STARS2019 / SMFNS2019

Friday 03 May 2019 - Sunday 12 May 2019

Museum Casa de los Árabes

Book of Abstracts

The events are the fifth and sixth in a series of meetings gathering scientists working on astroparticle physics, cosmology, gravitation, nuclear physics, and related fields. As in previous years, the meeting sessions will consist of invited and contributed talks and will cover recent developments in the following topics:
STARS2019 – New phenomena and new states of matter in the Universe, general relativity, gravitation, cosmology, heavy ion collisions and the formation of the quark-gluon plasma, white dwarfs, neutron stars and pulsars, black holes, gamma-ray emission in the Universe, high energy cosmic rays, gravitational waves, dark energy and dark matter, strange matter and strange stars, antimatter in the Universe, and topics related to these.
SMFNS2019 – Strong magnetic fields in the Universe, strong magnetic fields in compact stars and in galaxies, ultra-strong magnetic fields in neutron star mergers, quark stars and magnetars, strong magnetic fields and the cosmic microwave background, and topics related to these.
As part of the events, the school Relativistic Astrophysics and Connected Problems will be held in ICIMAF, Havana, 3 - 4 May, for students and young researchers.
Professor Walter Greiner Award will be granted to the best three posters presented by students at the conferences.

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Education and Cultural Astronomy

Author: Steven Gullberg[1]

[1] *University of Oklahoma*

The importance of including a thorough search for the potential use of astronomy in the examination of any culture is discussed. Educational strategies are included that can enable scholars to add related research knowledge that will enable them to augment their studies in this pursuit.

What can be learned from astronomy in culture is examined and the importance of including such research as a part of certain studies is emphasized. A primary goal is to help scholars to learn more about the research of astronomy in culture with the goal of increasing the numbers of those engaged with this in strong research and publication. Educational strategies and emerging programs will be discussed. Such educational initiatives will greatly strengthen this research in the future and will facilitate significant advancements in what we know about the astronomy of ancient and indigenous cultures world-wide.

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Exact magnetic contribution to a one-loop charged scalar field potential

Authors: Gabriella Piccinelli Bocchi[1] ; Angel Sánchez Cecilio[2]

[1] *Centro Tecnológico, FES Aragón, UNAM*

[2] *Facultad de Ciencias, UNAM*

In the context of a warm inflation scenario, we explore the effect of a primordial magnetic field on a charged scalar field potential.

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Black holes fueling and coalescence in galaxy mergers

Authors: Andrés Escala[1] ; Joaquin Prieto[1] ; Luciano del Valle[2]

[1] *Universidad de Chile*

[2] *IAP Paris*

Using a combination of Smooth Particle hydrodynamics and Adaptive Mesh Refinement simulations of galaxy mergers, with sub-parsecs scale resolution, we have study both the mass transport process onto the massive black holes throughout a galactic merger and especially, the posible black holes coalescence at galactic center. The final coalescence of these black holes lead to gravitational radiation emission that would be detectable up to high redshift by future gravitational wave experiment such as eLISA, which is expected to be launched in 2034.

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A breakthrough for the study of resolved stellar populations with ELTMOS/MOSAIC

Author: Roth Martin[1]

[1] *Leibniz-Institut für Astrophysik Potsdam (AIP)*

The study of resolved stellar populations in nearby galaxies outside of the Local Group has come within reach with the new generation of extremely large telescopes, featuring primary mirror diameters on the order of 30 meters. ELT, the European Extremely Large Telescope, is currently being built at the Armazones site in the Atacama desert of Chile. From the instrumentation suite for the ELT, the multi-object spectrograph ELT-MOS stands out with the capability of combining the large light collecting power with adaptive optics over the entire field-of-view of the ELT, thus becoming the perfect instrument to study the spectra of resolved stars in galaxies beyond the Milky Way and the Local Group. With an emphasis of the stellar science case, the instrument at the stage of the completed Phase-A study will be presented and discussed, in particular with a focus on the synergy potential with the MICADO imager at the ELT, and the MUSE IFU at the VLT.

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Observation of r-process abundance patterns in stars

Author: Norbert Christlieb[1]

[1] *Universität Heidelberg*

Stars conserve in their atmospheres, to a large extent, the chemical composition of the gas cloud from which they formed. The chemical compositions of old, metal-poor stars in the halo of our galaxy can hence be used for reconstructing the chemical enrichment history of the Milky Way, and studying the nucleosynthesis processes that contributed to the enrichment. For example, a unique abundance signature of the rapid neutron-capture process (r-process) has been observed in metal-poor stars strongly enriched in r-process elements, providing constraints on r-process models and the physical conditions of the site of this process.

In my talk I will review the recent progress that has been made in identifying large samples of metal-poor stars by means of wide-angle sky surveys, determinations of their chemical compositions with optical high-resolution spectra and state-of-the art stellar model atmospheres, and future prospects in the era of 4-10m telescopes equipped with highly multiplexed spectrographs, as well as the next generation of large ground-based telescopes currently under construction.

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Can the symmetry breaking in the SM be determined by the "second minimum" of the Higgs potential?

Authors: Alejandro Cabo [1] ; Jose Carlos Suarez [2] ; Denys Arrebato[3] ; Fernando Guzman[3] ; Jorge Luis Acosta[3]

[1] *Department of Theoretical Physics*

[2] *Daculty of Mathematics and Computer Science , Havana, University*

[3] *Instituto de Tecnologıas y Ciencias Aplicadas (InSTEC),*

The possibility that the spontaneous symmetry breaking in the Standard Model (SM) may be generated by the Top-Higgs Yukawa interaction (which determines the so called "second minimum" in the SM) is investigated. A former analysis about a QCD action only including the Yukawa interaction

of a single quark with a scalar field is here extended. We repeat the calculation done in that study of the two loop effective action for the scalar field of the mentioned model. A correction of the former evaluation allowed to select a strong coupling \alpha(m,LQCD) = 0.2254 GeV at an intermediate scale \mu = 11.63 GeV, in order to fix the minimum of the potential at a scalar mean field determining 175 GeV for the quark mass. Next, a scalar field mass m = 44 GeV is evaluated, which is also of the order of the experimental Higgs mass. The work is also considering the effects of employing a running with momenta strong coupling. For this purpose, the finite part of the two loop potential contribution determined by the strong coupling, was represented as a momentum integral. Next, substituting in this integral the experimental values of the running coupling, the minimum of the potential curve as a function of the mean field was again fixed to the top quark mass by reducing the scale to the value \mu = 4.95 GeV. The consideration of the running coupling also deepened the potential value at the minimum and slightly increased the mass of the scalar field up to 53.58 GeV. These results rested in assuming that the low momentum dependence of the coupling is "saturated" to a constant value being close to its experimental value at the lowest momentum measured.

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Magnetic field-dependence of the neutral pion mass in the linear sigma model coupled to quarks: The weak field case

Author: Daryel Manreza Paret[1]

Co-authors: Alejandro Ayala [2] ; Ricardo L. S. Farias [3] ; Saul Hernandez-Ortiz [2] ; Luis Hernandez [2] ; Renato Zamora [4]

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[4] *Centro de Investigacion y Desarrollo en Ciencias Aeroespaciales (CIDCA), Fuerza Aerea de Chile, Santiago, Chile.*

We compute the neutral pion mass dependence on a magnetic field in the weak field approximation at one-loop order. The calculation is carried out within the linear sigma model coupled to quarks and using Schwinger's proper-time representation for the charged particle propagators. We find that the neutral pion mass decreases with the field strength provided the boson self-coupling magnetic field corrections are also included. The calculation should be regarded as the setting of the trend for the neutral pion mass as the magnetic field is turned on.

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Exact configurations for interacting spin-2 fields in three dimensions

Authors: Eloy Ayón Beato [1] ; Elizabeth Rodríguez Querts[2]

[1] *Cinvestav*

[2] *ICIMAF*

We studied some exact configurations for the three-dimensional massive multi-gravity theory called "Viel-dreibein gravity". We find AdS wave solutions (which reflect the main dynamic properties of the model) and analyze their asymptotic behavior. In addition, we explore the existence of black holes in the context of this theory.

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Cosmogenic photon and neutrino fluxes in the Auger era

Authors: Rogerio de Almeida[1] ; Rafael Alves Batista[2] ; Kumiko Kotera[3] ; Bruno Lago[4]

[1] *Universidade Federal Fluminense*

[2] *Universidade de São Paulo*

[3] *Institut d'Astrophysique de Paris*

[4] *Centro Federal de Educacao Tecnologica Celso Suckow da Fonseca – Campus Nova Friburgo (CEFET/RJ – Campus Nova Friburgo), Nova Friburgo-RJ, Brazil*

The interaction of ultra-high-energy cosmic rays (UHECRs) with pervasive photon fields generates associated cosmogenic fluxes of neutrinos and photons due to photohadronic and photonuclear processes taking place in the intergalactic medium. We perform a fit of the UHECR spectrum and composition measured by the Pierre Auger Observatory for four source emissivity scenarios: power-law redshift dependence with one free parameter, active galactic nuclei, gamma-ray bursts, and star formation history. We show that negative source emissivity evolution is favoured if we treat the source evolution as a free parameter. In all cases, the best fit is obtained for relatively hard spectral indices and low maximal rigidities, for compositions at injection dominated by intermediate nuclei (nitrogen and silicon groups). In light of these results, we calculate the associated fluxes of neutrinos and photons. Finally, we discuss the prospects for the future generation of high-energy neutrino and gamma-ray observatories to constrain the sources of UHECRs.

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Effective potential of a higher derivative scalar field theory at finite temperature

Authors: M. A. Amaya[None] ; Gabriella Piccinelli Bocchi[1] ; Angel Sánchez[2]

[1] *Universidad Nacional Autónoma de México*

[2] *Facultad de Ciencias, UNAM*

In this contribution, I present the study of the effect of higher derivative terms in the effective potential of a scalar field theory. Preliminary results indicate that quantum correction coming from the higher derivative terms make the curvature of the effective potential, near the origin, becomes flatter. I will discuss how this result could be interesting within a warm inflation scenario.

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Charges and torsion

Authors: Diego Hidalgo[1] ; Ernesto Frodden[None] ; Roverto Oliveri[2]

[1] *Centro de Estudios Científicos*

[2] *Czech Academy of Sciences, Institute of Physics - CEICO*

We review the surface charge method in the Einstein-Cartan formalism and study in particular the role of torsion in the computation of charges. An example in 2+1 gravity is worked out explicitly and some advances in the Einstein-Cartan-Dirac theory are presented.

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Scale Invariance in Cosmology and Particle Physics using metric independent measures of integrations in the action

Author: Eduardo Guendelman[1]

[1] *Ben Gurion University*

Abstract The use of a metric independent measure of integration in the action opens new possibilities for constructing globally scale invariant theories, since the new measure can be assigned a different scaling transformation than the usual metric dependent measure sqrt(-g). There are various ways to construct a density that can serve as a metric independent measure of integration, from the derivatives of 4 scalar fields or the derivative of a three index tensor field contracted with the alternating symbol. The integration of the equations of motion of these "measure fields" leads to the spontaneous breaking of the scale invariance. A dilaton field with exponential potentials is added and coupled to the different measures. In the effective Einstein frame, potentials for the dilaton with flat regions appear, if curvature square terms are introduced, two flat regions appear, one capable of describing inflation and the other describing the slowly accelerated phase of the present universe. These models allow non singular cosmologies of the emergent type. In the context of the late universe, it is shown that the scale invariance is responsible for the avoidance of the 5th force problem that could have appeared in connection with the nearly massless dilaton. Also a see saw cosmological mechanism that could explain the smallness of the present vacuum energy can be formulated. Finally these techniques have been used to formulate scale invariant extensions of the Standard Model.

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Divergence-type hyperbolic theories for ultrarelativistic fluids

Author: Marcelo Enrique Rubio[1]

Co-author: Oscar Reula [2]

[1] *IATE - CONICET*

[2] *IFEG - CONICET*

In this talk I will present a novel theory with the aim of describing the dynamics of ultrarelativistic fluids considering dissipative effects up to second order. The problem of achieving a covariant relativistic extension of the equations that describe non-relativistic dissipative fluids constitutes a very active area of current research, given that a well-posed and causal theory of viscous fluids is essential for a better description of several astrophysical problems, as for example the coalescence of compact objects, which constitute nowadays the main source of gravitational wave production. After mentioning previous attempts for covariant extensions of viscous fluids, we will present a proposal for the study of the dynamic evolution of ultrarelative fluids. Then, we will show how to implement the equations of the theory numerically, using the Kurganov-Tadmor centered method, which allows capturing discontinuous solutions that simulate shock waves, and show some simulations in the one-dimensional case.

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Susceptibilities of strongly interacting matter in a finite volume

Author: Christian Spieles[1]

Co-authors: Marcus Bleicher [2] ; Carsten Greiner [2]

[1] *Frankfurt Institute for Advanced Studies (FIAS)*

[2] *Institut für Theoretische Physik, Goethe-Universität Frankfurt*

We investigate possible finite-volume effects on baryon number susceptibilities of strongly interacting matter. Assuming that a hadronic and a deconfined phase both contribute to the thermodynamic state of a finite system due to fluctuations, it is found that the resulting shapes of the net-baryon number distributions deviate significantly from the infinite volume limit for a given temperature T and baryochemical potential μ_B. In particular, the constraint on color-singletness for the finite quark-gluon phase contribution leads to a change of the temperature dependence of the susceptibilities in finite volumes. According to the model, the finite-volume effect depends qualitatively on the value of μ_B.

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Directed, elliptic and triangular flow of free protons and deuterons in Au+Au reactions at 1.23 A GeV

Authors: Paula Hillmann[None] ; Jan Steinheimer[None] ; Marcus Bleicher[1]

[1] *Uni Frankfurt*

Recently, the HADES experiment at GSI has provided preliminary data on the directed flow, v_1 elliptic flow, v_2 and triangular flow, v_3 of protons in Au+Au reactions at a beam energy of 1.23 A GeV. Here we present a theoretical discussion of these flow harmonics within the UrQMD transport approach. We show that all flow harmonics, including the triangular flow, provide a consistent picture of the expansion of the system, if potential interactions are taken into account. Cluster formation has a large contribution to the physics of collective flow. Therefore, the flow of deuterons and free protons are compared. Investigating the dependence of the flow harmonics on the nuclear interaction potentials it is shown that especially v_3 can serve as a sensitive probe for the nuclear equation of state at such low energies. The triangular flow and its excitation function with respect to the reaction-plane were calculated for the first time and indicate a complex interplay of the time-evolution of the system and the initial conditions at low beam-energies. Our study also indicates a significant softening of the equation of state at beam energies above E lab > 7 A GeV which can be explored by at the future FAIR facility.

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Delta mass shift as a thermometer of kinetic decoupling in Au+Au reactions at 1.23 AGeV

Author: Tom Reichert[1]

[1] *Institut für Theoretische Physik, Goethe Universität Frankfurt*

The HADES experiment at GSI will soon provide data on the production and properties of Δ baryons from Au+Au reactions at 1.23 AGeV. Using the UrQMD model, we predict the yield and spectra of Δ resonances. In addition we show that one expects to observe a mass shift of the Δ resonance on the order of 40 MeV in the reconstructable Δ mass distribution. This mass shift can be understood in terms of late stage Δ formation with limited kinetic energy. We show how the mass shift can be used to constrain the kinetic decoupling temperature of the system.

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The phase diagram of the Polyakov-Nambu-Jona-Lasinio approach

Author: Joerg Aichelin[1]

[1] *Subatech/CNRS, France*

Recently we succeeded, by introducing an interaction between the gluon mean field (presented by the a function of the Polyakov loop) and quarks, to reproduce the lattice equation of state for zero chemical potential with the Polyakov-Nambu-Jona-Lasinio model. Also, entropy density, interaction measure, energy density and the speed of sound are quite nicely reproduced. Even the first coefficient of the Taylor expansion of the lattice data with respect to the chemical potential is in the error bars of the lattice calculations. These findings are of great importance for future studies of heavy ion reactions because the Polyakov-Nambu-Jona-Lasinio model can be extended to finite chemical potentials (where lattice calculations are not possible) without introducing any new parameter. In addition, it shows at large chemical potentials a first order phase transition. It provides therefore a basis for theoretical studies in the energy range of the future FAIR and NICA facilities where one expects that heavy ion collisions are characterized by a large chemical potential. It may also serve as a equation of state for gravitational wave studies.

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Exploring the partonic phase at finite chemical potential within an extended off-shell transport approach

Authors: Elena Bratkovskaya[1] ; Pierre Moreau[2] ; Olga Soloveva[2] ; Lucia Oliva[3] ; Song Taesoo[4] ; Wolfgang Cassing[5]

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[5] *Institut für Theoretische Physik, Universität Giessen, Germany*

We extend the Parton-Hadron-String Dynamics (PHSD) transport approach in the partonic sector by explicitly calculating the total and differential partonic scattering cross sections as a function of temperature T and baryon chemical potential μ_B on the basis of the effective propagators and couplings from the Dynamical QuasiParticle Model (DQPM) that is matched to reproduce the equation of state of the partonic system above the deconfinement temperature T_c from lattice QCD.

The novel transport approach (PHSD5.0) thus incorporates no additional parameters compared to the default version PHSD4.0. We calculate the collisional widths for the partonic degrees of freedom at finite T and μ_B in the time-like sector and conclude that the quasiparticle limit holds sufficiently well. Furthermore, the ratio of shear viscosity η over entropy density s, i.e. η/s, is evaluated using the collisional widths and compared to lQCD calculations for μ_B = 0 as well. We find that the novel ratio η/s does not differ very much from that calculated within the original DQPM on the basis of the Kubo formalism. Furthermore, there is only a very modest change of η/s with the baryon chemical μ_B as a function of the scaled temperature $T/T_c(\mu_B)$. This also holds for a variety of hadronic observables from central A+A collisions in the energy range 5 GeV $\leq \sqrt{s_{NN}} \leq$ 200 GeV when implementing the differential cross sections into the PHSD approach. We only observe small differences in the antibaryon sector ($\bar{p}$, $\bar{\Lambda}+\bar{\Sigma}^0$) at $\sqrt{s_{NN}}$ = 17.3 GeV and 200 GeV with practically no sensitivity of rapidity and p_T distributions to the μ_B dependence of the partonic cross sections. Small variations in the strangeness sector are obtained in all studied collisional systems (A+A and C+Au), however, it will be very hard to extract a robust signal experimentally. Since we find only small traces of a μ_B-dependence in heavy-ion observables - although the effective partonic masses and widths as well as their partonic cross sections clearly depend on μ_B - this implies that one needs a sizable partonic density and large space-time QGP volume to explore the dynamics in the partonic phase. These conditions are only fulfilled at high bombarding energies where μ_B is, however, rather low. On the other hand, when decreasing the bombarding energy and thus increasing μ_B, the hadronic

phase becomes dominant and accordingly, it will be difficult to extract signals from the partonic dynamics based on "bulk" observables.

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Deuteron production in heavy ion collisions

Author: Marcus Bleicher[1]

[1] *Uni Frankfurt*

In this talk, we discuss UrQMD phase-space coalescence calculations for the production of deuterons. We compare with available data for various reactions from the GSI/FAIR energy regime up to LHC. It is found that the production process of deuterons, as reflected in their rapidity and transverse momentum distributions in p+p, p+A and A+A collisions at a beam energies starting from the GSI energy regime around 1 AGeV and up to the LHC, are in good agreement with experimental data. We further explore the energy and centrality dependence of the d/p ratios. Finally, we discuss anti-deuteron production for selected systems. Overall, a good description of the experimental data is observed. The results are also compatible with thermal model estimates. We also discuss the production of hypermatter within the same approach and find sizable production rates at FAIR.

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One-loop divergences in 7D Einstein and 6D conformal gravities

Author: Danilo Diaz[1]

Co-authors: Rodrigo Aros ; Fabrizzio Bugini

[1] *Universidad Andrés Bello*

Within the context of AdS/CFT Correspondence, we first compute one-loop infrared (IR) divergences of 7D Einstein Gravity in a certain Poincaré-Einstein background metric. We compute then the one-loop ultraviolet (UV) divergences of 6D Conformal Gravity on the boundary. We verify the equality of the above results that stems from the IR-UV connection of the duality dictionary. Key ingredients are heat kernel techniques, factorization of the boundary higher-derivative kinetic operator for the Weyl graviton on the 6D boundary Einstein metric and WKB-exactness of the Einstein graviton in the chosen 7D Poincaré-Einstein background.
In all, we elucidate the way in which the 6D results containing the type-A and type-B conformal anomalies for the Weyl graviton are encoded in the 7D "hologram" given by the fluctuation determinant for the Einstein graviton. We finally discuss possible extensions to include higher-spin fields.

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Generalized SU(2) Proca inflation

Author: Yeinzon Rodriguez Garcia[1]

[1] *UAN & UIS (Colombia)*

The generalized SU(2) Proca theory is the only modified gravity theory, nowadays, able to accommodate in a natural way a configuration of vector fields which is compatible with the homogeneous and isotropic nature of our Universe. In previous works, we have been able to uncover a self-tuning mechanism that drives an eternal slow-roll inflationary period for an ample spectrum of initial conditions. We have made a little and justified modification to the action so that the mentioned self-tuning mechanism is preserved but now the inflationary period has a graceful exit and is long enough to solve the classical problems of the standard Cosmology. The action is free of tachyonic, ghost, and Laplacian instabilities, and, in addition, provides a non-anomalous speed for the gravity waves. The usual naturalness problem of the primordial inflation in this scenario is, therefore, essentially absent.

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Lie-Backlund transformations for residual symmetries in General Relativity

Authors: Eloy Ayón Beato [1] ; Gerardo Velázquez Rodriguéz[2] ; Miguel Angel Marquina Carmona[3]

[1] *Cinvestav*

[2] *Arkansas State University Campus Queretaro*

[3] *CINVESTAV IPN*

Lie-Backlund transformations have been used to extend the criteria proposed by Ayón-Beato and Velázquez-Rodríguez for characterizing the residual symmetries of the gravitational ansatz developed according to Lie-point transformations. We found that non-local Lie-Backlund transformations allows us to obtain the more general residual symmetries of the metric. We present the generalized criteria for finding all residual symmetries for any metric ansatz in general relativity.

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Correlation functions of sourced gravitational waves in inflationary scalar vector models. A symmetry based approach

Authors: Josue Motoa Manzano[1] ; Juan Pablo Beltrán Almeida[2] ; Cesar Alonso Valenzuela Toledo[1]

[1] *Universidad del Valle*

[2] *Universidad Antonio Nariño*

In this work we use the correspondence between a field theory in de Sitter space in 4-dimensions and the dual conformal field theory in an euclidean space in 3-dimensions, to compute the form of two and three point correlation functions of scalar-tensor perturbations. To this end, we use an inflationary model, in which the inflaton field is interacting with a vector field trough the term $f(\phi)\left(F_{\mu\nu}F^{\mu\nu}+\kappa\tilde{F}_{\mu\nu}F^{\mu\nu}\right)$.

The first step of this method consist in to solve the equations of motion for the fields in the de Sitter 4D space-time, then evaluate this solutions in super-Hubble scales and compute the conformal weight of the projection of this fields in the 3D space. In a second stage, we propose a general form for the correlators, which involve scalar, vector and tensor perturbations and, using the first step result, find its momentum dependence by imposing that those are invariant under dilatations and special conformal transformation (SCT). As a result, we find the form for the different Spectrums of the tensor perturbations and for the a mixed Bispectrum coming from the vacuum and for the vector perturbations. They show to be in agreement with the results in the literature.

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The symmetry energy in neutron stars: constraints from GW170817 and direct Urca cooling

Authors: David Edwin Alvarez Castillo[1] ; David Blaschke[2]

[1] *JINR*

[2] *University of Wroclaw*

In this contribution I will review the state of the art measurements for the symmetry energy from both astrophysical and terrestrial laboratories. In particular the recent detection of gravitational radiation from the GW170817 event shed light on the properties of the neutron star equation of state, thus comprising both the study of the symmetry energy and stellar radius. Furthermore, I shall address the question on the possibility of a universal symmetry energy contribution to the neutron star equation of state under restricted Direct Urca cooling. When these two aspects are combined, powerful predictions for the neutron star equation of state are obtained.

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Stueckelberg-Horwitz-Piron (SHP) classical mechanics with evolving local metric

Author: Martin Land[1]

[1] *Hadassah College*

Stueckelberg-Horwitz-Piron (SHP) theory is a framework for posing classical and quantum relativistic physics in canonical form with an external parameter of evolution τ. SHP electrodynamics generalizes Maxwell theory by allowing the four-vector potential to depend on τ and introducing a scalar gauge potential $a_5(x,\tau)$ associated with this τ-dependence. As a result, current conservation, wave equations, and other scalar expressions suggest a formal 5D symmetry that breaks to tensor and scalar representations of O(3,1) in the presence of 4D matter. Following a similar approach, this electrodynamic theory has recently been extended to non-abelian gauge symmetries and to the classical and quantum many-body problem in curved 4D spacetime with local metric $g_{\mu\nu}(x)$, for $\mu, \nu = 0, 1, 2, 3$.

In this talk we examine another extension of classical SHP mechanics by allowing the local metric to be τ-dependent and introducing new metric components associated with τ evolution. In order to obtain a reasonable prescription for this generalization, consistent with an extended equivalence principle, the breaking of formal 5D tensor symmetries must be treated in detail. This extension permits us to describe particle motion in geodesic form with respect to a dynamically evolving background metric. As an example, we consider the field produced by a τ-dependent mass $M(\tau)$, first as a perturbation in the Newtonian approximation and then for a Schwarzschild-like metric. As expected, the extended Einstein equations imply a non-zero energy-momentum tensor, representing the flow of mass energy corresponding to the changing source mass. Moreover, the Hamiltonian (the scalar system mass) is driven by terms proportional to $dM/d\tau$ and is not conserved. In τ-equilibrium, this system becomes a generalized Schwarzschild solution for which the extended Ricci tensor and mass-energy-momentum tensor vanish.

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On the dynamics of rotationally supported galaxies

Author: Ramzi Suleiman[1]

[1] *Triangle Research & Development Center*

A recent finding, based on empirical data of 153 rotationally supported galaxies, with very different morphologies, masses, sizes, and gas fractions, revealed that the baryonic and the dark matter in galaxies are strongly coupled, such that, if the first is known, the second follows and vice versa. Here, we propose a completely theoretical analysis of the dynamics of rotationally supported galaxies, which results in the same conclusion. We find that the relationship between baryonic and dark matter densities at any radius r is governed by the law, ρ(r)_M + ρ(r)_DM = ρ_0, where ρ(r)_M, and ρ(r)_DM are, respectively, the densities of matter and dark matter at radius r, and ρ_0 is the density at the galaxy's center. Strikingly, we also found that the radius r_s, at which the rotation velocity is equal to half of its maximal value (or alternatively the radius r_c at which the baryonic matter density is equal to half of its density at the galaxy's center) constitutes a vivid signature of the galaxy, in the sense that it reveals rich information about the galaxy's dynamics, including the distribution of its matter and dark matter and their total amounts in the galaxy.

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A hybrid model for pulsar evolution

Authors: Zhi Fu Gao[1] ; Qiu He Peng[2]

[1] *Xinjiang Astronomical Observatory, Chinese Academy of Sciences*

[2] *Department of Astronomy and Key Laboratory of Modern Astronomy and Astrophysics, Nanjing University*

The combined effects of both the standard magnetic dipole model and the composite neutron superfluid vortex model on the energy loss rate of neutron stars and pulsar spin down are simultaneously taken into account to study the evolution of neutron stars on the P-Pdot diagram. The evolution path of each neutron star is dictated by a particular mechanism in our hybrid model in different parameter spaces and the valley of each curve is the most possible place for a neutron star to be observed since this is the place which corresponds to the minimum value of the evolution speed (i.e. the time derivative Pdot). In other words, pulsars would distribute around these valleys on the P-Pdot diagram. The combined model can be fitted very well with observation to yield the interesting results:(1) the suppressed region in the lower-right part of the diagram can be explained by neutrino cyclotron emission from the 1S0 neutron superfluid vortexes in neutron stars. (2) All radio pulsars that were identified with super strong magnetic fields with field strength beyond the critical quantum magnetic field before are now all lying inside the critical magnetic field line in our model. (3) The peak of neutron star magnetic fields (logB) distribution revels a gaussian distribution in our model whereas the statistics of the simple magnetic dipole model results in a distribution with non-symmetrical peak.

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Efficient cosmic-ray acceleration at reverse shocks in supernova remnants

Author: Satoru Katsuda[1]

[1] *Saitama University*

When a supernova explodes, a blast wave is generated and propagates into the ambient medium, whereas the deceleration of the ejecta by the ambient medium induces an inward-propagating shock wave, the so-called reverse shock (RS). If the RSs can efficiently accelerate cosmic-rays, then they can be important production sites of heavy-element cosmic-rays. We present evidence for efficient cosmic-ray acceleration at reverse shocks in young Galactic supernova remnants including Cassiopeia A and RCW 86, based on recent X-ray observations with Chandra.

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Crustal torsional oscillations inside the deeper pasta structures

Author: Hajime Sotani[1]

[1] *National Astronomical Observatory of Japan*

The quasi periodic oscillations (QPOs) observed in the soft-gamma repeaters are generally considered as a results of the global oscillations of the neutron stars. In this study, we first take into account the torsional oscillations excited in the tube and bubble phases, which can be excited independently of the oscillations in the phases of spherical and cylindrical nuclei, and successfully identify the observed QPO frequencies with such torsional oscillations. The resultant neutron star models are consistent with the mass formula for low-mass neutron stars and the constraint by the gravitational waves from the merger of the neutron star binary, GW170817.

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Gravitational wave emitted from core-collapse supernovae

Author: Tomoya Takiwaki[1]

[1] *Tomoya*

Gravitational wave signal from core-collapse supernova is the key to understand the mechanism of core-collapse supernovae. The evolution of the frequency of the signal tells us the property of neutron star and information of the accretion flow near the neutron star. In this study, I will introduce the gravitational waveform based on our recent 3D simulations and discuss what information extracted from the signal.

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Cosmic matter in the laboratory - Investigating neutron star core densities with FAIR

Author: Christian Sturm[1]

[1] *GSI Helmholtzentrum fuer Schwerionenforschung*

The Facility for Antiproton and Ion Research, FAIR, is presently being constructed adjacent to the existing accelerator complex of the GSI Helmholtz Centre for Heavy Ion Research at Darmstadt/Germany, expanding the research goals and technical possibilities substantially. The worldwide unique accelerator and experimental facilities of FAIR will open the way for a broad spectrum of unprecedented fore-front research supplying a large variety of experiments in hadron, nuclear, atomic and plasma physics as well as biomedical and material science which will be briefly described in this presentation. Emphasis will be put on the investigation of the highest baryon densities accessible in the laboratory by relativistic nucleus-nucleus collision at FAIR energies, probing strongly interacting matter under extreme conditions as we expect inside neutron stars.

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Predictions of the pseudo-complex theory of gravity for EHT observations: Observational tests

Authors: Thomas Boller[1] ; Peter Hess[2]

[1] *MPE Garching*

[2] *UNAM Mexico*

A modified theory of gravity, avoiding singularities in the standard theory of gravitation, has been developed by Hess \& Greiner, known as the pseudo-complex theory of gravitation. The pc-GR theory shows remarkable observational differences with respect to standard GR. The intensity profiles are significantly different between both theories, which is a rare phenomenon in astrophysics. This will allow robust tests of both theories using Event Horizon Telescope (EHT) observations of the Galactic Center. We also predict the time evolution of orbiting matter. In this paper we summarize the observational tests we have developed to date. In case that the EHT data are public, we will discuss their implication on the pc-GR theory.

1

Comparison of the predictions of the pc-GR to the observations of the EHT

Author: Peter Hess[1]

[1] *Universidad Nacional Autónoma de México*

The observation predictions of the pseudo-complex General Relativity, related to the structure of an accretion disk, are compared to the reported observations of the Event Horizon Telescope.

70

Physics and astrophysics with the Pierre Auger Observatory

Author: Rogerio de Almeida[1]

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One century after the discovery of cosmic rays, the origin of ultra high energy cosmic rays still remains enigmatic. Taking data since 2004, the Pierre Auger Collaboration has been expanding our knowledge about these cosmic particles with energies much higher than what LHC can achieve. Although some intriguing questions have been answered, some of the mystery still persists. The focus of this presentation is on the most recent results on ultra-high energy cosmic rays obtained with the Pierre Auger Observatory with emphasis on the anisotropy studies of the arrival directions of the most energetic particles.

44

CPT violation due to quantum decoherence tested at DUNE

Authors: Félix Napoleón Díaz Desposorio[1] ; Juan C. Carrasco[1] ; Alberto M. Gago Medina[1]

[1] *Pontificia Universidad Católica del Perú*

In this work we study the intrinsic CPT violation in the neutrino oscillations phenomena produced by quantum decoherence as sub-leading effect. In the usual representation, we find that only fifteen elements of the decoherence matrix violate the CPT symmetry intrinsically. We find exact solutions for the CPT asymmetry function in vacuum . We define an observable $\mathcal{R}$ to make predictions of this model for the future Long-Baseline experiment, DUNE. We found values of the decoherence parameters with 5σ of discrepancy to standard physics which are allowed by the current experimental limits, suggesting hints for new physics by this model in the context of future experiments.

arXiv:1811.04982

18

Non-linear electrodynamics for astrophysical plasmas

Author: Marcelo Enrique Rubio[1]

Co-author: Oscar Reula [2]

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In this work we study the initial value problem of a non-linear extension of classical Electromagnetism, known as "Force-Free Electrodynamics" (FFE). The FFE equations describe the dynamics of a diluted plasma near the event horizon of a rotating black hole. In these astrophysical regions, magnetic fields dominate the dynamics when compared with the matter that constitutes those plasmas, giving rise to an decoupled description for Electromagnetism.
As a starting point, we consider a covariant formulation of the FFE theory in terms of two scalar potentials, known as "Euler potentials", which allow a very elegant and precise geometric interpretation of it. The ease of formulating FFE in terms of two potentials lies in the fact that, being the only dynamical variables, it provides an optimal scenario for its numerical implementation. In this work we show that this formulation is weakly hyperbolic, which means that the system does not have a well posed initial value problem in the usual sense. In this way, it is not possible to guarantee uniqueness or continuity during the dynamic evolution, which implies that this formulation is not convenient for numerical simulations.

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Modeling anisotropic magnetized compact stars with γ metric: the white dwarfs picture

Authors: Diana Alvear Terrero[1] ; Victoria Hernandez Mederos[1] ; Samantha López Pérez[2] ; Daryel Manreza Paret[2] ; Aurora Perez Martinez[1] ; Gretel Quintero Angulo[2]

[1] *ICIMAF*

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Magnetic fields introduce an anisotropy in compact stars' equations of state by splitting the pressure into two components, one parallel and the other perpendicular to the magnetic field. This suggests the necessity of using structure equations accounting for the axial symmetry of the magnetized system. We consider an axially symmetric metric in spherical coordinates, the γ-metric, and construct a system of equations to describe the structure of spheroidal compact objects. In this way, we connect the geometrical parameter γ linked to the spheroid's radii, with the source of the anisotropy. So, the model relates the shape of the compact object to the physics that determines the properties of the composing matter.
To illustrate how our structure equations work, we present magnetized white dwarfs structure and discuss the stability of the solutions. The results are obtained for magnetic field values of 10^{12}G,

10^{13}G and 10^{14}G, in all cases with and without the Maxwell contribution to the pressures and energy density. This choice allows to have two sets of EoS, one featuring $\gamma > 1$ and other with $\gamma < 1$.

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Magnetic field effects on Bose-Einstein condensate stars

Authors: Gretel Quintero Angulo[1] ; Aurora Perez Martinez[2] ; Hugo Celso Perez Rojas[3] ; Daryel Manreza Paret[4]

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[2] *ICIMAF*

[3] *Unknown*

[4] *University of Havana*

We study magnetic field effects on the Equations of State (EoS) and the structure (mass-radius relation) of Bose-Einstein Condensate (BEC) stars, i.e. a compact object composed by a gas of interacting spin one bosons formed up by the pairing of two neutrons. To include magnetic field in the star description we suppose that particle-field and particle-particle interactions are independent, and consider two situations, one where the magnetic field is constant, and another where it is produced by the bosons. Magnetic field presence splits the pressure of the boson gas in two components, one parallel and the other perpendicular to field direction. At low densities and/or strong fields the smaller pressure might be negative, making the boson system unstable. This imposes a lower limit to the central mass density of the star in a way that, the stronger is the magnetic field, the denser has to be star to support its mass against collapse. Since the anisotropy in the pressures implies that the resulting star is not spherical, to compute the mass-radius relation we use the recently found γ-structure equations that describe axially symmetric objects provided they are spheroidal. The obtained BEC stars are, in general, less massive and smaller than in the non-magnetic case, being magnetic field effects more relevant for low densities. When the magnetic field is produced by the bosons, the inner profiles of the fields are determined self consistently as a function of the star inner radii, its values being in the orders expected for compact stars.

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Thermodynamic properties of a magnetized neutral vector boson gas at finite temperature

Author: Lismary de la Caridad Suárez González[1]

Co-authors: Aurora Perez Martinez [2] ; Gretel Quintero Angulo [3]

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We study the thermodynamic properties of a neutral vector boson gas in presence of a constant magnetic field at finite temperature. The study has been done considering relativistic and non-relativistic bosons. In general, one of the most outstanding properties of magnetized bosonic systems is the occurrence of Bose-Einstein condensation (BEC) and Bose-Einstein ferromagnetism: in the condensed state, the gas shows a spontaneous magnetization. The main purpose of this work is to study the effect of temperature on the equations of state for that matter that allows more accurate descriptions of compact objects, specifically of neutron stars, which might contain spin-1 bosons formed up by two paired neutrons. As a limit case we study the structure of stars fully composed by matter in this form.

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Modeling anisotropic magnetized strange quark stars

Authors: Samantha López[1] ; Gretel Quintero Angulo[2] ; Aurora Perez Martinez[1] ; Daryel Manreza Paret[3] ; Diana Alvear Terrero[1]

[1] *ICIMAF*

[2] *Facultad de Física, Universidad de La Habana*

[3] *University of Havana*

When studying the structure of magnetized compact objects, the anisotropy in their equations of state (EoS), due to the magnetic field, must be taken into account. This anisotropy consists in the splitting of the pressure in two components, one parallel and the other perpendicular to the magnetic field. In this work, we compare the size and shape of magnetized strange quark stars using three different sets of structure equations. First, we solve the standard isotropic Tolman-Oppenheimer-Volkoff equations for the parallel and perpendicular pressures independently. Then, we obtain the mass-radii curves of the magnetized strange quark stars using axially symmetric metrics in cylindrical and spherical coordinates, this last one called the gamma-metric. The differences between the results obtained in each case are discussed.

54

The magnetized photon time delay and Faraday rotation

Authors: Adrian William Romero Jorge[None] ; Lidice Cruz Rodríguez[None] ; Aurora Perez Martinez[1] ; Hugo Celso Perez Rojas[2] ; Elizabeth Rodríguez Querts[1] ; Gabriella Piccinelli Bocchi[3]

[1] *ICIMAF*

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[3] *Universidad Nacional Autónoma de México*

We study the propagation of photon in magnetized vacuum and medium, taking into account radiative corrections. We describe both time delay and Faraday rotation, with the aim of applying the results to astrophysical context.

42

The mathematical description of the influence of the expansion of the Universe on the metric of a black hole

Authors: Adrian Linares-Rodríguez[1] ; Ailier Rivero-Acosta[2] ; Carlos de la Caridad Rodríguez Fadragas[3]

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The existence of black holes has its analytical argumentation in Einstein's field equations. The first solution of general relativity that would characterize a black hole was found by Schwarzschild in 1916. Since then, these cosmic objects are being studied and investigated in their various variants: Scwartzshild, Kerr, Reissner-Nordström, Kerr-Newman, and others. The no-hair theorem states that a black hole has only three independent properties: mass, charge and angular momentum and is characterized by producing intense gravitational fields. On the other hand, the existence in the Universe of a dark material component of the repulsive type against the attractive action of gravitation

can be represented by the quintessence. The effect of the quintessence surrounding the black hole is then introduced. Ordinarily, an additional element within the stress-energy-moment tensor of the Einstein field equations is introduced. The mathematical description of this problem is complicated, in general. In this investigation, we have chosen to use a variant in which the effect of the quintessence is introduced as a perturbative action in the metric of the ordinary black hole introducing the time-dependent scale factor. The Einstein field equations are obtained using the perturbed metric and the results obtained correspond to those obtained by the ordinary way.

7

Extending observations to distances larger than 10 kpc should resolve the anomaly of a galaxy lacking dark matter

Author: Ramzi Suleiman[1]

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We investigated the claim that galaxy NGC 1052-DF2 lacks dark matter. For this purpose, we constructed a novel, theory-based computer simulation of the dynamical interaction of matter and dark matter in a prototypical ellipsoid galaxy and utilized it to predict the distributions of dark matter in a galaxy as a function of the galaxy's core radius and maximal rotation velocity. We ran the simulation using the parameters of NGC 1052-DF2 as well as the parameters of six other UDGs from the Coma cluster and seven dSph galaxies from the local group. For each galaxy, the simulation was run in steps of 2 kpc up to 100 kpc from the galaxy center. Inspection of the distributions of matter and dark matter generated by the simulated, as a function from distance r, reveals the following: (1) Consistent with the ΛCDM paradigm, all the tested galaxies, including galaxy NGC 1051-DF2, are predicted to be dark-matter-dominated. (2) The reported lack of dark matter within $r \leq 10$ kpc is supported by the simulation results. However, this result is an aftermath of conducting a "short-sighted" observation for only $r < 10$ kpc. (3) Consistent with ΛCDM models, the bulk of dark matter at galactic scales resides at the galaxies' halos. (5) The core radius of a galaxy is predictor of the proportions of matter and dark matter in the galaxy.

13

Homogeneity of the universe emerging from the Equivalence Principle and Poisson equation: A comparison between Newtonian and MONDian cosmology

Author: Eduardo Guendelman[1]

[1] *Ben Gurion University*

A correspondence between the Equivalence principle and the homogeneity of the universe is discussed. We show that under the Newtonian gravity, translation of co-moving coordinates in a uniformly expanding universe defines a new accelerated frame. A consistency condition for the invariance of this transformation yields the second Friedman equation. All these symmetries are lost when we modify Newton's second law and/ or the Poisson equation. For example by replacing Newton's second law with non-linear function of the acceleration, as Modified Newtonian Dynamics (MOND) suggested, the concept of relative acceleration is lost. As a consequence the homogeneity of the universe breaks. Therefore MOND which changes Newton's second law or a QUAdratic Lagrangian (AQUAL) which changes the Poisson equation are not complete theories and they should be amended to preserve the cosmological principle. Only locally could MOND be used as a toy model, but not as a global theory which should describe a universe in large scales.

71

A study in progres about a dynamical gravastar solution

Author: Duvier Fontanella[1]

[1] *ICIMAF*

We present the state of research devoted to investigate the consequences of a formerly proposed regular solution at the origin for the Einstein-Klein-Gordon equations. We implement a match with the Schwarzschild solutions with a zero scalar field outside a spherical region. The configuration of fields are used as a first step in an iterative process to calculate the vacuum expectation value of the energy-momentum tensor, aiming at further solving the Einstein semi-classical equation. The result shows the quantum corrections to the previous solution. It is expected that further steps in the iterative process will regulate the previous solutions, by leading to the convergence of the iterative solution. The first step in the iteration solution and an explicit dependence of the expectation value of the energy-momentum tensor with the metric are found.

24

Perturbations to planetary biospheres due to high energy muons from cosmic ray bursts originated in neutron star mergers

Authors: Lien Rodriguez-Lopez[1] ; Rolando Cardenas[2] ; Lisdelys Gonzalez Rodriguez[1] ; Liuba Peñate Alvariño[3] ; Oscar Parra Barrientos[1]

[1] *University of Concepcion, Chile*

[2] *Universidad Central "Marta Abreu" de Las Villas*

[3] *Austral University of Chile*

In this work a mathematical model for aquatic photosynthesis, modified by some of us to include particulate ionizing radiation, is used to assess the perturbations that muons coming from neutron star mergers could make to this biological process. It is then shown that neutron star mergers not too far from inhabited rocky planets have the potential to considerably deplete their aquatic photosynthesis. Some remarks concerning the affectation on other types of subsurface life are also done, and by extension some considerations on habitability of the Milky Way are presented.

49

Z production in pPb and PbPb collisions at 5.2 TeV

Authors: Dario Ramirez Zaldivar[1] ; Dairon Rodriguez Garcés[2] ; Fernando Guzman Martinez[1]

[1] *InSTEC, Havana University*

[2] *InST, Havana University*

There is a growing interest in the exam and analysis of results in the ALICE, ATLAS and CMS detectors in asymmetric systems (pPb) due to the possibilities of establishing some references for PbPb collisions and to gain insight into the behavior of the medium itself. The analysis of data in both cases can allow the understanding of the PDFs under different regimes. The study of the initial state in proton-lead collision at 5.02 TeV using Drell-Yan process was chosen because the inclusive lepton production is a clean process independent of the color degree freedoms. For the study, it was considered an extension of the Glauber model to express the cross-section. Under this approach, we can examine the initial vertex of the hard process described by sigma_pp and apply the usual calculation through the factorization theorem. In particular, we focused on the analysis of the pT distribution

and compared the role of different factorization schema in the behavior of the distribution at low pT.

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Towards the measurement of the anisotropic pressures effects in magnetized quantum vacuum

Authors: Hugo Celso Peréz Rojas[1] ; Elizabeth Rodríguez Querts[1]

[1] *ICIMAF*

Starting from the fact that vacuum pressure orthogonal to a constant magnetic field is negative, whereas along the field is positive, we estimate the shift of frequency for radiation moving in these directions to first order in α at small fields as compared to the Schwinger critical field Bc, and suggest ideas for its experimental test. For fields of order of or greater than 2Bc we briefly discuss the arising of an imaginary part on the vacuum energy, meaning its instability at such fields. We propose an heuristic model of bosonic electron-positron bound state leading to a ferromagnetic quantum phase transition of vacuum at critical fields 2Bc.

73

Neutrino luminosity from the hadron burning to quark matter inside neutron stars

Authors: Ernesto Kemp[1] ; Jhon A. Rosero [2]

[1] *University of Campinas*

[2] *University of Campinas- UNICAMP*

In this work, we study the neutrinos diffusion into the hybrid neutron star, after a phase transition from hadronic to quark matter in proto-neutron stars. We calculate the neutrino luminosity and signal features during the cooling of the hybrid neutron star. We use the MIT bag model for quark matter description, taking into account the effect of strong interactions in the perturbative regime to the order of QCD coupling constant and also the effect of finite temperature and strange quark mass. We show that the energy released by the emission of neutrinos considerably increases the event rate detected on earth after the phase transition of matter and during the cooling.

72

The influence of magnetic field geometry in neutron stars crustal oscillations

Authors: Cecilia Chirenti[None] ; Ernesto Kemp[1] ; Gibran Henrique de Souza[2]

[1] *University of Campinas*

[2] *University of Campinas - UNICAMP*

In this work, we show the solutions of the fluid perturbations equations confined in a neutron star crust with a dipolar magnetic field permeating the whole star. The perturbations are restricted to the crust, and dipolar an toroidal components describe the magnetic field. With this model, we seek to explain the frequencies observed in some Soft Gamma Repeaters flares.

65

Connecting compact stars and heavy ion collisions

Authors: Diana Alvear Terrero[1] ; David Blaschke[2] ; Niels-Uwe Bastian[2]

[1] *ICIMAF & University of Wroclaw*

[2] *University of Wroclaw*

Commonly used in astrophysics, DD2 is a relativistic mean-field equation of state (EoS) with density-dependent couplings parametrized to nuclei data. It reproduces successfully the properties of nuclear matter up to saturation density as well as neutron star masses observations, chiral effective field theory, and symmetry energy constraints. A known caveat of DD2 is the atypical behavior of finite baryon chemical potential for zero baryon density at finite temperature, which is not appropriate for studying the temperature axis of the QCD phase diagram. With the aim of obtaining a unified equation of state that can be used both in HIC and astrophysics, we intend to develop a new version of the EoS with the proper behavior at zero baryon density while keeping the current good features. As a first approximation to the problem, we modify the density dependent σ coupling so that its derivative at zero density vanishes and obtain a new parameter set by optimizing the difference of the new EoS with respect to the thermodynamic behavior of DD2.

9

Evolutions of magnetic field and spin-down of neutron stars

Authors: Zhifu Gao[1] ; Na Wang[1]

[1] *Xinjiang Astronomical Observatory, Chinese Academy of Sciences*

Here we summarized our recent work on evolutions of magnetic field and spin-down of neutron stars mainly focusing on magnetars, X/gamma-ray pulsar PSR J1640-4631 with high braking index n=3.15 (3) and the high-magnetic-field pulsar PSR J1734-3333 with low braking index n=0.9(2). Our work includes the following three parts: (1) Based on the estimated ages of their potentially associated supernova remnants (SNRs), we estimate the values of the mean braking indices of eight magnetars with SNRs, and find that five magnetars have smaller mean braking indices of $1 < n < 3$, and we interpret them within a combination of magneto-dipole radiation and wind-aided braking. The larger mean braking indices of $n > 3$ for the other three magnetars are attributed to the decay of external braking torque, which might be caused by magnetic field decay; (2) By introducing a mean rotation energy conversion coefficient, and combining the pulsar's high-energy and timing observations with a reliable nuclear equation of state, we estimate the initial spin period, initial dipole magnetic field and true age PSR J1640-4631, The measured braking index of n=3.15(3) for PSR J1640-4631 is attributed to its long-term dipole magnetic field decay and a low magnetic field decay rate; (3) The low braking index pulsar PSR J1734-3333 could undergo a supercritical accretion soon after its formation in a supernova explosion. The buried multipole magnetic fields will merger into a dipole magnetic field. Since the magnetic flow transfers from the core to the crust of the pulsar, its surface dipole field grows quickly at a power-law form assumed, which results in the small braking index of n = 0.9(2). Keeping the current field-growth index $\varepsilon = 1.34$, this pulsar will become a magnetar after next 50 kyrs and 100 kys, respectively.

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Neutron star equation of state after the GW170817 event

Authors: David Edwin Alvarez Castillo[1] ; David Blaschke[2]

[1] *JINR*

[2] *University of Wroclaw*

In this talk I will review the method of estimation of tidal deformabilities of compact stars and present results for pure hadronic as well as hybrid stars that include the mass twins case. Then I will discuss the impact of the nuclear symmetry energy in the determination of the compact star radius.In particular, the recent detection of gravitational radiation from the GW170817 event shed light on the properties of the neutron star equation of state (EoS), thus comprising both the study of the symmetry energy and stellar radius.
Furthermore, I will focus on the case of mass twin compact stars, hybrid compact stars with approximately the same masses but different radii. To qualify the above, I will show a recent developed EoS that features of a color superconducting chiral quark model with nonlocal, covariant interactions bearing density dependent vector meson coupling and a density-dependent bag pressure. This model allows for a scenario where the compact stars of the GW170817 event are either both hadronic, both hybrid, or simultaneously hadronic and hybrid configurations.

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Nuclear modification factor and dilepton production in pA collisions

Authors: Dairon Rodriguez Garces[1] ; Fernando Guzman Martinez[2] ; Dario Ramirez Zaldivar[1] ; Jorge Luis Valdes Albuernes[1] ; Gabriel de la Fuente Rosales[1]

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[2] *Deutsches Elektronen-Synchrotron (DE)*

The broadening of the transversal momentum (pT) spectrum, the so called Cronin effect, is traditionally explained as a consequence of the initial state interaction at partonic level. It also is a signature of the parton dynamic previous to the fragmentation. In this contribution we will focus on the nuclear modification factor having in mind, that the dilepton production avoid the hadronization phase. We explore such process in proton-nucleus collisions using the merging of the Matrix Elements (ME) approach calculated by the POWHEG in NLO with the Parton Shower simulated by the PYTHIA (PS) event generator.

45

Bayesian procedure for characterizing the physical parameters of the black hole binary coalescence GW-170814

Authors: Víctor Alexander Torres Sánchez[1] ; José Manuel Ramírez[2]

[1] *Yachay Tech University*

[2] *Yachay Tech*

After the first detection of Gravitational Waves (GWs) lead to win the Nobel of Physics, characterizing the parameters of the systems creating these events have become more important to shed light on our knowledge of the Universe. In this work, we aim to follow the scientific procedure used by the LIGO-VIRGO interferometer's network to characterize the physical parameters describing the event of the collision of a two Black Hole (BHs) Binary system using PYCBC toolkit. We show that our results for estimated masses M1=31.1±7.5 M2=23.1±6.5 Solar masses and Luminosity distance d_{L}= 710±250 that are in good agreement with the parameters estimated by the different inference processes done by the LIGO-VIRGO network.

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An anisotropic solution for neutron stars

Authors: Víctor Alexander Torres Sánchez[1] ; Ernesto Contreras[2]

[1] *Yachay Tech, University*

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In this work we obtained an anisotropic Neutron Star solution by a gravitational decoupling of sources. More precisely, we implement a method known as Minimal Geometric Deformation which allows to extended isotropic solutions to anisotropic domains with appropriated matching conditions. We have performed analytical calculations to show that, in this approach, the anisotropic solution has the same properties as its isotropic counterpart as pressures, density, and causality. Finally, we compare our results to the observational data of a Neutron star interior PSR J0348+0432 and also to the isotropic case.

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The ohmic decay of magnetic field in magnetars

Authors: Zhifu Gao[1] ; Na Wang[1]

[1] *Xinjiang Astronomical Observatory, Chinese Academy of Sciences*

Magnetars are a kind of pulsars powered by magnetic field energy. Part of the X-ray luminosities of magnetars in quiescence have a thermal origin and can be fitted by a blackbody with temperature about kT ~ 0.3−1 keV, much higher than the typical values for rotation-powered pulsars. The observation and theoretical study of magnetars is one of hot topics in the field of pulsars. Combined with the equation of state, we first calculated the electric conductivity of the crust under strong magnetic field, and then calculated the toroidal magnetic field decay rates and magnetic energy decay rates by using an eigenvalue equation of toroidal magnetic field decay and considring the effect of general relativity for magnetars. We found that, for most of magnetars with high X-ray luminosity.
The Ohmic decay of toroidal magnetic field can provide their observed isotropic soft X-ray radiationss, while for transient magnetars with low X-ray luminosities, their soft X-ray radiations may be powered by rotational energy loss rates. We also discussed other possible anisotropy origins of magnetar soft X-ray emissions, such as the formation magnetic spots and thermoplastic flow wave heating in the polar cap. Although anisotropic heating mechanisms are different from Ohmic decay, all of them require theire exists strong toroidal magnetic fields in the interior of a magnetar. However, the anisotropic heating mechanisms require higher toroidal multipole fields inside a magnetar(such as magnetic quadrupole field and octupole field) and are related to complex Hall drift, these may be our focus in the future.

32

Dark matter in a Standard Model extension with additional U(1) symmetry

Authors: Ricardo Gaitán[1] ; Marco Antonio Arroyo Ureña[None] ; José Halim Montes de Oca Yemha[2] ; Roberto Martinez[3] ; Luis Cabral Rosetti[4]

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[2] *UNAM*

[3] *Universidad Nacional de Colombia*

[4] *CIIDET*

We consider a model with U(1)′ local gauge symmetry, additional to the Standard Model gauge symmetry, which is broken by a singlet field scalar. In addition, the scalar sector contains two doublet scalar field. One of them is the usual Standard Model doublet scalar field that breaks the electroweak symmetry, meanwhile the second one is included to introduce the Weak Interacting Massive Particle that play the role of candidate for Dark Matter. The Z_2 discrete symmetry can be considered to eliminated the interactions in the potential which do not allow the stability of the Dark Matter candidate. We solve the Boltzmann equation to find the relic density for Dark Matter as a function of the scalar potential parameters, the new symmetry breaking scale and the U(1)′ gauge coupling constant.

19

Sirius project and synchrotron light

Author: Osvaldo Bezerra Silva Júnior[1]

Co-author: Willian Silva Mariano [1]

[1] *Federal Institute of Education, Science and Technology of Tocantins, Palmas Brazil*

Synchrotron Light, or Radiation, is a type of electromagnetic radiation that spans a wide range of the electromagnetic spectrum – from infrared light, to ultraviolet radiation and x-rays. Synchrotron light is produced when charged particles, accelerated to speeds approaching the speed of light, have their trajectory deflected by magnetic fields. The light we see – produced by the sun, by lamps or flames, reflected by objects, captured by our eyes and finally used by our brains to shape and color the world – corresponds only to a tiny fraction of the so-called electromagnetic waves. However, there are many electromagnetic waves, many types of light that we cannot see, but are produced in the most diverse natural and artificial phenomena. The study of these invisible waves leads not only to the understanding of the phenomena in which they are produced, but also to the development of technologies that use them, for example, to transmit and receive information.

Sirius, the new Brazilian Synchrotron Light Source, will be the largest and most complex scientific infrastructure ever built in the country and one of the first 4th-generation Synchrotron Light Sources in the World. It is planned to put Brazil in a leading position in the production of Synchrotron Light and is designed to be the brightest of all the equipment in its energy class. The first stage of the Sirius Project, the new synchrotron light source in Brazil, has just been inaugurated. Electrons were accelerated for the first time in the largest and most complex scientific facility ever built in the country, at the National Center for Research in Energy and Materials (CNPEM) in Campinas.