CosmoVerse@Lisbon
Program

Tuesday 30 May 2023

08:20	*Registration opens*	
09:00	Welcome talks	
09:20	**Plenary 1**	**Marika Asgari**
10:00	Talk 1	Elena Tomasetti
10:25	Talk 2	Richard Watkins
10:50	*Coffee break*	
11:20	Talk 3	Ricardo Cháves Murillo
11:45	Talk 4	Clecio Bom
12:10	Talk 5	Matilde Signorini
12:35	*Lunch break*	
14:30	**Plenary 2**	**Adam Riess**
15:30	*Coffee break*	
16:00	**Plenary 3**	**Richard Anderson**
16:40	Talk 6	Radoslaw Wojtak
17:05	Talk 7	Jenny Sorce
17:30	*End of Day*	

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Wednesday 31 May 2023

09:00	**Plenary1**	**Vivian Poulin**
09:40	**Plenary2**	**Olga Mena**
10:20	*Coffee break*	
10:50	Talk 1	Pawel Bielewicz
11:15	Talk 2	William Giarè
11:40	Talk 3	Maria Giovanna Dainotti
12:05	*Lunch break*	
14:00	Talk 4	Leandros Perivolaropoulos
14:25	Talk 5	J. Alberto Vazquez
14:50	Talk 6	Denitsa Staicova
15:15	Talk 7	Eoin O'Colgain
15:45	*Coffee break*	
16:10	Talk 8	Benjamin Giblin
16:35	Talk 9	Javier De Cruz Pérez
17:00	Talk 10	Guillermo Franco Abellán
17:25	Talk 11	Lindita Hamolli
17:50	*End of Day*	
19 :30	Conference Dinner	

Thursday 1 June 2023

09:00	**Plenary1**	**Emmanuel Saridakis**
09:40	**Plenary2**	**Steen Hannestad**
10:20	*Coffee break*	
10:50	Talk 1	Adrià Gómez-Valent
11:15	Talk 2	Ozgur Akarsu
11:40	Talk 3	Elsa Teixeira
12:05	*Lunch break*	
13:50	Poster Award + 5min talk	
14:00	Talk 4	Tiberiu Harko
14:25	Talk 5	Dario Bettoni
14:50	Talk 6	Nihan Katirci
15:15	*Coffee break*	
15:45	Talk 7	David Mota
16:10	Talk 8	Vitor Da Fonseca
16:35	Talk 9	Francesco Pace
17:00	Talk 10	Ignacio Sevilla
17:25	*Closing*	
18 :30	Public talk	

List of abstracts

Day 1: Tuesday 30 May 2023

Talk 1: Elena Tomasetti

A new constraint on the expansion history of the Universe with cosmic chronometers in VANDELS

In the era of precision cosmology, exploring new and complementary approaches to measure the expansion history of the Universe is crucial to increase the accuracy in the measurements and keep systematic effects under control. A novel approach that provides cosmology-independent constraints on the Hubble parameter is based on the analysis of the differential age evolution of massive and passively evolving galaxies as “cosmic chronometers” (CC). In this talk, I will present a new measurement of H(z) at z 1.26 obtained from the analysis of a sample of CC extracted from the survey VANDELS. In our work, we explore the feasibility of deriving accurate and robust differential ages from full-spectrum fitting in the range 1<z<1.5, derive the physical properties of the population, study in details the associated systematic uncertainties, and propagate those to the total error budget. These data are used both to derive a new measurement of the Hubble constant H0 (assuming a cosmological model) and to derive a cosmology independent estimate of the Hubble parameter at z~1.26. I will conclude discussing how this measurement can contribute to shed some light on the H0 tension, and the potential of this method

Talk 2: Richard Watkins

Analyzing the Large-Scale Bulk Flow using CosmicFlows4: Increasing Tension with the Standard Cosmological Model

We present an estimate of the bulk flow in a volume of radii 150 200h−1Mpc using the minimum variance (MV) method with data from the CosmicFlows4 (CF4) catalog. The addition of new data in the CF4 has resulted in an increase in the estimate of the bulk flow in a sphere of radius 150h−1Mpc relative to the CosmicFlows3 (CF3). This bulk flow has less than a 0.03% chance of occurring in the Standard Cosmological Model (ΛCDM) with cosmic microwave background derived parameters. Given that the CF4 is deeper than the CF3, we were able to use the CF4 to accurately estimate the bulk flow on scales of 200h−1Mpc (equivalent to 266 Mpc for Hubble constant Ho = 75 km/s/Mpc) for the first time. This bulk flow is in even greater tension with the Standard Model, having less than 0.003% probability of occurring.

Talk 3: Ricardo Cháves Murillo

Cosmological parameters via HII galaxies and systematic uncertainties

We present independent determinations of cosmological parameters using the distance estimator based on the established correlation between the Balmer line luminosity, L(Hβ), and the velocity dispersion (σ) for HII galaxies (HIIG). We also explore in detail the systematic uncertainties associated with HIIG as a cosmological tracer. These results are based on new VLT-KMOS high spectral resolution observations of 41 high-z ($1.3 < z < 2.6$) HIIG combined with previously obtained data for 45 high-z and 107 local HIIG.

Talk 4: Clecio Bom

Standard Siren Cosmology with Gravitational Waves from Binary Black Hole Mergers in Active Galaxy Nuclei

The detection of gravitational Waves (GW) has opened a new window for cosmology. The cur- rent tension between the measurement of the Hubble constant H0 from Cosmic Microwave Back- ground 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, a neutron star merger, GW170817. In the cases where no counterpart is identified/expected such as Binary Black Hole (BBHs) events, it is possible to use a statistical approach, also known as the "dark siren" method, to produce individually weaker constraints. This method provides a less precise cosmological constraint on an event-to-event basis, due to the typically large number of galaxies over which one needs to marginalize. Current constraints suggest that from ˜20% to 80% of LIGO/Virgo/KAGRA BBHs are associated with Active Galactic Nuclei (AGN) disks. The claim for a possible association of the BBH merger GW190521 with a flare in the AGN J124942.3+344929, alongside to the several proposed models and mechanisms to make a viable EM counterpart from BBHs in accretion disks suggested this might be a promising endeavor. Therefore, we explore the possibility of Standard Sirens in association with AGN hosts and AGN flares, through a hybrid method between bright and dark sirens. We simulate GW events from future LIGO/Virgo/KAGRA runs and derive the expected constraints in H0, Ωm, and dark energy equation of state parameter w. Depending on the fraction of AGN hosts and BBHs capable of flare we might obtain H0 from ˜ 10% (pessimistic) to ˜ 3% (optimistic) level in the next few years. We also show that the method could be applied to all possible AGNs hosts not requiring a flare in the GW localization area to prospect the cosmological constraints.

Talk 5: Matilde Signorini

Building the high-redshiP Hubble Diagram with quasars

In recent years, quasars have shown to be standardizable candles, allowing us to extend the Hubble Diagram from the Supernovae Ia range (z ˜ 0-1.5) up to very high redshift (z ˜ 6), and therefore explore the expansion history of the Universe at previously uninvestigated epochs. This implementation has shown the presence of a strong tension (>4σ) with a standard flat ΛCDM model, and indications in favor of Interacting Dark Sector alternative models. In this talk, I will first discuss the reliability of quasars as standard candles, focusing on possible sources of biases and systematics and how we can address them to build a valid quasar sample for cosmology. I will then focus on the observed dispersion of the luminosities relation, describing its possible causes and if and how we can lower it to get more precise distance measurements. Finally, I will discuss the high-redshift tension with the standard flat ΛCDM model.

Talk 6: Radoslaw Wojtak

Intrinsic tension in the supernovae sector of the local Hubble constant measurement and its implications

I will start my talk with a brief critical review of cosmological proposals put forward as potential solutions to the Hubble constant tension. I will argue that the lack of decisive observational evidence supporting any of the current models should motivate our community to reassess the risk-to-gain ratio of this line of research and perhaps restore a balance between the efforts put in testing a wide range of possible testing systematic effects in the measurements of the Hubble constant and ad hoc modifications of the standard cosmological model. In the second part of my talk, I will discuss a new reanalysis of Cepheid and type Ia supernova data used in the local determination of the Hubble constant. I will show the evidence of a discrepancy between the colour correction of supernovae in the calibration sample and the Hubble flow. This discrepancy is currently an intrinsic tension in the local determination of the Hubble constant and a source of unaccounted systematic errors. I will show that applying supernova standardisation which accounts for this anomaly by resolving two different observationally and theoretically motivated supernova populations related to two progenitor channels and dust extinction in their environments, yields the Hubble constant which is consistent with the Planck value. The new standardisation method is based on a novel Bayesian hierarchical model of type Ia supernovae which explains completely the Hubble residuals arising from the standard method of supernova standardisation in terms of extinction and intrinsic properties of supernovae originating from two observationally motivated populations (fast/slow decliners correlated with old/young stellar populations). I will give a brief overview of this model, the current constraints and the perspectives of using it in cosmological analyses of type Ia supernovae.

Talk 7: Jenny Sorce

Minimizing systematics with CLONES (Constrained LOcal & Nesting Environment Simulations)

To understand dark matter and energy, large cosmological surveys are designed to reach a few percent precision. To be fully exploited, this large quantity of data needs to be analyzed in light of cosmological simulations. Preliminary analyses brought out tensions between the standard cosmological model and observations. Reaching a 1% precision, systematics of the same order of magnitude, due to our cosmic environment, our survey specificities and our tool properties, probably rise out. Analyses need to be fuelled with a new type of cosmological simulations designed to reproduce our cosmic environment. Such simulations, that I named CLONES (Constrained LOcal & Nesting Environment Simulations), could provide a robust methodological framework to minimize these systematic errors. I will introduce the CLONES giving a few study examples. CLONES are a promising tool to increase our capacity to evade biases in future survey analyses.

Day 2: Wednesday 31 May 2023

Talk 1: Pawel Bielewicz

Tomographic cross-correlation of the CMB lensing and galaxy clustering - systematic errors from cross-talk between redshiP bins of galaxies

The effect of gravitational lensing of the cosmic microwave background (CMB) provides a unique opportunity to obtain a picture of the gravitational potential of the large-scale structure of the Universe at very high redshifts. Tomographic cross-correlation of the gravitational potential with other tracers of the large-scale structure at known redshifts allows tracing the evolution of the structure and testing cosmological models. However, the analysis of upcoming data will require a very good understanding of any systematic errors that may bias cross-correlation measurements. In this talk we will present studies of systematic errors arising from cross-talk between redshift bins of galaxies with photometric redshift uncertainties. We show their impact on the cross-correlation measurement and cosmological parameter estimates for future data sets. We also present an efficient method for removing the errors.

Talk 2: William Giarè

Assessing the consistency of Cosmic Microwave Background observations to probe new physics

In this talk I will discuss about the global agreement between the most recent observations of the Cosmic Microwave Background temperature and polarization anisotropies. I will point out some emergent anomalies that cannot be fully understood within the standard ΛCDM model of cosmology, hinting at significant unaccounted-for systematics in the CMB data or at basic missed ingredients in the theory. Either way, I will show that these anomalies are responsible for a global "CMB tension" between independent experiments that persists also in extended background cosmologies and analyze the implications for new physics beyond ΛCDM.

Talk 3: Maria Giovanna Dainotti

Gamma-Ray Burst cosmology and future perspectives

Cosmological models and their corresponding parameters are widely debated because of the current discrepancy between the results of the Hubble constant, H0, obtained by SNe Ia, and the Planck data from the cosmic microwave background radiation. Thus, considering high redshift probes like gamma-ray bursts (GRBs) is a necessary step. However, using GRB correlations between their physical features to infer cosmological parameters is difficult because GRB luminosities span several orders of magnitude. In our work, we use a three-dimensional relation between the peak prompt luminosity, the rest-frame time at the end of the X-ray plateau, and its corresponding luminosity in X-rays: the

so-called 3D Dainotti fundamental plane relation. We correct this relation by considering the selection and evolutionary effects with a reliable statistical method, obtaining a lower central value for the intrinsic scatter, σint = 0.18 ± 0.07 (47.1 per cent) compared to previous results, when we adopt a particular set of GRBs with well-defined morphological features, called the platinum sample. We have used the GRB fundamental plane relation alone with both Gaussian and uniform priors on cosmological parameters and in combination with SNe Ia and BAO measurements to infer cosmological parameters like H0, the matter density in the universe (ΩM), and the dark energy parameter w for a wCDM model. Our results are consistent with the parameters given by the Lambda cold dark matter model but with the advantage of using cosmological probes detected up to z = 5, much larger than the one observed for the furthest SNe Ia. We also show how many GRBs we would need to have if we aim to achieve the precision of SNe Ia as reached by the Pantheon sample by introducing a new GRB fundamental plane in optical wavelength.

Talk 4: Leandros Perivolaropoulos

Hidden physics signals or systematics in the Pantheon+ and SH0ES SnIa samples

The standard analysis of the Pantheon+ and SH0ES SnIa samples assumes that the SnIa absolute magnitude M can be standardized to a single value. I will demonstrate that if this assumption is withdrawn and if a transition of M is allowed at some distance scale, from M_< at low distances to M_> at high distances then the quality of fit to the data improves significantly. In addition, the M_< best fit value obtained from Pantheon+ and SH0ES is fully consistent with the inverse distance ladder calibration of M based on the CMB sound horizon scale. The implications of this result for the Hubble tension will be discussed.

Talk 5: J. Alberto Vazquez

Reconstructing the Universe properties

In the absence of a fundamental and well-defined theory, several parameterizations of cosmological functions have been suggested to get insights of the general DE behaviour and hence to look for possible deviations from the cosmological constant. Even though these parametric forms usually provide a better fit to the data, they have the limitation of assuming an a priori functional form which may lead to some bias or misleading model-dependent results, regardless of the DE nature. In this talk, to avoid these possible issues, non-parametric and model-independent techniques are presented, i.e., Gaussian process and Artificial Neural Networks. They allow us to extract information directly from the data to detect features within cosmological functions, for instance a decrease in the dark energy density component at early times and a transition to the phantom divide-line in the EoS.

Talk 6: Denitsa Staicova

DE models with combined H0·rd from BAO and CMB dataset and friends

It has been theorized that Dynamical Dark Energy (DDE) could be a possible solution to the Hubble tension. To avoid the degeneracy between the Hubble parameter H0 and the sound horizon scale rd, we use their multiplication as one parameter c/(H0rd). To the BAO points we add the SNIa Pantehon dataset and GRB dataset and the points from the CMB priors. We use different DE parametrizations to constrain the cosmological parameters and we compare the results based on statistical measures. We compare the results with the ones obtained by marginalizing over the H0·rd by redefining the likelihood in a BAO and SNIa datasets.

Talk 7: Eoin O'Colgain

Is H0 a constant?

Using a combination of mathematics and data analysis, I will explain why evolution of the Lambda- CDM cosmological parameters with effective redshift is expected. I will review observations showing such trends and explain why they tilt the cosmological tensions debate away from systematics and towards missing physics.

Talk 8: Benjamin Giblin

Enhanced weak lensing cosmology with the lensing PDF

Weak lensing cosmology stands at a crossroads, with cosmological tensions between cosmic shear experiments and those from Planck's analysis of the CMB hinting at either undiscovered physics or unaccounted-for systematics. In response to this mystery, we present a new weak lensing statis- tic capable of vastly enhancing cosmological inference. The "lensing PDF" - or the distribution of projected structures in various density bins - directly probes non-Gaussianities in large-scale structure, extracting extra cosmological information beyond the reach of two-point statistics conventionally employed in this field. Using numerical simulations tailored to match upcoming data from LSST, I demonstrate that lensing PDFs outperform standard lensing probes by >90% in con- straining the matter energy density and amplitude of the matter power spectrum. This approach consequently presents a promising means to shed light on the observed cosmological discordance.

Talk 9: Javier De Cruz Pérez

Current data are consistent with flat spatial hypersurfaces in the LCDM but favor more lensing than the model predicts

We study the performance of three pairs of tilted ΛCDM cosmological models, two pairs allowing for non-flat spatial hypersurfaces with CMB temperature and polarization power spectrum data (P18) from Planck, P18 lensing (lensing), and non-CMB data (non-CMB). For the six models, we measure cosmological parameters and study whether or not pairs of the data sets are mutually consistent in these models. Half of these models allow the lensing consistency parameter AL to be an additional free parameter, while the other three have AL=1. In the tilted non-flat models with AL=1 we find differences between P18 data and non-CMB data cosmological parameter constraints. While both P18 data and non-CMB data separately favor a closed geometry when P18+non-CMB data are jointly analyzed the evidence in favor of non-flat hypersurfaces subsides. Differences between P18 data and non-CMB data cosmological constraints subside when AL is allowed to vary. From the most restrictive P18+lensing+non-CMB data combination we get almost model-independent constraints and find that the AL>1 option is preferred over the Ωk<0 one, with the AL parameter, for all models, being larger than unity by ∼ 2.5σ. According to the deviance information criterion, in the P18+lensing+non-CMB analysis, the varying AL option is on the verge of being strongly favored over the AL=1 one, which could indicate a problem for the standard tilted flat ΛCDM model.

Talk 10: Guillermo Franco Abellán

Probing Early Modification of Gravity with Planck, ACT and SPT

In this talk, I discuss a model of Early Modified Gravity (EMG), which has been recently proposed as a promising solution to the Hubble tension. The model considers a scalar field σ with a quadratic non-minimal coupling to gravity of the form F(σ) = M 2 + ξσ2 and an effective mass induced by a quartic potential V (σ) = λσ4/4. For ξ = 0, the model reduces to an example of the popular Early Dark Energy (EDE) models. I show the first constraints on EMG using CMB anisotropy data from ACT DR4, SPT-3G, and Planck. Surprisingly, this combination of data shows a 3σ preference of EMG over ΛCDM, even after including the full high-ℓ information from Planck (unlike what happens for EDE). I discuss the role played by the non-minimal coupling ξ and explain what features in CMB data are responsible for this preference.

Talk 11: Lindita Hamolli

Detection of the lensed quasars by the Nancy Grace Roman Space Telescope

Strong gravitational lensing is a powerful tool for mapping the distribution of dark matter and testing various cosmological parameters. One such parameter is the Hubble Constant, which can be determined by measuring the time delay between lensed images. Our study focuses on the detection of lensed quasars by forthcoming Nancy Grace Roman Space Telescope (Roman) survey. Based on the capability of the Roman telescope and the recent results for the Quasar Luminosity Function (QLF) in the infrared band of Spitzer Space Telescope imaging survey, we predict that the Roman telescope will observe about 1.8×107 quasars. Also, we develop Monte Carlo simulations using the mass-luminosity distribution function of galaxies and the redshift distributions of galaxies and quasars and find that one in 180 observed quasars will be lensed by foreground galaxies. Even though this survey is not primarily designed as a strong lensing detection experiment, it will still provide a large complementary catalogue to forthcoming lensing discovery projects.

Day 3: Thursday 1 June 2023

Talk 1: Adrià Gómez-Valent

Fast test to assess the impact of marginalization in Monte Carlo analyses and its application to cosmology

Monte Carlo (MC) algorithms are commonly employed to explore high-dimensional parameter spaces constrained by data. All the statistical information obtained in the output of these analyses is contained in the Markov chains, which one needs to process and interpret. The marginalization technique allows us to digest these chains and compute the posterior distributions for the parameter subsets of interest. In particular, it lets us draw confidence regions in two-dimensional planes, and get the constraints for the individual parameters. It is very well known, though, that the marginalized results can suffer from volume effects, which can introduce a non-negligible bias into our conclusions. The impact of these effects is barely studied in the literature. In this talk I first illustrate the problem through a very clear and simple example in two dimensions, and suggest the use of the profile distributions (PDs) as a complementary tool to detect marginalization biases directly from the MC chains. I apply this method to four cosmological models: the standard ΛCDM, early dark energy, coupled dark energy and the Brans-Dicke model with a cosmological constant. I discuss the impact of the volume effects on each model and the cosmological tensions, using the full Planck 2018 likelihood, the Pantheon compilation of supernovae of type Ia and data on baryon acoustic oscillations. This test is very efficient and can be easily applied to any MC study. It allows us to estimate the PDs at a derisory computational cost not only for the main cosmological parameters, but also for the nuisance and derived ones, and to assess the need to perform a more in-depth analysis with the exact computation of the PDs. This talk is based on Phys.Rev.D 106 (2022) 6, 063506 [arXiv:2203.16285].

Talk 2: Ozgur Akarsu

Resolving cosmological tensions with a sign-switching cosmological constant

In this talk, inspired by the recent conjecture originated from graduated dark energy (gDE) that the universe has transitioned from anti-de Sitter vacua to de Sitter vacua in the late universe, we will discuss the superior features of the ΛsCDM model, which extends the standard ΛCDM model by a cosmological constant (Λs) that switches sign at a certain redshift z , over the standard ΛCDM model in the light of observational data. We will first discuss that, when the consistency of ΛsCDM with the CMB data is ensured, H0 and MB values are inversely correlated with z and reach H0 73.4 km s−1 Mpc−1 and MB 19.25 mag for z = 1.6, in agreement with the SH0ES measurements, and H(z) exhibits an excellent fit to the Ly-α data. We will then show that the CMB alone is not able to well constrain z and thus discriminate between ΛsCDM and ΛCDM models, but the CMB+BAO data set favors the sign switch of Λs providing the constraint: z = 2.44 0.29. The further observational

analysis using more data sets reveals that ΛsCDM is significantly favored over ΛCDM, and it resolves various tensions that prevail within ΛCDM; for instance, the CMB+Pan data set with MB prior gives z† = 1.784+0.14 along with H0 ≈ 72.38+0.98 km s−1 Mpc−1 0.18 S8 = 0.785 ± 0.012, and MB = −19.290−0.029, all of which are consistent with their local measurements, and moreover that the present-day age of the universe, t0, becomes consistent with the one estimated from globular clusters, the physical baryon density value, ωb, better agrees with the BBN constraints on it and H(z) exhibits excellent fit to the Ly-α data. While using the CMB+Pan+Ly-α data set provides us with the similar constrains, inclusion of the low-redshift BAO data, i.e., using CMB+Pan+BAO data set, leads to some compromise in these improvements. We will close the talk with a discussion on some other observational aspects and theoretical implications of the ΛsCDM model. This talk is based on the works Graduated dark energy: Observational hints of a spontaneous sign switch in the cosmological constant (O. Akarsu, J.D. Barrow, L.A. Escamilla and J.A. Vazquez, Phys. Rev. D 101 (2020) 063528) and Graduated dark energy: Observational hints of a spontaneous sign switch in the cosmological constant (O. Akarsu, S. Kumar, E. Ozulker and J.A. Vazquez, Phys. Rev. D 104 (2021) 123512), Graduated dark energy: Observational hints of a spontaneous sign switch in the cosmological constant (O. Akarsu, S. Kumar, E. Ozulker, J.A. Vazquez, and A. Yadav, arXiv:2211.05742), and several ongoing works by an extended group of leading researchers in the field of cosmology.

Talk 3: Elsa Teixeira

Cosmological Tensions in a Coupled Dark Sector

Reconciling the standard model's theoretical predictions with precision measurements from multiple probes stands as one of the most pressing challenges of modern cosmology. During the last decade, increasing evidence for persistent discrepancies in the value of cosmological parameters when inferred from model-dependent and -independent probes opened the door for a new paradigm. In this talk, I will address whether (part of) the cosmological tensions can be attributed to missing physics in the standard model. In particular I will focus on tests of different models with interactions between dark energy and dark matter.

Talk 4: Tiberiu Harko

Cosmological implications of Weyl geometric gravity

We investigate the dark energy in the Weyl geometric gravity, which is based on the introduction of a Weyl connection to describe the gravitational properties of the space-time. We consider the case in which the Lagrangian is given by the sum of the square of the Weyl scalar, of the strength of the field associated to the Weyl vector, and a conformally invariant geometry-matter coupling term, constructed from the matter Lagrangian and the Weyl scalar. The action is linearized in the Ricci scalar by introducing an auxiliary scalar field. After substituting the Weyl scalar in terms of its Riemannian

counterpart, the quadratic Wedyl action is defined in Riemann geometry, and involves a nonminimal coupling between geometry and matter. The field equations are obtained by varying the action with respect to the metric, the scalar field, and the Weyl vector. The cosmological implications of the Weyl geometric gravity field equations are investigated for different forms of the Weyl vector-matter Lagrangian coupling functions. From the generalized Friedmann equations of the model, obtained by assuming that the background Riemannian metric is of the Friedmann- Lemaitre-Robertson-Walker type, an effective geometric dark energy component can be generated, with the effective, geometric type pressure. A comparison with the standard ΛCDM model is also performed, and we find that the Weyl geometric gravity type cosmological models can give an acceptable description of the cosmological observations.

Talk 5: Dario Bettoni

Charged Dark Matter and the H0 tension

Is it possible to have long range forces competing with gravity at large, astrophysical and cosmological scales? The unknown nature of the dark sector allows to speculate on this possibility. In this talk I will present a model in which a universally charged dark matter component has this property. This scenario comes equipped with a natural screening mechanism a là K-mouflage thus avoiding traditional constraints on this kind of forces. After introducing the model properties, I will focus on its phenomenology. In particular, I will show how an inhomogeneous cosmological model is dynamically generated and explore its connection with the Hubble tension and astrophysical bodies dynamics. Finally, I will briefly discuss how further constraints on the model can be cast by considering the linear response of charged objects under an external static field.

Talk 6: Nihan Katirci

Can the simplest generalizations of the null inertial mass density alleviate the H0 tension?

In this talk, we overview dark energy models with negative energy density values in the past can alleviate the H0 tension. We investigate whether two minimal extensions of the ΛCDM model, together or separately, can successfully realize such a scenario: (i) the spatial curvature, which, in the case of spatially closed universe, mimics a negative density source and (ii) graduated and simple- graduated dark energy, which promote the null inertial mass density of the usual vacuum energy to an arbitrary function/constant– if negative, the corresponding energy density decreases with redshift similar to the phantom models, but unlike them crosses below zero at a certain redshift. We find that, a spatially closed universe along with a simple-gDE of positive inertial mass density, which work in contrast to each other, results in minor improvement to the H0 tension. The joint dataset, BAO+SN+H+PLK presents no evidence for a deviation from spatial flatness but almost the same evidence for a cosmological constant and the simple-gDE with an inertial

mass density of order O(10^{-12}) eV^4. We will talk about further inertial mass density parameterizations such as linear/oscillatory generalizations in scale factor as well as redshift of the vacuum energy. We then will close the talk with the possibility of obtaining effective sources such varying inertial mass densities from modified theories/extensions of gravity as like the constant inertial mass density (Simple gDE) arises from barotropic perfect fluid via the energy-momentum squared gravity of the logarithmic form. This talk is based on the works: [1] Simple-graduated dark energy and spatial curvature, G. Acquaviva, Ö. Akarsu, N. Katirci, J. A. Vazquez, Phys. Rev.D 104 (2021) 2, 023505, 2104.02623 [astro-ph.CO]. [2] Screening Λ in a new modified gravity model, Ö. Akarsu, J. D. Barrow, C.V.R. Board, N.M. Uzun, J. A. Vazquez, Eur.Phys. J.C 79 (2019) 10, 846, 1903.11519 [gr-qc]. [3]Graduated dark energy: Observational hints of a spontaneous sign switch in the cosmological constant, Ö. Akarsu, J. D. Barrow, L.A. Escamilla, J. A. Vazquez, Phys.Rev.D 101 (2020) 6, 063528 1912.08751 [astro-ph.CO]. [4] Dynamical analysis of logarithmic energy-momentum squared gravity, G. Acquaviva, N. Katirci, 2203.01234 [gr-qc].

Talk 7: David Mota

Astrophysical Probes of Gravity beyond General Relativity

Extending General Relativity by adding extra degrees of freedom is a popular approach to explain the accelerated expansion of the universe and to build high energy completions of the theory of gravity. The presence of such new degrees of freedom is, however, tightly constrained from observations and experiments. The viability of a given modified theory of gravity therefore strongly depends on the existence of screening mechanisms that suppresses the extra degrees of freedom in certain scales and regimes. I describe how one can use nonlinear structure formation to probe extensions to General Relativity, and will present a set of astrophysical observables that could give smoking guns of screening mechanism.

Talk 8: Vitor Da Fonseca

Varying alpha through the dynamics of dark energy

We propose a cosmological model that predicts the variation of the fine structure constant a with redshift, where the electromagnetic sector couples to the kinetics of a canonical scalar field ϕ. This is a generalization of the usual linear dependence of the interaction term on ϕ. This theory can be seen as a disformal coupling with radiation, where the conformal factor depends on the kinetic term of the scalar source. We have studied the phenomenology of the model by particularizing the scalar field as the quintessence component driving the current acceleration. We found the remarkable feature that the evolution of a follows the Hubble flow, slowing down at late times during dark energy dominance. We have constrained the free parameters with measurements of BBN, Planck, quasar absorption spectra, atomic clocks, and tests of the weak equivalence principle.

Talk 9: Francesco Pace

The halo mass function in clustering dark energy models as a tool versus the sigma8 tension

When N-body simulations deal with dark energy, they consider its effect only at the background level, modifying the Hubble expansion. A notable exception is the K-evolution code which simulates k-essence models with a low sound-speed using the effective field theory approach at the non-linear level. It has been demonstrated that this leads to divergences. Hence, a few authors recently proposed to investigate this issue by developing a code which can simulate a dark energy fluid in a way analogous to what normally done with dark matter and baryons modifying the Euler equation taking into account pressure contributions. In this talk I will explore the effects of this additional term in the formalism of the spherical collapse model and show how the evolution of perturbations compare to the standard equations and how the halo mass function is modified. A modification in the evolution of perturbations, also taking into account dark energy perturbations, will lead to a different normalization of the matter power spectrum, sigma8. This quantity can be further constrained with observed measurements of the halo mass function and indicate whether the sigma8 tension is alleviated or enhanced.

Talk 10: Ignacio Sevilla

Galaxy clustering systematic effects in photometric surveys

Galaxy clustering is one of the pillars of current cosmological parameter constraints, in particular for understanding the properties of the late universe and how they relate to those predicted from early universe measurements, in combination with cosmic shear observations. In photometric surveys, spurious correlations may be introduced by the spatial distribution of observational conditions and astrophysical properties over the sky. We make a short overview of how this problem is tackled in the Dark Energy Survey, as well as in other projects of its kind.