BRICS-AGAC 2024

ABSTRACT BOOK

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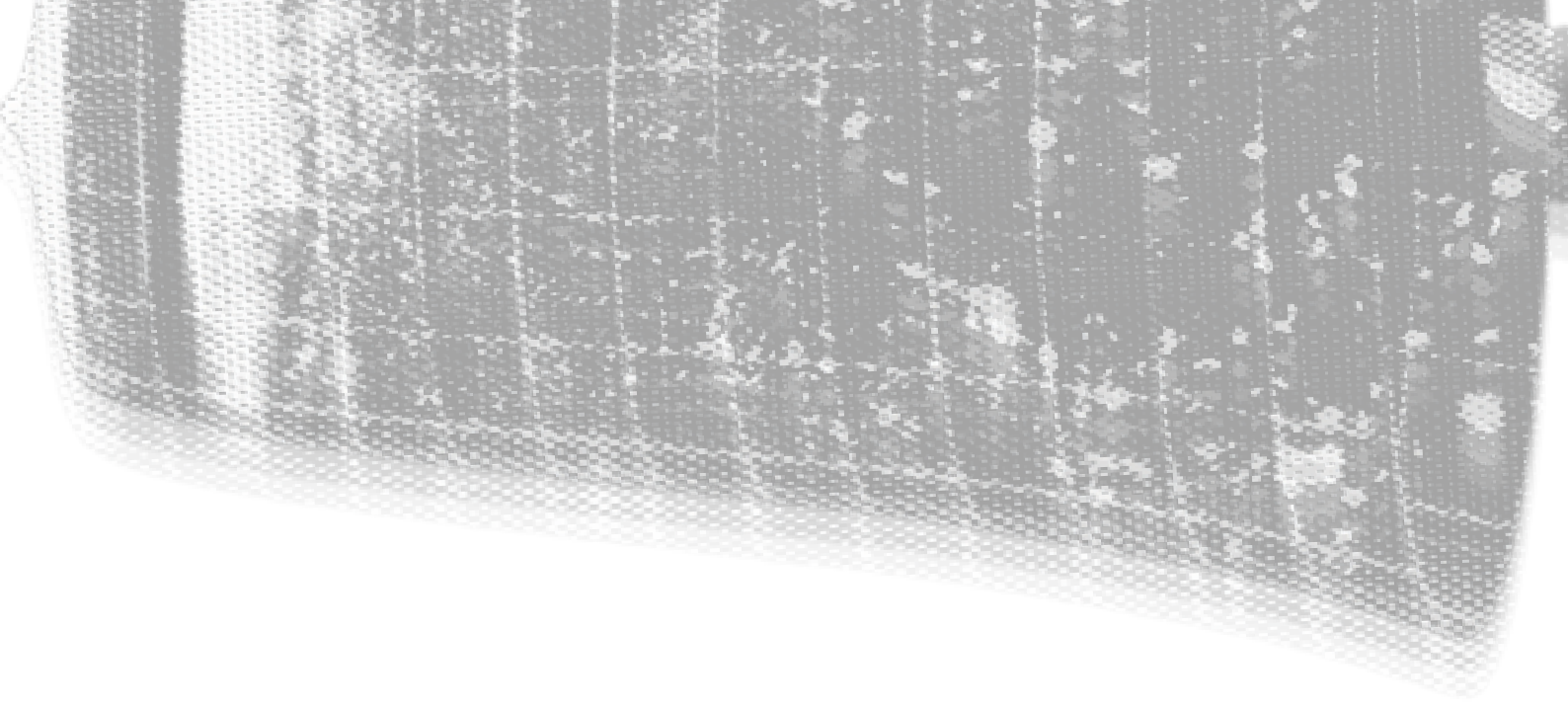

PLENARY SESSION SPEAKERS

Day 1: December 17, 2024

Anjan A. Sen Jamia Millia Islamia

Tensions in Cosmological Observations: Hints for New Physics?

The concordance ΛCDM model, although phenomenological, has been very successful in explaining most of the cosmological observations including the Planck measurement of the CMB. But in recent years, there have been few observations that showed the gaps in the ΛCDM model to explain a set of observational data. In this talk, I shall give a brief introduction to the tensions in the ΛCDM model and discuss new physics in the dark energy sector that may explain these tensions, if they are not due to any unknown systematics in the data.

Anzhong Wang Baylor University, USA

From Loop Quantum Cosmology to Loop Quanum Black Holes

General relativity (GR) has achieved great successes since its incarnation in 1915, ranging from cosmology to black holes. However, it also faces severe challenges in front of the big bang and black hole (BH) singularities, due to the divergence of curvatures at these points. At these points, quantum gravitational effects are expected to be strong. In fact, it is the general belief that such corrections are so strong that they will dominate physics, whereby the singularities are smoothed out and physics becomes predictable. In loop quantum cosmology (LQC), the big bang singularity is resolved, which is closely related to the fact that the area operator has a minimal and non-zero area gap after the quantization of the spatial geometry. Due to these quantum geometric corrections, the Big Bang singularity is replaced by a quantum bounce. The resultant LQC is consistent with all cosmological observations and could also explain some anomalies in recent cosmic microwave background observations. When applying the techniques of LQC to BHs, several issues raise, and so far, studies of loop quantum BHs have not been as successful as those in LQC. In this talk, I shall first give a brief review of LQC and then state clearly the obstacles that we have been facing when applying LQC to BHs, and finally discuss some possibilities to overcome these problems.

Harvinder Kaur Jassal IISER Mohali/NCRA-TIFR

A critical reanalysis of low redshift cosmological datasets

Extensive and diverse datasets have enabled determination of cosmological parameters to unprecedented precision. The availability of present and future large datasets makes it important to develop methods to determine cosmological parameters in model independent manner. In this talk, I will discuss present constraints on parameters, especially the dark energy equation of state parameter and consistency of datasets using different methods. I will also present results in the light of the so-called "Hubble tension",attempts to alleviate it and how internal consistency in data can provide a way to validate estimates of errors in parameters.

Sang Pyo Kim Gunsan National University, South Korea

Effective Actions in dS and High Curvature Terms

Starobinsky inflation model that best fits all cosmological observational data is based on a quadratic scalar curvature. A quantum field probing spacetime results in high curvature terms. In this talk, first the effective action in curved spacetime is perturbatively found and renormalized in the Pauli-Villa scheme, and second the one-loop effective actions probed by a massive scalar or fermion are found in the de Sitter space in the in-out formalism introduced by Schwinger and DeWitt. In the in-/out-state formalism, the exact one-loop effective actions of a massive scalar field or a Dirac field in the global coordinates of de Sitter spaces are given by Bogoliubov coefficients and renormalized via the gamma-function regularization scheme, which is a gravity analog of the Heisenberg-Euleraction in QED. The nonperturbative effective actions, modulo the angular momentum sum, have an imaginary part in all even dimensions, but the imaginary part of the effective actionsvanishes in all odd dimensions. In the weak curvature limit, the effective actions have all powers of scalar curvature.Finally, we discussthe zeta-function regularization over angular momenta of the renormalized,weak-curvature expanded effective action, which vanishes in any even dimension.

Suratna Das Ashoka University, India

Some "background checks" for Warm Inflation.

Warm Inflation is a variant inflationary scenario where the inflaton field continuously dissipates its energy to a subdominant radiation bath during inflation. Among the many advantages that WI has over its more standard counterpart, which we will refer to as Cold Inflation, is that WI smoothly transits to a radiation dominated Universe post inflation without invoking the need of a reheating phase, dynamics of which is still quite unknown. The dissipation effects effective during Warm Inflation makes the dynamics of the inflation quite intricate. Even the simple graceful exit in Cold Inflation turns out to be not so simple in Warm Inflation. In this talk, we will do the background analysis of Warm Inflation and shed light on how Warm Inflation ends or gracefully exits. These graceful exit criteria also constrain the form of the potential and the dissipative coefficients that one may choose for their Warm Inflationary model.

Banibrata Mukhopadhyay Indian Institute of Science

Energy extraction from a black hole and powerful astrophysical jets: Theory, simulation and observations

I will summarize the current understanding of the power of astrophysical accretion and jets around a black hole. This is based on the varied energy extraction mechanisms from the underlying systems. The most powerful energy extraction is possible from the ergosphere of a rotating black hole, but in the presence of strong magnetic fields. I will explore, by theory and numerical simulation, how such processes are expected to be responsible for observation of powerful astrophysical outflows and jets.

Day 2: December 18, 2024

Dhiraj K Hazra IMSc, Chennai

Some "background checks" for Warm Inflation.

I will discuss the cosmological aspects of Cosmic Microwave Background (CMB) data. In particular, I will show how both the early and late Universe can be constrained with CMB. Here I will discuss how other observations can complement CMB in the search for the standard model and beyond. Finally, I will analyze certain tensions within CMB observations and between CMB and other observations.

Indrani Banerjee National Institute of Technology, Rourkela

Prospects of constraining the nature of strong gravity from the Event Horizon Telescope data

The remarkable agreement of general relativity (GR) with a host of experimental tests only adds to its phenomenal success. However, GR often falls short in explaining the dark sector and is associated with singularities which makes the quest for a more complete theory increasingly compelling. This may either involve modifications in the gravity sector or additions to the matter sector or both. These alternatives to GR need to be tested against available observations so that they can be established/falsified/constrained. Such deviations from GR are primarily expected in the strong-field regime and the horizon-scale images of black holes (BHs), M87* and Sgr A*, released by the Event Horizon Telescope (EHT) collaboration provides an unprecedented window to test the nature of strong gravity.
In this talk, I shall discuss how the EHT data can be used to investigate possible deviations from the Kerr scenario and its possible consequences and implications.

Li Li ITP-CAS, China

Dark Side of Black Hole: Interior Structure and Dynamics

The existence of black holes has been confirmed by experiments and observations. While the exterior physics of black holes has been extensively investigated in the literature, the interior physics of black holes behind the event horizon has not been well understood. In this talk, I will introduce our recent progress toward understanding the interior of black holes, including the no inner-horizon theorem, the constraint on the number of horizons with energy conditions, and the interior dynamics of hairy black holes.

Sergey Sushkov Kazan State University, Russia

A cosmological bounce in the theory of gravity with non-minimal derivative coupling

T.B.D

S. Shankaranarayanan Indian Institute of Technology, Bombay

Gravitational wave memory as a tool to constrain cosmological models

ΛCDM model is a well-established, predictive, and simple cosmological framework that has remarkably accounted for a broad range of cosmological observations, including the current acceleration of the Universe. However, different approaches to estimating cosmological parameters have led to tensions, and recent DESI results suggest slight deviations from the ΛCDM model. hese tensions highlight potential gaps in the ΛCDM model and the need for different probes to understand dark energy and dark matter. This talk emphasizes the potential of \emph{gravitational wave memory} to distinguish between cosmological models. We explore cosmological memory as a specific case of the master equation for GW memory in Locally Rotationally Symmetric type II spacetimes. Unlike prior studies, the master equation for GW memory incorporates non-linear dependencies on background quantities. As a result, even though each successive GW is weaker than its predecessor, we demonstrate that their cumulative effect over cosmological time leads to an enhancement similar to the integrated Sachs-Wolfe effect. Finally, we show how GW memory can help constrain cosmological models with third-generation GW detectors such as Cosmic Explorer and Einstein Telescope.

Suresh Kumar Plaksha University, India

LsCDM Cosmology: A promising scenario to relax the cosmological tensions

In recent few years, the LsCDM cosmology, where the Universe transitions from anti-de Sitter vacua to de Sitter vacua, has emerged as one of the promising cosmological scenarios that relaxes the major cosmological tensions prevailing in the standard LCDM model. In this talk, I will present a complete journey of LsCDM cosmology so far, its successes and some future directions.

Mehedi Kalam Allah University, Kolkata

Slowly Rotating Neutron Stars in Modified Theory of Gravity

This study explores slowly rotating neutron stars in *f(R,T)* gravity using the Hartle-Thorne formalism, focusing on two models: $f(R,T)=R+2\chi T$ and $f(R,T)=R+\alpha R2+2\chi T$. For $f(R,T)=R+2\chi T$, quantities like change in radius, binding energy, eccentricity, and quadrupole moment (second-order in angular velocity) show greater deviations from general relativity (GR) in lighter neutron stars compared to heavier ones. However, the moment of inertia (first-order) exhibits minimal deviation. The equation of state-independent I-Love-Q relation remains robust, aligning with GR within 1%, even for maximum coupling. In $f(R,T)=R+\alpha R2+2\chi T$, including R2-corrections intensifies deviations for lighter neutron stars. These results highlight light neutron stars as sensitive probes for testing modified gravity. The robustness of I-Love-Q relations underscores their observational value, while deviations provide pathways to distinguish *f(R,T)* effects from GR in astrophysical settings.

Day 3: December 19, 2024

Alexey V. Toporensky
Moscow State University, Russia

Compactification Scenario in Gauss-Bonnet Cosmology

T.B.D.

Dawood Kothawalla
Indian Institute of Technology, Madras

Non-inertial frames as probes of gravitational fields

Two key insights leading to the conception and development of general relativity are the notion that accelerated frames in flat spacetime can help mimic effects of gravity locally, and gravity is described by the curvature of spacetime. It is difficult to reconcile these insights unless one relates the acceleration in the former to the curvature in the latter. In this talk, I will derive such a relation, and exhibit a curious geometrical relation that intertwines acceleration and tidal curvature. An accelerated quantum detector probing a quantum field can therefore detect spacetime curvature even locally. I will also discuss the broader implications of the result for certain foundational issues in general relativity, as well as in discussions on cosmological singularities and quantum field theory in curved spacetime.

Pradyumn Kumar Sahoo

BITS-Pilani, Hyderabad campus

$f(Q,L_m)$ gravity

In this talk, I will discuss the *f(Q)* symmetric teleparallel gravity by introducing an arbitrary coupling between the non-metricity *Q* and matter Lagrangian L_m in the Lagrangian density f of the theory, which thus leads to the $f(Q,L_m)$ theory. This generalisation encompasses Coincident General Relativity (CGR), and the Symmetric Teleparallel Equivalent to GR (STEGR). Using the metric formalism, we derive the field equation of the theory, which generalizes the field equations of f(Q) gravity. From the study of the covariant divergence of the field equations, it follows that the presence of the geometry-matter coupling leads to the non-conservation of the matter energy-momentum tensor. The cosmological implications of the theory are investigated in the case of a flat, homogeneous, and isotropic Friedmann-Lemaitre-Robertson-Walker geometry. As a first step in this direction, we obtain the modified Friedmann equations for the $f(Q,L_m)$ gravity in a general form. Specific cosmological models are investigated for several choices of $f(Q,L_m)$, including $f(Q,L_m)=-\alpha Q + 2L + \beta$, and $f(Q,L_m)=- \alpha Q + (2L_m)^2 + \beta$, respectively. Comparative analyses with the standard ΛCDM paradigm are carried out, and the observational implications of the models are investigated in detail.

Sumanta Chakraborty

Indian Association for the Cultivation of Science

Tides: A story of Love

In this talk, I will discuss recent advancements in the tidal Love numbers and tidal heating of BHs and exotic compact objects. In particular, I will show that contrary to popular belief, tidal Love numbers of rotating BHs are non-zero and for exotic compact objects the Love numbers have a Logarithmic dependence on compactness. I will also demonstrate how tidal heating can be used to test quantum nature of gravity at the horizon scale.

Alessandro Marins

University of Science and Technology of China, Brazil

T.B.D.

T.B.D.

Kinjalk Lochan IISER-Mohali

Quantum Effects in Late Time Cosmology

The universe, which is presumably born quantum, is assumed to have shed its quantum character gradually as it grew and expanded out of the initial quantum gravity domain. The inflationary era is predominantly understood to be a semiclassical regime where quantum matter/perturbations propagate over a classical background. We will explore the naturalness of such assumptions and settings and see if there are cases where such settings can be expected to receive significant corrections, finding the answer in affirmative. More interestingly and counter intuitively, we shall argue that even the very late (present day) era could not be completely free of quantum corrections as generally believed. Interesting implications of such effects will be discussed.

Roy Maartens Western Cape University, South Africa

Probing the Primordial Universe with Cosmological Surveys

T.B.D.

PARALLEL SESSION SPEAKERS

Day 1: December 17, 2024

Taotao Qiu
Huazhong University of Science and Technology, China
Interpreting PTA Data with Bouncing Cosmology

Umang Kumar
Ashoka University, India
A Generalized Method of Constraining Warm Inflation with CMB Data

Rahul Dhyani
Shiv Nadar University, India
Probing Dark Matter - Electron Interaction in the Cosmic Microwave Background Radiation

Kunal Pandey
Jamia Millia Islamia
An Alternative Approach towards Neutrino Masses

Shilaitya Porey
Shiv Nadar University, India
Primordial Dark Sector Relics from Inflaton and f(R, Φ) Gravity

Aman Verma
University of Delhi, India
Inhomogenous Cosmology

Tanima Duary
CCSP, SGT University, India
Warm Inflationary Thermodynamics

Anirban Dasgupta

National Institute of Technology, Rourkela

Signatures of Einstein-Maxwell dilation-axion gravity from the observed quasi-periodic oscillations in black holes

Debasmita Mohanty

BITS-Pilani, Hyderabad Campus

Charged Gravastar Model in Non-Commutative Geometry under f(T) Gravity

Ameya Kolhatkar

BITS-Pilani, Hyderabad Campus

Investigating Early and Late-Time Epochs in f(Q) Gravity

Sayantan Ghosh

BITS-Pilani, Hyderabad Campus

Study of DBI Fields in Modified STGR Using Dynamical System Analysis

Ritpratik Sengupta

Aliah University, India

A Novel Model of Non-Singular Oscillating Cosmology on flat RS-II Braneworld

Nandhida Krishnan P

CUSAT, Kerala, India

Modified Cosmology through Barrow Entropy: A Thermodynamic Perspective beyond Equilibrium

Day 2: December 18, 2024

Shao-Jiang Wang
Chinese Academy of Sciences, China
Black Hole as the Fastest Transmitter

Nur Jaman
Dhruba Chand Halder College, Kolkata
CMB Constraints on Natural Inflation with Gauge Field Production

Mohd. Shahalam
Integral University, Lucknow
Initial Conditions of Pre-Inflation with Generic Potentials in Loop Quantum Cosmology

Geeth Ongole
Baylor University, USA
Revisiting Quantum Black Holes from Effective LQG

Sarath N.
Indian Institute of Technology, Kanpur
Exploring Emergence of Cosmic Space and Horizon Thermodynamics via Kaniadakis Entropy

Monmoy Molla

Aliah university, India

Analysis of Properties of some features of Neutron Stars

Samik Dutta

BITS-Pilani, India

Understanding the Very High Energy (VHE) Gamma-ray emission from NGC 4278

Zenia Zuraiq

Indian Institute of Science

Simulating Magnetized White Dwarfs by Time Evolution: Chandrasekhar Limit and Beyond

Susmita Jana

Indian Institute of Technology, Bombay

Transient Electromagnetic Sources can detect Solitary Black Holes in Milky Way Galaxy