2PSS	Mon 10/3	Tue 11/3	Wed 12/3	Thu 13/3	Fri 14/3
09:00-09:30	Opening				
09:30-10:30	Ayon-Beato Lecture	Giri Lecture	Ben Achour Lecture	Ben Achour Lecture	Sapone
					Noreña
10:30-11:00	Coffe break				
11:00-12:00	Plyushchay Lecture	Ayon-Beato Lecture	Giri Lecture	Ayon-Beato Lecture	Magaña
					Riquelme
12:00-12:30	Canfora	Astefanesei	Correa	Rojas	Vera
12:30-13:00	Oliva	Corral	Sundell	Fazzi	Cuadros
13:00-15:00	Lunch break				
15:00-16:00	Plyushchay Lecture	Ben Achour Lecture	Ayon-Beato Lecture	Ayon-Beato Lecture	Macarena Lagos
					Araya
16:00-16:30	Coffe break				
16:30-17:00	Olea	Anabalon	Barrientos	Faraggi	Lara
17:00-17:30	Moreno	Anastasiou	Guajardo	Bianchi	Marcela Lagos
17:30-18:00	Cardenas	Mukhopadhyay	Fuentealba	Giri	Fathi

*Each slot includes at most 5 minutes for questions or comments

LECTURES

Last name	First name	Title	Abstract
Ayon-Beato	Eloy	New conformally dressed configurations: origins, black holes, stealths & challenges	The uniqueness of the most general scalar field action yielding a conformally invariant second-order equation in four dimensions was recently established. In these lectures we beging by reviewing the origins of this construction, rooted in powerful tools allowing the solution to the inverse problem of variational calculus. Next, we explore how to charge the resulting scalar self-gravitating configurations with ModMax, which is also conformally invariant. First, we provide a brief introduction to this nonlinear electrodynamics, including a simple derivation of it. The above leads to new conformally dressed black holes that are nonlinearly charged preserving duality invariance. Since the scalar action entails a more involved nonminimal coupling that explicitly breaks its conformal invariance, without spoiling it in the scalar equation, we also examine the generalization of the gravitational Cheshire effect to this non-Noetherian conformal theory. The resulting spherically symmetric stealth solutions in flat spacetime are fully characterized. Finally, we discuss some of the challenges in establishing the uniqueness of conformally invariant theories with additional degrees of freedom.
Ben Achour	Jibril	Black holes and radiative spacetimes in modified gravity	

Giri	Suvendu	Do Black Holes Have to Exist? The Road to Observing Horizonless Compact Objects	Gravitational wave detections by LIGO-Virgo-KAGRA and the striking images from the Event Horizon Telescope have given us an unprecedented look at highly compact objects in our universe. While these observations are consistent with black holes, they don't rule out alternative possibilities. However, black holes pose deep theoretical puzzles—challenging fundamental physical principles and motivating the need for viable, horizonless ultra-compact objects, often called "black hole mimickers". In this mini-course, I will first provide a broad overview of the field, summarizing what we know so far and highlighting key open questions. A major challenge is moving from toy models to realistic, well-motivated black hole mimickers that could one day be tested through astrophysical observations. I will discuss what is needed to bridge this gap and outline some promising approaches. As a concrete example, I will introduce "AdS black shells"—a compelling class of black hole mimickers—and explore their properties and outstanding theoretical questions.
Plyushchay	Mikhail	Conformal Symmetry: An Introductory Overview and Selected Applications	The two lectures will provide an accessible introduction to the basic properties of conformal transformations and their deep connection to hyperbolic geometry. We will explore how conformal symmetry manifests in various areas of mathematical physics, with particular emphasis on one-dimensional quantum scattering, quantum theory in periodic potentials, and the Schwarzian derivative. We will also discuss the Gelfand–Dikii equation and the bi-Hamiltonian structure of the Korteweg–de Vries equation, highlighting their connections to the Virasoro algebra within the framework of conformal symmetry. Throughout, the focus will be on conceptual understanding and broad insights rather than extensive technical detail.

TALKS

Last name	First name	Title	Abstract
Anabalón	Andrés	Black Holes and Neural Networks	I will describe the embedding of known taxonomies in some black hole spacetimes.
Anastasiou	Giorgos	Conformal renormalization of scalar-tensor theories	We study a conformally coupled scalar-tensor theory with a quartic potential possessing local conformal symmetry up to a boundary term. We show that requiring the restoration of the full local conformal symmetry fixes the counterterms that render the on-shell action finite. The building block of the resulting action is a conformally covariant tensor which is constructed out of the metric and the scalar field and it has the same conformal weight as the Weyl tensor. This allows us to obtain the counterterms for the scalar-tensor sector in a closed form. The finiteness of the conformally complete version of the action is suggestive on the validity of the conformal renormalization prescription. We extend this theory by adding the conformal gravity action and also the Einstein-AdS action written in MacDowell-Mansouri form. Even though the latter breaks the conformal symmetry, we find that the action is still renormalized provided a suitable falloff of the scalar field when considering asymptotically locally anti-de Sitter solutions. Black hole solutions in these theories are studied, for which the Hawking temperature and the partition function to first order in the saddle-point approximation are calculated, providing a concrete example of this renormalization scheme.

Araya	Ignacio	Renormalization of Lovelock-AdS gravity	We consider Lovelock-AdS gravity in even dimensions and show that, by adding the Euler density, one can obtain an action principle that reproduces the correct Lanczos-Lovelock equations of motion, but which can be explicitly written as a polynomial of total antisymmetric contractions of powers of a tensor which is given by a constant displacement of the Riemann curvature, such that it is zero for pure AdS. The coefficients of this polynomial can be expressed in terms of the degeneracy conditions and the resulting action is finite for AlAdS manifolds with a Weyl-flat boundary. In the six-dimensional case, we find a covariant total derivative term that should be added to the Einstein-Gauss-Bonnet action in order to make it finite for arbitrary AlAdS manifolds that are solutions of the theory. The variation of the action is finite and allows to recover the usual holographic stress tensor of the dual CFT theory, thus showing that the action is renormalized in the holographic sense.
Astefanesei	Dumitru	Virtual thermodynamic potential and black hole criticality	We propose a new method to study the criticality of black holes. We define a “virtual thermodynamic potential” by computing the off-shell regularized Euclidean action of a general geometry with spherical symmetry. Organizing our framework with the horizon radius as the order parameter, we provide a concrete criterion to obtain the critical point and Landau potential. The subtle relation between thermodynamics and geometry comes out naturally once we impose the on-shell constraint.
Barrientos	José	Electromagnetized black holes and swirling backgrounds in nonlinear electrodynamics: The ModMax case	We begin by constructing the Melvin-Bonnor electromagnetic universe in ModMax through a limiting procedure that connects the spacetime of two charged accelerating black holes with that of a gravitating homogeneous electromagnetic field. Building on this result, we proceed to construct the Schwarzschild and C-metric Melvin-Bonnor black holes within the ModMax theory, representing the first black hole solutions embedded in an electromagnetic universe in the context of nonlinear electrodynamics. Finally, we expand the spectrum of exact gravitational solutions within Einstein-ModMax theory by constructing a vortex-like background that coexists with the Melvin-Bonnor universe.

Bianchi	Marco	Exploring transcendentality in holography	Transcendental numbers and functions play a fundamental role in perturbative Quantum Field Theory. Uniform transcendentality streamlines the evaluation of Feynman integrals and kickstarts certain bootstrap methods. In this talk, I will discuss recent conjectures regarding the transcendental properties of two-point functions of supersymmetric operators in theories with holographic duals such as N=4 Super Yang-Mills and the ABJM model. Finally, I will demonstrate how to leverage such insights to extract novel predictions.
Canfora	Fabrizio	Novel BPS bounds	In this talk I will describe how to construct novel BPS bound when the obvious ones (with the natural topological charge on the RHS) cannot be saturated. I will analyze two cases in details: magnetized Baryonic layers and superconducting Pionic vórtices in Chiral Perturbation Theory.
Cárdenas	Marcela	Integrable perturbations of high-spin black holes	In this talk we focus on the near horizon region of Kerr extremal black holes and discuss the set of diffeomorphisms that resolve the Kerr extremal black hole throat. Considering the isometry-scalar transformations in the near horizon sector and their connection to the Jackiw-Teitelboim (JT) dilaton equations, we discuss the integrable structure of its field equations. We motivate Korteweg-de Vries asymptotic conditions and show that they can be promoted to dynamical modes as they can be related to a sector of axisymmetric gravitational perturbations.

Corral	Cristóbal	Electric-magnetic duality of dyonic Kerr-Newman-NUT-AdS spacetimes	We study the (anti-)self-duality conditions under which the electric and magnetic parts of the conserved charges of the dyonic Kerr-Newman-NUT-anti-de Sitter solution become equivalent. Within a holographic framework, the stress tensor and the boundary Cotton tensor are computed from the electric/magnetic content of the Weyl tensor. The holographic stress tensor/Cotton tensor duality is recovered along the (anti-)self-dual curve in parameter space. We show that the latter not only implies a duality relation for the mass but also for the angular momentum. The partition function is computed to first order in the saddle-point approximation and a Bogomol'nyi-Prasad-Sommerfield bound is obtained. The ground state of the theory is enlarged to all the (anti-)self-dual configurations when the SO(4) and U(1) Pontryagin densities are introduced. We demonstrate this at the level of the action and variations thereof.
Correa	Francisco	Integrable black hole dynamics in the asymptotic structure of AdS_3	In this talk we will consider a set of integrable asymptotic symmetries for AdS_3. They are given by an infinite set of integrable nonlinear equations known as the Ablowitz-Kaup-Newell-Segur (AKNS) hierarchy. They are characterized by an also infinite set of abelian conserved charges, which are related to the canonical charges associated with the asymptotic metric. We will explain how the temperature for stationary black holes is always constant, even though the solutions are not axisymmetric. We also present a special solution associated with the Korteweg-de Vries equation, which appears as a special case of the AKNS integrable equations.

Cuadros	Bertha	Stability and thermodynamics of Yukawa black holes	In this talk we present a new black hole solution sourced by a Yukawa-modified potential including a cosmological constant. A charged version is also found both through direct resolution of the Einstein equations and the application of Kerr-Schild method. For both solutions the dynamical and thermodynamical stability is studied. In the former case, the set of quasinormal frequencies for scalar, vector, and gravitational perturbations is obtained employing different methods. In the latter case, we calculated several thermodynamical properties and found phase transitions in different regimes. Also, the relation between quasinormal modes and shadow radius is verified.
Faraggi	Alberto		
Fathi	Mohsen	Analytical Studies of Light Propagation in Non-Magnetized Plasma within Stationary Spacetimes	The study of light propagation in plasmas provides a powerful tool for probing the geometry of astrophysical spacetimes. In this talk, I will discuss the behavior of light rays traveling through a non-magnetized plasma in stationary spacetimes, highlighting the impact of plasma dispersion on the trajectories of photons. By analyzing the modified geodesic equations, we uncover key deviations from vacuum propagation, including shifts in gravitational lensing and alterations in black hole shadow structures. These effects are particularly relevant for high-energy astrophysical environments, where plasma density variations influence observational signatures.
Fazzi	Marco		

Giri	Suvendu	Decoding Gravitational-Wave Deviations: From Observations to Theory	Gravitational wave observations provide an unprecedented opportunity to test General Relativity (GR) in the strong-field regime. While current data aligns well with GR, potential deviations—if detected—could offer crucial insights into new physics. But how do we bridge the gap between observational anomalies and theoretical frameworks beyond GR? In this talk, I will present a systematic approach to interpreting deviations in gravitational waveforms using an Effective Field Theory (EFT) framework. By linking deviations to curvature corrections in the inspiral phase of binary black holes, we establish a dictionary that connects gravitational-wave observations to generic beyond-GR theories. This framework not only clarifies how deviations scale with mass and curvature but also helps distinguish true signals of new physics from systematic errors. I will highlight key insights from our ongoing work, which will appear on arXiv soon, and discuss open questions in the search for physics beyond GR.
Guajardo	Luis	Primary scalar hair in Gauss-Bonnet black holes with Thurston horizons	In this talk, we introduce novel, asymptotically, locally AdS, black hole solutions of Einstein-Gauss-Bonnet theory at the Chern-Simons point, supported by a scalar field whose strength is governed by an independent integration constant. The quadratic part of the scalar field action corresponds to a conformally coupled scalar in five dimensions - an invariance of the matter sector that is explicitly broken by the introduction of a quartic self-interaction. These black holes are characterized by a compact, orientable but non-maximally symmetric horizon geometry, and two distinct parameters: the horizon radius and the temperature. Notably, there exists a straight line in the parameter space along which the horizon geometry exhibits enhanced isometries, corresponding to a previously reported solution. Away from this line, the metric's isometries undergo spontaneous breaking. We discuss the role of the geometry, the thermodynamics of the black hole solution, and possible generalizations to higher dimensions.

Lagos	Macarena	Nonlinear Gravitational Wave Ringdown	After the merger of two black holes (BHs), there is a distorted remnant black hole that rings down to its final stationary state by emitting gravitational waves (GWs). This ringdown GW signal has historically been modeled using linear perturbation theory in General Relativity, which predicts the signal to consist of characteristic frequencies that only depend on the remnant BH mass and spin. This simple prediction is planned to be used as a technique to perform tests of gravity in future gravitational wave detections. In this talk, I will discuss the presence of second-order effects, which are found to be sizeable in numerical simulations of BH mergers, having a much larger effect than previously thought. I will also discuss the potential detection of such second-order effects with future gravitational wave detectors such as Einstein Telescope and Cosmic Explorer, and their use to future tests of gravity.
Lagos	Marcela	Self-gravitating cylinders supported by hadronic matter	I present new exact solutions derived for the four dimensional SU(2) Einstein-non-linear-Sigma model and the Einstein-Skyrme model both non-minimally coupled to the Maxwell field that are free of curvature invariants and matter distribution singularities. First, using the SU(2) non-linear sigma model coupled to General Relativity and the Maxwell field, we construct asymptotically flat gyratons-inspired solutions. Then, we promote the model to the Skyrme theory, showing that the inclusion of the Skyrme term necessarily requires the space-time structure to be asymptotically de-Sitter.

Lara	Kristiansen	On stealths and their thermodynamics	We study a class of solutions within the context of modified gravity theories, characterized by a non-trivial field that does not generate any back-reaction on the metric. These stealth configurations correspond to a vanishing stress-energy tensor. In this talk, we introduce a novel approach to constructing this class of solutions. In contrast to the standard procedure, the starting point requires satisfying the stealth conditions for a given ansatz independently of the gravitational dynamics. This approach simultaneously determines the non-trivial field and the geometries capable of supporting it as a stealth configuration. Consequently, a gravity model can accommodate a stealth field only if its vacuum solution falls within the geometries permissible under stealth conditions. By applying this reverse procedure in the non-minimal $R\phi^2$ coupling, we recover all previously known stealth configurations and present new solutions. Although it seems intuitive to assume that this ``gravitationally undetectable'' scalar field leaves no physical traces, it reveals thermodynamic imprints, as its presence screens the black hole mass and modifies the entropy according to the first law.
Magaña	Juan	Phenomenology of Primordial Black Holes: Extended Mass Functions and the Hubble Tension	The recent gravitational wave detections of black hole collisions by LIGO have renewed interest in the existence of primordial black holes (PBHs). These black holes could have formed in the very early Universe due to fluctuations in the energy density field or other mechanisms. An intriguing hypothesis is that PBHs could constitute a significant fraction, or even the total content, of dark matter. The simplest approach is to consider a monochromatic (single mass) function, however a more realistic approach involves an extended mass distribution for PBHs. In this study, we present a modification of the Press-Schechter formalism to derive extended mass functions for primordial black holes, incorporating a monochromatic spike, typical of ultra-slow-roll inflation models. We derive observational constraints from various datasets across different scales and provide insights that the Hawking radiation evaporation mechanism could help alleviate the Hubble tension.

Moreno	Javier	Higher-dimensional Willmore energy as holographic entanglement entropy.	The vacuum entanglement entropy of a general conformal field theory (CFT) in five dimensions contains a universal term, F(A), which has a complicated and non-local dependence on the geometric details of the region A and the theory. Analogously to the previously known three-dimensional case, we prove that for CFTs in five dimensions which are holographically dual to Einstein gravity, F(A) is equal to a four-dimensional version of the “Willmore energy” associated to a doubled and closed version of the Ryu-Takayanagi (RT) surface of A embedded in R^5. The Willmore energy is shown to arise from a conformal-invariant codimension-two functional obtained by evaluating six-dimensional conformal gravity on the conically-singular orbifold of the replica trick. The new functional involves an integral over the doubled RT surface of a linear combination of three quartic terms in extrinsic curvatures and is free from ultraviolet divergences by construction. We verify explicitly the validity of our new formula for various entangling regions and argue that, as opposed to the three-dimensional case, F (A) is not globally minimized by a round ball. Rather, F(A) can take arbitrarily positive and negative values as a function of A. Hence, we conclude that the round ball is not a global minimizer of F(A) for general five-dimensional CFTs.

Mukhopadhyay	Ayan	Fundamental strings, gravity and quantum processors	I will show that the Nambu-Goto equations for.a string follow from the junction conditions of three dimensional gravity. The solutions of the junction conditions between two copies of an Einstein spacetime M are in one-to-one correspondence with the solutions of the non-linear Nambu-Goto equations obeyed by the average embedding of the junction in M up to rigid parameters related to spacetime and worldsheet isometries. In AdS, the solution of the Nambu-Goto equation corresponding to the bulk junction can be decoded from the relative time reparametrization at the dual CFT interface. In the more general constructions, each solution of the Nambu-Goto equation should be understood as a quantum processor i.e. a map between the Hilbert spaces of the CFT on the two sides of the dual interface. These results, remarkably, can be generalized to multi-way junctions between three dimensional spacetimes.
Noreña	Jorge		
Olea	Rodrigo	Conformal Renormalization and Holographic Energy Functionals	We consider the Conformal Renormalization of six-dimensional anti-de Sitter gravity, what amounts to finding the Conformal Gravity theory that contains an Einstein sector. For Einstein spaces, the action is equivalent to the one found by standard holographic techniques in a gauge/gravity framework. The evaluation of the action in manifolds with conical defects leads to singular contributions interpreted as an energy functional which, in turn, gives rise to a renormalized form of Holographic Entanglement Entropy for minimal surfaces. For arbitrary surfaces, this codimension-2 functional generalizes the notions of Hawking Mass and Willmore energy to higher dimensions.

Oliva	Julio	Holographic Plasma-Plasma Transition from Type IIB SUGRA	We show that the planar, charged black hole in AdS, dual to the strongly coupled Quark-Gluon Plasma thermal state of large N, SU(N), N=4 super Yang-Mills at finite chemical potential undergoes a third-order phase transition in the grand canonical ensemble to a hairy black hole of type IIB supergravity. The hairy phase is another strongly coupled fluid with a conformal equation of state and can be interpreted as another kind of Quark-Gluon plasma. This new Quark-Gluon plasma has less entropy and, therefore, seems to characterize some form of smooth hadronization. The locus of the transition in terms of the "Baryon" chemical potential, μ, and the temperature, T, is μ=2πT. We also explore the heavy quark-antiquark potantial obtained from holographic methods, and find surprising results.
Riquelme	Simón	Non-Lorentzian Dark Vector Production in the Early Universe	It is well understood that cosmological spacetimes spontaneously break time-translation invariance, leading to the existence of a preferred foliation defined by a time-like unit vector. Leveraging this structure, we explore Proca theory as a viable dark matter candidate within the framework of cosmological gravitational particle production, considering the presence of a quasi-spectator scalar field. We highlight the rich physics emerging from this seemingly simple effective field theory construction and discuss future directions for research in this area.
Rojas	Francisco		
Sapone	Domenico	Testing ΛCDM with BAO: Consistency Checks and Challenges	Baryon Acoustic Oscillations (BAO) play a crucial role in testing the internal consistency of the ΛCDM model and its extensions. In this talk, I will explore how BAO measurements can be used to perform cosmological consistency tests, highlighting their role in probing tensions and deviations from standard assumptions. Additionally, I will discuss the robustness of these tests by incorporating the latest DESI data, assessing their sensitivity to systematics and model dependencies.

Sundell	Per	AKSZ quantization of unfolded fields	We review essential aspects of renovating quantum field theory following principles from Vasiliev's higher spin gravity and topological field theory assembled using the Alexandrov-Kontsevich-Schwarz-Zaboronsky formalism for constructing Batalin-Vilkovisky path integral measures.
Vera	Aldo	Universal self-gravitating skyrmions	The self-gravitating skyrmion is an exact solution of the Einstein $SU(2)$-Skyrme model, describing a topological soliton with baryon number $B=1$ living in a $D=4$ space-time in the presence of a cosmological constant. Here we show that this solution can be generalized for arbitrary values of the flavor number, and when higher order corrections in the 't Hooft expansion are considered.