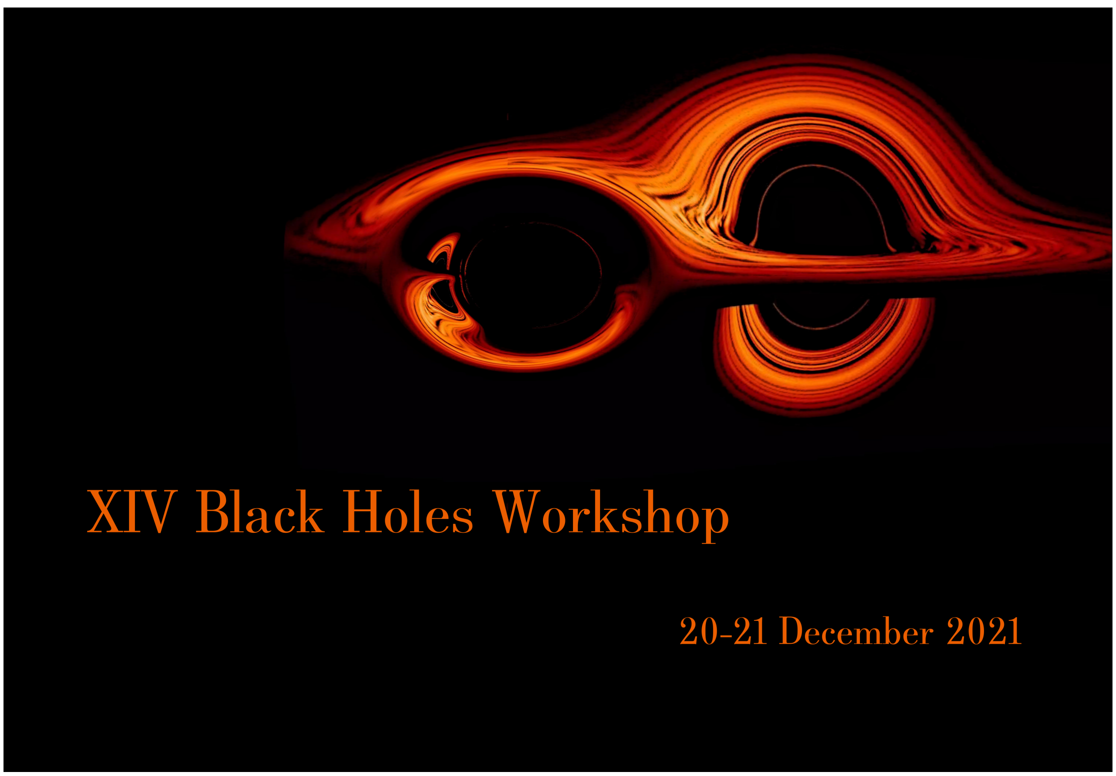
Book of Abstract

XIV Black Holes Workshop



Name: Alexandre M. Pombo

Affiliation: Aveiro University

Title: The ability of the spectral decomposition to correctly describe Kerr black holes with scalar hair

Abstract: The intricacies of massive, complex scalar fields surrounding Kerr black holes has long alienated further developments, namely, the study of their stability. To obtain a better insight into the structure of such objects, we, for the first time, propose a decomposition in spherical harmonics of all the functions that describe such solutions (metric and matter functions). We show that the first four non-zero spherical harmonics are sufficient to describe with high enough accuracy the solutions. To test the method, we use it to recover global quantities (Mass and scalar charge) and geometrical quantities (e.g. Light Ring and innermost stable circular orbit radial position). At last, we observe an evolution on the spherical harmonics individual contribution from the pure Kerr solution to the spinning Boson Star limit.

Name: Nuno M. Santos

Affiliation: Instituto Superior Técnico & Universidade de Aveiro

Title: A bound on energy extraction (and hairiness) from superradiance

Abstract: The possibility of mining the rotational energy from black holes has far–reaching implications. Such energy extraction could occur even for isolated black holes, if hypothetical ultralight bosonic particles exist in Nature, leading to a new equilibrium state – a black hole with synchronised bosonic hair – whose lifetime could exceed the age of the Universe. A natural question is then: for an isolated black hole and at maximal efficiency, how large is the energy fraction ϵ that can be extracted from a Kerr black hole by the superradiant growth of the dominant mode? In other words, how hairy can the resulting black hole become? A thermodynamical bound for the total superradiance efficiency, $\epsilon \lesssim 0.29$ (as a fraction of the initial black hole mass), has long been known, from the area law. However, numerical simulations exhibiting the growth of the dominant mode only reached about one third of this value. We show that if the development of superradiant instabilities is approximately conservative (as suggest by the numerical evolutions), this efficiency is limited to $\epsilon \lesssim 0.10$, regardless of the spin of the bosonic field. This is in agreement with the maximum energy extraction obtained in numerical simulations for a vector field and predicts the result of similar simulations with a scalar field, yet to be performed.

Name: Oleg Zaslavskii

Affiliation: V. N. Karazin Kharkov National University

Title: Nonextremal black hole as particle accelerator

Abstract: We consider particle collisions in the background of a nonextremal black hole. Two particles fall from infinity, particle 1 is fine-tuned (critical), collision occurs in its turning point. If the energy at infinity E_1 is big enough, the turning point is close to the horizon. Then, significant growth of the energy in the center of mass frame $E_{c.m.}$ is possible if (i) particle 1 is ultrarelativistic, (ii) a black hole is near-extremal. We also examine the possibility of unbounded energies E at infinity (super-Penrose process) and show that this is possible for static charged black holes in contrast to the case of rotating neutral ones.

Name: Adam Vrátný

Affiliation: Charles University, Prague

Title: An improved form of type D black holes

Abstract: The black-hole spacetimes of algebraic type D can be identified in the broad Plebański–Demiański class of metrics. Although this class plays a key role in the analysis of exact black hole solutions, its description is still not fully satisfactory. This talk will present a new and more transparent form of the Plebański–Demiański metric which we introduced in our new publication, and its physical interpretation.

Name: Jorge Delgado

Affiliation: University of Aveiro

Title: Equatorial timelike circular orbits around generic ultracompact objects

Abstract: For a stationary, axisymmetric, asymptotically flat, ultra-compact [i.e. containing light-rings (LRs)] object, with a $\mathbb{Z}_2$ north-south symmetry fixing an equatorial plane, we establish that the structure of timelike circular orbits (TCOs) in the vicinity of the equatorial LRs, for either rotation direction, depends exclusively on the radial stability of the LRs. Thus, an unstable LR delimits a region of unstable TCOs (no TCOs) radially above (below) it; a stable LR delimits a region of stable TCOs (no TCOs) radially below (above) it. Corollaries are discussed for both horizonless ultra-compact objects and black holes. We illustrate these results with a variety of exotic stars examples and non-Kerr black holes, for which we also compute the efficiency associated with converting gravitational energy into radiation by a material particle falling under an adiabatic sequence of TCOs. For most objects studied, it is possible to obtain efficiencies larger than the maximal efficiency of Kerr black holes, i.e. larger than 42%.

Name: Cristian Erices

Affiliation: Universidad Central de Chile

Title: Thermodynamics of axionic black strings in dynamical Chern-Simons modified gravity

Abstract: We study thermodynamics and conserved charges of analytic rotating anti-de Sitter black holes with extended horizon topology—also known as black strings—in dynamical Chern-Simons modified gravity. The solution is supported by a scalar field with an axionic profile that depend linearly on the coordinates that span the string. We compute conserved charges associated to the mass, entropy, and angular momentum using three different approaches: the Noether-Wald formalism, the renormalized boundary stress-energy tensor, and the Hamiltonian approach. We show explicitly that all of them coincide and yield a consistent first law of thermodynamics. Additionally, we derive a Smarr formula using a radial conservation law associated to the scale invariance of the reduced action. We find analytic solitons with nontrivial scalar fields and show that the black string can develop a phase transition below a critical temperature, where the soliton is thermodynamically favored.

Name: David Trestini

Affiliation: Institut d'Astrophysique de Paris (Sorbonne Université) - Laboratoire Univers et Théories (Observatoire de Paris)

Title: Gravitational Waves in Scalar-Tensor Theory to one-and-a-half post-Newtonian order

Abstract: We compute the gravitational waves generated by compact binary systems in a class of massless scalar-tensor (ST) theories to the 1.5 post-Newtonian order beyond the standard quadrupole radiation in general relativity (GR). Using (and adapting) the multipolar-post-Minkowskian and post-Newtonian formalism in GR we obtain in particular the tail and non-linear memory terms associated with the dipole radiation in ST theory. The multipole moments and GW flux are derived for general orbits and compared to previous results in the literature. In the case of quasi-circular orbits, we present ready-to-use templates for the data analysis of detectors.

Name: Romain Gervalle

Affiliation: Institut Denis Poisson (Tours)

Title: Asymptotically flat hairy black holes in Massive Bigravity

Abstract: We study asymptotically flat black holes with massive graviton hair within the ghost-free Bigravity theory. There have been contradictory statements in the literature about their existence: such solutions were reported some time ago, but later a different group claimed the Schwarzschild solution to be the only asymptotically flat black hole in the theory. We have analyzed the issue ourselves and have been able to construct such hairy black holes within a carefully designed numerical scheme. We analyze their perturbative stability and find that some of them can be stable, depending on the theory parameters values. The masses of such stable hairy black holes range from stellar values up to values typical for supermassive black holes. One of their two metrics is extremely close to Schwarzschild, while all their ""hair"" is hidden in the second metric that is not coupled to matter and not directly seen. If the Massive Bigravity theory indeed describes physics, the hair of such black holes should manifest themselves in violent processes only, like black hole mergers, and should be visible in the structure of the signals detected by LIGO/VIRGO.

Name: Raimon Luna

Affiliation: CENTRA, Instituto Superior Técnico

Title: The large D limit of General Relativity

Abstract: In this talk I will give an overview of the recent developments in the Large D limit of gravity. In this approach, we explore the limit General Relativity as the number of dimensions grows very large, which allows us to perform perturbative analysis with asymptotic expansions in powers of 1/D, with D being the dimension of spacetime. This makes it possible to access analytically (or with very modest numerical techniques) the physics of black holes, both in D=4 and in higher dimensions. In particular, I will focus on the effective theory for black holes with extended directions (mainly black strings and black branes) which has been used to recover the critical dimension of black strings, and most importantly to predict violations of Penrose's Weak Cosmic Censorship conjecture in black hole mergers through the so-called blobology formalism.

Name: Lorenzo Annulli

Affiliation: Aveiro University

Title: Close limit approximation for modified gravity: Scalar instabilities in binary black hole spacetimes

Abstract: The ability to model the evolution of compact binaries from the inspiral to coalescence is central to gravitational wave astronomy. Current waveform catalogues are built from vacuum binary black hole models, by evolving Einstein equations numerically and complementing them with knowledge from slow-motion expansions. Much less is known about the coalescence process in the presence of matter, or in theories other than General Relativity. In this talk, I take into account a black hole binary in theories including non-minimally coupled scalar fields, where static black holes are unstable to tachyonic instability, depending on the value of their mass. Hence, I will use the Close Limit Approximation as a tool to obtain a qualitative idea of the effect of the merger of two black holes on surrounding scalar fields in Einstein-scalar-Gauss-Bonnet gravity.

Name: Jose P. S. Lemos

Affiliation: CENTRA, IST, University of Lisbon

Title: Stability of quasiblack holes, quasinonblack holes and regular black holes

Abstract: A quasiblack hole is a highly compact star on the verge of forming a horizon, but never gets to the black hole state. A quasinonblack hole is a regular black hole on the verge of having its event horizon disappearing, but can never be a star. A regular black hole is a black hole with no singularities, in general it has matter in its central parts. Through a comprehensive electrically charged spherical symmetric exact solution in general relativity it is possible to make a robust stability analysis of all these objects against radial perturbations. It is found that quasiblack holes formed from extremal charged matter are stable, other types of quasiblack holes are unstable. It is found that quasinonblack holes with special features and with reasonable values of the perturbation adiabatic index are stable. It is also found that some regular black holes can be stable against these perturbations.

Collaborators: This work is in collaboration with Angel Masa and Vilson Zanchin of Universidade Federal do ABC, São Paulo, Brazil.

Name: Richard Brito

Affiliation: CENTRA, Instituto Superior Técnico

Title: Constraints on quasinormal-mode frequencies with LIGO-Virgo binary–black-hole observations

Abstract: The no-hair conjecture in general relativity (GR) states that the properties of an astrophysical Kerr black hole (BH) are completely described by its mass and spin. As a consequence, the complex quasinormal-mode (QNM) frequencies of a binary-black-hole (BBH) ringdown can be uniquely determined by the mass and spin of the remnant object. Therefore, a measurement of the QNM frequencies provides a test of the no-hair conjecture. In this talk I will describe how this test can be done using a parameterized inspiral-merger-ringdown waveform, thereby taking full advantage of the entire signal power and removing dependency on the predicted or estimated start time of the ringdown. Using this method, I will then discuss current constraints on the QNMs of the BBHs observed so far by LIGO and Virgo.

Name: Gabriel Lopes Cardoso

Affiliation: Instituto Superior Técnico

Title: BPS black holes and number theory: exact results for statistical black hole entropy

Abstract: The pioneering work of Strominger and Vafa has shown that it is possible to write down the Bekenstein-Hawking area law as a statistical entropy for special classes of black holes, called BPS black holes, by identifying and counting black hole microstates in string theory. This enumeration program has revealed fascinating connections with number theory, and has recently led to exact expressions for the number of microstates carried by BPS black holes in certain classes of string theory models. Moreover, these number theoretic connections show that only a finite amount of microscopic data is required in order to reproduce the exact expression for the statistical microstate degeneracy of BPS black holes. This number should, in turn, also be computable in terms of a suitably defined partition function of quantum gravity in an AdS_2 background which, as predicted by the exact microscopic results, will consist of an infinite series starting with the Bekenstein-Hawking entropy.

In this talk, we give a short overview of the recent advances mentioned above.

Name: Marco Calzà

Affiliation: University of Coimbra

Title: Evaporating primordial black holes, the string axiverse, and hot dark radiation

Abstract: We show that primordial black holes (PBHs) develop non-negligible spins through Hawking emission of the large number of axion-like particles generically present in string theory compactifications.This is because scalars can be emitted in the monopole mode ($l = 0$), where no angular momentum is removed from the BH, so a sufficiently large number of scalars can compensate for the spin-down produced by fermion, gauge boson, and graviton emission. The resulting characteristic spin distributions for 10^8-10^{12}kg PBHs could potentially be measured by future gamma-ray observatories,provided that the PBH abundance is not too small. This yields a unique probe of the total number of light scalars in the fundamental theory, independent of how weakly they interact with known matter. The present local energy density of hot, MeV-TeV, axions produced by this Hawking emission can possibly exceed ρ_{CMB}. Evaporation constraints on PBHs are also somewhat weakened.

Name: Ricardo Z. Ferreira

Affiliation: IFAE - Barcelona

Title: Super-Hawking Radiation

Abstract: The realization that space-times related by an asymptotic symmetry should be regarded as physically inequivalent has stimulated a critical revision of the basic assumptions of the black hole information paradox and has led to the identification of additional conserved quantities that should be employed to specify a black-hole configuration: the supertranslation and superrotation charges. However, if these additional charges are to bear relevance to the problem of information loss, one expects that the Hawking spectrum itself should be sensitive to the action of asymptotic symmetries. In this talk I will present some recent work where we address this question and find that supertranslations and superrotations do in general modify both the Bogolyubov coefficients by inducing nontrivial off-diagonal phases. However, while in the case of supertranslations they eventually leave the spectrum unaltered, in the case of superrotations the spectrum is significantly altered.

Name: Masato Minamitsuji

Affiliation: CENTRA, IST, UL

Title: Black holes in extended vector-tensor theories

Abstract: We investigate the static and spherically black hole solutions in the extended vector-tensor theories without suffering from the Ostrogradsky instabilities. We investigate the two classes of black hole solutions, for constant and nonconstant norms of the vector field, respectively. In the first case, we obtain the black hole solutions with the Schwarzschild, Schwarzschild-de Sitter/ anti-de Sitter, Reissner-Nordström-type, and Reissner-Nordström-de Sitter/ anti-de Sitter type metrics. We show that the conditions for the existence of these solutions are compatible with the degeneracy conditions for the Class-A theories, and recover the black hole solutions in the generalized Proca and degenerate higher-order scalar-tensor theories in the certain limits. In the latter case, we obtain a variety of the black hole solutions with various asymptotic properties.

Name: Miguel Zilhão

Affiliation: Instituto Superior Técnico

Title: Scalar fields and gravitational molecules

Abstract: We will explore the dynamics of scalar fields in the presence of black holes and show that light scalars can form quasibound states around black hole binaries. In the nonrelativistic regime, these states are formally described by the quantum-mechanical Schrödinger equation for a one-electron heteronuclear diatomic molecule. We performed extensive numerical simulations of scalar fields around black hole binaries showing that a scalar structure condenses around the binary – we dub these states "gravitational molecules". We further show that these are well described by the perturbative, nonrelativistic description.

Name: Jose Diogo Simao

Affiliation: FSU Jena

Title: Spin-foam models of Quantum Space-Time: Semiclassics

Abstract: Spin-foam models are a proposal for a non-perturbative and background-independent theory of quantum gravity, where classical space-time is reduced at the quantum level to discrete combinatorial structures. In this short talk I will introduce the general formulation of the theory, and I will show in which sense a notion of classical geometry can be asymptotically recovered in a relevant regime. Recent results regarding the semiclassics of a particular model (Lorentzian EPRL) will finally be discussed. This talk reports on joint work with Sebastian Steinhaus. Pre-print at arXiv:2106.15635.

Name: Marcello Ortaggio

Affiliation: Institute of Mathematics of the Czech Academy of Sciences

Title: Robinson-Trautman spacetimes coupled to conformally invariant electrodynamics in higher dimensions

Abstract: We investigate Robinson-Trautman spacetimes sourced by a conformally invariant, power-like, non-linear electrodynamics in $D > 4$ dimensions. The general solution includes static dyonic black holes with Einstein-Kaehler horizon geometries. In contrast to the linear $D > 4$ theory, time-dependent solutions are also possible which describe black holes gaining (losing) mass by receiving (emitting) electromagnetic radiation. Some extensions beyond Einstein's gravity will be mentioned.

Name: Jianzhi Yang

Affiliation: University of Aveiro

Title: Einstein-Maxwell-dilaton neutral black holes in strong magnetic fields: topological charge, shadows and lensing

Abstract: The light rings (LRs) topological charge (TC) of a spacetime measures the number of stable LRs minus the number of unstable LRs. It is invariant under smooth spacetime deformations obeying fixed boundary conditions. Asymptotically flat equilibrium black holes (BHs) have, generically, TC $= -1$. In Einstein-Maxwell theory, however, the Schwarzschild-Melvin BH - describing a neutral BH immersed in a strong magnetic field - has TC $= 0$. This allows the existence of BHs without LRs and produces remarkable phenomenological features, like panoramic shadows. Here we investigate the generalised Schwarzschild-Melvin solution in Einstein-Maxwell-dilaton theory, scanning the effect of the dilaton coupling a. We find that the TC changes discontinuously from TC $= 0$ to TC $= -1$ precisely at the Kaluza-Klein value $a = \sqrt{3}$, when the (empty) Melvin solution corresponds to a twisted Kaluza-Klein reduction of five-dimensional flat spacetime, i.e.the dilaton coupling a induces a topological transition in the TC. We relate this qualitative change to the Melvin asymptotics for different a. We also study the shadows and lensing of the generalised Schwarzschild-Melvin solution for different values of a, relating them to the TC.

Name: Pedro Cunha

Affiliation: University of Aveiro

Title: Testing the Kerr paradigm using strong gravitational lensing

Abstract: The image of M87* by the Event Horizon Telescope (EHT) has created a valuable opportunity to test the nature of Black Hole (BH) candidates in the cosmos. The Kerr hypothesis, which is motivated by multiple uniqueness theorems, states that astrophysical BHs are well described by the Kerr metric. However, alternative Kerr objects with possible astrophysical relevance can be constructed by circumventing these theorems. This talk will discuss the prospect of testing the Kerr hypothesis using shadow observations and lensing of the accretion flow around compact objects.

Name: Riccardo Della Monica

Affiliation: Universidad de Salamanca

Title: Orbital precession of the S2 star in Scalar-Tensor-Vector-Gravity

Abstract: We have obtained the first constraint of the parameter space of Scalar-Tensor-Vector-Gravity using the motion of the S2-star around the supermassive black hole at the centre of the Milky Way, and we did not find any serious tension with General Relativity. We used the Schwarzschild-like metric of Scalar-Tensor-Vector-Gravity to predict the orbital motion of S2-star, and to compare it with the publicly available astrometric data, which include 145 measurements of the positions, 44 measurements of the radial velocities of S2-star along its orbit, and only the inferred rate of precession, as the latest GRAVITY data are not yet public. We employed a Monte Carlo Markov Chain algorithm to explore the parameter space, and constrained the only one additional parameter of Scalar-Tensor-Vector-Gravity to $\alpha \lesssim 0.662$ at 99,7% confidence level, where $\alpha = 0$ reduces this modified theory of gravity to General Relativity.

Name: Christian Peterson Bórquez

Affiliation: CENTRA, Instituto Superior Técnico, Universidade de Lisboa

Title: Issues of the minimal gravity-Standard Model Extension from spacetimes with symmetries

Abstract: A natural way to extend GR is violating the theory's fundamental symmetries. From this perspective, the so-called Standard Model Extension (SME) is a framework that parametrizes all possible Lorentz violations in a systematic way through the introduction of non-dynamical fields in the action. In this talk I will present the ""t"" term of the SME, a tensor that couples to the Weyl tensor, in static and spherically-symmetric spacetimes. When explicit Lorentz violation is considered, it is possible to constrain the theory's coupling constant when comparing with observations. Moreover, when Lorentz violation is assumed to arise spontaneously, a possible explanation for the lack of physical effects in asymptotically flat spacetimes will be presented.

Name: Paulo Garcia

Affiliation: CENTRA/FEUP

Title: Recent results from the GRAVITY collaboration on SgrA* supermassive black hole

Abstract: We will present the recent efforts on the hunting and gathering of knowledge on the galactic centre supermassive black hole close environment, by the GRAVITY collaboration. In our last talk we celebrated the 2020 Nobel prize with a focus on the gravitational redshift and the Schwarzschild precession. In this talk we will focus on recent results on imaging the inner stars orbiting SgrA* and how these orbits constrain the central object and extended dark matter configurations. We will also address recent results on the flaring of SgrA* and on the environment near the horizon. We will end with the current effort to constrain the spin via the building of a new instrument Gravity+.

Name: Filipe Costa

Affiliation: CAMGSD - Instituto Superior Técnico, Universidade de Lisboa

Title: Frame-dragging: meaning, myths, and misconceptions

Abstract: Originally introduced in connection with general relativistic Coriolis forces, the term frame-dragging is associated today with a plethora of effects related to the off-diagonal element of the metric tensor. It is also frequently the subject of misconceptions leading to incorrect predictions, even of nonexistent effects. In this talk we will show that there are three different levels of frame-dragging corresponding to three distinct gravitomagnetic objects: gravitomagnetic potential, field, and tidal tensor, whose effects are independent, and sometimes opposing. It is seen that, from the two analogies commonly employed, the analogy with magnetism holds strong where it applies, whereas the fluid-dragging analogy (albeit of some use, qualitatively, in the first level) is, in general, misleading. Common misconceptions (such as viscous-type "body-dragging") are debunked. Applications considered include rotating cylinders (Lewis-Weyl metrics), Kerr, Kerr-Newman and Kerr-dS spacetimes, black holes surrounded by disks/rings, and binary systems.

Name: Guilherme Raposo

Affiliation: CIDMA - CENTRA

Title: Elastic compact objects in general relativity

Abstract: In this talk we will introduce a new framework to study spherically symmetric self-gravitating elastic bodies in general relativity. Using this newly found formalism we will show that spherically symmetric configurations can be built and we will discuss the viability of such solutions. We will show that elastic matter can produce more massive and more compact solutions than their fluid analogous and we will discuss how compact can a viable elastic compact object be.

Name: Taishi Ikeda

Affiliation: Sapienza University of Rome

Title: Black hole eating boson star

Abstract: The light complex scalar field is a fundamental field in theoretical physics. It is one of the candidate of the dark matter and dark energy, and plays an important role in cosmology. One of the typical configurations of light complex scalar fields in the Universe is the boson star, which is the compact object supported by its own gravity and its pressure. The boson star in the Universe interacts with other astrophysical objects through gravity. In particular, when a black hole is inside a boson star, the black hole absorbs the energy of the boson star, and the boson star energy decreases. In order to evaluate the effect of black holes on the boson star, we solve the time evolution of the spherically symmetric boson star black hole system, and discuss the absorption process of the boson star's energy into black holes.

Name: Nicolás Mora

Affiliation: Universidad de Concepción

Title: Slowly rotating black holes in Quasi-topological gravity

Abstract: In this talk, we will show some features of Quasi-topological gravities as a family of higher curvature gravity up to quartic order in respect to the Riemann tensor. Here we will explore rotating solutions, in particular we will construct slowly rotating black holes in these theories. In the cubic order, the equation of the off-diagonal metric function is second order, we will impose this in the quartic case to partially remove the degeneracy of these theories. Even more, in the quartic case, the equations of motion were obtained from a consistent reduced action principle, and the functions admit a simple integrarion in terms of quadratures. Going beyond the slowly rotation regime, we will explore the Kerr-Schild ansatz in the cubic Quasi-topological gravity, under the condition the asymptotically behavior match with the General Relativity case and for two and equal oblateness parameters, this ansatz does not lead a solution for generic values of the couplings.

Name: Šimon Knoška

Affiliation: Institute of Theoretical Physics Faculty of Mathematics and Physics, Charles University

Title: Schwarzschild-Bach black holes in the Eddington–Finkelstein-like coordinates: explicit solution and its properties

Abstract: Spherically symmetric geometries occupy a privileged position within the studies of exact spacetimes in various theories of gravity fairly due to their direct physical interpretations as well as their mathematical simplicity. We analyse such solutions in the framework of the quadratic gravity, representing the GR natural modification, which includes quadratic corrections in the action. We extend previous works employing the Eddington–Finkelstein-like coordinates. This allows to find the explicit solution in the form of power series, analogously to the previous pioneering approach using the conformal-to-Kundt metric form, however, our results provide more direct transition to the classic Schwarzschild-like coordinates and simultaneously naturally elucidate physical and geometrical properties of the resulting solution such as basic aspects of geodesic motion, the quadratic gravity mass contribution, or formation of the cosmological horizon.

Name: Michael Volkov

Affiliation: University of Tours

Title: Stationary generalizations for the Bronnikov-Ellis wormhole and for the vacuum ring wormhole

Abstract: We analyze the problem of constructing the stationary generalization for the ultrastatic wormhole solution supported by the phantom scalar field. The extreme simplicity of this solution suggests that its stationary version could be easily obtainable, however, no such solution has been found up to now. It turns out that the difficulty in finding this solution is not related to the scalar field, which can be eliminated within the Eris-Gurses procedure. The problem reduces to finding the stationary generalization for the vacuum wormhole sourced by a thin ring of negative tension, whose static limit is described by the locally flat geometry obtained from the Kerr metric in the zero mass limit. The corresponding solution of the vacuum Ernst equations is analytically unknown but can be constructed perturbatively and describes a rotating ring. This presumably describes the difficulty, since constructing solutions with an extended source is a non-trivial problem.

Name: Isabel Suárez Fernández

Affiliation: CENTRA / IST

Title: Comparison of linear Brill and Teukolsky waves

Abstract: Motivated by studies of critical phenomena in the gravitational collapse of vacuum gravitational waves we compare, at the linear level, two common approaches to constructing gravitational-wave initial data. Specifically, we construct analytical, linear Brill wave initial data and compare these with Teukolsky waves in an attempt to understand the different numerical behavior observed in dynamical (nonlinear) evolutions of these two different sets of data. In general, the Brill waves indeed feature higher multipole moments than the quadrupolar Teukolsky waves, which might have provided an explanation for the differences observed in the dynamical evolution of the two types of waves. However, we also find that, for a common choice of the Brill-wave seed function, all higher-order moments vanish identically, rendering the (linear) Brill initial data surprisingly similar to the Teukolsky data for a similarly common choice of its seed function.

Name: Julio Arrechea

Affiliation: Instituto de Astrofísica de Andalucía (IAA-CSIC)

Title: Semiclassical relativistic stars

Abstract: Quantum vacuum polarization violates energy conditions in the spacetime external to a compact star. As such an object is made to approach the black hole limit, semiclassical corrections become capable of producing new equilibrium end-states in stellar evolution. The semiclassical contribution is modeled by a massless quantum scalar field in the Boulware vacuum state, and its renormalized stress-energy tensor is firstly approached by an analytic Polyakov approximation. This already reveals a crucial difference with respect to classical stellar equilibrium: We find families of solutions that exhibit bounded pressures and mass up to a central core of Planckian radius. A minimal deformation of the Polyakov approximation inside this central core is sufficient to produce regular ultracompact configurations that surpass the Buchdahl compactness bound. We review the main features of these semiclassical relativistic stars.

Name: Francisco Duque

Affiliation: CENTRA, Instituto Superior Tecnico, Universidade de Lisboa

Title: Black-hole mimickers take time to fuel-up

Abstract: Ultracompact objects with photonspheres are known to mimic many observational features of black holes. It has been suggested that anomalous tidal heating or the presence of resonances in gravitational wave signals would be a clear imprint of a surface or absence of an horizon. Such claims and studies are all based on a frequency-domain analysis, assuming stationarity. In this talk, we will show that the object needs to first "fuel-up" until it reaches the stationary regime. The presence of a stable light ring and large light-travel times inside the object may in fact delay enormously the "charging-up" and effectively contribute to the effacement of structure. In other words, black hole mimickers behave as black holes more efficiently than previously thought.

Name: Alex Vano-Vinuales

Affiliation: GRIT, CENTRA, IST, University of Lisbon

Title: Hyperboloidal trumpet black hole slices and their causal visualization

Abstract: Hyperboloidal slices are smooth spacelike slices that reach future null infinity. The latter consists of the endpoints of future-directed null geodesics and is where global quantities of spacetimes are unambiguously defined. Here I will focus on hyperboloidal slices including a black hole in trumpet geometry, which is specially useful for simulations solving the Einstein equations as initial value formulation because it avoids the singularity. The simplest suitable option are constant-mean-curvature slices, which I will briefly describe for the Schwarzschild and Reissner-Nordström cases. I will use Carter-Penrose diagrams to represent some of them, as well as to show the causal behaviour of Schwarzschild trumpets dynamically relaxing to a stationary state.

Name: Filipe Moura

Affiliation: ISCTE-IUL and Instituto de Telecomunicações

Title: Asymptotic quasinormal modes of Gauss-Bonnet d-dimensional black holes

Abstract: We extend our previous work on the computation of quasinormal frequencies of string-theoretical black holes for tensorial gravitational perturbations in the highly damped regime. We consider now d-dimensional nonstringy solutions with Gauss-Bonnet corrections, and also vectorial and scalar gravitational perturbations. We compare all the results.

Name: Antoine Lehébel

Affiliation: IST

Title: The fate of observers in circular motion

Abstract: In Newtonian physics or in general relativity, the effect of energy dissipation is that observers moving along circular orbits slowly spiral towards the source of the gravitational field. I will show that the loss of energy has the same effect in any theory of gravity respecting the weak equivalence principle, by exhibiting an intimate relation between the energy of a massive test particle and the stability of its orbit. In addition, I will construct a toy metric which displays an unbound innermost stable circular orbit, a priori allowing particles that reach this orbit to be expelled away.

Name: João Luís Rosa

Affiliation: University of Tartu

Title: Observational signatures of bosonic stars at the galactic centre

Abstract: The GRAVITY collaboration has recently a detected continuous circular relativistic motion during infrared flares of Sgr A*, which has been interpreted as orbital motion near the event horizon of a black-hole. In this work, we use the ray-tracing code GYOTO to analyze the possibility of these observations being consistent with a central bosonic star instead of a black-hole. Our model consists of an isotropically emitting hot-spot orbiting a central boson or Proca star. Images of the orbit at different times and the integrated flux were obtained for both models and compared with the case of a Schwarzschild black-hole. Although the overall qualitative picture is comparable, the bosonic star models present an extra image when the emitting hot-spot passes behind the central object caused by photons travelling through the interior of the star. Furthermore, there are also measurable differences in the angles of deflection, orbital periods, and centroid of the flux, which can potentially be detected.

Name: Rodrigo Vicente

Affiliation: IFAE, Barcelona

Title: Dynamical friction of black holes in ultralight dark matter

Abstract: Cold dark matter (CDM) describes excellently the observed physics at large (cosmological) scales; however, it seems to be in tension with several smaller (galactic) scale observations. Ultralight dark matter, an alternative to CDM that is especially well motivated by several Standard Model extensions, may provide the solution to these small-scale problems, while keeping the excellent large-scale predictions of CDM. In this talk I will discuss how we can obtain simple analytical expressions, from first principles, for the dynamical friction acting on spinning black holes moving through an ultralight dark matter environment. I will also discuss applications of these results to problems like the evolution of black hole binaries in dark matter solitons (e.g., oscillons or boson stars) that may exist at the center of haloes.

Name: Pedro Ildefonso

Affiliation: CENTRA, Instituto Superior Técnico, University of Lisbon

Title: Evolution of Dipolar Boson Stars and Head-on Collisions of Spherical Boson Stars

Abstract: We probe the hypothesis of forming static dipolar like configurations of boson stars (BSs) from the head-on collision of two spherical BSs with opposite phases. We perform non-linear numerical simulations of psherical BSs in a model without self-interactions (mini-BSs) and show that the instabilities created during the collision lead to the gravitational collapse to a black hole (BH); however, by introducing fourth and sixth order self-interacting terms in the scalar potential (Q-stars), we show that the binary is robust enough to withstand the perturbations. These results support the healing power of self-interactions and provide a potential candidate mechanism for the formation of dipolar BSs. With this in mind, we study the dynamical stability of dipolar BSs in the model of Q-stars(doublet Q-stars). We show the existence of two (candidate) stable branches: the relativistic stable branch (for scalar field frequencies near the lower limit) and the Newtonian stable branch (for scalar field frequencies near the maximum value). Solutions outside of these branches show a migrating behaviour, whose final destiny still requires further investigation.

Name: Tiago Vasques Fernandes

Affiliation: Instituto Superior Técnico

Title: Grand canonical emsemble of a d-dimensional Reissner-Nordstrom black hole in a cavity

Abstract: We construct semi-classically the grand canonical ensemble of a d-dimensional Reissner-Nordstrom black hole inside a cavity. We use the path integral approach to compute the partition function of a spacetime inside a cavity, whose boundary is treated as a heat reservoir with a fixed electrostatic potential. To compute the path integral, we make the analytical continuation of the Lorentzian action, thus yielding an Euclidean path integral depending on the Euclidean action. We then perform the semi-classical approximation to the Euclidean path integral, which will be reduced to the contribution of the configuration with least action. We assume that spacetimes with spherical symmetry give the main contribution to the Euclidean path integral. We obtain two solutions for a Reissner-Nordstrom black hole in thermal and electrostatic equilibrium with the cavity in d-dimensions. We also analyse the reduced Euclidean action, which contains information about phase transitions and stability of the two black hole solutions found. We find that the solution with higher mass is stable, whereas the solution with lower mass is unstable.

Name: Nico Sanchis-Gual

Affiliation: University of Aveiro

Title: Can fermion-boson stars reconcile multi-messenger observations of compact stars?

Abstract: Mixed fermion-boson stars are stable, horizonless, everywhere regular solutions of the coupled Einstein-(complex, massive) Klein-Gordon-Euler system. While isolated neutron stars and boson stars are uniquely determined by their central energy density, mixed configurations conform an extended parameter space that depends on the combination of the number of fermions and (ultralight) bosons. The wider possibilities offered by fermion-boson stars could help explain the tension in the measurements of neutron star masses and radii reported in recent multi-messenger observations and nuclear-physics experiments. We construct equilibrium configurations of mixed fermion-boson stars with realistic equations of state for the fermionic component and different percentages of bosonic matter. We show that our solutions are in excellent agreement with multimessenger data, including gravitational-wave events GW170817 and GW190814 and X-ray pulsars PSR J0030+0451 and PSR J0740+6620, as well as with nuclear physics constraints from the PREX-2 experiment.

Name: Lissa de Souza Campos

Affiliation: University of Pavia

Title: Probing thermal effects on static black holes with Unruh-DeWitt detectors

Abstract: Experiments on black hole spacetimes can be carried out, theoretically, by Unruh-DeWitt detectors. In recent years, particle detectors have been used to tackle problems ranging from the conceptualization of the experimental detection of Unruh/Hawking effects to probing the quantum nature of the gravitational field itself through entanglement harvesting. Markedly, by providing a new perspective and new operational tools, this approach has also disclosed new thermal, quantum effects such as the anti-Unruh/Hawking effects, which are rather puzzling. In this talk, I will give a general overview of how we can probe thermal, quantum effects on static black holes within the particle detector framework. I will outline the main ingredients for the establishment of a free, scalar quantum field theory on static, curved, not necessarily globally hyperbolic spacetimes and for the computation of the transition rate of a static detector modelled as a two-level system and interacting for an infinite proper time with the quantum field. Then, I will highlight some of its applications, focusing on topological black holes and having in mind the works I have developed in collaboration with C. Dappiaggi, J.Pitelli and D. Sina [physletb.2021.136198, PhysRevD.103.025021, PhysRevD.104.085020, PhysRevD.104.105008].

Name: Justin C. Feng

Affiliation: CENTRA - Instituto Superior Técnico

Title: Sharp density gradients in generalized coupling theories

Abstract: Sharp matter density gradients, such as those which may be present at the boundary of compact objects (neutron stars for instance), present difficulties in gravity theories containing auxiliary fields. In generalized coupling theories, which will be the focus of this talk, discontinuities in matter density profiles generically produce discontinuities in the effective metric minimally coupled to matter. On the other hand, the "Einstein frame" metric encoding the gravitational degrees of freedom is not discontinuous. To gain insight into this problem, a recent analysis of sharp (but smooth) density gradients in the MEMe model (a simple instance of a generalized coupling theory) was conducted—I describe the analysis and discuss its implications in this talk.

Name: Dimitry Ayzenberg

Affiliation: University of Tuebingen

Title: Testing gravity with black hole shadow subrings

Abstract: The ideal black hole shadow, that is the projection of the spherical photon orbits onto the observer's sky, is in reality not a measurable observable. Instead, one observes the subrings of the shadow, where each subsequent subring is made up of photons that take an extra half orbit around the black hole before reaching the observer. There is much interest in using observations of these subrings to measure the properties of black hole spacetimes using the Event Horizon Telescope and its successors. Here, I present some recent work studying the ability of current and future telescope facilities to measure spacetime properties, including departures from the Kerr metric, using observations of the black hole shadow and its subrings.

Name: Valentin Boyanov

Affiliation: Universidad Complutense de Madrid

Title: Mass inflation in classical and semiclassical gravity

Abstract: We analyse the geometry of a spherically-symmetric black hole which has both an outer and inner apparent horizon, and is perturbed by collapsing thin shells of matter. On a classical level we observe that the mass inflation instability is triggered, and we compare the inner structure of the mass-inflated region with previous results obtained with perturbations in the form continuous fluxes of matter. We then perform an approximate calculation of the semiclassical backreaction around the inner apparent horizon. We find that the classical tendency for this horizon to move inward, present due to mass inflation, is challenged by a semiclassical tendency for it to evaporate outward.

Name: João G. Rosa

Affiliation: Universidade de Coimbra

Title: Primordial black hole superradiant instabilities

Abstract: I will discuss the possibility of primordial black holes undergoing superradiant instabilities in the early Universe, as well as their cosmological evolution, taking also into account other dynamical effects such as Hawking evaporation. In addition, I will explore the potential cosmological impact of these instabilities and the associated particle phenomenology.

Name: Arianna Foschi

Affiliation: Instituto Superior Técnico (CENTRA) and Universidade do Porto

Title: Constraining a scalar field cloud near Sgr A*.

Abstract: GRAVITY measurements allow us to know with extremely high precision the position in the sky of a large number of stars, namely the S-stars, orbiting very close to the supermassive black hole at the Galactic Center. These data can be used to test the presence of dark matter's distributions in a region of the Universe where gravity is very strong. To this aim, I will show how to exploit the astrometric data collected for S2-star to constrain the possible presence of a scalar field cloud around Sgr A*. The talk will be devoted to explain how to get the equations of motion in a setup given by a central black hole and a toroidal scalar field distribution, how to get the best estimates for the parameters describing the cloud using a Markov Chain Monte Carlo method and to show some preliminary results.

Name: Edgar Gasperin

Affiliation: CENTRA-IST, Instituto Superior Técnico, Universidade de Lisboa.

Title: Staticity and regularity for spin-2 fields near spatial infinity on flat spacetime

Abstract: Linear zero-rest-mass fields generically develop logarithmic singularities at the critical sets where spatial infinity meets null infinity. Friedrich's representation of spatial infinity is ideally suited to study this phenomenon. These logarithmic singularities are an obstruction to the smoothness of the zero-rest-mass field at null infinity and, in particular, to peeling. In the case of the spin-2 field it has been shown that these logarithmic singularities can be precluded if the initial data for the field satisfies a certain regularity condition involving the vanishing, at spatial infinity, of a certain spinor (the linearised Cotton spinor) and its totally symmetrised derivatives. In this article we investigate the relation between this regularity condition and the staticity of the spin-2 field. It is shown that while any static spin-2 field satisfies the regularity condition, not every solution satisfying the regularity condition is static.

Name: Jordan Nicoules

Affiliation: LUTH (Observatoire de Paris - CNRS - Université de Paris)

Title: First applications of a new evolution code based on the Kadath library

Abstract: I will present a new evolution code based on the Kadath library. The standard Kadath library is a free and open-source software commonly used for initial data computation. This new code implements time evolution schemes and preserves the modularity of Kadath. I will first demonstrate the validation of the code on a simple wave equation. I will then discuss the current process of validation in the context of GR with the evolution of a Teukolsky wave as well as how we cured some instabilities. In particular, we are using spherical coordinates and a special care is given to the treatment of the innermost spherical domain which contains the origin. I will conclude with some prospects about future applications of this code and possible developments.

Name: Enrico Cannizzaro

Affiliation: La Sapienza University of Rome

Title: Photon-plasma interactions in curved spacetime

Abstract: Astrophysical plasma may play a crucial role in the stability problem of black holes (BHs). In fact, within the context of General Relativity (GR) it is possible that spinning BHs could be affected by a plasma-driven superradiant instability. Electromagnetic waves scattering off a spinning BH can extract rotational energy from it through a phenomenon called superradiance. Interestingly, these modes can be naturally confined by astrophysical plasma in the vicinity of the BH, leading to an instability and a spin-down of the BH. This proposal could potentially explain the low values of the LIGO/Virgo BH spins, and has been also advocated as a possible explanation for the origin of fast radio bursts. Given the interesting phenomenological implications, a detailed understanding of this interaction is therefore crucial. In this talk, I will show how BHs surrounded by a tenous plasma are potentially unstable to plasma-driven superradiant instabilities at a linear level, but several mechanisms such as non-linear interaction and accretion hamper this instability and prevent the system to turn unstable.

Name: Jorge Gigante Valcarcel

Affiliation: University of Tartu

Title: Rotating Kerr-Newman space-times in Metric-Affine Gravity

Abstract: We present new rotating vacuum configurations endowed with both dynamical torsion and nonmetricity fields in the framework of Metric-Affine gauge theory of gravity. For this task, we consider scalar-flat Weyl-Cartan geometries and obtain an axisymmetric Kerr-Newman solution in the decoupling limit between the orbital and the spin angular momentum. The corresponding Kerr-Newman-de Sitter solution is also compatible with a cosmological constant and additional electromagnetic fields.

Name: Susanna Barsanti

Affiliation: Sapienza University of Rome

Title: Extreme Mass Ratio Inspirals as probes of scalar fields

Abstract: Extreme Mass Ratio Inspirals (EMRIs), binary systems in which a stellar mass compact object inspiral into a massive black hole (MBH), are among the primary targets for LISA, as they harbour the potential for precise gravity test. Although the description of these systems in modified theories of gravity can be dramatically complex, for a vast class of theories with additional scalar fields great simplifications occur. First, the MBH scalar charge is strongly suppressed, so that the background spacetime is simply described by the Kerr metric. Moreover, all information about the underlying gravity theory turns out to be encoded in the inspiralling body's scalar charge. In this talk I will show how, for these theories, the surviving charge strongly affects the binary dynamics, accelerating its coalescence and leaving an imprint on the emitted gravitational waves. By analysing such signals, I will finally present the extremely promising results on the LISA's detectability of the scalar charge, which render EMRIs encouraging probes of gravity and of new fundamental fields.

Name: Massimo Vaglio

Affiliation: Sapienza University of Rome

Title: Fast rotating massive boson stars from strongly self-interacting scalar fields: stellar structure and multipole moments

Abstract: Massive boson stars are among the most promising candidates which could act as mimickers of ordinary astrophysical compact objects. They represent a theoretically motivated alternative to the black hole paradigm, which can be tested with current and future observations. In this talk we present a detailed analysis of a class of fast rotating boson stars with a quartic self-interaction coupling, focused to outline the main stellar features that affect the gravitational wave emission from binaries, and can be useful to disentangle them from astrophysical black holes. Our results strengthen and extend previous numerical works, showing that the non-trivial multipolar structure induced by the rotational flattening, differs, even for the most compact configurations, from the one of a Kerr black hole in a wide range of the boson star's spin. We also discuss the presence of ergoregions for specific stellar configurations, as well as the viability of universal relations between boson star observables.

Name: Edoardo Giangrandi

Affiliation: CFisUC

Title: Effects of asymmetric bosonic dark matter on compact star properties

Abstract: We study an accumulation of asymmetric bosonic dark matter inside neutron stars and its further impact on star's evolution. We present the conditions at which dark matter particles tend to condensate in a core of the star or create an extended halo. We show that dark matter condensed in a core leads to a decrease of the total gravitational mass and tidal deformability compared to a pure baryonic star. In addition, at some conditions self-gravitating dark matter can collapse gravitationally and form a black hole that can destroy the star. We study the range of particle mass, coupling constant and fraction of dark matter inside the neutron star that lead to the formation of a black hole inside a compact star. By imposing an existing astrophysical and gravitational wave constraints we set a new limit on the mass and fraction of dark matter particles.

Name: João Oliveira

Affiliation: Universidade do Minho - CMAT

Title: Virial Identities for higher dimensional effective actions

Abstract: In a previous paper [1] we have presented a treatment of virial identities in relativistic gravity, within the framework of one-dimensional (1D) effective actions, using the Gibbons-Hawking-York term to generalize the procedure for any ansatz. In this talk, we start by summarizing the ways we can calculate the Virial identity of the 1D case and discuss the possible avenues on how this calculation can be generalized to higher dimensional effective actions like, for example, actions with axial symmetry depending on both the radius and an angle. We present some examples of the calculation for spacetimes of spinning compact objects.

[1] - C. A. R. Herdeiro, J. M. S. Oliveira, A. M. Pombo, and E. Radu, Phys. Rev. D 104, 104051

Name: António P. Morais

Affiliation: Universidade de Aveiro

Title: Ultralight bosons for strong gravity applications from simple Standard Model extensions

Abstract: We discuss families of simple extensions of the Standard Model that can yield ultralight real or complex vectors or scalars with potential astrophysical relevance. Specifically, the mass range for these putative fundamental bosons ($\sim 10^{-10} - 10^{-20}$ eV) can lead dynamically to compact objects such as bosonic stars and new non-Kerr black holes, with masses ranging from 1 up to about 10^{10} solar masses, corresponding to the mass range of astrophysical black hole candidates (from stellar mass to supermassive). For each model, we study the properties of the mass spectrum and interactions after spontaneous symmetry breaking, discuss its theoretical viability as well as some of its potential and most relevant phenomenological implications linking them to the physics of compact objects.

Name: Rita Teixeira da Costa

Affiliation: Princeton University / University of Cambridge

Title: Hidden spectral symmetries and mode stability for Kerr(-de Sitter) black holes

Abstract: The Teukolsky master equations describe the linear behavior of perturbations of the Kerr(-de Sitter) black hole family, of which the conformal Klein-Gordon equation is a particular case. As a first essential step towards stability, Whiting showed in 1989 that the Teukolsky equation on subextremal Kerr admits no exponentially growing modes. His method of proof breaks down in the Kerr-de Sitter setting.

In this talk, we present a new approach to mode stability, based on uncovering hidden spectral symmetries in the Teukolsky equations. This yields a novel proof of Whiting's classical result as well as a partial mode stability statement for Kerr-de Sitter. This talk is based on joint work with Marc Casals (CBPF/UCD).

Name: Haroldo Cilas Duarte Lima Junior

Affiliation: Federal University of Pará / University of Aveiro

Title: Can different black holes cast the same shadow?

Abstract: We consider the following question: may two different black holes (BHs) cast exactly the same shadow? In spherical symmetry, we show the necessary and sufficient condition for a static BH to be shadow-degenerate with Schwarzschild is that the dominant photonsphere of both has the same impact parameter, when corrected for the (potentially) different redshift of comparable observers in the different spacetimes. Such shadow-degenerate geometries are classified into two classes. The first shadow-equivalent class contains metrics whose constant (areal) radius hypersurfaces are isometric to those of the Schwarzschild geometry, which is illustrated by the Simpson and Visser (SV) metric. The second shadow-degenerate class contains spacetimes with different redshift profiles and an explicit family of metrics within this class is presented. In the stationary, axi-symmetric case, we determine a sufficient condition for the metric to be shadow degenerate with Kerr for far-away observers. Again we provide two classes of examples. The first class contains metrics whose constant (Boyer-Lindquist-like) radius hypersurfaces are isometric to those of the Kerr geometry, which is illustrated by a rotating generalization of the SV metric, obtained by a modified Newman-Janis algorithm. The second class of examples pertains BHs that fail to have the standard north-south Z2 symmetry, but nonetheless remain shadow degenerate with Kerr. The latter provides a sharp illustration that the shadow is not a probe of the horizon geometry. These examples illustrate that nonisometric BH spacetimes can cast the same shadow, albeit the lensing is generically different.

Name: Lucas Gardai Collodel

Affiliation: University of Tuebingen

Title: Geometrical Features of Black Holes in EsGB Theories

Abstract: In the past few years a lot of attention has been drawn towards Einstein-scalar-Gauss-Bonnet theories - defined by their coupling functions and parameter values - specially concerning compact objects such as neutron stars, black holes, wormholes and solitons. Even in the absence of matter, these theories feature an effective energy momentum tensor that violates some or even (locally) all energy conditions. In this talk we shall explore the impact this has on the metric potentials of black hole solutions and consequently on particle dynamics, which in turn plays a central role in astrophysical phenomenology and observation.

Name: José Afonso

Affiliation: Instituto de Astrofísica e Ciências do Espaço - Faculdade de Ciências da Universidade de Lisboa

Title: Supermassive Black Holes as drivers of galaxy formation: from the Milky Way to the edge of the Universe

Abstract: Active Galactic Nuclei (AGN), powered by the infall of matter to a supermassive black hole, are currently observed throughout the observable Universe and well into the first Gyr after the Big Bang. Theoretical work has been developed showing how this process must exist at even earlier epochs, driving not only galaxy evolution but galaxy formation itself. However, the origin and ultra-fast growth of such supermassive black holes is still unknown, and requires the identification and study of some of the most distant and extreme objects ever detected. Five decades after the proposal that also the Milky Way hosts a supermassive black hole, and a little over two years after the first image of one, I will describe our current understanding of the interplay between galaxy and supermassive black hole at their earliest epochs. I will also detail our recent efforts in developing innovative selection methodologies, using upcoming observations at radio and X-ray wavelengths, to identify and study powerful AGN well within the Epoch of Reioinization of the Universe, a necessary step to finally understanding the origin of these extreme objects.

Name: João L. Costa

Affiliation: Iscte and CAMGSD

Title: Black hole uniqueness theorems: brief history and state of affairs

Abstract: I will briefly describe some historical aspects of black hole uniqueness in vacuum and describe the current sate of the art concerning this classical problem in General Relativity.