Relativistic Gravitational Collapse in Electromagnetic Theory

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In this talk, we address the issue of gravitational collapse in electromagnetic theory. For this purpose, we adopt two approaches one by assuming charged perfect fluid in the interior of a star and another by studying the dynamics of thin shell of matter on the surface of a charged star. The cylindrically symmetric charged perfect fluid collapse is explored by assuming that charged perfect fluid is moving along geodesics in the interior of cylinder. In this case, the analytic solution of the Einstein-Maxwell field equations represents gravitational collapse. We formulate general dynamical equations using Israel thin shell formalism in charged background which helps to investigate gravitational collapse of scalar field and polytropic matter thin shell. In massless case, we find that scalar shell either expands to infinity or collapses to a point forming a curvature singularity. Also, the massive scalar field shell can exhibit the bouncing behavior. It is found that expanding and collapsing polytropic matter as well as perfect fluid shell comes to rest, then re-expands to infinity or re-collapses to a point. The charged perfect fluid collapse with positive cosmological constant is investigated in Friedmann model. We find marginally bound solution in this case. Also, the formation of apparent horizons is discussed. The end state of charged perfect fluid gravitational collapse in both models has been found as a black hole.

Cylindrical Gravitational Collapse of an Anisotropic Non-dissipative Fluid

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We investigate the cylindrical gravitational collapse with an anisotropic non-dissipative fluid by considering the appropriate geometry of the interior and exterior spacetimes. We matched collapsing fluid to an exterior containing gravitational waves. It is shown that the radial pressure is vanishing on the hypersurface.

Hawking Temperature of Rotating Charged Black Strings from Tunneling

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Thermal radiations from spherically symmetric black holes have been studied from the point of view of quantum tunneling. In this work we extend this approach to study radiation of fermions from charged and rotating black strings. Using WKB approximation and Hamilton-Jacobi method we work out the tunneling probabilities of incoming and outgoing fermions and find the correct Hawking temperature for these objects. We show that in appropriate limits the results reduce to those for the uncharged and non-rotating black strings.

Is Negative Dark Energy a Quantum Effect?

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The universe is becoming stranger by the day and now it is looking as if the dark energy may have been negative in the past. If "proved" this will be a very important twist in the tale and one that will require some new ideas if a consistent theoretical explanation are to be sought. Causal Set theory, a quantum gravity candidate theory, already has a natural explanation for the magnitude of the dark energy without any fine tuning. The same model can explain a change in the sign of the dark energy as well. I will discuss the model and both these aspects in some detail.

Solitonic Solutions of the Ricci flow, Einstein-Scalar Field Theory and Vacuum Axially Symmetric Static Metrics

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Ricci flow is at the center of geometric analysis and has been used to prove the Poincare conjecture. It has also been found to have profound links to physics via the Renormalization group flow. The talk will explore the first non-trivial connection between Ricci flow equations and the Einstein equations. In particular it will show that solutions of the Einstein equations with scalar-matter sources correspond to Ricci solitons (self-similar solutions of the flow) in one higher dimension and will provide explicit examples with co dimension-two maximal symmetry. To generate more complete, non-singular examples of Ricci solitons, it will then revisit Ricci-flat

solutions of two commuting hypersurface orthogonal Killing vector fields (which in Lorentzian signature are the axially symmetric static vacuum solutions) and present a new algebraic method of generating new one-parameter family of solutions from old ones.

Electron Radial Phase Space Density and Characteristic Signatures of Radial or Local Acceleration

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Radiation belt science has several enigmatic issues among which are the yet unexplained electron acceleration in the million electron Volt (MeV) energy range. An extensive data set of Relativistic Electron-Proton Tele-scope (REPT) on board the Radiation Belt Storm Probe (RBSP) is studied for the 28 June, 2013 electron acceleration event. Phase space density is first determined for 2.30 MeV particles from measured integral flux and then calculated for the appropriate energy that conserves the first adiabatic invariant. It is shown that the time dependent radial profile of phase space density supports the local acceleration mechanism.

Ricci Dark Energy of Amended FRW Universe in Chern-Simon Modified Gravity

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The energy density of the universe is proportional to the Ricci scalar curvature in the dynamical Chern-Simon (CS) modified gravity. In this paper, we consider the Amended Friedman-Robertson-Walker (AFRW) universe and explore its scale factor and the Ricci Dark Energy. These turned out to be well-defined and definite. We compare the scale factors of FRW, Generalized Chaplygin gas (GCG) and AFRW models graphically. The combined graph of these models show that the behavior of both FRW and AFRW models is similar as these overlap each other for choosing particular values of the integration constants. Also, we draw a combined graph of the Ricci dark energy densities of FRW and AFRW models, in CS gravity, and the energy density of GCG. It shows that the densities of former two models are increasing with time while the energy density of GCG is decreasing.

Teleparallel Killing Vectors of Bertotti-Robinson Metrics-I,II using Diagonal and Non-Diagonal Tetrad Fields

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The paper is devoted to explore the Killing vectors of Bertotti-Robinson metrics I and II by using two different sets of tetrad in the context of teleparallel theory of gravity. For this purpose, we consider diagonal and non-diagonal tetrad fields of the said metrics and solve the teleparallel version of the Killing equations. It is shown that the two sets of tetrad give different results. The comparison of the results with already available, in literature, in the context of General Relativity is given.

Superluminal Dirac Type Equation

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Superluminal propagation of neutrinos is investigated. A tachyonic Dirac equation is developed, which shows that tachyons propagate in the Euclidean space. Lorentz invariance is achieved by the introduction of new gamma matrices as the consequence of superluminal Dirac equation. Charge density, current density and Hamiltonian appeared with a negative sign. These observations and solution of the superluminal Dirac equation leads towards the statement that "superluminal fermions are actually the anti-fermions". Same technique guided the existence of superluminal bosons.

Kinetic Vortices in Non-Maxwellian Plasmas

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The Kinetic Theory of non-Maxwellian mode is developed with Orbital Angular Momentum (OAM) states for the un-magnetized plasmas. The Laguerre-Gaussian (LG) mode function is considered to model the modified non-Maxwellian dielectric function to study of Landau wave particle interaction.

Bounds on Majoron Emission from Muon to Electron Conversion Experiments

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In this work we studied the decay spectrum of bound muon in and beyond the standard model. In case of free muon decay in standard model, it is well known that due to the momentum conservation the maximum energy attained by the final state emitted electron is half of the muon mass. However, in the bound muon case the nucleus absorbs the three momentum of the emitted electron and hence it can have energy equal to the muon mass. This bound state nature changes the shape of the decay spectrum. Like-wise, we have also studied the binding effects in muon decay to electron and majoron. It is found that the future $\mu \rightarrow e$ conversion experiments may be able to produce bounds on the $\mu \rightarrow ej$ rates which are comparable with the ones from direct searches.

Two Point Correlation Functions in ADS/QCD

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We study the Hard Wall AdS/QCD model, the simplest model of bottom up approach to AdS/QCD. We reveal the relation between the fields in the model and operators in QCD, fix parameters of model and calculate several quantities of interest. We underline the problems of the model and proposed the way to solve them.

Lie Algebras and Linearizations

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Differential Equations play a significant role in mathematical modeling of physical problems in applied sciences from atoms to star. In this talk Linearization and its connection with Lie algebras will be discussed. Moreover their applications for Scalar ODEs will be discussed. Furthermore the extension of this approach for systems of ODEs will be discussed in details. Physical examples will be discussed to illustrate this approach.

Thin Shell Wormhole in Born-Infeld Electrodynamics with Modified Chaplygin Gas

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In this paper, we construct spherically symmetric thin-shell wormholes in the scenario of Born-Infeld electrodynamics theory. We take the modified Chaplygin gas for the description of exotic matter around the wormhole throat. The stability of static wormholes with different values of charge and Born-Infeld parameter is investigated. We compare our results with those obtained for generalized Chaplygin gas and conclude that stable static wormhole solutions also exist even for large value of Born-Infeld parameter.

Cosmological Issues in F(T) Gravity Theory

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As an approach to explain the current accelerated expansion of the universe, there exists a way of modifying gravity at a long distance. In this presentation, among such gravity theories, we concentrate on extended teleparallel gravity called “F(T) gravity", where T is the torsion scalar in teleparallelism. We discuss various cosmological aspects of F(T) gravity including the evolution of the equation of state for the universe, finite-time future singularities, thermodynamics, and a four-dimensional effective F(T) gravity theory coming from the higher-dimensional Kaluza-Klein (KK) and Randall-Sundrum (RS) theories.

Some Inhomogeneity Factors in Self-gravitating Systems

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In this talk, we will discuss the effects of some physical factors on the inhomogeneity of self-gravitating system filled with imperfect matter.

A Holographic Model of p-wave Superconductor

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In the Einstein-Maxwell-complex vector field theory with negative cosmological constant, we build a holographic model of p-wave superconductor. We find that the charged vector condenses via a second order phase transition both in the black hole and AdS soliton background. Depending on two parameters, the mass and charge of the vector field, we find a rich phase structure: zeroth order, first order and second order phase transitions can happen in this model. We also find "retrograde condensation" in which the hairy black hole solution exists only for the temperatures above a critical value with the free energy much larger than the black hole without hair. We construct the phase diagram for this system in terms of the temperature and chemical potential. When an external magnetic field appears, it is found that the background magnetic field can induce the condensate of the vector field even in the case without chemical potential/charge density. In the case with non-vanishing charge density, the transition temperature rises with the applied magnetic field, and the condensate of the charged vector operator forms a vortex lattice structure in the spatial directions perpendicular to the magnetic field.

Noether Guage Symmetries in Some Gravity Theories

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In this study, we derive the Noether gauge symmetries of a canonical Lagrangian for somegravity theories. To get the appropriate equations of motion in the considered theory of gravity, we set up an effective point-like Lagrangian in terms of its configuration space variables and their velocities. Using this effective Lagrangian, we calculate and classify Noether gauge symmetry generators. Furthermore, we give conservation laws admitted by Lagrangians for representing physical system.

Hydrostatic Equilibrium and Stellar Structure in f(R) Gravity

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We investigate the hydrostatic equilibrium of stellar structure by taking into account the modified Lane'-Emden equation coming out from f(R)-gravity. Such an equation is obtained in metric approach by considering the Newtonian limit of f(R)-gravity, which gives rise to a modified Poisson equation, and then introducing a relation between pressure and density with polytropic index n. The modified equation results an integro-differential equation, which, in the limit of General Relativity becomes the standard Lane'-Emden equation. We find the radial profiles of gravitational potential by solving for some values of n. The comparison of solutions with those coming from General Relativity shows that they are compatible and physically relevant. This analysis gives rise to unstable modes not present in the standard Jeans analysis (derived assuming Newtonian gravity as weak filed limit of f(R) =R). In this perspective, we discuss several self-gravitating astrophysical systems whose dynamics could be fully addressed in the frame work of f(R)-gravity.

Gravitational Microlensing-Probing Populations of Celestial Bodies Over Nine Decades in Mass

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The gravitational bending of light by celestial bodies is a "most curious" effect, yielding rare transient events. Given that it probes mass, it provides us with an unparalleled opportunity to study populations of faint or dark objects over a mass range spanning nine decades from black holes, neutron stars, and white dwarfs over brown dwarfs and planets, down to satellites. With emerging technology and new instruments, we are just on the verge of fully exploiting this tremendous potential for pushing the frontier of astronomical exploration at several fronts.

Oscillations in Fully Degenerate Pair and Warm Pair-ion Astrophysical Plasmas

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On astrophysical scales, quantum plasmas are found naturally in dense end-stage stars, for instance white dwarfs and neutron stars. Similarly quantum plasma effects are notable in high energy density matter and next generation laser-dense target interaction experiments. Rapidly increasing attention has been noted in the past decade in quantum plasmas due to their potential applications in various important physical systems.

Pair plasma (broadly known as Electron-positron (EP) plasma) is a class of plasmas with equal mass and absolute charge which is believed to having existed abundantly in early universe. Such plasmas are ubiquitous in many astrophysical environments, e.g., in the bipolar outflows (jets) in active galactic nuclei in the interior of accretion disks surrounding black holes, in the magnetospheres of pulsars and neutron stars, polar regions of neutron stars, at the center of Milky Way galaxy, and so on. Such plasmas of astrophysical origin particularly in neutron stars are highly degenerate and ultra-dense.

The aim of the present work is to study the low frequency (lower than the electron cyclotron frequency for electron mode and ion cyclotron frequency for ion mode) electrostatic and electro-magnetic modes in a dense and highly degenerate EP as well as warm EPI plasmas. We emphasize the dispersive and degeneracy effects, ion weak thermal effects as well as the properties of such modes when magnetic field is enormously high as the case of neutron stars.

Scalar and Electromagnetic Waves Scattering from Schwarzschild Black Hole

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The scattering phenomenon of scalar and electromagnetic waves by a spherically symmetric nonrotating Schwarzschild black is considered and presented. We discussed the scattering of electromagnetic wave incident upon a Schwarzschild black hole. By applying the partial wave analysis techniques for the electromagnetic scattering cross section interesting numerical results are obtained that are in good agreement with analytical approximations. In present talk the scattering of electromagnetic waves is compared with the scattering of scalar waves.

Symmetries, Orbits and Isotropy in General Relativity Theory

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This lecture gives a review of the study of symmetry in Einstein's General Theory of Relativity mainly from the global, geometrical viewpoint. Although concentrating mostly on metric (Killing) symmetry, the techniques described are applicable also to homothetic, conformal, projective and affine symmetry together with the symmetries of the curvature tensor and Weyl's conformal and projective tensors and these are briefly described. A discussion will also be given of Killing orbit theory including the possible dimensions and types of such orbits and of the associated isotropies. As examples, these results will be applied to cosmology and plane waves in general relativity. A few brief remarks are given on local symmetry.

Gravitational Radiation Within its Source

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We review a recently proposed framework for studying axially symmetric dissipative fluids. Some general results are discussed at the most general level. Next, the shear-free case is considered. It follows in this case that all geodesic and shear-free fluids are irrotational, and as consequence of this, they are also purely electric. Such a result holds for a general fluid (non necessarily perfect). Now, if following Bel we define a state of intrinsic gravitational radiation (at any given point), to be one in which the super-Poynting vector does not vanish for any unit timelike vector, then since the vanishing of the magnetic part of the Weyl tensor implies the vanishing of the super-Poynting vector, it is clear that when looking for gravitationally radiating sources (at least under the geodesic condition) we should consider shearing fluids. Therefore as a further step to the understanding of gravitationally radiating sources, we shall next discuss the simplest fluid distribution compatible with a non-vanishing super-Poynting vector, namely: perfect fluid under the geodesic condition. Two cases are clearly differentiated: with and without vorticity. In the latter case, explicit expressions for the scalars defining the magnetic part of the Weyl tensor are found, but no gravitational radiation is expected. The purely magnetic subcase is analyzed in some detail. The case with non-vanishing vorticity is expected to produce gravitational radiation, and is also considered in detail, some specific models are found.

Symmetries of the Geodesic Lagrangian in Bianchi type V Spacetimes

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In this paper we investigate Noether symmetries of Bianchi type V spacetimes. Our study is mainly divided into three main parts. (a) First we carry out complete classification of Bianchi type V spacetimes using Lie algebra of Noether symmetries. (b) Then we employ Noether's theorem to obtain conservation laws in each case and discuss their analytical properties. (c) Lastly we give a brief comparison of their Noether symmetry algebras, conformal Killing vectors, homotheties, Weyl and Ricci collineation.

Dynamics of Thin-Shell for a String Cloud

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In this paper we study the dynamics of scalar field thin shell in a string cloud background. We formulate equation of motion using Israel junction conditions. The corresponding effective potentials and scalar fields are evaluated numerically for massless and massive cases.

Impact of Solar Spin on Planetary Orbits

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It is an empirical fact based on solar physics of sunspots, that our sun and generally stars are spinning gravitational sources for bodies in orbit in any such solar system. Thus, a planetary theory for the gravitational field of a star or a satellite dynamics around a (spinning) planet- including the problem of artificial satellites- should in principle, take into account the possible effect of axial symmetry. But to the best of our knowledge, existing formalisms of gravitation physics do not address the problem of spin referred to above. This paper proposes the following strategy to handle this kind of computational physics. Our calculations suggest that this kind of spin should give rise to a slight residual perturbation on constant areal velocity, computed by the standard model of orbital theory. In particular, the second law of planetary motion might require revision. Also, it turns out that the classical result of Kepler is recoverable from our result as a special case.

Hybrid Model in the Light of PLANCK and BICEP2

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Role of quantum corrections has been studied during the inflationary era, employed to the Non-Super Symmetric Hybrid models. These correction terms are the result of Yukawa interaction between inflaton field and right handed neutrinos. In contrast to tree level hybrid inflationary (TLHI) model, red tilted spectral index ns is obtained for radiatively corrected hybrid inflationary (RCHI) model, consistent with PLANCK data for sub-Planckian inflaton field. The predicted tensor-to-scalar ratio by RCHI model for sub-Planckian inflaton field lies well below the precision of PLANCK mission to observe primordial gravitational waves.

Charged Particle Dynamics around Black Holes

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We discuss the dynamics of a charged particle around slowly rotating Kerr black hole.

Hawking's Phenomena of Black Hole Radiation

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We studied some significant characteristics of Hawking's radiation spectrum as a tunneling phenomenon of charged particles. Hawking radiation effects are investigated by considering charged fermions tunneling through black hole horizon by applying semi-classical approximation to the general covariant Dirac equation. From this process, we evaluate the tunneling probabilities of outgoing charged particles and their corresponding Hawking temperatures.

Analysis of Generalized Ghost Pilgrim Dark Energy in Non-flat FRW Universe

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The work is based on the non-flat geometry which contains the framework of interacting generalized ghost pilgrim dark energy with cold dark matter. Some well-known cosmological parameters (evolution parameter and squared speed of sound) and planes (ω_{Λ}-ω'_{Λ} and state finder) are constructed in this scenario. The results of obtained cosmological parameters and planes are compared with present-day observational data.

Gravitational Wave Detection from Space

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I will present the proposed satellite eLISA/NGO as an ESA space-based mission to detect gravitational waves from space. I will give an overview of the main scientific goals. In particular, this mission will be able to study in great detail black hole mergers and this way test general relativity in the case of strong gravity to high accuracy. Moreover, it will give a census of black hole masses and spins and distinguish between competing scenarios for the formation and growth of massive black holes through hierarchical merger and accretion.

Zero Age Main Sequence Star Modeling Using Statstar Code

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Stars are formed following the gravitational collapse of cold molecular clouds found in the Universe. As the cloud or portions of it collapses, approximately half of the gravitational energy gained is used to increase the internal temperature of the cloud and the remaining energy is irradiated as electromagnetic radiation in space.

Zero Age Main Sequence (ZAMS) is the time when a star first joins the main sequence on the Hertzsprung-Russell diagram (HR diagram) by burning hydrogen in its core through fusion reactions. After this time, the star enters into a phase of stellar evolution that is quite stable, and steadily processes Hydrogen into higher elements. As a result, the main sequence is a broadband that is displaced slightly from this zero-age strip.

Stars are comparatively easier to analyse than some other astronomical objects because they have simple shapes and structure i.e. spherically symmetric. The stellar model contains four basic first-order differential equations; two represent the variability of the matter and pressure with radius; and other two represent how temperature and luminosity vary with radius.

In our paper, the Statstar code has been used to model ZAMS star of mass. The star is in hydrostatic equilibrium i.e. its size is fixed and the atmosphere, rotation and magnetic field of the star are exempted in this model. We have solved some basic stellar structure equations by assuming star into spherically symmetric mass shells with specified boundary conditions and calculated associated properties of the star such as temperature, pressure, density and opacity in each zone.

Study shows that the temperature and the pressure of the star are higher at the core while the luminosity and opacity of the star is higher at the surface.

Hawking Radiations of Scalar Particles and Charged Fermions Tunneling from Accelerating and Rotating Black Holes

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Hawking radiation of uncharged and charged scalars/Fermions from accelerating and rotating black holes is studied. We calculate the tunneling probabilities of these particles from the rotation and acceleration horizons of these black holes. Using the tunneling method we recover the correct Hawking temperature as well.

Global Stability of a Competitive System of Second Order Rational Difference Equation

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In this paper, we study the qualitative behaviour of a competitive system of second-order rational difference equations. More precisely, we investigate the boundedness character, existence and uniqueness of positive equilibrium point, local asymptotic stability and global stability of the unique positive equilibrium point, and rate of convergence of positive solutions of the system. Some numerical examples are given to verify our theoretical results.

Coalescing Supermassive Black Hole Binaries-promising Sources of Gravitational Waves

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Galaxies harbour Supermassive Black Hole (SMBH) at their centres. Merger of two galaxies brings two SMBHs together in a single galaxy resulting inevitably in a binary SMBH system. Evolution of SMBH binary occurs in three distinct phases, namely, dynamical fiction caused by background stars, stellar encounters with SMBHs and emission of gravitational waves (GWs). Coalescing SMBH binaries constitute loudest sources of GW emission. However there exists a potential bottleneck in transition from stellar encounter phase to GW emission phase as supply of stars on orbits intersecting SMBH binary orbit become limited due to slingshot ejection. It was feared that SMBH binaries may stall at separations ~ 1 parsec and it will take longer than a Hubble time for them to coalesce – Final Parsec Problem (FPP). We model complete evolution of SMBH binaries in galaxy mergers, axisymmetric and tri-axial galactic nuclei by taking into account post-Newtonian corrections in equation of motion of SMBH binaries. Our studies suggest that SMBH binaries overcome FPP and coalesce in few hundred million years to few billion years depending on galaxy profiles. This coalescence time is much shorter than the age of the universe hence coalescing SMBH binaries must be promising sources of GWs for ground based and future space borne GW detectors.

Developing Theoretical Relativistic Framework for Research in Open and Flexible Learning: A New Trend in Educational Research

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The purpose of research study is to develop a theoretical framework for research in open and flexible learning because it is a new dimension in the field of education. Developing a theoretical framework for any research study is first and prime step in walking on the track to reach the distinction set by the researcher. Open and flexible learning is a new trend in education, especially in ODL and open and flexible education that is enriched with ICT-use as a basic demand of the 21st century generation in all parts of the globe. So, it requires a theoretical framework for its initiation, implementation, development and evaluation.

In any research study the literature review is carried out in order to develop, build or construct a theoretical framework. The researcher of the study has observed while attending the international conference on ODL (AAOU, 2013) that most of the studies require theoretical underpinning for ICT-use in education. The researcher assume that being a new trend in education to use ICT for teaching learning purpose; it requires conceptual clarity and theoretical background of the user and researcher, because, without theory the practice is wastage of money, time and energy and it becomes ineffective as well as sometimes unreliable and losing validity.

So, the problem stated by the researcher for the study is: Developing theoretical framework for research in open and flexible learning in ICT-rich environment: A new trend in educational research. The objective of the study is integrating the interrelated concepts to build a pnemonological network for identifying the constructs in ICT-rich open and flexible learning environment. The study is significant because it will provide theoretical background for conducting research in ICT-use for teaching and learning through open and flexible system; whether blended or online learning and training.

The methodology used by the researcher is qualitative and interpretive because there is reviewing literature and meta-analysis for building the framework. The data were analyzed and interpreted by the researcher for the findings and drawing conclusions. On the basis of findings the researcher has made suggestions and recommendations for conducting research in open and flexible learning environment by using this theoretical framework. The framework is named as Virtual Learning Environment Framework (VLEF).

Spacetime Invariants and their Uses

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There are various types of global and local spacetime invariant in general relativity. The talk will focus in the local invariants obtainable from the curvature tensor and its derivatives. The number of such invariants at each order of differentiation that are algebraically independent will be discussed. There is no universally valid choice of a minimal set. The number in a complete set will also be discussed. The invariants can then be used to characterize solutions of the Einstein equations (locally), to test apparently distinct solutions for equivalence, and to construct solutions. Other applications concern limits of families of spacetimes, the characterization of horizons and singularities, and junction conditions, and work in numerical relativity, cosmology, and, beyond general relativity, in other classical and quantum gravity theories.

Geodesics of Particle around Reissner Nordstrom Spacetime Surrounded by Quintessence

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Considering the naked singularity of the Reissner Nordstrom spacetime surrounded by Quintessence, we study the behaviour of the geodesics of an observer falling freely from infinity with some initial velocity. We find the equations of motion of particle in Kruskal coordinates for Quintessence like Reissner Nordstrom spacetime.

Dynamical Stability of Stars in Brans-Dicke Gravity

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Stability analysis can be used to describe gravitational collapse phenomenon in modified theories of gravity. It can explains collapse in different configurations (spherically, cylindrically and axially symmetries etc.) as well as in different dynamical conditions, i.e., effects of dissipation and electromagnetism etc. In this manuscript, we explain instability of spherically symmetric star in Brans- Dicke gravity. For this purpose, we use contracted Bianchi identities and perturbation approach to construct collapse equation (hydrostatic equilibrium). We obtain instability ranges in Newtonian and post- Newtonian regimes by incorporating equation of state involving adiabatic index (\Gamma).

Point-Spread Function (PSF) Photometric Analysis Open Clusters: Melotte 72 & NGC 2158

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PSF photometry of open star clusters Melotte 72 and NGC 2158 is performed utilizing g and r band data from Sloan digital Sky Survey (SDSS) Data Release 7. Stellar data, extracted using IRAF, then transformed into UBVRI photometric system using Johnsons-Cousins transformation equations. Colour-Magnitude (CM) diagrams are produced and compared against the SDSS isochrones for AB stellar system for different ages and/or metallicities. The objective of our study is to determine the physical parameters (age, distance, metallicity, reddening) of open clusters from CM diagrams. The best fit isochrones were used to estimate the star clusters parameters. The parameters have been compared against the literature (WEBDA).

First-forbidden β-decay Rates of Neutron-rich Nuclei for Astrophysical Applications

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In astrophysical environments, allowed Gamow-Teller (GT) transitions are important, particularly for β-decay rates, since they contribute to the fine-tuning of the lepton-to-baryon content of the stellar matter prior to and during the collapse of a heavy star. In environments where GT transitions are un-favored, first-forbidden (FF) transitions become important especially in medium heavy and heavy nuclei. In case of neutron-rich nuclei, FF transitions are favored primarily due to the phase-space amplification for these transitions. The FF transitions play an important role in reducing the half-lives as against those by the GT contributions alone. In this paper we calculate $0^+ \rightarrow 0^-$ and $0^+ \rightarrow 2^-$ transitions for neutron-rich nuclei. The pn-QRPA model with separable interaction is used to calculate GT and FF transitions. Half-lives calculated after inclusion of FF transitions are in better agreement with the measured half-lives. The astrophysical implications of calculated rates are also discussed.

Finite Temperature Effects on QED Interactions in Early Universe

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We aim to calculate the scattering cross sections by incorporating the finite temperature effects at one loop level using the relevant modifications in QED due to background effects in the heat bath. The early universe is usually described as a hot gas of particles in nearly thermodynamical equilibrium. The finite temperature effects arise due to continuous particle exchange during the physical interactions in the background heat bath need to be appropriately taken into consideration at temperatures ~1 MeV (~10^{10}K). In real time formulation the statistical background effects in QFT at finite temperature are included in the fermions and bosons propagator through the Fermi-Dirac and Bose-Einstein distribution functions, respectively.

The particle states, masses and couplings are known to modify due to finite temperature effects. We aim to calculate the self-energy and vacuum polarization corrections to determine the modifications in scattering processes through these radiative corrections.

Inflationary Cosmology

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The purpose of this work was to introduce the basic concepts of inflationary cosmology. Starting from the basics of general relativity I motivated why the inflationary theory is necessary and how it works. A brief discussion about the physical origin of the inflationary expansion is given and it is also described how quantum fluctuations during inflation become the seeds for the formation of large-scale structures. Finally I turned to the possible models (where potentials are main ingredients) for inflation, where by calculating different physical observables by using WMAP data of seven year, we tried to find a suitable form of potential which caused the inflation.

On Dynamical Instability of Spherical Star in f(R,T) gravity

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This work is based on stability analysis of spherically symmetric collapsing star surrounding in locally anisotropic environment in f(R, T) gravity, where R is Ricci scalar and T corresponds to the trace of energy momentum tensor. Field equations and dynamical equations are presented in the context of f(R, T) gravity. Perturbation scheme is employed on dynamical equations to find the collapse equation. Furthermore, condition on adiabatic index Γ is constructed for Newtonian and post-Newtonian eras to address instability problem. Some constraints on physical quantities are imposed to maintain stable stellar configuration. The results in this work are in accordance with f(R) gravity for specific case.

Noether Gauge Symmetries of Bianchi I Spacetimes in Scalar-Coupled Gravity Theories

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We consider the induced theory of gravity in Bianchi I. We found new exact solutions of those spacetimes via Noether gauge symmetries. We use the Noether gauge symmetries to write the first integrals and find the exact solutions of field equations for the induced theory of gravity.

Radiative Corrections for Magnetic Field Seed Generation by a Kerr Black Hole in the Accretion Disc

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Mahajan and Yoshida had proposed the generation of a seed magnetic field in hot plasma due to special relativistic effects. Asenjo, Mahajan and Qadir had used the same principles for generating a seed magnetic field due to spacetime curvature in a Schwarzschild background. This was further extended to the Kerr black hole by Qadir, Asenjo and Mahajan. Whereas the field generated by the special relativistic effects and the Schwarzschild black hole was initially very small and relied on a large build-up due to nonlinearities, for the Kerr black hole the fields could

be arbitrarily high and in fact posed a problem of divergence of the field very close to the hole. It was expected that the divergence would be controlled by the radiative back-reaction. Of course, the worry was that the back-reaction might kill the magnetic seed field. Here this question is investigated.

Reconstruction Scenario in f(T) Gravity

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The search for a viable DE model is the basic key leading to the reconstruction phenomenon, particularly in modified theories of gravity. The corresponding energy densities are compared to construct the modified function in the underlying gravity. We consider pilgrim dark energy model in f(T) gravity to discuss the accelerated expansion of the universe. The reconstructed model is discussed under some cosmological parameters as well as analysis of some cosmological planes.

Star Formation Process–Tracing the Path of Evolution for Low-Mass Proto-Stars

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The early phase of a low-mass proto-star system that emerges under self-gravity and thermal pressure of a cold molecular gas in the interstellar medium has been investigated numerically. Smoothed Particle Hydrodynamics (SPH) is utilized as a numerical tool to study the evolving physical processes involved. We have found that small temperature variations at the beginning along with the initial density perturbations are the driving agents to determine the outcome of gas collapse. Our experiments have also revealed that these thermal variations are responsible for significant changes in proto-binary separations. Critical density of the collapsing molecular core is also found as one of the key factors in determining the number of protostars emerging within collapsing gas. Furthermore, the critical density affects the structural evolution of the envelope of gas and also the dimension of emerging rotating disk structures during collapse. The entire numerical experiment is conducted by using 250025 SPH particles. These SPH particles help us to construct the geometry of molecular core investigated here.

Information Loss Paradox in Black Holes

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We discuss the information loss paradox in black holes as first propounded by Stephen Hawking. The concept of Black Hole Complementarity, Brick walls, and AMPS paradox are studied. Finally relation of entanglement with the Einstein-Rosen Bridge usually called as ER=EPR is deliberated upon as it is tied to the deeper issue of quantum gravity.

Spin-3/2 fields and the C-metric

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Emission of spin-3/2 particles in the background of accelerating black holes and the C-metric is discussed. We calculate the emission and absorption probabilities of spin-3/2 particles on these spacetimes. These backgrounds contain both black hole horizon and acceleration horizon, and have general electric and magnetic charges, rotation, and acceleration parameter.

Direction of Holy Kaaba, Diameter, Horizontal and Equatorial Coordinates of the Sun with the Help of Potable Homemade Device

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This paper mainly describes how to make a potable homemade tool to calculate the Horizontal coordinates of Celestial bodies like sun. The sun altitude and azimuth are the functions of earth motion around the sun. They are functionally varied throughout the year. The conversion of these coordinates to equatorial coordinates has also been described. Direction of Holy Kaaba with the help of this tool has been calculated for the study area. Mathematical techniques of Concurrent and Similarity has used to calculate the diameter of the sun. With the assumption as the sun is a spherical in shape the volume of the sun disk has been calculated. The complete description to make this tool is also the part of this paper.

Logamediate Brane and Warped DGP Inflationary Universe Model

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We study the dynamics of warm logamediate inflation in the context of brane and warped DGP model. In order to discuss inflationary perturbations, we evaluate perturbed parameters like scalar and tensor power spectra, scalar and tensor spectral indices as well as tensor to scalar ratio. We checked the compatibility of our model with recent data of Planck and BICEP2 by constraining the model and perturbed parameters.

Investigation of Infrared Active Phonons in Gd Doped Lmo

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XRD and FTIR patterns are studied for gadolinium doped lanthanum manganese oxide. Effective charges are find out by fitting the lorentz oscillator model to the measured reflectivity spectra.

Introduction to Torsional, Teleparallel and f(T) Gravity and their Cosmological Applications

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Torsion has been proved to be crucial in gauging gravity, which is in turn a necessary step towards its quantization. On the other hand, almost all the efforts in modifying gravity have been performed in the usual curvature-based framework. We investigate the case where one modifies gravity based on its torsional-teleparallel formulation, namely the f(T) gravity paradigm, and its cosmological applications. Moreover, we analyze the perturbations of the theory examining the growth history, we construct a cosmological bounce, and we use solar system observations in order to impose constraints on the f(T) forms. Additionally, we study the case where T is non-minimally coupled to a scalar field, as well as other extensions of the theory. Finally we analyze the charged black hole solutions of the theory, performing a comparison between f(R) and f(T) modifications.

Decay and Production Channels of Higgs & SM4

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I studied decay and production channels of higgsbososn. Different normalization and regularization techniques are used. In addition a fourth generation of leptons was studied to study these channels.

Gravitational Collapse of Dust Cloud with Dark Energy with Interaction

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We have studied the gravitational collapse of a spherical symmetric star with anisotropic pressure; this star is made of dust cloud and dark energy. The effect of dust cloud and dark energy has led to the investigation on the gravitational collapse and we found that black hole is formed as a result of interaction between these two. This work provides an overview of isotropic pressure to anisotropic pressure (Cai and Wang in Phys. Rev. D **73(**2006)063005).

Proper Projective Symmetry and Rank of the Riemann Tensor

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A study of proper projective symmetry in space-times is given using rank of the Riemann tensor, direct integration and algebraic techniques. The cases when the rank of the Riemann tensor is one, two, three or four than the space-times do not admit proper projective symmetry. Here we also discuss the very special class of the cases when the rank of the Riemann tensor is five or six.

Generalized Higgs Inflation

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The attempts to use Standard Model Higgs field as the driving force behind inflation seem not to be successful. To make it in best agreement with the experimental observations, the SM Higgs inflation has been modified and thus four different models have been presented so far. In this work, the previous four variants of Higgs inflation are unified as subclasses of generalized Higgs inflation. The result of this unification provides another model of inflation yet to be explored. In particular, the formulas of primordial fluctuations in these generalized Higgs inflation models are given in terms of the slow-roll parameters and field-dependent functions in the Lagrangian, which will be helpful to single out the model favored by the future experimental and observational data from the LHC experiment and the Planck satellite, etc. A definitive test of this paradigm would be of fundamental importance. Gravitational waves generated by inflation have the potential to provide such a definitive test. The recent discovery of gravitational waves by the BICEP2 collaboration is extremely important for the success of inflationary cosmology.

Measurement of Muon Acceptance and Tight Identification Efficiency

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This dissertation presents the measurement of Acceptance and Muon Tight Identification Efficiency in $Z \rightarrow \mu^+\mu^-$ channel and tqZ in lepton final state. The measurement was performed by using 2012 data recorded by CMS detector at LHC with Centre of Mass Energy $\sqrt{s} = 8$ TeV. Double Mu Run A data set was analyzed. The dataset has integrated luminosity of 0.82 fb-1.Acceptance was calculated for MC (Z sample) and tqZ (background) and found to be 0.357 and 0.724 respectively. Tag and probe method was used to measure Muon Tight Identification Efficiency. Scale factors are derived by comparing efficiency measured in data with $Z \rightarrow \mu^+\mu$ and tqZ MCs. These scale factors could be useful for the cross-section measurement of tqZ. Then scale factors can be applied to correct tqZ MC, which is an important requirement for tqZ cross-section measurement.

Timelike and Spacelike Matter Inheritance Vectors in Specific Astrophysical Fluids

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This paper is devoted to the investigation of the consequences of timelike and spacelike matter inheritance vectors in specific forms of astrophysical fluids, i.e., for radially symmetric and magnetized fluids. Necessary and sufficient conditions are developed for these cosmologies to admit a timelike matter inheritance vector and a spacelike matter inheritance vector. Finally, we discuss these results for the existence of matter inheritance vector in the special cases of the above mentioned spacetimes.

Existence of Double-Null Form for (3+1)-Dimensional Spacetimes

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The importance of double-null form of spacetimes is supported, especially, due to simplifications of different calculations in such coordinates. Here, using the coordinate transformations, existence of the double-null form for (3+1) dimensional spacetimes is discussed.

A Simple Relativistic Cosmology of the Universe

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The paper presents a relativistic extension of Newton's mechanics, termed Newtonian Relativity, and utilizes it to infer the state of the observable universe. The theory is successful in making significant predictions regarding the accelerating nature of the universe, its composition of matter, dark matter and dark energy, and regarding the time-line of the evolution of chemical elements. The theory yields simple expressions for the dynamics of normal matter, dark matter, kinetic energy and dark energy, in their dependence on redshift. It also yields simple expressions for the prediction of Ω_{matter} and Ω_{Λ} for any given redshift range. Predictions from these expressions are compared with observations-based ΛCDM cosmologies. Strikingly, the theoretical distribution of the kinetic energy density in the universe is bell shaped and

symmetrical around the famous Golden Ratio. With regard to the evolutionary time-line of chemical elements, the theory predicts that the chemical elements may have been formed twice: first, in massive galaxy structures at the early universe, and second, in young galaxies in the recent history of the universe.

Dark Energy from Two Higgs Doublet Model (2HDM)

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Scalar fields are among the possible candidate for dark energy. In this research work I took scalar fields from 2HDM, where instead of one (as in the standard model), two SU(2) doublets are used. After the rotation with angle beta the component fields of one (new) SU(2) doublet acts in an identical way to the standard model Higgs while the component fields of the second (new) SU(2) doublet are taken to be the dark energy candidate whose VeV is now zero. It is found that one can arrange for late time acceleration by using an SU(2) Higgs doublet in the inert Higgs doublet model, whose vacuum expectation value is zero, in the quintessential regime.

Precision Cosmology and Detectability of Quantum Gravitational Effects from the Early Universe

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I shall first give a brief introduction on the current development of observational cosmology and state clearly the demands for theoretical calculations of cosmological models with high precision. In particular, I shall emphasize that quantum gravitational effects from inflationary models are within the range of detections of the next generations of Cosmic Microwave Background (CMB) experiments. Then, I shall present the uniform approximation method developed recently by us, which is specially designed to study such effects with the upper bounds of errors less than 0.15 % up to the third-order approximations. As an example, I shall show that the quantum gravitational effects from loop quantum cosmology can be detected by Stage IV CMB experiments.

Dynamical Instability of Relativistic Fluids in f(R)Gravity

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In this talk, we discuss the role of f(R) model on dynamical instability of self-gravitating system. For this purpose, we consider such a system a system which begins collapse under some constraints. We evaluate dynamical equations and consider perturbation scheme which linearize field equations and help to construct collapse equation to study the role of stiffness parameter.

Wavelet Characterization of Discontinuities in Astrophysical Signals

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In this communication we have utilized Wavelet analysis to detect the exact instant when a signal changes. The sites of the change have been identified with their amplitude. This clearly suggests the presence of high frequency information i.e. a sudden change or discontinuity. We have determined that the spikes approximation level a_1 to a_5 of perturbed, unperturbed & mean concentration and parcel velocity of ionospheric F2 & E_S layers respectively at Pakistan air space. It has been found out that during the spikes of mean concentration & parcel velocity the unperturbed concentration and parcel velocity is very smooth. This process shows the corresponding perturbed concentration & parcel velocity while the spikes of mean concentration & parcel velocity at that instant show the strength of the signal. Similarly, at the instant when the spikes exist in unperturbed concentration & parcel velocity there is comparatively very smooth behavior obtained for the data set of mean concentration & parcel velocity. This clearly emphasizes that solar flare activity is responsible for perturbed concentration & parcel velocity.

Energy Constraints on Modified Theories Involving Non-minimal Matter-Geometry Coupling

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The present paper examines the validity of energy bounds in a modified theory of gravity involving non-minimal coupling of torsion scalar and perfect fluid matter. In this respect, we formulate the general inequalities of energy conditions by assuming the flat FRW universe. For the application of these bounds, we particularly focus on two specific models that are recently proposed in literature and also choose the power law cosmology. We find the feasible constraints on the involved free parameters and evaluate their possible ranges graphically for the consistency of these energy bounds.

Super Symmetric Hybrid Inflation in Super Symmetric SU(5)

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The adjoint field hybrid inflation is realized in a super symmetric model with a GUT gauge symmetry group SU (5). In minimal Super symmetric SU (5) hybrid inflation monopoles are produced at the end of inflation. Therefore the non-minimal model of shifted hybrid inflation based on Super symmetric SU (5) is explored by including a non-renormalizable term in the super potential, which generates an inflationary valley along which SU (5) is broken to the standard model gauge group. Thus, catastrophic production of the magnetic monopoles, which are predicted by the model, cannot occur at the end of inflation. We find that the super gravity corrections with non-minimal Kahler potential are crucial to realize the central value of the scalar spectral index ns = 0.96 consistent with the seven year WMAP data. The tensor to scalar ratio r is quite small, taking on values r ~ 10 ^-5.