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Institut Henri Poincaré

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SKA et l'énergie noire

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The Trouble with Hubble: signs of new physics?

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The value of the Hubble constant as measured using the classical distance ladder method is 4 to 6sigma higher than the value inferred from a ΛCDM fit to the cosmic microwave background (CMB). While the possibility that unaccounted for systematic effect are responsible for this discrepancy, none are currently universally accepted. Moreover, we now have several independent local probes of the Hubble constant (supernovae, strongly lensed quasars), such that none of the suggested systematics could simultaneously explain all measurements. Consequently, increasing attention is given to the possibility that this "Hubble tension"indicates new physics beyond ΛCDM. In this talk, I would like to review promising solutions to this tension. I will first argue that this discrepancy should be interpreted as a tension between our understanding of the early and late universe cosmology, rather than a tension between a few datasets. In particular, I will show that the Hubble tension is better understood when recast in terms of a tension between measurement of the "sound horizon" at recombination. I will then explain why data currently disfavor modifications of the universe dynamics at low-redshift over new physics in the pre-recombination era. Finally, I will entertain the idea that these observations might indicate that our Universe has undergone anomalous expansion due to the presence of an early dark energy (EDE) at redshift z ~ 3500. Such idea, if confirmed, could have far-reaching implications for our understanding of the current epoch of dark energy domination. While undetectable for Planck, I will show that future CMB experiment should be able to unambiguously tell us about the presence of the EDE.

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Le CDS et la cosmologie : outils et expertise

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MaunaKea Spectroscopic Explorer (MSE)

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Résultats du Hyper Suprime-Cam (HSC) Survey

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Le point sur la mission Euclid

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Résultats de ZTF et le projet ZTF2

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I will going to provide a summary of the first 1.5 years of ZTF and present the exiting science case of ZTF Phase 2

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Dark Energy and the Swampland

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Retours atelier Théories

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Nouvelles du Large Synoptic Survey Telescope

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Retour Voyage 2050 et perspectives

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Où en est DESI ?

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Résulats de DES

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La simulation RAMSES

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New quantum phase of the Universe before Inflation: Its today and Dark Energy implications

Auteur correspondant norma.sanchez@obspm.fr

The physical history of the Universe is completed by including the quantum planckian and superplanckian phase before Inflation in the Standard Model of the Universe in agreement with observations. In the absence of a complete quantum theory of gravity, we start from quantum physics and its foundational milestone: the universal classical-quantum (or wave-particle) duality, which we extend to gravity and the Planck domain. A new quantum precursor phase of the Universe appears beyond the Planck scale. Relevant cosmological examples as the Cosmic Microwave Background, Inflation and Dark Energy have their precursors in this era. A whole unifying picture for the Universe epochs and their quantum precursors emerges with the cosmological constant as the vacuum energy, entropy and temperature of the Universe, clarifying the so called cosmological constant problem which once more in its rich history needed to be revised. The consequences for the deep universe surveys, and DE missions will be outlined.

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Present and future constraints on general theories of Dark Energy after the GW observations

Auteur correspondant s.casas@protonmail.com

The Effective Field Theory of Dark Energy (EFToDE) is a powerful formalism that classifies and unifies theories of modified gravity according to their imprints on the cosmological background and structure formation and links these properties to specific operators in the action. It also contains the famous Horndeski theory as a subset. Despite the fact that the original functional parameter space is very large, due to the free functions involved, recent LSS and CMB observations and especially the GW+EM observation of GW170817, have managed to rule out large parts of the theory. Other corners of parameter space have been excluded due to stability and consistency considerations. In this talk I will review the present constraints on EFT theories based on CMB+LSS data and some future forecasts for Euclid, DESI and SKA, taking into account different parametrizations, which unsurprisingly change the results in a non-trivial way.

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retours atelier Outils

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Constraining neutrino masses with weak lensing peak counts for surveys like Euclid

Auteurs: Virginia Ajani[1]; Austin Peel[2]; Valeria Pettorino[3]; Jean-Luc Starck[4]; Zack Li[5]; Jia Liu[5]

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Massive neutrinos deeply affect the background evolution of the Universe as well as the evolution of cosmological perturbations and structures formation. Modified gravity models that include massive neutrinos can present a degeneracy with ΛCDM model. Hence, being able to constrain the value of the sum of neutrino masses constitutes one among the key science goals of nowadays cosmology. Weak gravitational lensing by the large-scale structure encodes the evolution of structure growth under the influence of massive neutrinos, representing a promising tool to explore these effects and extract the corresponding cosmological information. Future galaxy surveys as Euclid will use weak lensing as a cosmological probe to test different models and to improve our current knowledge on cosmological parameters. We use the weak lensing convergence maps from the public MassiveNus simulations suite to perform bayesian inference on cosmological parameters for a survey with Euclid-like noise, specifically deriving constraints on the sum of neutrino masses M_ν, the present matter-component density Ω_m and the primordial power spectrum normalization, A_s. We use the power spectrum as second order statistics and the peak counts as higher-order statistics to better appreciate the non gaussian information encoded at small-scales, where neutrinos have the strongest impact. We perform MCMC analysis, combining the two summary statistics and computing the predictions with Gaussian Processes interpolation. We explore the impact on the constraints of different filters techniques to smooth the noise in both single redshift and tomographic configurations for the statistics alone and combined.

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Résultats de KiDS

Auteurs: Nicolas Martinet[1]; Collaboration KiDS[None]

[1] *LAM/CNES*

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Le Kilo Degree Survey (KiDS) est l'un des trois grands relevés contemporains de cisaillement cosmique, avec DES et HSC. Je présenterai les premiers résultats cosmologiques de KiDS publiés en 2016/2017, puis l'évolution de notre compréhension de la tension observée entre ces contraintes cosmologiques et celles obtenues à partir du satellite Planck. Cela nous amènera à considérer différentes extensions au modèle cosmologique standard ainsi que plusieurs biais systématiques. Je discuterai également la complémentarité des trois relevés mentionnés, et en particulier la ré-analyse des données DES avec le pipeline KiDS. Dans cette présentation je me concentrerai sur l'estimateur classique du cisaillement cosmique, la fonction de corrélation à deux points du cisaillement gravitationnel, mais aborderai également d'autres estimateurs en développement.

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Big Data cosmology with Spark

Auteur: stephane plaszczynski[1]

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L'environement de travail Apache Spark est tres utilise dans
l'industrie pour organiser et analyser les grands volumes de donnees.
Je montrerai que cette "technologie Big Data" peut egalement etre
appliqueee en science sans trop de souffrances, en particulier en
astrophysique ou les volumes de donnees des prochains grands releves
de galaxies augmentent drastiquement.
A partir d'une simulation simple mais realiste de 10 ans de donnees du
telescope LSST, je montrerai les divers interets d'une telle approche
pour l'analyse interactive d'un releve de 6 milliards de galaxies.
Je developperai l'aspect utilisateur et montrerai par des
exemples simples et pratiques en python comment obtenir d'excellentes
performance sur un cluster de taille modeste.

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Résultats de ZTF et le projet ZTF2

Auteur: Mickael Rigault[1]

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I will going to provide a summary of the first 1.5 years of ZTF and present the exiting science case of ZTF Phase 2

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The Leavitt law of Milky May Cepheids from Gaia DR2 static companion parallaxes

Auteurs: Louise Breuval[1]; Pierre Kervella[1]

[1] *Observatoire de Paris, LESIA*

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Cepheids represent a fundamental tool for measuring the distances in the Universe thanks to the Leavitt law (period-luminosity) relation. In order to calibrate this relation accurately, precise distance measurements are required. The Gaia satellite monitors a large number of Galactic Cepheids, and will eventually provide extremely accurate parallaxes to hundreds of them. This will considerably improve the calibration of the Leavitt law, setting it on a solid basis of trigonometric distance measurements.

However, the second Gaia data release (DR2) shows that variable star parallaxes are subject to biases due to saturation (for the nearest stars) and to the large amplitude of their color variation. As a result, the calibration of the Leavitt law using the present DR2 Cepheid parallaxes is unreliable. In order to overcome this difficulty, we used the parallaxes of the detached companions of a sample of 23 Galactic Cepheids as a proxy for the parallaxes of the Cepheids themselves. Their Gaia parallaxes are unaffected by saturation and color related biases, since they are relatively faint and stable stars. Based on these parallaxes, we obtained a new calibration of the Galactic Leavitt law. Scaling the existing Hubble constant value determined by Riess et al. (2019), our new calibration implies a value of 68.4 +/- 2.1 km/s/Mpc for a Gaia parallax zero point of 0.029 mas. This value is close to the determination from the Planck satellite.

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Concordance and challenges of the Dirac-Milne cosmology

Auteurs: Gabriel Chardin[1]; Giovanni Manfredi[1]

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\documentclass[a4paper,oneside,12pt]{article}
\usepackage{geometry}
\geometry{top=25mm,bottom=25mm,left=25mm,right=25mm,nohead,nofoot,includeheadfoot}
\usepackage{graphicx}
\pagestyle{empty}
\begin{document}
{\Large \bf Concordance and challenges of the Dirac-Milne cosmology\par}
\vspace{0.5cm}
{\large \bf G. Chardin$^1$, G. Manfredi$^2$\par}
\vspace{0.2cm}
{\footnotesize\itshape
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2. Universit\'e de Strasbourg, CNRS, IPCMS UMR 7504, F-67000 Strasbourg, France.
\par}
\vspace{0.5cm}
\noindent
The Dirac-Milne cosmology [1] features a symmetric matter-antimatter universe,
which is the analog of the electron-hole system in a semiconductor, hence the reference to Dirac.
In this universe, matter and antimatter decouple gravitationally at $z \approx 10^5$,
avoiding annihilation at later epochs.
We recall the elements of concordance between our universe and the Dirac-Milne universe on the age,
SN1a luminosity distance, nucleosynthesis, Hubble constant z-dependence and,
very surprisingly, CMB angular scale.
We discuss the tensions on helium-3 production and BAO, as well as future tests of the
Dirac-Milne cosmology, notably in structure formation [2-4].
Finally, following Price, we provide arguments that the Dirac-Milne universe and
MOND (Modified Newtonian Dynamics) may be explained,
{\it within General Relativity}, by the vacuum polarisation as soon as negative
mass components exist (as virtual particles) in the vacuum.

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\textbf{References}\par
\footnotesize
\vspace{0.5cm}

[1] A. Benoit-L{\'e}vy and G. Chardin, A\&A {\bf 537}, A78 (2012).

[2] G. Chardin, G. Manfredi, Hyperfine Interactions, {\bf 239}: 45 (2018); arXiv:1807.11198

[3] G. Manfredi, J.-L. Rouet, B. Miller, G. Chardin, Phys. Rev. D {\bf 98}, 023514 (2018).

[4] G. Manfredi, J.-L. Rouet, B. Miller, G. Chardin, this conference.

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UCHUU - A new high-resolution cosmological N-body simulation

Auteur: Eric Jullo[1]

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In this talk, I will present a new high-resolution N-body simulation called Uchuu. It consists in a cosmological box size 2Gpc/h, and 12400^3 particles. The mass resolution is 2x10^8 Msun/h, and it has been produced with the latest Planck cosmological parameters. Rockstar halos catalogues, merger trees, lensing ligthcones up to z=7 and semi-analytical galaxies are being produced. The first Data Release is expected April, 2019. This simulation could be useful to prepare the Euclid deep field observations, or other high redshift surveys.

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Cosmology in the non-linear regime: the small scale miracle

Auteur: Fabien Lacasa[1]

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I will show how the non-Gaussianity induced by the non-linear growth of structure needs to be accounted for for the next-generation of galaxy surveys. I will present new non-Gaussian covariance terms and their numerical implementation for the galaxy angular power spectrum, showing that it is necessary to go beyond the previous state of the art already for a Euclid baseline cosmological analysis. This non-Gaussianity will prove critical to avoid unrealistically optimistic forecasts on Dark Energy constraints, but I will also show that it has positive consequences. Pushing the analysis to smaller scales, I will challenge the community's unconscious lore, by showing that information disappointingly plateaus at the beginning of the non-linear regime, but strikingly rises again in the deeper highly non-linear regime. I will carefully explain why this happens, due to the impact of non-linearity both on the observables and on covariances. I will conclude on how this motivates joint analysis of cosmology and astrophysics.

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La cartographie d'intensite (IM) a 21cm : un futur outil pour l'energie noire ?

Auteur: olivier perdereau[1]

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La cartographie d'intensite du rayonnement a 21cm de l'hydrogene neutre, a bas redshidt (z~1-3), pourrait permettre de reconstruire la distribution de la matiere a grande echelle et d'en extraire les proprietes statistiques. Idealement, on pourrait obtenir une tomographie de cette distribution sur un large intervalle de redshift et une large fraction du ciel. On presentera les defis, observationnels et theoriques, qui se presenteront sur cette voie. On abordera enfin quelques projets en cours (Chime, Tianlai, PAON4) et futurs (comme PUMA) pour explorer cette voie.

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FINK: enabling supernova cosmology in the era of LSST

Auteurs: Anais Moller[1]; Emille Ishida[2]; Julien Peloton[3]

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Next generation experiments will provide an unprecedented volume of data to constrain the nature of Dark Energy. LSST is expected to detect 10,000 transient candidates every 30 seconds, within these alerts LSST will discover supernovae that can be used in cosmology analyses. To fully harness the power of LSST, it is imperative to develop innovative methods able to deal with large data volumes as well as optimize the use of scarce spectroscopic resources. In this talk I will present Fink, an IN2P3 broker initiative being developed to face these challenges focusing on the data avalanche expected by the biggest survey of this upcoming decade, LSST. Fink has the potential to positively impact cosmology by (i) selecting large samples of SNe Ia without spectroscopy for population, systematic and Dark Energy studies and (ii) enabling efficient and traceable use of spectroscopic follow-up. Fink is designed to use state-of-the-art machine learning methods that allow, not only accurate classification, but also the construction of optimal training samples to improve these classifications.

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SDSS/eBOSS and 4MOST/Cosmology surveys

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SDSS/eBOSS and 4MOST/Cosmology surveys

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Recherche de trous noirs de masse intermédaire par effet de microlentille gravitationnelle

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Les microlentilles gravitationnelles permettent de contraindre l'abondance d'object compacts massifs. Les expériences passées (MACHO, EROS, MOA, OGLE) ont permis d'écarter des objets de masse inférieure à environ 10 masses solaires comme composante dominante de la matière noire. Cependant les détections récentes par LIGO/Virgo d'ondes gravitationnelles issues de coalescences de trous noirs de plusieurs dizaines de masses solaires ont relancé l'intérêt pour la recherche d'objets compacts. L'efficacité des expériences passées étant limitée par leur durée, regrouper ces bases de données permet d'obtenir de très longues courbes de lumière et donc une sensibilité étendue jusqu'à des lentilles de plusieurs centaines de masses solaires. Je présenterai plus en détail ces problématiques puis le travail en cours de combinaison des catalogues publics (MACHO et EROS).

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Cosmology with peculiar velocities

Auteur: Romain Graziani[1]

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The large scale structures (LSS) of our Universe result from the competition between expansion and gravitational interaction of matter. Hence, measuring the growth of LSS, through their peculiar velocities, is a key to probe both the expansion and gravity and precisely determine the nature of dark energy and validate General Relativity.
Peculiar velocity measurements rely on precise extragalactic distances estimation. Since peculiar velocities of galaxies are deviations from the Hubble expansion law, they have poor signal to noise ratio and are particularly sensible to usual systematic uncertainties such as calibration issues. Hence, the future of peculiar velocity analyses lies in Type Ia Supernovae observations from ZTF and, then, LSST campaigns, which will provide large distance datasets over the full sky and with known selection effects.
During this presentation I will present statistical methods used for peculiar velocity analysis so as forecasts for future surveys in which IN2P3 is involved.

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On the amplitude of matter fluctuation parameter ”discomfort”.

Auteur: ziad sakr[1]

Co-auteurs: Stéphane Ilic [2]; ALAIN BLANCHARD [3]

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Despite the remarkable success of LCDM model to fit almost all of the cosmological observations, a non negligible difference of the amplitude of matter fluctuation σ_8 still persists between local and deep universe probes. We review the status of this potential discrepancy with outcomes from the latest probes, then we show, in particular, the results from our investigation on trying to reconcile the difference found between constraints on σ_8 using cluster counts and that obtained from CMB temperature and polarization angular power spectrum. For that we show the impact of three common extensions to LCDM model, i.e. massive neutrinos, a change in the growth index or that in the equation of state parameter of dark energy on the confidence contours of the value of σ_8 obtained from the aforementioned probes. We conclude at the end on the ability or not of these extensions to alleviate the tension.

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CMB in (relative) tensions

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Kids

Auteur correspondant nicolas.martinet@lam.fr

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Statut d’Euclid

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Bilan de l’action Dark Energy