Abstracts

1. **Speaker:** Ghulam Abbas
   Institution: The Islamia University of Bahawalpur, Bahawalpur, Pakistan
   Title: Complexity Factor for Anisotropic Source in Non-minimal Coupling Metric f(R) Gravity

Abstract: In this talk we have presented the idea of complexity factor for static anisotropic self-gravitating source with generalized f(R) metric gravity theory. In present consideration, we express the Einstein field equations, hydrostatic equilibrium equation, the mass function and physical behavior of f(R) model by using some observational data of well-known compact stars like 4U 1820âˆ’30,SAX J1808.4âˆ’3658 and Her Xâˆ’1. We define the scalar functions through the orthogonal splitting of the Reimann-Christoffel tensor and then find the vanishing complexity condition for self-gravitating system with the help of these scalars. It has been found that the vanishing condition for the complexity are pressure anisotropy and energy density inhomogeneity must cancel each other. Moreover, we study the momentous results of an astral object for the vanishing of complexity factor. Finally, these solutions reduced to previous investigation about complexity factor in General Relativity by taking coupling parameter \lambda=0.

2. **Speaker:** Bobomurat Ahmedov
   Institution: National University of Uzbekistan, Uzbekistan
   Title: On Observational Properties of Gravitational Compact Objects

Abstract: Modern astronomical observations on the international level on the ground and space telescopes, and recent discoveries have provided convincing evidence that black holes have a significant impact on nearby objects around, emitting powerful gamma-ray bursts, absorbing the next star, and stimulating the growth of newborn stars in the surrounding areas. Study the photons motion around rotating black holes, in particular, the discovery and analysis of the form of silhouettes of these objects, setting and effective implementation of relevant radiostronomical observations on the proof of the existence of the black hole horizon and retrieval of information events on the central object in our galaxy within the Black Hole Cam (BHC) and Event Horizon Telescope (EHT) international projects is one of the most important tasks of modern astrophysics. Recently on April 2019 the first image of the 'shadow' of the supermassive black hole candidate in the galaxy M87 has been released by the EHT collaboration. The image shows the distinctive features of a black hole showing an inner edge for the accretion disk and suggesting the existence of an infinitely red-shifted surface.

Then gravitational lensing in the vicinity of a slowly rotating massive object surrounded by plasma has been studied. The obtained deflection angle of the light ray in the presence of plasma depends on (i) the frequency of the electromagnetic wave, due to the dispersion properties of the plasma; (ii) the gravitational mass M; and (iii) the angular momentum of the gravitational lens. We have

studied photon motion around axially symmetric rotating (i) Kerr black hole, (ii) wormhole in the presence of a plasma with radial power-law density. It is shown that in the presence of a plasma, the observed shape and size of the shadow of rotating (i) Kerr black hole, (ii) wormhole changes depending on the (i) plasma parameters, (ii) gravitational object spin, and (iii) inclination angle between the observer plane and the axis of rotation of the black hole/wormhole. We have developed a general formalism to describe the black hole shadow as an arbitrary polar curve expressed in terms of a Legendre expansion. New developed formalism does not presume any knowledge of the properties of the shadow, e.g., the location of its center, and offers a number of routes to characterize the distortions of the curve with respect to reference circles. These distortions can be implemented in a coordinate independent manner by different teams analyzing the same data. It has been shown that the new formalism provides an accurate and robust description of noisy observational data, with smaller error variances when compared to previous measurements of the distortion.

Finally, I will discuss end state of evolution of massive stars, various observational properties of magnetized neutron stars. The energetics of rotating black holes and neutron stars is also in the scope of my talk.

3. **Speaker:** Artur Alho
   Institution: CAMGSD-IST University Lisbon, Lisbon, Portugal
   Title: Dynamical systems analysis of quintessence

Abstract: We consider quintessence models with a scalar field and matter in a spatially flat and isotropic spacetime. The field equations are recast into complementary dynamical systems, which enables situating quintessence evolution in a global solution space context. Moreover, we use the dynamical systems to obtain straightforward derivations of new and known simple and accurate approximations for quintessence evolution which includes thawing and tracker solutions.

4. **Speaker:** Nisa Amir
   Institution: Quaid-i-Azam University, Islamabad, Pakistan
   Title: The Black Hole Perturbation ToolKit

Abstract: Black Hole Perturbation Toolkit (BHPToolkit) is an open tool for the black hole perturbation theory (BHPT). The BHPToolkit provides both the software and data relating to BHPT, which can be used to model the gravitational radiations emitted from small mass ratio binaries and the ringdown of BHs, which are the key source for the future space-based gravitational waves detector, LISA. The overall goal of this Toolkit for researchers is to spend less time on writing codes and more time on doing physics. Currently, there are many codes developed for scattered BHPT by a wide range of individuals and groups. The aim of this project is to unify some of the basic components of these codes into a toolkit for all people across the globe.

This presentation will give an initial insight to the BHP Toolkit for new users. It explains its different components, tools, modules and how different packages can be tailored and executed depending upon the researcher's narratives and requirements. Some applications will also be discussed.

5. **Speaker:** Sana Arshad
   Institution: National Textile University, Faisalabad, Pakistan
   Title: Effect of Electric Field on Collapsing String Fluid in Rainbow Gravity

Abstract: This work is devoted to study the effects of electric field intensity on the spherically symmetric gravitational collapse of anisotropic string fluid in Rainbow gravity. The Einstein field equations are modified and solved to obtain the values of physical parameters of fluid including energy density, pressure and string tension in terms of electric field intensity. These dynamical quantities are graphically analyzed and specific values of Rainbow parameter is found for physical solutions. It is found that the presence of electric field slows down the collapse. Moreover, the electric field contributes in an increase in pressure and decrease in matter density and string tension of the fluid.

6. **Speaker:** Mariyah Aslam
   Institution: University of the Punjab, Lahore-Pakistan
   Title: Compact Objects by Gravitational Decoupling in f(R) Gravity

Abstract: The objective of this paper is to discuss anisotropic solutions representing static spherical self-gravitating systems in f(R) theory. We employ the extended gravitational decoupling approach and transform temporal as well as radial metric potentials which decomposes the system of non-linear field equations into two arrays: one set corresponding to seed source and the other one involves additional source terms. The domain of the isotropic solution is extended in the background of f(R) Starobinsky model by employing the metric potentials of Kroriâ€"Barua spacetime. We determine two anisotropic solutions by employing some physical constraints on the extra source. The values of unknown constants are computed by matching the interior and exterior spacetimes. We inspect the physical viability, equilibrium and stability of the obtained solutions corresponding to the star Her X-I. It is observed that one of the two extensions satisfies all the necessary physical requirements for particular values of the decoupling parameter.

7. **Speaker:** Nadeem Azhar
   Institution: COMSATS University Islamabad, Lahore Campus, Pakistan
   Title: Gravitational Baryogenesis in Modified Theories of Gravity

Abstract: In this presentation, we investigate the gravitational baryogenesis phenomena and its generalized form for well-known models of $f (G, T)$ (where G denotes the Gaussâ€"Bonnet topological invariant and T is the trace of the energy momentum tensor) theory of gravity. We consider power law scale factor for each model and compute baryon to entropy ratio by assuming that the universe is filled by perfect fluid and dark energy. It is found that baryon to entropy ratio

for f (G,T) gravity (specific models: $f(G,T)=Î´G^m+Î»T$ and $f(G,T)=Î´G^m+T+ÏµT^2$) lies in the range $6.5_(-2.5)^(+2.5)Ã—10^(-11)$ and $4_(-5)^(+5)Ã—10^(-11)$. It is also mentioned here that results of general form of baryogenesis are also consistent with observational bounds for these models of modified theories of gravity.

8. **Speaker:** Yousra Aziz
   Institution: National Textile University, Faisalabad, Pakistan
   Title: On Evolution of Compact Stars from String Fluid in Rastall Gravity

Abstract: The aim of this work is to discuss the evolution of compact stars from the view point of a string fluid in Rastall theory using Karori-Barua metric as interior geometry to find a singularity free solution of Einstein's field equations. The exterior spacetime is considered as Schwarzschild metric while matching of interior and exterior spacetimes lead to coefficients of KB ansatz. The field equations and dynamical variables of the string fluid are explored. Our investigation displays an interesting feature that the anisotropy of compact stars increases with the radial coordinate and attains its maximum value at the surface which seems an inherent property for the singularity free ansisotropic compact objects. Further we find that our proposed model is consistent with the energy conditions for different values of Rastall parameter η which shows the existence of physical matter. We conclude that the string fluid is responsible for the evolution of compact stars in the cosmos.

9. **Speaker:** Kazuharu Bamba
   Institution: Fukushima University, Japan
   Title: Review on the generation of primordial magnetic fields in inflationary cosmology

Abstract: It is known that cosmic magnetic fields are observed not only in galaxies but also in clusters of galaxies. The origin of such a large-scale magnetic field is not understood well. One of the most natural origins of large-scale magnetic fields is the quantum fluctuations of the electromagnetic fields in the inflationary stage. To produce the quantum fluctuations of the electromagnetic fields, the conformal invariance of the electromagnetic fields must be broken. In this presentation, in the former part we review the generation of large-scale magnetic fields in inflationary cosmology through the breaking of the conformal invariance of the electromagnetic fields owing to non-minimal coupling of the electromagnetic fields with a scalar field or the gravitational field. In the latter part, we explain our original works related to the magnetogenesis from inflation.

10. **Speaker:** Aroonkumar Beesham
    Institution: University of Zululand, Kwa-Dlangezwa 3886, South Africa
    Title: Dark Energy, Chaplygin Gas and Viscosity

Abstract: The bulk of the matter of the universe is believed to be in the form of dark energy, which makes up about 70% of the total matter content of the universe. Since its discovery around

1998, researchers have been trying to find out about the nature of this dark energy. Despite a lot of effort, there is still no proper explanation for it. Two possible candidates for dark energy are Chaplygin gas and bulk viscosity. There is a lot of similarity in these two proposed forms. The relationship between them is explored in this presentation, and it is shown that mathematically, they are in some sense, equivalent, although their physical interpretation is different.

11. **Speaker:** Muhammad Bilal
    Institution: Abdus Salam School of Mathematical Sciences, GCU, Lahore-Pakistan
    Title: Analysis of the Velocity Rotational Curves Via Weyl-Interactive Modified Gravity

Abstract: Instead of appealing to dark matter to explain the flat rotation curves of galaxies, it had been proposed that the law of gravitation should be modified. However, the idea had been to modify Newton's law. Harko et al. (Phys. Rev. D84(2011) 024020) suggested that modified gravity be used. Qadir, Lee and Kim (Int. J. Mod. Phys. D26(2017) 1741001) had proposed a modification of the Einstein-Hilbert Lagrangian with cosmological constant by adding a product of the Ricci and matter tensors. Later Qadir and Lee (Int. J. Mod. Phys. D28(2017) 1741001) proposed coupling the matter with Weyl curvature, reminiscent of the way the charge couples with the electromagnetic field in QED, and provided the equations of motion for it. They considered the rotational velocity curves for a simple model, for different values of the coupling constant. The value of the coupling constant has been determined for the M31 galaxy for this simple model used and compared with that for the Milky Way to see if the suggestion seems consistent, barring minor adjustments in the matter distribution in the galaxies.

12. **Speaker:** Danijela Brankovic
    Institution: School of Electrical Engineering, University of Belgrade, Belgrade, Serbia
    Title: Dynamics of the ΛCDM model of the universe from the mathematical point of view

Abstract: In this paper we apply the theory of the dynamical systems in the study of the dynamics of the standard cosmological model of the universe, under the assumption that matter content in our universe consists of barotropic fluids which are noninteracting. We use the information that the Friedmann equations of the ΛCDM model of the universe can be represented as a Lotka-Volterra system, that enables us to give another interpretation of the universe's dynamical features, besides physical. Also, we give new dependencies between cosmological density parameters and the scale expansion factor of the universe.

13. **Speaker:** Rong-Gen Cai
    Institution: Chinese Academy of Science, China
    Title: Primordial black holes and stochastic gravitational waves induced by scalar perturbation

Abstract: The primordial black hole formed in the early universe is a promising candidate of dark matter, even the primordial black holes might only a small portion of the total dark matter. The large curvature perturbations on the small scales are responsible to the formation of the primordial black holes and stochastic gravitational waves. In this talk I will introduce some features of the stochastic gravitational waves induced from the scalar curvature perturbations and potential observational implications.

14. **Speaker:** Ugur Camci
    Institution: Roger Williams University, USA
    Title: Integration of the geodesic equations via Noether Symmetries

Abstract: In this paper I will overview the use of Noether symmetry approach in discussing the integration of the geodesic equations for the geodesic Lagrangians of space-times. I will also give some examples to explore the efficiency of Noether symmetry approach by finding the first integrals related for the geodesic equations of the considered space-times.

15. **Speaker:** Salvatore Capozziello,
    Institution: University of Naples Federico II, Italy
    Title: Non-Local Gravity Cosmology

Abstract: Recently the so-called Non-Local Gravity acquired a lot of interest as an effective field theory towards the full Quantum Gravity. In this talk, we sketch its main features, discussing, in particular, possible infrared effects at astrophysical and cosmological scales. In particular, we focus on general non-local actions including curvature invariants like the Ricci scalar and the Gauss-Bonnet topological invariant, in metric formalism, or the torsion scalar, in teleparallel formalism. In both cases, characteristic lengths emerge at cosmological and astrophysical scales. Furthermore, it is possible to fix the form of the Lagrangian and to study the cosmological evolution considering the existence of Noether symmetries.

16. **Speaker:** Shahid Chaudhary
    Institution: COMSATS University Islamabad, Lahore Campus, Pakistan
    Title: Thermodynamics and Grey-body factors of Black Holes

Abstract: According to Stephen Hawking, black holes emit radiations which are known as Hawking radiations. We find out the thermodynamical quantities like Hawking temperature, mass, entropy of black holes. We investigate the Hawking evaporation process and stability of the black holes. The study of grey-body factor helps us to understand the quantum nature of the black hole. We evaluate the gravitational potentials and bounds on the grey-body factors of black hole in well -known modified theory of gravity and study the effects of modified gravity parameters on the grey-body factors.

17. **Speaker:** Naresh K. Dadhich
    Institution: Inter-University Center for Astronomy & Astrophysics, India
    Title: The two constants of spacetime structure

Abstract: We shall geometrically characterize "free" spacetime -- free of all forces and dynamics. That is, space is homogeneous and isotropic, and time is homogeneous. Thus emerges an invariant velocity, c, without reference to anything else and it binds space and time into spacetime. Free spacetime is therefore homogeneous (space is homogeneous and isotropic and time is homogeneous), and so should be its geometry. That is, Riemann curvature should be covariantly constant -- a spacetime of constant curvature -- an invariant length, $1/\sqrt{\Lambda}$. That is how the second constant of spacetime structure arises. These are the two most fundamental constants of Nature. The next question is, what happens when spacetime is inhomogeneous? Then emerges Einstein's theory of gravitation --- general relativity naturally which is sourced by matter fields responsible for spacetime inhomogeneity. We would also delve and hint on similar geometric understanding of other fundamental forces.

18. **Speaker:** Allah Ditta
    Institution: The Islamia University of Bahawalpur, Bahawalpur, Pakistan
    Title: Matter accretion onto holographic massive gravity black hole

Abstract: We investigate the matter accretion of well-known fluids flowing onto a Schwarzschild black hole in holographic massive gravity along with two additional mass parameters R and C due to massive gravitons.

19. **Speaker:** Martin Dominik
    Institution: University of St Andrews, UK
    Title: The new frontiers of gravitational microlensing

Abstract: Albert Einstein referred to gravitational microlensing as a “most curious effect”, and while its underlying principles are intriguingly simple, their universality makes a powerful tool for inferring information about a wide range of astronomical bodies. Much has happened since the first observation of a gravitational microlensing event in 1992, and the frontiers have shifted. What we did not dare dreaming about just a few decades ago turned into reality, and we have not reached the end of the journey. New challenges and opportunities lie ahead. Where might we be able to go and how can we get there?

20. **Speaker:** Ume Farwa
    Institution: University of the Punjab, Lahore-Pakistan
    Title: Role of Structure Scalars in the Study of Axially and Reflection Symmetric Space-time

Abstract: This work is devoted to a general study on axial and reflection-symmetric self-gravitating sources. For this purpose, all the fundamental equations and notions set to carry out the general study are established. The corresponding field and dynamical equations are also exhibited. To discuss the thermodynamics aspects of the selected system, the modified transport equation is presented. The Weyl-tensor is utilized to evaluate the generalized version of scalar variables named structure scalars. To produce modified scalar equations, we employ the structure scalars. The applications of our obtained results are examined on the dynamics of the source. We conclude that the modified structure scalars play an important role in the dynamics of the compact objects.

21. **Speaker:** Fizza Furqan
    Institution: University of the Punjab, Lahore-Pakistan
    Title: Extended Decoupled Static Spherical Objects in f(R,T) Theory

Abstract: We discuss the extended gravitational decoupling approach for a static sphere in the framework of f (R, T) gravity where R represents the Ricci scalar and T is the trace of the energy-momentum tensor. In this approach, transformations in both radial and temporal metric functions split the initial system into two subsystems corresponding to isotropic and additional sources. We consider the Tolman IV metric as a solution for the system related to seed source and extend it to anisotropic domain using some physical constraints. A linear gravity model, f(R,T)=R+Ï‡T, is utilized where Ï‡ produces a pathway for matter and geometry coupling. We also analyze effects of decoupling parameter and Ï‡ on the considered model. Further, we perform graphical analysis to explore the physical acceptability of anisotropic solutions for the compact star Her-X1. It is found that the constructed solutions show realistic behavior for certain values of the decoupling parameter. We conclude that the modified f(R, T) gravity is a suitable theory to describe compact stellar structures.

22. **Speaker:** Sijie Gao
    Institution: Beijing Normal University, China
    Title: General properties of light rings for stationary spacetimes

Abstract: Light rings (LRs) are closed photon orbits which play an important role in gravitational wave observations and black hole photographs. In this talk, we first prove the general existence of LRs in black hole spacetimes. We also find that LRs always appear in pairs in horizonless spacetimes. Only some natural and generic assumptions are used in our proof. The results are applicable to general relativity as well as most modified theories of gravity. Then we investigate the relationship between LRs and stability of ultracompact objects. We revisit the quasi-black hole solutions, a family of horizonless spacetimes whose limit is the extremal Reissner-Nordstrom

black hole. We find a critical parameter at which the light rings just appear. We then calculate the quasinormal modes of the quasi-black holes. Both the WKB result and the numerical result show that long-live modes survive for the range where light rings exist, indicating that horizonless spacetimes with light rings are unstable. This result provides a strong and explicit example that light rings could be direct observational evidence for black holes.

23. Speaker: Diego Rubiera-Garcia
Institution: Complutense University of Madrid, Spain
Title: Light rings as smoking guns of black hole mimickers

Abstract: I will describe the optical appearance of spherically symmetric objects when immersed in an optically and geometrically thin accretion disk. Using some toy-models I will argue that the presence of additional light rings in a shadow observation - besides the infinite sequence of self-similar but exponentially demagnified rings ascribed to the Kerr solution - could be interpreted as a smoking gun for the existence of a, black hole mimicker having more than one critical curve.

24. Speaker: Muhammad Zeeshan Gul
Institution: University of the Punjab, Lahore-Pakistan
Title: Study of Isotropic Compact Objects in Energy-Momentum Squared Gravity

Abstract: This paper investigates the geometry of compact stellar objects filled with isotropic matter configuration in the context of energy-momentum squared gravity. This new covariant generalization of general relativity allows the presence of non-linear term ($T\_Î±Î² T^Î±Î²$) in the action of functional theory. Consequently, the relevant field equations are different from general relativity only in the presence of matter sources. There is a maximum energy density and corresponding a minimum length scale at the early universe. This means that there is a bounce at early times and this theory avoids the presence of an early-time singularity. Moreover, this theory possesses a true sequence of cosmological eras. Although cosmological constant does not play an important role in the early times and becomes important only after the matter-dominated era. In this theory, the â€œrepulsiveâ€• nature of the cosmological constant plays a crucial role at early times in resolving the singularity. We consider static spherically symmetric spacetime and formulate the corresponding field equations as well as junction conditions. We consider a specific model of this theory as well as apply analytic solutions of Krori and Barua metric using the mass-radius relation to examine the basic features of compact stars like Her X-1, SAX J 1808.4-3658 and 4U 1820-30.

25. Speaker: Muhammad Usman Haider
Institution: Quaid-i-Azam University, Islamabad, Pakistan
Title: Construction of Kazokov-Solodukhin Kerr Black Hole

Abstract: According to various approaches to quantization of gravity the Schwarzschild solution representing a spherically symmetric black hole in General Relativity must acquire

quantum corrections. The spherically symmetric deformation of the Schwarzschild solution owing to the quantum corrections to gravity is known as Kazokov-Solodukhin blackhole metric.
The Newman Janis Algorithm is a complicated method for introducing rotation into a static seed spacetime, which is used to discover the exact solution to Einstein's Field Equation in general relativity. E. T. Newman and A.I. Janis devised this method in 1964 as an alternate derivation of an axisymmetric metric of the spinning source using spherically symmetric coordinates. In this presentation we use this algorithm to derive the quantum corrected blackhole.

26. **Speaker:** L. Herrera
    Institution: University of Salamanca, Spain
    Title: Hyperbolically Symmetric Fluids

Abstract: Motivated by a Schwarzschild black hole model, proposed in a recent article (L. Herrera, L. Witten, Adv. High Energ. Phys. 2018), in which the region inner to the horizon is described by a vacuum solution endowed with hyperbolical symmetry, we carry out a comprehensive study on dissipative dynamic fluid distributions endowed with such a symmetry. In the non-dissipative case, if we assume the evolution to be homologous or quasi-homologous, two different versions of hyperbolically symmetric FRW spacetimes are obtained. In the dissipative case several solutions are found. If we relax the homologous or quasi-homologous condition, then shearing, geodesic models are obtained which may be regarded as hyperbolically symmetric versions of LTB spacetimes. These include non-dissipative dust models and anisotropic models (dissipative or not). In the non-dissipative case, all models satisfying the vanishing complexity factor condition, obey the stiff equation of state.

27. **Speaker:** Ibrar Hussain
    Institution: National University of Science and Technology, Islamabad, Pakistan
    Title: Schwarzschild black hole surrounded by quintessence and the existence of marginally stable circular orbits of test particles

Abstract: Marginally stable circular orbits of test particles are studied in the vicinity of the Schwarzschild black hole surrounded by quintessence, for three different values of the equation of state parameter, ω_q. It is shown that the marginally stable circular orbits exist for different ranges of the normalization factor α, in all the three cases.

28. **Speaker:** Ayesha Ikram
    Institution: University of Education, Lahore, Pakistan
    Title: Stability Analysis of Einstein Universe in f(G,T) Gravity

Abstract: This talk explores the stability of the Einstein universe against linear homogeneous isotopic and anisotropic perturbations in the background of f(G, T) gravity. The static as well as

perturbed field equations are constructed in order to investigate the stability regions for the conserved as well as non-conserved energy-momentum tensor. The equation-of-state parameter is used to parameterize the stability regions. The graphical analysis shows that the suitable choice of parameters leads to stable regions of the Einstein universe.

29. **Speaker:** Muhammad Jawed Iqbal
    Institution: University of Karachi, Karachi, Pakistan
    Title: Globular Clusters Age Determination for Putting Constraints on Cosmological Models

Abstract: Globular Clusters are recognized as one of the oldest observable objects in the universe. Globular clusters are therefore of great importance for finding lower limit of age of universe. The age estimates of the globular clusters have become noticeably accurate in recent decades mainly due improved theoretical models of stellar interiors and improved observations from satellites like HST, Hipparcos and Gaia. The age of globular clusters strong constraints on cosmological models.

30. **Speaker:** Faisal Javed
    Institution: National University of Modern Languages, Islamabad, Pakistan
    Title: Study of Thin-Shell Wormholes with Nonlinear Electrodynamics

Abstract: This seminar is based on the comprehensive study of the stable configuration of thin-shell wormholes formulated from two equivalent geometries of charged black hole with nonlinear electrodynamics. We consider Visser cut and paste approach and Israel formalism to construct a thin-shell. The corresponding components of stress-energy tensor of matter distribution located at the wormhole throat can be evaluated through Lanczos equations. We analyze the attractive/repulsive behavior of wormhole throat and also examine the presence of exotic matter at thin-shell through energy conditions. The stability of thin-shell is investigated by using equations of state for exotic matter and radial perturbation about equilibrium throat radius. It is found that the presence of nonlinear electrodynamics gives the possibility of a stable structure for barotropic as well as variable models.

31. **Speaker:** Philippe Jetzer
    Institution: University of Zurich, Switzerland
    Title: Tests of general relativity with LISA

Abstract: The LISA (Laser Interferometric Space Antenna) is an ESA/NASA space mission with the aim to observe gravitational waves in space at lower frequencies than is possible with Earth bounded detectors. I shall briefly describe the objectives of the mission and discuss in particular the possibilities to test the theory of general relativity.

32. Speaker: Umara Kausar
Institution: National University of Sciences and Technology, Islamabad, Pakistan
Title: Mei Symmetries of Bardeen Space-times

Abstract: Singularity-free black hole space-time is described by Bardeen space-time, which is regular space-time. On the other hand, Mei symmetries are useful in a wide range of physics and applied mathematics applications. Mei symmetries are modern approach to obtain the conserved quantities. Mei symmetries of the geodesics Lagrangian for the Bardeen space-times are developed in this article. The definitions and criteria for constructing Mei symmetries are explicitly explained. A comparison between Mei symmetries and Noether gauge symmetries are presented.

33. Speaker: Sadia Khaliq
Institution: Quaid-i-Azam University, Islamabad, Pakistan
Title: Acoustic Black Holes

Abstract: We are all somehow familiar with the definition of black hole and an event horizon. Science fiction works have greatly contributed to the widespread knowledge of these points of no return in space-time amongst the general public. What is perhaps unknown to most is how easily one can reproduce characteristics of black holes. Indeed, it has been shown that sound waves, in a moving fluid, behave analogously to scalar fields in a curved space-time. Supersonic fluid flow can generate a ``dumb hole", which corresponds to a region in space from which no information can be extracted. This is the analogue of a black hole in the theory of general relativity. In this presentation, we will focus on acoustic analogues to study the remarkable connection between classical Newtonian physics and the differential geometry of curved (3+1)-dimensional Lorentzian space-times.

34. Speaker: Shiraz Khan
Institution: University of Management and Technology, Lahore-Pakistan
Title: A Framework for Generalized polytropes with Complexity Factor using Charged Cylindrical Symmetry

Abstract: In this study we develop two consistent system of three differential equations using complexity factor with generalized polytropic equation state in presence of charge and a general frame work is established for modify form of Lane-Emden equations. For this purpose, an anisotropic fluid distribution is considered in cylindrical static symmetry with two cases of generalized polytropic equation of state (i) mass density μ_{o} and (ii) energy density μ. A graphical analysis will be carried out for the numerical solution of these systems of three differential equations for different values of charge.

35. **Speaker:** Suhail Khan
    Institution: University of Peshawar, Peshawar, Pakistan
    Title: Spherically Symmetric Static Lorentzian Ricci Soliton

Abstract: Our aim is to find Ricci solitons of spherically symmetric static spacetimes. It is shown that special classes of such spacetime metrics admit shrinking, expanding or steady Ricci solitons. It is found that spherically symmetric static spacetimes possess four, five, eight, ten or eleven Ricci soliton vector fields. It is observed that non-Einstein metrics also exist with shrinking or expanding Ricci soliton vector fields. In all the cases the obtained Ricci soliton vector fields are proved to be gradient and concircular potential fields.

36. **Speaker:** Ruth Lazkoz
    Institution: University of the Basque Country, Spain
    Title: Observational constraints on cosmological solutions of f(Q) theories

Abstract: Over the last years some interest has been gathered by f(Q) theories, which are new candidates to replace Einstein prescription for gravity. The nonmetricity tensor Q allows to put forward the assumption of a free torsionless connection and, consequently, new degrees of freedom in the action are taken into account. This work focuses on a class of f(Q) theories, characterized by the presence of a general power-law term which adds up to the standard (linear in) Q term in the action, and on new cosmological scenarios arising from them. Using the Markov chain Monte Carlo method, we carry out statistical tests relying upon background data such as Type Ia supernovae luminosities and direct Hubble data (from cosmic clocks), along with cosmic microwave background shift and baryon acoustic oscillations data. This allows us to perform a multifaceted comparison between these new cosmologies and the (concordance) \lambda-CDM setup. We conclude that, at the current precision level, the best fits of our f(Q) models correspond to values of their specific parameters which make them hardly distinguishable from our general relativity chantillon that is, \lambda CDM.

37. **Speaker:** Francesco S. N. Lobo
    Institution: University of Lisbon, Portugal
    Title: Curvature-matter couplings in modified gravity

Abstract: In this work, we review a plethora of modified theories of gravity with generalized curvature-matter couplings. The explicit nonminimal couplings, for instance, between an arbitrary function of the scalar curvature and the Lagrangian density of matter, induces a non-vanishing covariant derivative of the energy-momentum tensor, implying non-geodesic motion and consequently leads to the appearance of an extra force. Applied to the cosmological context, these curvature-matter couplings lead to interesting phenomenology, where one can obtain a unified description of the cosmological epochs. In addition to this, these models are extremely useful for describing dark energy-dark matter interactions, and for explaining the late-time cosmic acceleration. We explore the physical and cosmological implications of the non-conservation of

the energy-momentum tensor by using the formalism of irreversible thermodynamics of open systems in the presence of matter creation/annihilation. The particle creation rates, pressure, and the expression of the comoving entropy are obtained in a covariant formulation and discussed in detail. Applied together with the gravitational field equations, the thermodynamics of open systems lead to a generalization of the standard \Lambda-CDM cosmological paradigm, in which the particle creation rates and pressures are effectively considered as components of the cosmological fluid energy-momentum tensor.

38. **Speaker:** Malcolm A. H. MacCallum
    Institution: Queen Mary University of London, UK
    Title: Spacetimes with continuous local isotropies

Abstract: In my presentation at the 2019 PUICGC I gave a list of open problems concerning spacetimes with continuous local isotropies. I am now able to give a comprehensive survey of such spacetimes and present the answers to those problems, they give the relations of local invariances of the curvature and its derivatives to the existence (locally) of groups of motions of spacetime in the various possible cases.

39. **Speaker:** Amal Majid
    Institution: University of the Punjab, Lahore-Pakistan
    Title: Decoupled Solutions in Self-Interacting Brans-Dicke Gravity

Abstract: The aim of this talk is to explore the efficiency of decoupling technique via a minimal geometric deformation in the context of self-interacting Brans-Dicke gravity. In this method, new physical characteristics are incorporated in the seed matter distribution by including an extra source in the original energy-momentum tensor. In order to extract a solution of field equations, the radial metric function is transformed to decouple the field equations into two sets: the first set corresponds to the seed source whereas the second array corresponds to additional source only. Moreover, both sources gravitationally affect each other which implies that no energy is transferred between them. The system corresponding to the original matter distribution is specified by metric functions of a well-behaved solution. On the other hand, the second set is closed by imposing constraints on the additional matter source. Interesting physical features of corresponding models (for different values of the decoupling parameter) are checked by ensuring smooth matching of interior and exterior spacetimes at the junction.

40. **Speaker:** Rubab Manzoor
    Institution: University of Management and Technology, Lahore-Pakistan
    Title: Cluster of Star in Modified Gravity

Abstract: This talk explores the dynamics of evolving cluster of stars in the presences of exotic matter. The f(R) theory is used to presume exotic terms for evolution scenario. We use structure

scalars as evolution parameters to explore dynamics of spherically symmetric distribution of evolving cluster of stars

41. **Speaker:** Jaime de Cabo Martin
    Institution: National Centre for Nuclear Research (NCBJ), Warsaw, Poland
    Title: Inequivalent Quantum Cosmological bouncing models and the primordial structure

Abstract: By quantising the background as well as the perturbations in a simple one fluid cosmological model, we show that there exists an ambiguity in the choice of relevant variables, potentially leading to incompatible observational physical predictions. In a classical inflationary background, the exact same canonical transformations lead to unique predictions, so the ambiguity we put forward demands a semiclassical background with a sufficiently strong departure from classical evolution. The latter condition is clearly satisfied by bouncing models. We propose coherent states as the tool for introducing the semiclassical universe. We solve the quantum dynamics of the perturbation modes both analytically and numerically and investigate the amplitude spectra of the perturbations. We study the underlying quantum state, the Bunch-Davies vacuum, from the point of view of late-time observers by means of the Bogolyubov transformations. In particular, we study the phase space probability distributions obtained with the standard coherent states built from instantaneous vacua. We discuss the issue of the temporal phase shift with which the modes emerge from the bounce as sine waves. Finally, we find that the model may be fitted to data and shed light on the physical universe, constraining free parameters of the bouncing universe.

42. **Speaker:** Jameel Un Nabi
    Institution: University of Wah, Wah Cantt**,** Pakistan
    Title: Publishing of a new list of important weak-interaction nuclei during presupernova evolution

Abstract: An ensemble consisting of 728 nuclei, in the mass range of A = 1–100, under stellar conditions was considered in this project. The mass fractions of these nuclei were computed using Saha's equation for predetermined values of T (core temperature), ρ (stellar density), and Ye (lepton to baryon fraction) and assuming nuclear statistical equilibrium. The nuclear partition functions were obtained using a newly introduced recipe where excited states, up to 10 MeV, were treated as discrete. The weak interaction rates (electron capture (ec) and β-decay (bd)) of all 728 nuclei were calculated in a totally microscopic fashion using the proton–neutron quasiparticle random phase approximation model and without assuming the Brink–Axel hypothesis. The calculated rates were coupled with the computed mass fractions to investigate the time rate of change of Ye of the stellar matter. Noticeable differences up to orders of magnitude were reported with previous calculations. A new list of the top 50 ec and bd nuclei, which have the largest effect on Ye for conditions after silicon core burning was published. American Astronomical Society (AAS) Journals Senior Lead Editor, Prof. Frank Timmes

interviewed the author for his AAS Journal Author Series on 19th May, 2021 on account of this publication (YouTube link: https://youtu.be/xH8MouvsFG8).

43. **Speaker:** Syed Naqvi
    Institution: Astronomical Observatory, Jagiellonian University, Poland
    Title: Standing Gravitational Waves

Abstract: The phenomena of standing waves is well known in mechanical and electromagnetic setting where the wave has the maximum and minimum amplitude at the antinodes and nodes, respectively. In context of exact solution to Einstein Field equations, we analyze a spacetime which represents standing gravitational waves in an expanding Universe. The study the motion of free masses subject to the influence of standing gravitational waves in the polarized Gowdy cosmology with a three-torus topology. We show that antinodes attract freely falling particles and we trace the velocity memory effect.

44. **Speaker:** Iqra Nawazish
    Institution: University of the Punjab, Lahore, Pakistan
    Title: Cosmological Evolution of non-flat GGPDE *f (R)* model

Abstract: The basic idea of this work is to explore the cosmic evolution of non-flat Friedmann Robertson Walker universe through generalized ghost pilgrim dark energy model in the background of *f (R)* gravity. For this purpose, two well-known scale factors, i.e., power-law and unified scale factors are considered in terms of red shift parameter. For these scale factors, the given dark energy model is reconstructed in *f (R)* gravity and determine its stability/instability through squared speed of sound parameter. In order to discuss the behavior of reconstructed and dark energy models, the well-known cosmological parameter such as equation of state parameter along with ω–ω' plane is discussed. In addition to this, we also investigate compatibility of new models with standard cosmological models through state-finder parameters. The density parameter is formulated for both ordinary matter as well as dark energy components and results are compared with Planck 2018 constraints. The cosmological parameters reveal consistency with recent observations while the value of density parameter suggested by Planck 2018 is achieved by power-law scale factor in most of the cases as compared to unified scale factor.

45. **Speaker:** Hammad Nazar
    Institution: The Islamia University of Bahawalpur, Bahawalpur, Pakistan
    Title: Stellar Shear-Free Gravitational Collapse with Karmarkar Condition in f(R) Gravity

Abstract: This work has investigated the outcomes of spherically symmetric radiating dissipative gravitational collapse model with anisotropic heat conducting matter distribution by imposing time-dependent Karmarkar condition in the alternative f(R) theory of gravity. For this evaluation, we defined the smooth matching conditions between the interior space-time and exterior Vaidya solution at the junction interface. Afterwards, we have

found an exact particular solution of our radiative star model by using the Karmarkar condition. Moreover, the physical components of the matter distribution, energy conditions and time relaxational effects on the temporal profile are thoroughly discussed with graphical analysis which indicates the system is well behaved.

46. **Speaker:** Gonzalo J. Olmo
    Institution: University of Valencia, Spain
    Title: Recent progress on Ricci-Based Gravity theories

Abstract: I will present an overview of several recent works on Ricci-Based Gravity theories (RBGs). We will see how the dynamics of these theories can be studied from within GR itself and then will provide some examples of applications involving scalar fields, fluids, and electromagnetic fields. In particular, I will discuss the properties of some exotic scalar compact objects, boson stars, rotating charged objects, and multicenter solutions. I will also comment on experimental constraints on these theories.

47. **Speaker:** Isil Basaran Oz
    Institution: Antalya, Turkey
    Title: Solutions for the plane symmetric f(R) theory via Noether symmetry

Abstract: The f(R) theory is considered for static plane-symmetric spacetimes. In order to find solutions to the field equations of these models, the Noether symmetry method is used. With the assumption of f(R)=f_0*R^n , cases with matter and non-matter are examined and general solutions are determined.

48. **Speaker:** Francesco De Paolis
    Institution: University of Salento, Italy
    Title: Never bet against Einstein

Abstract: Even if Einstein himself often did not believe in what it was written in his equations, it is never a good idea to bet against him. The main predictions and experimental verifications, up to the most recent ones, of Einstein's Theory of General Relativity will be discussed.

49. **Speaker:** Asghar Qadir
    Institution: Abdus Salam School of Mathematical Sciences, GCU, Pakistan
    Title: Foliation of Schwarzschild and Reissner-Nordstrom black holes Revisited

Abstract: In the Sixteenth Marcel Grossmann Meeting the talk of the Nobel Laureate Gerard 't Hooft and some others made some points that more-or-less repeated some work of Azad Siddiqui and myself on what we called "flat foliations", about fifteen or more years ago. Further, some work by others showed a lack of clarity about various phenomena related to the Schwarzschild black

hole that are contained in that work. As such, it seems to be worth highlighting the lessons to be learned from that work. That will be done in this talk.

50. **Speaker:** Umer Rehman
Institution: Air University Islamabad, Islamabad, Pakistan
Title: The Quantum Gravitational Instability Analysis of Compact Astrophysics Objects

Abstract: Using quantum magneto-hydrodynamic (Q-MHD) model, a set of governing equations is presented for a gravitational instability in an extremely dense plasma environment such as Neutron stars. A local dispersion relation is derived for the gravitational mode in a magnetized charge particle environment, where the effects of exchange and correlation for electrons are taken into account. The dispersion relation is then analyzed both analytically as well as numerically. It is found that inclusion of the exchange and correlation effects modifies the growth rate of the gravitational instability and gives the quantum gravitational mode a stabilizing effect. The linear growth rate of the mode is found to be localized due to Bohm potential and the potential associated with the exchange and correlation. It is estimated that results might be useful in interpreting the stability analysis of a quantum nonuniform magneto-plasma system of natural phenomena such as astrophysical compact objects (white dwarfs/ neutron stars).

51. **Speaker:** Luciano Rezzolla
Institution: Goethe University, Germany
Title: Imaging a supermassive black hole

Abstract: I will briefly discuss how the first image of a black hole was obtained by the EHT collaboration. In particular, I will describe the theoretical aspects that have allowed us to model the dynamics of the plasma accreting onto the black hole and how such dynamics was used to generate synthetic black-hole images. I will also illustrate how the comparison between the theoretical images and the observations has allowed us to deduce the presence of a black hole in M87 and to extract information about its properties. Finally, I will describe the lessons we have learned about strong-field gravity and alternatives to black holes.

52. **Speaker:** Khalid Saifullah
Institution: Quaid-i-Azam University, Islamabad, Pakistan
Title: Deformations of the Kerr Black Hole

Abstract: The Kerr black hole hypothesis can be tested by using two approaches namely the top-bottom approach and bottom-up approach. The first one involves introducing the deviations in the Kerr metric through a theoretical model. The second approach involves introducing the deviations in terms of parameters. The metric proposed by Johannsen and Psaltis is one such parametrically deformed Kerr spacetime. It reduces to the Kerr metric when one sets the deviation parameters to zero. We construct some generalizations of this spacetime including the charged and accelerated versions and discuss their horizon structure and thermodynamics.

53. Speaker: Rabia Saleem
Institution: Comsats University Islamabad, Lahore Campus, Pakistan
Title: Wormholes with Vanishing Sound Speed under a Numerical Approximation

Abstract: We explore exact solution of the field equations for static spherically symmetric wormhole metric in the framework of modified gravity. We adopt the Pad\'{e} approximants to characterize rational shape function. The lowest Pad\'{e} order $P(0,1)$ is considered, and the stable fluid perturbations are obtained for particular shape functions inside the wormhole throat. We determine the suitable bounds for involved model parameters providing the stability and vanishing sound speed in the wormhole geometry.

54. Speaker: Iqra Shahid
Institution: Study of Warm In ation using Irreversible Thermodynamical Description within Rastall Gravity
Title: COMSATS University Islamabad, Lahore Campus, Pakistan

Abstract: This manuscript aims to study warm inflation via ``irreversible thermodynamics of open systems'' with matter creation/decay within Rastall theory of gravity. Interacting scalar field and radiation are assumed to be the components of cosmological fluid in spatially flat FRW universe model. Considering early universe as an open system, and implementing the thermodynamics along with the dynamical equations in Rastall gravity on the interacting cosmological fluid leads to modify the standard formalism of warm inflationary model, including the creation(decay) pressure, which is considered as part of the energy-momentum tensor explicitly. Under slow-roll approximation and introducing some dimensionless variables, numerical solutions of the thermodynamical equations (scale factor, number of scalar field particles, energy densities of scalar field and radiation and temperature) are obtained and represented graphically. For appropriate set of initial conditions, these results depict the phase transition from acceleration to deceleration phase. Using obtained solutions, we calculate inflationary observable like ``slow-roll parameters, number of e-folds, scalar/tensor power spectra, scalar/tensor spectral indices and tensor-to-scalar ratio''. By constraining the free model parameters, the theoretical predictions of the under lying model are compared with the Planck-2018 data.

55. Speaker: Umber Sheikh
Institution: National Textile University, Faisalabad, Pakistan
Title: On Dynamics of Anisotropic Compact Stars in Rainbow Gravity

Abstract: This work is devoted to analyze the evolution of compact stars from an anisotropic string fluid using Karori-Barua metric. The field equations and dynamical variables of the string fluid are explored. We found the values Rainbow parameter, for which the dynamical variables satisfy the energy conditions which shows the existence of physical matter. Further, we shall investigate the physical features including anisotropy, stability, TOV equation, mass function, compactness and red-shift of compact stars in Rainbow Gravity.

56. Speaker: Aisha Siddiqa
Institution: Virtual University of Pakistan, Lahore, Pakistan
Title: Gravitational waves propagation in the context of f(R) theory

Abstract: In this talk, the propagation of gravitational waves (GWs) will be discussed in the framework of the f(R) theory. The metric tensor and the energy momentum tensor of matter are perturbed by using the Reggeâ€“Wheeler perturbations scheme. The coupled system of differential equations of the perturbation parameters for two cosmological eras namely the radiation-dominated epoch and the de Sitter stage are formulated. In the former case, the model considered predicts exactly the same result of the General Relativity theory. However, for de Sitter era the propagation of GWs is affected by the presence of higher order curvature terms.

57. Speaker: Azad A. Siddiqui
Institution: National University of Science and Technology, Pakistan
Title: On Solutions of the Einstein-Maxwell Field Equations using the Segre Classification

Abstract: There is arbitrariness in finding solutions of the Einstein-Maxwell field equations. Many solutions of these equations are obtained by assuming expressions for electric field intensity, gravitational potential, equation of state, etc. Here, using the Segre classification, we present a scheme that limits the number of assumptions required to be taken.

58. Speaker: Muhammad Tahir
Institution: Govt. Graduate College Mailsi, Pakistan
Title: Spherically symmetric gravitational collapse in Einstein Gauss–Bonnet theory

Abstract: This paper deals with spherically symmetric gravitational collapse of inhomogeneous perfect fluid in Einstein Gauss–Bonnet gravity. The physical quantities have been plotted in the EGB gravity. The Ricci Scalar and Kretschmann scalar have been determined to study the curvature singularity. The shell focusing curvature singularities are generated at the last stage of gravitational collapse of the object. The formation of singularity and apparent horizon depends on the initial data. Also, the energy conditions have been discussed for the reasonable energy momentum tensor. The presence of GB coupling constant α modifies the structure of singularity and formation of apparent horizon.

59. Speaker: Zoha Tariq
Institution: University of the Punjab, Lahore, Pakistan
Title: Effects of charge on Polytropes in Modified theory of gravity

Abstract: The center of attention of this article is to examine the dynamics of conformally flat anisotropic spheres in the background of electromagnetic field satisfying the polytropic equations of state. We have resorted to the general framework developed in Herrera and Barreto (2013) that helps to inspect the rudimentary attributes of polytropic spheres in the framework of a particular f

(R) gravity. We explored physical constraints for couple of families of relativistic polytropes in this scenario. By making use of conformally flat condition, the stability of such polytropes is then checked analytically via the Tolman-mass. We conclude that electromagnetic field produces the same role as that of anisotropic pressure and the configurations made are quite compact.

60. **Speaker:** Anzhong Wang
    Institution: Baylor University, USA
    Title: Testing Gravitational Theories with Broken Lorentz Symmetry by Gravitational Wave and Black Hole Observations

Abstract: So far (September 1, 2021) more than 50 gravitational waves (GWs), emitted by binary systems of black hole - black hole (BBH), or black hole - neutron star (BBN), or neutron star - neutron star (BNS), have been observed by LIGO and Virgo collaborations, since the first detection in the human history by LIGO on September 14, 2015. The 2017 physics Nobel Prize was awarded to three leaders of the observation, Profs. Rainer Weiss, Barry Barish and Kip Thorne, while half of the 2020 physics Nobel Prize went to Prof. Roger Penrose ``for the discovery that black hole formation is a robust prediction of the general theory of relativity." Soon, observations of GWs will become routine, and their applications to understanding fundamental physics just start. One of such applications is to test gravitational theories by GW observations.

In this talk, I shall present our recent studies on testing Einstein-aether theory by GWs. Einstein-aether theory is a particular type of the general vector-tensor theory, in which the vector field, the so-called aether, is timelike and unity, so it defines a preferred direction at each given moment and spatial point. As a result, it locally breaks the Lorentz symmetry - a cornerstone of modern physics. Yet, it is self-consistent (free of ghosts, instabilities, and so on), and is consistent with all the observations and experiments. Its Cauchy problem is also well imposed. In addition, due to the presence of the aether, three different species of gravitons exist, the spin-0, spin-1, and spin-2 gravitons, while in Einstein's general theory of relativity (GR), only spin-2 gravitons exist. This will bring dramatical differences especially in the strong-field regime.

In this talk, I shall first provide a basic overview on GWs in GR, and then report what we have found in Einstein-aether theory. In particular, I shall show that the GW observations already reduce the four free coupling constants of the theory to two, and future studies of GWs emitted in the inspiral and ringdown phases shall further reduce the parameter space of the theory.

61. **Speaker:** Aqsa Yasmin
    Institution: National University of Sciences and Technology, Islamabad, Pakistan
    Title: Massive Sterile Neutrinos in Dark Matter Halos

Abstract: This study pertains to an investigative analysis of the Ruffini-Arguelles-Rueda (RAR) model of a self-gravitating gas of about 48 to 345 keV degenerate fermions that form a fully degenerate core, with and without considering the cutoff effects. These fermions are taken to provide the non-baryonic dark matter which lie outside the standard model of Particle Physics, and

are known as "sterile neutrinos" or "neutralinos". It assumes a degenerate Fermi core surrounded by a partially degenerate Fermi halo. We see if we get the cores collapsing into black holes in such a system enhancing the potential well of the degenerate fermions. In order to conduct an analysis, we use fermions of masses 48 keV, 56 keV, 100 keV, 200 keV, and 345 keV for the calculations. The density profiles and rotation curves show three remarkably different regimes: the quantum core, transition region from quantum to classical effects, and classical halo. We also check the results for masses below 48 keV. Latest research shows that at fermion mass 56 keV/c2 a compact core with mass and size close enough to that of Sgr A* is obtained, this gives an excellent explanation to the idea of considering a fermionic core as an alternative to Sgr A*.

62. Speaker: Muhammad Ayub Khan Yousuf Zai
Institution: University of Karachi, Karachi, Pakistan
Title: Wavelet Analysis of Interaction of Radio Wave with the Ionosphere at Pakistan Air Space Gravitationally decoupled fluid spheres in f(R,T) theory

Abstract: In this study we are in a position to recognize the property of ionized upper atmospheric region ranging up to 700 Km, the ionosphere the part of upper atmosphere interferes high frequency radio signals. The fluctuation in electron-ion concentration is function of temperature, solar radiation and altitude in the ionosphere region The data sets obtained from local and global sources that contain the periods mentioned as Karachi Ionosphere station (KIS) 1996, 2000, 2006, Islamabad Ionosphere station (IIS) 2005, 2006 and Wakanai (WK) 545-2005.

This work also counts the parametric variability of the ionosphere. The local data has been acquired from the space agency of Pakistan (SUPARCO) using Digisonde-256. The implementations of the implementations of explorative analytic approach provided insight into the ionosphere. We have performed wavelet analysis. This approach has been utilized both in space and frequency components of ionospheric variables. The principal so far it is known as 1-Dimentional Haar wavelet transform one-to-five level.

It has been implemented and functionalized with discontinuities. The ionospheric variables have been decomposed using this technique. Another aspect of wavelet has been considered as de-noising process that can fractionate the noisy signals. The evaluation of signal construction is carried out by analyzing the coefficient and detail approximation. The patterns and trends for Pakistan and Japan ionosphere regions are found comparable.

It has been observed that all the estimations and forecasts values are of international standard and useful for public and private organizations dealing with ionosphere communication research & development. This research work appraises results for Pakistan and Japan ionospheres and revealed physical behavior of ionosphere at Pakistan and Japan regions.

63. Speaker: Muhammad Zubair
Institution: COMSATS University Islamabad, Lahore Campus, Pakistan
Title: Gravitationally decoupled fluid spheres in f(R,T) theory

Abstract: An analytic anisotropic fluid sphere is obtained in light of f(R, T) gravity theory and gravitational decoupling by means of Extended minimal geometric deformation scheme in EMGD. All the limitations and implications of f(R,T) gravity in EMGD framework have been presented in detail. A thoroughly study on the main salient features of the output such as density, radial pressure, transverse pressure and anisotropy factor is performed to check the feasibility of the model, in order to determine whether this structure can represent real celestial bodies such as neutron stars. Furthermore, the consequences of EMGD on some relevant astrophysical parameters, that is, the total mass M and gravitational redshift z around the object are explored.