Gravitational Physics and Astronomy 2022

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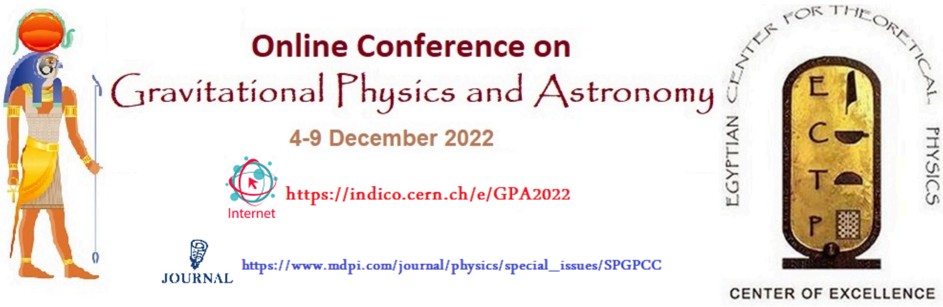

Book of Abstracts

Contents

1

Gravitational slip parameter and Gravitational Waves in Modified Gravity theories

Authors: Maryam Ranjbar[1]; Siamak Akhshabi[2]

[1] *Master's student at Golestan University, Iran.*

[2] *Assistant professor at Golestan University*

Corresponding Author: m.ranjbar98@stu.gu.ac.ir

Despite the discovery of late-time accelerated expansion of the universe, we still have no clue about the physics behind that. Therefore, the answer might be lied in Modified Gravity theories. A modification in geometric structure of space-time causes noticeable differences in gravitational waves equation compared to the known form of gravitational waves in general relativity.
Various gravity theories have two general phenomenological effects at the level of linear and scalar perturbation:
1. A modification of the strength of gravity at large scales
2. An alteration of the weak gravitational lensing effect
Measurement of the two aforementioned effects allows us to obtain gravitational slip parameter η; which is the ratio of two scalar gravitational potentials $\eta=\Phi/\Psi$.
The existence of gravitational slip parameter ($\eta\neq1$) in the presence of perfect fluid matter is a clue of a modification in gravity. In addition, this parameter is a model independent quantity which distinguishes the groups of gravity models. In this research, we study the gravitational slip parameter and gravitational waves equation in the context of theories including torsion, such as Einstein-Cartan theory.

2

Superfluids and local gravitational field

Author: ANTONIO GALLERATI[1]

[1] *Polytechnic of Turin, DISAT Department, Italy*

Corresponding Author: antonio.gallerati@polito.it

We discuss the possible coupling between a superfluid and the local gravitational field. After introducing a quantum-gravity theoretical framework to describe the supercondensate-graviton coupling, we exploit an effective theory for generalized Maxwell-type fields to analyze quantum effects originating from the proposed interplay.

From an experimental point of view, it had been shown that generalized electric-type fields can be induced in (super)conductors by the presence of the Earth's weak gravitational field. These observations led to the theoretical, formal introduction of an effective modified electric-type field, determining detectable corrections to the free fall of charged particles.
The above remarkable experimental results can be combined to the theoretical weak-field gravity formulation, leading to a more general definition of new, generalized electromagnetic fields. The latter feature a component defined in terms of the weak gravitational perturbations, and satisfy a specific set of equations that can be put in a form closely analogous to Maxwell's equations.
The latter symmetry is then exploited to analyse the gravity/supercondensate interplay, the new generalized fields being involved in quantum effects originating from the interaction with the weak gravitational background (in analogy to what happens for gravity-induced electric fields in superconductors).
In particular, the emerging formal symmetry allows to use the Ginzburg–Landau model for the description of the physics, resulting in a mean-field theory for the system's thermodynamics, including the effects of thermal fluctuations. We then quantitatively analyse how the local gravitational field

could couple to the superfluid condensate in a superconductor, making use of the time-dependent Ginzburg–Landau equations in the regime of fluctuations.

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3

Two-body freefall time in a matter dominant expanding universe

Author: Sean Xu[None]

Corresponding Author: sx4776@gmail.com

Predicting freefall time is a major problem in galactic dynamics. The relaxation time of collisionless dark matter, which heavily influences galaxy evolution, is closely related to its freefall time. Calculating freefall time using Kepler's Third Law does not consider the effects of the universe's expansion. This paper proposes a new formula for calculating freefall time in an expanding background. The derivation of the formula starts from the governing equations of an N-body system in an expanding background. Two-body simulations were run using equations of motion with constant damping (to represent the effects of expansion) derived from the N-body equations. More than 5,200 different two-body systems with different separation distances, mass, and damping were simulated. The simulated freefall time was compared with good agreement against the proposed formula. The results demonstrate that two-body freefall time is dependent on the time at which collapse began. The earlier it began, the longer the freefall time. A weak gravitational attraction, caused by the small mass of the system or the great distances involved, exacerbates this effect. The galaxy that started to form earlier is expected to take longer to form. A better understanding of freefall time can lead to greater insight into galaxies'historical and future evolution.

4

The informational physical model and fundamental physical problems

Author: Sergey Shevchenko[1]

[1] *Institute of Physics of NAS of Ukraine, ret., now independent researcher*

Corresponding Author: sshev2g@gmail.com

This article is some review of results that were obtained at 2007-2021 years development of "The Information as Absolute"concept and the informational physical model, which is based on the concept; including a number of fundamental physical problems are briefly considered in framework of the conception and the model. Recently in physics there are several publications, that present lists of the problems. However, those lists are essentially incomplete, for at least two reasons. Firsts of all, a number of phenomena are studied traditionally by philosophy, and so corresponding problems are usually considered to be "metaphysical". However, they relate also to some concrete physical phenomena. For example, physics evidently studies Matter, and so the metaphysical problems "what is ontology of Matter", "what is "Space", "Time"and a few other physical phenomena and notions as well, are really a Meta-physical problem "what does physics study?"There are other fundamental physical problems, which are not considered as such in physics, and are absent in the "fundamental problems lists". Those include the problems, which really exist, yet are incorporated into standard physical theories, and so are fundamental "implicitly", which in physics are "solved by default". Note, though, that a number of "Meta-physical", and concrete fundamental, problems more in detail are considered in the paper "The Informational Conception and Basic

Physics", https://arxiv.org/abs/0707.4657 , v5 (2021), so this paper is, in certain sense, an expanded conclusion of this paper, which includes, correspondingly, more in detail consideration of some more general physical problems. Besides, the concrete problem "What is Life", and the rational cosmological model, where a few vague points in standard cosmology rather probably are rationally clarified, while the fundamental problem "matter –antimatter asymmetry"in Matter is solved practically for sure, are considered, and one of recently published rather complete "lists of fundamental problems" is commented in Appendix.

5

Eikonal quasinormal modes and photon orbits of deformed Schwarzschild black holes

Author: Che-Yu Chen[1]

[1] *Institute of Physics, Academia Sinica*

Corresponding Author: b97202056@gmail.com

The geometric optics approximation provides an interpretation for eikonal correspondence that, in black-hole-containing spacetimes, connects high-frequency black hole quasinormal modes with closed photon orbits around said black hole. This correspondence has been identified explicitly for several GR black holes, violation of which can be a potential hint toward physics beyond GR. However, the identification of the correspondence seems largely relies on specific symmetries of the spacetimes that correspond to the separability of equations. One naturally asks how the eikonal correspondence would appear if the spacetime is less symmetric. In this talk, we consider a deformed Schwarzschild spacetime retaining only axisymmetry and stationarity. We show that up to the first order of spacetime deformations, the eikonal correspondence manifests through the definition of the averaged radius of trapped photon orbits along their one period. This averaged radius overlaps the potential peak in the master wave equation, which can be defined up to the first order of spacetime deformations, allowing the explicit identification of the eikonal correspondence. The talk is based on arXiv:2205.02433.

6

The Gravitational Memory Effect

Author: DEESHANI MITRA[1]

[1] *St Xavier's College(Autonomous),Kolkata*

Corresponding Author: deeshani1997@gmail.com

In this dissertation we intend to study the background related to the memory effect that leads to "gravitational-wave memory effect" and two types of memory effect:(1) We intend to study a whole outline of what is memory effect.(2) We intend to solve the linear memory for N Gravitationally Unbound Particles where we will study different kinds of spherical harmonics,mass quadrapole leading to linear memory effect.\begin{equation}
\boxed{ {\Delta{h^{TT}*{jk}}}=\triangle{{\sum*{A=1}^{N}}}{\frac{4M_{A}}{r{\sqrt{1-v^{2}*{A}}}}[\frac{v^{j}*{A}v^{k}*{A}}{1-{{v*{A}.N}}}]^{TT}}}
\end{equation}(3)Then we try to examine the memory effect for the individual radiated neutrinos\cite{mukhopadhyay2021memo
\begin{equation}
{h^{xx}*{TT}}={h(r,t)}={\frac{2G}{rc^{4}}{\int^{t-r/c}*{{-\infty}}}dt'L_{\nu}(t')}{\alpha(t')}
\end{equation}
(4) Then we will discuss briefly about the introduction of non linear memory effect.

7

Energy spectrum for elementary particles

Author: Boyu Chen[1]

[1] *HsinChu Science Part*

Corresponding Author: boypatrick.tw@gmail.com

This is an unified theory by using an energy model to explain mass, called the energy spectrum. To explain this theory, a multidimensional concept will be projected on plots. The energy spectrum model can explain from quantum level to universe level physic behaviors.

8

The Gravitational Memory Effect

Author: DEESHANI MITRA[1]

[1] *St Xavier's College(Autonomous),Kolkata*

Corresponding Author: deeshani1997@gmail.com

In this dissertation we intend to study the background related to the memory effect that leads to "gravitational-wave memory effect" and two types of memory effect:(1) We intend to study a whole outline of what is memory effect.(2) We intend to solve the linear memory for N Gravitationally Unbound Particles where we will study different kinds of spherical harmonics,mass quadrapole leading to linear memory effect.

$\Delta h_{jk}^{TT} = \triangle\sum_{A=1}^{N}\frac{4M_A}{r\sqrt{1-v_A^2}}[\frac{v_A^j v_A^k}{1-v_A.N}]^{TT}$

(3)Then we try to examine the memory effect for the individual radiated neutrinos
citemukhopadhyay2021memory h$_{TT}^{xx} = h(r,t) = \frac{2G}{rc^4}\int_{-\infty}^{t-r/c} dt' L_\nu(t')\alpha(t'), wherecisthespeedoflight, tisthetimep$
is the all-flavors neutrino luminosity α is the time-varying anisotropy parameter as mentioned in \cite{mukhopadhyay2021neutrino}
(4) Then we will discuss briefly about the introduction of non linear memory effect.

9

Gravitational entropy, cosmology and black holes

Author: Vaibhav Kalvakota[None]

Corresponding Author: vaibhavkalvakota@icloud.com

The Weyl curvature hypothesis by Penrose describes the evolution of the universe according to the second law of thermodynamics using a form of gravitational entropy, described by the Weyl curvature tensor. Using this, the evolution of the universe is guided by a monotonically increasing Weyl curvature, and the proposal has several conditions, one of them being that the gravitational entropy reduces to the Hawking-Bekenstein entropy for black holes. In this talk, we will discuss some of the aspects of this proposal, formalisms and their structure wihh to respect to cosmology and black holes.

10

Scalar Particles Creation by an External Electric Field in a Non-Commutative Space-time

Author: Hadjar Rezki[None]

Co-author: Slimane Zaim [1]

[1] *Department of Physics, Faculty of Material Sciences, University of Batna 1*

Corresponding Author: h.rezki94@gmail.com

The phenomenon of scalar particles creation in a non-commutative space-time when an electric field is present, is analyzed. Our purpose is to study the effect of the electric field on the creation of particles from vacuum. We have used the Bogoliubov transformation technique to calculate the number density of the spin-0 created particles in a non-commutative space-time , it is necessary to specify the asymptotic behavior of "in "and "out "vacuum states. This method based on the exact mode functions.
According to the formalism of Klein-Gordon equation in non-commutative space-time, We investigated the mechanism of particles production from the solutions which are in terms of special functions. The results have been interpreted.
The obtained results confirm the fact that particle creation is a property of curved space-time, Our aim in the future is to study the process of Dirac particles creation in non-commutative spaces.

11

The detection of gravitational waves new approach

Author: Sarra Garah[1]

Co-author: Hadjer Rezki [2]

[1] *Faculty of exact sciences, university of tebessa*

[2] *Laboratoire de Physique des Rayonnements et de leurs Intéractions avec la Matière*

Corresponding Author: gareh64@gmail.com

The gravitational waves appear as wave solution for the Einstein's equations of General Relativity. They were predicted by Einstein in 1916. These ripples of space time are generated by the punctual acceleration of matter in the Universe. The existence of gravitational waves was confirmed by the study of the Binary Pulsar PSR 1913+16 in 1980s. The first experimental discovery was on September 14, 2015, by the collaboration LIGO-Virgo, staging the fusion of two black holes. After a theoretical and historical description of the actual scientific research, we will propose a new detection method that is based on the presence of an electromagnetic field via several examples of applications.

12

The Informal Spread of Light Around Nebula

Author: Suryansh Saxena[None]

Co-author: Nishant Yadav

Corresponding Authors: astrosury@gmail.com, ynishant762@gmail.com

This research paper is about the informal (symmetric/asymmetric) distribution of light around nebulas, which also provides us a brief on how and on what factors the shape of the structure depends

upon. This research work is conducted by observing and using different image sets as well as sonification of the observed images to get a better and concrete result for the research work. At the end of the research, we will observe the reasons for several types of nebulae to be asymmetric or symmetric.

13

Three characteristic relations of a simple model of quantum cosmology

Author: Satya Seshavatharam Utpala Venkata[None]

Co-author: Lakshminarayana S [1]

[1] *Andhra University, Visakhapatnam-03,AP, India*

Corresponding Author: seshavatharam.uvs@gmail.com

We propose three characteristic relations in developing a simple model of quantum cosmology. We assure the reader that by studying and analyzing them, Lambda cosmology can be refined with ease and clarity.
Relation-1: Galactic light travel distances can be fitted with, $d_G \cong \left(\frac{z}{1+z}\right)\left(\frac{c}{H_0}\right)$.
Relation-2: Relation between current cosmic temperature and Hubble parameter can be expressed as, $T_0 \cong \frac{\hbar c^3}{8\pi k_B G\sqrt{M_0 M_{pl}}} \cong \frac{\hbar\sqrt{H_0 H_{pl}}}{4\pi K_B}$ where $\frac{2GM_0}{c^2} \cong \frac{c}{H_0}$, $M_{pl} \cong \sqrt{\frac{\hbar c}{G}}$ and $H_{pl} \cong \frac{1}{2}\sqrt{\frac{c^5}{G\hbar}}$.
Relation-3: For any galaxy, virtual dark matter can be estimated as, $(M_{dark})_G \cong \left[\frac{(M_{baryon})_G^{\frac{3}{2}}}{(4.0\times 10^{38})^{\frac{1}{2}}}\right]$ kg where 4.0×10^{38}kg $\cong$ 200Million solar masses can be called as the 'current dark matter reference mass unit'.

14

The tunneling wavefunction in Kantowski-Sachs quantum cosmology

Authors: Alexander Vilenkin[1]; George Fanaras[None]

[1] *Tufts University*

Corresponding Author: georgios.fanaras@tufts.edu

We use a path-integral approach to study the tunneling wave function in quantum cosmology with spatial topology S1×S2 and positive cosmological constant (the Kantowski-Sachs model). If the initial scale factors of both S1 and S2 are set equal to zero, the wave function describes (semiclassically) a universe originating at a singularity. This may be interpreted as indicating that an S1×S2 universe cannot nucleate out of nothing in a non-singular way. Here we explore an alternative suggestion by Halliwell and Louko that creation from nothing corresponds in this model to setting the initial volume to zero. We find that the only acceptable version of this proposal is to fix the radius of S1 to zero, supplementing this with the condition of smooth closure (absence of a conical singularity). The resulting wave function predicts an inflating universe of high anisotropy, which however becomes locally isotropic at late times. Unlike the de Sitter model, the total nucleation probability is not exponentially suppressed, unless a Gauss-Bonnet term is added to the action.

15

Estimation of distances associated with galactic flat rotation speeds

Author: Satya Seshavatharam Utpala Venkata[1]

Co-author: Lakshminarayana S [2]

[1] *I-SERVE, Survey no-42, Hitech city, Hyderabad-84,Telangana, India*

[2] *Andhra University, Visakhapatnam-03,AP, India*

Corresponding Author: seshavatharam.uvs@gmail.com

We are proposing a very simple formula for estimating galactic distances associated with flat rotation speeds. Our basic idea is that, as galactic total mass increases, galactic flat rotation speed as well as the distance associated with flat rotation speed increases. Galactic total mass can be considered as the sum of galactic baryonic mass and dark mass. Galactic core radius seems to depend on galactic baryon mass, current cosmic Hubble mass and the ratio of galactic baryon mass to total mass. Similarly, galactic flat rotation distance seems to depend on galactic total mass, current cosmic Hubble mass and the ratio of galactic baryon mass to total mass. Galactic baryon mass plays a vital role in understanding and estimating the galactic dark mass. In this study, (180 to 200) million solar masses can be considered as an upper limit of ordinary gravity. Ratio of current cosmic Hubble mass to 180 million solar masses seems to be equal to the exponential of ratio of current Hubble radius to current baryon acoustic bubble radius.

16

Simplified views of 4G Model of final unification

Author: Satya Seshavatharam Utpala Venkata[None]

Co-author: Lakshminarayana S

Corresponding Author: seshavatharam.uvs@gmail.com

Recently we have proposed a mechanism for understanding the nuclear structure based on three large gravitational constants assumed to be associated with weak, strong and electromagnetic interactions. Considering the Newtonian gravitational constant as the forth gravitational constant, we call our model as 4G model of unification. Interesting points to be noted are, 1) Weak interaction seems to be mediated by a fermion of rest energy $M_w c^2 \cong 584.725$ GeV. 2) Weak gravity seems to play a crucial role in understanding quantum phenomena with a relation of the form, $\hbar c \cong G_w M_w^2$ where G_w is the weak gravitational constant. 3) There exists a nuclear charge e_w in such a way that, $e \cong \left(\frac{G_w M_w^2}{G_n m_p^2}\right) e_n \cong \frac{1}{3} e_n$ where G_n and m_p are the nuclear gravitational constant and proton rest mass respectively. Based on this kind of approach, we noticed that, 1) Strong nuclear charge is having a crucial role in understanding proton structure, nuclear structure and quark structure. 2) Weak interaction is having a crucial role in understanding nuclear stability and binding energy. In this context, we review the basics of nuclear and atomic physics.

17

Fitting the currently accepted cosmic time scale for (1+z)=1100 with light speed expanding Hubble-Hawking Cosmology

Author: Satya Seshavatharam Utpala Venkata[None]

Co-author: Lakshminarayana S

Corresponding Author: seshavatharam.uvs@gmail.com

In our recently proposed papers, we have proposed new concepts and results pertaining to a very simple and practical model of quantum cosmology based on light speed expanding black hole universe having no dark matter and no dark energy. Our model can be called as Hubble-Hawking Cosmology. Big bang concept can be replaced with Plank scale. Cosmic temperature and expansion rate can be related with scaled Hawking's Black hole temperature formula. Starting from cosmic center to cosmic boundary, a decreasing trend of galactic acceleration can be understood with continuous light speed expansion at cosmic boundary. Issue of 'causal disconnection of galaxies at large scale distances' can be eliminated by cosmic black hole physical concepts. Dark matter concept can be eliminated with 'super gravity of galactic baryonic mass caused by weak interaction'. Cosmic inflation and dark energy concepts can be eliminated with 'light speed expansion'. To fit the estimated light travel distances and to eliminate the dark energy, cosmic red shift can be redefined as the ratio of change in photon wavelength to observed photon wavelength. In this contribution, up to $(1+z) \cong 1100$ with a great accuracy, $t \cong \left(\frac{1}{1+z}\right)^{\frac{3}{2}} \frac{1}{H_0} \cong \frac{\sqrt{1+z}}{H_t} \cong \frac{[(\exp(\gamma_0-\gamma_t)]^{\frac{1}{4}}}{H_t}$ where $\frac{H_t}{H_0} \cong \left(\frac{T_t}{T_0}\right)^2 \cong (1+z)^2$, $H_{pl} \cong \frac{1}{2}\sqrt{\frac{c^5}{G\hbar}}, \gamma_t \cong 1 + ln\left(\frac{H_{pl}}{H_t}\right)$, $\gamma_0 \cong 1 + ln\left(\frac{H_{pl}}{H_0}\right)$, $T_t \cong \frac{\hbar c^3}{8\pi k_B G\sqrt{M_t M_{pl}}} \cong \frac{\hbar\sqrt{H_t H_{pl}}}{4\pi k_B}$, $M_{pl} \cong \frac{c^3}{2GH_{pl}} \cong \sqrt{\frac{\hbar c}{G}}$ and $M_t \cong \frac{c^3}{2GH_t}$. It needs further study.

18

Dark matter and Gravitational Effects

Author: Swapnil Singh[None]

Corresponding Author: swapnilsingh018@outlook.com

List item

`**Dark matter and Gravitational Effects**`

Author: Swapnil K Singh
BMS College of Engineering, Bull Temple Rd, Basavanagudi, Bengaluru, Karnataka, India 560019
(Email ID: swapnil.me21@bmsce.ac.in)

The nature of dark matter (DM) is currently one of the most intriguing questions of fundamental physics. Yet, its existence is still debated, and relies on the observations of gravitational effects in large-scale structures and in cosmology. One of the most striking types of evidence of unexpected gravitational effects come from galaxies, and in particular spiral galaxies. In spiral galaxies, most of the visible mass is gathered in the budge and the disc. Using the Gauss'theorem, the velocity of stars v at the distance R from the galactic centre reads
v(R)=√((GM(R))/R)
As a consequence, the velocity is expected to decrease as v(R) ∝ Rˆ(1/2) most of spiral galaxies however the observed velocity far from the centre is approximately constant.
The most striking cases are the ones of strong gravitational lensing of distant galaxies behind a galaxy cluster, which appear under the form of several distorted images spread on the so-called Einstein circle. The angular radius of the Einstein circle is related to the mass which gave rise to light deflection through the formula.
∅_E= √(4GM/cˆ2 ((D_s-D_l))/(D_s D_L))

Gravitational lensing is therefore often used to weigh galaxy clusters, and numerous studies are consistent and tend to demonstrate that the visible mass represents only 10-20% of the total mass, similarly to the commonly found result in galaxies.

In the early universe when Matter starts gathering via gravitational collapse in the denser regions, forming large-scale structures in which galaxies also emerge. Two main effects which affected the structure formations are gravitational interaction attracts matter in the centres of masses, and the expansion of the Universe drives structures away from each other. the interplay between expansion and gravity and study the role of dark matter in this process is very important. Thus, there are various computer simulations which we run to visualise the formation of the universe. The standard cosmological model ΛCDM shows a remarkable agreement with all the observations from disparate scales. Finally, the combined results of are consistent with the large-scale structure data, and reveal that the ratio of baryonic mass over total matter mass is close to 15%, which is in agreement with the results at galaxy and galaxy cluster scales.

19

Various cosmological distances in Hubble-Hawking universe

Author: Satya Seshavatharam Utpala Venkata[None]

Co-author: Lakshminarayana S

Corresponding Author: seshavatharam.uvs@gmail.com

With reference to our recently proposed light speed expanding Hubble-Hawking universe, in this contribution, up to $(z+1) \cong 1100$, with a marginal error, we make an attempt to fit light travel distances, comoving distances and luminosity distances with very simple relations. Key point to be understood is that, red shift can also be defined as the ratio of increase in photon wavelength to observed photon wave length. Mathematically, if $z_{new} \cong \frac{\lambda_{Observed}-\lambda_{Lab}}{\lambda_{Observed}} \cong \frac{z}{1+z}$, Light Travel Distance can be approximated with, $LTD \cong z_{new}\left(\frac{c}{H_0}\right)$, Comoving Distance can be approximated with, $CD \cong exp\left(z_{new}\right)LTD$, and Luminosity Distance can be approximated with,$LD \cong \frac{CD}{1-z_{new}}$. With further research, Lambda cosmology and Hubble-Hawking cosmology can be studied in a unified manner.

20

Discrete Relativity

Author: Frederic Lassiaille[None]

Co-author: frederic lassiaille

Corresponding Author: fichoto@hotmail.fr

In General Relativity (GR) Einstein equation is constructed from GR lagrangian under an implicit assumption. It is that in regular matter, energy of particles in motion can be completely discarded. This appears when the opposite assumption is tried and when its consequences in GR are studied. This study is lead by a macroscopic approximation given by a new equation called "Discrete Relativity equation". An unexpected consequence is that strong theoretical arguments exist for replacement of today's assumption by the new one. The most important consequence is that the "surrounding effect", which is the central concept of a previous work, is in the inner part of this new GR. But in most of the cases the 2 assumptions predictions are the same. And GR lagrangian in vacuum remains a fundamental equation common to the 2 assumptions. A direct result is that a surrounding effect arises in gravitation and this gives an explanation to the gravitational issues of today. And under a second assumption which is a unifying one, it explains also the Millenium Yang-Mills problem.

21

The History of The Cosmos; From The Big-Bang to The Present-Epoch

Author: Riccardo Storti[None]

Corresponding Author: zordan@ozemail.com.au

In 2007, Storti predicted that the value of the Cosmic Microwave Background Radiation (CMBR) Temperature may be improved by one-order-of-magnitude; from the Particle Data Group (PDG) value of [T0 = 2.725 ± 0.001 (K)] to [T0 = 2.7254 (K)]. In 2011, the PDG revised their value of CMBR to [T0 = 2.7255 ± 0006 (K)]; confirming Storti's prediction. In 2008, Storti predicted a ΛCDM Hubble Constant of [H0 = 67.0843 (km/s/Mpc)]. In the same year, the PDG published their value as being [H0 = 73 ± 3 (km/s/Mpc)]. In 2013 the PDG published a revised value of [H0] distributed via the Planck Collaboration (PC) utilising the Planck Satellite (PS) as being considerably lower [H0 = 67.3 ± 1.2 (km/s/Mpc)]; again confirming Storti's prediction. These predictions & experimental confirmations, in particular the value of [H0] being successfully predicted five (5) years in advance of the PC & without PS instrumentation, demonstrates the power of the technique applied; i.e. the Electro-Gravi-Magnetic (EGM) Photon Radiation Method (PRM). Herein, we utilise the EGM-PRM technique {constrained by the present value of CMBR [T0 = 2.7255 (K)]} to calculate the present values of: (i) the ΛCDM Hubble Constant [H0 = 67.1181447977434 (km/s/Mpc)] {whereas the PDG-2022 value is [H0 = 67.4 ± 0.5 (km/s/Mpc)]}, (ii) the Dark Energy Density Parameter [ΩΛ = 0.677345709533812] {whereas the PDG-2022 value is [ΩΛ = 0.685 ± 0.007]}, (iii) the Pressureless Matter Parameter [Ωm = 0.322654290466188] {whereas the PDG-2022 value is [Ωm = 0.315 ± 0.007]}, (iv) the Deceleration Parameter [q0 = −0.338672854766906] {whereas a PDG-2022 value is not specified} & (v), the Cosmological Constant [Λ = 0.789639109726698 10ˆ-56 (cm-2)] {whereas the PDG-2022 value is [Λ = 1.088 10ˆ-56 (cm-2)]}. The EGM-PRM is subsequently utilised to describe the complete History of The Cosmos from the instant of The Big-Bang to the Present-Epoch; in complete agreement with the Standard Model of Cosmology (SMoC) & compliant with all currently available experimental observations. In addition, Cosmological Inflation (CI) & Accelerated Cosmological Expansion (ACE) are derived organically, demonstrating that CI ceased by approximately [t = 7.8793484858429 10ˆ-23 (s)] & apparent ACE [q = 0] commenced at approximately [t = 9.63456829206598 (Gyr)]; in precise agreement with the Frieman et. al. {FermiLab: 2008} determination of [˜ 10 (Gyr)]. We also demonstrate that the PDG-ACE 2019-2022 "age when acceleration was zero"value of [7.7 (Gyr)] denotes a misinterpretation of results; that is, the PDG misinterpret [Λ = 0] for [q = 0] at [7.7 (Gyr)]. Subsequently, we assert that the PDG value proximally corresponds to our determination that [Λ = 0] at [t = 7.28426797653236 (Gyr)].

22

Study on CMB dipole using COBE/FIRAS data set

Author: SOMITA DHAL[1]

[1] *BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI*

Corresponding Author: somitadhal1995@gmail.com

Cosmology, as the name suggests, concerns the study of the origin, structure, laws, and ultimate fate of the universe on a very large scale. The origin of the universe and its evolution have always been the most sought-after information for us. To know how the universe came into existence, CMB is the most practical tool, or the only one, at least for now, available to us. CMB, the earliest light in the universe, is one of the most effective techniques for examining the physics of the cosmos. In recent years there has been a substantial shift towards the model formation, simulation and computational technique with a desire to contribute precise results by twining with the experimental satellite data. The latest studies and observations on CMB impart that detected radiation is not from a solitary blackbody with a specific temperature but are radiations due to combination or mixture of blackbodies. This creates the distortion in the CMB spectrum namely μ and y distortion. Temperature and distortions of CMB are the crucial parameters for the investigation of the origin of the existing universe. As the CMB spectrum resembles a Planck spectrum we can analyse the probability distribution of temperature for CMB. One of the such techniques is blackbody radiation inversion.
In this research the technique of blackbody radiation inversion is applied to calculate the CMB temperature and its uncertainty from COBE/FIRAS dipole dataset. It is also found that the process is somehow similar to mixing of weighted blackbodies. The temperature and its spreading obtained from the distribution is 2.514 ± 0.555K. This spreading is larger than the estimated spreading (3.3 × 10-3 K) by considering relative motion. Deviation from gaussian behaviour is established by measuring skewness and kurtosis. The comparison between the probability distribution of temperature of monopole, dipole and their resultant are also done. The distribution is found to be asymmetrically oriented. Interpreting the spreading as the distortion we calculated the μ and y-distortions, and

found to be in the order of 10-1 and 10-2 respectively. This research presents the very first mention of CMB dipole temperature and its spreading assuming the mixing of black bodies.

23

Black Hole Metamorphosis on a Quantum Computer

Authors: Chinonso Onah[1]; Georgi Dvali[None]; Oleg Kaikov[2]

[1] *Ludwig Maximillian University, Munich*

[2] *MPP and LMU, Munich*

Corresponding Author: chinonso.onah@physik.uni-muenchen.de

Blackholes are known to be just one among objects of maximal microstate entropy permitted by unitarity, the so-called saturons. Such systems are also known to possess enhanced memory capacity and are subjected to a universal effect of memory burden, which suppresses their decay. Motivated the generic properties of saturons, we attempt a realization of the prototype saturon model on a quantum computer. This affords us the rare opportunity to study and analyze the full dynamics of these fascinating objects. It is also well known that memory burden can be overcome by rewriting stored quantum information from one set of degrees of freedom to another one. However, due to a suppressed rate of rewriting, the evolution becomes extremely slow compared to the initial stage and when pplied to black holes, this predicts a metamorphosis, including a drastic deviation from Hawking evaporation, at the latest after losing half of the mass. We exploit the quantum quench dynamics of the realized model to investigate these cosmological phenomena on a quantum computer. It is hoped that this quantum experiment will shed some light tenuous questions about the fate of a black hole and the possibility of small primordial black holes as viable dark matter candidates.

24

Production of Primordial black holes via single field inflation and observational constraints

Author: Mayukh Gangopadhyay[1]

Co-authors: Devanshu Sharma [2]; Jayesh Jain [3]; Yogesh Yogesh [4]

[1] *Center For Theoretical Physics, Jamia Millia Islamia, New Delhi*

[2] *SVNIT, Surat*

[3] *National Institute of Technology, Rourkela, India*

[4] *Jamia Millia Islamia*

Corresponding Author: jayeshphysics00@gmail.com

In a class of single field models of inflation, the idea of primordial black holes (PBHs) production is studied. In this case, the dynamics on small cosmological scales differs significantly from that of the large scales probed by the observations of cosmic microwave background (CMB). This difference becomes a virtue in producing correct physical ambiance for the seeds required to produce PBHs. Thus, once the perturbed scales re-enter the horizon of our Universe during the later epochs of radiation domination and subsequent matter domination, these seeds collapses to produce PBHs. We have shown, in this class of model, depending on the model parameters and the class defining set parameters, one can have PBHs formed for a vast mass ranges from 10^{-18} to 10^{6} solar mass ($M_{\odot}$). We have also shown, for a particular class of model, the total dark matter density today can be attributed to the PBHs density. The vast range of the mass depending on the class parameter, gives ample opportunity to study enriched phenomenological implications associated with this model to probe the nascent Universe dynamics.

25

Radio-galaxies as Ultra-High Energy Cosmic Rays sources

Authors: Augusto Ohtuka[None]; Rita de Cassia Dos Anjos[None]

Corresponding Author: ohtuka@alunos.utfpr.edu.br

Ultra-high energy cosmic rays (over 1 EeV) are astrophysical phenomena with no defined source. Near-Earth radio-galaxies (< 50Mpc distance), in particular Centaurus A, M87 and Fornax A, are considered to be one of the main group of ultra-high energy cosmic rays sources, according to data collected from the Pierre Auger Collaboration. Cosmic rays are deflected throughout the Universe, because of interactions with electromagnetic fields and/or other particles. In this work we study, in detail, radio-galaxies and describe the influence of their characteristics as plausible sources of cosmic rays using CRPropa3 software. We compare our results with data from the Pierre Auger Observatory to understand which mechanisms are involved in the acceleration of particles and the impact of interactions between particles from these sources on their propagation in the Universe.

26

Separating the spectral counterparts in NGC 1275/Perseus cluster in X-rays

Authors: Anatolii Tugay[1]; Elena Fedorova[2]; Lidiia Zadorozhna[3]; Nadiia Pulatova[4]; Olexandr Gugnin[5]

[1] *Taras Shevchenko National University of Kyiv*

[2] *INAF OAR*

[3] *Jagiellonian University, Faculty of Physics, Astronomy and Applied Computer Science; Taras Shevchenko National University of Kyiv*

[4] *Max-Planck-Institut fur Astronomie; Main Astronomical Observatory of the National Academy of Sciences of Ukraine*

[5] *Astronomical Observatory of Taras Shevchenko National University of Kyiv*

Corresponding Author: tugay.anatoliy@gmail.com

We are developing the optimal recipe to separate the spectral counterparts of the active galactic nucleus NGC 1275 and the Perseus cluster surrounding it in the spectra observed by Suzaku/XIS cameras. The key problem here is due to the fact that the emission of the cluster reaches the energies significantly higher than in the most cases of AGN even for those situated in the surroundings quite dense. Namely, the traces of the cluster medium emission can be traced in the soft-to-hard X-rays up to the level of 9-10 keV. That is why the separation of these two components: the AGN and the cluster, is especially important in this case. We prefer to avoid the usage of spectral fitting to perform this task due to huge quantity of fitting parameters necessary to describe all the components of this spectrum (i.e. abundances of elements the cluster consists of, thermal and Compton emission of the nucleus itself, and the jet SSC/IC emission spectral parameters as well) and as a result, the model degeneracy. Instead we use the spatial resolution of the components and double background subtracting. For this purpose we choose the following regions to collect all the photons from them: (1) circular region of the radius around the source (AGN); (2) ring-shape region surrounding the AGN (for cluster); (3) remote empty circular region for the background. Having collected the photons from those regions we subtract the background (i.e. photons from the third region) from the source and cluster spectra. On this stage one can see the emission line near 6.55 keV clearly visible in both the AGN and cluster spectra. Being emitted in the cluster this line can be used to estimate the quality of background subtracting on the second step. Namely, from the AGN spectrum we subtract the cluster counts normalized with the relation between the 6.55 keV emission line amplitudes in the AGN and cluster spectra. The absence of this line in the spectrum after the second background subtraction step can be considered as a criteria of the correctness of the procedure. We have performed this procedure to the whole set of the Suzaku/XIS observational data for NGC 1275 to obtain the cleaned spectra of the AGN in this system.

27

The possible quantization of Riemann curvature tensor on 3-Sphere

Author: Abdel Nasser Tawfik[1]

Co-author: Eiman Abou El Dahab [2]

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

[2] *MTI University*

Corresponding Author: atawfik@cern.ch

With the minimum measurable length uncertainty emerged from the relativistic generalized uncertainty principle in curved spacetime and the generalization of the pseudo-Riemannian manifold to eight-dimensional tangent bundle, the fundamental tensor is conformally modified to accommodate quantum-mechanical, geometric, and gravitational imprints, especially in the relativistic regime. In this talk, I shall be presenting the possible quantization of the Riemann curvature tensor on 3-sphere.

28

On the resummation of non-global and clustering logarithms for jet shapes beyond the leading log accuracy

Author: Hana Benslama[1]

Co-author: Yazid Delenda [2]

[1] *Batna1*

[2] *university of Batna1*

Corresponding Author: benslamaphysique@gmail.com

The azimuthal decorrelation ΔΦ for dijet production in e+e− annihilation, is a typical example of a jet shape distribution that promise to provide valuable information on perturbative and non-perturbative QCD dynamics. Where the jets are nearly back to back, the observable in question is sensitive to soft emissions, giving rise to large single logarithms. Employing the four vector recombination scheme (E− scheme), used at the Tevatron, the observale at hand is non-global. One of the main complications that arise in such observables particularly at next to leading logarithmic (NLL) accuracy, are twofold. On the one side, non-global logarithms will arise in the jet shape distribution when the jets are defined using both the kt and anti−kt clustering procedures. On the other side new logarithmic contributions, clustering logs in the independent emission piece will show up at the said logarithmic accuracy, when the kt clustering algorithm is applied. In this work we shed light on these very contributions for the aforementioned observable and we analytically compute the full R dependence of non-global and clustering logarithms for various jet algorithms at fourth order in the perturbative expansion. Employing the small jet radius approximation, we also perform an analytical fixed order calculation of non-global logarithms with kt clustering algorithm up to two-loops in the coupling.

29

jet substructure techniques with the production of Z+jet at the LHC

Author: Safa Gaid[1]

[1] *University of Batna (Algeria)*

Corresponding Author: safa.gaid@univ-batna.dz

Jet substructure techniques have an important role in high-energy collider physics computations of the hard processes. In this poster, we present the study of the production of a Z-boson plus one jet from pp collision .We show an analytical computation of the jet mass observable at leading order and next to leading order, implementing the trimming technique. As a consequence, after applying the clustering algorithm we note the contribution of the clustering logs and non-global logs that should be taken into consideration. Moreover, we shed light on preliminary results from the Monte Carlo event generators madgraph and pythia8 for the case of NLO computation. We compare the analytical part with the simulated one and use Rivet to analyze the resulting hepmc file .

31

Towards a Learning Based Error Mitigation Method for Simulating Quantum Fields

Author: Chinonso Onah[1]

[1] *Ludwig Maximillian University, Munich*

Corresponding Author: chinonso.onah@physik.uni-muenchen.de

Noise poses a practical challenge to quantum computation on NISQ devices Earlier attempts to simulate quantum fields on a quantum computer have all utilized error mitigation to extract meaningful results as it would not be possible otherwise. Usually, the mitigation technique is Zero Noise Extrapolation (ZNE) but recent results have proved a large difference in error reduction between ZNE and Learning based error mitigation techniques. Here, we investigate whether these recent developments can improve the simulation of the dynamics of Quantum Fields on Quantum Computers. In particular, we explore variable noise Clifford Data Regression vnCDR using the error mitigation technique. We report that indeed, learning based error mitigation improves the simulation of Quantum Fileds on Quantum Computers.

32

The Bose Hubbard Hamiltonian Reproduces Blackhole Dynamics on a Quantum Computer

Author: Chinonso Onah[1]

[1] *Ludwig Maximillian University, Munich*

Corresponding Author: chinonso.onah@physik.uni-muenchen.de

It is possible to simulate scalar fields' dynamics on quantum omputers by the Bose-Hubbard Hamiltonian. On the other hand, scalar fields are equally ubiquitous in modern comology. In particular many properties of Blackholes can be modelled by scalar fields and blackholes are thought to be quantum objects. Especially with regards to information processing. Thus motivated, we attempt to reproduce balckhole dynamics on currently available quantum computers. We hope that this will introduce a new way to investigate blackholes and other cosmological phenomena experiemntally.

33

Gamma Ray Burst and Afterglow

Author: Swapnil Singh[None]

Corresponding Author: swapnilsingh018@outlook.com

Gamma-ray bursts (GRB's), short and intense pulses of low-energy γ rays, have fascinated astronomers and astrophysicists since their unexpected discovery in the late sixties. GRB's are accompanied by long-lasting afterglows, and that they are associated with core-collapse supernovae. The detection of delayed emission in X-ray, optical, and radio wavelength, or "afterglow," following a γ-ray burst can be described as the emission of a relativistic shell decelerating upon collision with the interstellar medium.
Several hundred afterglows have now been observed across the electromagnetic spectrum. While it is fair to say that there is strong diversity amongst the afterglow population, probably reflecting a diversity in energy, luminosity, shock efficiency, baryon loading, progenitor properties, circumstellar medium and more, the afterglows of GRBs do appear more similar than the bursts themselves, and it is possible to identify common features within afterglows that lead to some canonical expectations.
After an initial flash of gamma rays, a longer-lived "afterglow" is usually emitted at longer wavelengths (X-ray, ultraviolet, optical, infrared, microwave and radio). It is a slowly fading emission at longer wavelengths created by collisions between the burst ejecta and interstellar gas.
In X-ray wavelengths, the GRB afterglow fades quickly at first, then transitions to a less-steep drop-off (it does other stuff after that, but we'll ignore that for now). During these early phases, the X-ray afterglow has a spectrum that looks like a power law. This kind of spectrum is characteristic of synchrotron emission, which is produced when charged particles spiral around magnetic field lines at close to the speed of light
In addition to the outgoing forward shock that ploughs into the interstellar medium, there is also a so-called reverse shock, which propagates backward through the ejecta. In many ways"reverse" shock can be misleading, this shock is still moving outward from the rest frame of the star at relativistic velocity, but is ploughing backward through the ejecta in their frame, and is slowing the expansion. This reverse shock can be dynamically important, as it can carry comparable energy to the forward shock.

In the early phases of the GRB afterglow still provides a good description even if the GRB is highly collimated since the individual emitting regions of the outflow are not in causal contact at large angles, and so behave as though they are expanding isotropically, If the emission from the GRB itself is confined into a relativistic jet with some half opening angle ∅⊠, then the true burst energy is not that observed by a GRB detector, but is modified by the fraction of the sky illuminated by the jet. This is only strictly true for a so-called top hat jet, where the energy per solid angle is the same for any observer, but is commonly assumed.
In this case, the correction from the measured energy of the burst ⊠⊠⊠⊠ to its true Energy.

At early times, individual elements within the relativistic outflow are not in causal contact, since they experience time dilation. However, the jet is slowing as it ploughs into the medium and the evolution of the Lorentz factor

The majority of afterglows, at times typically observed, fall in the slow cooling regime and the cooling break lies between the optical and the X-ray. Numerous observations support this broad picture for afterglows.
In the spectral energy distribution of the afterglow of the very bright GRB. The bluer light (optical and X-ray) appears to follow a typical synchrotron forward shock expectation (note that the apparent features in the X-ray and optical spectrum are due to the presence of dust within the host galaxy).
Gamma ray bursts are among the most energetic phenomena in the universe, we still don't fully understand the physical processes that drive them.
Science from studies of GRBs is now important across the bulk of astronomy, and even beyond fundamental physics. GRBs have been used to provide stringent limits on quantum gravity effects through differing speeds of light at different energies; have been proposed to explain mass extinction events in the geological history of the Earth; have progenitors for short bursts that may create the majority of heavy elements throughout the Universe; are successfully used to probe the physical conditions in the early Universe; provide a route to mapping the build-up of stellar mass and metals across cosmic history; provide unique constraints on the processes of particle acceleration and the production of ultra- high energy cosmic rays and neutrinos; probe the stellar evolution of the most massive stars and have been demonstrated as route to enabling multi messenger astronomy.

34

SCHWARZSCHILD RADIUS FOR ELECTRIC CHARGE

Author: Yevhen Lunin[None]

Corresponding Author: btkza@ukr.net

SCHWARZSCHILD RADIUS FOR ELECTRIC CHARGE

The aim of this work is to prove the formula for the Schwarzschild radius analog in case of a static spherically symmetric electric charge. The work contains two elegant proofs of the formula for the gravitational radius and for its analog in the case of an electric charge. The author mathematically proves that the Schwarzschild radius formula should not have a multiplier of 2. The formula for the Schwarzschild radius analog in case of a static spherically symmetric electric charge was obtained. Proposed by the author in 2006 the relationship formula between the electric charge and the energy of this electric charge was applied in the proof of the formula for the Schwarzschild radius analog in case of a static spherically symmetric electric charge. And this fact, on the author's opinion, is another confirmation of the statement validity about the electric charge equivalence and its energy. An analysis was carried out on the correspondence of the formula for the Schwarzschild radius analog in case of a static spherically symmetric electric charge to the Reissner-Nordström and Schwarzschild solutions results and it is shown that they are in full agreement with each other. The radiation temperature expression is proposed for a spherically symmetric black hole with a static electric charge, but without rotation. An expression is obtained for the particles production probability estimating in a static electric field of a black hole. The author proposes the Coulomb's law application limit explanation. The author explains the existence possibility of long-lived charged black holes. The expounded ideas in this work, in the author's opinion, have absolute originality and novelty and require further discussion for a more detailed research. The work proposes an original method of the gravity formulas converting into the electricity formulas and vice versa, which allows finding unknown dependencies in physics. This work is another step towards the standardization of physics and its formulas and to some general approach in the problems solving from completely different sections of physics. This work considers some general approach to the problems solving in such sections of physics as gravity and electricity. And it is possible due to the analogy of formulas, which include such physical quantities as mass and electric charge.
Keywords: the Schwarzschild radius, the electric charge non-invariance, gravitational constant, the Coulomb's law application limit, the Reissner-Nordström solution.

Yevhen Lunin
E-mail: btkza@ukr.net
ORCID: 0000-0002-5233-6353

35

Radiative Corrections to the Direct Detection Process of Higgsino-like Dark Matter

Authors: Arindam Chatterjee[1]; Syed adil Pasha[2]

[1] *Shiv Nadar Institution of Eminence, Greater Noida*

[2] *Shiv Nadar University, Greater Noida*

Corresponding Author: sp855@snu.edu.in

In the R-parity conserving Minimal Supersymmetric Standard Model (MSSM)
the Lightest Supersymmetric Particle (LSP) is a well-motivated dark matter (DM) candidate.
From the perspective of naturalness, light Higgsino-like neutralino states are favored and have been studied widely in the literature. In this presentation, we focus on the direct detection prospects for light higgsino-like neutralino DM. In particular, we have studied certain classes of one-loop radiative corrections to the spin-independent direct detection cross-section, which contributes significantly

to the same. This is especially so in the parameter space where (almost) pure higgsino is the LSP, thanks to its suppressed coupling with the Higgs bosons.
Further, we comment on the implications for the mu parameter in light of recent data from spin-independent direct detection.

36

Memory effect of gravitational wave pulses in pp-wave spacetimes

Author: Deeshani Mitra[1]

[1] *St Xavier's College(Autonomous),Kolkata*

Corresponding Author: deeshani1997@gmail.com

A gravitational wave pulse, while passing through spacetime, brings about a change in the relative separation between free particles. This 'memory effect serves as one of its signatures of GW. In this paper, we choose some viable pulse profiles which are yet to be analyzed by earlier workers (e.g. u^{-4}, u^{-2}. $c/(u^2 + au + b)^2$), and examine the memory effect produced by these pulses in pp-wave spacetimes. For our work, we choose the pp-wave spacetime in Brinkmann coordinate to study the geodesic equations. We observe increasing displacement memory effect in all the cases along all directions and the velocity memory effect either continues to increase or reaches saturation after an initial increase.

37

Graphene in Anti deSitter space

Author: Lakhdar Sek[None]

Co-authors: Mokhtar Falek ; Mustafa Moumni

Corresponding Author: lakhdar.sek@univ-biskra.dz

In this work,we study the (2+1) dimensional massless dirac equation within a uniform magnetic field in the
commutation relations of the Anti deSitter space.Firstly, we solved the system in order to obtain the en-
ergy eigenvalues and the corresponding wave function as Jacobi polynomials by using the Nikiforov-Uvarov
method, we find the findings have been affected by the studied deformation of the space AdS which has a
hard confinment for large values of n (the quantum number)

38

On Possible Minimal Length Deformation of Metric Tensor and Affine Connection

Author: Fady T. Farouk[1]

Co-authors: Abdel Nasser Tawfik [2]; F. Salah Tarabia [1]; Muhammad Maher [1]

[1] *Physics Department, Faculty of Science, Helwan University.*

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

Corresponding Author: m.maher@science.helwan.edu.eg

When the minimal length approach emerges from noncommutative Heisenberg algebra, generalized uncertainty principle (GUP), and thereby integrating gravitational fields to this fundamental theory of quantum mechanics (QM) is thoughtfully extended to Einstein field equations, the possible deformation of the metric tensor could be suggested. This is a complementary term combining the effects of QM and general relativity (GR) and comprising noncommutative algebra together with maximal spacelike four–acceleration. This deformation compiles with GR as curvature in relativistic eight–dimensional spacetime tangent bundle, generalization of Riemannian spacetime, is the recipe applied to derive the deformed metric tensor. This dictates how the affine connection on the Riemannian manifold is straightforwardly deformed. We have discussed the symmetric property of the deformed metric tensor and affine connection. Also, we have evaluated the dependence of a parallel transported tangent vector on the spacelike four–acceleration given in units of L, where L, where $L = \sqrt{dfrachslashGc^3}$ is a universal constant, c is the speed of light, and $\hbar$ is Planck constant, and G is Newton's gravitational constant.

39

Covariant Hamiltonians for F(R) Gravity

Authors: Bohuslav Matouš[1]; Josef Klusoň[2]

[1] *Masaryk University, Brno, Czechia*

[2] *Masaryk University*

Corresponding Author: bmatous@mail.muni.cz

The conventional Hamiltonian theory fails to provide covariant Hamiltonian description of relativistic physics. To achieve covariant Hamiltoninan description, the covariant Hamiltonian theory also called Weyl-de Donder theory can be used. With its help, we have shown, that covariant Hamiltonian can be found for F(R) gravity.
F(R) gravity is a modification of General Relativity, where scalar curvature in the Lagrangian is replaced with an unspecified function F(R) of scalar curvature.
F(R) gravity can be formulated in Jordan frame and using the Weyl transformation also in Einstein frame. For both frames, the covariant Hamiltonians can be formulated and also it can be demonstrated that they are bound with canonical transformation.

40

Recognizing of gravity waves from all-sky airglow images using machine learning over a complete solar cycle

Author: Mostafa Nasser[1]

[1] *Helwan University*

Corresponding Author: mostafanasser205@gmail.com

To study atmospheric gravity waves, a large number of airglow images must be processed. In this work we present a program that was developed to recognizing gravity waves patterns in ASAI images. The recognizing procedure contains a classification model based on a convolutional neural network (CNN) and object detection models. Classification model selects clear nighttime images from all ASAI raw data picture. The object detection model locates the extent of the waveform. Then the wave parameters (horizontal wavelength, period, direction, etc.) can be calculated over the

range of the wave sample, All data used in this paper based on 557.7-nm airglow images at shigaraki (SGK) (35°N, 136°E,2008-2019(24th solar cycle)), Japan.

41

Searches for Dark Matter and Extra Dimensions with the ATLAS Experiment at the LHC

Author: Monica Verducci[1]

[1] *Universita & INFN Pisa (IT)*

Corresponding Author: monica.verducci@cern.ch

The presence of a non-baryonic Dark Matter (DM) component in the Universe is inferred from the observation of its gravitational interaction. If Dark Matter interacts weakly with the Standard Model (SM) it could be produced at the LHC. On the other hand, the existence of extra spatial dimensions could provide solutions to longstanding issues with the SM, such as the hierarchy problem, and enable the search for massive gravitons and microscopic black holes in colliders. The ATLAS Collaboration has developed a broad search program for DM candidates in final states with large missing transverse momentum produced in association with other SM particles (light and heavy quarks, photons, Z and H bosons, as well as additional heavy scalar particles) and searches where the Higgs boson provides a portal to Dark Matter, leading to invisible Higgs decays. ATLAS also has an array of searches looking for massive gravitons in leptonic, hadronic, and bosonic final states. The results of recent searches on 13 TeV pp data from the LHC, their interplay and interpretation will be presented.

42

Real Time Ultrasoft Scalars Self Energy at Next to-leading order in Hot Scalar QED

Author: Karima Bouakaz[1]

[1] *ENS-KOUBA*

Corresponding Author: karima.bouakaz@g.ens-kouba.dz

In a series of works, we have used the imaginary time formalism to study the infrared behavior of the gluon and quark damping rates [1, 2, 3, 4, 5, 6, 7]. The results have indicated that there are difficulties in the infrared sector. A similar observation has been done in the context of scalar electrodynamics [8]. To look further into the infrared behavior, we propose to calculate the next-to-leading order dispersion relations for slow-moving Scalars at high temperature scalar quantum electrodynamics (Scalar QED), using the real time formalism (RTF) in physical representation. We derive the analytic expressions of hard thermal loop (HTL) contributions to propagators and vertices to determine the expressions of the effective propagators and vertices in RTF that contribute to the complete next-to leading order contribution of retarded scalars self-energy. The real part and the opposite of the imaginary part of the retarded scalars self-energy are related to the next-to-leading order contributions of energy and damping rate respectively.

1. A. Abada, O. Azi and K. Benchallal, Phys. Lett.B425, 158-164 (1998).
[2]. A. Abada, O. Azi, Phys. Lett.B463, 117-125 (1999).
[3]. A. Abada, K. Bouakaz and O. Azi, Phys. Scr. 74, 77-103 (2006).
[4]. A. Abada, K. Bouakaz and N. Daira-Aifa, Eur. Phys. J.C18, 765-777 (2001).
[5]. A. Abada, N. Daira Aifa and K. Bouakaz, Int.J.Mod.Phys.A21, 5317-5332 (2006).
[6]. K. Bouakaz, A. Abada, AIP Conf.Proc.1006:150-153, (2008).

[7]. A. Abada, K. Bouakaz and D. Deghiche, Mod.Phys.Lett.A22, 903-914 (2007).
[8]. A. Abada and K. Bouakaz, JHEP01, 161-187 (2006).

43

Studying the Neutron Star Equation of State with the CBM Experiment at FAIR

Author: Kshitij Agarwal[1]

[1] *Eberhard Karls Universität Tübingen (DE)*

Corresponding Author: kshitij.agarwal@uni-tuebingen.de

The Nuclear Equation of State (EoS) at suprasaturation densities and its importance in determining Neutron Star properties has been the focus of several experimental and theoretical activities worldwide. This truely multi-messenger effort spans all the way from the nuclear theory calculations based on Chiral Effective Field Theory all the way to astrophysical measurements of the neutron stars and their collisions. Complementary information from Heavy-Ion Collisions (HIC) provide a means to study EoS inside the laboratory in controlled conditions, therefore represent another crucial source of information.

This contribution will give an overview of diverse sources of information that can be used to infer the properties of dense nuclear matter, namely nuclear theory, astrophysical data, and heavy-ion collisions. A special emphasis will be placed on HIC's pivotal role in constraining the dense-matter EOS at around twice nuclear saturation density over the past two decades. Moreover, as an outlook, an introduction to the Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) will be given as it continues the HIC effort to higher densities, with the experiment expecting data-taking in 2028-29.

44

Minimal Length Deformation of Spacetime Curvature

Author: Muhammad Maher[1]

Co-authors: Abdel Nasser Tawfik [2]; F. Salah Tarabia [1]; Fady T. Farouk [1]

[1] *Physics Department, Faculty of Science, Helwan University.*

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

Corresponding Author: m.maher@science.helwan.edu.eg

When generalized noncommutative Heisenberg algebra accommodating impacts of finite gravitational fields as specified by loop quantum gravity, doubly–special relativity, and string theory, for instance, is thoughtfully applied to the eight-dimensional manifold, the generalization of the Riemannian manifold. By constructing the deformed affine connections on a four-dimensional Riemannian manifold, we have determined the minimal length deformation of Riemann curvature tensor and its contractions, the Ricci curvature tensor, and Ricci scalar. Consequently, we have been able to construct the deformed Einstein tensor. As in Einstein's classical theory of general relativity, we have proved that the covariant derivative of the deformed Einstein tensor vanishes, as well. We conclude that the minimal length correction suggests a correction to the spacetime curvature like the additional curvature terms in corrected Riemann tensor, and its contractions. Accordingly, the spacetime curvature endows additional curvature and geometrical structure

45

Quantum Mechanics

Introduction to Quantum Mechanics

46

General Relativity

Introduction to General Relativity

47

Expansion of Raychudhuri Equation in Parameterized Absolute Parallelism Geometry

Author: Tahia Dabash [None]

Co-authors: Mona El hoseiny [1]; Mamdouh Wanas [2]

[1] *Ain Shams university*

[2] *Cairo university*

Corresponding Author: tahia.dabash@science.tanta.edu.eg

Following the assumption that the expansion of the Raychudhuri equation in a geometry wider than the Riemannian geometry might avoid the space singularity often associated with various astrophysical models, we aim in the present script at deriving the expansion and its temporal variation in the parametrized absolute parallelism geometry out approach utilizes a modified version of geodesic, and also a modified version of the Raychudhuri equation. We also use the generalized definition of expansion in the modified Raychaudhuri equation to get the expansion and its temporal evolution in parameterized absolute parallelism geometry. Here, we use a geometric structure based on absolute parallelism geometry together with the metric of Riemannian space, associated with this structure. We obtained a general form of the expansion. This form matches with the expansion in the case of radial, marginally bound, time-like geodesics of the Schwarzschild space-time in the Riemannian geometry.