COSMO'22

Report of Contributions

https://indico.cern.ch/e/886404

Contribution ID: **10** Type: **Plenary/Parallel talk**

The HIBEAM/NNBAR Experiment at the ESS

Tuesday, 23 August 2022 09:50 (40 minutes)

The HIBEAM/NNBAR experiment is a two stage experiment for the European Spallation Source (ESS) to search for baryon number violation. The experiment would make high sensitivity searches for baryon number violating processes: n ⟶ nbar and n ⟶ n′(neutron to sterile neutron), corresponding to the selection rules in baryon number ΔB = 2, 1 , respectively. The experiment addresses topical open questions such as baryogenesis and dark matter, and is sensitive to a scale of new physics substantially in excess of that available at colliders. This is a cross-disciplinary experiment with a clear particle physics goal. The community encompasses physicists from large collider experiments and low energy nuclear physics experiments, together with scientists specialising in neutronics and magnetics. European, US and Asian communities are represented. The experiment would increase the sensitivity to neutron conversion probabilities by three orders of magnitude compared with previous searches. The opportunity to make such a leap in sensitivity in tests of a global symmetry is a rare one.

Presenter: MEIROSE, Bernhard (Stockholm University (SE))

Session Classification: Plenary Talk

Contribution ID: **13** Type: **Plenary/Parallel talk**

Reheating and Post-inflationary Production of Dark Matter

In the first stages of inflationary reheating, the mean energy of the radiation produced by inflaton decay is higher than the commonly defined reheating temperature. In thermal equilibrium, particle production can then be significantly enhanced relative to the subsequent radiation dominated era. Furthermore, in the earliest stages of reheating, before thermalization takes place, scattering of the inflaton decay products with momenta comparable to the inflaton mass can further enhance the particle production rate relative to the thermal one.

In this talk I will present a landscape of scenarios for freeze-in dark matter production during reheating. I will discuss the role played in the determination of the dark matter relic abundance by the shape of the inflationary potential (which in general is not quadratic near the minimum), the energy dependence of the dark matter production cross section, the perturbative or non-perturbative nature of the inflaton decay, and the thermalization time-scale for the decay products of the inflaton. In many scenarios, the thermal and non-thermal enhancement dominate over the dilution by the later generation of entropy near the end of reheating, leading to a relic abundance that is sensitive to the maximum temperature of the Universe. This makes dark matter a potential probe of the dynamics during the earliest stages of reheating, just after the end of inflation.

Primary author: Dr GARCIA GARCIA, Marcos A. (Instituto de Fisica Teorica UAM)

Presenter: Dr GARCIA GARCIA, Marcos A. (Instituto de Fisica Teorica UAM)

Session Classification: Poster session

Contribution ID: **14** Type: **Poster**

Seeding primordial black holes in multifield inflation

The inflationary origin of primordial black holes (PBHs) relies on a large enhancement of the power spectrum of the curvature fluctuation ζ at wavelengths much shorter than those of the CMB anisotropies. Quantum gravity inspired models are characterized by moduli spaces with highly curved geometries and a large number of scalar fields that could vigorously interact with ζ (as in the cosmological collider picture). Here we show that isocurvature fluctuations can mix with ζ inducing large enhancements of its amplitude. This occurs whenever the inflationary trajectory experiences rapid turns in the field space of the model leading to amplifications that are exponentially sensitive to the total angle swept by the turn, which induce characteristic observable signatures on the power spectrum. We derive accurate analytical predictions and show that the large enhancements required for PBHs demand noncanonical kinetic terms in the action of the multifield system.

Primary authors: Mr ZENTENO, Cristobal (University of Chile); Dr PALMA, Gonzalo (University of Chile); SYPSAS, Spyros (Chulalongkorn University)

Presenter: SYPSAS, Spyros (Chulalongkorn University)

Session Classification: Poster session

Contribution ID: **15** Type: **Plenary/Parallel talk**

Phase Transitions as Cosmological Witnesses

Phase Transitions as Cosmological Witnesses
4 May 2020, 15:15
15m
Parallel Talk Cosmology Cosmology I
Speaker
Dan Vagie
Description

We study the gravitational wave background from a first order phase transition generated during standard and nonstandard cosmological histories. We analyze the hydrodynamic properties of the plasma to define a self-similar invariant velocity profile to be utilized in the Sound Shell Model for acoustic gravitational wave production. We show that the relevant equations in an expanding universe take on the usual Minkowski form when the quantities are appropriately scaled. This allows us to investigate the impact an Early Matter Dominated era or a period of Kination before the Standard Radiation Dominated era will have on the stochastic gravitational wave background.

Primary authors: GUO, Huaike (University of Oklahoma); SINHA, Kuver (University of Oklahoma); VAGIE, Dan; WHITE, Graham (TRIUMF); LOGGIA, Elizabeth

Presenter: VAGIE, Dan

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **16** Type: **Plenary/Parallel talk**

Towards precision simulations for Cluster Cosmology

Friday, 26 August 2022 11:40 (40 minutes)

The next galaxy cluster survey has the potential of being a very competitive cosmological probe. The main cosmological inference done with clusters is the so-called number counts, within which the halo mass function (HMF) is a vital theoretical quantity. This talk revises the calibration of the HMF, focusing on the numeric and theoretical systematic effects from the simulation's purely numerical aspects to the baryonic feedback. While statistical and numerical systematic errors marginally impact the final cosmological constraints forecasted for future surveys, different halo definitions, and baryonic physics can systematically bias the results, raising awareness on the need for better understanding the connection between simulations and observations clusters are identified consistently in both.

Primary author: CASTRO, Tiago (INAF-OATS)

Presenter: CASTRO, Tiago (INAF-OATS)

Session Classification: Plenary Talk

Track Classification: Large scale structure

Contribution ID: **19** Type: **Plenary/Parallel talk**

Baryogenesis and Cosmological Consequences of Hořava-Lifshitz Gravity with Starobinsky Potential

In the late 90's, Reiss et al. [1] and Perlmutter at al. [2] by taking the Supernovae 1a independently proved that the universe is passing through an accelerated expansion. Many observations have supported this accelerated expansion of the late time universe [1,2,3,4,5]. The biggest mystery in the early universe is the production of excess of matter over antimatter [6,7,8. The present study reports the reconstruction schemes of the cosmological parameters of the modified Chaplygin gas and modified holographic dark energy models under Hořava-Lifshitz gravity and its baryogenesis. To initiate the study, we have considered the Starobinsky type potential. The scalar field and its potential of Hořava-Lifshitz gravity is reconstructed with Starobinsky type potential and is found to be consistent with the expansion of the universe. For the modified Chaplygin gas and modified holographic dark energy under the Hořava-Lifshitz gravity wih Starobinsky potential, the evolution of equation of state parameters are reconstructed and found out to be quintessence for both the cases. It is also proved that either the equal number of baryon density and anti baryon density will be attained by the model or the generalized second law of thermodynamics will be satisfied by the model.

References

[1] A.G. Reiss et al., Astron. J., 116, 1009 (1998).
[2] S. Perlmutter et al., Astrophys. J., 517, 565 (1999).
[3] P. de Bernardis et al., Nature, 404, 955 (2000).
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[7] M. Trodden, Rev. Mod. Phys., 71, 1463 (1999).
[8] D. E. Morrissey and M. J. Ramsey-Musolf, New J. Phys., 14, 125003 (2012).

Primary author: CHAKRABORTY, Gargee (Amity University, Kolkata)

Presenter: CHAKRABORTY, Gargee (Amity University, Kolkata)

Session Classification: Poster session

Contribution ID: **20** Type: **Plenary/Parallel talk**

Generalized SU(2) Proca theory and constant-roll inflation

Monday, 22 August 2022 14:00 (20 minutes)

This talk will be divided into two pieces. In the first part of the talk, I will present the generalized SU(2) Proca theory (GSU2P for short). As a modified gravity theory that introduces new gravitational degrees of freedom, the GSU2P is the non-Abelian version of the well known generalized Proca theory where the action is invariant under global transformations of the SU(2) group. New interesting possibilities arise in this framework because of the existence of new interactions of purely non-Abelian character and new configurations of the vector field resulting in spatial spherical symmetry and the cosmological dynamics being driven by the propagating degrees of freedom. In the second part of the talk, I will show what the impact of the GSU2P is on the cosmic primordial inflation epoch. Inflation is of the constant-roll type, featuring de Sitter expansion, and shows as an attractor straight line with an attraction basin covering most of the phase space. No Big-Bang singularities appear in this scenario. The predictions on the primordial curvature perturbation spectrum and bispectrum are obtained and shown to be in agreement with observations.

Primary author: RODRÍGUEZ GARCÍA, Yeinzon

Presenter: RODRÍGUEZ GARCÍA, Yeinzon

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **22** Type: **Plenary/Parallel talk**

Gravitational wave signatures of axionic domain walls

Tuesday, 23 August 2022 16:45 (20 minutes)

Axions are often accompanied by discrete symmetries that are spontaneously broken in the early universe and lead to the formation of a network of cosmic domain walls (DW).
In this talk, I will discuss the stochastic gravitational wave (GW) background produced by such networks. I will show that in some heavy QCD axion models, the GW signal is within reach of current and future detectors and is accompanied by a correction to the neutron (proton) electric dipole momentum that can be detected by future experiments.
I will also present a recent search for GWs from cosmic DWs in pulsar timing array data that shows that DWs can explain the signals that have been detected and lead to striking correlated signals at CMB and laboratory/collider experiments.

Primary author: ZAMBUJAL FERREIRA, Ricardo

Presenter: ZAMBUJAL FERREIRA, Ricardo

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **23** Type: **Plenary/Parallel talk**

Dynamical Stability Analysis of Accelerating f(T) Gravity Models

Monday, 22 August 2022 17:10 (20 minutes)

In this paper, we have emphasized the stability analysis of the accelerating cosmological models obtained in $f(T)$ gravity theory. The behaviour of the models based on the evolution of the equation of state parameter shows phantom-like behaviour at the present epoch. The scalar perturbation technique is used to create the perturbed evolution equations, and the stability of the models has been demonstrated. Also, we have performed the dynamical system analysis for both the models. In the two specific $f(T)$ gravity models, three critical points are obtained in each model. In each model, at least one critical point has been observed to be stable.

Primary author: Prof. MISHRA, Bivudutta (BITS-Pilani, Hyderabad Campus)

Presenter: Prof. MISHRA, Bivudutta (BITS-Pilani, Hyderabad Campus)

Session Classification: Parallel Session Lecture Room

Track Classification: Modified gravity & dark energy

Contribution ID: **24** Type: **Poster**

Dark Matter models implemented in PYTHIA8

We studied the four models implemented in PYTHIA8 for the production of dark matter or associated particles at the LHC based on the simplest extensions of the Standard Model. The first model includes dark matter production via s-channel mediators. This includes production in association with a jet for a vector boson or scalar mediator. Aside from the standard simplified models where the dark matter is accompanied by a new s-channel mediator, two other models were also studied where the dark matter particle is accompanied by charged partners that may be produced via Drell Yan production. The fourth model is a generalized model of mixed dark matter where the dark matter is a mixture of an SU(2) singlet and N-plet. We find that the last two models are also ideally suited to study the production of a range of long-lived particle signatures.

Primary author: FIRDOUS, Nameeqa (GIFT University Gujranwala Pakistan)

Co-author: Mr MALIK, Junaid (University of Innsbruck)

Presenter: FIRDOUS, Nameeqa (GIFT University Gujranwala Pakistan)

Session Classification: Poster session

Contribution ID: **25** Type: **Plenary/Parallel talk**

Jackiw-Teitelboim and Kantowski-Sachs quantum cosmology

We study quantum cosmology of the 2D Jackiw-Teitelboim (JT) gravity with $\Lambda > 0$ and calculate the Hartle-Hawking (HH) wave function for this model in the minisuperspace framework. Our approach is guided by the observation that the JT dynamics can be mapped exactly onto that of the Kantowski-Sachs (KS) model describing a homogeneous universe with spatial sections of S1×S2 topology. This allows us to establish a JT-KS correspondence between the wave functions of the models. We demonstrate that some earlier proposals for the HH state of JT either do not have properties expected for the HH wave function or they don't satisfy the Wheeler-deWitt equation. To offer an alternative, we shift our attention to the 4D Kantowski-Sachs framework and obtain the semiclassical Hartle-Hawking state by evaluating the path integral and employing the methods of Picard-Lefschetz theory. The JT-KS connection formulas allow us to translate this result to JT gravity, define the wave function and obtain a probability distribution for the dilaton field.

Primary author: FANARAS, George

Co-author: Prof. VILENKIN, Alexander (Tufts University)

Presenter: FANARAS, George

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **26** Type: **Plenary/Parallel talk**

An effective fluid description of scalar-vector-tensor theories under the sub-horizon and quasi-static approximations

Monday, 22 August 2022 16:50 (20 minutes)

In general, modified gravity theories can be seen as dark energy theories using the effective fluid approach. In this work, we apply this formalism to the most general second-order scalar-vector-tensor (SVT) theory of gravity. This will allow us to encompass all the free functions of the theory in terms of the equation of state, speed of sound, velocity, and anisotropic stress of a very general dark energy fluid. We show that under the quasi-static and sub-horizon approximations it is possible to obtain analytical expressions for the fields and the gravitational potentials, and thus fairly condensed expressions for the perturbations of the fluid. Using these analytical results, we reproduce some well-known computations in cosmological models within the SVT framework, such as quintessence, kinetic gravity braiding, f(R), and others, in order to test the accuracy of our approach. Furthermore, we propose a designer dark energy model whose background evolution is identical to that of the standard cosmological model, but different at the linear perturbative level. For this designer model, we compute some cosmological observables, such as the growth factor, the angular power spectrum, and the matter power spectrum, and compare them with the predictions given by the standard cosmological model.

Primary author: ORJUELA-QUINTANA, JOHN BAYRON (UNIVERSIDAD DEL VALLE)

Co-authors: VALENZUELA TOLEDO, CESAR ALONSO (Departamento de Física, Universidad del Valle); ALBERTO CARDONA CASTRO, WILMAR

Presenter: ORJUELA-QUINTANA, JOHN BAYRON (UNIVERSIDAD DEL VALLE)

Session Classification: Parallel Session Lecture Room

Track Classification: Modified gravity & dark energy

Contribution ID: **27** Type: **Plenary/Parallel talk**

Dynamical system with anisotropic tachyon field

We studied a dark energy (DE) model with tachyonic fields coupled to a vector field in a Bianchi-I anisotropic background. Then, the dynamical analysis of the differential equations was made using a Monte Carlo approach in the parameters space, in order to restrict the physically allowed regions having anisotropic DE as an attractor. Next, the boundary of the region was fitted, that was how we obtained an approximate analytical expression for the region that we got numerically. The differential equations could therefore be solved by taking parameters within the allowed region and setting the initial conditions in the radiation era. We obtained the evolution of the density parameters, the shear and the effective equation of state of the Universe and of the DE, which behaved in a similar manner in the late time evolution of the Universe, having values near to -1. Furthermore, the shear for this evolution took non-zero values and it was stabilized depending on the parameters. Finally, the largest amount of fluctuations in the DE equation of state and the shear was found around the DE-Matter phase transition due to the interaction between the tachyonic and vector fields.

Primary authors: VALENZUELA TOLEDO, CESAR ALONSO (Departamento de Física, Universidad del Valle); GARCIA SERNA, SANTIAGO; Prof. OCAMPO DURÁN, Hernán (Universidad Del Valle); ORJUELA QUINTANA, John Bayron (Universidad del Valle)

Presenter: GARCIA SERNA, SANTIAGO

Session Classification: Poster session

Contribution ID: **30** Type: **Plenary/Parallel talk**

Remarks on the black hole shadows in Kerr-de Sitter space times

This work is geared towards analysis of shadows cast by Kerr-de Sitter (kds) and Revisited Kerr-de Sitter (RKdS) black holes. Considering observers in the vicinity of the static radius, we derive the impact parameters defining the apparent positions of the shadows. Such observers are of interest to our work because embedding diagrams have shown that de Sitter space-time is analogous to an asymptotically flat one in the vicinity of the static radius. We also perform a comparative analysis between our result with that in Ref.[1]. Furthermore, we numerically obtain the radii of curvature, vertical diameters and horizontal diameters of the shadows. We find that for $\Lambda = 1.11 \times 10^{-52} m^{-2}$, M87*observations cannot distinguish a RKdS black hole shadow from that of a Kerr black hole. Additionally, for the same value of* Λ*, KdS and RKdS black hole shadows are, in practise, indistinguishable. Previously, it has also been shown that when* $\Lambda = 1.11 \times 10^{-52} m^{-2}$*, KdS and Kerr black hole shadows are indistinguishable. Utilizing the 2017 EHT observations of M87* on the allowed range of the characteristic radius of the shadow, we obtain constraints on both black holes. When, $a/M > 0.812311$, we observe that large angles of inclination ($\theta > 30.5107°$) do not pass the constraints for both KdS and RKdS black holes.

Primary authors: OMWOYO, Eunice; Prof. VELTEN, Hermano (Universidade Federal de Ouro Preto); Prof. BELICH, Humberto (Universidade Federal do Esp\'irito Santo); Prof. C. FABRIS, Julio (Universidade Federal do Esp\'irito Santo)

Presenter: OMWOYO, Eunice

Session Classification: Poster session

Contribution ID: **32** Type: **Plenary/Parallel talk**

Expansion Lensing –A new luminosity-angular distances relation derived from Friedmann-Lemaître-Robertson-Walker metric

In this talk I will show how the Expansion Lensing relationship d_L=d_A(1+z) is derived from the Friedmann-Lemaître-Robertson-Walker (FLRW) metric. The expression also follows from the fact that the angular distance of a galaxy (d_A=S/theta), i.e. the distance at emission, is defined identically for both static and expanding universes, and hence both images subtend the same angle theta. Therefore, there is no flux dispersion on expanding universe with respect to the static one, but only flux dilution due to time dilation for path elongation and wavelength redshift. Both effects are comprised in an unique (1+z) factor. The talk is completed showing empirical evidences of the new relation and comprehensible view of the Hubble tension.

References:
https://arxiv.org/abs/2003.05307
https://arxiv.org/abs/2003.06139
https://arxiv.org/abs/2203.01417

Primary author: NOT SUPPLIED, Vicente Albendea, Juan Francisco

Presenter: NOT SUPPLIED, Vicente Albendea, Juan Francisco

Session Classification: Poster session

Contribution ID: **33** Type: **Plenary/Parallel talk**

On possible quantization of spacetime curvature

When generalized noncommutative Heisenberg algebra accommodating gravitational field as specified by string theory, for instance, is thoughtfully applied on Finsler manifold, the quantized metric tensor could be defined. By constructing the affine connections on pseudo–Riemannian manifold, quantization of Riemann curvature tensor and its unique contractions, Ricci curvature tensor and scalar, are also formed. Accordingly, we have constructed the Einstein tensor, in which besides quantization additional geometric structures are emerged. As in Einstein's theory of general relativity, we have proved that the covariant derivative of the quantized Einstein tensor vanishes, as well.

Primary author: Prof. TAWFIK, Abdel Nasser (ECTP)

Presenter: Prof. TAWFIK, Abdel Nasser (ECTP)

Session Classification: Poster session

Contribution ID: **34** Type: **Plenary/Parallel talk**

The Escalation in Hubble's Tension in the Era of Gravitational Waves Standard Sirens

The Hubble's Constant (H0)is one of the most fundamental and essential cosmological parameters which gives the expansion of Local Universe. Hubble's Constant is measured by different methods and one of them is by using electromagnetic sources called distance ladder. With the detections of gravitational waves and using Gravitational Wave (GW) analysis this value can be measured; making GW sources another significant method to act as standard sirens with their electromagnetic counterparts from their host galaxy and adding to the accuracy. The GW event GW 170817 which was the result of the merger of two neutron stars helped to find H0. The corresponding counterpart electromagnetic event was recorded from the host galaxy NGC4993. The GW170817 event is considerable success in measuring the value of universe acceleration close to the value H0 = 70.0+12.0 −8.0 kms−1 Mpc−1. These results from GW170817 event are compared with the other observations which are done by methods involving CMB and Cosmic Distance Ladder. The H0 is also calculated from the data of another GW event GW19081, which is the merger of Compact Binary Coalescence involving a 22.2 −24.3 Solar Masses Blackhole and a compact object with a mass of 2.50 −2.67 Solar Masses. The EM counterpart of this event is unknown so far and hence the event is named Dark Siren. The GW merger event GW190814 gives a different value for H0. The Hubble' s value calculated from the data of GW190814 is close to H0 = 75+59 −13 km s−1Mpc−1 . There have been many other GW detections and they fit closely to the General Relativity. But these all detections are further adding to the different values of H0 thus escalating the Hubble's Tension. However, with further development in the technology and more GW events to be recorded in the coming future, we suppose the uncertainty limits will reduce.

Primary author: DUBEY, Rajesh Kumar

Presenter: DUBEY, Rajesh Kumar

Session Classification: Poster session

Contribution ID: **36** Type: **Plenary/Parallel talk**

Dark matter theory and phenomenology

Thursday, 25 August 2022 11:00 (40 minutes)

I will review the status of the dark matter theory and phenomenology.

Primary author: CHOI, Ki Young

Presenter: CHOI, Ki Young

Session Classification: Plenary Talk

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **37** Type: **Plenary/Parallel talk**

Cosmology With Bright Standard Sirens

Tuesday, 23 August 2022 14:30 (20 minutes)

Since the first gravitational wave detection from a merging binary black hole system by the large interferometers LIGO, a new window of the Universe was opened leading us to use these waves to probe the expansion of the Universe. Gravitational wave sources with electromagnetic counterparts, called bright standard sirens, are very useful to cosmology as their luminosity distances can be measured from the gravitational wave signal amplitude and their redshifts from the host galaxy identification. As the current gravitational waves detectors have detected only one bright standard siren, we explore the power of future third generation detectors, such as Einstein Telescope and Cosmic Explorer, to detect them, and perform forecasts on cosmological analysis with them. We show that a few hundred bright sirens, detected by Einstein Telescope, is more than enough to constrain H_0 with better accuracies than that one measured by SH0ES. We also show how many detections will be required to rank nested cosmological models and how the distributions of these detections can affect our results.

Primary author: MENDONÇA, Josiel (Universidade Federal do Rio Grande do Norte)

Co-author: STURANI, Riccardo

Presenter: MENDONÇA, Josiel (Universidade Federal do Rio Grande do Norte)

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **38** Type: **Plenary/Parallel talk**

On dynamical system approaches in f(R) gravity

Dynamical system formulation is an important qualitative tool now widely used in cosmology to understand the cosmological solution space of a theory. A number of dynamical system formulations have been proposed over the last few years to analyse cosmological solutions in f(R) gravity. I will try to give a brief introduction to the di erent approaches, presenting them in a chronological order as they appeared in the history of the relevant scientific literature. I will particularly illuminate how the shortcoming(s) of an existing formulation encouraged the development of an alternative formulation. I will also try to emphasize the utility of the dynamical system formulation in to study various aspects of cosmological perturbations.

Primary authors: CHAKRABORTY, Saikat (North-West University); DUNSBY, Peter (University of Cape Town); MACDEVETTE, Kelly (University of Cape Town)

Presenter: CHAKRABORTY, Saikat (North-West University)

Session Classification: Poster session

Contribution ID: **39** Type: **Plenary/Parallel talk**

Axion cosmology: production and experimental constraints

Monday, 22 August 2022 11:40 (40 minutes)

Axions and axion-like particles are a leading candidate for composing the dark matter in the universe. After reviewing how they emerge in the context of particle physics, we will discuss their production in the early Universe and the prospects for their detection. Interestingly, the distribution of axions is generically expected to be non-homogeneous, and we will discuss how this may lead to the production of primordial black holes or be linked to the mysterious fast radio bursts.

Primary author: FERRER ESCURSELL, Francesc

Presenter: FERRER ESCURSELL, Francesc

Session Classification: Plenary Talk

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **40** Type: **Plenary/Parallel talk**

Galaxies and Halos on Graph Neural Networks: Deep Generative Modeling Scalar and Vector Quantities for Intrinsic Alignment

In order to prepare for the upcoming wide-field cosmological surveys, large simulations of the Universe with realistic galaxy populations are required. In particular, the tendency of galaxies to naturally align towards overdensities, an effect called intrinsic alignments (IA), can be a major source of systematics in the weak lensing analysis. As the details of galaxy formation and evolution relevant to IA cannot be simulated in practice on such volumes, we propose as an alternative a Deep Generative Model. This model is trained on the IllustrisTNG-100 simulation and is capable of sampling the orientations of a population of galaxies so as to recover the correct alignments. In our approach, we model the cosmic web as a set of graphs, where the graphs are constructed for each halo, and galaxy orientations as a signal on those graphs. The generative model is implemented on a Generative Adversarial Network architecture and uses specifically designed Graph-Convolutional Networks sensitive to the relative 3D positions of the vertices. Given (sub)halo masses and tidal fields, the model is able to learn and predict scalar features such as galaxy shapes; and more importantly, vector features such as the 3D orientation of the major axis of the ellipsoid and the complex 2D ellipticities. For correlations of 3D orientations the model is in good quantitative agreement with the measured values from the simulation, except for at very small and transition scales. For correlations of 2D ellipticities, the model is in good quantitative agreement with the measured values from the simulation.

Primary author: JAGVARAL, Yesukhei

Co-authors: LANUSSE, François; MANDELBAUM, Rachel (Carnegie Mellon University)

Presenter: LANUSSE, François

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **41** Type: **Plenary/Parallel talk**

Dark Matter from Preheating

Friday, 26 August 2022 14:40 (20 minutes)

The production of dark relics from the decay of the primordial inflaton condensate must always be considered when building models of the very early Universe. Even in the absence of direct couplings, dark matter and radiation can be produced from the gravitational interaction between the dark and inflaton sectors. In this talk I will discuss the non-equilibrated production of scalar dark matter during inflation and (p)reheating in the weakly and strongly coupled regimes, combining perturbative (Boltzmann) and non-perturbative (Hartree/Lattice) approaches. For weak (strong) coupling I will present the corresponding phase space distributions and show how the relic abundance is dominantly populated during inflation (reheating). Relic abundance, reheating, and structure formation constraints from the observation of the Lyman-α forest will be presented and discussed in detail.

Primary author: Prof. GARCIA GARCIA, Marcos A. (Instituto de Fisica, UNAM)

Presenter: Prof. GARCIA GARCIA, Marcos A. (Instituto de Fisica, UNAM)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **43** Type: **Plenary/Parallel talk**

Testing dark matter in galaxies with the normalized additional velocity distribution

Thursday, 25 August 2022 15:20 (20 minutes)

I will introduce a fast and complementary approach to study galaxy rotation curves directly from the sample data, instead of first performing individual rotation curve fits. The method is based on a dimensionless difference between the observational rotation curve and the expected one from the baryonic matter (δV^2). It is named as Normalized Additional Velocity (NAV). Using 153 galaxies from the SPARC galaxy sample, we find the observational distribution of δV^2. This result is used to compare with the model-inferred distributions of the same quantity. We consider the following five models to illustrate the method, which include a dark matter model and four modified gravity models: Burkert profile, MOND, Palatini $f(R)$ gravity, Eddington-inspired-Born-Infeld (EiBI) and general relativity with renormalization group effects (RGGR). We find that the Burkert profile, MOND and RGGR have reasonable agreement with the observational data, the Burkert profile being the best model. The method also singles out specific difficulties of each one of these models. Such indications can be useful for future phenomenological improvements. The NAV method is sufficient to indicate that Palatini $f(R)$ and EiBI gravities cannot be used to replace dark matter in galaxies, since their results are in strong tension with the observational data sample.

Primary author: RODRIGUES, Davi (Universidade Federal do Espirito Santo)

Presenter: RODRIGUES, Davi (Universidade Federal do Espirito Santo)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Modified gravity & dark energy

Contribution ID: **44** Type: **Plenary/Parallel talk**

Empirical relation in supernova gravitational waves

Thursday, 25 August 2022 14:40 (20 minutes)

The supernova, which is the event at the last moment of the massive star's life, is the next promising candidate as the gravitational wave source. Up to now, gravitational waves from supernova explosions have been mainly discussed via numerical simulation. These results tell us the existence of the gravitational waves whose frequencies increase from a few hundred hertz up to kHz within a second. However, the physics behind this signal has been unclear. In this talk, we discuss the supernova gravitational waves from the approach with asteroseismology and we show the empirical relation in the supernova gravitational waves.

Primary author: SOTANI, Hajime

Presenter: SOTANI, Hajime

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **45** Type: **Plenary/Parallel talk**

Dark Matter search by the XENON collaboration

Thursday, 25 August 2022 16:50 (20 minutes)

The evidence for dark matter is overwhelming, yet there has not been an unambiguous detection of a dark matter particle. The XENON collaboration has operated successively larger experiments in the hunt for WIMP-dark matter using dual phase time projection chambers with xenon as the target material. The XENON collaboration is one of the leading collaborations in constraining the WIMP-nucleon scattering cross-sections, as well as being sensitive to other rare processes such as solar-axions coherent elastic scattering of solar neutrinos and two-neutrino double electron capture in ^{124}Xe. The XENONnT detector with a target mass of 8000kg is operated at the INFN Gran Sasso National Laboratory in Italy and in this talk I will discuss results of XENONnT and its predecessor, XENON1T, along with the plans for operating XENONnT in the future.

Primary author: ANGEVAARE, Joran

Presenter: ANGEVAARE, Joran

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **46** Type: **Plenary/Parallel talk**

BBN Photodisintegration Constraints on Gravitationally Produced Vector Bosons

Monday, 22 August 2022 16:50 (20 minutes)

Gravitational production of massive particles due to cosmic expansion can be significant during the inflationary and reheating period of the Universe. In this work, we focus on the gravitational production of light vector bosons that couple feebly to the Standard Model (SM) particles. Due to the very feeble coupling, the light vector bosons never reach thermal equilibrium and if the Hubble scale at the end of inflation is above 108 GeV, the gravitational production can overwhelm the thermal production via freeze-in mechanism by many orders of magnitude. As a result, much stronger constraints from the Big Bang Nucleosynthesis (BBN) can be placed on the lifetime and mass of the vector bosons compared to the scenario where
only thermal production is considered.1 As an example, we study the sub-GeV scale dark photons which couple to the SM only through kinetic mixing and derive constraints from the photodisintegration effects on the light element abundances relevant at the end of the BBN when the cosmic age was around 3 hours.

Primary authors: FONG, Chee Sheng; RAHAT, Moinul; SAAD, shaikh (University of Basel)

Presenter: FONG, Chee Sheng

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **48** Type: **Plenary/Parallel talk**

Component separation in BINGO 21 cm simulated maps using GNILC

Wednesday, 24 August 2022 11:45 (20 minutes)

The 21 cm hydrogen line is arguably one of the most powerful probes to explore the Universe, from recombination to the present times. To recover it, it is essential to separate the cosmological signal from the much stronger foreground contributions at radio frequencies. The Baryon Acoustic Oscillations from Integrated Neutral Gas Observations (BINGO) radio telescope is designed to measure the 21 cm line and detect baryon acoustic oscillations (BAOs) using the intensity mapping technique. This work, analyses the performance of the Generalized Needlet Internal Linear Combination (GNILC) method, combined with a power spectrum debiasing procedure. The method was applied to a simulated BINGO mission. It compares two different synchrotron emission models and different instrumental configurations, in addition to the combination with ancillary data to optimize both the foreground removal and recovery of the 21 cm signal across the full BINGO frequency band, as well as to determine an optimal number of frequency (redshift) bands for the signal recovery.

Primary author: SANTOS, Larissa

Presenter: SANTOS, Larissa

Session Classification: Parallel Session Lecture Room

Track Classification: Radiocosmology

Contribution ID: **49** Type: **Plenary/Parallel talk**

Searching for boson-star mergers in gravitational-wave data

Thursday, 25 August 2022 14:20 (20 minutes)

Boson-stars are self-gravitating Bose-Einstein condensates of ultra-light boson fields, which are widely considered as strong candidates to account for at least part of Dark Matter. Boson-star mergers can produce gravitational-wave signals observable by current detectors such as Advanced LIGO and Virgo. I will present a systematic comparison of existing (high-mass) gravitational-wave signals to a catalog of ~800 numerical simulations of (vector) boson-star mergers, performing model selection with respect to the canonical black-hole merger scenario. In particular I will show that the controversial event GW190521 slightly prefers the boson-star merger model over the black-hole merger one and that all analysed events yield consistent boson-mass estimates. Finally, I will present preliminar results on the potential population of these objects.

Primary authors: TORRES-FORNÉ, Alejandro (University of Valencia); CALDERON BUSTILLO, Juan (University of Santiago de Compostela); HERDEIRO, Carlos; Prof. RADU, Eugen (University of Aveiro); WONG, Isaac Chun Fung (Department of Physics, the Chinese University of Hong Kong); Prof. FONT, Jose A. (University of Valencia); CHANDRA, Koustav (ITT Mombay); SANCHIS-GUAL, Nicolas; LEONG, Samson (The Chinese University of Hong Kong); Prof. LI, Tjonnie (K.U. Leuven)

Presenter: CALDERON BUSTILLO, Juan (University of Santiago de Compostela)

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **50** Type: **Plenary/Parallel talk**

A new mechanism for primordial black hole formation during reheating

Monday, 22 August 2022 14:20 (20 minutes)

In this talk, we explore the possibility of primordial black holes (PBHs) forming from the gravitational collapse of either the structures virialized during reheating (referred as inflaton halos or inflaton clusters), or from the collapse of the central core of these configurations (referred as inflaton stars). We compute the threshold amplitude for the density contrast to undergo this process, for both the free and self-interacting scalar fields. We discuss our results in light of the constraints to PBHs abundances at the lower end of the mass spectrum and apply our findings to an example inflationary scenario.

Primary author: PADILLA ALBORES, Luis Enrique

Presenter: PADILLA ALBORES, Luis Enrique

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **51** Type: **Plenary/Parallel talk**

First constraints on the intrinsic CMB dipole and our velocity with Doppler and aberration

Thursday, 25 August 2022 16:50 (20 minutes)

We test the usual hypothesis that the Cosmic Microwave Background (CMB) dipole, its largest anisotropy, is due to our peculiar velocity with respect to the Hubble flow by measuring independently the Doppler and aberration effects on the CMB using Planck 2018 data. We remove the spurious contributions from the conversion of intensity into temperature and arrive at measurements which are independent from the CMB dipole itself for both temperature and polarization maps and both SMICA and NILC component-separation methods. Combining these new measurements with the dipole one we get the first constraints on the intrinsic CMB dipole. Assuming a standard dipolar lensing contribution we can put an upper limit on the intrinsic amplitude: 3.7 mK (95% CI). We estimate the peculiar velocity of the solar system without assuming a negligible intrinsic dipole contribution: v=(300+111−93) km/s with (l,b)=(276±33,51±19)◦ [SMICA], and v=(296+111−88) km/s with (l,b)=(280±33,50±20)◦ [NILC] with negligible systematic contributions. These values are consistent with the peculiar velocity hypothesis of the dipole.

Primary author: DA SILVEIRA FERREIRA, Pedro (UFRJ)

Presenter: DA SILVEIRA FERREIRA, Pedro (UFRJ)

Session Classification: Parallel Session Lecture Room

Track Classification: Radiocosmology

Contribution ID: **53** Type: **Plenary/Parallel talk**

Searching for primordial black holes at current and future gravitational wave detectors

Thursday, 25 August 2022 11:40 (40 minutes)

Primordial Black Holes might comprise a significant fraction of dark matter in the Universe and can give rise to observable signatures at current and future gravitational wave experiments. First, we review the PBH model and discuss how accretion and clustering may affect the properties of PBH binaries. Second, we confront the PBH model with LIGO/Virgo/KAGRA data showing its upsides and shortcomings, by also including state-of-the-art astrophysical models in a multi-population inference. Finally, we discuss how future generation detectors may be able to discover a PBH population by searching for high redshift merger events.

Primary author: FRANCIOLINI, Gabriele

Presenter: FRANCIOLINI, Gabriele

Session Classification: Plenary Talk

Track Classification: Gravitational waves and black holes

Contribution ID: **54** Type: **Plenary/Parallel talk**

New opportunities for axion dark matter searches in nonstandard cosmological models

Tuesday, 23 August 2022 17:05 (20 minutes)

We study axion dark matter production from a misalignment mechanism in scenarios featuring a general nonstandard cosmology. Before the onset of Big Bang nucleosynthesis, the energy density of the universe is dominated by a particle field ϕ described by a general equation of state ω. The ensuing enhancement of the Hubble expansion rate decreases the temperature at which axions start to oscillate, opening this way the possibility for axions heavier than in the standard window. This is the case for kination, or in general for scenarios with $\omega > 1/3$. However, if $\omega < 1/3$, as in the case of an early matter domination, the decay of ϕ injects additional entropy relative to the case of the standard model, diluting this way the preexisting axion abundance, and rendering lighter axions viable. Interestingly, the coupling axion-photon in such a wider range can be probed with next generation experiments such as ABRACADABRA, KLASH, ADMX, MADMAX, and ORGAN.

Primary author: VENEGAS, Moira

Presenter: VENEGAS, Moira

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **55** Type: **Plenary/Parallel talk**

New CMB lensing mass maps from the Atacama Cosmology Telescope and their implications for structure growth

Thursday, 25 August 2022 17:10 (20 minutes)

Dark matter not only provides the invisible scaffolding from which the birth of galaxies takes place, but by studying its distribution in our Universe we can infer a great deal of information regarding the growth of structure and cosmic expansion. Measuring the gravitational lensing of the CMB allows the mapping of all the matter distribution (for which the majority is dark matter) to very high redshifts. New observations with the Atacama Cosmology Telescope will allow CMB lensing measurements to reach higher precision than those derived from Planck, reporting preliminary measurements of CMB lensing at 50σ. This high signal-to-noise lensing spectrum will translate into a few percent determination of σ_8, hence providing a robust test of low amplitudes reported by galaxy lensing surveys and also one of the tightest constraints on the sum of neutrino masses. This measurement also sets the foundation for ground-based high-resolution lensing covering a large fraction of the sky. Novel methods to tackle problems related to atmospheric noise and extragalactic foregrounds, along with almost 200 null tests, were employed to provide this state of the art lensing measurements. In my talk, I will discuss how these methods are implemented in detail, as well as the relevance of our results in the context of cosmological tensions.

Primary authors: QU, Frank (University of Cambridge); MADHAVACHERIL, Mathew (Princeton)

Presenter: QU, Frank (University of Cambridge)

Session Classification: Parallel Session Lecture Room

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **56** Type: **Plenary/Parallel talk**

Einstein-Cartan Magnetogenesis and Axionic Dynamos

Einstein-Cartan magnetogenesis are investigated in two cases: i) First in the case of torsion suppression in Brans-Dicke inflation. ii) in the second, Einstein-Cartan-Holst magnetogenesis is investigated. In the first case axion dark matter is investigated with axion-torsion transmutation.

references: 1. L C Garcia de Andrade, Topoçogical defects in Einstein-Cartan magnetogenesis and dynamo effects, Acad publishers (2021) Moldavia

2; Garcia de Andrade, Dynamical torsion suppression in Brans-Dicke inflation with LV, Eur Phys J C (2022) in press.

Primary author: GARCIA, Luiz (uerj)

Presenter: GARCIA, Luiz (uerj)

Session Classification: Poster session

Contribution ID: **57** Type: **Plenary/Parallel talk**

Unified description of corpuscular and fuzzy scalar dark matter

Monday, 22 August 2022 16:30 (20 minutes)

We present a finite temperature model for dark matter. In this work, we show coupled equations for self-interacting scalar dark matter which can include both a condensed, low momentum fuzzy component and one with higher momenta that may be described as a collection of classical particles. We do this from first principles, using two distinct but equivalent approaches: firstly via the Schwinger-Keldysh path integral and secondly using the operator evolution equation of the density matrix, also known as the ZNG formalism in the cold atom community. The resulting coupled equations consist of a modified Gross-Pitaevskii equation describing the condensate, a kinetic equation describing the higher momentum modes (the particles), and the Poisson equation for the gravitational potential sourced by the two components.

Primary author: SOTO, Alex (Newcastle University)

Co-authors: RIGOPOULOS, Gerasimos (Newcastle University); Dr PROUKAKIS, Nikolaos (Newcastle University)

Presenter: SOTO, Alex (Newcastle University)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **59** Type: **Plenary/Parallel talk**

Cosmological bootstrap in slow motion and the low speed collider

Monday, 22 August 2022 15:20 (20 minutes)

Identifying the particle content of inflation is one of the most important targets of primordial cosmology. In this respect, how the masses and spins of new particles active during inflation can be read off from the statistical properties of primordial density fluctuations is well understood. However, not when the propagation speeds of the new degrees of freedom and of the curvature perturbation differ, which is the generic situation in the effective field theory of inflationary fluctuations. In this talk, I will explain how recently developed bootstrap techniques can be used to find exact analytical solutions for primordial 2-,3- and 4-point correlation functions in this context, and I will discuss the associated observational consequences. In particular, I will show the existence of new signatures of heavy fields when coupled to the curvature perturbation propagating at a reduced sound speed, manifesting in the form of resonances in the squeezed limit of the bispectrum, a phenomenon that we call the low speed collider. Based on 2205.10340

Primary author: RENAUX-PETEL, Sébastien

Presenter: RENAUX-PETEL, Sébastien

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **61** Type: **Plenary/Parallel talk**

On the recoverability of the BAO signal on BINGO HI IM simulations

Monday, 22 August 2022 15:00 (20 minutes)

A new and promising technique for observing the Universe and study the dark sector is the intensity mapping of the redshifted 21-cm line of neutral hydrogen (HI). The Baryon Acoustic Oscillations [BAO] from Integrated Neutral Gas Observations (BINGO) radio telescope will use the 21-cm line to map the Universe in the redshift range $0.127 \leq z \leq 0.449$, in a tomographic approach, with the main goal of probing BAO.
This work presents the forecasts of measuring the transversal BAO signal during the BINGO Phase 1 operation. We use two clustering estimators: the two-point angular correlation function (ACF), in configuration space, and the angular power spectrum (APS), in harmonic space, and a template-based method to model the ACF and APS estimated from simulations of the BINGO region and extract the BAO information. The tomographic approach allows the combination of redshift bins to improve the template fitting performance. We compute the ACF and the APS for each of the 30 redshift bins and measure the BAO signal in 3 consecutive redshift blocks (lower, intermediate and higher) of 10 channels each. Robustness tests are used to evaluate several aspects of the BAO fitting pipeline for both clustering estimators.
We find that each clustering estimator shows different sensitivities to specific redshift ranges, although both of them perform better at higher redshifts. In general, the APS estimator provides slightly better estimates, with smaller uncertainties and larger probability of detection of the BAO signal, achieving $\sim 90\%$ at higher redshifts. We investigate the contribution from instrumental noise and residual foreground signals and find that the former has the greater impact, getting more significant as the redshift increases, in particular the APS estimator. Indeed, including noise in the analysis increases the uncertainty up to a factor of ~ 2.2 at higher redshifts. Foreground residuals, in contrast, do not significantly affect our final uncertainties. In summary, our results show that, even including realistic systematic effects, BINGO has the potential to successfully measure the BAO scale in radio frequencies.

Primary authors: NOVAES, Camila (Instituto Nacional de Pesquisas Espaciais); Dr ZHANG, Jiajun; MERICIA, Eduardo; ABDALLA, Filipe; LICCARDO, Vincenzo; WUENSCHE, Carlos; DE-LABROUILLE, Jacques; REMAZEILLES, Mathieu; SANTOS, Larissa; LANDIM, Ricardo; ABDALLA, Elcio; BAROSI, Luciano; QUEIROZ, Amilcar; VILLELA, Thyrso; WANG, Bin; BRITO, Francisco; COSTA, André; FERREIRA, Elisa; MARINS, Alessandro; SANTOS, Marcelo

Presenter: NOVAES, Camila (Instituto Nacional de Pesquisas Espaciais)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **63** Type: **Plenary/Parallel talk**

Classical and quantum and probes of axionlike particles

Tuesday, 23 August 2022 16:25 (20 minutes)

Axionlike particles (ALPs) are among the most well-motivated extensions of the Standard Model of particle physics, and are increasingly popular dark matter candidates. Extreme astrophysical environments, such as dense and hot supernovae, or vast and magnetised galaxy clusters, provide unique opportunities to test the theory. In this talk, I will discuss recent progress in searching for ALPs using classical and quantum phenomena.

First, classical ALP-photon mixing underlies the most powerful probes of light ALPs, but often hinges on astrophysical magnetic fields that are poorly known. In this talk, I will combine theoretical arguments about the structure of ALP-photon conversion with state-of-the-art magnetic field models, including those from new magnetohydrodynamic (MHD) simulations, to test the robustness of the ALP predictions. Magnetic non-Gaussianity of MHD models leads to novel "fat tails" in the distribution of conversion probabilities, but simpler models often generate conservative predictions.

Second, quantum ALP-photon mixing can be of critical importance even for ALPs that only couple to electrons at tree-level. I will show that properly accounting for the quantum effective couplings has drastic implications for ALP dark matter searches by direct detection experiments, and leads to new, subtle predictions for ALP production in supernovae.

Primary authors: BRANDENBURG, Axel (Nordita); Prof. REYNOLDS, Christopher (University of Cambridge); MARSH, David; MÜLLER, Eike; Dr MATTHEWS, James (University of Cambridge); CARENZA, Pierluca; Dr SHARMA, Ramkishor (Nordita); ZAMBUJAL FERREIRA, Ricardo

Presenter: MARSH, David

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **66** Type: **Plenary/Parallel talk**

Next generation of CMB lensing power spectrum estimation

Friday, 26 August 2022 16:55 (20 minutes)

In this talk I will introduce a new CMB lensing power spectrum estimator for deep polarisation surveys. Thanks to the B modes of polarisation produced by gravitational lensing, upcoming surveys will optimally reconstruct the lensing field by iteratively delensing the observed polarisation maps. I will show that despite the increased complexity of the reconstructed lensing map, its power spectrum shares similarities to the state-of-the-art quadratic estimator. I will demonstrate that this new spectrum estimator and its likelihood are robust to modelling biases and can improve the signal to noise ratio of the lensing amplitude by 80% while keeping the numerical cost under control. This new lensing estimator can improve the constraints on a combination of cosmological parameters of interest, including the neutrino mass, by 30%.

Primary author: LEGRAND, Louis

Co-author: CARRON, Julien (University of Sussex)

Presenter: LEGRAND, Louis

Session Classification: Parallel Session Lecture Room

Track Classification: Radiocosmology

Contribution ID: **67** Type: **Plenary/Parallel talk**

Primordial Black Holes from Multifield Inflation with Non-minimal Couplings

Friday, 26 August 2022 14:00 (20 minutes)

Primordial Black Holes (PBHs), first postulated more than half a century ago, remain an active and fascinating area of research and provide an exciting prospect for accounting for Dark Matter. In this talk I will discuss the possibilities for production of PBHs near to Dark Matter mass scales from realistic multi-field inflation models that arise naturally from supergravity. These models fit neatly within the current status of inflationary models as constrained by CMB observations; they behave effectively as a single-field models for much of their evolution, and the isocurvature modes remain heavy throughout. Moreover, such models yield efficient post-inflation reheating with $N_{\rm reh} \sim O(1)$ e-folds after the end of inflation. I will demonstrate how our class of two-field models in particular give rise to inflationary dynamics that yield predictions for observables in close agreement with recent empirical data, such as the spectral index and ratio of power spectra for tensor to scalar perturbations. As has been noted in previous studies of PBH formation resulting from a period of ultra slow-roll inflation, we found that at least one dimensionless parameter must be fine-tuned, but I will show that we nonetheless find such models yield accurate predictions for a significant number of observable quantities using a smaller number of free parameters.

Primary authors: Prof. KAISER, David (MIT); MCDONOUGH, Evan; GELLER, Sarah (MIT); QIN, Wenzer (MIT)

Presenter: GELLER, Sarah (MIT)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **68** Type: **Plenary/Parallel talk**

Dynamical dimensional reduction in multi-valued Hamiltonians

Several physical systems of interest in cosmology, such as the Lovelock extension of general relativity in higher dimensions, k-essence fields, Horndeski theories, and nonlinear electrodynamics, have apparent ill-defined sympletic structures, due to the fact that their Hamiltonians are multivalued functions of the momenta. In this talk, based on the paper [PRD 105, 084064 (2022)], the dynamical evolution generated by such Hamiltonians is described as a degenerate dynamical system, whose sympletic form does not have a constant rank, allowing novel features and interpretations not present in previous investigations, which could lead to remarkable consequences on the evolution of dark matter models and modified gravity theories. In particular, it is shown how the multivaluedness is associated with a dynamical mechanism of dimensional reduction, as some degrees of freedom turn into gauge symmetries when the system degenerates.

Primary authors: LEITE FERREIRA JUNIOR, Alexsandre (UFES); Prof. ZANELLI, Jorge (CECS Valdivia); Prof. PINTO-NETO, Nelson (CBPF)

Presenter: LEITE FERREIRA JUNIOR, Alexsandre (UFES)

Session Classification: Poster session

Contribution ID: **69** Type: **Poster**

The Cosmology Large Angular Scale Surveyor (CLASS): Overview and Survey Status

The Cosmology Large Angular Scale Surveyor (CLASS) is a set of four ground-based telescopes designed to measure and characterize the polarization signal of the cosmic microwave background (CMB) on the largest angular scales in order to probe the epochs of inflation and reionization. Located in a high-altitude site in the Atacama Desert, CLASS covers 70% of the sky in frequency bands centered at 38, 93, 148, and 217 GHz. Such frequencies allow us to avoid spectral regions of high atmospheric emission and span the minimum of the polarized Galactic foregrounds. We present an observatory overview, survey status and telescope instrumentation.

Primary authors: CLASS COLLABORATION (Johns Hopkins University); DENES COUTO, Jullianna (Johns Hopkins University)

Presenter: DENES COUTO, Jullianna (Johns Hopkins University)

Session Classification: Poster session

Contribution ID: **70** Type: **Plenary/Parallel talk**

Constraints on modified gravity from gravitational wave distance and slip measurements

It has been shown in the literature that detections of gravitational waves (GWs) emitted by binary sources can provide measurements of luminosity distance. The events followed by electromagnetic counterparts are, then, suitable for probing the distance-redshift relation and doing cosmological parameter estimation, as well as investigating modified gravity models. In the context of the Horndeski theories, even when requiring that the speed of propagation is equal to that of light, this GW distance differs from the standard electromagnetic luminosity distance due to the presence of a modified friction in the wave propagation. The very same source of this friction also affects the scalar sector, generating slip, i.e. a difference between the scalar potentials. In this talk I will discuss about how precisely the future-planned interferometer Einstein Telescope will probe such deviations from General Relativity and how such constraints from the tensor sector compare to the ones coming from measurements of the slip or, more generally, to those from the scalar sector, in particular, current CMB data and Euclid forecasts.

Primary author: SANTIAGO DE MATOS, Isabela

Co-authors: Dr BELLINI, Emilio (INFN, National Institute for Nuclear Physics); Prof. ORTIZ CALVÃO, Maurício (Universidade Federal do Rio de Janeiro); Prof. KUNZ, Martin (Université de Genève)

Presenter: SANTIAGO DE MATOS, Isabela

Session Classification: Poster session

Track Classification: Modified gravity & dark energy

Contribution ID: **71** Type: **Plenary/Parallel talk**

Cosmic birefringence mediated by dark U (1)

Thursday, 25 August 2022 17:10 (20 minutes)

A kinetic coupling between the photon and a dark photon, a massless U(1)-gauge boson in the dark sector, transfers dark photon's birefringence to observed cosmic birefringence. Regardless of the origin of the dark birefringence, the amplitude and unique frequency-dependence of the cosmic birefringence depend on the kinetic-coupling constant and the dark-photon temperature. To explain the reported tantalizing 3-sigma hint of cosmic birefringence, the dark photon temperature must exceed 0.82 K, corresponding to $\Delta N_{\rm eff} \geq 0.022$, which is within reach of the CMB Stage-4.

Primary author: GONG, Jinn-Ouk

Co-authors: KANG, Dong Woo; JUNG, Dong-Won; JEONG, Donghui; PARK, Seong Chan; LEE, Sung Mook

Presenter: GONG, Jinn-Ouk

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **72** Type: **Poster**

Magnetic diffusion and interaction effects on Ultrahigh Energy Cosmic Rays: protons and nuclei

Magnetic fields present in the Universe and interactions with the cosmic radiation backgrounds play an important role shaping the flux of the ultrahigh energy cosmic rays. To account for both processes we include in the SimProp cosmic ray propagation code a routine to follow the direction of propagation of the particles in a turbulent magnetic field. We compute thus the modification of the spectrum due to the magnetic horizon effect, both for primary nuclei and for the secondary nuclei resulting from the photodisintegration of the primary ones. We provide analytic parameterizations of the attenuation effects, as a function of the magnetic field parameters and of the density of cosmic ray sources. Therefore, we can obtain the expected spectra in the presence of the magnetic fields from the spectra that would be obtained in their absence. The discrete nature of the distribution of sources also affects the spectrum of cosmic rays at the highest energies. There, the interactions with the radiation backgrounds suppress the flux, and we present parameterizations of these effects.

Primary authors: ROULET, Esteban (C); GONZALEZ, Juan Manuel (Instituto Balseiro-CONICET); MOLLERACH, Silvia

Presenter: GONZALEZ, Juan Manuel (Instituto Balseiro-CONICET)

Session Classification: Poster session

Contribution ID: **73** Type: **Plenary/Parallel talk**

Determining black-hole's parameters from the shape of shadow

It is interesting to know whether or not we can determine black-hole's parameters such as the mass, spin, inclination angle, and distance only from the information of black-hole's shadow. In this work, assuming a non-spinning black hole, i.e., a Schwarzschild black hole, with an infinitely thin accretion disc for simplicity, we show that the system's parameters such as the angular gravitational radius GM/c^2r, where M is the black-hole mass and r is the distance between the black hole and observer, and the inclination angle can be determined only from the shadow's shape in principle. The crucial point of our analysis is to take into account the finiteness of the distance between the black hole and observer. We indicate that additional information such as the flux and accretion rate makes it possible to determine the mass, distance, and inclination angle without degeneracy.

Primary author: Prof. MIYAMOTO, Umpei (Akita Prefectural University)

Co-author: Dr HIOKI, Kenta (Sumitomo Mitsui Banking Corporation)

Presenter: Prof. MIYAMOTO, Umpei (Akita Prefectural University)

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **74** Type: **Plenary/Parallel talk**

Effective Field Theory of Black Hole Perturbations with Timelike Scalar Profile

Thursday, 25 August 2022 15:00 (20 minutes)

In this talk I will present the formulation of the Effective Field Theory (EFT) of black hole perturbations within scalar-tensor theories on an inhomogeneous background. In particular, the EFT is constructed while keeping a background of a scalar field to be timelike, which spontaneously breaks the time diffeomorphism. I will then discuss a set of consistency relations that are imposed by the invariance of the EFT under the 3d spatial diffeomorphism. Finally, I will discuss the dynamics of black hole perturbations around a spherically symmetric, static background metric using our EFT.

Primary authors: Dr YINGCHAROENRAT, Vicharit (Kavli IPMU, Tokyo); Prof. MUKOHYAMA, Shinji (YITP, Kyoto)

Presenter: Dr YINGCHAROENRAT, Vicharit (Kavli IPMU, Tokyo)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Modified gravity & dark energy

Contribution ID: **75** Type: **Plenary/Parallel talk**

A new dark sector solution to the EDGES anomaly

We propose a new solution to explain the anomalous absorption feature detected by the EDGES collaboration in the 50-100 MHz range, using a new millicharged dark matter model, taking into account the existing cosmological and astrophysical constraints. We predict new unique signals to test our dark matter model with future cosmological surveys.

Primary authors: GANGULY, Anoma (TIFR Mumbai); KHATRI, Rishi (Tata Institute of Fundamental Research); ROY, Tuhin (Tata Institute of Fundamental Research)

Presenter: GANGULY, Anoma (TIFR Mumbai)

Session Classification: Poster session

Contribution ID: **76** Type: **Plenary/Parallel talk**

y-type E and B modes of the Sunyaev Zel'dovich effect from reionisation and post reionisation epochs.

Friday, 26 August 2022 16:35 (20 minutes)

We study the E and B mode polarisation of the cosmic microwave background (CMB) originating from the transverse peculiar velocity of free electrons during reionisation and post reionisation era. Interestingly, apart from having a blackbody part, the spectrum also contains a Sunyaev Zel'dovich (SZ) type (y-type) distortion, which makes it distinguishable from primordial polarisation as well as from other secondary sources, such as gravitational lensing. Furthermore, it is also differentiable from other y-type signals such as from the thermal SZ effect as it involves polarised radiation. The E and B modes of y-type distortion provide a way to beat the cosmic variance of primary CMB anisotropies and are an independent measurement of the cosmological parameters.

Primary authors: GON, Aritra Kumar (Tata Institute of Fundamental Research); KHATRI, Rishi (Tata Institute of Fundamental Research)

Presenter: GON, Aritra Kumar (Tata Institute of Fundamental Research)

Session Classification: Parallel Session Lecture Room

Track Classification: Radiocosmology

Contribution ID: **77** Type: **Poster**

High performance numerical simulation of astrochemical problems

Astrochemistry plays an important role in the most of astrophysical processes on all stages of the universe life. Unfortunately, the most of the chemical processes can't be simulated in labs because of the physical conditions. We will show our latest high-performance computing code for numerical simulation of astrochemical problems. This code can be used as standalone application for simulation and visualisation of modelled chemical processes as well as a part of hydrodynamics codes for complex astrophysical simulation. We will show some test results for simple and complex astrochemical problems from hydrogen formation to stars astrochemistry as well as complex astrophysical simulation with hydrodynamics, chemistry, cooling/heating and other processes.

Primary authors: Dr CHERNYKH, Igor (Siberian Supercomputer Center ICMMG SB RAS); KULIKOV, Igor (ICMMG SB RAS)

Presenter: Dr CHERNYKH, Igor (Siberian Supercomputer Center ICMMG SB RAS)

Session Classification: Poster session

Contribution ID: **78** Type: **Plenary/Parallel talk**

The Euclid mission NISP instrument: performances and data simulations

Thursday, 25 August 2022 16:30 (20 minutes)

The Euclid space-based survey will observe and map the distribution of galaxies with unprecedented accuracy, allowing us to improve the knowledge of the Universe and its dynamics as well as the nature of the so-called dark matter that contributes up to a quarter of the total energy density of the Universe. Furthermore, key research will involve the measurements of the subtle features produced by neutrinos on the cosmological observables, providing new constraints on the sum of the neutrino masses with a precision better than 0.03 eV at 1-sigma level. Observations will be taken by two instruments located inside the payload of the satellite, one taking data from light in the visual spectrum (VIS) and the second one in the near-infrared spectrum (NISP). NISP will allow two observing modes: photometric and spectroscopic imaging, the latter via slit-less spectroscopy. In the presentation, we will focus on the status and the perspectives of the first period of the NISP instrument.
Padua is responsible for all the activities related to the NISP warm electronics assembly, software integration and validation. Currently, we are in the latest phase of the hardware tests, just before the launch of the satellite. Ground tests were performed using both a telescope simulator and the Euclid telescope. They provide emulations of point-like sources at different wavelengths, dark reference exposures and flat-field illumination. All the results from these tests will be shown during the presentation, focusing on the performance of the NISP instrument and its observation strategy. Finally, we will present the comparison of data to simulations, currently used to calibrate and validate the algorithms developed within the Euclid consortium to extract galaxy redshifts from image data.

Primary author: TROJA, Antonino

Presenter: TROJA, Antonino

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **79** Type: **Plenary/Parallel talk**

First measurement of projected phase correlations and large-scale structure constraints

Tuesday, 23 August 2022 14:10 (20 minutes)

Phase correlations have been proposed as an efficient higher-order statistic able to extract cosmological and astrophysical information that is largely independent from the two-point function or power spectrum. In this talk, we develop an estimator for the line correlation function of projected fields, corresponding to the correlation between the harmonic-space phases of the field at three equi-distant points on a great circle. We then use this estimator to make a first measurement of phase correlations on data from the 2MASS photometric survey. Finally, we demonstrate that the projected line correlation function contains information that is largely orthogonal to the power spectrum. Focusing on the galaxy-halo connection, we show that this can lead to a dramatic reduction in the final parameter uncertainties.

Primary author: Dr OLIVEIRA FRANCO, Felipe (University of Oxford)

Co-author: ALONSO, David

Presenter: Dr OLIVEIRA FRANCO, Felipe (University of Oxford)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **81** Type: **Plenary/Parallel talk**

Generalizing the stochastic gravitational wave signal to Horndeski theories

In this work, we generalize to a viable Horndeski theory of gravity, the most general scalar-tensor theory that has second-order field equations in four dimensions, the expression of a statistically homogeneous and unpolarized stochastic gravitational wave background signal measured as the correlation between the individual signals detected by two not coincident and not coaligned GW interferometers. We also discuss an inconsistency between results found in literature regarding cosmological distances in modified theories, namely, the simultaneous validity of a duality-distance relation for gravitational wave signals and of the coincidence between the gravitational wave luminosity distance and amplitude distances. This discussion allows us to conclude that the spectral energy density of an astrophysical stochastic gravitational wave signal has the same functional dependence with the luminosity of each emitting source as in General Relativity. Using the generalized expression of the gravitational wave energy-momentum tensor and the modified propagation law for the tensorial modes, we conclude that, for any wave-packet, the energy density of gravitational waves maintain the same functional relation with the scale factor as in General Relativity.

Primary authors: CAVEDAGNE LOBATO, João (Universidade Federal do Rio de Janeiro); SANTIAGO DE MATOS, Isabela; ORTIZ CALVÃO, Maurício (Universidade Federal do Rio de Janeiro); Prof. WAGA, Ioav (Universidade Federal do Rio de Janeiro)

Presenter: CAVEDAGNE LOBATO, João (Universidade Federal do Rio de Janeiro)

Session Classification: Poster session

Contribution ID: **84** Type: **Plenary/Parallel talk**

Neural networks in cosmological data analysis

Artificial neural networks can model nonlinear relationships in datasets. In observational cosmology there are many situations involving complex datasets, therefore in this talk we present some applications of neural networks in the framework of cosmological data analysis. We use observational data and numerical simulations; the tasks we have tackled with neural networks have been classification, reconstructions of cosmological functions, prediction and acceleration of numerical methods.

Primary author: GÓMEZ VARGAS, Isidro (Instituto de Ciencias Físicas, Universidad Nacional Autónoma de México)

Presenter: GÓMEZ VARGAS, Isidro (Instituto de Ciencias Físicas, Universidad Nacional Autónoma de México)

Session Classification: Poster session

Contribution ID: **85** Type: **Poster**

The impact of massive neutrinos on Cosmology and Particle Physics

The observation of neutrino flavor oscillations by various experiments involving both natural (solar and atmospheric) and man-made (accelerators and reactors) neutrino sources firmly indicates that neutrinos are massive particles.

In fact, all these experiments can be well understood if we assume the so-called {\it Standard Paradigm} that is, that the three known neutrino interaction eigenstates (ν_e, ν_μ, ν_τ) are a mixture of three neutrino mass eigenstates (ν_1, ν_2, ν_3). We need two different mass squared difference scales $\Delta m^2_{21} \approx 7.5 \times 10^{-5}$ eV^2 and $|\Delta m^2_{31,32}| \approx 2.5 \times 10^{-3}$ eV^2 to explain the oscillation data. These measurements give rise to two possible mass ordering: $m_1 < m_2 < m_3$ (normal) or $m_3 < m_1 < m_2$ (inverted).

In principle, other particle physics non-oscillation neutrino experiments can measure the total neutrino mass, but these are fairly difficult experiments. Tritium β-decay experiments can measure (or limit) the so-called
effective electron neutrino mass m_β, while neutrinoless double β-decay ($0\nu\beta\beta$) experiments can measure (or limit) the effective Majorana neutrino mass $m_{\beta\beta}$.

Cosmological observations, however, seem to be more prone to measure the total neutrino mass and even contribute to the determination of the mass ordering.
Massive neutrinos leave distinct signatures on the Cosmic Microwave Background (CMB) and large-scale structure (LSS) at different epochs of the evolution of the Universe.

Moreover, they are also sensitive to the number of effective relativistic degrees of freedom $N_{\rm eff}$ and so to the number of relativistic neutrino species.

In this work, we aim to combine all available neutrino particle physics data from oscillation and non-oscillation experiments with state-of-the-art cosmological observations (SDSS and DES in our case) to try to determine the neutrino mass spectrum.

We present our preliminary study of it, including the acquiring data, mask selection, Cl and Pseudo-Cl analysis, and the likelihood used in this case.
The analysis aims to use the Cl (which is a more powerful statistical tool than just the BAO measurement) generated by PseudoPower from the SDSS or DES galaxy data in order to constrain cosmological parameters relates to massive neutrinos such as m_1, Δm^2_{21}, $\Delta m^2_{31,32}$ and the Hierarchy.
The constraints are done in the UCLCl code (MCMC estimator) which uses Polychord sampler (Slice Sampling) to do the cosmological constraint.

Primary author: Dr FORNAZIER , KARIN SILVIA FRANZONI (IFUSP)

Co-authors: SANTOS, AMANDA FARIAS (IFUSP); Prof. ABDALLA, FILIPE BATONI (IFUSP); HOERNING , GABRIEL (IFUSP); Prof. FUNCHAL, RENATA Z. (IFUSP)

Presenters: SANTOS, AMANDA FARIAS (IFUSP); Prof. ABDALLA, FILIPE BATONI (IFUSP); HOERNING , GABRIEL (IFUSP); Dr FORNAZIER , KARIN SILVIA FRANZONI (IFUSP); Prof. FUNCHAL, RENATA Z. (IFUSP)

Session Classification: Poster session

Contribution ID: **86** Type: **Plenary/Parallel talk**

The first dark matter halos as probes of cosmology

Friday, 26 August 2022 14:20 (20 minutes)

Through their observable properties, the first and smallest dark matter halos represent a rare probe of subkiloparsec-scale variations in the density of the early Universe. These density variations could hold clues to the nature of inflation, the postinflationary cosmic history, and the identity of dark matter. The first halos are understood to possess a uniquely compact central mass distribution in which density scales with radius as $\rho \propto r^{-3/2}$, but this property has been largely neglected owing to doubts about its persistence. I will show new results demonstrating how this feature can persist as a halo grows and evolves, and I will discuss why previous works underestimated its survival prospects. The compact central structure boosts microhalos' observational prospects, particularly in models where dark matter annihilates; for some models this effect can boost the annihilation rate by a factor of order 10. Additionally, the $\rho \propto r^{-3/2}$ structure is highly resistant to tidal stripping, so the abundance of microhalos inside larger halos (such as the Galactic halo) may be much greater than previously assumed. I will also discuss how as a probe of cosmology, the $\rho \propto r^{-3/2}$ feature is particularly convenient because its details are tightly connected to the properties of the primordial density field.

Primary author: Dr DELOS, M. Sten (Max Planck Institute for Astrophysics)

Presenter: Dr DELOS, M. Sten (Max Planck Institute for Astrophysics)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **87** Type: **Plenary/Parallel talk**

Detectable stochastic background of gravitational waves in the presence of primordial black holes

Primordial black hole (PBH) has come up as a very promising cold dark matter candidate in recent years. The signature of PBHs in the gravitational wave background is expected as PBH formation requires a large amplfication in inflationary scalar curvature perturbation, which sources the tensor perturbation in second-order and leads to a detectable amplification in the gravitational wave (GW) background. We explore this possibility with a specific PBH-forming inflationary model with different reheating histories. On the other hand, isocurvature perturbation from PBH distributions contributes to the adiabatic perturbation. It leads to resonant amplification in the induced GW background if PBHs dominate the universe for a small duration. Combining these two effects can lead to a smoking gun signature for ultra-low mass primordial black hole scenarios, which will have significant implications for various cosmology and particle physics aspects, like baryon anti-baryon asymmetry and dark matter relic density, etc.

Primary author: BHAUMIK, Nilanjandev (Indian Institute of Science, Bengaluru)

Co-authors: JAIN, Rajeev Kumar (Indian Institute of Science); LEWICKI, Marek (University of Warsaw); GHOSAL, Anish (Indian Institute of Technology-Madras, Chennai)

Presenter: BHAUMIK, Nilanjandev (Indian Institute of Science, Bengaluru)

Session Classification: Poster session

Contribution ID: **88** Type: **Poster**

Brans-Dicke accelerated cosmologies with fermionic sources

In the framework of the Brans-Dicke scalar-tensor theory of gravitation, we investigate the role of a self-interacting fermionic field in an FLRW universe filled with dust and radiation constituents. This model is shown to present a variety of qualitative behaviors, depending on the numerical parameters chosen. In particular, we find that the fermionic field is capable of promoting a transition from an initially decelerated, radiation-dominated period to a later accelerated regime where the fermion prevails. The Brans-Dicke field is found to approach a constant value, and an intermediary matter-dominated era is observed. The dependence of the acceleration on the fermionic potential was also investigated. On a second numerical analysis, the possibility of a direct energy exchange between the constituents was considered, using the dynamical pressure approach. On this later formulation a three-era cosmological regime emerged.

Primary author: MOLINARI, Piero (Centro Brasileiro de Pesquisas Físicas (CBPF))

Co-authors: DEVECCHI, Fernando (Universidade Federal do Paraná (UFPR)); RIBAS, Marlos (Universidade Tecnológica Federal do Paraná (UTFPR))

Presenter: MOLINARI, Piero (Centro Brasileiro de Pesquisas Físicas (CBPF))

Session Classification: Poster session

Contribution ID: **89** Type: **Plenary/Parallel talk**

Does General Relativity hold in galactic scales? A test at a z ˜0.3 elliptical lens galaxy

Thursday, 25 August 2022 14:40 (20 minutes)

General Relativity (GR) has been successfully tested mainly at Solar system scales; however, in the last few decades, galaxy-scale tests have become popular. In particular, some recent works dedicate close attention to the $\eta_{\rm PPN}$ parameter, which is commonly associated with the spatial curvature generated per unit mass. Under the assumption of GR, and a vanish anisotropic stress tensor, $\eta_{\rm PPN} = 1$. In this work, using ALMA, HST, and VLT/MUSE data, we combine mass measurements, using gravitational lensing and galactic dynamics, for the SDP.81 elliptical lens galaxy ($z = 0.299$) to constrain the slip parameter. We assume a self-consistent mass profile, parameterised by a sum of elliptical Gaussians, which is flexible enough to allow us to decompose the mass profile into two components: (i) a stellar-mass component, obtained by deprojecting the observed lens surface brightness profile; (ii) a dark matter halo, described by a Navarro-Frank-White profile. We model the gravitational lensing effect by solving the lens equation and reconstructing the source object, whereas the kinematical data were modelled by solving the Jeans equations. We infer, for our fiducial model, $\eta_{\rm PPN} = 1.42 \pm 0.27$, which is in tension with GR within 1σ. For this result, we take into account possible systematic uncertainties, for instance, the mass profile adopted, the uncertainty in the Hubble constant, and the impact of the stellar templates used to fit the kinematic data. However, this result should be faced with care. Although we carry out a thorough analysis, it is necessary to highlight that our kinematic data have poor quality and can bias the results. Nonetheless, we notice that if we choose a narrow Gaussian prior that privileges GR, i.e. centred at GR predictions, we found $\eta_{\rm PPN} = 1.13 \pm 0.27$, which recovers their predictions. Although, we believe that such a prior should not be used, as it assumes that GR could be valid from the beginning. Some recent works using a sample of strong gravitational lenses and their velocity dispersions have found higher values for $\eta_{\rm PPN}$ as well, typically in statistical accordance with our fiducial model result. A common feature between those results and ours is the inclusion of galaxies at intermediate redshift, which may be bringing $\eta_{\rm PPN}$ to higher values. To clarify this issue, better kinematic data are needed. In that regard, the newer state-of-art NIRSpec instrument, onboard JWST, will play an essential role, possibly providing data with a higher signal-to-noise ratio and more spatial resolution, allowing strong constraints in the dynamic mass of galaxies at intermediate redshift.

Primary author: MELO, Carlos (IF/UFRGS)

Co-authors: FURLANETTO, Cristina (IF/UFRGS); CHIES-SANTOS, Ana (IF/UFRGS SHAO/CAS)

Presenter: MELO, Carlos (IF/UFRGS)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Modified gravity & dark energy

Contribution ID: **90** Type: **Poster**

Astrophysical tests of modified gravity

The big open questions we still have currently in the fields of gravitation and cosmology, such as the dark matter and dark energy problems, among other reasons, have led to the development of many modified theories of gravity. These theories need to be tested in various scenarios to see whether they solve the problems they try to solve. Neutron stars are one of the best astrophysical candidates for testing the strong field regime of gravity, where there is expectation that deviations from General Relativity could be observed. Nowadays, a scenario still little explored are the tests of modified gravity for neutron stars that are rapidly rotating. Therefore, we studied neutron stars, with realistic equations of state, in the context of rapidly rotation in the $f(R,T)$ modified theory of gravity. Using an iterative numerical method, we obtained solutions for these systems, and physical quantities of interest, such as mass-radius relations and moment of inertia, were calculated and analysed. As a result, we found significant deviations in the physical quantities studied when comparing the General Relativity with the $f(R,T)$ case.

Primary author: M. DA SILVA, Franciele (Universidade Federal do Espírito Santo)

Co-authors: C. N. DOS SANTOS, Luis (Universidade Federal da Paraíba); E. MOTA, Clésio (Universidade Federal de Santa Catarina); O. F. DA COSTA, Túlio (Universidade Federal do Espírito Santo); C. FABRIS, Julio (Universidade Federal do Espírito Santo)

Presenter: M. DA SILVA, Franciele (Universidade Federal do Espírito Santo)

Session Classification: Poster session

Contribution ID: **91** Type: **Plenary/Parallel talk**

The cosmological basis with Euclid survey

Friday, 26 August 2022 09:10 (40 minutes)

The Euclid survey will map the large scale structure with the aim of measuring the parameters of the standard cosmological model with unprecedented precision.
However, the great sensitivity of Euclid can also be exploited to test the most fundamental assumptions at the basis of the standard cosmological model. Here we present two works of the Euclid Consortium where, forecasts from Euclid together with data from other surveys, are used to constrain the cosmic distance duality relation and the assumptions of homogeneity and isotropy of the universe on large scales.

Primary author: SAPONE, Domenico

Presenter: SAPONE, Domenico

Session Classification: Plenary Talk

Contribution ID: **92** Type: **Poster**

Cosmological forecasts from the 21cm angular power spectra: a Monte Carlo approach

A recent project which aims to understand dark energy properties is the BINGO Telescope: an Intensity Mapping instrument designed to measure BAO in the radio band, through the measurement of the 21cm line of emission. In this work we present cosmological forecasts for BINGO by the nested sampling Monte Carlo method. This method is more robust and reliable, although more computationally expensive, than the Fisher matrix method, which relies on the assumption that the parameters are linearly correlated. Our work is the first to make forecasts for BINGO in a Monte Carlo approach. The likelihood depend on at least two ingredients: the angular power spectra measured from the observations and an estimate of the covariance matrix of the spectra. Since BINGO did not make observations yet, we use mocks created for develop and test the data-analysis pipeline. The mocks constitute in dark matter halos from the Horizon Run 4 catalogue populated with Hydrogen in order to mimic the BINGO Intensity Mapping signal. For the covariance matrix we used 500 lognormal simulations using the FLASK code. As a first analysis we place constraints on the ΛCDM model without taking in account noise or foreground removal. We compare constraints for BINGO + Planck with Planck alone, and we find that we can place better constraints combining Planck with BINGO.

Primary author: MOTTA, Pablo

Co-authors: Dr NOVAES, Camila; Prof. ABDALLA, Elcio; Prof. ABDALLA, Filipe; Prof. ZHANG, Jiajun

Presenter: MOTTA, Pablo

Session Classification: Poster session

Contribution ID: **93** Type: **Plenary/Parallel talk**

Identifying the dark matter nature from new observations of nearby faint galaxies

The well-known small-scale discrepancies between the observed satellite abundance in the Local Group and predictions from Cosmological simulations in CDM seems to point to missing physics in our models. This new physics may be a different dark matter nature beyond the standard WIMP candidate. In my talk I will discuss how the internal structure and increasing discoveries of fainter galaxies nearby can provide a way to distinguish among dark matter candidates, including the ultra-light and Self-interacting dark matter models. Upcoming astronomical surveys focusing in detecting the smallest galaxies in the universe will provide new clues to identify the most viable dark matter candidate.

Primary author: ROBLES, Victor (Yale University)

Presenter: ROBLES, Victor (Yale University)

Session Classification: Poster session

Contribution ID: **94** Type: **Plenary/Parallel talk**

Reconstructing Dark Energy

The problems with the stantard model of cosmology ΛCDM are well-known, such as the origin and behaviour of Dark Matter and Dark Energy or some tensions with the inferred value of some parameters when using distinct data sets, and several solutions have been proposed. One approach to try and elucidate the nature of the Dark Energy and relieve the parameter tensions is through reconstructions, both parametric and model-independent. In this talk we will discuss some of these reconstructions, their advantages and disadvantages and some statistical tools to perform model selection when comparing the reconstructions with the standard model.

Primary author: Mr ESCAMILLA, Luis (ICF, UNAM)

Presenter: Mr ESCAMILLA, Luis (ICF, UNAM)

Session Classification: Poster session

Contribution ID: **95** Type: **Plenary/Parallel talk**

Relativistic and PNG contributions to initial conditions of N-body simulations

We implement relativistic corrections to the evolutions of dark matter structures in Newtonian simulations of a LCDM universe via the initial conditions. We show how fNL and gNL contributions can be introduced consistently in the same fashion. We implement such corrections to the L-PICOLA code and compute the power spectrum and bispectrum of the evolved matter field. Our results confirm that both relativistic and PNG features are the most prominent at very large scales and for squeezed triangulations.

Primary author: ENRIQUEZ, Miguel

Presenter: ENRIQUEZ, Miguel

Session Classification: Poster session

Contribution ID: **96** Type: **Plenary/Parallel talk**

Decaying warm dark matter

During the recent years, decaying dark matter models have received renewed interest as proposed solutions to the current cosmological tensions, mainly due to their flexible expansion histories and clustering properties. While much focus has been on decaying cold dark matter, in this talk, I will present our recent work on decaying warm dark matter based on our recent preprint arXiv:2205.13628. Decaying warm dark matter generalises its cold counterpart, and interpolates between a wide range of cosmological models, admitting considerable customisability with few model parameters. Among other things, I will discuss a new, efficient method of computing the perturbations of the decaying sector and present results from a comprehensive MCMC analysis, evaluating the consequence of the model on the Hubble and σ_8 tensions. Lastly, I emphasise the power of agnosticism with respect to the underlying particle physics realisation and discuss applications to majorons and neutrino decays, both of which can be described as decaying warm dark matter.

Primary author: HOLM, Emil Brinch

Co-authors: TRAM, Thomas (Aarhus University); HANNESTAD, Steen (Aarhus University)

Presenter: HOLM, Emil Brinch

Session Classification: Poster session

Contribution ID: **97** Type: **Plenary/Parallel talk**

Extension of evolution mapping to velocity statistics

By choosing a suitable set of cosmological parameters, one can classify them into two groups with respect to their impact on the linear matter power spectrum $P_{\rm L}(k)$ when it is expressed in Mpc units: the evolution parameters, $\Theta_{\rm e}$, which determine its amplitude at a given redshift and the shape parameters, $\Theta_{\rm s}$, which only affect its shape. This division results in a perfect degeneracy in the impact of the evolution parameters on the $P_{\rm L}(k)$ which can, in turn, be accounted for by a single parameter: σ_{12}, the rms linear density variance on spheres of a radius of 12 Mpc.
Sanchez et al. 2021 has shown that this degeneracy is present also on the non-linear power spectrum where it presents differences between cosmologies with various evolution parameters that can be predicted by looking at their different structure formation histories. We show how this "evolution mapping"framework can be extended also to describe the non-linear velocity field, which is a crucial ingredient to model the impact of redshift-space distortions on clustering statistics.

Primary authors: Dr SANCHEZ, Ariel (Max Planck Institute for Extraterrestrial Physics); ESPOSITO, Matteo (Max Planck Institute for Extraterrestrial Physics)

Presenter: ESPOSITO, Matteo (Max Planck Institute for Extraterrestrial Physics)

Session Classification: Poster session

Contribution ID: **98** Type: **Plenary/Parallel talk**

Inflation with two-form field: the production of primordial black holes and gravitational waves

Monday, 22 August 2022 14:40 (20 minutes)

Antisymmetric tensor field (two-form field) is a ubiquitous component in string theory and generally couples to the scalar sector through its kinetic term. In this paper, we propose a cosmological scenario that the particle production of two-form field, which is triggered by the background motion of the coupled inflaton field, occurs at the intermediate stage of inflation and generates the sizable amount of primordial black holes as dark matter after inflation. We also compute the secondary gravitational waves sourced by the curvature perturbation and show that the resultant power spectra are testable with the future space- based laser interferometers.

Primary author: Dr OBATA, Ippei (Max-Planck-Institute for Astrophysics)

Co-authors: Prof. FUJITA, Tomohiro (Waseda Institute for Advanced Study, Waseda University); Dr NAKATSUKA, Hiromasa (Institute for Cosmic Ray Research, The University of Tokyo); YOUNG, Sam (Instituut-Lorentz for Theoretical Physics, Leiden University)

Presenter: Dr OBATA, Ippei (Max-Planck-Institute for Astrophysics)

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **99** Type: **Plenary/Parallel talk**

Kink-antikink scattering in a quantum vacuum

Tuesday, 23 August 2022 15:10 (20 minutes)

We study kink-antikink scattering in the sine-Gordon model in the presence of interactions with an additional scalar field, ψ, that is in its quantum vacuum. In contrast to the classical scattering, now there is quantum radiation of ψ quanta and the kink-antikink may form bound states that resemble breathers of the sine-Gordon model. We quantify the rate of radiation and map the parameters for which bound states are formed. Even these bound states radiate and decay, and eventually there is a transition into long-lived oscillons.

Primary authors: ZAHARIADE, George; SFAKIANAKIS, Evangelos; MUKHOPADHYAY, Mainak (Arizona State University); VACHASPATI, Tanmay (Arizona State University)

Presenter: ZAHARIADE, George

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **100** Type: **Plenary/Parallel talk**

Quantum Mechanics of Gravitational Waves

In a series of papers with Maulik Parikh and Frank Wilczek we study the effect of a quantized gravitational wave on a LIGO-type gravitational wave detector. We find that the arm-length is subject to a stochastic tidal force whose properties depend on the exact quantum state of the gravitational field, if the gravitational field is quantized. The quantum nature of gravity may thus be detectable as an additional noise source at gravitational wave detectors.

Primary authors: ZAHARIADE, George; Prof. WILCZEK, Frank; Prof. PARIKH, Maulik

Presenter: ZAHARIADE, George

Session Classification: Poster session

Contribution ID: **104** Type: **Plenary/Parallel talk**

Constraints on dark interactions with the EFTofLSS and BOSS

Tuesday, 23 August 2022 14:30 (20 minutes)

I will describe recent developments on the nonlinear modelling of LSS, in the context of momentum-exchange interacting dark energy. I will review the Dark Scattering model and show how it can alleviate the current S_8 tension between early and late-Universe data. I will present new constraints on this interaction from a likelihood analysis of the BOSS DR12 power spectrum multipoles, while briefly describing the EFT-based model and likelihood used in the analysis. I will show a hint of a detection of this dark coupling, driven by the preference of late-time data for a lower amplitude. If confirmed, this result could restore concordance between the early and the late Universe.

Primary author: CARRILHO, Pedro (Queen Mary University of London)

Presenter: CARRILHO, Pedro (Queen Mary University of London)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **105** Type: **Plenary/Parallel talk**

Calibration requirements for the width of redshift distribution for complex intrinsic alignment models

Intrinsic alignment (IA) modelling and photometric redshift estimation are two of the main sources of systematic uncertainty in weak lensing surveys. We investigate the impact of redshift errors when using different IA models. We show that both errors on the mean of the redshift bin δ_z and errors of the width of the redshift bin σ_z can lead to biases in cosmological constraints. We find that such biases can only be partially resolved by marginalizing over δ_z and σ_z. For a Stage-III survey, data does not have enough information to constrain δ_z and σ_z. We find that these biases are dominated by prior volume effects. For a Stage-IV survey, we observe that marginalizing over redshift parameters has an impact and reduces the bias. We compute requirements on σ_z and δ_z for both Stage-III and Stage-IV surveys. Assuming that the contribution of the redshift systematics should account for less than half of the statistical noise contribution, and the median bias should be smaller than 0.25σ, we find that the uncertainty on δ_z has to be < 0.025 for NLA as IA model in a Stage-III survey. We find no requirement threshold for σ_z since we meet the requirements even for our maximum prior width of 0.3. For TATT, the uncertainty on δ_z has to be < 0.02 and the uncertainty on σ_z has to be < 0.2. Current redshift precision of Stage-III surveys is therefore high enough to meet these requirements. Due to the increasing precision, systematic effects will become much more important in Stage-IV surveys. To meet the requirement from above, the uncertainty of δ_z has to be < 0.005 and the uncertainty of σ_z should be < 0.1 with no significant dependence on the IA model. The required high precision will be a major challenge for the future. Finally, we investigate if redshift systematics combined with IA modelling errors can explain the S_8-tension between cosmic shear results and CMB measurements. We find that redshift systematics alone are unlikely to explain the S_8-tension. However, we find that the noise contribution of a Stage-III survey can lead to biases of up to -0.5σ.

Primary author: FISCHBACHER, Silvan (ETH Zurich)

Co-authors: KACPRZAK, Tomasz (ETHZ - ETH Zurich); BLAZEK, Jonathan (Northeastern University); REFREGIER, Alexandre

Presenter: FISCHBACHER, Silvan (ETH Zurich)

Session Classification: Poster session

Contribution ID: **106** Type: **Plenary/Parallel talk**

Searching for the fundamental nature of dark matter in the cosmic large-scale structure

The fundamental nature of dark matter so far eludes direct detection experiments, but it has left its imprint in the large-scale structure (LSS) of the Universe. Extracting this information requires accurate modelling of structure formation and careful handling of astrophysical uncertainties. I will present new bounds using the LSS on two compelling dark matter scenarios that are otherwise beyond the reach of direct detection. Ultra-light axion dark matter, particles with very low mass and astrophysically-sized wavelengths, is produced in high-energy models like string theory ("axiverse"). I will rule out axions that are proposed to resolve the so-called cold dark matter "small-scale crisis" (mass ˜ 10ˆ-22 eV) using the Lyman-alpha forest (mass > 2 x 10ˆ-20 eV at 95% c.l.), but demonstrate how a mixed axion dark matter model (as produced in the string axiverse) could resolve the S_8 tension (mass ˜ 10ˆ-25 eV) using Planck, ACT and SPT CMB data and BOSS galaxy multipoles. Further, I will set the strongest limits to-date on the dark matter – proton cross section for dark matter particles lighter than a proton (mass < GeV). The LSS model involves one-loop perturbation theory (EFT of LSS), a non-cold dark matter halo model and, to capture the smallest scales, a machine learning model called an "emulator", trained using hydrodynamical simulations and an active learning technique called Bayesian optimisation.

Primary authors: ROGERS, Keir; DVORKIN, Cora; PEIRIS, Hiranya

Presenter: ROGERS, Keir

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **107** Type: **Plenary/Parallel talk**

Multi-field oscillons

Oscillons are oscillating, localized configurations in real scalar field theories. They appear in potentials that are shallower than quadratic away from the minimum and can be extremely long-lived.

Since plateau models are of great relevance for inflation, oscillons have been shown to form efficiently during preheating in a wide range of such models. Their formation and decay are accompanied by a characteristic GW signature which makes them particularly interesting from an experimental point of view.

Most work on oscillons has focused on single-field dynamics, however, various theories of fundamental physics that go beyond the Standard Model suggest the presence of a multitude of scalar fields in the early Universe. In this talk, I will describe the work I performed on the dynamics of oscillons in multi-field theories.

In particular, I will show how to construct multi-field oscillons in the non-relativistic limit of scalar field theories, and use this formalism to explain the origin of their stability and long lifetimes in a specific model with an exchange symmetry. I will talk about my most recent work in which I show that instabilities in the quantum vacuum can naturally lead to the condensation of multi-field oscillons. This is of special interest in the context of preheating scenarios, but could also find other applications in cosmology.

Finally, I will comment on strategies for generalizing this work to other models, for example, models with an arbitrary number of fields.

Primary authors: VAN DISSEL, Fabio (IFAE); Dr SFAKIANAKIS, Evangelos

Presenter: VAN DISSEL, Fabio (IFAE)

Session Classification: Poster session

Contribution ID: **109** Type: **Plenary/Parallel talk**

Early dark energy meets neutrinos

Early dark energy (EDE) alleviates the H_0 tension at the cost of increasing the clustering amplitude and worsening the S_8 discrepancy. Motivated by massive neutrinos' ability to suppress structure, we study their impact on EDE combining Planck and BOSS full-shape clustering data. A Bayesian analysis returns no evidence for a non-zero neutrino mass sum M_ν ($< 0.15, \mathrm{eV}$ at 95%˜C.L.), with limits driven primarily by shifts in the BAO scale. A frequentist profile likelihood analysis reveals a correlation between M_ν and the EDE fraction f_{EDE}, which keeps H_0 fixed as M_ν increases. Compared to the best-fit baseline EDE model ($M_\nu = 0.06, \mathrm{eV}$), a model with $M_\nu = 0.15, \mathrm{eV}$ maintains the same H_0(km/s/Mpc)=(70.08, 70.12, respectively) whilst decreasing S_8=(0.837, 0.831 respectively), whilst still representing a better fit ($\Delta\chi^2 = -3.1$) relative to ΛCDM. Our results indicate that an EDE+M_ν model can keep the H_0 tension at the same level as baseline EDE while mitigating the enhanced clustering issue. Further analysis of this model and neutrino mass measurements in general require the careful addition of extra datasets. I will also present preliminary work on the extension of a multi-probe combination analysis at map-level of a broad combination of cosmological data sets. This approach provides strong constraints on the LCDM model, its extensions and systematics, through the combination of both auto- and cross-correlations of the different probes.

Primary author: REEVES, Alexander (ETH Zurich)

Presenter: REEVES, Alexander (ETH Zurich)

Session Classification: Poster session

Contribution ID: **111** Type: **Plenary/Parallel talk**

Direct detection with superconducting nanowires

Thursday, 25 August 2022 16:10 (20 minutes)

Superconducting nanowires, a mature technology originally developed for quantum sensing, can be used as a target and sensor with which to search for dark matter interactions with electrons. We leverage recent developments in the theory of dark matter interactions in dielectrics to robustly predict the event rate in a nanowire device, fully accounting for the many-body physics of the detector. As a proof of concept, we use data from a 180-hour measurement of a prototype device to place new constraints on dark matter–electron interactions, including the strongest terrestrial constraints to date on sub-MeV (sub-eV) dark matter that interacts with electrons via scattering (absorption) processes. We present a roadmap for the development of future experiments and demonstrate the prospects for superconducting nanowires to lead exploration of the light dark matter parameter space.

Primary authors: HOCHBERG, Yonit (Hebrew University); LEHMANN, Benjamin (UC Santa Cruz); CHARAEV, Ilya (Massachusetts Institute of Technology); CHILES, Jeff; COLANGELO, Marco; NAM, Sae Woo; BERGGREN, Karl (MIT)

Presenter: LEHMANN, Benjamin (UC Santa Cruz)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **112** Type: **Poster**

Surprise and discordances

In this talk I'll explore how we can use Shannon entropy and the Surprise to quantify discordances between datasets. The Surprise is a tool based on the Kullback-Leibler divergence and offers a way to quantify discordance between datasets in multiple dimensions in parameter space. I'll analyze Supernovae, time delay gravitational lensing, BAO and CMB data for LambdaCDM model and variations with one more parameter. We'll compare both measures of discordance with the usual measure of distances between marginalized posterior distributions and see how they relate to each other in the context of the Hubble tension. Also, we'll talk about how the Surprise behaves when we analyze distributions with weak non-gaussianities, compared with an analytical solution for the Surprise for gaussian distributions.

Primary author: RIBA MELLO, Pedro

Presenter: RIBA MELLO, Pedro

Session Classification: Poster session

Contribution ID: **113** Type: **Plenary/Parallel talk**

Effective field theory of waterfall in hybrid inflation

Monday, 22 August 2022 15:00 (20 minutes)

We examine the validity of the classical approximation of the waterfall phase transition in hybrid inflation from an effective field theory (EFT) point of view. The EFT is constructed by integrating out the waterfall field fluctuations, up to one-loop order in the perturbative expansion. Assuming slow-roll conditions are obeyed, right after the onset of the waterfall phase, we find the backreaction of the waterfall field fluctuations to the evolution of the system can be dominant. In this case the classical approximation is completely spoiled. We derive the necessary constraint that ensures the validity of the EFT.

Primary authors: Dr GONG, Jinn-Ouk (Ewha Womans University); MYLOVA, Maria (Ewha Womans University)

Presenter: MYLOVA, Maria (Ewha Womans University)

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **114** Type: **Poster**

Redshift estimation using machine learning and photometric probability evaluation through K-d tree.

Spectroscopic redshifts (z) are obtained through the spectra of astronomical objects, this process is time-consuming, expensive, and frequently impossible for large numbers of galaxies due to telescope time limitations. Thus, in order to find this parameter z, in this work, we use the photometry of galaxies to determine this same quantity. Photometric redshifts can be evaluated through the empirical method which is using machine learning and data analysis. In our work, we used a sample of accurate spectroscopic information from the VIMOS Public Extragalactic Redshift Survey (VIPERS) that mapped the distribution of about 60,000 galaxies at 0.5<z<1.2$ as the training set to estimate the photometric redshift of almost 700 million galaxies from the Dark Energy Survey (DES). We used three machine learning methods: the Artificial Neural Network for photometric redshifts (ANNz2), the Gaussian processes for photometric redshifts (GPz), and a code written by us using a deep learning application programming interface written in Python called Keras. However, DES galaxies are not a representative set from VIPERS, so the estimated redshift of some of the galaxies would not be precise at all. In order to identify such galaxies, we used a space-partitioning data structure (K-d tree) to divide the galaxies along with the k-nearest neighbors algorithm. Consequently, we were able to evaluate the probability of each DES galaxy being photometric similar to the VIPERS galaxies.

Primary author: SANTOS, Amanda (University of Sao Paulo)

Co-authors: Mr RIBEIRO, Rafael (University of Sao Paulo (USP)); ABDALLA, Filipe; FORNAZIER, Karin (IFUSP); ABDALLA, Elcio; MARINS, Alessandro

Presenter: SANTOS, Amanda (University of Sao Paulo)

Session Classification: Poster session

Contribution ID: **115** Type: **Plenary/Parallel talk**

Cosmology with galaxy clustering: a joint analysis of the power spectrum and bispectrum

Thursday, 25 August 2022 14:00 (20 minutes)

Future generations of galaxy redshift surveys will sample the large-scale structure of the Universe over unprecedented volumes with high-density tracers, allowing for precise measurements of the clustering statistics. In order to properly exploit the full potential of such data, a robust likelihood pipeline is required, starting with an accurate theoretical prediction of cosmological observables, down to constraints on cosmological parameters. The main probe used in the context of spectroscopic galaxy surveys is the two point correlation function, or its Fourier transform, the power spectrum. However, it has been shown that the inclusion of higher order correlation functions in the analysis can significantly improve the accuracy with which cosmological parameters are measured. I will present a software for the joint likelihood analysis of the galaxy power spectrum and bispectrum, which includes for the first time also higher order bispectrum multipoles, and describe its validation against a large set of N-body simulations that allows to assess possible systematics in the theoretical model. Moreover, I will present forecasts for the joint analysis of power spectrum and bispectrum for future stage-IV galaxy surveys, both for the standard model and beyond-LCDM models.

Primary author: MORETTI, Chiara (University of Edinburgh)

Presenter: MORETTI, Chiara (University of Edinburgh)

Session Classification: Parallel Session Main Cupula: DM

Contribution ID: **116** Type: **Plenary/Parallel talk**

The search of dark satellites with gamma rays

Monday, 22 August 2022 17:10 (20 minutes)

A prediction of the standard LCDM cosmological model is that dark matter (DM) halos are teeming with numerous self-bound substructure, or subhalos. The most massive ones host the observed dwarf satellite galaxies, while smaller subhalos may host no stars/gas at all and thus may have no visible astrophysical counterparts and would remain completely dark. Yet, some of these 'dark satellites'are expected to be excellent targets for gamma-ray DM searches given their typical distances and structural properties. In this talk, I will discuss the importance that DM subhalos may have for DM searches with present or future gamma-ray observatories, such as the NASA Fermi satellite and the future Cherenkov Telescope Array (CTA). I will also describe the recent efforts we have made to search for dark satellites in Fermi-LAT data and to set constraints (predictions, for CTA) on the nature of the DM particle using these elusive targets. [This talk will be based on results from 1906.11896, 1910.14429, 2101.10003 and 2204.00267.]

Primary author: Dr SÁNCHEZ-CONDE, Miguel A. (IFT UAM/CSIC)

Presenter: Dr SÁNCHEZ-CONDE, Miguel A. (IFT UAM/CSIC)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **117** Type: **Plenary/Parallel talk**

BINGO Telescope: An Overview

Wednesday, 24 August 2022 11:25 (20 minutes)

The BINGO instrument is being constructed with the goal to be the first radio telescope to detect Baryonic Acoustic Oscillations (BAO) in the radio frequency band (˜ 1 GHz) using the 21 cm hyperfine transition of the neutral hydrogen using an observation technique known as intensity mapping (IM). However, the 21 cm signal is a few orders of magnitude weaker than the emission from other astrophysical processes in the same frequency band. This difference in signal magnitude demanded that the instrumental requirements contemplated a very clean beam profile, low sidelobes levels, and a rejection of cross-polarization better than 99%. In recent works of the collaboration, we showed that the optical design meets these requirements, with a focal arrangement composed of 28 feed horns. The mechanical design allows the vertical displacement of the horns for better sky sampling. We are currently using the foreground extraction packages GNILC, GMCA, and FastICA, to accurately recover the 21 cm signal from simulated sky maps with white noise. Additional steps on this matter contemplates the inclusion of radio frequency interference (RFI) contamination and 1/f noise.

Primary author: WUENSCHE, Carlos

Co-authors: ABDALLA, Elcio; Prof. WANG, Bin (Shanghai Jiao Tong University); ABDALLA, Filipe; Prof. QUEIROZ, Amilcar (Universidade Federal de Campina Grande); MARINS, Alessandro (University of Sao Paulo)

Presenter: WUENSCHE, Carlos

Session Classification: Parallel Session Lecture Room

Track Classification: Radiocosmology

Contribution ID: **118** Type: **Plenary/Parallel talk**

Fast Radio Bursts: Mock Generation and Cosmological Parameters Constraints

Fast Radio Bursts (FRBs) are a relatively recent discovered object in cosmology and astrophysics, whose origin is still an open problem. They are a class of brief ($\sim$ ms) and bright ($\sim$ Jy) radio transients that have been detected by a number of radio telescopes around the globe. There is a new generation of radio telescopes coming online, such as the BINGO, CHIME, SKA and others, which are going to make possible that many more samples of FRB will be detected in the near future. In this work, we have used the code FRBlip to study how effective BINGO will be to detect FRBs considering the interferometry between its horns and other three proposed external detectors i.e., horns with or without mirrors, and phased arrays devices. With this analysis, the Phased Arrays device, together with the BINGO's horns, proved to be the best setup to detect FRBs in our context. The increase in the detection rate is in the one order of magnitude compared to the other detectors in a certain period. With this study, we have simulated FRB mocks in order to verify if the cosmological quantities, i.e., as the redshift distribution and the dispersion measure (DM) extracted from the signal, will have statistical weight to be used to constrain cosmological parameters. In principle, there are degeneracies contained in the prediction of the DM of the FRBs which would allow cosmological parameters to be constrained in different degeneracy directions than the CMB and Intensity Mapping (IM) surveys such as BINGO. E.g., the CMB measures well the parameter $\Omega_b h^2$, whereas IM experiments have a better handle on the cosmological distances and FRB measurements should measure a ratio of Ω_b and h. We explore to what extent a combination of these experiments can shed a light on the values of the parameters described above.

Primary author: HOERNING, Gabriel (University of São Paulo)

Co-authors: QUEIROZ, Amilcar (Universidade Federal de Campina Grande); WANG, Bin (Shanghai Jiao Tong University); WUENSCHE, Carlos; ABDALLA, Elcio; ABDALLA, Filipe; BAROSI, Luciano

Presenter: HOERNING, Gabriel (University of São Paulo)

Session Classification: Poster session

Contribution ID: **119** Type: **Plenary/Parallel talk**

CONNECT - A neural network based framework for emulating cosmological observables and cosmological parameter inference

As numerical complexities of cosmological models are increasing in recent years, so too are the demands for resources when computing solutions to the Einstein-Boltzmann equations with codes like \textsc{class} and \textsc{camb}. A solution to this demand is, of course, more computational power through increasingly better and faster hardware, but perhaps another and more sustainable approach is emulating the Einstein-Boltzmann solver codes using a neural network. In doing so, we heavily decrease the time for each model evaluation, and a whole new world of parameter inference beyond Markov chain Monte Carlo opens.
In this talk I will present the new code \textsc{connect} introduced in Nygaard et al. (arXiv: 2205.15726), which is a framework for sampling training data and training a neural network of custom architecture to emulate the outputs of \textsc{class}. We found that the naïve approach of using a latin hypercube as training data leads to erroneous results in certain cases of complex likelihood shapes and it often requires a huge amount of data points, i.e. individual \textsc{class} computations, of orders 10^5 to 10^6. We thus propose another sampling method of training data based on an iterative process where we start from a rough latin hypercube and use the network trained on this to perform a high-temperature MCMC sampling resulting in new points in the parameter space to be included as training data for the next iteration. This process builds a representative set of training data and halts when the data reaches convergence. We can thus limit the number of class computations with one or two orders of magnitude, and by not having to accommodate regions of vanishing likelihood in the parameter space, the network is trained to be good only in the region of interest.

Primary author: NYGAARD, Andreas (Aarhus University)

Co-authors: HANNESTAD, Steen (Aarhus University); HOLM, Emil Brinch; TRAM, Thomas (Aarhus University)

Presenter: NYGAARD, Andreas (Aarhus University)

Session Classification: Poster session

Contribution ID: **120** Type: **Plenary/Parallel talk**

Primordial gravitational waves from excited states

Thursday, 25 August 2022 14:00 (20 minutes)

New degrees of freedom active during inflation lead to nontrivial signatures across scalar and tensor primordial spectra. We will discuss how such deviations from single-field, slow-roll inflation, manifested as particle excitations, lead to distinct signals in the stochastic gravitational wave background generated during inflation and how its characteristics are related to sharp features of the inflationary dynamics.

Primary author: SYPSAS, Spyros

Presenter: SYPSAS, Spyros

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **121** Type: **Plenary/Parallel talk**

Field Level Neural Network Emulator for Cosmological N-body Simulations

Monday, 22 August 2022 14:40 (20 minutes)

We present a fully differential, field level emulator for large-scale structure formation that is accurate in the deeply nonlinear regime. Our emulator consists of two convolutional neural networks trained to output the nonlinear displacements and velocities of N-body simulation particles based on their linear inputs. Cosmology dependence is encoded in the form of style parameters at each layer of the neural network, enabling the emulator to effectively interpolate the outcomes of structure formation between different flat ΛCDM cosmologies over a wide range of background matter densities. The neural network architecture makes the model differentiable by construction, providing a powerful tool for fast field level inference. We test the accuracy of our method by considering several summary statistics, including the density power spectrum with and without redshift space distortions, the displacement power spectrum, the momentum power spectrum, the density bispectrum, halo abundances, and halo profiles with and without redshift space distortions. We compare these statistics from our emulator with the full N-body results, the COLA method, and a fiducial neural network with no cosmological dependence. We find our emulator gives accurate results down to scales of $k \sim 1\ \mathrm{Mpc}^{-1}\,h$, representing a considerable improvement over both COLA and the fiducial neural network. We also demonstrate that our emulator generalizes well to initial conditions containing primordial nongaussianity, without the need for any additional style parameters or retraining.

Primary author: Dr JAMIESON, Drew (Max Planck Institute for Astrophysics)

Co-authors: LI, Yin; VILLAESCUSA-NAVARRO, Francisco (OATS-INAF); ALVES DE OLIVEIRA, Renan; HE, Siyu; HO, Shirley; SPERGEL, David

Presenter: Dr JAMIESON, Drew (Max Planck Institute for Astrophysics)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **122** Type: **Plenary/Parallel talk**

Gravitational wave background from non-Abelian reheating after axion-like inflation

If a pseudoscalar inflaton couples to the topological charge density of a non-Abelian gauge field, it can decay into gauge bosons that may thermalize quickly due to their self-interactions. In the resulting medium, non-Abelian "strong sphaleron" interactions increase the thermal friction felt by the inflation field, which can in turn lead to a self-amplifing and efficient reheating after inflation. Presenting work published in 2201.02317, we compute a lower bound on the new physics (NP) contribution to a gravitational wave background resulting from such a process. We find that the amount of energy converted into gravitational waves is modest compared to the corresponding background from standard model interactions. This suggests that non-Abelian models may avoid the overproduction issues of some Abelian models.

Primary authors: Prof. LAINE, Mikko (Bern University); Dr KLOSE, Philipp Mauritz (Bern University); PROCACCI, Simona (Bern University)

Presenter: Dr KLOSE, Philipp Mauritz (Bern University)

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **123** Type: **Plenary/Parallel talk**

Rubin Observatory's Legacy Survey of Space and Time (LSST): Opportunities and Challenges from the Brazilian Participation Group Perspective

Monday, 22 August 2022 09:50 (40 minutes)

The Vera C. Rubin Observatory under construction in Chile will conduct the 10-year Legacy Survey of Space and Time (LSST) that will produce an unprecedented astronomical data set. This data set will be used to explore several different aspects of the universe, such as: the nature of dark energy and dark matter, objects in the solar system, mapping the Milky Way and transient phenomena in the sky. In this talk I'll briefly describe the project and comment on the opportunities and challenges, focusing on the perspective from the Brazilian Participation Group.

Primary authors: KRAUSE, Elisabeth; ANDRADE-OLIVEIRA, Felipe; MOREIRA, Maria; ROSENFELD, Rogério; HUANG, Hung-Jin; SIMONOVIC, Marko; MIRANDA, Vivian; FANG, Xiao

Presenter: ROSENFELD, Rogério

Session Classification: Plenary Talk

Track Classification: Large scale structure

Contribution ID: **125** Type: **Plenary/Parallel talk**

The lensing amplitude $A_L = 1$ is not a good cosmological parameter for the ΛCDM model

Monday, 22 August 2022 14:20 (20 minutes)

Precise measurements at small angles of the cosmic microwave background (CMB) angular power spectrum (APS), done by the Planck collaboration, have stimulated accurate analyses of the lensing amplitude parameter A_L to confirm if it satisfies the value expected by the flat ΛCDM concordance model, i.e. $A_L = 1$.
We discuss a possible excess in the Planck APS not accounted by the ΛCDM APS. Firstly, we test the hypothesis that the residual APS (i.e., the measured APS minus the ΛCDM APS) is white noise, or not. Then we quantify how much lensing amplitude is lacking in the Planck analyses of the flat ΛCDM concordance model (with $A_L = 1$ as a premise). We find that, indeed, there is a residual gravitational lensing signal that is well explained as a lacking lensing amplitude, in the ΛCDM APS, of around 15%.

Primary authors: BERNUI, Armando (Observatorio Nacional); MOKEDDEM, Rahima (UFES); HIPOLITO-RICALDI, Wiliam

Presenter: BERNUI, Armando (Observatorio Nacional)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **126** Type: **Plenary/Parallel talk**

Massive scalar wave packet emission by a charged Black Hole and Cosmic Censorship Conjecture violation

We study the tunneling probability of a massive (m_w) uncharged scalar packet out from a near-extremal, static charged black hole (with mass M and charge $Q \to M^+$). We show that there is indeed a \textit{net} probability that a massive uncharged particle tunnels out from the black hole so that the final state (with new mass $M' \equiv M - m_w < Q$) does violate the cosmic censorship conjecture. Nevertheless, the typical time for such a black hole to discharge (i.e, to absorb charge $-Q$ from its surroundings and then become neutral) is much smaller than the tunneling time; therefore, the violation is never attained in practice. Even for a completely isolated black hole (should it exist), the standard time dilation near the horizon stretches the typical violation time scale to unobservable values. In recen studies we will show that this method is in accordance with a recently publish result of exact tunneling solution.

Primary author: LIPPARELLI FERNANDEZ, Rodrigo

Co-authors: JORÁS, Sergio; Dr DOS REIS, Ribamar Rondon de Rezende (Instituto de Física - UFRJ)

Presenter: LIPPARELLI FERNANDEZ, Rodrigo

Session Classification: Poster session

Contribution ID: **127** Type: **Plenary/Parallel talk**

Attractor solutions and features in the power spectrum from turns in multi-field inflation

Friday, 26 August 2022 14:00 (20 minutes)

We explore observational signatures from multi-field inflationary models with more than two fields. We first revisit the two-field case where the attractor solution with either small or large turn rate can be found analytically and investigate under what conditions the same procedure can be generalised for more fields. For three fields in the slow-roll, slow-twist and extreme turning regime we provide elegant expressions for the attractor solution for generic field-space geometries and potentials and study the behaviour of first order perturbations. In addition, we find that multiple (sharp) turns can significantly enhance the power spectrum and can therefore lead to efficient primordial black holes production. Finally, we apply our discussion to concrete supergravity models.

Primary author: CHRISTODOULIDIS, Perseas

Co-authors: GONG, Jinn-Ouk (Ewha Womans University); ROSATI, Robert

Presenter: CHRISTODOULIDIS, Perseas

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **128** Type: **Plenary/Parallel talk**

The Impact of Beam Convolution on Mapmaking

Wednesday, 24 August 2022 12:05 (20 minutes)

With the recent development of projects for the gathering of cosmological data through radioastronomy, mainly using the redshifted 21 cm signal line, various systematic effects have been analysed to improve sensibility and precision. This includes instrumental features such as beam analysis, which involves studying the how the reflectors modify the data through optical aberrations, and how it is possible to adequately handle this issue. Usually, in literature, only the beam main lobe's effects are considered and taken out of the final results, but it is known that sidelobe residuals remain on the final data. In this work, I present the impact of sidelobe contamination on sky maps using the framework of the BINGO Telescope's reflectors and its 28 horns. This is achieved using a Zernike Polynomials decomposition of the beams, inserted into the HIDE & SEEK softwares, which perform survey simulations and mapmaking.

Primary author: ALBERTO DE MORAES BARRETOS, Joao

Co-authors: ABDALLA, FILIPE BATONI (IFUSP); MARINS, Alessandro (University of Sao Paulo); Mr DO NASCIMENTO OTOBONE, Carlos Henrique (Instituto de Física da USP); Mr VIEIRA, Jordany (Instituto de Física da USP)

Presenter: ALBERTO DE MORAES BARRETOS, Joao

Session Classification: Parallel Session Lecture Room

Track Classification: Radiocosmology

Contribution ID: **129** Type: **Plenary/Parallel talk**

EFT Approach to Black Hole Scalarization and its Compatibility with Cosmic Evolution

Friday, 26 August 2022 16:55 (20 minutes)

We address the issue of black hole scalarization and its compatibility with cosmic inflation and big bang cosmology from an effective field theory (EFT) point of view. In practice, using a well-defined and healthy toy model which (in part) has been broadly considered in the literature, we consider how higher-order theories of gravity, up to cubic operators in Riemann curvature, fit within this context. Interestingly enough, we find that already at this minimal level, there is a non-trivial interplay between the Wilson coefficients which are otherwise completely independent, constraining the parameter space where scalarization may actually occur. Conclusively, we claim that the EFT does exhibit black hole scalarization, remaining compatible with the inflationary paradigm, and admitting General Relativity as a cosmological attractor.

Primary authors: RIQUELME, Simón (Universidad de Chile); Dr ERICES, Cristián (Universidad Central de Chile); Dr ZALAQUETT, Nicolás (Ludique Research Lab)

Presenter: RIQUELME, Simón (Universidad de Chile)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Modified gravity & dark energy

Contribution ID: **130** Type: **Poster**

Bayesian error propagation for neural-net based inference

Neural nets have become popular to accelerate parameter inferences, especially for the upcoming generation of galaxy surveys in cosmology. As neural nets are approximative by nature, a recurrent question has been how to propagate the neural net's approximation error, in order to avoid biases in the parameter inference. We present a Bayesian solution to propagating a neural net' s approximation error and thereby debiasing parameter inference. We exploit that a neural net reports its approximation errors during the validation phase. We capture the thus reported approximation errors via the highest-order summary statistics, allowing us to eliminate the neural net's bias during inference, and propagating its uncertainties. We demonstrate that our method is quickly implemented and successfully infers parameters even for strongly biased neural nets. In summary, our method provides the missing element to judge the accuracy of a posterior if it cannot be computed based on an infinitely accurately theory code.

Primary author: Mrs GRANDÓN, Daniela (University of Chile)

Co-author: Dr SELLENTIN, Elena (Leiden University)

Presenter: Mrs GRANDÓN, Daniela (University of Chile)

Session Classification: Poster session

Contribution ID: **131** Type: **Poster**

Primordial Black Holes with magnetic fields as a candidate for Fast Radio Bursts

Black Holes with masses of the order of 10^{14}g would be evaporating today, which could have been formed in the beginning of the universe. On the other hand, Fast Radio Bursts are thought to be associated to compact objects with extreme magnetic fields. Starting from V. Manko's solution of the Einstein Equations for a Rotating Black Hole with a magnetic field, it's emission properties are being studied and analysed as a candidate model for FRBs.

Primary authors: FONTANA FORMIGARI, LUCAS (Universidade de São Paulo); ABDALLA, Elcio

Presenter: FONTANA FORMIGARI, LUCAS (Universidade de São Paulo)

Session Classification: Poster session

Contribution ID: **132** Type: **Plenary/Parallel talk**

Lens map in Horndeski theory of Gravity

Horndeski Gravity is the most general 2nd order scalar-tensor theory in 4 dimensions. This theory contains well known
modified Gravity Theories such as k-essence, f(R) and Galileon Gravity.
In this work we aim to derive the lens map and related quantities such as the time delay in the framework of Horndeski gravity in general spacetimes, and more specifically in the case of a point lens in a FLRW spacetime.
This generalizes previous results obtained in Modified Gravity Theories, providing a formalism for the study of Weak and Strong
Gravitational Lensing in general scalar-tensor theories, and a probe to test Dark Energy and Modified Gravity theories using
graviational lensing observables."

Primary author: BESSA, Pedro

Presenter: BESSA, Pedro

Session Classification: Poster session

Contribution ID: **133** Type: **Plenary/Parallel talk**

Rare events are non-perturbative.

In recent years, it has been noted that perturbative treatment of large fluctuations fails to make correct predictions, e.g., for the formation of primordial black holes. Some non-perturbative methods like stochastic formalism were introduced to explore the tail of distributions, resulting in exponential tails for probability distributions in some models when quantum kicks dominate the classical trajectory. We advocate that the \delta N formalism can be applied to non-perturbatively calculate the tail of the distribution of fluctuations. We study a model of single-field inflation in which the tail of the PDF decays more slowly than exponential. This may significantly enhance the probability of the formation of PBHs. Furthermore, we employ the nonlinear \delta N formalism in a model of two-field ultra-slow-roll (USR) inflation. We show that the geometry of the surface of the end of USR phase in the field space plays a crucial role in the PDF of fluctuations. In particular, we illustrate how the geometrical properties of the boundary may lift the tail of PDF for curvature perturbation.

References:
arxiv/2112.04520
arxiv/2201.07258

Primary author: HOOSHANGI, Sina

Presenter: HOOSHANGI, Sina

Session Classification: Poster session

Contribution ID: **134** Type: **Plenary/Parallel talk**

studying remapping effects on 21cm mocks

In this work we extend the remapping method proposed by Mead and Peacock (MNRAS 440, 1233–1247 (2014)). This method allow us to remmap N-body simulations catalogues from one cosmology into another different cosmology directly without necessity of running an N-body simulations for each cosmology. On the other hand, it is well known that 21 cm mocks are constructed from, for example, halo or galaxy N-body simulations catallogues. Here we are interested in extending and validating, Mead and Peackok method to the 21 cms mocks conctructions. This will allows to construct 21cm intensity maps in different cosmologies in a more computationally eficient and faster way. The resulting mocks are going to be used in the BINCO telescope analysis.

Primary authors: MOKEDDEM, Rahima; Prof. HIPOLITO, wiliam

Presenter: MOKEDDEM, Rahima

Session Classification: Poster session

Contribution ID: **135** Type: **Plenary/Parallel talk**

A new formalism to define a vacuum state in curved space-time

Friday, 26 August 2022 14:20 (20 minutes)

The problem of finding a vacuum definition for a single quantum field in curved spaces is discussed under a new geometrical perspective. The minimum complex structure in phase space necessary to define a vacuum state is mapped to a 2-dimensional hyperbolic space in which distances can be defined. It is shown that well known vacuum prescriptions in the literature correspond to points in this hyperbolic space from which all mapped phase space solutions move on circles around it in the time-independent case, or within thin annular regions in the time-dependent case when the adiabatic approximation is valid. These properties are shown to be equivalent to the stability of the vacuum choice. The analysis is extended to time-dependent cases in which the adiabatic approximation is not valid, in the super-Hubble or low frequency regime. It is shown that stability points or curves can also be found in these situations, and stable quantum vacua can be obtained. This new formalism is applied to two situations: de Sitter space, where the Bunch-Davies vacuum is obtained in a complete different manner through an analysis in the super-Hubble regime, and in the context of cosmological bouncing models in which the contracting phase is dominated by a cosmological
constant in the asymptotic past. A new vacuum state for cosmological perturbations is proposed in this situation.

Primary authors: Dr PENNA-LIMA, Mariana (Universidade de Brasília); PINTO-NETO, Nelson; Dr VITENTI, Sandro (Universidade Estadual de Londrina)

Presenter: PINTO-NETO, Nelson

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **137** Type: **Plenary/Parallel talk**

Probing the dark sector with the Angular Redshift Fluctuations

In the context of next generation galaxy surveys, new statistics of the distribution of matter are being developed. Among these, I will present the Angular Redshift Fluctuations (ARF), which keep some of the information contained in the density fluctuations of galaxies along the line of sight into an angular summary statistics. I will show how the ARF are sensitive to the peculiar velocities of galaxies, and as such to the growth of structures.
Using the Fisher formalism, I will then show how a combined analysis of ARF with traditional angular galaxy clustering can help in breaking degeneracies between cosmological parameters. In particular, in the context of upcoming galaxy surveys such as Euclid, I will focus on what we will learn on the dark sector.

Primary authors: Dr HERNANDEZ-MONTEAGUDO, Carlos (Instituto de Astrofísica de Canarias); LEGRAND, Louis

Presenter: LEGRAND, Louis

Session Classification: Poster session

Contribution ID: **141** Type: **Poster**

The Unruh effect from a De Broglie-Bohm perspective

The particle concept in curved space-time is, in general, observer dependent, as is well-known from the Unruh effect. This, in particular, is really important to understand the particle emission from black holes. In this work, we study the Unruh effect under the perspective of De Broglie-Bohm interpretation of quantum mechanics, where from the wave functional we obtain the associated trajectories and the two-point correlation function, studying the high-temperature limit and comparing with the classical distribution. These results will be published soon in a forthcoming paper, in which we will also investigate the Bunch-Davies vacuum, according to De Broglie-Bohm's view.

Primary author: Ms PAIXÃO, Matheus Maia de Araújo (Brazilian Center for Research in Physics (CBPF))

Co-authors: Prof. PINTO NETO, Nelson (Brazilian Center for Research in Physics); Dr GALKIN, Olesya (Brazilian Center for Research in Physics)

Presenter: Ms PAIXÃO, Matheus Maia de Araújo (Brazilian Center for Research in Physics (CBPF))

Session Classification: Poster session

Contribution ID: **142** Type: **Plenary/Parallel talk**

Anisotropic Superclustering of Cosmic Gas: an analysis with ACT+Planck and DES data

Monday, 22 August 2022 14:00 (20 minutes)

The distribution of baryons in the cosmic web contains a wealth of cosmological and astrophysical information. In particular, measurements of the hot gas in anisotropic structures—such as filaments and superclusters—are important for the census of cosmic baryons. Such localized anisotropic measures can also provide cosmological information beyond two-point statistics and help to constrain models of baryonic feedback. Although hot gas is observable in CMB data through the the thermal Sunyaev-Zel'dovich (tSZ) effect, the signals from low-mass halos and unbound filament gas are weak, necessitating the use of stacking methods to boost signal-to-noise. By applying oriented stacking in selected regions of the cosmic web, we measure the anisotropic large-scale superclustering of thermal energy around galaxy clusters in tSZ maps from the Atacama Cosmology Telescope and Planck satellite. We compare with oriented measurements of galaxy density and weak lensing from Dark Energy Survey data. Our analysis probes the projected relationships between hot gas, galaxies, and the underlying matter density in filaments and superclusters. Comparisons to theory and simulations elucidate some of the successes and limitations of the current modelling of cosmic baryons.

Primary author: LOKKEN, Martine

Co-authors: Prof. HLOŽEK, Renée (Dunlap Institute); Prof. BOND, J Richard (CITA); Prof. VAN ENGELEN, Alexander (Arizona State University); Dr MADHAVACHERIL, Mathew (Perimeter Institute)

Presenter: LOKKEN, Martine

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **143** Type: **Plenary/Parallel talk**

Searching for signatures of non-Gaussianity in the Cosmic Web with the Peak Patch simulations

All models of inflation predict some non-Gaussian signatures in the cosmological distribution of energy, the search for which is a subject of great importance to our understanding of the early universe. In this work, we present simulated sky maps for a novel extended stochastic inflation model that is motivated by an ambitious suite of high-accuracy lattice simulations of early-universe field theories. This model leads to spatially-localized, intermittent and uncorrelated non-Gaussianities with amplitudes not confined by the tight constraints on classical $f_{\rm NL}$. Post-inflation fields are input to produce dark matter halo catalogues and mock observables of Sunyaev-Zel'dovich effects, the cosmic infrared background (CIB) and lensing maps using the Peak Patch-Websky pipeline, which is being effectively used at CITA for a wide array of large-scale structure (LSS) modelling. These simulations are fast and versatile because the highly dynamical halos are modelled patches moving through a weakly non-linear background, so only low-order solutions to the equations of motion are needed to produce catalogues. As a result, we can generate maps at orders of magnitude less computational expense than N-body simulations, making this both a highly efficient and sustainable template to identify important non-Gaussian features in the complex cosmic web.

Primary author: CARLSON, Nathan J. (CITA/University of Toronto)

Co-authors: BOND, J Richard (CITA); Mr HAIDER, Jibran (CITA/University of Toronto); Mr MORRISON, Thomas (CITA/University of Tornto)

Presenter: CARLSON, Nathan J. (CITA/University of Toronto)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **144** Type: **Plenary/Parallel talk**

A Tale of Tails: Instabilities During Inflation and Novel Forms of Non-Gaussianity

The generation of non-Gaussianity during inflation is often viewed in the context of perturbative processes producing small amounts of non-Gaussianity correlated with an underlying Gaussian field. However, there exist physical mechanisms by which non-Gaussianity can be produced non-perturbatively and in novel forms which are poorly modeled by the data templates used in current analysis. We study a generic class of such mechanisms where a feature in the potential causes a transverse field to become unstable. Simulating the system on a lattice allows us to compute the contribution to the gauge invariant quantity ζ and isolate its non-Gaussian component, which we find takes the form of intermittent peaks in real space, and gives rise to an extended non-Gaussian tail.

Having the full numerical solution in hand, we construct a semi-analytic model capturing the most relevant non-linear dynamics and reproducing this novel form of ζ non-Gaussianity.

Primary author: MORRISON, Thomas (University of Toronto, Canadian Institute for Theoretical Astrophysics)

Co-authors: Prof. BOND, J Richard (Canadian Institute for Theorectical Astrophysics); Dr BRADEN, Jonathan (Canadian Institute for Theoretical Astrophysics)

Presenter: MORRISON, Thomas (University of Toronto, Canadian Institute for Theoretical Astrophysics)

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **145** Type: **Plenary/Parallel talk**

Stability Criteria in f(R) Gravity from Thermodynamics Analogy

Friday, 26 August 2022 14:40 (20 minutes)

In this work we analyze the stability criteria in $f(R)$ theories of gravity in the metric formalism under the approach of a thermodynamics analogy proposed in [C.D. Peralta and S.E. Jorás JCAP06(2020)053] for ϕ^4 and double well inflationary potentials. We starting from the mentioned potentials in the Einstein frame, and obtain a parametric form of $f(R)$ in the corresponding Jordan frame. Such approach yields plenty of new pieces of information, namely a self-terminating inflationary solution with a linear Lagrangian, a robust criterion for stability of such theories, and a dynamical effective potential for the Ricci scalar R.

The addition of an *ad-hoc* Cosmological Constant in the Einstein frame leads to a Thermodynamical interpretation of this physical system described by a Van der Waals like behavior, which allows whole thermodynamics picture then follows: a equation of state, binodal and spinodal curves, phase transition, critical quantities (pressure, volume and temperature), entropy jumps, specific-heat divergence (and the corresponding critical exponent).

Primary authors: Dr PERALTA, César (Universidad Antonio Nariño); Dr JORÁS, Sergio (UFRJ)

Presenter: Dr PERALTA, César (Universidad Antonio Nariño)

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **146** Type: **Poster**

Galaxy superclusters in the nearby universe

At scales of dozens of Mpcs, the galaxy distribution forms the cosmic web. Galaxy clusters occupy its nodes and are connected to other nodes by vast filamentary chains of galaxies and groups of galaxies. In this work we are investigating some nearby superclusters and filaments in the southern skies. We use the high-precision photometric redshifts obtained in the 12 band S-PLUS photometric survey to probabilistically identify galaxies that may be members of the Hydra-Centaurus Supercluster. This work is useful both for the identification of galaxy membership –which allows us to investigate the properties and evolution of galaxies in these structures –and also for target selection for new spectroscopic redshift surveys, such as CHANCES (Chilean Cluster Galaxy Evolution Survey).

Primary authors: Mr LÖSCH, Elismar (IAG-USP); Dr SODRÉ, Laerte (IAG-USP)

Presenters: Mr LÖSCH, Elismar (IAG-USP); Dr SODRÉ, Laerte (IAG-USP)

Session Classification: Poster session

Contribution ID: **147** Type: **Plenary/Parallel talk**

Dimensional deformation of sine-Gordon breathers into oscillons

Oscillons are localized field configurations oscillating in time with lifetimes orders of magnitude longer than their oscillation period. This talk shows the deformation of one-dimensional breather solutions of the sine-Gordon (SG) equation into oscillons. SG equation is deformed by a radial damping term present in the d-dimensional Laplacian. Oscillons are evaluated (a) in a regime of perturbative corrections to the 1-D field equations, and (b) in two and three spatial dimensions. Our results show that we can only connect SG breathers and oscillons in the perturbative regime. Moreover, we show the existence of solutions with amplitude modulation, which are compatible with critical behavior near the energy threshold where solutions are no longer stable. Beyond the perturbative regime, we find that enlarging the initial parameter space is necessary to increase the availability of stable oscillons.

Primary authors: Dr BRADEN, Jonathan (Canadian Institute for Theoretical Astrophysics); GALVEZ GHERSI, Jose Tomas (Canadian Institute for Theoretical Astrophysics)

Presenter: GALVEZ GHERSI, Jose Tomas (Canadian Institute for Theoretical Astrophysics)

Session Classification: Parallel Session Lecture Room

Track Classification: Inflation and the primordial universe

Contribution ID: **149** Type: **Plenary/Parallel talk**

Model-independent tests of the standard cosmological model

Thursday, 25 August 2022 16:10 (20 minutes)

The standard cosmological model, namely the flat LCDM model, has been tremendously successful in describing cosmological observations for over two decades. Still, it suffers from theoretical caveats, in addition to recent problems like the SH0ES tension between H0 measurements from the early- and late-time Universe. In light of these issues, I will show results of some null tests of fundamental assumptions underlying the standard model in a model-independent fashion, such as a null test of the FLRW assumption, the variability of the speed of light, and the evidence for late-time cosmic acceleration.

Primary author: BENGALY, Carza (Observatório Nacional)

Presenter: BENGALY, Carza (Observatório Nacional)

Session Classification: Parallel Session Lecture Room

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **150** Type: **Plenary/Parallel talk**

Dynamical mass generation for a massless minimal scalar with quartic plus cubic self interaction in de Sitter spacetime

We consider a minimally massless coupled quantum scalar field with an asymmetric (quartic plus cubic) self interaction, V (φ) = λφˆ4/4!+βφˆ3/3! in the (3 + 1)-dimensional inflationary de Sitter background. This potential is bounded from below regardless the sign of β. The motivation of this study comes from the fact that such a potential may generate negative vacuum expectation value of V(φ) at late time, thereby decreasing the value of cosmological constant which is essential to end the inflation.
We investigate this theory via Starobinsky stochastic technique and compare it with the field theoretic results upto O(λˆ2) and O(λβˆ2). We compute the vacuum expectation value of φ, φˆ2, V(φ) and a non-perturbative as well as stochastic computation of the dynamically generated mass. We also estimate the possible shift of the inflationary cosmological constant due to this potential V(φ).

Primary author: JOSHI, Nitin (IIT Ropar)

Co-author: Dr BHATTACHARYA, Sourav (IIT Ropar)

Presenter: JOSHI, Nitin (IIT Ropar)

Session Classification: Poster session

Contribution ID: **153** Type: **Plenary/Parallel talk**

Measuring the Hubble constant with black sirens

Tuesday, 23 August 2022 14:50 (20 minutes)

We investigate a recently proposed method for measuring the Hubble constant from gravitational wave detections of binary black hole coalescences without electromagnetic counterparts. In the absence of a direct redshift measurement, the missing information on the left-hand side of the Hubble-Lemaître law is provided by the statistical knowledge on the redshift distribution of sources. We assume that source distribution in redshift depends on unknown hyperparameters, modeling our ignorance of the astrophysical binary black hole distribution. With tens of thousands of these "black sirens" – a realistic figure for the third generation detectors Einstein Telescope and Cosmic Explorer – an observational constraint on the value of the Hubble parameter at percent level can be obtained.

Primary authors: Dr LEANDRO, Hebertt (UFRN); STURANI, Riccardo (IFT-UNESP/ICTP-SAIFR); Prof. MARRA, Valerio (UFES)

Presenter: STURANI, Riccardo (IFT-UNESP/ICTP-SAIFR)

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **154** Type: **Plenary/Parallel talk**

Status and latest results of the KM3NeT neutrino telescope

Wednesday, 24 August 2022 09:10 (40 minutes)

We report on the status and latest results of the KM3NeT neutrino telescope in the Mediterranean Sea. KM3NeT has two detectors, KM3NeT/ORCA in France, optimized for the measurement of atmospheric neutrinos, and KM3NeT/ARCA in Italy, focussed on the detection of cosmic neutrinos. Although the detector is still under construction, first results with data using configurations of six lines in ORCA and six lines in ARCA are presented. These includes measurements of neutrino oscillations and limits on non-standard interactions, neutrino decay and quantum decoherence, as well as searches for cosmic neutrino sources and follow-ups of alerts of transient phenomena in a multi-messenger context. An outlook will be presented, including the sensitivity to the neutrino mass ordering.

Primary author: DE JONG, Paul (Nikhef National institute for subatomic physics (NL))

Presenter: DE JONG, Paul (Nikhef National institute for subatomic physics (NL))

Session Classification: Plenary Talk

Contribution ID: **155** Type: **Plenary/Parallel talk**

Gauged B-L interacting sterile neutrino dark matter revisited

Monday, 22 August 2022 16:10 (20 minutes)

We re-examine sterile neutrino dark matter in gauged $U(1)_{B-L}$ model. Improvements have been made by proper inclusion of all relevant processes and tracing the evolution of the number densities of sterile neutrino and extra neutral gauge boson Z'. The energy density of Z' turns out to to be much greater than in earlier studies. We revise the space of the viable parameters .

Primary author: SETO, Osamu

Co-authors: SHIMOMURA, Takashi (University of Miyazaki); EIJIMA, Shintaro

Presenter: SETO, Osamu

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **156** Type: **Plenary/Parallel talk**

Using gravitational waves to detect dark matter

Wednesday, 24 August 2022 11:45 (20 minutes)

Gravitational-wave interferometers can be used to probe the existence of dark matter. Different types of dark matter, such as primordial black holes, ultralight boson clouds around spinning black holes, axions and dark photons, could leave different imprints on gravitational-wave detectors. While arising from physically different sources, such gravitational-wave and dark-matter signals share common traits, and can be searched for with similar methods. In this talk, I explain how persistent, quasi-monochromatic signals in ground- and space-based detectors could arise from each of the aforementioned dark matter candidates. I also describe various methods and summarize search results from the most recent observing runs of Advanced LIGO, Virgo, and KAGRA.

Primary author: MILLER, Andrew (UCLouvain)

Presenter: MILLER, Andrew (UCLouvain)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Gravitational waves and black holes

Contribution ID: **157** Type: **Plenary/Parallel talk**

Radial oscillations of quark stars admixed with dark matter

Friday, 26 August 2022 16:35 (20 minutes)

We discuss compact stars consisting of cold quark matter and fermionic dark matter treated as two admixed fluids. After the computation of the stellar structure and fundamental radial oscillation frequencies for different masses of the dark fermion in the cases of weak and strong self-interacting dark matter, we show that the fundamental frequency can be dramatically modified and, in some cases, stable dark strange planets and dark strangelets with very low masses and radii can be formed. We also discuss effects from a strong magnetic field.

Primary authors: FRAGA, Eduardo (Instituto de Física, UFRJ); Dr JIMÉNEZ, José

Presenter: FRAGA, Eduardo (Instituto de Física, UFRJ)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **158** Type: **Poster**

Strong Lensing Cross Section for the Singular Isothermal Sphere with Elliptical Sources

Since the late 1980s, when the first gravitational arcs were observed, the strong effect of gravitational lensing has been a key observable in both Cosmology and Extragalactic Astrophysics. This phenomenon predicted by General Relativity, whose effect is the distortion and magnification of the image of a distant cosmic object (source) due to the deflection of the light's trajectory caused by the local space-time curvature created by another object (lens), has many applications, from obtaining the matter distribution of galaxies and galaxy clusters, to testing modified gravity models and measuring cosmological parameters. In view of this importance, we sought in this work analytical and approximate expressions of certain important quantities in the modeling and observation of gravitational arcs. In our research, we make use of the Singular Isothermal Sphere (SIS) model to describe the lens and consider an uniform elliptical source. This model, although simple, describes the phenomenon of gravitational lensing by galaxies with good accuracy, as the total distribution of matter (baryonic + dark matter) in massive elliptical and lenticular galaxies is very close to the one in the SIS model. In fact, the simplicity of this model is a good feature, as we were able to find analytical approximations in the low ellipticity regime, for the length and width of the arcs and, in particular, in addition of small font sizes, of the so-called cross section for arc formation. These solutions not only help us in the physical interpretation of observational results, but also in numerical methods for fitting models to observations. This will be particularly useful considering the substantial increase in galaxy-galaxy strong lensing systems predicted to be discovered by the LSST, Nancy Grace Roman Space Telescope and Euclid spacecraft expected in the upcoming years.

Primary author: VALADÃO, Eduardo

Co-author: MAKLER, Martin (CBPF)

Presenter: VALADÃO, Eduardo

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **159** Type: **Plenary/Parallel talk**

R^2-gravity quark stars from perturbative QCD

Monday, 22 August 2022 16:10 (20 minutes)

We investigate the structure of quark stars in the framework of $f(R) = R + \alpha R^2$ gravity using an equation of state for cold quark matter obtained from perturbative QCD, parametrized only by the renormalization scale. We show that a considerably large range of the free parameter α, within and even beyond the constraints previously reported in the literature, yield non-negligible modifications in the mass and radius of stars with large central mass densities. Besides, their stability against baryon evaporation is analyzed through the behavior of the associated total binding energies for which we show that these energies are slightly affected by the modified gravity term in the regime of high proper (baryon) masses

Primary authors: JIMÉNEZ, José; Dr PRETEL, Juan (CBPF); FRAGA, Eduardo (Instituto de Física, UFRJ); JORÁS, Sergio; Prof. RIBAMAR, Reis (IF-UFRJ)

Presenter: JORÁS, Sergio

Session Classification: Parallel Session Lecture Room

Track Classification: Modified gravity & dark energy

Contribution ID: **160** Type: **Plenary/Parallel talk**

Entropy bounds and nonlinear electrodynamics

Demanding the validity of the Generalized Second Law implies the existence of entropy bounds. By considering the absorption of matter from arbitrarily close to the horizon, Bekenstein and collaborators derived a universal entropy bound valid for any charged, rotating distribution of matter (including the Kerr-Newman black hole); and, based on the no-hair conjecture, argued that this bound cannot be further generalized, even when nonlinear interactions are taken into account. In this work we study the analogous situation of a Born-Infeld charged particle falling into an Einstein-Born-Infeld black hole. We derive two modified entropy bounds corresponding to both Schwarzschild and Reissner-Nordström like behaviors for the black hole and verify that both bounds violate the original Bekenstein bound. In the process we derive an important theorem towards obtaining the electrostatic potential of a nonlinear electrodynamics-charged particle in an arbitrary spherically symmetric background.

Primary authors: FALCIANO, Felipe (Brazilian Center for Research in Physics); PEÑAFIEL RAMIREZ, Miguel; C. FABRIS, Julio (Universidade Federal do Esp\'irito Santo)

Presenter: PEÑAFIEL RAMIREZ, Miguel

Session Classification: Poster session

Contribution ID: **161** Type: **Poster**

SuGOHI! Dissecting a strong lensing interacting galaxy system

Friday, 26 August 2022 15:00 (20 minutes)

Gravitational arcs are strongly magnified images of distant galaxies (known as sources) caused by the deflection of light produced by a foreground galaxy or galaxy cluster (the lens). This strong lensing phenomenon has been used to study high-redshift sources, to assess the mass distribution in the lens, to constrain cosmological parameters and to set limits on modified gravity. In addition, merging lensing systems have been used to set constraints on dark matter properties, such as a possible self-interaction cross section. In this work we present a detailed analysis of the strong lensing system J083933.4-014044.4, originally discovered in the Survey of Gravitationally-lensed Objects in HSC Imaging (SuGOHI). The lens is an early-type galaxy in the dense environment of a galaxy cluster and the images have the characteristic shape of a large arc with three bright peaks and a counter image. This configuration allows one to carry out the so-called lens inversion, providing parameters of the lens, such as the mass within the Einstein radius and the ellipticity of the mass distribution, and a coarse reconstruction of the (unlensed) source. A closer look into this system reveals the presence of tidal tails connecting the central galaxy with two dwarf spheroidals. Therefore, this object offers a unique opportunity of contrasting the complex dynamics of the merging systems with a lensing mass estimate. Furthermore, the unusual fact that the images are red, makes this system particularly relevant for studying the distant lensed galaxy. We have made a "dissection"of this system, first fitting and subtracting a smooth model of the lensing galaxy. This enhances the tidal features and removes contamination of the lens light for modeling the images. We then perform the lens inversion, obtaining parameters of the lens mass distribution and reconstructing the source shape. This lensing model is also used to subtract the arcs from the original images, providing a further "cleaned"view of the tidal features. Motivated by the potential applications of this system we have carried out spectroscopic observations with the Southern Astrophysical Research (SOAR) and Gemini telescopes, aiming at: i) obtaining the redshift of the source, ii) measuring the velocity dispersion of the lens, iii) obtaining redshifts of the dwarf spheroidals, to confirm the collision interpretation, iv) deriving physical properties of the lens and the source. Preliminary analysis of the data yielded the redshift of the source. A comparison between the lens velocity dispersion and the lensing mass estimate will allow us to quantify the effects of the mergers on the global dynamics of the lens galaxy. The detailed modelling of this peculiar lensing system may not only unveil aspects of its history and dynamics, but may also set constraints on dark matter properties.

Primary author: FRANÇA, João Paulo (CBPF)

Co-authors: Mrs BELOTO, Ingrid (IAG-USP); Prof. CYPRIANO, Eduardo (IAG-USP); Prof. GONCALVES, Thiago (Universidade Federal do Rio de Janeiro); Prof. MAKLER, Martin (CBPF); Prof. MAST, Damián (Córdoba Astronomical Observatory); ALVES DE OLIVEIRA, Renan (Universidade Federal do Espírito Santo); Mrs ARAUJO, Fernanda (CBPF); BEZERRA, Grasiele (CBPF); Mr CASO, Juan (Observatorio Astronomico de La Plata); Prof. DE BOM, Clécio (CBPF); Prof. FURLANETTO, Cristina (IF/UFRGS); Prof. GONZÁLEZ, Elizabeth (Instituto de Astronomía Teórica y Experimental); MELO, Carlos (UFRGS); Prof. MENÉNDEZ-DELMESTRE, Karín (Observatorio do Valongo); Dr OIO, Gabriel (Instituto de Astronomía

Teórica y Experimental); RODRIGUES, Davi (Universidade Federal do Espirito Santo); Prof. SILVA, Luidhy; VALADÃO, Eduardo; Prof. VARELA, Anibal (Universidad de Buenos Aires)

Presenter: FRANÇA, João Paulo (CBPF)

Session Classification: Parallel Session Lecture Room

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **162** Type: **Plenary/Parallel talk**

Bias Expansion for Covariance Matrices

Monday, 22 August 2022 15:20 (20 minutes)

Covariance matrices are a fundamental component in the process of constraining physical models from observations, determining the sensibility of the dataset to modifications in the model parameters. However, estimating them correctly presents many challenges; in particular, when computing this quantity using simulations, one must assume a galaxy formation model and a set of fiducial parameters. This represents a twofold limitation: on the one hand, the model or the chosen parameters may not represent well the relevant galaxy population; on the other hand, populating simulations with galaxies represents a large computational cost that sums to the already costly process of generating thousands of dark-matter only simulations. In this work, we are able to circumvent these issues by presenting an application of the bias formalism which allows us to obtain covariances for galaxies as a linear combination of quantities estimated from dark-matter only simulations, weighted by constant bias parameters. This allows one to vary agnostically the galaxy formation model used to build the covariances at essentially no computational cost.

Primary author: MAION, Francisco (Donostia International Physics Center)

Co-author: Dr ANGULO, Raul (Donostia International Physics Center)

Presenter: MAION, Francisco (Donostia International Physics Center)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **163** Type: **Plenary/Parallel talk**

Accurate modelling of extragalactic microlensing by compact objects

Microlensing of extragalactic sources, in particular the probability of significant amplifications, is a potentially powerful probe of the abundance of compact objects outside the halo of the Milky Way. Accurate experimental constraints require an equally accurate theoretical model for the amplification statistics produced by such a population. In this article, we argue that the simplest (strongest-lens) model does not meet this demanding requirement. We thus propose an elaborate practical modelling scheme for extragalactic microlensing. We derive from first principles an expression for the amplification probability that consistently allows for: (i) the coupling between microlenses; (ii) realistic perturbations from the cosmic large-scale structure; (iii) extended-source corrections. An important conclusion is that the external shear applied on the dominant microlens, both by the other lenses and by the large-scale structure, is practically negligible. Yet, the predictions of our approach can still differ by a factor of a few with respect to existing models of the literature. Updated constraints on the abundance of compact objects accounting for such discrepancies may be required.

Primary author: BOSCA NAVARRO, Victor David (Institute for Theorerical Physics (IFT) UAM-CSIC)

Co-authors: GARCIA-BELLIDO, Juan; FLEURY, Pierre (Institut de Physique Théorique CEA/CNRS)

Presenter: BOSCA NAVARRO, Victor David (Institute for Theorerical Physics (IFT) UAM-CSIC)

Session Classification: Poster session

Contribution ID: **164** Type: **Plenary/Parallel talk**

Gravitational-wave polarizations in generic higher-curvature gravity

Monday, 22 August 2022 16:30 (20 minutes)

We study the polarizations of gravitational waves (GWs) in generic higher-curvature gravity (HCG) whose Lagrangian is an arbitrary polynomial of the Riemann tensor. On a flat background, the linear dynamical degrees of freedom in this theory are identified as massless spin-2, massive spin-2, and massive spin-0 fields. Employing a fully gauge-invariant formalism, we demonstrate that (i) the massless spin-2 is the ordinary graviton with 2 tensor-type (helicity-2) polarizations, (ii) the massive spin-2 breaks down into 2 tensor-type (helicity-2), 2 vector-type (helicity-1) and 1 scalar-type (helicity-0) polarizations, and (iii) the massive spin-0 provides 1 scalar-type (helicity-0) polarization. Therefore, GWs in generic HCG exhibit 6 massive polarizations on top of the ordinary 2 massless ones. In particular, we find convenient representations of the scalar-polarization modes connected directly to the theory parameters of HCG. They are utilized to discuss methods to determine the theory parameters by GW-polarization observations.

Primary author: Mr TACHINAMI, Tomoya (Hirosaki University)

Co-authors: Mr TONOSAKI, Shinpei (Hirosaki University); Prof. SENDOUDA, Yuuiti (Hirosaki University)

Presenter: Mr TACHINAMI, Tomoya (Hirosaki University)

Session Classification: Parallel Session Lecture Room

Track Classification: Modified gravity & dark energy

Contribution ID: **166** Type: **Plenary/Parallel talk**

Dynamical Analysis in Generalized 4D Einstein-Gauss-Bonnet Gravity

We consider an extension of the novel 4D Einstein-Gauss-Bonnet (EGB) gravity by proposing a coupling between the scalar field and the Gauss-Bonnet term, which is otherwise absent in the novel 4D EGB theory, and demonstrate that the additional contributions to the equations of motion come from both the scaling of a coupling constant and the non-minimal coupling between the scalar field and gravity. By choosing the exponential functions for the potential and the coupling function to the Gauss-Bonnet term, we investigate the system's stability based on the fixed points and dynamical system approach. Our result shows that the system is not only stable but also can explain the late-time acceleration of the universe. However, stable accelerating solutions exist under specific conditions that the model parameters, including the potential parameter, must satisfy.

Primary authors: Dr SUNLY, Khimphun (Graduate School of Science, RUPP, Cambodia); RITHY, Phearun (Royal University of Phnom Penh); Dr GANSUKH, Tumurtushaa (Department of Science Education, JNU, Jeju, 63243, Korea)

Presenter: RITHY, Phearun (Royal University of Phnom Penh)

Session Classification: Poster session

Contribution ID: **167** Type: **Plenary/Parallel talk**

E and B-modes in Light-Cone perturbations

Tuesday, 23 August 2022 14:50 (20 minutes)

In this talk, I will present a method to extract the Scalar Vector Tensor (SVT) first order perturbations from the Cosmological Perturbations Theory developed in a homogeneous and isotropic Geodesic Light Cone (GLC) background. Due to its adapted light-cone decomposition, the GLC-SVT relation becomes involved, notwithstanding, I will present two different strategies to easy this relation. In the first one I will show how different gauge fixings may simplify these relations, however, at the cost of losing the GLC adaptability to cosmological observables. In the second one I will show how screen projected degrees of freedom have simple formulae when expressed in terms of spin raising and lowering operators, preserving the past light-cone symmetries in terms of
well-known physical quantities and its respective E and B modes.

Primary author: MEDEIROS, Matheus (Università di Pisa, INFN Pisa)

Co-authors: Dr FANIZZA, Giuseppe (University of Lisbon); Prof. MAROZZI, Giovanni (University of Pisa, INFN Pisa)

Presenter: MEDEIROS, Matheus (Università di Pisa, INFN Pisa)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Large scale structure

Contribution ID: **168** Type: **Plenary/Parallel talk**

Spherical Collapse of non-top-hat profiles in the presence of dark energy with arbitrary sound speed

Thursday, 25 August 2022 14:20 (20 minutes)

We study the spherical collapse of non-top-hat matter fluctuations in the presence of dark energy with arbitrary sound speed (c_s). The model is described by a system of partial differential equations solved using a pseudo-spectral method with collocation points. This method can reproduce the known analytical solutions in the linear regime with an accuracy better than 10^{-6} % and better than 10^{-2} % for the classical results of the spherical collapse model. We show the impact of nonlinear dark energy fluctuations on matter profiles and discuss some issues regarding phantom dark energy models. We also compute how dark energy sound speed affects the threshold for collapse and virialization density of halos. We confirm previous results for clustering dark energy $c_s \to 0$ and homogenous dark energy $c_s \to 1$, and extend them to arbitrary values of c_s. Finally, show how the gravitational potential and halo mass functions are impacted by c_s.

Primary authors: Prof. DE OLIVEIRA, Henrique (State University of Rio de Janeiro); Prof. C BATISTA, Ronaldo (Federal University of Rio Grande do Norte); Prof. ABRAMO, Luis Raul (University of São Paulo)

Presenter: Prof. C BATISTA, Ronaldo (Federal University of Rio Grande do Norte)

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Modified gravity & dark energy

Contribution ID: **169** Type: **Plenary/Parallel talk**

Photons and Light Propagation in Massive, Non-Linear, Standard-Model Extension Theories for astrophysics and cosmology

Astrophysical observations are largely based on electromagnetic signals still read with the Maxwellian massless and linear theory, possibly an approximation of a larger theory, as Newtonian gravity is for Einsteinian gravity in weak fields. Photons are the sole free massless particles in the Standard-Model (SM). Apart from massive formalisms (de Broglie-Proca, Bopp, Stueckelberg and others), the SM Extension dresses the photon of a mass dependent from the Lorentz-Poincaré symmetry violation. Non-linear theories by Euler-Heisenberg (for second order quantum electrodynamics and strong magnetic fields) and Born-Infeld (to normalise the infinitesimal charge) and followers complete the picture of the Extended Theories of Electromagnetism (ETE). Adopting ETE lead to surprising options for reading the universe: deviations from Maxwell's laws; light dispersion with a bearing on multi-messenger astronomy; birefringence; photon frequency shift in vacuo with a bearing on the red shift and dark energy. Some of the results in theory, observations and experiments from a collaboration (CERN-King's College London, Univ. Napoli, UERJ and CBPF Rio de Janeiro, IAC Tenerife and other institutes) will be addressed. Finally, time permitting, the application of the Heisenberg uncertainty principle to cosmology shall be mentioned with respect to the Hubble tension and the Hubble-Lemaître parameter as quantum measurement.

Primary author: Prof. SPALLICCI, Alessandro (Université d'Orléans - CNRS)

Presenter: Prof. SPALLICCI, Alessandro (Université d'Orléans - CNRS)

Session Classification: Poster session

Contribution ID: **170** Type: **Plenary/Parallel talk**

The cosmology dependence of the concentration-mass-redshift relation

The concentrations of dark matter haloes provide crucial information about their internal structure and how it depends on mass and redshift – the so-called $c(M, z)$ relation. I will present an extensive study of the cosmology-dependence of halo concentrations based on a suite of 72 dark matter-only simulations in which the following cosmological parameters are varied: σ_8, $\Omega_{\rm M}$, $\Omega_{\rm b}$, $n_{\rm s}$, h, M_ν, w_0 and $w_{\rm a}$. I will analyze how different cosmological parameters impact the values of the concentrations for different halo masses and redshifts. In agreement with previous work, and for all cosmologies studied, there exists a tight correlation between the characteristic densities of dark matter haloes and the critical density of the Universe at suitably defined formation time. This finding, when combined with excursion set modeling of halo formation histories, allows us to accurately predict the concentrations of dark matter haloes for arbitrary masses, redshifts, and values of the cosmological parameters.

Primary author: LÓPEZ, Daniel

Co-authors: Dr ANGULO, Raul (DIPC); Dr LUDLOW, Aaron (UWA)

Presenter: LÓPEZ, Daniel

Session Classification: Poster session

Contribution ID: **171** Type: **Plenary/Parallel talk**

Baryogenesis in bouncing cosmologies

We present results regarding the applicability of Gravitational Baryogenesis for bouncing cosmologies generated by quantum effects represented by a Wheeler-DeWitt equation, interpreted according to the de Broglie-Bohm theory. In the context of minisuperspace models, we show that it is possible to obtain the correct baryon asymmetry observed in the Universe, for large regions in the parameter space of this theory. Furthermore, we discuss how different types of bounces, both symmetric and asymmetric, affect these regions.

Primary authors: Dr VICENTE, Gustavo; Ms MOURÃO, Tiago; Dr JESUS, Marcos; Prof. PINTO-NETO, Nelson; Ms DELGADO, Paola

Presenter: Ms MOURÃO, Tiago

Session Classification: Poster session

Contribution ID: **172** Type: **Poster**

On the effects of finite source and wave optics in gravitational microlensing magnification

In the geometric optics regime gravitational lensing is an achromatic phenomenon. However, certain physical situations require wave optics to be taken into account, such that the deflection angle becomes wavelength dependent and the interference between multiple images must be taken into account. These effects are particularly relevant in the case of lensing by low mass compact objects, such as Primordial Black Holes (PBHs), which could constitute the dark matter. For PBH of masses
$lesssim 10^{-10} M_{Sun}$, i.e. objects with asteroid masses, the Einstein radius becomes of the same order or smaller than the light wavelength, so that wave optics must be used. This effect could, in principle, be detected in the spectrum of distant sources (stars in other galaxies or compact objects on cosmological scales) or even in the magnification of these sources. However, the finite source size impacts the wave optics signatures. In this work we study the impact of the combination of wave optics and finite sources on gravitational microlensing through the magnification. In the low-frequency limit, the light deflection does not depend on the source size, but strongly differs from geometric optics. As for high frequencies, the magnification has an oscillatory behavior, which is attenuated for higher frequencies and increasing source size. As the magnification calculation in this context is computationally intensive, we derive approximations valid for different frequency regimes and source sizes. We can use these results to optimize numerical calculations for the study of femtolensing and microlensing of low-mass PBHs, contributing to set more stringent limits on the abundance of dark matter in the form of compact objects lensing stars and extragalactic object of different sizes and distances.

Primary author: CAMARA MESQUITA, Arthur

Co-author: Dr MAKLER, Martin (CBPF)

Presenter: CAMARA MESQUITA, Arthur

Session Classification: Poster session

Track Classification: Dark matter, neutrinos & astroparticle physics

Contribution ID: **173** Type: **Plenary/Parallel talk**

Dark Matter Annihilations in Massive Stars: A New Lease on Life?

Wednesday, 24 August 2022 11:25 (20 minutes)

Stars whose initial mass is between approximately 150 and 240 $M_\odot$ face a fate of complete explosion in a pair instability supernova (PISN). However, by injecting energy into the star, it may be possible in some cases to avoid this fate. We outline conditions on this energy injection which can lead to the survival or incomplete explosion of the star, and we discuss how dark matter annihilations throughout a star may offer one mechanism to provide this energy. Finally, we begin to explore the range of energy conditions which may allow stars to avoid PISN.

Primary author: ZIEGLER, Joshua

Co-author: FREESE, Katherine (University of Michigan)

Presenter: ZIEGLER, Joshua

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Gravitational waves and black holes

Contribution ID: **174** Type: **Plenary/Parallel talk**

Standard Siren Cosmology: The new dark sirens constraints and perspectives of a novel hybrid method.

Tuesday, 23 August 2022 14:10 (20 minutes)

The detection of gravitational waves (GW) has opened a new window for cosmology. The current tension between the measurement of the Hubble constant H0 from Cosmic Microwave Background and Supernova analyses makes an independent, standard siren measurement of H0 from gravitational waves particularly interesting.
However, up to date, the astronomical community has confidently identified only one optical counterpart to a GW event, GW170817. In the cases where no counterpart is identified, it is possible to use a statistical approach, also known as the "dark siren"method, which needs a complete galaxy catalog over the GW localization area. In this contribution, we present a new constraint on the Hubble constant using a sample of well-localized gravitational wave events detected up to as statistical standard sirens, using data from Dark Energy Spectroscopic Instrument (DESI) imaging combined with the bright standard siren measurement from GW170817.
Due to the possible association of the gravitational-wave (GW) binary black hole (BBH) merger GW190521 with a flare in the Active Galactic Nuclei (AGN) J124942.3+344929, we explore the possibility of Standard Sirens in association with BBH flares. Current constraints suggest that from 25% to 80% of BBHs are associated with AGN disks. Furthermore, our formalism allows us to jointly infer cosmological parameters from a sample of BBH events that include chance coincidence flares.

Primary authors: R. BOM, Clecio (Centro Brasileiro de Pesquisas Físicas); Dr PALMESE, Antonella (University of California, Berkeley)

Presenter: R. BOM, Clecio (Centro Brasileiro de Pesquisas Físicas)

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **175** Type: **Plenary/Parallel talk**

The bispectrum in the hybrid bias expansion

In this talk, I will present the hybrid lagrangian bias expansion and how we can use it to make predictions for the auto and cross bispectra up to non-linear scales. I will show that the third-order bias expansion is enough to describe all triangular configurations of the bispectrum up to scales ~ 0.6 Mpc$/h$. We used N-body simulations and a subhalo abundance matching model to test the expansion for different types of galaxy selections, number densities, and redshifts. We also found that the posterior of the bias parameters are consistent when using just the bispectrum or the power spectrum. Because of the great constraining power of the bispectrum, especially on small scales, we expected to also get major improvements in information about the cosmological parameters.

Primary author: VOIVODIC, Rodrigo

Presenter: VOIVODIC, Rodrigo

Session Classification: Parallel Session Lecture Room

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **177** Type: **Plenary/Parallel talk**

A Needle in a Haystack - Characterizing Primordial Non-Gaussianity with Machine Learning to Probe the Early Universe

The detection of non-Gaussianity in primordial perturbations offers monumental new information about the early Universe. All models of inflation predict at least some level of primordial non-Gaussianity, and many models result in potentially observable non-Gaussian signatures. While detection efforts thus far have not found any significant primordial non-Gaussianity, they are not sensitive to all possible forms of non-Gaussianity. We go beyond past approaches by employing machine learning to characterize spatially localized and intermittent primordial non-Gaussianity that results from novel multi-field models of inflation. In particular, we use a multi-layered, 'deep-learning' formulation of Independent Component Analysis (ICA). Previously unexplored in the search for primordial non-Gaussianity, ICA is an unsupervised machine learning method used to separate generic non-Gaussian signals. Working with massive 1D simulations of curvature-perturbation fields with spatially localized and intermittent non-Gaussianity, we demonstrate that even in its standard form with some assumptions about the data, ICA effectively recovers the global presentation of non-Gaussianity. We then generate a large number of multi-scale component-separation layers. Each layer is composed of three steps: linear scale-filtering, non-linear ICA, and non-linear localized anomaly-extraction. Our adapted-ICA algorithm demonstrates promising detection of non-Gaussianity in a multi-scale, localized manner.

Primary author: HAIDER, Jibran (University of Toronto, Canadian Institute for Theoretical Astrophysics (CITA))

Co-authors: Prof. BOND, J Richard (CITA); BRADEN, Jonathan (Canadian Institute for Theoretical Astrophysics / University of Toronto); CARLSON, Nathan (University of Toronto); MORRISON, Thomas (CITA/University of Tornto)

Presenter: HAIDER, Jibran (University of Toronto, Canadian Institute for Theoretical Astrophysics (CITA))

Session Classification: Parallel Session Main Cupula: DM

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **178** Type: **Poster**

Baryon acoustic oscillations in thin redshift shells from BOSS DR12 and eBOSS DR16 galaxies

In an age of large astronomical datesets and severe cosmological tensions, the case for model independent analyses is compelling. We present a set of 14 baryon acoustic oscillations measurements in thin redshift shells with 3% precision that were obtained by analyzing BOSS DR12 and eBOSS DR16 galaxies in the redshift range $0.32 < z < 0.66$. Thanks to the use of thin shells, the analysis is carried out using just redshifts and angles so that the fiducial model is only introduced when considering the mock catalogs, necessary for the covariance matrix estimation and the pipeline validation. We compare our measurements, with and without supernova data, to the corresponding constraints from Planck 2018, finding good compatibility. A Monte Python module for this likelihood is available at github.com/ranier137/angularBAO.

Primary authors: SILVA, Ranier; MARRA, Valerio (UFES)

Presenter: SILVA, Ranier

Session Classification: Poster session

Contribution ID: **179** Type: **Poster**

Almanac: Cosmological constraints using full cosmic shear signal

I present a fully Bayesian MCMC-based signal extraction technique, which also solves the E/B-leakage problem for Stage-IV Surveys caused by their partial sky coverage. For cosmic shear, classical analyses lose information cutting off small scales because the noise dominates its signal, and additionally large scales as a result of the leakage between E and B modes. Our code Almanac allows us to reincorporate those scales and obtain a signal that does not bias the cosmological parameters.
Almanac samples the posterior distribution of al m and Cl given input data as spin−0 or spin−2 fields on the sphere for different redshift bins. The sampling is performed using a guided Hamiltonian Monte Carlo algorithm. In this poster, I produce shear sky maps for two redshift bins under a known wCDM cosmology using a Euclid-like footprint together with a stellar mask. From Almanac, I obtain the full non-Gaussian posterior of the power spectra for E and B modes, and additionally the posterior's sample-estimated covariance matrix. Additionally, I compute an analytical covariance matrix. With these ingredients, I compare two likelihoods: the full non-Gaussian solution and the standard Gaussian likelihood assumption. From both I infer the wCDM parameters and compare the bias and constraining power of the two approaches.

Primary author: SILVA LAFAURIE, Javier (Leiden)

Presenter: SILVA LAFAURIE, Javier (Leiden)

Session Classification: Poster session

Track Classification: Radiocosmology

Contribution ID: **180** Type: **Poster**

Probing spatial orientability of Friedmann–Robertson–Walker spacetime from electromagnetic quantum fluctuations

Orientability is an important topological property of spacetime manifolds. It is widely believed that spatial orientability can only be tested by global journeys around the Universe to check for orientation-reversing closed paths. Since such global journeys are not feasible, theoretical arguments that combine universality of physical experiments with local arrow of time, CP violation and CPT invariance are usually offered to support the choosing of time- and space-orientable spacetime manifolds. The nonexistence of globally defined spinor fields on a non-orientable spacetime is another theoretical argument for orientability. We show that it is possible to access spatial orientability of Friedmann–Robertson–Walker spacetime through local physical effects involving quantum electromagnetic fluctuations. We argue that a putative non-orientability of the spatial sections of spatially flat FRW spacetime can be ascertained by the study of the stochastic motions of a charged particle or a point electric dipole under quantum vacuum electromagnetic fluctuations. In particular, the stochastic motions of a dipole permit the recognition of a presumed non-orientability of $3-$space in itself. Our findings open the way to a conceivable experiment involving quantum electromagnetic fluctuations to locally probe the spatial orientability oF FRW spacetime.

Primary author: REBOUÇAS, Marcelo (CBPF)

Presenter: REBOUÇAS, Marcelo (CBPF)

Session Classification: Poster session

Contribution ID: **182** Type: **Poster**

Rotating cosmologies: classical and quantum

I will talk about Bianchi cosmologies coupled to a matter source that has the field theoretical description of a solid. Models of solid inflation are known for not being very efficient in diluting away anisotropy. While confirming this fact, our study finds another potential feature of solid inflation, namely a "rotation"of the principal axes of the expansion. Such a rotation is not just a gauge artifact as in the case of Bianchi models alone or coupled to homogeneous scalar fields. Due to the anisotropic stress generated by the solid, rotation becomes a real dynamical quantity. The quantum counterpart of this model can be used as a framework to tackle certain puzzles of quantum cosmology, namely how to characterize the spacetime symmetries of a quantum state at the level of the wavefunction of the universe. Our approach reveals the ambiguities in operating a minisuperspace-like truncations of degrees of freedom, and how it could fail to be consistent at the quantum level.

The talk would be based on the recently submitted paper: arXiv:2204.04110

Primary author: ZEGHARI, Kenza (Aix-Marseille University)

Presenter: ZEGHARI, Kenza (Aix-Marseille University)

Session Classification: Poster session

Track Classification: Modified gravity & dark energy

Contribution ID: **183** Type: **Plenary/Parallel talk**

De-singularizing the extremal GMGHS black hole via higher derivatives corrections

Thursday, 25 August 2022 15:00 (20 minutes)

The Gibbons-Maeda-Garfinkle-Horowitz-Strominger (GMGHS) black hole is an influential solution of the low energy heterotic string theory. As it is well known, it presents a singular extremal limit. We construct a regular extension of the GMGHS extremal black hole in a model with $\mathcal{O}(\alpha')$ corrections in the action, by solving the fully non-linear equations of motion. The de-singularization is supported by the $\mathcal{O}(\alpha')$-terms. The regularised extremal GMGHS BHs are asymptotically flat, possess a regular (non-zero size) horizon of spherical topology, with an $AdS_2 \times S^2$ near horizon geometry, and their entropy is proportional to the electric charge. The near horizon solution is obtained analytically and some illustrative bulk solutions are constructed numerically.

Primary author: UZAWA, Kunihito (Kwansei Gakuin University)

Presenter: UZAWA, Kunihito (Kwansei Gakuin University)

Session Classification: Parallel Session Lecture Room

Track Classification: Gravitational waves and black holes

Contribution ID: **184** Type: **Plenary/Parallel talk**

A Test of the Standard Cosmological Model with Geometry and Growth

Thursday, 25 August 2022 16:30 (20 minutes)

We perform a general test of the ΛCDM and wCDM cosmological models by comparing constraints on the geometry of the expansion history to those on the growth of structure. Specifically, we split the total matter energy density, Ωm , and (for wCDM) dark energy equation of state, w, into two parameters each: one that captures the geometry, and another that captures the growth. We constrain our split models using current cosmological data, including type Ia supernovae, baryon acoustic oscillations, redshift space distortions, gravitational lensing, and cosmic microwave background (CMB) anisotropies. We focus on two tasks: (i) constraining deviations from the standard model, captured by the parameters ΔΩm ≡ Ωmˆ{grow} − Ωmˆ{geom} and Δw ≡ wˆ{grow} − wˆ{geom}, and (ii) investigating whether the S8 tension between the CMB and weak lensing can be translated into a tension between geometry and growth, i.e. ΔΩm ≠ 0, Δw ≠ 0. In both the split ΛCDM and wCDM cases, our results from combining all data are consistent with ΔΩm = 0 and Δw = 0. If we omit BAO/RSD data and constrain the split wCDM cosmology, we find the data prefers Δw < 0 at 3.6σ significance and ΔΩm > 0 at 4.2σ evidence. We also find that for both CMB and weak lensing, ΔΩm and S8 are correlated, with CMB showing a slightly stronger correlation. The general broadening of the contours in our extended model does alleviate the S8 tension, but the allowed nonzero values of ΔΩm do not encompass the S8 values that would point toward a mismatch between geometry and growth as the origin of the tension.

Primary author: Dr VON MARTTENS, Rodrigo

Presenter: Dr VON MARTTENS, Rodrigo

Session Classification: Parallel Session Lecture Room

Track Classification: Statistical Methods and Tensions in Cosmology

Contribution ID: **185** Type: **Poster**

Large-scale structure cross-correlation of the Universe

We present a joint analysis of the power spectra of the Planck Compton y-parameter map and the projected galaxy density field using the WISE all-sky survey. We detect the statistical correlation between WISE and Planck data (gy) with a significance of 21.8σ. We also measure the auto-correlation spectrum for the tSZ (yy) and the galaxy density field maps (gg) with a significance of 150σ and 88σ, respectively. We then construct a halo model and use the measured correlations Cℓgg, Cℓyy and Cℓgy to constrain the tSZ mass bias B≡M_500/M_tSZ500. We also fit for the galaxy bias, which is included with explicit redshift and multipole dependencies as bg(z,ℓ)=b0g(1+z)α(ℓ/ℓ0)β, with ℓ0=117. We obtain the constraints to be B=1.50±0.07(stat)±0.34(sys), i.e. 1−bH=0.67±0.03(stat)±0.16(sys) (68% confidence level) for the hydrostatic mass bias, and b0g=1.28+0.03−0.04(stat)±0.11(sy with α=0.20+0.11−0.07(stat)±0.10(sys) and β=0.45±0.01(stat)±0.02(sys) for the galaxy bias.

Similarly, We present a joint cosmological analysis of the power spectra measurement of the Planck Compton y-map and the integrated Sachs-Wolfe (ISW) map. We detect the statistical correlation between the Planck tSZ map and ISW data with a significance of 1.7σ , while the significance of the auto-correlation for Planck tSZ data and ISW data are 3.3σ and 2.1σ respectively. The joint auto and cross-power spectra constrain the matter density Ωm = 0.316 ± 0.011, Hubble constant h = 0.723 ± 0.01, and the rms matter density fluctuation σ8 = 0.767 ± 0.014 at 68% confidence level. The derived growth of structure parameter is S8 ≡ σ8(Ωm /0.3)0.5 = 0.788+0.0187 −0.0198. In addition, we obtain the constraint of the product of the gas bias, gas temperature and density as bgas (Te/(0.1 keV)) (ne/1 m-3) = 5.60+0.30
−0.34. We find that this leads to an estimate on the electron temperature for
today to T0e = (4.33+0.232−0.266) × 106 K .

Incoming data sets from future CMB and galaxy surveys (e.g. Rubin Observatory) will allow probing the large-scale gas distribution in more detail.

Primary author: Mr IBITOYE, Ayodeji (University of KwaZulu Natal)

Presenter: Mr IBITOYE, Ayodeji (University of KwaZulu Natal)

Session Classification: Poster session

Contribution ID: **187** Type: **Plenary/Parallel talk**

Neutrinos and Astroparticle Physics: Experimental Overview

Wednesday, 24 August 2022 09:50 (40 minutes)

This talk will provide an overview of neutrinos in physics, astrophysics and cosmology. I will broadly cover detection of neutrinos over a wide range of energies, highlighting several ongoing and future projects.

Primary author: SCHOLBERG, Kate

Presenter: SCHOLBERG, Kate

Session Classification: Plenary Talk

Contribution ID: **188** Type: **Plenary/Parallel talk**

Searching for Dark Matter: the direct detection of WIMPs

Thursday, 25 August 2022 09:10 (40 minutes)

The nature of dark matter is one of the outstanding open questions in physics. Although the observational evidence for the existence of a non-baryonic, non-luminous and non-relativistic component of the universe has been strengthen in recent years, its nature still remains unknown. A class of theoretically-motivated non-relativistic particles with masses approximately in the GeV to TeV range, commonly referred to as Weakly Interacting Massive Particles (WIMPs), has been extensively investigated as a constituent of dark matter. Direct detection experiments aim to detect WIMPs by looking for the energy deposited in a detector when a WIMP from our galactic halo scatters off a nucleus of a target/detector sensitive material. In recent years, such detectors have reached the multi-ton scale and even larger ones are being planned. They will become sensitive to astrophysics neutrinos that will generate events via coherent elastic neutrino-nucleus scattering (CEνNS), similar to those of the WIMPs.

Here, we overview the recent progress in WIMP direct detection experiments, discuss the impact of the so called "neutrino fog" and present future directions for WIMP search.

Primary author: LOPES, Isabel

Presenter: LOPES, Isabel

Session Classification: Plenary Talk

Contribution ID: **189** Type: **Plenary/Parallel talk**

Primordial non-Gaussianity beyond the bispectrum

Thursday, 25 August 2022 09:50 (40 minutes)

I will review recent progress to address the generation of primordial non-Gaussianity during cosmic inflation. I will focus my attention on the origin of non-Gaussian signals that are poorly parametrized by the bispectrum (the three-point function). Such non-Gaussian deformations of the statistics may be crucial to understand the generation of primordial black holes, and necessarily require non-perturbative techniques taking into account every n-point function.

Primary author: PALMA, Gonzalo

Presenter: PALMA, Gonzalo

Session Classification: Plenary Talk

Contribution ID: **190** Type: **Plenary/Parallel talk**

Cosmology results from the Dark Energy Survey

Tuesday, 23 August 2022 11:00 (40 minutes)

The Dark Energy Survey (DES) is a 5000 square degree galaxy imaging survey which completed six years of observations in 2019. By measuring the shapes and colors of more than 200 million galaxies in addition to conducting a supernova survey, DES is a multi-purpose experiment that is able to study the large-scale properties of the Universe using measurements of weak gravitational lensing, galaxy clustering, galaxy clusters, and supernovae in order to test LCDM as the standard cosmological model. This talk will primarily focus on the survey's combined analysis of galaxy clustering and weak lensing. I will describe how we use those measurements to constrain cosmology and will give an overview of the findings from the analysis of the survey's first three years of data, highlighting the recently released constraints on several model extensions to LCDM.

Primary author: MUIR, Jessie

Presenter: MUIR, Jessie

Session Classification: Plenary Talk

Contribution ID: **191** Type: **Plenary/Parallel talk**

A travel through CMB science: accomplishments and perspectives for the following decade

Monday, 22 August 2022 09:10 (40 minutes)

Since its discovery, the study of the cosmic microwave background anisotropies has been pursued from space, balloons and the ground with great success. The results have helped in shaping the current standard cosmological model, and forged the new questions we are now trying to answer. I will review the main legacy of past experiments, and discuss the scientific goals and expectations for the current and upcoming experiments.

Primary author: PIERPAOLI, Elena

Presenter: PIERPAOLI, Elena

Session Classification: Plenary Talk

Contribution ID: **192** Type: **Plenary/Parallel talk**

Galaxy clusters and cosmology

Tuesday, 23 August 2022 11:40 (40 minutes)

I will review the role that galaxy clusters have as tracers of growth of cosmic structures and to constrain the Dark Sector of the Universe. After overviewing the current state of cluster cosmology, I will show one example of cosmic tension arising when comparing cosmological posteriors derived from galaxy clusters and Lyman-alpha forest. Within this context, I will critically discuss the systematics, possibly at the origin of this tension, that need to be understood to fully exploit the potential of ongoing and future surveys (e.g. Euclid/LSST). I will then highlight the important role played by simulations within this context, and show a few examples of systematics that have been addressed thanks to the use of such simulations.

Primary author: BORGANI, Stefano

Presenter: BORGANI, Stefano

Session Classification: Plenary Talk

Contribution ID: **193** Type: **Plenary/Parallel talk**

Cosmology with future galaxy surveys: an overview of the Euclid mission

Monday, 22 August 2022 11:00 (40 minutes)

ESA's Euclid satellite, designed to map the geometry of the Universe and scheduled for launch in 2023, will observe billions of galaxies with the ultimate goal of unveiling the nature of dark matter and dark energy. I will give an overview of the instrument and the current status of the Euclid mission. I will then focus on one of its main probes, galaxy clustering, and describe the challenges and approaches we are taking in order to maximise the amount of information extracted from the unprecedented high-precision measurements of cosmic expansion and structure growth that Euclid will provide.

Primary author: MORETTI, Chiara

Presenter: MORETTI, Chiara

Session Classification: Plenary Talk

Contribution ID: **194** Type: **Plenary/Parallel talk**

Gravitational-wave observations and cosmology with gravitational waves

Tuesday, 23 August 2022 09:10 (40 minutes)

The first three observing runs of the LIGO-Virgo-KAGRA detector network have led to 90 detections of compact binary coalescences and have ushered in a wealth of results in fundamental physics, astrophysics and cosmology. In this talk we give a brief overview of the observations and focus on standard-siren cosmology, namely the use of compact binaries as standard distance indicators to measure cosmological parameters such as the Hubble constant. We discuss the current results, with and without use of bright electromagnetic counterparts, and discuss the prospects and challenges towards precision cosmography using gravitational-waves.

Primary author: GHOSH, Archisman

Presenter: GHOSH, Archisman

Session Classification: Plenary Talk

Contribution ID: **195** Type: **Plenary/Parallel talk**

"Prince Andrew can't sweat"solves σ8 tension

Friday, 26 August 2022 09:50 (40 minutes)

Primary author: SELLENTIN, Elena

Presenter: SELLENTIN, Elena

Session Classification: Plenary Talk

Contribution ID: **197** Type: **Plenary/Parallel talk**

Indiscriminate R˜50 spectroscopy in the entire footprint: the spectro-photometric approach of J-PAS

Friday, 26 August 2022 11:00 (40 minutes)

The J-PAS (Javalambre Physics of the Accelerating Universe Astrophysical Survey) scans the sky through 56 narrow band (˜140 Å) + 3 broad band optical filters that render a R˜50 spectra of every object detected in the footprint. The first square degree covered by the miniJPAS survey has produced \sigma_{NMAD}<0.005 x (1+z) for most galaxies with r<22.5, thus enabling an accurate reconstruction of the cosmic web conforming Large Scale Structure (LSS) of the universe. The first tests with realistic photo-z PDFs on simulated mocks are also providing an optimal recovery of the 3D power spectrum up to scales of k ˜ 0.1-0.2˜h/Mpc. The miniJPAS survey has also allowed the identification of ˜100 groups with masses above 5x10ˆ{13} M_sun, with high level of purity and completeness up to z˜0.4. Likewise, the narrow band filters are particularly sensitive to broad band features such as QSO/AGN emission lines, enabling miniJPAS to identify and pin the redshift of hundreds of QSOs, to be further followed up spectroscopically with WEAVE-QSO. Finally, J-PAS'sister survey, J-PLUS, with only 12 (7 narrow band + 5 broad band) optical filters, has just covered 3,000 square degrees, and has identified hundreds of thousands of galaxies with high accuracy photo-zs (\sigma_{NMAD}<0.01 x (1+z)). The associated preliminary clustering analyses are demonstrating the potential of spectro-photometric surveys like J-PAS and S-PLUS.

Presenter: HERNANDEZ-MONTEAGUDO, Carlos

Session Classification: Plenary Talk

Contribution ID: **198** Type: **Plenary/Parallel talk**

O universo em expansão: 100 anos do artigo de Friedmann

Thursday, 25 August 2022 19:00 (50 minutes)

Em 1922 o matemático russo Alexander Friedmann publicou o artigo em que pela primeira vez na história se evocava a possibilidade que o universo fosse dinâmico e pudesse estar em expansão. A expansão do universo seria pouco depois confirmada pelas observações. Desse momento em diante, o moderno modelo cosmológico foi sendo paulatinamente construído. Hoje ele se alicerça sobre vários sólidos pilares, mas convive por outro lado com várias dificuldades e tensões. Este seminário procura discutir a construção do atual modelo cosmológico padrão, seus sucessos e seus problemas.

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Presenter: FABRIS, Júlio (UFES)

Session Classification: Plenary Talk

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Concluding remarks: the COSMO conferences

Friday, 26 August 2022 16:05 (30 minutes)

Presenter: ROSZKOWSKI, Leszek

Session Classification: Plenary Talk