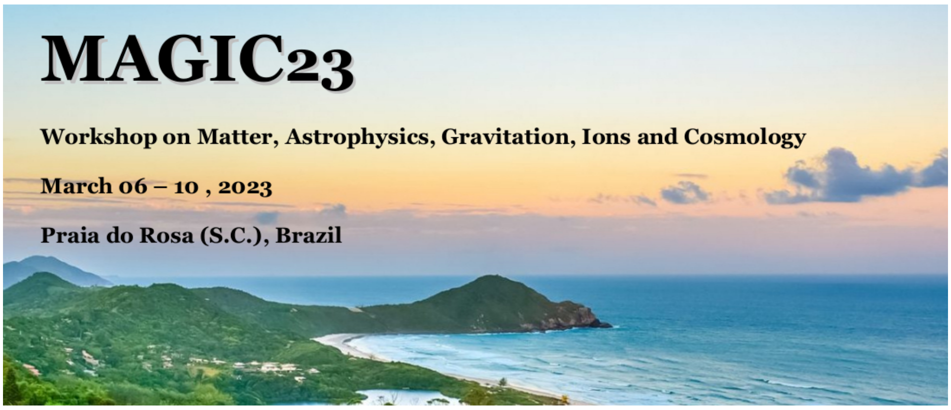
# MAGIC23 Workshop (Matter, Astrophysics, Gravitation, Ions and Cosmology)

Monday, 6 March 2023 - Friday, 10 March 2023

Praia do Rosa (S.C.), Brazil




# Book of Abstracts

# Contents

Evidences for the Branch-Cut Cosmology . . . . . . . . . . . . . . . . . . . . . . . . . . 1

studying remapping effects on 21cm mocks . . . . . . . . . . . . . . . . . . . . . . . . . 1

Einstein tensor with quantum mechanical imprints on 3-sphere . . . . . . . . . . . . . . . 1

On characterizing the leptonic phase diagram in early Universe . . . . . . . . . . . . . . 1

Uncertainty relation in viscous hydrodynamics and its effects in collective flow observables . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2

Relativistic equations of state for neutron stars . . . . . . . . . . . . . . . . . . . . . . . 3

An association with preferred-frame $S_V$ and Critical Speed of a superfluid . . . . . . . . 3

Anisotropic charged compact stellar configurations in the perspective of gravitational decoupling approach . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4

Interpreting SDSS extragalactic data in the era of JWST . . . . . . . . . . . . . . . . . . 4

On the overall properties of young pulsars . . . . . . . . . . . . . . . . . . . . . . . . . . 4

The effects of a minimal length on the Kerr metric . . . . . . . . . . . . . . . . . . . . . 5

Exploration of Matter in extreme conditions with Machine Learning . . . . . . . . . . . 5

Massive particle pair production and oscillation in Friedman Universe: its effect on inflation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5

The Laser Interferometric Gravitational Wave Detector Calibrator Magnetic Suspension 6

Circumstellar disc around first generation of stars . . . . . . . . . . . . . . . . . . . . . 6

Entanglement entropy in high energy physics . . . . . . . . . . . . . . . . . . . . . . . . 7

Cosmology and multi-messenger astrophysics with Gamma-Ray Bursts . . . . . . . . . . 8

Exclusive production of excited light vector mesons with a holographic wave function model . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 8

Measuring the speed of gravity in short distances . . . . . . . . . . . . . . . . . . . . . . 8

Equation of state of nuclear matter; applications in astrophysics and heavy ion physics . 9

Probing protocluster regions in the distant Universe . . . . . . . . . . . . . . . . . . . . 9

Neutron stars as a tool to understand QCD phase transitions . . . . . . . . . . . . . . . . 10

The lepton non-universality and the leptoquark solution . . . . . . . . . . . . . . . . . . . . 10

Radiation pressure of photon propagating in a magnetized vacuum . . . . . . . . . . . . 11

Light vector mesons photoproduction and the nuclear shadowing . . . . . . . . . . . . 11

Resolution tests for modified gravity models . . . . . . . . . . . . . . . . . . . . . . . . . . 11

SFDM AND STRUCTURE FORMATION . . . . . . . . . . . . . . . . . . . . . . . . . . . . 12

Two scalar fields as dark matter . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 12

Gauge fixing in unimodular gravity . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13

INFLUENCE OF INITIAL CONDITION OF POLARIZED DIPOLE AMPLITUDE EVOLUTION EQUATION ON SPIN DEPENDENT OBSERVABLES IN HIGH ENERGY PHYSICS . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13

Stars and Ceremonial Timing . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 13

Finding Structure in the Speed of Sound of Dense Matter . . . . . . . . . . . . . . . . . . . 14

Interior solution and structure equations for the γ-metric . . . . . . . . . . . . . . . . . . 14

Ultra-compact low mass neutron stars compatible with the observational properties of HESS J1731-347 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 14

Phenomenological quark-mass density-dependent model: a self-consistent treatment . . 15

M87* and Sgr A*: Imaging supermassive black holes . . . . . . . . . . . . . . . . . . . . . 15

Instantaneous non-local quark model for quark matter under the influence of strong magnetic fields . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15

CP Violation in a Noncommutative Spacetime . . . . . . . . . . . . . . . . . . . . . . . . . 16

3D-FF non-local NJL model satisfying modern astrophysical observations and lattice QCD constraints . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 16

On CCGG, the De Donder-Weyl Hamiltonian formulation of canonical gauge gravity . . 16

Surface tension and curvature energy of cold quark matter in the SU(3)_f NJL model with vector interactions . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 17

Investigating the partonic entropy at low Bjorken-x within gluon saturation approach . 17

A Pedagogical Introduction of Bayesian Parameter Estimation Method and Its Application in Fitting the Prompt Lightcurves of Gamma-Ray Bursts . . . . . . . . . . . . . . . . 17

AN ACCRETION-JET MODEL FOR 3C 84: INTERPRETING THE SPECTRAL ENERGY DISTRIBUTION AND FARADAY ROTATION MEASURE . . . . . . . . . . . . . . . . . . 18

Color-superconductivity of asymptotically conformal quark matter as a portal between astrophysics and heavy ions collision . . . . . . . . . . . . . . . . . . . . . . . . . . . . 18

The model of magetar crustal mageto-thermal evolution and application to AXP 1E 2259+586 . . . . 19

Investigation of the anisotropy of pressure of magnetars . . . . 19

The spin-down and magnetic inclination angle evolutions under the vacuum and plasma-filled models . . . . 20

The Physics and Astrophysics of GRBs . . . . 20

Progress on obtaining unified neutron star EOSs in RMF models . . . . 21

Repeating FRBs: An Magnetospheric Origin . . . . 21

Renormalization group techniques applied to the thermodynamics of a derivatively interacting model . . . . 22

Structure and Stability of Differentially Rotating Neutron Stars . . . . 22

CSS parametrization: a case study . . . . 22

Effects of a Generalized Uncertainty Principle on the MIT Bag Model Equation of State . . 23

Gravitational waves from isolated magnetized quark stars . . . . 23

γCygni SNR morphology viewed in the electromagnetic spectrum . . . . 23

Astrophysical approach to search for heavy neutrino decay . . . . 24

Studies of bright flat-spectrum radio quasar 3C454.3 at high and very-high energies . . . 24

Particle acceleration test with Cas A multiwavelength emission . . . . 25

Effects of the anomalous magnetic moment of quarks and regularization issues in the two-flavor Nambu–Jona-Lasinio model with a magnetic field . . . . 25

Particle identification studies of e-/e+ beams in the Test Beam detector at FERMILAB . . 26

**5**

## Evidences for the Branch-Cut Cosmology

**Author:** Cesar Augusto Zen Vasconcellos[None]

**Corresponding Author:** cesarzen@cesarzen.com

In this brief report, we approach the singularity, flatness, homogeneity and horizon problems from the classical point of view of the branch-cut cosmology.

**8**

## studying remapping effects on 21cm mocks

**Author:** Rahima Mokeddem[None]

**Corresponding Author:** rahimamokeddem@gmail.com

In this work we extend the remapping method proposed by Mead and Peacock (MNRAS 440, 1233–1247 (2014)). This method allow us to remmap N-body simulations catalogues from one cosmology into another different cosmology directly without necessity of running an N-body simulations for each cosmology. On the other hand, it is well known that 21 cm mocks are constructed from, for example, halo or galaxy N-body simulations catallogues. Here we are interested in extending and validating, Mead and Peackok method to the 21 cms mocks conctructions. This will allows to construct 21cm intensity maps in different cosmologies in a more computationally eficient and faster way. The resulting mocks are going to be used in the BINCO telescope analysis.

**9**

## Einstein tensor with quantum mechanical imprints on 3-sphere

**Authors:** Abdel Nasser Tawfik[1]; Tahia F. Dabash[2]

[1] *Future University in Egypt (FUE)*

[2] *Tanta University*

**Corresponding Author:** atawfik@cern.ch

With the relativistic generalized noncommutative Heisenberg algebra accommodating gravitational fields and emerging a minimal measurable length uncertainty and with the generalization of the four-dimensional pseudo-Riemann manifold, the fundamental tensor straightforwardly becomes modified. As this appears conformal, we compare it with Weyl's conformal theory. By constructing the Levi-Civita connections, we could determine the quantum-induced revisiting Riemann curvature tensor and its contractions. Consequently, the Einstein tensor, in which, besides the quantum mechanical imprints emerging in the relativistic regime, additional geometric structures and curvatures appear, is then applied to the 3-sphere. Such a graphical illustration highlights, at least qualitatively, the possible contributions that the quantization of curved spacetime likely comes up with in the relativistic regime.

**10**

## On characterizing the leptonic phase diagram in early Universe

**Authors:** Abdel Nasser Tawfik[1]; Eman Abou Elyazeed[2]; Hayam Yassin[2]; Mahmoud Hanafy[3]; Muhammad Ajaz[4]; Muhammad Waqas[5]; Prabir Kumar Haldar[6]; Sabyasachi Ghosh[7]

[1] *Future University in Egypt (FUE)*

[2] *Ain Shams University*

[3] *Benha University*

[4] *Abdul Wali Khan University Mardan*

[5] *Beijing, GUCAS*

[6] *Cooch Behar Panchanan Barma University*

[7] *Indian Institute for Technology*

**Corresponding Authors:** sabya@iitbhilai.ac.in, mahmoud.nasar@fsc.bu.edu.eg, ajaz@awkum.edu.pk, prabirkrhaldar@gmail.com, eman.reda@women.asu.edu.eg, waqas_phy313@yahoo.com, atawfik@cern.ch, hiam_hussien@women.asu.edu.eg

The lattice QCD simulations predict a slow cross-over from parton to hadron matter, especially at small baryon densities. When attempting to apply this to the early universe, we find that the latest non-leptonic phase transition would not account for the large-scale structure of the universe. In the early epochs of the evolution of the universe, it is conjectured that the baryonic density, especially after the era of quark-gluon plasma, is negligibly small. On the other hand, the leptonic degrees of freedom likely survive the strong parton–hadron phase transition. Accordingly, the lepton chemical potential apparently remains finite, while the baryon chemical potential is nearly vanishing. In a thermal model with the entire PDG compilation, we analysed how the temperature varies with the lepton density. The dependence of the critical temperature on the lepton density maps out a richly structured phase diagram that might contribute to understanding the large-scale structure of the universe.

**11**

## Uncertainty relation in viscous hydrodynamics and its effects in collective flow observables

**Authors:** Gyell Gonçalves de Matos[1]; Takeshi Kodama[2]; Tomoi Koide[1]

[1] *UFRJ*

[2] *UFRJ, UFF*

**Corresponding Author:** tomoikoide@gmail.com

It is considered that the uncertainty relation is one of key features
of quantum mechanics which distinguishes quantum and classical systems.
Recently, we developed a new formulation of the uncertainty relations based on the generalized scheme of variational principle, the stochastic variational method [1]. In this method, the uncertainty relation is related to the non-differentiability of observables and thus can be obtained even in classical stochastic systems [2,3,4]. This new formulation resolves the famous paradox in quantum mechanics, the angular uncertainty relation without introducing artificial assumptions [5].

In this presentation, we show that the fluctuations of position and momentum for a non-relativistic viscous fluid element satisfies the uncertainty relation analogous to the corresponding quantum mechanical one. Such a fluctuation is sensitive to the temperature gradient at the freezeout surface and can affect the collective flow anisotropy in relativistic heavy-ion collisions [6].

[1] K. Yasue, "Stochastic calculus of variation", J. Funct. Anal. 41, 327 (1981).

[2] T. Koide and T. Kodama, "Generalization of uncertainty relation for quantum and stochastic systems", Phys. Lett. A 382, 1472 (2018).

[3] T. Koide, "Viscous control of minimum uncertainty state in hydrodynamics", J. Stat. Mech. 023210, (2022).

[4] G. Gonçalves de Matos, T. Kodama and T. Koide, "Uncertainty relations in Hydrodynamics", Water 12, 3263 (2020).

[5] J.-P. Gazeau and T. Koide, "Uncertainty relation for angle from a quantum-hydrodynamical perspective", Ann. Phys. 416, 168159 (2020).

[6] G. Gonçalves de Matos, T. Kodama and T. Koide, "Possible enhancements of Collective Flow Anisotropy induced by Uncertainty Relation for Fluid element", arXiv:2208.00452. J. Phys. G in press.

**12**

## Relativistic equations of state for neutron stars

**Author:** Jadna Louise Barauna[1]

[1] *UFSC*

**Corresponding Author:** jadnabarauna@hotmail.com

The present research aimed to describe macroscopic properties of neutron stars assuming zero temperature and different nuclear models, such as the (linear) QHD –I and the non-linear Walecka model. The first one considers that the interaction inside the nucleus has two contributions: an attractive one at large distances, and a repulsive one at short distances. Adding to that, the second model also brings to consideration the interaction between the existing scalar fields and the inclusion of a vector-isovector interaction. The equations of state (EoS) for nuclear matter are investigated and then stellar matter is obtained and then used as input to the Tolman, Oppenheimer and Volkoff (TOV) equations, making it possible to get information such as maximum masses and radius of the compact object under study. For a better analysis, graphs were made with such data (pressure vs baryonic density and solar masses vs radius) and the results for each type of matter, with its respective model and parameters, were compared.

**13**

## An association with preferred-frame $S_V$ and Critical Speed of a superfluid

**Author:** Rodrigo F. Santos[1]

**Co-authors:** Antonio Carlos Amaro de Faria Jr [2]; Luis Gustavo Almeida [3]

[1] *Secretaria de Educação de Belford-Roxo*

[2] *Universidade Tecnologica Federal do Parana*

[3] *Universidade Federal do Acre*

**Corresponding Authors:** atoni.carlos@gmail.com, luisalmeida@ufac.br, santosst1@gmail.com

A preferred frame S V with minimal speed associeted as a critical speed of superfluid and acoustical causal structure. The gravitational vacuum as superfluid Abstract. We studied a preferred-frame proposal generated from the introduction of a minimum speed in lorentz transformations. We motivate the deformation of Lorentz's transformations , building a geodesic compatible with the existence of a minimum velocity, we deduce a hypothesis of the clock deformed by the presence of minimal speed and relationship of uncertainty. We show that the clock hypothesis and the relationship of uncertainty time energy have a relationship of reciprocity with each other.This structure is then compared to a superfluid via Landau's criterion, which demonstrates that the minimal velocity previously postulated can be understood as a critical velocity for a Landau superfluid. Next, we studied the causation and geometric implications of the relationship of the privileged reference with an Einstein-Euller observer

**14**

## Anisotropic charged compact stellar configurations in the perspective of gravitational decoupling approach

**Author:** pramesh tamta[1]

[1] *Kumaun University Nainital Uttarakhand India*

**Corresponding Author:** pramesh.tamta123@gmail.com

We construct the physically admissible charged compact star models threaded with anisotropic matter contents via gravitational decoupling approach. Durgapal IV solution containing charge is considered as seed solution for applying minimal geometric deformation approach.We extend the isotropic seed solution into anisotropic domain by imposing suitable mimic constraints on the physical variables i.e. pressure and density. The extended solution is employed to frame the models of dense relativistic structures.We study the geometrical and thermodynamic behavior of the models and examine the physically admissible attributes of the models via graphical patterns. The stability status of the compact entities is examined through different stability criteria. The essential energy bounds are found to be satisfied within the compact star models.We performed the extensive analysis of the model for the star RXJ 1856-37 having mass 0.9MΘ and radius 6 km. The extended anisotropic solution is also compatible with observed masses as well as radii of some compact starsEXO 1785-248 and PSRJ1614-2230.

**15**

## Interpreting SDSS extragalactic data in the era of JWST

**Author:** ALEXANDER MAYER[None]

**Corresponding Author:** amayer@alum.mit.edu

We present empirical evidence from the Sloan Digital Sky Survey (SDSS), including statistically-significant, independent measurements of galaxy theta-z, redshift-magnitude, and redshift-population. These corroborating data sets are clearly inconsistent with the optimal ΛCDM standard model of Big Bang cosmology, exacerbating the Hubble constant tension; the sigma;8 (clustering parameter) discrepancy; the lensing anomaly; the large-angular-scale anomalies in CMB temperature and polarization; and other anomalies that now confront cosmologists. A set of predictive equations are put forward that are consistent with de Sitterrsquo;s exact solution to the Einstein field equations. This new ldquo;temporal geometryrdquo; predictive model, which requires vetting by the mathematical physics and cosmology communities, is consistent with the high-quality SDSS data and relieves the unexpected new tensions in cosmology created by the initial and ongoing James Webb Space Telescope (JWST) observations.

**16**

## On the overall properties of young pulsars

**Authors:** Ana Beatriz Minari dos Santos[1]; Carlos Frajuca[2]; Cristian Giovanny Bernal[1]; Henrique Domingues Hirsch[1]; Lucas Bonifacio Selbach[None]

[1] *FURG*

[2] *IFSP*

**Corresponding Authors:** lucasselbachlbs@gmail.com, henriquedhirsch@gmail.com, bernalcg@gmail.com, frajuca@gmail.com, minari@furg.br

The spin evolution of Rotation-Powered Pulsars is well known and used to estimate ages and surface magnetic fields of old pulsars. Due the energy loss by radiation allows the pulsar to undergo a systematic spin-down from an initial spin period, then, the deceleration of the pulsar is given by an empirical formula obtained by balancing the spin-down luminosity with the energy loss by radiation (a dipole magnetic field, for instance). In the present work, we study the effects of magnetic field growth models on the spin-down properties of young pulsars. Such magnetic field evolution is not a new idea but the evolutionary implications have not been followed up completely.

**17**

## The effects of a minimal length on the Kerr metric

**Authors:** Leila Maglahoui[None]; Peter Hess[1]

[1] *UNAM*

**Corresponding Authors:** maghlaoui.th@gmail.com, hess@nucleares.unam.mx

The effects of a minimal length on the Kerr metric are studied within a generalized metric theory, called the pseudo-complex General Relativity (pcGR), allowing for accumulation of dark energy around a star. The relevant parameters are the rotational Kerr parameter $a$ and the mass of a black hole, a parameter measuring the amount of dark energy accumulated. It is found that the metric is modified by a function factor, depending on $r$ and the minimal length $l$, implying a maximal acceleration. This factor shows several singularities. The corresponding effective potentials exhibit potential barriers, avoiding the increase of the black hole's mass.

**18**

## Exploration of Matter in extreme conditions with Machine Learning

**Author:** Kai Zhou[1]

[1] *FIAS, Goethe-University Frankfurt am Main*

**Corresponding Author:** zhou@fias.uni-frankfurt.de

In this talk I will demonstrate how we can use machine learning based computational paradigm to help our exploration of QCD matter in extreme conditions. The focus is about properties of hot and dense nuclear matter related studies. Around it, experimentally the relativistic nuclear collision are performed to realize the extreme conditions for studying it while theoretically the first-principle lattice field theory constructs the main path to investigate the equilibrium thermodynamics of the matter. Meanwhile, the astronomical observations on Neutron Star also provide constraints on the equation of state of the dense nuclear matter. Machine Learning within the broadly Artificial Intelligence (AI) brand is a rapidly developing field that has been proven to be powerful in recognizing patterns from complex data, and powerful as well in representing relationships/mappings of systems. This modern computation technologies has become increasingly prominent in all sectors of our everyday life, and also into frontiers of scientific research especially in computational related studies. Specifically, in this talk I will introduce the potential of machine learning for research about hot and dense nuclear matter, ranging from identifying essential physics from nuclear collision experiment, to assisting the lattice QCD data analysis, and to efficiently exploiting astronomical observations in inferring the Neutron Star equation of state.

**19**

## Massive particle pair production and oscillation in Friedman Universe: its effect on inflation

**Author:** She-Sheng Xue[1]

[1] *ICRANet, and Sapienza University of Rome. Italy*

**Corresponding Author:** xue@icra.it

We study the classical Friedman equations for the time-varying cosmological term $\tilde{\Lambda}$ and Hubble function $H$, together with quantised field equations for the production of massive $M \gg H$ particles, namely, the $\tilde{\Lambda}$CDM scenario of dark energy and matter interactions. Classical slow components $\mathcal{O}(H^{-1})$ are separated from quantum fast components $\mathcal{O}(M^{-1})$. The former obeys the Friedman equations, and the latter obeys a set of nonlinear differential equations. Numerically solving equations
for quantum fast components, we find the production and oscillation of massive
particle-antiparticle pairs in microscopic time scale $\mathcal{O}(M^{-1})$. Their density and pressure averages over microscopic time do not vanish.
It implies the formation of a massive pair plasma state in macroscopic time scale $\mathcal{O}(H^{-1})$, whose effective density and pressure contribute to the Friedman equations. Considering the inflation driven by the time-varying cosmological term and slowed down by the massive pair plasma state, we obtain the relation of spectral index and tensor-to-scalar ratio in agreement with recent observations. We discuss the singularity-free
pre-inflation, the CMB large-scale anomaly, and dark-matter density perturbations imprinting on power spectra.

**20**

## The Laser Interferometric Gravitational Wave Detector Calibrator Magnetic Suspension

**Authors:** CARLOS FRAJUCA[1]; FÁBIO Bortoli[2]; NADJA SIMAO MAGALHAES[3]

[1] *FURG*

[2] *IFSP - Federal Institute of Sao Paulo*

[3] *UNIFESP*

**Corresponding Authors:** nadjasm@gmail.com, bortoli.fabio@gmail.com, frajuca@gmail.com

In 2015 the first detection of gravitational waves was made, such detection was made by kilometer size interferometer detectors. The calibration of such a detector is still a challenge then a calibrator was proposed. This calibrator is a resonant mass gravitational wave detector that operates at frequencies where the gravitational waves have been detected. Previou work showed that a tradicional suspension will couple to the detection modes of the calibrator then a magnetic suspension is proposed. This work shows the calculations in designing such suspension. The calibrator has its vibration modes simulated in finite element methods and its operational frequency is tuned to the desired range to allow coincident operation with the laser iterferometric gravitational wave detectors.

**21**

## Circumstellar disc around first generation of stars

**Author:** Rafeel Riaz[1]

**Co-authors:** Dominik Schleicher [2]; Ralf Klessen [3]; Siegfried Vanaverbeke [4]; Stefano Bovino [2]

[1] *Centro de Investigación en Astronomía, Universidad Bernardo O'Higgins, Av. Viel 1497, Santiago, Región Metropolitana, Chile*

[2] *Universidad de Concepcion*

[3] *Universita¨t Heidelberg, Zentrum fu¨r Astronomie, Institut fu¨r Theoretische Astrophysik, Albert-Ueberle-Str 2, D-69120 Heidelberg, Germany 5Universita¨t Heidelberg, Interdisziplina¨res Zentrum fu¨r Wissenschaftliches Rechnen, Im Neuenheimer Feld 205, D-69120 Heidelberg, Germany*

[4] *Centre for mathematical Plasma-Astrophysics, Department of Mathematics, KU Leuven, Celestijnenlaan 200B, B-3001 Heverlee, Belgium*

**Corresponding Authors:** siegfriedvanaverbeke@gmail.com, klessen@uni-heidelberg.de, rafeel.riaz@ubo.cl, dschleicher@astro-udec.cl, stefanobovino@astro-udec.cl

The formation of circumstellar discs (CSDs) around the first generation (Population III) stars is an important phenomenon to understand the characteristics of CSDs in the early universe. In the primordial gas environment, cooling is essential to first form the protostars which subsequently can develop disc structure around them. This may lead to disc fragmentation, which can influence the initial mass function (IMF) of the first stars. Here we investigate the properties of circumstellar discs of the most massive population III stars formed in our simulations under the primordial cooling regimes of H2 line cooling and the cooling via collision induced emission (CIE). We performed a systematic numerical study of increasing levels of initial turbulence (Mach = 0.1 - 1.0) in the primordial gas cloud and examined their effects on the formation of CSDs under the two distinct cooling regimes. We find that the disc-star mass ratio Mdisc/Mstar is larger in CIE cooling than in H2 line cooling regime. Moreover, the increasing levels of initial turbulence within the subsonic range systematically increase Mdisc/Mstar. The surface density of the CSDs remains insensitive to the initial turbulent levels. However, in general, CIE cooling yields CSDs with higher surface density than H2 line cooling. Ratio of radial velocity to azimuthal velocity vr/vphi in the CSDs exhibits orders of magnitude differences when the two gas cooling regimes are compared. With the exception of model with Mach = 0.8, CSDs around the most massive first stars show a stable disc structure against fragmentation.

**23**

# Entanglement entropy in high energy physics

**Author:** Gabriel Silveira Ramos[None]

**Co-author:** Magno Valerio Trindade Machado [1]

[1] *UFRGS*

**Corresponding Authors:** magnus@if.ufrgs.br, gsramos7@gmail.com

Entanglement entropy is the physical quantity that measures the degrees of entanglement of a quantum system. There are theoretical models that seek to compute this quantity in order to evaluate its connection with the final entropy measured in particle accelerators at high energies in eP collisions.

In the evaluation of entanglement entropy, it is necessary to evaluate the states that are entangled. One possibility is entanglement between the measured states and the complementary part of the proton in a DIS. In this case, it is possible to establish a connection with the entanglement entropy and the gluon PDF at high energies from the Balitsky-Kovchegov equation (BK). Another available formalism is the entanglement between the wavefunction of the soft gluons and the valence quarks in the Color Glass Condensate (CGC) framework which can be obtained from the coherent wavefunction of the gluons as well as the basis of the particle number operator.

One way to do the phenomenology of these models is from the analytical distributions for the gluon PDF and the use of the saturation scale, both from the Golec-Biernat and Wusthoff (GBW) models. The theoretical models are expanded to the case of collisions with heavy ions with the necessary adaptations.

**24**

## Cosmology and multi-messenger astrophysics with Gamma-Ray Bursts

**Author:** Lorenzo Amati[1]

[1] *INAF - OAS Bologna*

**Corresponding Author:** lorenzo.amati@inaf.it

Gamma-Ray Bursts constitute one of the most fascinating and relevant phenomena in modern science, with strong implications for several fields of astrophysics, cosmology and fundamental physics. Indeed, the huge luminosity, the redshift distribution extending at least up to z˜10 and the association with the explosive death of very massive stars make long GRBs (i.e., those lasting up to a few minutes) potentially extremely powerful probes for investigating the early Universe (pop-III stars, cosmic re-ionization, SFR and metallicity evolution up to the "cosmic dawn") and measuring cosmological parameters. The combination of extreme distances, the huge number of photons emitted over about three orders of magnitude in photon energy and the variability down to few ms
makes these phenomena also a uniquely powerful and promising tool for performing tests of fundamental physics like Lorentz Invariance Violation (LIV) with unprecedented accuracy. At the same time, as demonstrated by the GW170817 event, short GRBs (lasting no more than a few s) are the most prominent electromagnetic counterpart of gravitational-wave sources like NS-NS and NS-BH merging events, and both long and short GRBs are expected to be associated with neutrino emission. My review will include the status, concepts and expected performances of space mission projects (e.g, THESEUS, Gamow Explorer) aiming at fully exploiting these unique potentialities of the GRB phenomenon, thus providing an ideal synergy with the large e.m. facilities of the future like LSST, ELT, TMT, SKA, CTA, ATHENA in the e.m. domain, advanced second generation (2G++) and third generation (3G) GW detectors and future large neutrino detectors (e.g., Km3NET)

**26**

## Exclusive production of excited light vector mesons with a holographic wave function model

**Author:** Cheryl Henkels[1]

[1] *Federal University of Santa Catarina*

**Corresponding Author:** cherylhenkels@hotmail.com

The exclusive photo- and electroproduction of the light vector mesons $\rho$, $\omega$ and $\phi$ are studied within the color dipole picture as function of the center-of-mass energy of the $\gamma p$ collision and the momentum transfer squared $|t|$. The corresponding vector meson wave functions have been computed with the relativistic AdS/QCD holographic approach. This enabled us to obtain a good description of all available data for the ground-state light mesons $\rho(1S)$, $\omega(1S)$, and $\phi(1S)$ as well as to make predictions for the excited states $\rho(2S)$, $\omega(2S)$, and $\phi(2S)$ with the same formalism. This study revealed the existence of a sizeable theoretical uncertainty coming from modeling the partial dipole amplitude in the non-perturbative kinematical domain. These uncertainties could be deeply investigated with measurements of the light vector meson cross sections in future hadron colliders.

**27**

## Measuring the speed of gravity in short distances

**Authors:** Carlos Frajuca[1]; Fabio da Silva Bortoli[1]; Nadja Simao Magalhaes[2]; Natan Vanelli Garcia[1]

[1] *IFSP*

[2] *UNIFESP*

**Corresponding Authors:** nadja.magalhaes@unifesp.br, bortoli.fabio@gmail.com, natanvanelli92@gmail.com, frajuca@gmail.com

In order to investigate the speed of gravitational signals traveling in air and through a different medium a experiment is proposed. The experiment contains 2 masses vibrating (emitters), the masses will emit a periodic tidal gravitational signal and one sapphire device that behaves as a detector is located between the two vibrating masses. This detector is suspended in vacuum and cooled down to 4.2 K will. The vibrational amplitude of the sapphire detector is measured by a microwave signal with ultralow phase-noise that uses resonance in the whispering gallery modes inside the detector device. Sapphire has quite high mechanical and electrical Qs which implies a very narrow detection band thus reducing the detector sensitivity but amplifies the phase difference of the signal coming from the emitters. With the aid of a finite element program the normal mode frequencies of the detector can be calculated with high precision. The results allow to choose the better operational frequency and calculate the sensitivity of such experiment.

**28**

## Equation of state of nuclear matter; applications in astrophysics and heavy ion physics

**Author:** Laszlo Jenkovszky[1]

[1] *Bogolubov ITP, Kiev*

**Corresponding Author:** jenk@bitp.kiev.ua

László Jenkovszky
Bogolyubov ITP, Kiev, Ukraine

An equation of state (EoS) of the hot and dense nuclear matter is derived from the S-matrix formulation of statistical mechanics and observed high-energy hadron scattering data. The EoS shows a local minimum with negative temperature (super-cooling) with observable effects in astrophysics and/or heavy ion collisions.

**29**

## Probing protocluster regions in the distant Universe

**Author:** Mariana Rubet[1]

**Co-author:** Karín Menéndez-Delmestre [1]

[1] *Universidade Federal do Rio de Janeiro*

**Corresponding Authors:** marianarubet@ov.ufrj.br, kmd@ov.ufrj.br

The most massive structures of the Universe formed at the knots of the cosmic web at high redshifts and constitute the present-day clusters of galaxies. They are dense, gravitationally bound, nearly virialized systems of galaxies. The early stages of these structures are called protoclusters and they are the natural laboratories to observe the role of environmental effects on galaxy evolution. Protoclusters frequently harbor galaxies with intense star formation, and many times, dust-obscured ones, resulting in great luminosities in the restframe infrared bands. In this work, we use submillimeter galaxies (SMGs) - a population of dusty, distant, starburst galaxies, whose copious infrared emission is redshifted to the submm bands - as targets for protocluster searches. We use combined wide-band and narrow-band optical photometry to identify Ly-alpha emitters (LAEs) around SMGs at $z \sim 4.5$ in the COSMOS field, as a means to identify typical star-forming galaxies that may compose the underlying structure containing our target SMGs. We use deep imaging obtained by our team with the IMACS instrument on the Baade (6.5 m) telescope at the Las Campanas Observatory. With a field of view of 27 arcmin-diameter, we probe a physical scale of $\sim 10Mpc$ in size at $z = 4.5$, consistent with protocluster scales. Our approach picks out line emitters as narrow-band excess objects. We denominate these objects as Ly-alpha candidates. We use additional IMACS spectroscopic data to confirm these candidates as bona fide LAEs and thus protoclusters members, eliminating low-redshfit ($z \sim 0.8$) interlopers whose [OII] emission might be responsible for the observed excess in the narrow band. In comparisson with LAE density in the field, our preliminary results point to a mild excess in LAE density around SMGs at $z \sim 4.5$. We estimate the dynamical mass of this structure and, considering N-body simulation studies, we predict the mass this structure evolves into at $z = 0$.

**31**

## Neutron stars as a tool to understand QCD phase transitions

**Author:** Débora Menezes[1]

[1] *UFSC*

**Corresponding Author:** debora.p.m.26@gmail.com

Neutron stars are the most mysterious objects in the universe, with a radius of the order of 10 km and masses that can reach two solar masses. In 2017, a gravitational wave was detected (GW170817) and its source was identified as the merger of two neutron stars. Later on, a mass-gap object (either a neutron star or a black hole) was identified in the GW190814 event. To understand neutron stars, an appropriate equation of state that satisfies bulk nuclear matter properties has to be used and gravitational wave detections have provided some extra constraints to determine it. Moreover, the NICER telescope, launched in 2017, has also started (in 2021) to send information that helps us determine the radius of these compact objects 1.
On the other hand, the analysis of the QCD phase diagram points to a deconfined quark phase standing exactly at the region related to neutron stars, i.e., high densities and low temperatures, which opens the possibility that neutron stars can be different classes of compact objects: hadronic stars, hybrid stars with hadrons and quarks and even strange stars satisfying the Bodmer-Witten conjecture.
I will show that, using quantum hadrodynamics and MIT based models, massive hybrid stars can be obtained and, for certain parameter choices, quark cores corresponding to more than 80% of both, its total mass and radius, are possible 2. Moreover, all classes of compact objects mentioned above can explain the mass-gap object in the GW190814 event [3].

1 Débora P. Menezes, Universe 2021, 7, 267 and references therein.

2 Luiz L. Lopes. Carline Biesdorf and Débora P. Menezes, MNRAS 512, 5110-5121 (2022)

[3] Luiz L. Lopes and Débora P. Menezes, Astroph. J. 936:41 (2022).

**32**

## The lepton non-universality and the leptoquark solution

**Author:** Joao Vitor[1]

[1] *Universidade Federal de Santa Catarina*

**Corresponding Author:** joaovitorcl1000@gmail.com

Precise experiments yielded results significantly discordant with the predictions of the standard model; among them, the beautiful decays and the value of the anomalous magnetic moment of the muon. I will make a brief exposition of these problems as well as review the solution of a vector leptoquark which, by virtue of explaining many of the disagreements with the SM, is increasingly gaining the appreciation of the scientific community.

**33**

## Radiation pressure of photon propagating in a magnetized vacuum

**Authors:** Aurora Perez Martinez[None]; Elizabeth Rodriguez Querts[1]; Maria Angeles Perez-Garcia[2]

[1] *Instituto de Cibernetica Matematica y Fisica, ICIMAF Cuba*

[2] *Universidad de Salamanca*

**Corresponding Authors:** mperega@usal.es, elizabeth@icimaf.cu, aurora@icimaf.cu

Using the quadratic expansion in the photon fields of Euler-Heisenberg (EH) non-linear electrodynamics (NLED) Lagrangian model we study relevant vacuum properties in a scenario involving the propagation of a photon probe in the presence of a background constant and static magnetic field, $\mathbf{B_e}$.We compute the gauge invariant, symmetric and conserved energy-momentum tensor (EMT) and the angular momentum tensor (AMT) for arbitrary magnetic field strength using the Hilbert method under the soft-photon approximation. We discuss how the presence of magneto-electric terms in the EH Lagrangian is a source of anisotropy and induce the non-zero trace in the EMT, the latter being connected to the non-conformal anomaly of the non-linear Lagrangian and with the non-conservation of the light cone in Minkowski space-time inducing birefringence.
From the EMT we analyze some quantities of interest such as the energy density, pressures, Poynting vector, and angular momentum vector and we compare them with those obtained from the Noether method. The magnetized vacuum properties are also studied showing that a photon-effective magnetic moment can be defined for different polarization modes. The calculations are done in terms of derivatives of the two scalar invariants of electrodynamics hence, extension to other NLED Lagrangian is straightforward.
We discuss further physical implications and experimental strategies to test magnetization, photon pressure, and effective magnetic moment.

**34**

## Light vector mesons photoproduction and the nuclear shadowing

**Authors:** Haimon Otto Melchiors Trebien[1]; Emmanuel de Oliveira[2]

[1] *Universidade Federal de Santa Catarina*

[2] *UFSC, Brazil*

**Corresponding Authors:** emmanuel.de.oliveira@ufsc.br, haimontrebien@yahoo.com.br

In this work we study the photoproduction of ρ mesons considering the proton and the nucleus as the target. Utilizing the dipole picture and the wave functions obtained via AdS/QCD, we were able to describe the HERA ρp data and extend the formalism to the nuclear case considering the Glauber-Gribov model. The preliminary results obtained in the nuclear regime are compared to the recent LHC PbPb ⟶ ρPbPb data and suggest the presence of a nuclear effect called shadowing.

**37**

## Resolution tests for modified gravity models

**Author:** Flor Lozano-Rodríguez[None]

**Corresponding Author:** dimihadj@gmail.com

In this work we analyze the formation of the cosmological structure in different models of modified gravity: the symmetron model, which is characterized by a scalar field that decouples from matter in regions of high density due to a symmetry breaking potential; an f(R) model, which proposes a generalization of the Einstein Hilbert action substituting the Ricci scalar for a function of it; and the DGP model, one of the simplest braneworld models representative of high-dimensional cosmological models.The analysis is carried out through cosmological simulations obtained with the MG-PICOLA code , for which we perform resolution tests in search of the optimal combination of parameters for the analysis of the effect of each model on structure formation. Subsequently, from the mass power spectrum, we find specific behaviors of the models and differences with respect to the standard cosmological model Lcdm.

**39**

## SFDM AND STRUCTURE FORMATION

**Author:** Stefany G. Medellin-González[1]

**Co-authors:** Alma X. González-Morales [1]; L. Arturo Ureña-López [1]

[1] *Universidad de Guanajuato*

**Corresponding Authors:** lurena@ugto.mx, sg.medellingonzalez@ugto.mx, gonzalez.alma@ugto.mx

In this work, we solve the structure formation in the Universe for the scalar field model as dark matter in its hydrodynamic approximation, and for this, we implement the model in the MG-PICOLA code, which uses the COLA method, which allows solving the model with a lower computational cost but with a reduction in resolution compared to other methods such as N-body simulations. We perform numerical simulations and analyze them using the mass power spectrum (MPS) to compare with simulations that solve the model using the full Schrodinger-Poisson solution to establish the reliability scales of this method and how it matches with the scales allowed by the full method.

**42**

## Two scalar fields as dark matter

**Author:** Johnatan Román[1]

**Co-authors:** Francisco X. Linares Cedeño [2]; L. Arturo Ureña-López [1]

[1] *Universidad de Guanajuato*

[2] *Universidad Michoacana de San Nicolas de Hidalgo*

**Corresponding Authors:** lurena@ugto.mx, jo.romanherrera@ugto.mx, francisco x. linares cedeño, francisco.linares@umich.mx

In this work the cosmological dynamics of two scalar dark matter fields are analyzed, using different potentials and masses. The purpose is to constrain the relationship between the energy densities that each axion contributes to, as well as to estimate the range of masses that these fields can have. We use " the area criterion" and the Monte Python code using estimated data from Lyman-alpha observations.

**43**

## Gauge fixing in unimodular gravity

**Author:** Francisco X. Linares Cedeño[1]

**Co-author:** Ulises Nucamendi [1]

[1] *Universidad Michoacana de San Nicolas de Hidalgo*

**Corresponding Authors:** francisco.linares@umich.mx, ulises@ifm.umich.mx

In this talk the gravitational theory known as Unimodular Gravity is reviewed. In particular, a cosmological model is built and compared with the standard LCDM model. Once the dynamics of a homogeneous and isotropic universe is analyzed, cosmological perturbations are studied. These, unlike what has been reported in the literature so far, do present distinctions typical of the theory due to the unimodular condition. The fluctuations of dark matter density obtained in this theory are compared with the case of General Relativity, and possible implications for large-scale structure formation are discussed.

**44**

## INFLUENCE OF INITIAL CONDITION OF POLARIZED DIPOLE AMPLITUDE EVOLUTION EQUATION ON SPIN DEPENDENT OBSERVABLES IN HIGH ENERGY PHYSICS

**Author:** Gabriel Zardo Becker[1]

[1] *Federal University of Santa Catarina - UFSC*

**Corresponding Author:** zardobecker@gmail.com

The dependence of partons on the constitution of proton spin remains an interesting and persistent problem in hadron physics, but one that should be widely addressed by future colliders with polarized beams, such as the Electron-Ion Collider (EIC). Quark helicity contributions and spin-dependent parton distribution functions (hPDFs) can be calculated using the Kovchegov-Pitonyak-Sievert (KPS) helicity evolution equation at small x, which is described in terms of the polarized dipole amplitude and can be used to calculate the physical observables associated with electron-proton (ep) polarized deep inelastic scattering (DIS) at high energies. It was found that the initial conditions have a relevant influence over the evolution of the polarized dipole amplitude, altering the asymmetries between the quark and antiquark distributions with spin-dependent, as well as the helicity contributions of the different flavors of the quarks to the total spin value of the hadron. Therefore, in this work we analyze different formulations of the initial conditions based on both parameterizations and calculations using the dipole formalism in light cone coordinates, in order to verify the influence of each initial polarization state on the photon fluctuation in quak pairs of quark-antiquark (dipole) and the helicity distributions of partons in spin-dependent observables.

**46**

## Stars and Ceremonial Timing

**Author:** Mark Raney[1]

[1] *University of Oklahoma*

Event timing and star lore can be used to identify associated asterisms both in Mesoamerica and the American Southwest. The findings are given greater weight due to correlations between the two

areas. This presentation will focus on Tezcatlipoca, Quetzalcoatl, Tlaloc, and Chalchiuhtlicue, along with their counterparts at Hopi.

**47**

## Finding Structure in the Speed of Sound of Dense Matter

**Author:** Veronica Dexheimer[None]

**Corresponding Author:** vdexheim@kent.edu

Analyses that connect astrophysical observations of neutron stars with nuclear matter properties sometimes rely on equation-of-state insensitive relations. We show that the slope of the binary Love relations (i.e.~between the tidal deformabilities of binary neutron stars) encodes the rate of change of the nuclear matter speed of sound below three times nuclear saturation density. Twin stars lead to relations that present a signature ‘’hill”, ‘’drop”, and ‘’swoosh” due to the second (mass-radius) stable branch, requiring a new description of the binary love relations.

**48**

## Interior solution and structure equations for the $\gamma$-metric

**Authors:** Adriel Rodriguez[None]; Gretel Quintero[None]

**Corresponding Authors:** gretica.qa@gmail.com, adrielerdz@gmail.com

Compact stars possess some of the strongest magnetic fields in nature. Such magnetic fields affect their shape, driving them apart from the spherical symmetry. Modelling magnetized stars is an open problem due to the difficulties in finding interior solutions to Einstein’s field equations in axial symmetry. Here we present a new set of structure equations for uniformly magnetized stars based on the γ-metric, an exact vacuum solution in axial symmetry. This metric has been used before to find structure equations for compact objects but only in the case of stars that slightly depart from the spherical shape (low magnetic field). Nevertheless, our equations can deal with any deformation. An analysis of the magnetic field influence in the observables of Bose-Einstein condensate stars is done using this new framework.

**49**

## Ultra-compact low mass neutron stars compatible with the observational properties of HESS J1731-347

**Author:** David Edwin Alvarez Castillo[1]

[1] *Institute of Nuclear Physics PAS*

**Corresponding Author:** david.alvarez@ifj.edu.pl

The recent observation of the object HESS J1731-347 by Doroshenko et al. (2022) suggests the existence of a very light and very compact neutron star.
In order to quantify this result, the authors of this study consider a family of chiral equation of state (EOS) models that can reproduce the properties of the aforementioned object as well as to fulfill state-of-the-art compact stars constraints derived from NICER measurements of PSR J0030+0451 and PSR J0740+6620 pulsars as well as from the GW170817 event and its associated electromagnetic counterparts AT2017gfo and GRB170817A. In this contribution, we present two alternative EoS equally valid, a) a pure hadronic relativist mean field approach featuring sigma-delta meson interactions

leading to a softening of the EoS in a moderate range of densities, and b) a hybrid equation of state that produces hybrid compact stars of low mass therefore very compact and whose hadronic matter is rather stiff. For simplicity, their quark matter core is described by the constant speed of sound approach which is well compatible with some more detailed but complex superconducting quark matter descriptions.

**50**

## Phenomenological quark-mass density-dependent model: a self-consistent treatment

**Authors:** Ana Gabriela Grunfeld[None]; Germán Lugones[1]

[1] *Universidade Federal do ABC*

**Corresponding Authors:** g.lugones@yahoo.com, ag.grunfeld@gmail.com

The quark mass density-dependent model was widely used to mimic cold deconfined quark matter at high densities. However, it presents thermodynamic inconsistencies in the grand canonical ensemble that can be cured in the frame of the canonical ensemble, where the minimum of the energy per baryon occurs at zero pressure, and Euler's relation is verified. We will present the equation of state for a generic mass formula, and analyze its behavior for different input parameters.

**51**

## M87* and Sgr A*: Imaging supermassive black holes

**Author:** Luciano Rezzolla[1]

[1] *Institute for Theoretical Physics, Frankfurt*

**Corresponding Author:** rezzolla@itp.uni-frankfurt.de

I will briefly discuss how the first images of the supermassive black holes M87*and Sgr A* were obtained by the EHT collaboration. In particular, I will describe the theoretical aspects that have allowed us to model the dynamics of the plasma accreting onto the black hole and how such dynamics was used to generate synthetic black-hole images. I will also illustrate how the comparison between the theoretical images and the observations on a broad range of frequencies has allowed us to deduce the presence of supermassive black holes and to extract information about the accretion process. Finally, I will describe the lessons we have learned about strong-field gravity and alternatives to black holes.

**52**

## Instantaneous non-local quark model for quark matter under the influence of strong magnetic fields

**Author:** Sebastian A. Ferraris[1]

**Co-authors:** Ana Gabriela Grunfeld [1]; Juan Pablo Carlomagno [1]

[1] *Comisión Nacional de Energía Atómica (C.N.E.A)*

**Corresponding Author:** sebastianferraris18@gmail.com

We study the behavior highly magnetized two light flavors quark matter
in the frame of a non-local NJL-type model including the coupling of fermions
to the Polyakov loop.
We considered a Gaussian "instantaneous" form factor that depends on the spacial components
of the momentum (3DFF). We show the phase diagrams in the $T-\mu$ plane for different
strengths of the magnetic field. We compare our results with previous results
obtained with a covariant form factor.

**53**

## CP Violation in a Noncommutative Spacetime

**Author:** Geovane Naysinger[1]

**Co-authors:** César A. Z. Vasconcellos [1]; Dimiter Hadjimichef [1]

[1] *UFRGS*

**Corresponding Authors:** cesaraugustozenvasconcellos@gmail.com, dimihadj@gmail.com, geovaneviolao@gmail.com

One of the great modern scientifc mysteries is the abundance of matter over antimatter. Cosmic matter-antimatter asymmetry arises through many mechanisms, for example in the Standard Model (SM) this asymmetry is credited to CP violation. Experimental evidence has systematically shown that CP violation from the weak interaction alone may not be suffcient to explain this imbalance, so new sources CP violation are needed. In this study we consider the effect of noncommutative spacetime as a possible new source of CP violation.

**54**

## 3D-FF non-local NJL model satisfying modern astrophysical observations and lattice QCD constraints

**Authors:** Ana Gabriela Grundfeld[1]; David Blaschke[2]; Gustavo A. Contrera[3]; Juan Pablo Carlomagno[3]

[1] *CNEA - CONICET*

[2] *University of Wroclaw*

[3] *IFLP-CONICET*

**Corresponding Authors:** blaschke@ift.uni.wroc.pl, ag.grunfeld@gmail.com, contrera@fisica.unlp.edu.ar, carlomagno@fisica.unlp.edu.ar

In the present work, we study the phase diagram in the $T$–$\mu_B$ plane, in the frame of a non-local NJL model with a Gaussian form factor that depends on the spatial components of the momentum (3D-FF), which is fitted to lattice QCD results in the Coulomb gauge. We considered two light quark flavors, diquarks, and vector interactions. Hybrid EOS are obtained by a Maxwell construction of the first-order phase transition between a hadronic phase described by the relativistic density-dependent EOS with excluded volume effects. To simultaneously fulfill the constraints from the NICER radius measurement for PSR J0740+6620, its Shapiro delay maximum mass determination, and tidal deformability from GW170817, it is necessary to consider a $\mu_B$-dependent bag pressure that mimics confinement in the quark model.

**55**

## On CCGG, the De Donder-Weyl Hamiltonian formulation of canonical gauge gravity

**Authors:** David Vasak[1]; Jürgen Struckmeier[1]

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

**Corresponding Authors:** vasak@fias.uni-frankfurt.de, struckmeier@fias.uni-frankfurt.de

The purpose of this talk is to illuminate the advantages of the manifestly covariant formulation of canonical gauge gravity. The framework of the De Donder-Weyl Hamiltonian field theory and of canonical transformations is introduced. We sketch how the Canonical Covariant Gauge theory of Gravity (CCGG) is derived from a few basic physical and mathematical assumptions. Some novel implications of CCGG for particle dynamics and cosmology are presented. Among those are:
Spacetime geometry with AdS ground state, inertia, torsion and geometrical vacuum energy Poisson-like equations for curvature and torsion (with Dirac spin density as source term for torsion). Emergent length parameter from the Dirac field Anomalous Pauli coupling of spinors to curvature torsion of spacetime, and a metric dependent mass correction. Zero-energy balance of the Universe leading to a vanishing cosmological constant. First numerical results indicating the viability of the concept of torsional dark energy.

**56**

## Surface tension and curvature energy of cold quark matter in the SU(3)_f NJL model with vector interactions

**Author:** María Florencia Izzo Villafañe[1]

[1] *Comisión Nacional de Energía Atómica (C.N.E.A)*

**Corresponding Author:** florciv@gmail.com

We study the surface tension and the curvature energy of three-flavor cold quark matter in equilibrium under weak interactions within the Nambu-Jona-Lasinio model including vector interactions. We consider both cases of local and global electric charge neutrality.
In order to describe finite size effects we use the multiple reflection expansion (MRE) framework, and show our results for different input parameters.

**57**

## Investigating the partonic entropy at low Bjorken-x within gluon saturation approach

**Author:** Magno Machado[None]

**Co-author:** Gabriel Silveira Ramos

**Corresponding Authors:** gsramos7@gmail.com, mvtmachado@gmail.com

In this contribution we investigate the maximally entangled proton wave function in lepton-proton scattering in the high energy regime. We compare the corresponding entanglement entropy and the final state hadron entropy. The gluon and quark degrees of freedom are taken into account and comparison with experimental measurements is done.

**58**

## A Pedagogical Introduction of Bayesian Parameter Estimation Method and Its Application in Fitting the Prompt Lightcurves of Gamma-Ray Bursts

**Authors:** Guan-Lun Ma[1]; Wei Xie[1]

**Co-authors:** Wan-Kai Wang [1]; Ai-Jun Dong [1]; Jian-Chao Feng [1]

[1] *Guizhou Normal University*

**Corresponding Author:** xieweispring@gznu.edu.cn

Bayesian parameter estimation has been widely used in scientific data processing or model fitting, especially in the field of astronomical research nowdays. There have benn several Python packages (e.g., emcee, PyMC3, etc.) available on PyPI. In this paper the statistics theory of Bayesian parameter estimation and the MCMC (Markov Chain Monte Carlo) sampling algorithm is displayed in a pedagogical way, aiming to help beginners understand and use these packages more directly. As a manner of verification, we programmed our own code of MCMC fitting, and compare the results with that based on the package emcee, it is found that the results are highly consistent with each other. And then we fitted the prompt lightcurves of 46 gamma-ray bursts (GRBs), which present single or multiple pulses. Each pulse is fitted by the fast-rising exponential-decay (FRED) profile. The statistical property of these pulses are analized and compared with previous works.

**59**

## AN ACCRETION-JET MODEL FOR 3C 84: INTERPRETING THE SPECTRAL ENERGY DISTRIBUTION AND FARADAY ROTATION MEASURE

**Author:** Jianchao Feng[1]

**Co-author:** Xiaowen Wang [1]

[1] *Guizhou Normal University*

**Corresponding Author:** fengjc@gznu.edu.cn

In this work we mainly investigated the accretion and jet process near the black-hole horizion of 3C 84 through the high-spatial resolution, multi-waveband data and Faraday rotation measure (RM). Through the multi-waveband spectral energy distribution (SED) of 3C 84, we find that the SED is difficult to fit with pure advection dominated accretion flow (ADAF) or pure jet model. We used a coupled ADAF-jet model to fit the SED of 3C 84. We found that the radio emission and the millimeter emission can be naturally reproduced by the synchrotron radiation of non-thermal electrons in the jet, and the X-ray emission may predominantly come from the synchrotron emission from the thermal electrons in ADAF. Finally, according to the RM obtained by the polarization observation, we considered the possible location of the polarizing source (from the different positions in the accretion disk or jet) and found that the calculated RM in the jet is roughly consistent with the observational constraints.

**60**

## Color-superconductivity of asymptotically conformal quark matter as a portal between astrophysics and heavy ions collision

**Author:** David Blaschke[1]

**Co-author:** Oleksii Ivanytskyi [1]

[1] *Institute of Theoretical Physics, University of Wroclaw*

**Corresponding Author:** david.blaschke@gmail.com

We present a relativistic density functional approach to color superconducting quark matter that mimics quark con nement by a fast growth of the quasiparticle self-energy in the con ning region 1. The approach is shown to be equivalent to a chiral model of quark matter with medium dependent couplings. The approach to the conformal limit at asymptotically high densities is provided by a medium dependence of the vector-isoscalar, vector-isovector and diquark couplings motivated by non-perturbative gluon exchange 2. While the (pseudo)scalar, vector-isoscalar and vector-isovector sectors of the model are tted to the mesonic mass spectrum and vacuum phenomenology of QCD, the strength of interaction in the diquark channel is varied in order to obtain the best agreement with the observational constraints from measurements of mass, radius and tidal deformability of neutron stars. These constraints favor an early onset of decon nement and
color superconductivity in neutron stars with masses below one solar mass. We also discuss a new two-zone interpolation scheme for the construction of the hadron-to-quark matter transition [3] that allows to test different structures of the QCD phase diagram with one, two or no critical endpoints in simulations of supernova explosions, neutron star mergers and heavy-ion collisions. We argue that the formation of color-superconducting quark matter drives the trajectories of its evolution in supernovae and neutron star mergers towards the regimes reached in terrestrial experiments with relativistic heavy ion collisions.

1 O. Ivanytskyi and D. Blaschke, Phys. Rev. D 105, 114042 (2022)
2 O. Ivanytskyi and D. Blaschke, Particles 5, 514 (2022)
[3] O. Ivanytskyi and D. Blaschke, Eur. Phys. J A. 58, 152 (2022)

**61**

# The model of magetar crustal mageto-thermal evolution and application to AXP 1E 2259+586

**Author:** Hui Wang[1]

**Co-author:** Zhifu Gao [2]

[1] *Department of physics and electronic engineering, Yuncheng university, Yuncheng*

[2] *Xinjiang Astronomical Observatory, CAS,150, Science 1-Street, Urumqi, Xinjiang*

**Corresponding Author:** zhifugao@xao.ac.cn

Magnetars are a type of pulsars powered by magnetic field energy. Part of X-ray luminosities of magnetars in quiescence have a thermal origin and can be fitted by a blackbody spectrum with temperature kT $\sim 0.2 - 0.6$ keV, much higher than the typical values for the rotation-powered pulsars. The observation and theoretical study of magnetar are one of hot topics in the field of pulsar research. The persistent thermal emissions and bursts of magnetars indicates the presence of some internal heat sources in their outer crusts. In this work, we have formulated the energy balance equation and used it to study the thermal evolution in the magetar crust by considering the heating mechanism, whcih inculde the Ohmic decay and the electron capture processes. This model can be explain the chang the X-ray luminosity of AXP 1E 2259+586 associated with the supernova remnant CTB 109.

Key words:Magnetar, mageto-thermal evolution, electron capture,
1E 259+586

**62**

# Investigation of the anisotropy of pressure of magnetars

**Author:** Biao Peng[1]

**Co-author:** Zhi-Fu Gao [1]

[1] *Xinjiang Astronomical Observatory, CAS,150, Science 1-Street, Urumqi, Xinjiang*

**Corresponding Author:** zhifugao@xao.ac.cn

Magnetars are strong magnetized neutron stars endowed with surface magnetic fields of the order of $10^{14} - 10^{15}$ G, and with presumably much stronger fields in their interior. They could emit quiescent X-ray, repeating burst of soft gamma ray, and even the giant flares. We investigate the effects of a strong magnetic
field $B$ on the anisotropy of pressure of magnetars using a relativistic mean-field theory model. Within a variable magnetic field configuration, the stellar structure is obtained. The mass and radius of magnetars are found to be weakly enhanced by the strong magnetic field. By considering the magnetization of charged particles in a
strong magnetic field, we calculate the pressure parallel to the magnetic field, and the pressure perpendicular to the magnetic field, and find that the anisotropy of pressure caused by the magnetic field can be ignored. Unlike other previous study, the magnetic field is unable to violate the mass limit of neutron stars.

Key words:Magnetars, relativistic mean field theory, anisotropy of pressure, equation of state

**63**

## The spin-down and magnetic inclination angle evolutions under the vacuum and plasma-filled models

**Author:** Biao-Peng Li[1]

**Co-author:** Zhi-Fu Gao [1]

[1] *Xinjiang Astronomical Observatory, CAS,150, Science 1-Street, Urumqi, Xinjiang*

**Corresponding Author:** zhifugao@xao.ac.cn

The inclination angle $\chi$ between the magnetic and rotation axes of pulsars is an important physical parameter, whose change would lead to observable effects, such as varitions in the pulse beam width and braking index of the star. In this paper, we first give a comparison between the vacuum model and the plasma-filled model, then investigate the magnetic inclination angle change rates for 12 high-braking index pulsars without a glitch, whose timing observations are obtained using the Nanshan 25-m Radio Telescope at Xinji

**64**

## The Physics and Astrophysics of GRBs

**Author:** Remo Ruffini[1]

[1] *ICRANet*

**Corresponding Author:** ruffini@icra.it

The observations of Ic supernovae (Ic/SNe) occurring after the prompt emission of long gamma-ray bursts (GRBs) are addressed within the binary-driven hypernova (BdHN) model. Here, the GRBs originate from a binary composed of a ~ 10M_⊠ carbon-oxygen (CO) star and a companion neutron star (NS). We assume these same progenitors originate from the Ic/SN. The binary evolution depends

strongly on the binary period, P_bin. The trigger, given by the CO core collapse, for P_bin of up to a few hours leads to an Ic/SN with a fast-spinning NS (νNS) at its center. For Pbin ~ 4–5 min, BdHN I occur with 37 energies 10ˆ52–10ˆ54 erg, a contribution by the black hole (BH) created by the NS companion collapse, originating the Mev/GeV radiations. The ~ 1 millisecond νNS originates, by synchrotron radiation,the X-ray afterglow. For P_bin ~ 10 min, BdHN II occurs with energies of 10ˆ50–10ˆ52 erg. For P_bin ~ hours, BdHN III occurs with energies below 10ˆ50 erg. The 1–1000 ms νNS, in all BdHNe, originates from the X-ray afterglow by synchrotron emission. The SN Ic follows an independent evolution, becoming observable by the nickel decay after the GRB prompt emission. We report 24 Ic/SNe associated with BdHNe, their optical peak luminosity and their time of occurrence are similar and independent of the associated GRBs. We give four examples of BdHNe and their associated hypernovae. We approach, for the first time, new physical processes in BdHNe; we identify seven episodes and their signatures in their spectra.

**65**

## Progress on obtaining unified neutron star EOSs in RMF models

**Author:** Cheng-Jun Xia[1]

[1] *Yangzhou University*

**Corresponding Author:** cjxia@yzu.edu.cn

In the framework of Thomas-Fermi approximation, we study systematically the EOSs and microscopic structures of neutron star matter in a vast density range with nb ≈ 10-10 -2 fm-3, where various covariant density functionals are adopted, i.e., those with nonlinear self couplings (NL3, PK1, TM1, GM1, MTVTC) and density-dependent couplings (DD-LZ1, DDME-X, PKDD, DD-ME2, DD2, TW99). Six types of nuclear matter structures (droplet, rod, slab, tube, bubble, and uniform) are examined adopting spherical and cylindrical approximations for the Wigner-Seitz cell, where the optimum configurations in β-equilibrium are obtained by searching for the energy minimum at fixed baryon number density nb. It is found that the EOSs generally coincide with each other at nb <10-4 fm-3 and 0.1 fm-3 <nb <0.3 fm-3, while in other density regions they are sensitive to the effective interactions between nucleons. By adopting functionals with larger slope of symmetry energy L, the curvature parameter Ksym and neutron drip density generally increase, while the droplet size, proton number of nucleus, core-crust transition density, and onset density of non-spherical nuclei decrease. All functionals predict neutron stars with maximum masses exceeding the two-solar-mass limit, while those of DD2, DD-LZ1, DD-ME2, and DDME-X predict optimum neutron star radii according to the observational constraints. Approximate linear correlations between neutron stars' radii at M = 1.4 M⊠ and 2 M⊠, the slope L and curvature parameter Ksym of symmetry energy are observed as well. The results presented here are applicable for the investigations on the structures and evolutions of compact stars in a unified manner.

**67**

## Repeating FRBs: An Magnetospheric Origin

**Authors:** Weiyang Wang[1]; Renxin Xu[1]

[1] *School of Physics and KIAA, Peking University*

**Corresponding Author:** r.x.xu@pku.edu.cn

Fast radio bursts (FRBs) are millisecond-duration radio flashes with extremely high bright temperatures, but the origin is still unknown since the discovery in 2007 though this research field witnessed a rapid growth in the frontiers both observational and theoretical. We propose that coherent curvature radiation by bunches (maybe triggered by starquakes) in a magnetosphere of neutron star to explain FRB's radiative mechanism, i.e., the nature of narrowband radiation with time-frequency drifting, as well as a variety of polarization features. The generation of energetic charged bunches, indeed, is still a matter of debate, which is meaningful to understand the nature of repeating FRB's central engine.

**68**

## Renormalization group techniques applied to the thermodynamics of a derivatively interacting model

**Author:** Gabriel Ferrari[1]

[1] *IFSC - Instituto Federal de Santa Catarina*

**Corresponding Author:** gnevesferrari@gmail.com

A recently developed variational resummation technique, incorporating renormalization group properties consistently, has been shown to solve the scale dependence problem that plagues the evaluation of thermodynamical quantities, e.g., within the framework of approximations such as in the hard-thermal-loop resummed perturbation theory. This method is used in the present work to evaluate thermodynamical quantities within the two-dimensional nonlinear sigma model, which, apart from providing a technically simpler testing ground, shares some common features with Yang-Mills theories, like asymptotic freedom, trace anomaly and the nonperturbative generation of a mass gap. The present application confirms that nonperturbative results can be readily generated solely by considering the lowest-order (quasi-particle) contribution to the thermodynamic effective potential, when this quantity is required to be renormalization group invariant.

**69**

## Structure and Stability of Differentially Rotating Neutron Stars

**Author:** Delaney Farrell[1]

[1] *San Diego State University*

**Corresponding Author:** dfarrell@sdsu.edu

Depending on the dynamics of a binary neutron star merger, the collision may result in a differentially rotating compact object. Differentially rotating stars can sustain a total mass considerably higher than that of a uniformly rotating star, giving rise to "hypermassive"objects like hypermassive neutron stars. These stars are likely to exhibit extreme structural deformation along the radial axis due to their high masses. Both the increased mass and structural deformations supported by differential rotation allow the compact remnant to remain stable in otherwise unstable configurations on short, dynamical timescales. In this work, we numerically simulate differentially rotating neutron stars to explore an increase in mass and structural deformation for three relativistic mean-field equations of state models. Results are used to predict outcomes for recent gravitational wave observations of binary neutron star mergers.

**70**

## CSS parametrization: a case study

**Authors:** Cesar Augusto Zen Vasconcellos[1]; Fabio Kopp[1]; J. E. Horvath[2]

[1] *IF-UFRGS*

[2] *IAG-USP*

**Corresponding Authors:** fabiokopp@proton.me, foto@iag.usp.br, cesaraugustozenvasconcellos@gmail.com

In this contribution we combine the quark matter CSS parametrization (constant speed-of-sound) with the MIT bag model in order to verify the stiffness impact of the EoS of twin stars on the speed of sound within Seidov's condition. Our preliminary results for the mass-radius relations indicate as expected a correlation between the stiffness of twin stars and sound velocity determined by the medium's compressibility, composition and density, the characteristic phenomenon of wave compression propagation, typical in liquid and gases. In conclusion, the sound velocity may represent an additional signature and a constraint for modeling the EoS of a twin star and compact stars in general.

**72**

## Effects of a Generalized Uncertainty Principle on the MIT Bag Model Equation of State

**Authors:** M. N. Marzola[1]; C. A. Z. Vasconcellos[1]; D. Hadjimichef[1]

[1] *UFRGS*

**Corresponding Author:** mnmarzola@gmail.com

The Generalized Uncertainty Principle (GUP) is motivated by the premise that spacetime fluctuations near the Planck scale impose a lower bound on the achievable resolution of distances, leading to a minimum length. Inspired by a semiclassical method that integrates the GUP into the partition function by deforming its phase space, we induce a modification on the thermodynamic quantities of the MIT bag model that we propose serves as an effective semiclassical description of quark matter in a space with minimal length. We investigate the consequences of this deformation on the zero-temperature limit, for which we obtain analytical solutions.

**73**

## Gravitational waves from isolated magnetized quark stars

**Authors:** Daryel Manreza Paret[1]; Samantha López Pérez[2]; Aurora Pérez Martínez[2]

[1] *Department of General Physics, Faculty of Physics, University of Havana*

[2] *Department of Theoretical Physics, Institute of Cybernetics, Mathematics and Physics*

**Corresponding Author:** dmanreza@gmail.com

We study the effects of magnetic fields on gravitational wave signals emitted from isolated quark stars due to deformation caused by the strong magnetic field. For this purpose we construct a toy model in order to make estimates of the order of magnitude of the magnetic field that will cause sufficient deformation in a quark star for the detection of gravitational waves.

**74**

## γCygni SNR morphology viewed in the electromagnetic spectrum

**Authors:** V. G. Sinitsyna[1]; V. Y. Sinitsyna[1]; K. A. Balygin[1]; S. S. Borisov[1]; A. I. Klimov[1]; R. M. Mirzafatikhov[1]; N. I. Moseiko[1]; I. E. Ostashev[1]

[1] *P.N. Lebedev Physical Institute, Russian Academy of Science*

**Corresponding Author:** mirzafatihovrm@lebedev.ru

Cygnus Region contains many objects that are bright in all wavelengths, including one of the most powerful active star formation regions as well as pulsars, and supernova remnants. One of them is γCygni SNR shell-type supernova remnant which is considered a middle-aged SNR. γCygni SNR has been intensively studied through multi-wavelength observations in radio, X-rays, and MeV-TeV energy ranges which aimed to reveal the explosion footprints and interactions with the surrounding medium. γCygni SNR has shell-like radio and X-ray structures of similar diameter but has a different morphology. The radio-emission is brighter towards the south-east and north-west of the shell than along the north-east south-west axis. Whereas the X-ray emission is mostly bright in the south-west. At GeV energies, the Fermi-LAT observed extended emission over all of the SNR radio shell. At TeV energies, the SHALON telescopes discovered extended emission with the main contribution to the very-high-energy γ-ray fluxes given by the regions correlated with the North-West and outh-East parts of the shell. The overall morphology of γCygni SNR was examined, to find spectral characteristics of TeV-detected regions and correlations with shocks at the locations of the interaction of the supernova ejecta and the surrounding medium.

**75**

# Astrophysical approach to search for heavy neutrino decay

**Authors:** V. G. Sinitsyna[1]; V. Y. Sinitsyna[1]

[1] *P.N. Lebedev Physical Institute, Russian Academy of Science*

**Corresponding Author:** sinits@sci.lebedev.ru

Cosmic rays have become a very valuable tool in astronomy, as they provide a very different picture of the sky. During the past decades a large number of active astrophysical objects in our Galaxy and beyond have discovered with gamma-ray telescopes. Ground based telescopes are designed to detect the Cherenkov light of the air shower produced when a 0.1–100 TeV photon enters the atmosphere. Cosmic rays may also offer an opportunity to study the properties of elementary particles. The main objective in experiments like IceCube or Auger is to determine a flux of neutrinos or protons as they interact with terrestrial matter. These interactions involve energies not explored so far at particle colliders, so their study should lead us to a better understanding of that physics. In addition, the size of the detector and its distance to the nteraction
point is much larger there than in colliders, which may leave some room for unexpected effects caused by long-lived particles. Investigations with SHALON Cherenkov telescope has included observations of extensive air showers from the sub-horizontal direction $\Theta = 97^{o}$. This inclination defines an Earth skimming trajectory with 7 km of air and around 1000 km of rock in front of the telescope. After a cut of shower-like events that may be caused by chaotic sky flashes or reflections on the snow of vertical showers, we have detected 5 air showers of TeV energies. These events may be caused by the decay of a long-lived penetrating particle entering the atmosphere from the ground and decaying in front of the telescope. As a possible explanation, two scenarios with an unstable neutrino of mass $m \approx 0.5$ GeV and $c\tau \approx 30$ m is discussed. Remarkably, one of these models has been proposed to explain an excess of electron-like neutrino events at MiniBooNE.

**76**

# Studies of bright flat-spectrum radio quasar 3C454.3 at high and very-high energies

**Authors:** V. G. Sinitsyna[1]; V. Y. Sinitsyna[1]; S. S. Borisov[1]

[1] *P.N. Lebedev Physical Institute, Russian Academy of Science*

**Corresponding Author:** sergebor@gmail.com

The radio-loud active galactic nuclei having the radio emission arising from a core region rather than from lobes are often referred to as "blazars" and include Flat Spectrum Radio Quasars (FSRQ) and BL Lacertae (BL Lac) objects. The extragalactic source of radio emission source 3C454.3 is a well-known flat-spectrum radio quasar (FSRQ) at redshift z = 0.859. It has shown remarkably high activity since 2000. 3C454.3 has been very bright in the MeV-GeV gamma-rays and is intensively studied by the Fermi-LAT and AGILE. Spectral characteristics of 3C454.3 at MeV-GeV energies were found to exhibit a complex shape. 3c454.3 shows the significant flux variability in the different energy ranges including high and very high energies. At the end of 2010, 3c454.3 demonstrated extraordinary activity at high energies which was detected by Fermi-LAT. The long-term observations of 3C454.3 at 800 GeV–100 TeV energies with the SHALON telescope were started in the 1998 year. A number of activity periods were found. The most significant flaring state of 3c454.3 at TeV energies was detected in the SHALON observational period of Nov. - Dec. 2010. This increase is correlated with the flares at a lower energy range in observations of Fermi-LAT. The direct association of the significant gamma-ray flux changes with strong core radio-flares are not absolutely clear but observed correlations and lags in multiwavelength activity point to the complexity of the emission processes in blazars connected with disturbance propagating in the jet.

**77**

## Particle acceleration test with Cas A multiwavelength emission

**Authors:** V. G. Sinitsyna[1]; V. Y. Sinitsyna[1]

[1] *P.N. Lebedev Physical Institute, Russian Academy of Science*

**Corresponding Author:** sinicinavy@lebedev.ru

The Cas A structure and spectral features obtained with the multiwavelength observations have clear signs of young SNRs, which are expected to be a shell formed with the explosion blast wave moving into the circumstellar medium with magnetic fields, as well as another one due to the decelerating and compressing the outflowing ejecta. In observations in radio and X-rays, both features were detected. The forward and reverse shocks in Cas A were identified. In studies of Cas A at very high energies by SHALON was found that TeV gamma-ray emission region lays within the position of reveres shock that also corresponds to the observed bright radio ring. Also, the spectral energy distribution was obtained at high and very high energies. Two approaches involving forward and both reverse and forward shocks within the mechanism of diffusive shock acceleration in Cas A were applied to describe the spectral and structural features of this SNR viewed in nonthermal emission, including ones at high energies. Results of calculations demonstrate that the observational properties of Cas A are well reproduced by the hadronic model with significant contribution of both the forward and reverse shocks in the generation of broadband emission. It considers the very high efficiency of particle acceleration in Cas A, which value is up to 25% of the supernova explosion energy. But the energy of accelerated particles cannot exceed $10^{14}$ –$10^{15}$ eV. Whereas, the forward shock model predicts the spectral characteristics of the TeV-gamma-emission corresponding to ones detected at 800 GeV –40 TeV that are the evidence of acceleration of the hadronic cosmic rays in shells of supernova remnants up to $10^{17}$ eV.

**79**

## Effects of the anomalous magnetic moment of quarks and regularization issues in the two-flavor Nambu–Jona-Lasinio model with a magnetic field

**Authors:** William R. Tavares[1]; Sidney S. Avancini[2]; Ricardo L. S. Farias[3]; Rodrigo M. Nunes[3]

[1] *UERJ*

[2] *UFSC*

[3] *UFSM*

**Corresponding Author:** wrtensor@gmail.com

In this work, we consider the effect of quark anomalous magnetic moment (AMM) in the context of the hot and magnetized two-flavor Nambu—Jona-Lasinio model. Making use of the mean field approximation and the vacuum magnetic regularization (VMR) scheme, we apply the Schwinger ansatz to effectively implement the quark AMM. To this end, we consider two sets of constant AMM parameters with high and low values, chosen in such a way as to reproduce the magnetic moments of the proton and the neutron. When applying the low AMM value, we observe the usual magnetic catalysis in the effective quark masses. On the other hand, a high value of quark AMM induces a small window, for $eB < 0.1\text{GeV}^2$ , where the pseudocritical temperature decreases as a function of the magnetic field accompanied by an incomplete restoration of the chiral symmetry. For both values of quark AMM we observe the magnetic catalysis at $T = 0$, a smooth crossover transition at high temperatures and the absence of oscillations in the pseudocritical temperature as a function of the magnetic field. These results, mainly for a high quark AMM value, are in contradiction with most applications of the quark AMM with NJL model which, in general, ake use of non-VMR schemes.

William R. Tavares é bolsista de pós-doutorado FAPERJ (FAPERJ postdoctoral fellow)

**80**

## Particle identification studies of e-/e+ beams in the Test Beam detector at FERMILAB

**Authors:** Carlos Solano[1]; Edgar Chavarria[1]

[1] *UNI*

**Corresponding Authors:** jsolano@uni.edu.pe, echavarria@uni.pe

Our motivation is to collaborate with the study of neutrinos, in this case of neutrino-matter interactions processes in MINERvA experiment at FERMILAB, USA. We had the problema that MINERvA doesn't have a muon spectrometer and particle identification separation foe e-/e+. We solved the muon problem with the help of the muon spectrometer of ND MINOS experiment. For the e-/e+ identification and separation we used the Test Beam detector (a small MINERvA detector replica with some adaptions and improvements). After different studies (Energy absorbed distribution, EM shower starting module, Em shower opening angle) we could identify very well the e-/e+ identification separation for the 2-6 GeV range, and with less resolution for 6-8 GeV range