IWARA2020 Video Conference - 9th International Workshop on Astronomy and Relativistic Astrophysics

domingo, 6 de septiembre de 2020 - sábado, 12 de septiembre de 2020

Programa

Tabla de contenidos

Sunday 06 September 2020

Opening (7:45-8:00)

ARCHAEOASTRONOMY, BHs, GRBs, SNOVAE: Live Plenary Talks (6 sept. 2020 8:00-12:30)

time	[id] title
8:00	**[50] IWARA 2023: Proposal from Guatemala** *Presentador: SACAHUI REYES, Jose Rodrigo (Universidad de San Carlos de Guatemala)* Guatemala is a small country located in Central America, which has a great legacy of one of the biggest cultures of the American Continent, the Mayas, a civilization with a great scientific legacy and that developed a great understanding of astronomy. They measured the time based on astronomical events predicting solar eclipses and their calendar is one of the most precise ever developed. In the present the numbers in scientific resources are not so encouraging, having one of the lowest budgets in scientific and technological activities as well as a low number of full time researchers when compared to other countries of the continent (14 million of habitants). Efforts are being made from several institutions and this is expected to be reflected in the upcoming years. In recent years Guatemala has held conferences like SILAFAE 2016 and three editions of the Guatemalan School of Astrophysics (GUASA 2013, 2015, 2017). These scientific meetings detonated scientific collaborations as well as encouraged students to pursue major degrees in Astrophysics. In this talk I present Guatemala as a proposal to receive IWARA in the 2023's edition, intended to be held at Antigua Guatemala, UNESCO world heritage site, a perfect place to hold meetings. We expect that IWARA could become an important activity in order to grow the local scientific community which in time could become the critical mass to trigger strong research groups.
8:30	**[51] Inka's Worldview in Astronomy** *Presentador: ROJAS GAMARRA, Milton (UNSAAC Universidad de San Antonio Abad del Cusco)* Each civilization, since immemorial times, has developed their own culture, their own ethos and their own worldview. It was no different in the Inka culture. The man, in the different regions of the Inca empire (in Quechua, Tawantinsuyo), in his evolutionary process, also developed customs, habits, ways of being, ways of behavior. Finally, they sought to answer fundamental questions in the spirit of Imaymana Wiracocha, the eldest of the two sons of the god Ticci Wiracocha, he who inquires and seeks the truth. Among those questions we emphasize: how to be? (Imaynakay) or how to live? (Imaynakawsay). Like other ancient civilizations, the inkas also sought to interpret and understand the Cosmos, from its primordial stages, and even yhey sought to seek a sense for the Cosmos. In this process, the Inkas developed their own worldview (kawaypacha). Moreover, they built their own principles of life (Kawsay), standing out among them, gratitude and reprocity (Ayni - the force of reciprocity) and the creative life force of Pachamama (Kawsaypacha - everything in the Cosmos lives). Ayni is a reflection of the reality that exists in the energetic world. Kawsaypacha corresponds moreover to the energy present in time and space. In this lecture, we will address these principles, concluding that the Andean culture is based on a rationality which is distinct from Western cultures: the principles that govern the Andean worldview are based on transversal concepts and principles that can be synthesized in rationality, integrality and cyclicality. Thus, the proper understanding and interpretation of the Inka legacy in the fields of Astronomy, Archeoastronomy and Astronomy requires a change of perspective, based on the Inka worldview instead of a look based on the Western perspective. In this lecture we will also cover other principles, such as Duality and Convergence (Tinkuy - point of convergence) and complement the discussion with a study applied to Astronomy.
9:00	**[52] The Astronomy of Teotihuacan** *Presentador: GULLBERG, Steven (University of Oklahoma)* Northeast of Mexico City are the extant remains of one of the largest urban centers of the ancient world. Built long before, the Aztecs later adopted the site and named it "the place where the gods were created", or Teotihuacan. They considered this to be the location where time began. Elements of the vast complex were created with astronomical alignments, a common practice with many ancient cultures. The sophistication found in the urban planning design demonstrates the level of understanding of celestial movements that had been amassed by those who constructed the massive temples, and the importance that they assigned to this knowledge. Teotihuacan's Pyramid of the Sun and Pyramid of the Moon were built with intriguing alignments, and interesting orientations have been as well identified at the Temple of Quetzalcoatl, or La Ciudadela, the name given to it by the Spaniards. These important features are examined with cultural context. Cyclical patterns are prominent, and as in many cultures the alignments would have been used to assist with calendrical needs and crop management. It is also significant that certain elements of astronomy found at Teotihuacan exhibit similarities with those at other sites in the greater region. This presentation will illustrate the fascinating level of astronomical knowledge and prowess exhibited in the region and will explore visual effects of archaeoastronomy displayed at Teotihuacan.

9:30	**[53] Teotihuacán, its cultural links with southern Mesoamerica** *Presentador: ORTEGA CABRERA, Veronica (INAH)* The Pre-Hispanic city of Teotihuacán was the scene of multiple social dynamics, in which groups originating from various regions of Mesoamerica were involved. This is because the cosmopolitan nature of the city allowed the daily coexistence of people who came to it, either for reasons of exchange of objects and goods, such as the religious, political and cultural prestige that distinguished it from its beginnings and for more than five centuries. Archaeological investigations carried out since the sixties of the last century in the pre-Hispanic remains have provided information about the permanent relationships that various groups in the city had with those who lived in other cities. Among these we highlight Monte Albán, in the current state of Oaxaca, Kaminaljuyú in the Maya area or Matacapan in Veracruz, in such a way that archaeological contexts have been located that indicate the residence of people with customs and traditions originating from said areas. In this talk I will address in a general way the conformation of the city and the evidence of the cultural ties that were established between its residents and those of other cities in southern Mesoamerica, particularly Monte Albán, in the current state of Oaxaca. We show in particular the archaeological evidence of the most recent excavations in Tlailotlacan, the Oaxacan neighborhood of Teotihuacán.
10:00	Conference break: Video synthesis of spotlight plenary talks
10:15	Spotlight Session 1
11:15	Conference break: Video synthesis of recorded talks
11:30	**[55] Discovery of energy extraction from a Kerr Black Hole by discrete "Black-Holic" quanta in GRB 190114C, GRB 130427A, GRB 160509A and GRB 160625B** *Presentador: RUFFINI, Remo (ICRANet, ICRA, INAF)* Almost fifty years after the paper "Introducing the Black Hole" by Ruffini and Wheeler and the Black Hole (BH) mass energy formula by Christodoulou, Ruffini and Hawking, we can finally assert that we have been observing the moment of creation of a BH in the BdHN I in GRB 190114C, GRB 130427A, GRB 160509A and GRB 160625B, with the corresponding rotational energy extraction process. The first appearance of the Supernova, the SN-rise, triggering the BdHN has been identified. The hypercritical accretion on the SN ejecta on the new NS (νNS) created in the SN, is shown to originate the X-ray afterglow observed by the NASA Niels-Gehrels SWIFT satellite (SWIFT). The hypercritical accretion of the SN on the NS binary companion in the BdHN I model leads to the formation of the newly formed BH. The onset of the GeV radiation coinciding with the BH formation has revealed self similar structures in the time resolved spectral analysis of all sources. Consequently, we find evidence for quantized-discrete-emissions in all sources, with energy quanta of 1037 ergs with repetition time of 10-14 sec. GRBs are the most complex systems ever successfully analyzed in Physics and Astrophysics, and they may well have a role in the appearance of life in the Cosmos. These results have been made possible by a long-lasting theoretical activity, a comprehensive unprecedented high quality data analysis, an observational multi-messenger effort by the astronomical, the physical and the space research communities. This observational effort is well epitomized by the original Vela Satellites, the NASA Compton space mission (CGRO), the Italo-Dutch Beppo SAX satellite, the Russian Konus Wind Satellite, the SWIFT satellite, the Italian AGILE satellite, the NASA FERMI mission and most recently the Chinese satellite HXMT. These space missions have been assisted by radio and optical equally outstanding observational facilities from the ground.

QM, PARTICLES, ATOMS, NUCLEI, SNOVAE MERGERS, QED, BHS, GRBS, COMPACT STARS: Parallel Session Discussions (6 sept. 2020 12:30-13:26)

time	[id] title
12:30	**[30] Very Significant Revision Required for Electron Densities in White Dwarfs Deduced from Widths of Hydrogen Spectral Lines** *Presentador: OKS, Eugene (Auburn University)* In strongly magnetized plasmas of DA white dwarfs, where the magnetic field B could be as high as ~ (10^2 – 10^5) Tesla, electrons move along strongly helical trajectories. The allowance for helical trajectories of plasma electrons dramatically changes the Stark width of hydrogen spectral lines compared to all previous calculations. We show analytically that without allowance for this effect, the electron densities deduced from all previous and future observations of hydrogen lines in DA white dwarfs can be erroneous by up to one order of magnitude. Thus, a very significant revision of electron densities deduced from all observations of hydrogen lines in DA white dwarfs, is required.

12:37 **[117] Astrophysics of multi-state fuzzy dark matter**

Presentador: GUZMÁN, Francisco S. (Universidad Michoacana de San Nicolás de Hidalgo)

Going beyond the fuzzy dark matter model, we present the construction of multi-state configurations of the Gross-Pitaevskii-Poisson system that rules the dynamics of this matter, their stability, mechanism of formation and application in galactic astrophysics.

12:44 **[165] Einstein and Møller Energies of a Particular Asymptotically Reissner-Nordström Non-Singular Black Hole Solution**

Presentador: RADINSCHI, Irina (Gheorghe Asachi Technical University of Iaşi – TUIASI)

The localization of energy-momentum for a four-dimensional charged, static, and spherically symmetric, non-singular black hole solution that asymptotically behaves as a Reissner-Nordström solution, is studied. The space-time geometry is distinguished by a distribution function entering the mass function m(r). The non-singular character of the metric is warranted by the coupling of general relativity with a non-linear electrodynamics, whereby the resulting electric field is everywhere non-singular and asymptotically tends to the Maxwell field. The energy and momentum distributions are computed by applying the Einstein and Møller energy-momentum complexes. It is found that all the momenta vanish, while the energies depend on the electric charge, the mass, and the radial coordinate. Finally, the behavior of the energies near the origin, near infinity, as well as in the case of a vanishing electric charge is examined.

12:51 **[46] The blazar sequence revised**

Presentador: RUEDA-BECERRIL, Jesús M. (Purdue University)

We propose and test a fairly simple idea that could account for the blazar sequence: all jets are launched with similar energy per baryon, independently of their power. For instance, FSRQs, the most powerful jets, manage to accelerate to high bulk Lorentz factor, as observed in the radio. As a result, the emission region will have a rather modest magnetization which will induce a steep particle spectra therein and a rather steep emission spectra in the gamma-rays; particularly in the Fermi-LAT band. For the weaker jets, namely BL Lac objects, the opposite holds true; i.e., the jet does not achieve a very high bulk Lorentz factor, leading to more magnetic energy available for non-thermal particle acceleration and harder emission spectra. Moreover, this model requires but a handful of parameters. By means of numerical simulations we have accomplished to reproduce the spectral energy distributions and light-curves from fiducial sources following the aforementioned model. With the complete evolution of the broadband spectra we were able to study in detail the spectral features at any particular frequency band at any given stage. Finally numerical results are compared and contrasted with observations.

12:58 **[164] Symmetry energy and neutron pressure of finite nuclei using the relativistic meanfield formalism**

Presentador: BHUYAN, Mrutunjaya (Department of Physics, Faculty of Science University of Malaya)

In this theoretical study, we establish a correlation between the neutron skin thickness and the nuclear symmetry energy for the even-even isotones for magic neutron N = 20, 40, 82, 126, 172 (expected) within self-consistent relativistic mean-field formalism for non-linear NL3* and density-dependent DD-ME2 parameter sets [1-3]. The local density approximation is used to formulate the symmetry energy, and its co-efficient, namely, neutron pressure of finite nuclei over the isotonic chains [4]. We find a few moderate signatures of pick and/or depth over the isotonic chains at and/or near the proton magic for symmetry energy and neutron pressure, which is a manifestation of the persistence of shell/sub-shell closure. Furthermore, we show the symmetry energy as a function of neutron-proton asymmetry, which results in similar behavior as persisted in the mass-dependence curve. The obtained results are of considerable importance since due to shell closure over the isotonic chain, will act as awaiting point in nucleosynthesis of the r-process. These results are also further strengthened the experimental investigations for the existence of magicity in the drip-line region of the nuclear chart [1].

Reference:

[1] M. Bhuyan and S. K. Biswal, Phys. Rev. C (Communicated) (2020).
[2] G. Lalazissis, S. Karatzikos, R. Fossion, D. P. Arteaga, A. Afanasjev and P. Ring, Physics Letters B 671, 36 (2009).
[3] G. A. Lalazissis, T.Nikc, D. Vretenar and P. Ring, Phys. Rev. C 71, 024312 (2005).
[4] B. K. Agrawal, J. N. De, and S. K. Samaddar, Phys. Rev. Lett. 109, 262501 (2012).

13:05 **[142] Hadron properties under strong magnetic fields in the NJL model**

Presentador: SCOCCOLA, Norberto (Comision nacional energia atomica)

We study the magnetic field dependence of the masses of pions, diquarks and nucleons in the context of the Nambu-Jona-Lasinio model. Eigenvalue equations associated with charged particles are obtained using the Ritus formalism. In this way we fully take into account the existence of non-vanishing Schwinger phases. Our results are compared with those available in the literature obtained using Lattice QCD and/or Chiral Perturbation Theory.

13:12 **[166] Magnetic field decay in neutron stars**

Presentador: POPOV, Sergei (Sternberg Astronomical Institute – SAI, Lomonosov Moscow State University – LMSU)

We analyse physical grounds for large braking indices of some young radio pulsars and investigated four hypothesis explaining origin of large braking indices: (1) binarity, (2) magnetic field decay, (3) evolution of the obliquity angle, and (4) complicated multipole structure of the poloidal magnetic field. We find that the magnetic field decay is the only plausible explanation for the majority of large braking indices. The evolution of the obliquity angle can cause large n for certain initial obliquity angles only in the nonphysical case of vacuum magnetosphere. Plasma-filled magnetosphere gives n~3 for all initial obliquity angles. Although large multipoles l=3,4 can explain unusual braking indices of some objects, these surface fields need to have strength well in excess of physical limits for a NS stability. Magnetic field decay can proceed with different speed in different NSs depending on the crust composition (crust impurity parameter Q) or cooling of NSs. It is derived from our simplified model that if a fraction of 10-20~per~cent of NSs are low-mass M~1.1~Mʊ, the poloidal magnetic field decays fast due to large phonon resistivity causing the braking index to reach values n=10-100. The same effect can be obtained if a similar fraction of NSs have extreme crustal impurities Q~20-200, however, then they are doomed to loose their magnetic field rapidly. Observations of NSs in HMXBs do not support such high fraction of low-field relatively young compact objects.

13:19 **[167] Transient phenomena powered by a newborn neutron star: GRBs, SLSNe, mergernovae, and AICs**

Presentador: YU, Yun-Wei (College of Physical Science and Technology, Central China Normal University – CCNU)

The formation of neutron stars (NSs), both from collapses of massive stars and mergers of compact objects, can usually be indicated by a bright transient emission that is generated from the explosively-ejected material. In particular, as the newborn NSs can rotate very quickly and have a sufficiently high magnetic field, the spin-down of the NSs would provide a remarkable amount of energy to the emitting material. As a result, internal-origin GRB afterglow emission or super-luminous supernovae can be produced in the massive stellar collapse cases, while fast blue optical transients including the so-called mergernovae/kilonovae can arise from NS mergers and accretion-induced collapses of white dwarfs. Some multi-wavelength emission features can be used to identify and classify these NS-powered transient phenomena.

Closing of the day (13:26-13:30)

Monday 07 September 2020

Waiting room (7:45-8:00)

COSMOLOGY, DE, DM, COMPACT STARS, GRAVITY, BHs, GWs: Live Plenary Talks (7 sept. 2020 8:00-12:30)

time	[id] title
8:00	**[60] Black holes at cosmic dawn** *Presentador: MIRABEL, I. F. (IAFE-UBA-Argentina)* Theoretical models and observations suggest that primordial stellar Black Holes (Pop III-BHs) were prolifically formed in HMXBs, which are powerful jet-sources of synchrotron radiation called Microquasars (MQs). Possible signatures of large populations of BH-HMXB-MQs at cosmic dawn are: a synchrotron cosmic radio background (CRB) observed with ARCADE 2, and the unpredicted large excess amplitude of HI absorption at z=17 reported by EDGES, believed to be boosted by the CRB of ARCADE 2. Pop III BH-HMXB-MQs precede supernovae, neutron stars and dust. BH-HMXB-MQs promptly inject hard X-rays and relativistic jets into the IGM, which overtake the HII regions ionized by progenitor Pop III stars, heating and partially ionizing the IGM over larger distance scales. BH-HMXBs are channels for the formation of BBHs. The large masses of GW-BBHs relative to X-ray-BHs, and the high rates of BBH-mergers, are consistent with a high formation rate of BH-HMXBs and BBHs at cosmic dawn.
9:00	**[49] Computer Simulations of the Early Universe** *Presentador: GARRISON, David (University of Houston Clear Lake)* We are now able to simulate much of the early universe from the time of the Electro-Weak Phase Transition through the end of primordial nucleosynthesis. This simulation is performed using a General Relativistic Magnetohydrodynamic code based on the Cactus framework. It solves both the relativistic magnetohydrodynamic equations and Einstein's equations of General Relativity. As a result, it can simulate: magnetogenesis, primordial gravitational waves, turbulence, primordial perturbations and the role of dark matter in the early universe. Future work will involve extrapolating this work to the present epoch.
9:30	**[79] Mass load of magnetically-dominated jets** *Presentador: ESTEBAN ROMERO, Gustavo (Instituto Argentino de Radioastronomía)* Relativistic jets in active galactic nuclei start as a Poynting flux produced in the ergosphere of rapidly rotating black holes. However, at distances of a few tens of gravitational radii from the black hole these jets produce synchrotron and inverse Compton radiation, a clear indication that they have a significant content of charged particles. In this talk I discuss the origin of such particles with emphasis on the role played by the hot accretion flows in the process of jet generation.
10:00	Conference break: Video synthesis of spotlight plenary talks
10:15	Spotlight Session 2
11:15	Conference break: Video synthesis of recorded talks
11:30	**[58] Precision Cosmology for Modified and Extended Theories of Gravity** *Presentador: ESCAMILLA-RIVERA, Celia (Instituto de Ciencias Nucleares ICN-UNAM)* In this talk we present current cosmological results about Modified and Teleparallel Gravity Cosmology. We demonstrate that according the current astrophysical data (CC+Pantheon+BAO+GW samplers with late universe measurements SH0ES+H0LiCOW) these theories can provide another interpretation to the oscillatory behaviour of the dark energy equation of state when applied to late times and alleviate the tension issues related to H0 and σ8.
12:00	**[59] Brief review on ultra light bosons as dark matter** *Presentador: UREÑA-LOPEZ, Luis (University of Guanajuato)* The model of ultra light bosons to conform the dark matter of the Universe has been under strong scrutiny in the last two decades, and has of lately become an alternative reference model to the cold dark matter one of the standard cosmological model. In this talk we will present the general results of the model and a summary of the observations that can constrain its physical parameters. In addition to the mass of the boson, we will also consider a parameter of self-interaction that in turn influences the cosmological observables. We finally comment on upcoming tests that may or may not validate the model.

COSMOLOGY, DE, DM, COMPACT STARS, NSs, BHs, GWs, GRAVITY: Parallel Session Discussions (7 sept. 2020 12:30-13:26)

time [id] title

12:30 **[96] Timeless state of gravity: one observer Universe**

Presentador: Dr FARAG ALI, Ahmed (Benha University)

We consider spacetime foliation, at every given moment according to canonical observers, each with its speed at that moment. Consider a black hole spacetime as a spacetime with horizon. The Universe in that sense look like a sequence of frozen moments like a cartoon movie. The Rindler observer would analyze the ADM formalism as if the shift function Ni equal zero. Therefore, the normal vector □ to the spatial slice is proportional to the time basis □□ of Rindler frame field with proportionality factor that is equal to the lapse function. This is the only way to make special relativity preferred frames match with general relativity Rindler frame.

12:37 **[168] Magnetized Strange Stars versus Magnetized BEC stars**

Presentador: PEREZ MARTINEZ, Aurora (Instituto de Cibernética, Matemática y Física – ICIMAF)

We study the spheroidal magnetized Quark and Bose–Einstein Condensate (BEC) Stars. The former are supposed composed by strange quark matter while the later by the pairing of two-neutrons forming an interacting spin-one bosons. We calculate the equation of states (EoS) of the magnetized strange stars matter using Bag model while the corresponding EoS for magnetized BEC stars are doing considering the particle-magnetic field interaction and particle-particle interaction as two independent quantities. For Strange Stars we study first the stability of strange quark matter and we get stable configurations of the corresponding Strange Stars. Self-magnetized BEC may be possible so it allows to get inner magnetic field profiles of the stars as a function of the equatorial radii. The values obtained for the core and surface magnetic fields are in agreement with those typically found in compact objects.

12:44 **[40] Supercritically charged objects and electron-positron pair creation**

Presentador: Dr XIA, Cheng-Jun (Zhejiang University Ningbo Institute of Technology)

We investigate the stability and e^+e^- pair creation of supercritically charged superheavy nuclei, udQM nuggets, strangelets, and strangeon nuggets based on the Thomas-Fermi approximation. The model parameters are fixed by reproducing masses and charge properties of these supercritically charged objects reported in earlier publications. It is found that udQM nuggets, strangelets, and strangeon nuggets may be more stable than ^{56}Fe at the baryon number $A\geq 315$, 5×10^4, and 1.2×10^8, respectively. For those stable against neutron emission, the most massive superheavy element has a baryon number $\sim$965, while udQM nuggets, strangelets, and strangeon nuggets need to have baryon numbers larger than 39, 433, and 2.7×10^5. The e^+e^- pair creation will inevitably start for superheavy nuclei with charge numbers $Z\geq177$, for udQM nuggets with $Z\geq163$, for strangelets with $Z\geq 192$, and for strangeon nuggets with $Z\geq 212$. A universal relation $Q/R_e = \left(m_e - \bar{\mu}_e\right)/\alpha$ is obtained at a given electron chemical potential $\bar{\mu}_e$, where Q is the total charge and R_e the radius of electron cloud. The maximum number of Q without causing e^+e^- pair creation is then fixed by taking $\bar{\mu}_e=-m_e$. For supercritically charged objects with $\bar{\mu}_e<-m_e$, the decay rate for e^+e^- pair production is estimated based on the Jeffreys-Wentzel-Kramers-Brillouin (JWKB) approximation. It is found that most positrons are emitted at $t\leq 10^{-15}$ s, while a long lasting positron emission can be observed for large objects with $R\geq 1000$ fm. The emission of positrons and electron-positron annihilation from supercritically charged objects may be partially responsible for the short γ-ray burst during the merger of binary compact stars, the 511 keV continuum emission, as well as the narrow faint emission lines in X-ray spectra from galaxies and galaxy clusters.

12:51 **[169] Dynamical black hole in a bouncing universe**

Presentador: PEREZ, Daniela (Instituto Argentino de Radioastronomía)

In this talk, I analyze the dynamical evolution of a black hole that is immersed in a universe that goes through a classical bounce. The black hole is represented by the McVittie metric, an exact solution of Einstein Field Equations for an inhomogeneity embedded in a Friedmann-Lemaître-Robertson-Walker cosmological background. I present a full analysis of the causal structure of the spacetime. This includes the calculation of trapping horizons, radial null geodesics, and curvature invariants throughout the cosmic time. I close the presentation with a possible interpretation of this spacetime and a discussion of the implications of the results obtained for classical bouncing cosmologies.

12:58 **[170] Pulsar kick velocity and strong magnetic fields**

Presentador: MANREZA PARET, Daryel (Universidad de La Habana – UH)

We study the anisotropic neutrino emission from the core of neutron stars induced by the star's magnetic field. We model the core as made out of a magnetized ideal gas of strange quark matter and implement the conditions for stellar equilibrium in this environment. The calculation is performed without resorting to analytical simplifications and for temperature, density and magnetic field values corresponding to typical conditions for a neutron star's evolution. The anisotropic neutrino emission produces a rocket effect that contributes to the star's kick velocity. We find that the computed values for the kick velocity lie within the range of the observed values. We also show that neutrino quirality flip during the birth of a neutron star, with a strange quark matter core, is an efficient mechanism to allow neutrinos to anisotropically escape, thus providing a plausible explanation for the observed neutron star kick velocities.

13:05 **[48] Using triangles to test gravity in galaxy surveys**

Presentador: Dr NIZ, Gustavo (Universidad de Guanajuato)

We model the 3PCF of General Relativity (GR) and a representative model of Modified Gravity (f(R)) using Cosmological Perturbation Theory and compare it with the non-linear evolution of N-body simulations.

13:12 **[113] Simulated X-ray Emission in Galaxy Clusters with AGN Feedback**

Presentador: Ms KAR CHOWDHURY, Rudrani (Presidency University)

Several studies suggest that active galactic nuclei (AGN) play a significant role in the cosmological evolution of their host galaxies and dark matter halos. There is considerable evidence that the formation and evolution of the central AGN and the diffuse gas in the halo are coupled together by the activity of the supermassive blackhole (SMBH), usually termed as AGN feedback in the literature. To investigate this effect, we study the diffuse X-ray emission from galaxy groups and clusters by coupling the Astrophysical Plasma Emission Code (APEC) with the highest resolution cosmological hydrodynamic simulation involving feedback from AGN. We then construct a statistical sample of synthetic Chandra X-ray photon maps to observationally characterize the effect of AGN on the surrounding medium. By examining the flux and photon maps, we validate a recently used technique of X-ray stacking to study the effect of feedback on the intra-cluster medium (ICM) from high redshift AGN. Our results show that AGN are indeed effective in displacing the hot X-ray emitting gas from the centers of groups and clusters, and that these signatures remain evident in observations of the X-ray surface brightness profiles. Through this study we provide a robust method to extract the fraction of total energy output of the AGN that couples to the surrounding gas as feedback. This technique is applied to 200 ks Chandra X-ray observations of the ICM. We further discuss this detection feasibility in the light of current and upcoming X-ray missions.

13:19 **[171] Strong Lensing of a Regular Black Hole with an Electrodynamics Source**

Presentador: MANNA, Tuhina (St. Xavier's College)

In this paper we have investigated the gravitational lensing phenomenon in the strong field regime for a regular, charged, static, non-linear black hole having a electrodynamics source. We have obtained the angle of deflection and compared it to a Schwarzschild black hole and Reissner Nordstrom black hole with similar properties. We have also done a graphical study of the relativistic image positions and magnifications. We hope that this method may be useful in the detection of non-luminous bodies like this current black hole.

Closing of the day (13:26-13:30)

Tuesday 08 September 2020

Waiting room (7:45-8:00)

MMA, DE, DM, CCGG, X-RAYS, MWA, NSs, SNOVAE, GRAVITY: Live Plenary Talks (8 sept. 2020 8:00-13:30)

time	[id] title
8:00	**[61] X-ray Polarization in Supernova Remnants** *Presentador: SLANE, Patrick (Harvard-Smithsonian Center for Astrophysics)* The fast shocks in supernova remnants are known to accelerate particles to extremely high energies. The acceleration process is closely tied to the magnetic field structure in the shock region. This, in turn, can be modified considerably by the shock. Synchrotron emission from the shock regions provides crucial details about the magnetic field strength and orientation through its polarization. Radio polarization studies of several SNRs have provided important maps of the field orientation, and these provide clues about the connection with particle acceleration. Due to the rapid losses of the highest-energy particles, however, X-ray polarization measurements provide magnetic field information from particles much closer to the acceleration sites. Here I discuss how X-ray polarization observations can be used to investigate the magnetic fields in SNRs in order to address questions about acceleration efficiency dependence on shock obliquity, levels of turbulence in the fields, and acceleration of particles at the reverse shock.
8:30	**[82] Canonical gauge theory of gravitation for fermions** *Presentador: STRUCKMEIER, Juergen (FIAS)* For gauge theories based on the action principle, the covariant Hamiltonian formalism is the description of choice as one can then take advantage of the canonical transformation framework. The latter restricts transformations of the dynamical variables to exactly those that follow from a generating function, which entails by construction that the form of the action principle is maintained and hence that the transformation is physically admissible. On that basis, the canonical gauge theory of gravitation was successfully worked out for scalar (spin-0) and vector (spin-1) matter fields. Compared to scalar fields, vector fields were confirmed to exhibit additional couplings to a dynamic spacetime. As a result, Einstein's General Relativity turned out to apply to particles without internal degrees of freedom (spin-0) only. In this talk it is shown that novel couplings of spin-1/2 particles to spacetime emerge. In particular, fermions acquire an additional effective mass term and a torsion-dependent correction of their dynamics.
9:30	**[57] Dark Energy and Inflation as effects of torsion and geometry in the Covariant Canonical Gauge theory of Gravity (CCGG)** *Presentador: VASAK, David (FIAS)* CCGG is a mathematically rigorous derivation of the coupling of matter and spacetime geometry from a few basic postulates. The framework, based on the canonical transformation theory in the covariant de Donder-Hamiltonian formulation, yields a classical Palatini field theory extending the Einstein-Hilbert ansatz by an admixture of quadratic gravity. That term, quadratic in the Riemann-Cartan curvature tensor, endows space-time with inertia and generates geometrical modifications of the stress-energy tensor. Its relative contribution is determined by a dimensionless coupling constant, facilitating a new free parameter for gravity. Applied to the Friedman model of the universe, CCGG gives rise to scale dependence of both, the cosmological constant and the curvature contribution to the Hubble function. Numerical analysis on the basis of the LCDM set of cosmological parameters shows, depending on the choice of the new parameter, three distinct solution types: Non- singular (bouncing), singular Big Bang with following inflationary periods, and a standard Big Bang scenario. All solutions share a graceful exit into the late dark energy era. Our preliminary analysis presented here indicates that the modified Hubble function alleviates the Hubble tension between the SNeIa and the CMB data. Moreover, the cosmological constant problem is resolved as the cosmological term replacing Einstein's cosmological constant is a composite entity.
10:00	Conference break: Video synthesis of spotlight plenary talks
10:15	Spotlight Session 3
11:15	Conference break: Video synthesis of recorded talks

11:30 **[64] Studying the onset of deconfinement with multi-messenger astronomy of neutron stars**

Presentador: BLASCHKE, David (University of Wroclaw)

One of the most intriguing questions in the astrophysics of neutron stars is whether their interiors harbour deconfined quark matter. With the first multi-messenger observation of a binary neutron star merger (GW170817) new constraints became available for masses and radii of neutron stars. In this lecture, I will discuss what we may infer for their mass and the central density at the onset of deconfinement under
certain assumptions that may become testable in the near future. First, I will give an overview on the scenarios discussed in the literature, involving variations of hadronic as well as quark matter equations of state and commenting on their reliability. Then I will focus on the implications that precise simultaneous measurements of mass and radius in certain regions of the mass radius diagram will have for disentangling the onset of deconfinement and the characteristics of the phase transition. Such measurements are expected in near future from the NICER experiment. I will discuss Bayesian analyses with the presently available data as well as fictitious mass radius data that could in principle be the outcome of the NICER observations. Finally I will give an outlook on possible consequences for the structure of the QCD phase diagram, in particular for the existence of one or more critical endpoints of first-order phase transitions.

12:30 **[123] A virtual tour of the recent results of the Pierre Auger Observatory**

Presentador: NELLEN, Lucas (National Autonomous University of Mexico - UNAM)

The Pierre Auger Observatory, covering an area of 3000 km^2 is currently the larges observatory to study the highest energy cosmic rays, with energies above 10^{18} eV. The main part observatory consists of a surface detector with about 1600 stations, spaced 1.5 km apart, and 4 fluorescence detector sites with a total of 17 telescopes, overlooking the surface detector. We will start our tour of the Observatory and the underlying detection techniques. A significant part of the tour will be spend on the highlights of the recent results from the Pierre Auger Observatory. We will conclude our tour presenting the upgrade of the Observatory which is currently being installed, and how it will extend the
science reach of the Observatory.

X- & CR RAYS, QM, SNOVAE, GRAVITY, DM, COSMOLOGY, PARTICLES, COMPACT STARS, GALAXIES: Parallel Session Discussions (8 sept. 2020 13:30-14:26)

time [id] title

13:30 **[126] BH Mass, Jet and Accretion Disk Connection: An Analysis of Radio-loud and Radio-quiet Quasars**

Presentador: Ms CHAKRABORTY, Avinanda (Presidency University)

Surveys have shown radio-loud (RL) quasars constitute 10%-15% of the total quasar
population and rest are radio-quiet (RQ). However, it is unknown if the radio-loud fraction or RLF (RL quasars/Total quasars) remains consistent among different parameter spaces. This study shows that RLF increases for increasing full width half maximum (FWHM) velocity of the Hβ and MgII broad emission line. Our data has been obtained from Shen et al. (2011) catalogue. Our sample consists of quasars with magnitude less than 19.1 and limited upto redshift 0.75 for Hβ and 1.9 for MgII. We are getting RLF for the Hβ and MgII broad emission line FWHM greater than 15000km/s is 0.577 and 0.408 respectively. To investigate the reason, in this preliminary study we analyse various properties like bolometric luminosity, optical continuum luminosity, black hole (BH) mass and accretion rate of RL quasars (RLQs) and RQ quasars (RQQs) sample which have FWHM greater than 15000km/s (High Broad Line or HBL). From the distributions we can conclude for all the properties in HBL,RLQs are having higher values than RQQs. We have predicted RLQs are intrinsically brighter than RQQs and also predicted BH mass-jet connection and accretion disk-jet connection from our results but to conclude anything more analysis is needed.

13:37 **[182] Thermo-dynamical effects on FRW cosmological model for various Dark Energy**

Presentador: NAYAK, Bishnukar (National Institute of Science, Technology Institute Park)

In this discussion, we have analysed the thermo-dynamical effects of a cosmological model using Einstein Theory. To study the model, we have considered several time varying dark energy states in two different assumptions, from which we found a phantom phase during spatially open universe for Λ □ □ □−□ and all remaining results indicates a quintessence phase. The temperature and entropy density of the model remain positive for both the cases. In view of Energy Conditions, the assumptions yields identical result. The Strong Energy Condition violates, that indicates an accelerating expansion of the Universe.

13:44 **[177] Dark photons in a Higgs Stueckelberg model for dark matter**

Presentador: HADJIMICHEF, Dimiter (Federal University of Rio Grande do Sul – UFRGS)

An extension of the Standard Model (SM) is studied, in which two new vector bosons are introduced, a first boson (Z') coupled to the SM by the usual minimal coupling, producing an enlarged gauge sector in the SM and a second boson field, in the dark sector of the model, remains massless and originates a dark photon, in a hybrid mixing scenario based on a combined Higgs and Stueckelberg mechanisms. An astrophysical application is evaluated obtaining an estimate of the impact on stellar cooling of white dwarfs.

13:51 **[173] Quantum magnetic collapse of a partially bosonized npe-gas: implications for astrophysical jets**

Presentador: QUINTERO ANGULO, Gretel (Facultad de Física, Universidad de La Habana)

We study the quantum magnetic collapse of a partially bosonized npe-gas and obtain that this type of collapse might be one of the mechanisms behind matter expulsion out of compact objects. We check also that this gas might form a stable stream of matter whose collimation is due to its strong self-generated magnetic field. Possible astrophysical applications of these results, in particular related to jet formation and its maintenance, are discussed.

13:58 **[176] Thermodynamic consequences for modified Rastall gravity**

Presentador: CASTO NOGALES VERA, José Alberto (Federal University of Lavras – UFLA)

We studied thermodynamic aspects of modified Rastall gravity; recently, we proposed a modified Rastall gravity related to unimodular gravity. In this context, we study the non-conservation of the energy-momentum tensor; we develop covariant formalism of the first and second laws of thermodynamics. The second law implies a non-zero entropy flow and it is necessary to introduce particle production as part of the laws of thermodynamics, we show the consequences for the FLRW cosmological model.

14:05 **[172] Possible role of fragmentation and accretion on the stellar Initial Mass Function?**

Presentador: RIAZ, Rafeel (Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción – UdeC)

The stellar Initial Mass Function (IMF) appears to be close to universal within the Milky Way galaxy. However, it is strongly suspected to be different in the primordial Universe, where molecular hydrogen cooling is less efficient and the gas temperature can be higher by a factor of 30. In between these extreme cases, the gas temperature varies depending on the environment, metallicity and radiation background. We explore if changes of the gas temperature affect the IMF of the stars considering fragmentation and accretion. We have good indications that typical features of the IMF such as the mean, minimum and maximum stellar mass are regulated by the two key physical processes of fragmentation and mass accretion. Our simulations indicate the presence of two distinct regimes of protostellar mass growth, one where the protostellar masses are dominated by the initial fragmentation, and one where they are dominated by the accretion process. In the fragmentation dominated regime one expects at best a very weak dependence on the initial temperature of the gas, as the Jeans mass is very similar at the transition point from an approximately isothermal to an adiabatic equation of state (EOS). In the accretion dominated regime, on the other hand, we find that the average mass correlates with the gas temperature. We have quantified the role of these processes with numerical simulations, varying the initial gas temperature from 10 to 50 K, assuming transonic turbulence and a ratio of rotational to gravitational energy of 1 %. We pursued two sets of models with different random seeds to initialize the turbulence, corresponding to different realizations with the same statistical properties. Before the transition to the regime dominated by accretion, there is no evidence of a temperature dependence, confirming previous reported findings. As a result, one may expect a rather universal IMF if the star formation efficiency (SFE) is low enough. If higher SFEs are reached, our simulations show that one would expect a dependence of the accretion process on temperature. This could be caused by local radiation backgrounds that heat up the gas. The minimum temperature of the gas is expected to increase with cosmic redshift, as cooling becomes inefficient below the CMB temperature. The temperatures explored here correspond to a redshift range from 2.7 to 17.3, if interpreted to be due to the temperature of the CMB, thus covering a significant range in redshift, while in the presence of a sufficiently strong radiation background heating the gas, the models can be applied at lower redshift as well. Our approach implicitly assumes the presence of dust, as the latter regulates the transition from an approximately isothermal to an adiabatic regime. The effective mass accretion phase helps the protostars to grow in mass as well as in number which lead to the eventual higher mean masses associated to the warmer clouds until the SFE reaches $\xi = 15$ % at the end of our simulations. The total number of protostars in each of our models and the associated protostellar mergers as a function of SFE also provide an insight which support the existence of a transition from a fragmentation dominated to an accretion dominated phase inside collapsing gas clouds. Despite the lesser number of mergers the warmer gas clouds show a higher mean mass after a critical SFE of about $\xi = 5$ to 7 %. Our analysis of mass accretion for the longest surviving protostar in each model provides a demonstration of the transition from the fragmentation dominated regime to accretion dominated regime in star forming gas clouds.

14:12 **[183] Gravitational memory effects and Bondi-Metzner-Sachs symmetries in scalar-tensor theories**

Presentador: HOU, Shaoqi (Wuhan University)

The relation between gravitational memory effects and Bondi-Metzner-Sachs symmetries of the asymptotically flat spacetimes is studied in the scalar-tensor theory. For this purpose, the solutions to the equations of motion near the future null infinity are obtained in the generalized Bondi-Sachs coordinates with a suitable determinant condition. It turns out that the Bondi-Metzner-Sachs group is also a semi-direct product of an infinitesimal dimensional supertranslation group and the Lorentz group as in general relativity. There are also degenerate vacua in both the tensor and the scalar sectors in the scalar-tensor theory. The supertranslation relates the vacua in the tensor sector, while in the scalar sector, it is the Lorentz transformation that transforms the vacua to each other. So there are the tensor memory effect similar to the one in general relativity, and the scalar memory effect, which is new. The evolution equations for the Bondi mass and angular momentum aspects suggest that the null energy fluxes and the angular momentum fluxes across the null infinity induce the transition among the vacua in the tensor and the scalar sectors, respectively.

14:19 **[89] The Graphical Presentation of 4-Dimensiona Spacetime Worldline and the Existence of Objects Inferred from the Worldline**

Presentador: Dr WU, Yuxiang (retired)

Since we do not know how to draw a 4-dimensional graph, Minkowski compressed his (x,y,z,t) model to (x,y,t), and using spacetime light cone to represent 4-dimensional space graph. But such light cone brings lots of problems and errors. We showed some in the paper. To overcome that, we developed a new method to draw a real 4-dimensional spacetime graph. From the application of such method to draw multi-world lines in one graph, we were hinted to develop the Law of Existence of Objects: an object only exists at the “present” moment.

Closing of the day (14:26-14:30)

Wednesday 09 September 2020

Waiting room (7:45-8:00)

COMPACT STARS, DM, GWs, PARTICLES, ϒ-RAYS, QGP QCD, HIC, SNOVAE: Live Plenary Talks (9 sept. 2020 8:00-13:30)

time	[id] title
8:00	**[65] The highest gamma ray energy sources observed by HAWC and the Galactic Pevatrons** *Presentador: SANDOVAL, Andrés (Instituto de Física, UNAM)* The HAWC gamma ray observatory situated at 4200 m altitude in the Volcan Sierra Negra, Central Mexico, has observed several sources that emit gamma rays of energies greater than 50 TeV. What are they? What is the production mechanism? How do they look in other frequencies? How do they relate to the sources of energetic cosmic rays? These are some of the questions that will be discussed.
8:30	**[66] The Southern Wide Field Gamma Ray Observatory (SWGO)** *Presentador: BARRES, Ulisses (Centro Brasileiro de Pesquisas Físicas)* The scientific potential of a wide field of view, and very high duty cycle, ground based gamma ray detector has been demonstrated by the current generation of instruments, such as HAWC and ARGO, and will be further extended in the Northern hemisphere by LHAASO. Nevertheless, no such instrument exists in the southern hemisphere yet, where a great potential lies uncovered for the mapping of Galactic large scale emission as well as providing access to the full sky for transient and variable multi-wavelength and multi-messenger phenomena. Access to the Galactic Centre and complementarity with the CTA-South are other key motivations for such a gamma ray observatory in the south. There is also significant potential for cosmic ray studies, including investigation of cosmic ray anisotropy. In this talk I will present the concept for the future Southern Wide-Field Gamma-ray Observatory (SWGO), now formally established as an international Consortium (www.swgo.org) and starting its R&D phase, as well as its scientific perspectives.
9:00	**[67] Can gravitational waves prove the existence of the quark- gluon plasma?** *Presentador: HANAUSKE, Matthias (Institut für Theoretische Physik)* The long-awaited detection of a gravitational wave (GW) from the merger of a binary neutron star (BNS) in August 2017 (GW170817) marked the beginning of the new field of multi-messenger gravitational wave astronomy. By exploiting the extracted tidal deformations of the two neutron stars from the late inspiral phase of GW170817, it was possible to constrain several global properties of the equation of state of neutron star matter. With future gravitational wave detections we will be able to investigate the hadron-quark phase transition (HQPT) by analyzing the spectrum of the post-merger GW of the differentially rotating hypermassive hybrid star (HMHS). In contrast to hypermassive neutron stars (HMNS) these highly differentially rotating objects contain deconfined strange quark matter in their slowly rotating and rather cold inner region. HMHS live only a view seconds and during the collapse of the HMHS to a Kerr Black the color degrees of freedom of the pure quark core get macroscopically confined by the formation of an event horizon.
9:30	**[68] NS 1987A in SN 1987A** *Presentador: PAGE, Dany (Universidad Nacional Autonoma de Mexico)* The possible detection of a compact object in the remnant of SN 1987A presents an unprecedented opportunity to follow its early evolution. The suspected detection stems from an excess of infrared emission from a dust blob near the compact object's predicted position. The infrared excess could be due to the decay of isotopes like 44Ti, accretion luminosity from a neutron star or black hole, magnetospheric emission or a wind originating from the spindown of a pulsar, or thermal emission from an embedded, cooling neutron star (NS 1987A). It is shown that the last possibility is the most plausible as the other explanations are disfavored by other observations and/or require fine-tuning of parameters. Not only are there indications the dust blob overlaps the predicted location of a kicked compact remnant, but its excess luminosity also matches the expected thermal power of a 30 year old neutron star. Furthermore, models of cooling neutron stars within the Minimal Cooling paradigm readily fit both NS 1987A and Cas A, the next-youngest known neutron star. If correct, a long heat transport timescale in the crust and a large effective stellar temperature are favored, implying relatively limited crustal n-1S0 superfluidity and an envelope with a thick layer of light elements, respectively. If the locations do not overlap, then pulsar spindown or accretion might be more likely, but the pulsar's period and magnetic field or the accretion rate must be rather finely tuned. In this case, NS 1987A may have enhanced cooling and/or a heavy-element envelope.
10:00	Conference break: Video synthesis of spotlight plenary talks
10:15	Spotlight Session 4

11:15	Conference break: Video synthesis of recorded talks
11:30	**[70] Properties of the QGP created in heavy-ion collisions** *Presentador: BRATKOVSKAYA, Elena (GSI, Darmstadt & GU, Frankfurt)* We review the properties of the strongly interacting quark-gluon plasma (QGP) created in heavy-ion collisions at ultrarelativistic energies, i.e. out-of equilibrium, and compare them to the equilibrium case. The description of the strongly interacting (non-perturbative) QGP in equilibrium is based on 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 Tc from lattice QCD. We study the transport coefficients such as the ratio of shear viscosity and bulk viscosity over entropy density, diffusion coefficients, electric conductivity etc. versus temperature and baryon chemical potential. Based on a microscopic transport description of heavy-ion collisions we discuss which observables are sensitive to the QGP creation and its properties.
12:30	**[76] The nuclear equation of state at highest compression - from gravitational waves and high energy heavy ion collisions** *Presentador: STOECKER, Horst (GSi)* Compressed hot nuclear matter can be produced in high energy heavy ion collisions and in supernova collapse and binary neutron star mergers. Relativistic numerical nuclear fluid dynamics demonstrates that the densities and temperatures reached in these cosmic environments match neatly those reached at the new international FAIR facility in Europe. The gravitational wave spectrum of the former and the flow signatures of the latter can yield information about phase transitions in the nuclear equation of state into resonance matter and strange quark matter.

COMPACT STARS, DM, DE, GWs, ϒ RAYS, QGP, QCD, HIC, SNOVAE, BHs, PARTICLES, GALAXIES: Parallel Session Discussions (9 sept. 2020 13:30-14:33)

time	[id] title
13:30	**[180] A Minimal Length Uncertainty Approach to Cosmological Constant Problem** *Presentador: DIAB, Abdel Magied Abdel (Modern University for Information – MTI)* Based on quantum mechanical framework for the minimal length uncertainty, we demonstrate that the generalized uncertainty principle (GUP) parameter - on one hand - could be best constrained by recent gravitational waves observations, and - on other hand - suggest modified dispersion relations (MDRs) to calculate the difference between the group velocity of gravitons and that of photons. Utilizing features of the UV/IR correspondence and the obvious similarities between GUP (including non-gravitating and gravitating impacts on Heisenberg uncertainty principle) and the discrepancy between the theoretical and the observed cosmological constant (apparently manifesting gravitational influences on the vacuum energy density), we suggest a possible solution for the cosmological constant problem.
13:37	**[179] Quantization consequences on the metric tensors** *Presentador: TAWFIK , Abdel Nasser (Nile University – NU)* When minimal length uncertainty emerging from generalized uncertainty principle (GUP) is thoughtfully implemented, it is of great interest to consider its impacts on Einstein's gravitational field equations (EFE) and to find out whether the corresponding modification in the metric manifests properties of quantum geometry due to quantum gravity. GUP takes into account the gravitational impacts on the noncommutation relations of the distance and momentum operators and of the time and energy operators, etc. On the other hand, the EFE relates classical geometry or gravity to the energy-momentum tensors, i.e. quantum equations of state. Despite the technical difficulties, we confront GUP to the metric tensors so that the line metric, geodesic equation, Christoffel connection, etc. are accordingly modified. We illustrate our idea on approaching quantum gravity by focusing the discussion on the corresponding modified geodesic equation, which apparently encompasses acceleration, jerk, and snap (jounce) of a particle in the quasi-quantized gravitational field.
13:44	**[185] Static EKG stars and matter-scalar field interactions** *Presentador: CABO MONTES DE OCA, Alejandro (Instituto de Cibernética, Matemática y Física – ICIMAF)* Static (not stationary) solutions of the Einstein-Klein-Gordon (EKG) equations including matter are obtained for real scalar fields. The scalar field interaction with matter is considered. The introduced coupling allows the existence of static solutions in contraposition with the case of the simpler EKG equations for real scalar fields and gravity. Surprisingly, when the considered matter is a photon-like gas, it turns out that the gravitational field intensity at large radial distances becomes nearly a constant, exerting an approximately fixed force to small bodies at any distance. The effect is clearly related with the massless character of the photon-like field. It is also argued that the gravitational field can generate a bounding effect, that could avoid the unlimited increase in mass with the radius of the obtained here solution. This effect, if verified, furnishes a possible mechanism for explaining how the increasing gravitational potential associated to dark matter finally decays at large distances from the galaxies. A method for evaluating these photon bounding effects is just formulated in order to be further investigated.

13:51 **[187] Primordial Black Holes and their Formation**

Presentador: ERFANI, Encieh (Institute for Advanced Studies in Basic Sciences)

With the discovery of gravitational waves from merging pairs of massive black holes, the interest in the question of whether Primordial Black Holes (PBHs) could constitute the Dark Matter (DM) has recently been revived. In this talk, I will review the different mechanisms for (DM) PBHs formation with a focus on inflation which can source the required large density fluctuations for PBHs formation. I will also explain the excursion set theory as a new formalism for the formation of DM PBHs.

13:58 **[32] A new code for the numerical simulation of relativistic flows on supercomputers by means of a low-dissipation scheme**

Presentador: KULIKOV, Igor (ICMMG SB RAS)

A new code to simulate special relativistic hydrodynamic flows on supercomputer architectures with distributed memory is described. The code is based on a combination of Godunov's method and a piecewise parabolic method with a local stencil. This approach has good conservation properties, correctly reproduces shock waves, and ensures high accuracy on smooth solutions and low dissipation on discontinuities. Only a local computation stencil is needed for the piecewise parabolic reconstruction of the solution. The code scalability is 94% on a cluster, Intel Xeon X5670 NKS-30T, with 768 cores. The results of code verification using a relativistic jet problem and computational experiments on the evolution of a galactic jet are presented.

14:05 **[181] New Graviton Mass Bound from Binary Pulsars**

Presentador: SHAO, Lijing (Peking University)

In Einstein's general relativity, gravity is mediated by a massless metric field. The extension of general relativity to consistently include a mass for the graviton has profound implications for gravitation and cosmology. Salient features of various massive gravity theories can be captured by Galileon models, the simplest of which is the cubic Galileon. The presence of the Galileon field leads to additional gravitational radiation in binary pulsars where the Vainshtein mechanism is less suppressed than its fifth-force counterpart, which deserves a detailed confrontation with observations. We choose a set of well-timed binary pulsars, and from their intrinsic orbital decay rates we put a new bound on the graviton mass. Furthermore, we extensively simulate times of arrival for pulsars in orbit around stellar-mass black holes and the supermassive black hole at the Galactic center, and investigate their prospects in probing the cubic Galileon theory in the near future.

14:12 **[34] A Reconstruction scheme for f(T) gravity through interacting variable-generalized Chaplygin Gas form of dark energy and its thermodynamics**

Presentador: Dr CHATTOPADHYAY, Surajit (Amity University, Kolkata)

Late time accelerated expansion of the Universe is well documented in the literature. An exotic matter, characterized by negative pressure is considered to be the driving force behind this late time acceleration of the Universe and it is dubbed as dark energy (DE). The negative pressure p leads to negative equation of state (EoS) parameter $w = p/\rho$, where ρ is the density of the Universe. In order the acceleration to occur, we require $w < -1/3$. If w is above −1 then we consider it to be quintessence and if below, then phantom. If there is a transition from quintessence to phantom, then we consider it to be quintessence. Although the cosmological constant Λ characterized by $w = -1$ happens to be the simplest candidate of DE, other models with time varying w have also been reported in the literature. These include scalar field models, Chaplygin gas models and holographic dark energy models. This study reports a study on a type of Chaplygin gas model, namely variable-generalized Chaplygin gas (VGCG) whose equation of state is $p_\lambda = -A_0 a^n/\rho_\lambda^\alpha$. In this study an interacting scenario is considered, where the VGCG interacts with pressureless dark matter (DM) and Q is chosen as $Q = 3H\delta\rho_\Lambda$, where ρ_Λ represents the VGCG density. Interacting VGCG has been studied for detailed cosmology and the EoS parameter has been observed. Attainment of ΛCDM fixed point has also been observed. Replacement of the scalar Lagrangean R with a function f(R) of the scalar curvature is the simplest way of modifying the Einstein's general relativity (GR). Another interesting sort of modified theories is the so-called f(T) gravity (T is torsion). In the second part of the study, a reconstruction scheme for f(T) gravity is demonstrated with power-law form of the scale factor. The EoS parameter corresponding to the reconstructed f(T) has shown quintom behavior. Finally, the generalized second law (GSL) of thermodynamics has been investigated under the purview of the reconstructed f(T) cosmology, where the universe is considered as a closed bounded system with future event horizon as the cosmological boundary. We have associated two different entropies with the cosmological horizons with a logarithmic correction term and a power-law correction term. We have studied the validity of the GSL for both of these corrections.

14:19 **[47] Dark-matter admixed neutron stars**

Presentador: SAGUN, Violetta (University of Coimbra)

We study an impact of asymmetric dark matter on properties of the neutron stars and their ability to reach the two solar masses limit, which allows us to present a new range of masses of dark matter particles and their fractions inside the star. Our analysis is based on the observational fact of the existence of three pulsars reaching this limit and on the theoretically predicted reduction of the neutron star maximal mass caused by the accumulation of dark matter in its interior. We also demonstrate that light dark matter particles with masses below 0.2 GeV can create an extended halo around the neutron star leading not to decrease, but to increase of its visible gravitational mass. By using recent results on the spatial distribution of dark matter in the Milky Way, we present an estimate of its fraction inside the neutron stars located in the Galaxy center. We show how the detection of a 2M neutron star in the most central region of the Galaxy will impose an upper constraint on the mass of dark matter particles of □ 60 GeV. Future high precision measurements of the neutron stars maximal mass near the Galactic center, will put a more stringent constraint on the mass of the dark matter particle. This last result is particularly important to prepare ongoing, and future radio and X-ray surveys.

14:26 **[95] The electrical conductivity, magnetic parameter, plastic flow and toroidal magnetic field decay in magnetars**

Presentador: GAO, Zhi-Fu (Xinjiang Astronomical Observatory, Chinese Academy of Sciences)

Magnetars are a kind of pulsars powered mainly by superhigh magnetic fields. They are popular sources with many unsolved issues in themselves, but also linked to various high-energy phenomena, such as Quasi-periodic oscillation, giant flares, fast radio bursts and super-luminous supernovae. In this presentation, combining with the latest EoSs, we first introduce the eigen equations of Ohmic dissipation of high-order toroidal magnetic fields in general relativity, then calculate the electrical conductivity, give a specific relation between the magnetization parameter, defined as the ratio of Ohmic dissipation timescale to Hall drift timescale, and magnetic field in the crust, and apply this specific relation to the magnetic field evolution of high braking-index magnetars. Finally, using verified transition state theory and quantum plasticity theory, we investigate the temperature-dependent shear (strain) rates as well as temperature-dependent (shear) viscosity considering magnetically driven plastic flows in the crust of magnetars, the onset of the soft gamma repeater outburst maybe controlled by magnetospheric dissipation induced by the plastic motions of the crust, according to our results and analysis of relevant energy scales.

Closing of the day (14:33-14:40)

Thursday 10 September 2020

Waiting room (7:45-8:00)

DENSE MATTER, QCD, QFT, HIC, GWs, DM, COSMOLOGY: Live Plenary Talks (10 sept. 2020 8:00-13:30)

time	[id] title
8:00	**[71] Galaxy - Dark matter connection in cosmology** *Presentador: FROMENTEAU, Sebastien (ICF - UNAM)* While the large scale structures formation is dominated by Cold Dark Matter (CDM) field evolution, we generally have only access to baryonic tracer like galaxies. In particular, Mexico is involved in three of the most important galaxy surveys of next decade: DESI, SDSS-V and LSST. The usual method is to link the galaxy distribution to the CDM density field using a linear bias. We propose to use a luminosity-based methodology in order improve this mapping in order enhance the galaxy-CDM connection using different galaxy tracers. Moreover, I will present how this methodology can improve the standard reconstruction method which allows to enhance the Baryonic Acoustic Oscillation Peak position, one of the most important probe for the cosmic expansion acceleration.
8:30	**[72] Hybrid star construction with the extended linear sigma model** *Presentador: WOLF, Gyorgy (Wigner RCP)* The interior of compact stars is usually divided into two major parts, the outer part called crust and the inner part called core. There are several possibilities for the composition of these parts. One is a hybrid star, in which the crust contains nuclear matter, while the inner core contains quark matter. Since at large baryon densities one can work with effective models, and nuclear and quark matter are usually described by different models, some unification of the two parts is needed. We show two different approaches for a composite model and some recent developments in hybrid star constructions using the extended linear sigma model for modeling the quark matter at the core.
9:00	**[84] Gravitational waves signatures and magnetars** *Presentador: MENEZES, Debora (UFSC)* A neutron star was first detected as a pulsar in 1967. It is one of 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. The same event was seen in X-ray, gamma-ray, UV, IR, radio frequency and even in the optical region of the electromagnetic spectrum, starting the new era of multi- messenger astronomy. To understand neutron stars, an appropriate equation of state that satisfies bulk nuclear matter properties has to be used and GW170817 has provided some extra constraints to determine it. On the other hand, some neutron stars have strong magnetic fields up to 10^{15} Gauss on the surface as compared with the usual 10^{12} Gauss normally present in ordinary pulsars. They are called magnetars. While the description of ordinary pulsars is not completely established, describing magnetars poses a real challenge because the magnetic fields can produce an anisotropic equation of state. One elegant way to circumvent this problem is the use of the chaotic field approximation. It is also known that low magnetic fields do not affect the equation of state and the resulting star macroscopic properties but they do affect the crust-core transition and the crust thickness with many consequences, as the explanation of glitches and the calculation of the Love number that enters the quadrupole tidal polarizabilities. Moreover, just before the merging, tidal interactions can excite the star crust fluid modes by resonance and the fundamental mode can be greatly excited with a strong influence on the gravitational wave emission. I will talk about the importance of the new constraints imposed by GW170817 in the determination of appropriate equations of state, in the calculation of the fundamental mode and possible ways to describe hadronic and quark matter subject to strong magnetic fields.
9:30	**[74] The equation of state of strongly interacting matter and the consequences for transport approaches** *Presentador: AICHELIN, Joerg (Subatech/CNRS)* The equation of state (EoS) of strongly interacting matter for finite chemical potentials cannot be calculated from first principles (lattice QCD) so one have to rely on effective theories like the Polyakov-Nambu-Jona-Lasinio model. Recently it has been shown that they can reproduce the lattice calculations at vanishing chemical potential and provide therefore a solid basis for the extrapolation to finite chemical potentials. The knowledge of the EoS at finite chemical potentials is necessary to understand neutron stars, neutron star collisions but also relativistic heavy ion collisions. We present the current status of this development and discuss the consequences for transport approaches.
10:00	Conference break: Video synthesis of spotlight plenary talks
10:15	Spotlight Session 5
11:15	Conference break: Video synthesis of recorded talks

12:30 **[101] GW 170817 and other mergers. What happened? What are the implications? What should we expect now?**

Presentador: PIRAN, Tsvi (The Hebrew University)

The detection of gravitational waves and accompanying EM signals from a binary neutron star merger, GW 170817 was one of the most remarkable scientific achievements of the last decade. The discovery confirmed numerous long standing predictions, ranging from the mergers being the cosmic foundries of r-process elements to the origin of short gamma-ray bursts. It also revealed the potential of these events to serve as tools to explore new physics, ranging from the measurement of the Hubble constant on the largest scales to the estimations of the equation of state at ultra high densities at the smallest. I describe current understanding of what have we seen, I summarize some of the new understanding that has emerged and I discuss the prospects for future discoveries. Interestingly many of these ideas had to be revised following the late observations of the EM signals from GW 170817 and gravitational waves observations of other mergers during the O3 campaign.

DENSE MATTER, QCD, QFT, HIC, GWs, NSs, DM, COSMOLOGY , FTH-INFLATION: Parallel Session Discussions

(10 sept. 2020 11:30-12:30)

time [id] title

11:30 **[195] General relativistic mass and spin of a Kerr black hole in terms of redshifts**

Presentador: HERRERA AGUILAR, Alfredo (Meritorious Autonomous University of Puebla – BUAP)

In this talk we derive closed general relativistic formulas for the mass M and the spin parameter a of a Kerr black hole in terms of observational data: the red- and blue-shifts of photons emitted by massive particles (stars or gas) geodesically orbiting around the black hole, and their respective orbital radius. It turns out that given a set of two (three) stars revolving around the Kerr black hole, the aforementioned formulas involve just eight (twelve) observational data: the redshift in six (nine) positions and the corresponding two (three) orbital radii. We also analyze the case of a single star orbiting the black hole, for it we need a minimal set of four observational measurements to analytically determine both black hole mass and spin parameters in closed form. Applications to astrophysical systems are briefly discussed.

11:36 **[189] The role of quark matter surface tension in dense compact star matter**

Presentador: GRUNFELD, Ana Gabriela (National Commission of Atomic Energy – CNEA, National Scientific and Technical Research Council – CONICET)

Quark matter surface tension plays a key role in the understanding of neutron star (NS) interiors. However, despite its relevance for NS physics, the surface tension is still poorly known for quark matter. We focus on the thermodynamic conditions prevailing in NSs, hot lepton-rich protoneutron stars (PNSs), and binary NS mergers. We explore the role of temperature, baryon number density, trapped neutrinos, droplet size, and magnetic fields within the multiple reflection expansion formalism (MRE), assuming that astrophysical quark matter can be described as a mixture of free Fermi gases composed of quarks u, d, s, electrons, and neutrinos, in chemical equilibrium under weak interactions. Finally, we discuss some astrophysical consequences of our results.

11:42 **[191] The Challenge of Calibrating a Laser Interferometric Gravitational Wave Detector**

Presentador: FRAJUCA, Carlos (Federal Institute of Education, Science and Technology of São Paulo – IFSP)

In 2015 the first detection of gravitational waves was made, gravitational waves from the violent collision of two black holes. This collision sent waves through space-time as Einstein predicted. This detection was made possible by many advances in measurement technology, mainly vibration isolation for the detector optics; at 10 Hz, the motion of the laser interferometer detector mirrors is at least on billion times smaller than the seismic motion of the ground and also makes the laser locked-in the detection configuration in a large band of the spectrum. This was made possible by using many feedback and feedforward control loops. But, to reach such requirements more than 100 of such active systems are included in the detectors to allow lock acquisition, lock stability, and sensitivity of the instrument. In this work, the challenges of reaching these requirements will be addressed and how this makes the calibration of these detectors very challenging.

11:48 **[190] Mapping Stellar Mass in the local universe — a crucial step towards understanding dark matter distribution in Nearby Galaxies**

Presentador: MENÉNDEZ-DELMESTRE, Karín (Observatório do Valongo, Universidade Federal do Rio de Janeiro – UFRJ)

Local galaxies are the endpoint of all cosmological evolution: to understand how galaxies evolve through cosmic time, we need a careful characterization of galaxy structures in the local universe. The Spitzer Survey of Stellar Structure in Galaxies (S4G) is one of the major legacy surveys of the post-cryogenic campaign of the Spitzer Space Telescope. With deep mid-infrared (3.6/4.5um) imaging of > 2300 nearby galaxies with the IRAC camera probing stellar surface densities down to << 1 Msun/pc2, S4G is the largest, deepest and most homogenous mid-infrared survey of the nearby Universe to date and provides the ultimate inventory of the distribution of stellar mass and structure in local galaxies. Combined with deep optical follow-up, an unprecedented opportunity opens up to complement a stellar mass census with a detailed analysis of the stellar populations in stellar structures. With this in mind we have initiated the Census of Austral Nearby GAlaxies (or CANGA survey), an observational campaign using the Goodman imager on the SOAR telescope to go after local galaxies in the southern sky. With a projected sample of >1000, CANGA will represent the deepest mapping ever of a complete sample in this hemisphere, providing a spatially-resolved analysis of stellar populations at the 10s-to-100 pc-scale of key stellar structures in nearby galaxies. CANGA complements the exquisite work that has been performed by the Sloan Digital Sky Server (SDSS) in the northern hemisphere, but largely surpasses its sensitivity. Combining the spatially-resolved analysis of stellar populations from CANGA with the stellar mass mapping from S4G, this program represents a meticulous probe of the baryonic component required for the decomposition of galaxy rotation curves. This, in turn, allows for the subsequent isolation of the dark matter (DM) component, with important inputs (DM profile for our galaxy, as well as an estimate of the local DM density) for direct detection experiments of DM. As one of the original members of the S4G collaboration and PI of CANGA, I intend to provide a brief review of discoveries we have made within this combined data set, placing them within the broad context of galaxy evolution over cosmic times.

11:54 **[184] Cosmic inflation without inflaton**

Presentador: JAIME, Luisa (Instituto Nacional de Investigaciones Nucleares)

During this talk I will present a novel proposal to explain cosmic inflation in the Universe with the following features: (i) its vacuum spectrum solely consists of a graviton and is ghost-free, (ii) it possesses well-behaved black hole solutions which coincide with those of Einsteinian cubic gravity, (iii) its cosmology is well-posed as an initial value problem and, most importantly, (iv) it entails a geometric mechanism triggering an inflationary period in the early universe (driven by radiation) with a graceful exit to a late-time cosmology arbitrarily close to ΛCDM. In the frame of these theories, we compute the inflationary predictions of the theory and we show that all models considered here produce inflation and, most of them coincide, some better than others, with the marginalized 95% CL region given by Planck's collaboration.

12:00 **[37] Reheating and Post-inflationary Production of Dark Matter**

Presentador: Dr GARCIA GARCIA, Marcos A. (Instituto de Fisica Teorica UAM)

In this talk I will present a systematic analysis of dark matter production during post-inflationary reheating. The damped oscillations of the inflation as it decays, the thermalization rate of its decay products, and the evolution of the temperature of the subsequently thermalized radiation determine the production rate of dark matter, and they are in turn dependent on the shape of the inflation potential. I will show that dark matter production is sensitive to the inflation potential, and depends heavily on the thermalization rate when the potential is not quadratic near the minimum. I will also discuss how to exploit dark matter as a probe of the dynamics during reheating, through smoking-gun signals such as monochromatic neutrinos or gamma ray lines for super-GeV dark matter masses, or through Lyman-alpha data for sub-GeV dark matter.

12:06 **[161] Strong decay of hybrid mesons**

Presentador: DA SILVA, Mario Luiz Lopes (Universidade Federal de Pelotas)

In this work, we calculate the decay rates of some resonances that can be considered as hybrid mesons. This study was carried out using the constituent gluon model. We specifically studied the resonances $\pi_1(1400)$ and $\pi_1(1600)$, since the lightest hybrid meson, with quantum numbers J^{PC} = $1^{−+}$, is expected to be in this region of hadronic spectrum. The constituent gluon model considers that the hybrid meson is composed by a quark-antiquark pair and a gluon. Thus, the decay occurs via the gluon breaking in a quark-antiquark pair. The constituent gluon model is established in the theory of strong interaction through the coupling between quarks and gluons fields, considering that the force between both is mediated by gluon exchange.

12:12 **[160] Angular momentum conservation and core superfluid dynamics for the pulsar J1734-3333**

Presentador: MAGALHAES, Nadja (Federal University of Sao Paulo)

Pulsars emit pulsed radiation in well-defined frequencies. In the canonical model, a pulsar is assumed to be a rotating, highly magnetized sphere made mostly of neutrons that has a magnetic dipole misaligned with respect to its rotation axis, which would be responsible for the emission of the observed pulses. The measurement of the pulse frequency and its first two derivatives allows the calculation of the braking index, n. One limitation of the canonical model is that for all pulsars it yields n = 3, a value that does not correspond to observational values of n. In order to contribute to the solution of this problem we proposed a model for pulsars’ rotation frequency decay assuming that the star’s total moment of inertia would vary with time due to mass motions inside the core. As a result, we found that the pulsar J1734-3333 has total angular momentum practically conserved, a phenomenon that we explain relating the motion of neutron superfluid vortices in the core to torques associated to radiation emission.

12:18 **[29] Energy Conditions in Non-minimally Coupled f(R,T) Gravity**

Presentador: Prof. SAHOO, Pradyumn Kumar (Birla Institute of Technology and Science-Pilani, Hyderabad Campus)

In today's scenario, going beyond Einstein's theory of gravity leads us to some more complete and modified theories of gravity. One of them is the f(R,T) gravity in which R is the Ricci scalar, and T is the trace of energy-momentum tensor. A well-motivated f(R,T) gravity model, $f(R,T) = R + \alpha RT$ where α is the model parameter is considered here. In this work, we studied the strong energy condition (SEC), the weak energy condition (WEC), the null energy condition (NEC), and the dominant energy condition (DEC) under the simplest non-minimal matter geometry coupling with a perfect fluid distribution. The model parameter α is constrained by energy conditions and the equation of state parameter $\omega = p/\rho$, resulting in the compatibility of f(R,T) models with the accelerated expansion of the universe. It is seen that the EoS parameter ω illustrate the quintessence phase $0 \geq \omega > -1$ in a dominated accelerated phase, $\omega = -1$ pinpoint to the cosmological constant, i.e., ΛCDM model and $\omega < -1$ yields the phantom era. Also, the present values of $H0 = 67.9$ and $q0 = -0.503$ are used to check the viability of f(R,T) gravity. It is observed that the positive behavior of DEC, WEC indicates the validation of the model. In contrast, SEC is violating the condition resulting in the accelerated expansion of the universe.

12:24 **[188] Thermodynamics of f(R) Theories**

Presentador: JORÁS, Sergio (Universidade Federal do Rio de Janeiro – UFRJ)

This work starts from a toy model for inflation in a class of modified theories of gravity in the metric formalism. Instead of the standard procedure -- assuming a non-linear Lagrangian f(R) in the Jordan frame -- we start from a simple φ^2 potential in the Einstein frame and investigate the corresponding f(R) in the former picture. The addition of an ad-hoc Cosmological Constant in the Einstein frame leads to a thermodynamical interpretation of this physical system, which allows further insight on its (meta)stability and evolution.

Closing of the day (13:30-13:45)

Friday 11 September 2020

Waiting room (7:45-8:00)

DM, DE, GWs, BHs, GRAVITATION, GALAXIES, EROSITA: Live Plenary Talks (11 sept. 2020 8:00-12:30)

time	[id] title
8:00	**[78] Magnetic field effect on early universe events** *Presentador: PICCINELLI BOCCHI, Gabriella (Universidad Nacional Autónoma de México)* An outlook of different aspects of the incidence of magnetic fields on early universe events is presented. The events we will focus on include inflation and the electroweak phase transition. The guideline of the study is mainly the effect of the magnetic field on the effective potential of phase transitions and the decay process of the field leading the phase transition to other fields. We will consider both weak and strong magnetic field approximations, since this issue seems to make some important differences in the results. Besides presenting the results of our working group, we will also discuss other works that can be found in the literature.
8:30	**[77] A crucial test of the fermion dark matter constituency of our Galactic core from the geodesic motion of S2 and G2** *Presentador: RUEDA, Jorge (ICRANet)* The motion of the S stars around the Galactic center implies the existence of a central gravitational potential dominated by a compact source, Sagittarius A* (Sgr A*), with a mass of four million solar masses. Traditionally, it has been assumed that such a gravitational potential is produced by a supermassive black hole (SMBH) sitting at the center of our Galaxy. It is particularly important for this hypothesis, and for any alternative model, the explanation of the multiyear, accurate astrometric data of S2. With an orbital period of nearly 16 years, it is one of the closest stars to Sgr A*. The accuracy of the S2 data has allowed the GRAVITY Collaboration to recently verify the gravitational redshift of light predicted by general relativity Another important object is G2 whose most recent data challenges the SMBH scenario its post pericenter radial velocity is lower than the expectation from a Keplerian orbit around the putative SMBH. This scenario has been reconciled by introducing a drag force on G2 by an accretion flow. Alternatively, I discuss here the consistency of the "dense core diluted halo" fermionic dark matter (DM) profile, obtained from the general relativistic treatment of the Ruffini-Argüelles-Rueda (RAR) model, with the data of S2 and G2. It has been already shown that for a fermion mass in the range 48-345 keV, the RAR DM profile accurately fits the rotation curves of the Milky Way halo. It is here shown that, without invoking a central SMBH, the solely gravitational potential of such DM profile explains: 1) all the available data of the orbit and radial velocity of S2; 2) the general relativistic redshift measured in S2; 3) the currently available data on the orbit and radial velocity of G2 and 4) its deceleration after its pericenter passage, without introducing a drag force, hence a purely geodesic motion. All this for the same fermion mass of 56 keV. A DM core made of these fermions is expected to collapse into a BH if it gets a mass of about million solar masses, thereby providing formation scenario for the observed central SMBH in active galaxies such as M87.
9:00	**[80] News from Gravitational Waves Astronomy** *Presentador: ROSINSKA, Dorota (University of Zielona Gora)* Gravitational waves astrophysics is a new and promising field of research of the Universe. In contrast to the observations of the electromagnetic waves (radio waves, visible light, X rays and gamma), which are the main source of our current knowledge, we "listen" to the Universe by registering minor disturbances of the space time curvature using the LIGO and Virgo laser interferometric detectors. Gravitational waves are emitted during the largest cosmic cataclysms mergers of binary systems of neutron stars or black holes, explosions of supernovae, and by other sources, eg unstable or deformed rotating neutron stars. The direct detection of gravitational waves allows the study of objects that are dark (do not shine in electromagnetic waves), testing the theory of gravity in the dynamic regime of strong gravitational field, and the direct study of the interior of neutron stars which contain the densest and most extreme matter existing currently in the Universe. These information cannot be currently obtained using other methods. In this talk we present an overview about recent discoveries on this so promising field of research.
10:00	Conference break: Video synthesis of spotlight plenary talks
10:15	Spotlight Session 6
11:15	Conference break: Video synthesis of recorded talks

11:30 **[45] eROSITA observations of the Narrow-Line Seyfert 1 Galaxy 1H 0707-495: Discovery of an ultra-soft flaring X-ray light curve**

Presentador: BOLLER, Thomas (MPE Garching)

One of the most prominent AGNs, the ultrasoft Narrow-Line Seyfert 1 Galaxy 1H 0707-495, has been observed with eROSITA as one of the first CAL/PV observations on October 13, 2019 for about 60.000 seconds. 1H 0707-495 is a highly variable AGN, with a complex, steep X-ray spectrum, which has been the subject of intense study with XMM- Newton in the past. Large amplitude variability with a factor of more than 50 has been detected in the eROSITA light curve. The soft band is dominating the variability, while in the hard band the variability is much less extreme. No significant variability has been detected in the UV in the XMM-Newton OM observations, indicating that the primary source for the soft X-ray variability is the soft X-ray excess itself, originating from the innermost regions around the central black hole. 1H 0707-495 entered the lowest hard flux state of all 20 years of XMM-Newton observations. In the eRASS1 observations taken in April 2020 the X-ray light curve is still ultrasoft, with an increase in soft and hard band count rates going back to previously observed flux states. A changing partial coverer spectral model with relativistic reflection provides a physical interpretation which is also in agreement with the observed light curve.

DM, DE, GWs, BHs, GRAVITATION, GALAXIES, QCD, LIFE, GRBs, COSMOLOGY, OA, KT: Parallel Session Discussions (11 sept. 2020 12:30-13:33)

time [id] title

12:30 **[178] 21 cm cosmology and the BINGO radio telescope**

Presentador: WUENSCHE, Carlos Alexandre (National Institute for Space Research – INPE)

Cosmology in the XXI century is experiencing a "Golden Age", with observations and theoretical models contributing to a large-scale description of the Universe. The current view is that it can be well described by the so-called Lambda-CDM model, but some open problems challenge physics and cosmology, including the origin and properties of so-called dark energy. The so-called baryonic acoustic oscillations (BAO), detected for the first time in 2005, are considered one of the most effective probes to understand the properties of dark energy. However, given the implications of these measurements, it is important that they are confirmed at other wavelengths and measured over a wide range of redshifts. The radio band provides a unique and complementary observation window, by emitting 21 cm of neutral hydrogen. The redshifted 21 cm (1420 MHz) emission of the hyperfine transition of neutral hydrogen is measured at lower frequencies, so that the observation frequency is converted directly into information about the source's redshift. The BINGO radio telescope (BAO from Integrated Neutral Gas Observations) is a new instrument, designed specifically to observe BAO, mapping a redshift band between 0.13 and 0.45. This seminar will present the basics of 21 cm BAO cosmology, the intensity mapping technique used and describe the current development status of the BINGO radio telescope.

12:37 **[109] Accretion-induced collapse to third family compact stars as trigger for eccentric orbits of millisecond pulsars in binaries**

Presentador: ALVAREZ CASTILLO, David Edwin (JINR)

A numerical rotating neutron star solver is used to study the temporal evolution of accreting neutron stars using a multi-polytrope model for the nuclear equation of state named ACB5. The solver is based on a quadrupole expansion of the metric, but confirms the results of previous works, revealing the possibility of an abrupt transition of a neutron star from a purely hadronic branch to a third-family branch of stable hybrid stars, passing through an unstable intermediate branch. The accretion is described through a sequence of stationary rotating {stellar} configurations which lose angular momentum through magnetic dipole emission while, at the same time, gaining angular momentum through mass accretion. The model has several free parameters which are inferred from observations. The mass accretion scenario is studied in dependence on the effectiveness of angular momentum transfer which determines at which spin frequency the neutron star will become unstable against gravitational collapse to the corresponding hybrid star on the stable third-family branch. It is conceivable that the neutrino burst which accompanies the deconfinement transition may trigger a pulsar kick which results in the eccentric orbit. A consequence of the present model is the prediction of a correlation between the spin frequency of the millisecond pulsar in the eccentric orbit and its mass at birth.

12:44 **[186] The magnetized photon: properties and astrophysical applications**

Presentador: RODRIGUEZ QUERTS, Elizabeth (Instituto de Cibernética, Matemática y Física – ICIMAF)

We study the properties of photon propagation both in QED vacuum and medium, taking into account radiative corrections, in an external magnetic field. We explore possible applications of the results in an astrophysical context.

12:51 **[174] Hybrid star with non interacting dark matter fermion core**

Presentador: KÖPP, Fábio (Universidade Federal do Rio Grande do Sul – UFRGS)

In this work we study the influences of the dark matter fermion mass on the structure of the hybrid star. We fixed the Fermi momentum of dark matter and considered the mass of dark matter from 0.1 GeV to 100 GeV, since the mass of dark matter is more uncertain than its density approximation related to ordinary matter. Further, we used the Maxwell construction to make the phase transition between DD2 EoS and vMIT EoS. The implementation of DM is made in a simple way, i.e. considering it as a fermion with mass M_x without interactions. Finally, we compared our results with the latest observed masses > $2M_\odot$ and similar approaches considering interactions in the current literature.

12:58 **[194] Study of diffractive gluon jet production in electron-ion collisions**

Presentador: PECCINI, Guilherme (Universidade Federal do Rio Grande do Sul – UFRGS)

In this work we investigate the diffractive gluon jet production in electron-ion collisions at the energies of the EIC, LHeC, HE-LHeC and FCC-eA, assuming that the diffractive mass is much larger than the photon virtuality. In addition, we apply a model inspired in the GBW parametrization to describe the dipole amplitude, showing that the diffractive cross section is highly sensitive to the saturation scale. Furthermore, we verify that it is possible to extract this scale from the experiment.

13:05 **[192] Hawking-Bekenstein temperature and entropy from uncertainty principle**

Presentador: PÉREZ ROJAS, Hugo (Instituto de Cibernética, Matemática y Física – ICIMAF)

We give an alternative way for deducing the Hawking-Bekenstein black hole temperature and entropy by using the Heisenberg uncertainty principle. We consider as known the black hole mass as M and consequently its energy. Quantities as temperature T and entropy S can be found under the hypothesis that incoming radiation and matter leads to a thermodynamic equilibrium state. Obviously this is not seen by an external observer, who may know only the horizon temperature T´. The results are obtained theoretically, by using the convergence of general relativity, thermodynamics and quantum mechanics. We start by assuming small black holes, although the resulting equations have a more general validity. It can be shown that reciprocally, starting from the Hawking-Bekenstein temperature, uncertainty relation equations can be obtained. Examples are given for small and large blackhole masses.

13:12 **[196] Axial ring down modes in General Relativity and in its pseudo-complex extension**

Presentador: HESS, Peter (National Autonomous University of Mexico - UNAM)

We calculate the axial ring-down frequencies of the merger of two black holes, using a modified version of the pseudo-complex General Relativity (pc-GR) and comparing it with the standard General Relativity (GR).

13:19 **[193] Modeling Dark Matter Halos With Nonlinear Field Theories**

Presentador: RIBEIRO DA SILVA MORAES, Pedro Henrique (Instituto de Astronomia, Geofísica e Ciências Atmosféricas – IAG, Universidade de São Paulo – USP)

In the present work we show that it is possible to model galactic dark matter from nonlinear scalar field theories coupled to the gravity sector. In order to obtain analytical solutions for the scalar fields we consider a spherically symmetric space-time. We also assume a theoretical framework where dark matter consists of a complex scalar field, which is responsible for producing galactic halos through Bose condensation coupled to gravity. The developed approach is able to predict a good theoretical fit for the rotation curves in both dwarf and low surface brightness late-type galaxies.

13:26 **[175] The Physics of twin stars**

Presentador: OLIVEIRA GOMES, Rosana (Frankfurt Insitute for Advanced Studies)

In this contribution, we investigate the possibility of a third family of compact stars under different scenarios. First, we will focus on the microscopic description of stars and discuss how different properties of matter can influence the rising of twin stars. For doing so, we carry out an analysis of different parameters used to describe hadronic and quark matter with relativistic mean field models. Next, we discuss how macroscopic properties of stars, such as magnetic fields and rotation can also play a role in the creation and elimination of twin stars scenarios. Finally, we briefly present results for cooling of such stars, highlighting its importance as another observable for identifying third families scenarios.

Closing of the day (13:33-13:40)

Saturday 12 September 2020

Waiting room (7:45-8:00)

DENSE MATTER, SNOVAE, DM, COMPACT STARS, DE, BHs, COSMOLOGY: Live Plenary Talks (12 sept. 2020 8:00-12:30)

time	[id] title
8:00	**[39] Near-horizon structure of escape zones of electrically charged particles around weakly magnetized rotating black hole: case of oblique magnetosphere** *Presentador: KARAS, Vladimir (Astronomical Institute, Czech Academy of Sciences)* We study the effects of large scale magnetic field on the dynamics of charged particles near a rotating black hole. We consider a scenario in which the initially neutral particles on geodesic orbits in the equatorial plane are destabilized by a charging process. Fraction of charged particles are then accelerated out of the equatorial plane and then follow jet-like trajectories with relativistic velocities. We explore non-axisymmetric systems in which the magnetic field is inclined with respect to the black hole spin. We study the system numerically in order to locate the zones of escaping trajectories and compute the terminal escape velocity. By breaking the axial symmetry we notice increasing fraction of unbound orbits which allow for acceleration to ultrarelativistic velocities.
8:30	**[73] Three flavors in a triangle** *Presentador: XU, Renxin (School of Physics, Peking University)* As for strong condensed matter, normal nuclei are 2-flavored (u, d), but what if matter is squeezed so great that nuclei come in close contact to form giant strong matter? The latter could be 3-flavored (u, d, s) because of leptonic asymmetry (i.e., electron and positron), since both the strong and the weak interactions play an important role there. Therefore, one should focus on three flavors to discuss the nature of strong matter, both small and giant, taking advantage of a triangle diagram as explained this presentation.
9:00	**[85] Deconfinement Phase Transition in Neutron-Star Mergers** *Presentador: DEXHEIMER, Veronica (Kent State University)* We study in detail the nuclear aspects of a neutron-star merger in which deconfinement to quark matter takes place. For this purpose, we make use of the Chiral Mean Field (CMF) model, an effective relativistic model that includes self-consistent chiral symmetry restoration and deconfinement to quark matter and, for this reason, predicts the existence of different degrees of freedom depending on the local density/chemical potential and temperature. We then use the out-of-chemical-equilibrium finite-temperature CMF equation of state in full general-relativistic simulations to analyze which regions of different QCD phase diagrams are probed and which conditions, such as strangeness and entropy, are generated when a strong first-order phase transition appears. We also investigate the amount of electrons present in different stages of the merger and discuss how far from chemical equilibrium they can be.
9:30	**[86] Unraveling the Universe with spectroscopic surveys: Final results of eBOSS, present and future with DESI** *Presentador: VARGAS MAGAÑA, Mariana (Instituto de Física UNAM)* One of the most important open questions in cosmology today is the understanding of the accelerated expansion of the Universe. Spectroscopic surveys provided a unique opportunity to explore the expansion history of the Universe as well as to measure the growth of structure through the analysis of the large-scale structure in the Universe. Cosmic Acceleration can be explained by either modifying General Relativity on cosmological scales, or within the framework of the standard cosmological model introducing an unknown new component called “dark energy”. During the last 2 decades, SDSS have been operating a succession of spectroscopic surveys: SDSS, BOSS and eBOSS, all of them driven by the same science goal of decrypting the mysterious cosmic expansion. Just after eBOSS finishes its program, the next generation stage IV ground-based dark energy experiment, Dark Energy Spectroscopic Instrument (DESI) will start their science operations for 5 years. DESI will revolutionize dark energy constraints improving the precision by at least one order of magnitude current stage III experiments. In this talk I will present the final analysis of eBOSS and their cosmological results released this summer that represents a culmination of 20 years of clustering analysis with spectroscopic surveys in SDSS. I will also review the DESI dark energy experiment that had turn of the first light in Fall 2019, carry on their commissioning program and started the survey validation programs this year, both programs preceding the science survey programmed to start next year 2021. I will review DESI instrument, the current status and a summary of the forecast for the key observables of the survey (BAO and RSD).
10:00	Conference break: Video synthesis of spotlight plenary talks

10:15	**[87] Neutron star origins and masses** *Presentador: HORVATH, Jorge (IAG-USP)* We present a brief general view of the issue of neutrons star births and current masses. We argue that there are reasons to expect very massive objects in Nature, in particular those in "spider" binary systems that undergo very long accretion histories. A maximum value of 2.5 M_{max} is obtained directly from the observed mass distribution using a simple Bayesian analysis. This is consistent with the recent report of a very asymmetric GW 190814 smallest component, which may be the heaviest neutron star ever detected. If so, the dense matter equation of state will be challenged to be stiff enough to explain these masses.
10:45	Marcos Moshinsky Award
11:15	Conference break: Video synthesis of recorded talks
11:30	**[88] A Review on Algebraic Extensions in General Relativity** *Presentador: HESS, Peter (Universidad Nacional Autónoma de México)* A brief review on algebraic extensions of General Relativity will be given. After a short summary of first attempts by Max Born and Albert Einstein, all possible algebraic extensions will be discussed, with the pseudo-complex extension left as the only viable one, because it does not contain ghost solutions. Some predictions of the pseudo-complex extension are given.

Final closing (12:30-12:45)