches have been developing in three main directions: direct detection experiments, focused on detecting dark matter particles through nuclei scattering inside the detectors; collider experiments, where it is expected to detect dark matter through its production in collision of highly energetic particles; and indirect detection experiments, focused on detecting subproduct particles from dark matter reactions, whether annihilation or decay in high density environments of the Universe, or scattering reactions with other SM particles in high energy astrophysical environments. Here I am focused on indirect detection, in the case of dark matter and cosmic-rays scattering. The scattering of cosmic-ray protons and dark matter particles could generate an observable flux of gamma rays in a similar way that happens for the interaction of these protons and interstellar gas, and in this case, the dark matter halo is playing the role of the target gas. This novel and distinct gamma-ray signal could be a new way to probe and constrain our current models through indirect detection, possibly giving information in a different energy range than the usually studied annihilation process.

Dark Matter Sensibility to Non-standard Early Cosmological Scenarios

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Right-handed neutrinos appear in several extensions beyond the Standard Model, especially in connection to neutrino masses. Motivated by this, we present a model of right-handed neutrino dark matter that interacts with Standard Model particles through a new gauge symmetry as well as via mass mixing between the new vector field and the Z boson, and investigate different production mechanisms. We derive the dark matter relic density when the Hubble rate is faster than usual, when dark matter decouples in a matter domination epoch, and when it decouples in a radiation domination regime, which is then followed by a matter domination era. We put all these results into perspective with existing flavor physics, atomic parity violation, collider, and direct detection bounds. Lastly, we outline the region of parameter space in which weak-scale right-handed neutrino dark matter stands as a viable dark matter candidate comparing the effect of non-standard early cosmologies.

Determination of the response of the SWGO Cherenkov Water Detector to the secondary cosmic ray background

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Using complex simulations of the interaction of cosmic rays with the atmosphere (CORSIKA) and with particle detectors (GEANT4) we will study the response of the water Cherenkov detectors (WCD) to be used by the future SWGO Gamma Ray Observatory: Southern Wide- field Gamma-ray Observatory. To understand the response of these detectors to the radiation background to which they will be exposed.

Influence of hadronic interaction models on the estimation of the CTA sensitivity

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The forthcoming Cherenkov Telescope Array (CTA) observatory will be the leading experiment measuring gamma rays with Imaging Atmospheric Cherenkov Telescopes (IACTs). Operating on the range of tens of GeV to hundreds of TeV, the computed sensitivity of the CTA to incoming gamma-ray fluxes is a fundamental quantity required to explore its potential on different physics scenarios. As the background signal of the CTA will be dominated by hadronic particles, mainly protons, the modelling of hadronic interactions in the development of extensive air showers is a critical aspect when determining the experimental sensitivity. In this contribution, the influence of the uncertainty on modelling hadronic interaction at CTA energies is investigated through detailed Monte Carlo simulations of the experimental response to gamma-rays and cosmic-ray fluxes. It is shown that the background-rejection capability of the experiment is affected to a factor of up to two when taking into account the different available description of hadronic interactions. As a result, the estimated sensitivity can be as high as ~30% in the energy range 1-30 TeV.

Compact central object as a source of high-energy cosmic rays

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The production of energetic particles in the Universe is one of the great mysteries of modern science. In recent years, some efforts have been made to identify Galactic sources capable of accelerating particles to 1 PeV, known as PeVatrons. The different morphology of Galactic supernova remnants (SNRs) is directly correlated with the nature of the star's explosion and the existence of a possible Compact Central Object (CCO). CCOs have small radii and intense gravitational fields on their surfaces. Due to these strong fields and interactions with magnetized clouds (MCs) around them, they are considered possible candidates for the production of cosmic rays. In August 2002, the XMM-Newton spacecraft dedicated two of its orbits to the compact object 1E 1207.4-5209, with a total observation time of 257,303 s. The compact X-ray source 1E 1207.4-5209 is located very close to the remnant center G296.5+10.0. In this work, we obtain the contribution of high-energy gamma-ray emission (E > 100 GeV) from the acceleration and propagation of cosmic rays from the Central Compact Object 1E 1207.4-5209 and its host SNR G296.5+10.0. We also calculate the contribution of this association to the total observed Galactic cosmic-ray flux, considering the cosmic-ray propagation within the Galaxy with all energy losses and particle interactions. We propose that the above configuration can provide a rich scenario for the generation of GeV-TeV and cosmic ray to PeV ranges within the Galaxy. The new version of the GALPROP software was used and explored in order to obtain good results. Keywords. Cosmic Rays. Gamma Radiation. Compact Central Object

Investigating the gamma-ray emissions of Sagittarius A*

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During this research work, I am trying to understand a little better what the environment around Sagittarius A* is like and what are the mechanisms responsible for the emission of gamma rays that we detect coming from it. This research is divided into two major phases. The first one consisted of producing a Spectral Energy Density (SED) for Sagittarius A* using photons with energy between 100MeV and 500GeV that were captured between the years 2008 and 2022 by the LAT, an instrument on board the Fermi Space Telescope. For this, it was necessary to carry out the modeling of a square-shaped region-of-interest, centered on Sagittarius A* with a width of 15 degrees. The second phase, which is in progress, consists of properly modeling and interpreting the SED with an investigation of leptonic and hadronic gamma-ray emission models.

Exploring the inert doublet model with very high energy observatories

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The true nature of the largest matter density component of the Universe, the so-called dark matter (DM), is one of the most elusive problems of Physics. One of the primary direction for DM searches lies in the particle physics point of view, through the Weakly Interacting Massive Particles (WIMPs). These are particles with masses in the GeV – TeV range and weak-scale interaction strength. In high-density environments of the Universe, WIMPs may self-annihilate and produce a strong gamma-ray signal. Dwarf galaxies, galaxy clusters and the Galactic Center (GC) are compelling candidates to harbour such sizeable high-energy gamma-ray signals. This project aims to estimate the sensitivity of future gamma-ray observatories, such as the Southern Wide field-of-view Gamma-ray Observatory (SWGO) and the Cherenkov Telescope Array (CTA), to probe the non-canonical DM models. The first scenario analyzed is the Inert Doublet Model (IDM), which postulates an extra Higgs doublet to the Standard Model (SM). This new doublet is stable due to a Z2 symmetry which stabilizes the lightest scalar, leading to a good DM candidate. We are now analyzing the capacity of the CTA and SWGO to probe the IDM on targets like the GC, moving forward in the results pointed out by recent studies.

Radioasteonomia no ensino de fisica

Lucia Horta

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Nesse trabalho os alunos aprendem o que é radioastronomia, como funciona todo o processo de captação dos grandes observatórios radioastronomico e com equipamentos .adorei montam uma estação de captação de ondas eletromagnéticas. Com essa prática o aluno aprende toda a parte de ótica, ondas, eletricidade, eletromagnetismo construindo o aprendizado através da prática .

Unveiling the origin of UHECR: the role of local sources

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Cosmic rays are charged relativistic particles of extraterrestrial origin. In particular, particles belonging to the highest energy end of the energy spectrum of cosmic rays are commonly named ultra-high energy cosmic rays (UHECR). There are several open questions involving these fascinating particles. For instance, a mystery that remains in Astrophysics is the origin of UHECR. Due to interactions with the radiation and magnetic fields that permeate the Universe, the detection of these particles does not provide direct information about their original energy spectrum, distribution of arrival directions and abundance. UHECR energy losses via photopion production and photodisintegration cause a suppression in the energy spectrum, which highlight the relevant role that local sources play to describe the spectrum. Furthermore, the flux of cosmic rays drops orders of magnitude with increasing energy, which results in a low statistic for the range in which UHECR belong to. While the aforementioned features make the study of UHECR quite challenging, it is possible to notice that there is plenty of space for important discoveries to come out. In the last years, the Pierre Auger Observatory, the largest cosmic ray detector ever built, has measured the first indications of anisotropy in the distribution of arrival directions of such particles, which has raised the expectation of solving this decades-long question in the upcoming years. Therefore, the aim of this work is to further develop the understanding about the impact of astrophysical hypotheses in modeling the main anisotropy measurements used to search for the origin of UHECR. The goal is to calculate an upper limit on the density of sources without making too strong hypotheses by analyzing the dipole amplitude provided by the Pierre Auger Observatory. It is worth mentioning that having such information about the sources is extremely important, since it can help us to eliminate a huge space of possibilities of existing models in highly energetic cosmic ray research.

Enhancing the detection sensitivity for extragalactic observations with the Cherenkov Telescope Array

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Active galactic nuclei (AGN) are the most numerous class of identified very-high-energy (VHE) gamma-ray sources. This work aims to investigate different observation strategies for detecting blazar sources. We simulated populations of VHE blazars by extrapolating the luminosity functions of BL Lac objects from GeV (compatible with Fermi-LAT observations) to TeV (CTA region of interest). The propagation of the gamma-rays in the extragalactic medium is also considered including absorption effects. Observation time, sky coverage and pointing spacing are searched to improve the detection sensitivity. Enhancing the sensitivity is essential to better reconstruct the luminosity function of blazars. The better the sensitivity, the greater the probability of detecting gamma events and, consequently, the better the quality of the reconstructed luminosity function. The analyses can also be applied to improve the CTA's ability to detect and/or monitor extragalactic sources.

Simultaneously unveiling EBL opacity and intrinsic spectral parameters of gamma-ray sources via MCMC methods

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During the last decades there was a significant increase in the detection of extragalactic very high energy sources (VHE: above 100 GeV), with many more expected to be detected by the Cherenkov Telescope Array (CTA). To correctly interpret extragalactic VHE data, it is necessary to take into account attenuation effects resulting from pair-production in the interaction between the gamma-ray photons and the Extragalactic Background Light (EBL). However, the exact EBL spectrum is not known, as direct measurements mostly provide lower or upper limits, leaving the intrinsic, unattenuated, gamma-ray spectra also uncertain. One alternative is to indirectly infer the EBL attenuation by analyzing gamma-ray spectra. We apply Monte Carlo Markov Chain (MCMC) techniques – in particular the variant known as Hamiltonian Monte Carlo – to sample the posterior distribution of parameters characterizing the EBL and the intrinsic spectrum of gamma-ray sources, in a Bayesian approach. We utilize 65 spectra from 36 distinct AGNs measured by current Imaging Atmospheric Cherenkov Telescopes and obtain the local EBL spectrum and the corresponding cosmic gamma-ray horizon, while also analyzing the emerging fit of all gamma-ray spectra. The advantage of the MCMC sampling is to provide an easy way of marginalizing over regions of the parameter space, for instance treating EBL or source variables separately as nuisance parameters, so we can incorporate the uncertainties of the former into the later and vice-versa. The results reveal a real capacity of constraining EBL and intrinsic spectral parameters when using a large data sample, which should be improved by the future operation of CTA.

Indirect search for Dark Matter in Dwarf Galaxies with the Southern Wide field-of-view Gamma-ray Observatory

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Weakly Interacting Massive Particles (WIMPs) are a prominent candidate for dark matter because they can reproduce the observed abundance of dark matter in the universe. One way to search for evidence of WIMPs is through indirect detection, which involves looking for the standard model particles produced by the decay or self-annihilation of dark matter particles. When the mass of the dark matter particle is in the range of GeV to TeV, this type of search can be conducted by detecting gamma rays in astrophysical objects with high concentrations of dark matter. Dwarf galaxies, although not the most dense with dark matter, are excellent targets for this type of observation because they are gravitationally dominated by dark matter and relatively close to Earth. In particular, spheroidal dwarf galaxies, which have an older stellar population and no ongoing star formation, would have almost no gamma-ray emission if dark matter were not present. The goal of this work is to predict the detectability of dark matter annihilation or decay signals from dwarf galaxies using the Southern Wide-field Gamma-ray Observatory (SWGO), a future observatory that will be built in South America. This wide-field survey instrument will be able to study many important dark matter targets in the Southern Hemisphere, and the combined observation of all targets will provide competitive, if not the best, limits on the mass of dark matter in the range of 500 GeV to PeV.

Lepton Flavor Violation in a Non-Universal U(1) Extension to Standard Model

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Based in the current bounds on the bracing ratios of the different Charged Lepton Flavor Violation (CLFV) two body radiative decays and pure leptonic CLFV three body decays, I will present the allowed parameter space region of a Non-Universal U(1) Extension to Standard Model, particularly the parameter space of leptonic sector of the model, focusing on the Charged Lepton Flavor Violation couplings. The CLFV three body decays are studied as a tree level processes, while the CLFV two body decays are studied as one-loop processes. It is worth mentioning that the Majorana Neutrinos and the exotic lepton that come from the Non-Universal U(1)-Model play a key role in the one-loop processes.

Analysis of reconstruction methods of shower cores in MATHUSLA

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In this work, we show the results of a comparative analysis of different reconstruction methods of shower cores produced by Cosmic Rays (CR's) in a layer of Resistive Plate Chambers (RPC's) that is under consideration for MATHUSLA (Massive Timing Hodoscope for Ultra-Stable neutraL pArticles). The analysis was performed with Monte Carlo simulations. Extensive air showers were simulated with CORSIKA using the GEISHA and QGSJET-II-04 hadronic interaction models for primary protons and iron nuclei in the energy range from 10 TeV to 100 PeV and zenith angles < 20°. The detector response was simulated with a simplified Python-based program. The location of the shower core was found using the center of mass of the deposited charge distribution, the maximum of the charge distribution, a fit with an exponential function to the projected distributions on the X and Y horizontal directions of the 2D charge distributions, and fits with an exponential and a Nishimura-Kamata-Greisen (NKG) lateral functions to the 3D charge distributions of the RPC. We found that the fits of the X and Y projections with an exponential function and the fits with a NKG function to the 3D signal distributions have a better performance than the other methods.

On the effect of the bouncing thermal freeze out on dark matter indirect detection.

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Recently, a novel feature of thermal dark matter decoupling process has been pointed out: the yield of the dark matter particle goes from a exponentially decreasing equilibrium evolution to an exponentially increasing one. The mechanism has been referred as bouncing dark matter. In this work we present the conditions and the performance of this mechanism in the context of a two-component dark matter BSM model: a Dirac fermion and a pseudo-Nambu-Goldstone scalar, both gauge singlets. In addition to direct detection signals, we show the impact of the bouncing mechanism on indirect detection observables including CTA prospects.

Determination of solar Ápex and Ante Ápex

Raphael Gomes sousa

UFS

With each new release of data from telescopes and observatories, an opportunity opens up to react. evaluation of the results found in the dissemination of previous data, such as finding a new method more efficient method of determining physical quantities. Today, with the observational precision achieved, and a constant need to update data related to astrophysical phenomena, a review of the positions of the apex and ante solar apex can contribute a lot to finvestigations in Galactic Astrophysics. The data released by GAIA's DR3 and made available on the European Space Agency website in the form of databases, has an enormous potential for this purpose, being able to be filtered and downloaded for analysis. later sixes. In this work, a review of the Apex and ante Apex positions obtained from the data is proposed. HIPPARCOS (High Precision Parallax Collecting Satellite), using codes written in python that access the Gaia DR3 database online, filtering the data collection in 100 pc around the Sun and optimizing data extraction for self-motion analysis in RA (Right Ascension) and DEC (Decline). nation), positions in galactic coordinates (Galactic Longitude (l) and Galactic Latitude (b)), so that the error in the parallax value is less than 1. A pre-analysis begins at this stage, for which we translate to Python language running codes for converting coordinates to proper motion in latitude and galactic longitude. We also proposed an analysis of the moments of the movements themselves, with emphasis on for the averages and the coefficient of asymmetry (skewness) of the distribution, in addition to the study of the moments of own movements, highlighting the averages and the coefficient of asymmetry (skewness) of the distribution. We formed a database containing the previous results in a scan of the entire sky, from a separate cone search every 10 degrees, meeting Niquist's minimum sampling criterion for each direction. Remapping the surroundings of these regions with 1 degree precision and using the identification technique locating centroids in the parameter map we found the values $(69, 52 \pm 0.04, 20, 47 \pm 0.04)$ for the Apex and $(246, 49 \pm 0.01, -17, 49 \pm 0.04)$ for ante Apex. Secondary regions were also identified both by mean and skewness and apparently result from bulge object residues, unrecorded in previous works, in this way, from the proposed codes, we not only reproduced the obtaining of the Ápex and Ante Ápex, as well as identifying some peculiar results in the statistical distribution of the own movements that may result in potential lines of investigation.

A CONNECTION BETWEEN TEV GAMMA-RAY FLUX AND COSMIC RAYS IN THE SEYFERT GALAXY NGC 1068*

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Hadronic interactions in cosmic-ray propagation can produce charged and neutral pions. The neutron pion decays into photons, while positrons and electrons are produced due to the decay of charged pions. The basic mechanisms that can produce gamma-ray fluxes associated with jets of cosmic rays are the decay of neutral pions electron/positron bremsstrahlung, and inverse Compton scattering. These cascade processes show a correlation between the upper limit on the integral GeV–TeV gamma-ray flux and the ultra-high energy cosmic rays (UHECR) luminosity. We calculate the UHECR cosmic-ray luminosity for the NGC 1068 galaxy using the upper limits on TeV gamma-ray flux by H.E.S.S. and MAGIC observatories. We compare our neutrino flux to current estimates of NGC 1068 neutrino flux.

Supernova as source of new light particles

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Supernovae are rare astronomical events caused by the death of stars with a mass approximately 10 times that of the Sun. They are characterized by their beautiful brightness, with variations of up to 19 magnitudes, and remain visible long enough to be detected. They represent one of the possible final stages that high-mass stars can reach before dying. These stars obtain energy throughout their lives from the nuclear fusion of hydrogen atoms that act as fuel. Once it is fully consumed, it destabilizes the equilibrium between the star's pressure and gravity, causing its core to contract with force. The protons absorb the electrons from the atmosphere, converting them into neutrons and electron neutrinos, the latter being very efficient at transporting a large amount of energy from the star, due to their low interaction with matter, a process commonly known as ”cooling”. By stealing this energy, a shock wave is produced in the core that releases energy in an incredible explosion, which is what we know as a supernova. This poster will describe the process by which stars will become supernovae and how this energy release could involve the production of new light particles from the interactions of neutrinos coming from the star.