Colloque national CMB-France #6

Rapport sur les contributions

https://indico.in2p3.fr/e/34251

ID de Contribution: **1** Type: **Non spécifié**

The NIKA2 LPSZ Scaling Relation and cosmological implications

jeudi 19 décembre 2024 14:45 (20 minutes)

In Sunyaev-Zeldovich (SZ) cluster cosmology, accurately determining cluster masses is crucial for constraining cosmological parameters through cluster number counts.
As the mass is not an observable, a scaling relation is needed to link cluster masses to the integrated Compton parameter Y, i.e., the SZ observable, to exploit data from large millimeter surveys. Current cosmological results use a scaling relation obtained with clusters at low redshift ($z < 0.5$) observed in X-ray and in SZ at an angular resolution above 1 arcminute.
The SZ large program (LPSZ) of the NIKA2 collaboration is a sample of 25 clusters at intermediate to high redshift (from $z = 0.5$ to $z = 0.9$) observed at similarly high-angular resolution both in SZ and in X-ray. From these data, it will be possible to study various systematic effects that can affect the scaling relation.
Currently, all LPSZ clusters have been observed, and the analyses toward final results are underway. In this talk, I will present the LPSZ and the method to obtain a reliable estimation of the SZ-Mass scaling relation along with the expected effect on cosmological constraints.

Author: MOYER, Alice (LPSC (CNRS))

Orateur: MOYER, Alice (LPSC (CNRS))

Classification de Session: Ground-based observatories #2

ID de Contribution: **2** Type: **Non spécifié**

Non-Gaussian effects in CMB lensing maximum a posteriori methods

mercredi 18 décembre 2024 17:30 (20 minutes)

We will discuss non-Gaussian effects in CMB lensing maximum a posteriori methods (MAP) coming from the large-scale structure bispectrum and extragalactic foregrounds emission. We will show how MAP methods naturally mitigate biases that are relevant for standard CMB lensing estimators, both in auto and cross-correlation analyses. This will not be relevant only for CMB-S4, for which MAP methods are statistically optimal, but also for current surveys, such as the Simons Observatory (SO), and the South Pole Telescope (SPT).

Author: DARWISH, Omar (University of Geneva)

Orateur: DARWISH, Omar (University of Geneva)

Classification de Session: CMB analysis and results

ID de Contribution: **3** Type: **Non spécifié**

Setting requirements on out-of-band rejection for next-generation CMB experiments.

mercredi 18 décembre 2024 16:30 (20 minutes)

Next-generation CMB experiments have very stringent constraints to achieve the required sensitivity to target polarization B-modes. In this work, we intend to set constraints on out-of-band rejection level and derive requirements on the telescope filtering scheme. We follow a global approach, taking into account the impact on detector noise, on thermal balance and on thermal stability. This work was applied to the LiteBIRD instrument design but the methodology is very general and this is what I will present.

Author: MOUSSET, Louise (LPENS)

Co-auteur: MONTIER, Ludovic (IRAP)

Orateur: MOUSSET, Louise (LPENS)

Classification de Session: CMB analysis and results

ID de Contribution: **4** Type: **Non spécifié**

Characterizing the properties of the atmospheric emission in the 10-40 GHz range with QUIJOTE data

jeudi 19 décembre 2024 12:10 (20 minutes)

The QUIJOTE MFI instrument (2012-2018) observed the sky at four frequency bands, 11, 13, 17, and 19 GHz, at 1 degree angular resolution. For ground-based Cosmic Microwave Background experiments like QUIJOTE, the atmosphere is a major source of contamination in the data. Using the entire database of MFI wide-survey observations (2013-2018), we characterized the correlation properties of the atmospheric signal in those frequency bands. This analysis involved performing the cross-correlation function of time-ordered data (TOD) between the signals of QUIJOTE's horn measuring at the same frequency. We found that the atmosphere stays stable for a period of around 2 to 3 hours. Moreover, we investigated the cross-power spectrum of atmospheric signals at 17, 19, 30, and 40 GHz, and we characterized their scale dependence. This information will help improve the current sky models at these frequencies. It could also be used in further MFI reanalyses or to prepare future observations at these frequencies (e.g., the new QUIJOTE MFI2 instrument, or the Tenerife Microwave Spectrometer).

Author: CHAPPARD, Apolline (Ias)

Orateur: CHAPPARD, Apolline (Ias)

Classification de Session: Ground-based observatories #1

ID de Contribution: **5** Type: **Non spécifié**

Optimal lensing estimators for future CMB surveys

mercredi 18 décembre 2024 17:50 (20 minutes)

Gravitational lensing of the Cosmic Microwave Background (CMB) will soon be reconstructed with unprecedented precision, driven by deep polarisation maps from upcoming experiments like SPT-3G, the Simons Observatory, and CMB-S4. Reconstructing and subtracting the lensed B modes of polarisation is crucial to uncover the primordial B modes from inflation. In this talk, I will introduce an optimal estimator for the CMB lensing mass map, demonstrating how it surpasses the widely-used quadratic estimator in accuracy and robustness. This optimal estimator is designed to be resilient against modelling assumptions, contamination from unknown anisotropic signals, instrumental noise and non-Gaussianities in the lensing mass distribution. This novel estimator will be crucial for maximising cosmological constraints, particularly for tightening bounds on neutrino masses and on the tensor-to-scalar ratio.

Author: LEGRAND, Louis (DAMTP, University of Cambridge)

Orateur: LEGRAND, Louis (DAMTP, University of Cambridge)

Classification de Session: CMB analysis and results

ID de Contribution: **6** Type: **Non spécifié**

Simons Observatory status and early data from the Small Aperture Telescopes

jeudi 19 décembre 2024 09:00 (20 minutes)

The Simons Observatory is an ensemble of telescopes being progressively deployed on Cerro Toco (Chile), aiming at measuring both small and large angular scales of the cosmic microwave background. Three Small Aperture Telescopes have been successfully installed on site and started operating from late 2023. These half-meter mirrors telescopes are designed to measure the large-scale polarization signal from ~10% of the sky in multiple frequency bands. This measurement will ultimately be used to look for imprints of the propagation of primordial gravitational waves in the early-universe : primordial B-modes. The observatory will be further improved with contributions from the international collaborators, providing additional SATs for improved sensitivity and frequency coverage. In this talk, I will present an overview of the current status of the experiment, with a particular focus on the SATs, and the strategies we will deploy to analyze its data.

Author: LA POSTA, Adrien (Oxford University)

Orateur: LA POSTA, Adrien (Oxford University)

Classification de Session: Ground-based observatories #1

ID de Contribution: **7** Type: **Non spécifié**

Extensions and first applications of the minimally informed component separation approach, MICMAC and MICS

jeudi 19 décembre 2024 11:10 (20 minutes)

Component separation is the crucial and challenging analysis step to estimate the CMB signal in the presence of astrophysical contaminants.
The Galactic dust and synchrotron are the primary millimeter emissions to remove in the search for primordial CMB B-modes.
One major unknown is the full complexity of the polarized astrophysical foreground spectral properties, which is yet to be assessed by the current and future generations of CMB experiments.
In this context, the novel non-parametric component separation approach proposed by Leloup et al. (2023) allows us to consider the foreground cleaning problem with minor assumptions on the foreground spectral properties.
This novel method has been extended within a pixel-based approach implemented in the open-source JAX package MICMAC (Minimally Informed CMB MAp Constructor) as described in Morshed et al. (2024).
I will present the method, its implementation, and its first applications, along with preliminary results towards the use of this formalism within the MICS forecasting tool (Leloup et al. – in prep.).

Author: MORSHED, Magdy (INFN Ferrara)

Orateur: MORSHED, Magdy (INFN Ferrara)

Classification de Session: Ground-based observatories #1

ID de Contribution: **8** Type: **Non spécifié**

Advancing polarimetry for CMB research: LEKIDs polarization tests and COSMOCal calibration insights

jeudi 19 décembre 2024 11:50 (20 minutes)

The ambitious quest to detect the faint B-modes of CMB polarization, pursued by projects like the Simons Observatory (SO) and LiteBIRD, requires rigorous control over systematic effects in polarimetry. The PolarKID project, supported by CNES (2023–2025), is dedicated to testing LEKIDs in a filled array configuration to demonstrate their capability for precise polarization detection. This setup has been used to qualify LEKID in the context of the proposed French SAT for SO (KAIROS project), and also to perform a first characterization of the millimeter source in the context of the COSMOCal project. I will present detailed results on the polarisation angle reconstruction with LEKIDs together with preliminary results of the first COSMOCal qualification measurements in Grenoble and the first campaign at the IRAM 30-meter telescope. During this latter campaign, we successfully tested the first calibrator-telescope interface for large ground-based telescopes. These initial findings highlight COSMOCal's potential to enhance calibration accuracy, supporting the reliability of measurements essential for upcoming CMB research.

Author: SAVORGNANO, Sofia (LPSC Grenoble)

Orateur: SAVORGNANO, Sofia (LPSC Grenoble)

Classification de Session: Ground-based observatories #1

ID de Contribution: **9** Type: **Non spécifié**

Resurrecting Gravitational Vector Modes and their Magnetogenesis

jeudi 19 décembre 2024 14:25 (20 minutes)

The detection of primordial tensor modes, i.e. gravitational waves, through primordial CMB B-modes is considered the smoking gun signal for inflation. However, in order to solidify this conclusion, we need to insure that other primordial mechanisms do not produce the same signal. To that end, primordial gravitational vector modes (V-modes) and their sourcing of primordial magnetic fields (PMF), i.e. magnetogenesis, is revisited in this talk. As the adiabatic V-mode generically decays with expansion, we consider three exotic initial conditions, involving both the neutrino and dark sectors, which circumvent this issue and lead to observational imprints. The best fitting parameters in these three cases to CMB and BAO data are found, and their resulting B-mode spectra are compared to data from BICEP/Keck and SPTpol. The outcome is that none of the proposed initial conditions can produce large enough PMFs to seed every type of magnetic fields observed. However, the resultant V-modes are still consistent with the data and ought to be constrained for a better understanding of the primordial Universe before its hot big-bang phase.

Author: KHALIFE, Ali Rida (IAP-CNRS and Sorbonne University)

Orateur: KHALIFE, Ali Rida (IAP-CNRS and Sorbonne University)

Classification de Session: Ground-based observatories #2

ID de Contribution: **10** Type: **Non spécifié**

Towards constraining cosmological parameters from SPT-3G observations of 25% of the sky

jeudi 19 décembre 2024 14:05 (20 minutes)

The South Pole Telescope (SPT) observes the CMB with its 10m primary mirror from the South Pole and its third generation camera SPT-3G started collecting data in 2018. The Wide field is one of the three regions observed by SPT-3G and extends the survey area to cover 25% of the sky in total. This field is divided in nine subfields spread in the south hemisphere around the galactic plane with a declination ranging from -20deg to -80deg. These features represent new challenges to be taken into account in the analysis. In this talk, I will discuss the analysis strategy of this field. I will show the tests we performed to ensure that the loss of information due to analyzing the subfields independently is negligible on cosmological parameters. I will also present how the Wide field complements the two other fields observed by SPT and how it allows to test models beyond LCDM, namely those proposed to solve the Hubble tension.

Author: VITRIER, Aline (IAP)

Orateur: VITRIER, Aline (IAP)

Classification de Session: Ground-based observatories #2

ID de Contribution: **11** Type: **Non spécifié**

A high frequency SAT for SO: the Kairos Project

jeudi 19 décembre 2024 09:20 (20 minutes)

Over the past year, the proposal to build a high-frequency Small Aperture Telescope (SAT) to add to the Simons observatory has gradually become more and more consolidated. This project named Kairos is currently submitted for funding to the RI2 CNRS program (Recherche à risque et à impact) and has obtained the support of three institutes (IN2P3, INSU and INP). We propose to deploy a focal plane of about 30k LEKID detectors to observe the sky in two bands centered at 280 GHz and 340 GHz taking care of all the different sub-systems within the french collaboration. Adding a high frequency SAT to the pre-existing SATs will allow us to answer the outstanding question of mapping the polarized emission of interstellar dust with great sensitivity giving to the whole project a more precise measurement of the contamination of galactic dust emissions which currently constitutes one of the most limiting factors for CMB B-mode observations. We will present from a general point of view the instrumental configuration we propose to implement.

Author: CATALANO, Andrea (LPSC - Grenoble)

Orateur: CATALANO, Andrea (LPSC - Grenoble)

Classification de Session: Ground-based observatories #1

ID de Contribution: **12** Type: **Non spécifié**

Cosmology with Rayleigh scattering of the CMB

jeudi 19 décembre 2024 10:00 (20 minutes)

Rayleigh scattering of the Cosmic Microwave Background (CMB) is a less studied yet potentially powerful probe of the recombination history. Scattering of CMB photons off neutral species right after recombination presents a distinctive ν^4 scaling with frequency as well as a strong correlation with the primary CMB. These unique features should facilitate its detection by the next generation of CMB experiments. We will present detectability forecasts combining the Simons Observatory and CCAT experiments, two ground based observatories currently under construction, as well as more futuristic space missions. We will present potential cosmological implications of the detection of this signal. Finally, we will assess the impact of foreground contamination and instrumental systematics on the detectability of the Rayleigh scattering signal.

Author: BERINGUE, Benjamin (APC, CNRS)

Orateur: BERINGUE, Benjamin (APC, CNRS)

Classification de Session: Ground-based observatories #1

ID de Contribution: **13** Type: **Non spécifié**

Mapping the hot baryonic gas across the entire sky with LiteBIRD

mercredi 18 décembre 2024 10:30 (20 minutes)

This talk will highlight the LiteBIRD space mission's capability to map the thermal Sunyaev-Zeldovich (SZ) effect, arising from the scattering of CMB photons by hot baryonic gas within and around galaxy clusters. Although primarily designed to search for large-scale CMB B-mode polarization, LiteBIRD will deliver full-sky maps in total intensity with unprecedented sensitivity across 15 frequency bands ranging from 40 to 402 GHz, thus offering an extensive dataset for detailed extraction and mapping of the thermal SZ effect. Despite its lower angular resolution, LiteBIRD outperforms ESA's Planck mission in both sensitivity and frequency coverage, allowing for the reconstruction of a new all-sky map of the thermal SZ Compton y-parameter ("y-map") with significantly reduced foreground contamination at large and intermediate angular scales compared to Planck. Moreover, combining LiteBIRD and Planck datasets into the component separation pipeline enables to produce an optimized y-map that leverages both LiteBIRD's sensitivity and Planck's angular resolution, improving cosmological constraints on sigma8 by 15% compared to the Planck y-map alone. The talk will also discuss the cosmological potential unlocked by a clean, all-sky map of diffuse thermal SZ emission from LiteBIRD.

Author: Dr REMAZEILLES, Mathieu (IFCA, CSIC-UC)

Co-auteur: LITEBIRD COLLABORATION, et al., for the

Orateur: Dr REMAZEILLES, Mathieu (IFCA, CSIC-UC)

Classification de Session: Space missions and balloons

ID de Contribution: **14** Type: **Non spécifié**

A flexible parameterization to test early physics solutions to the Hubble tension with future CMB data

mercredi 18 décembre 2024 18:10 (20 minutes)

The discrepancy between local measurements of the Hubble constant and inferences from CMB and galaxy clustering data, known as the "Hubble tension", has motivated numerous models introducing additional components active before recombination. While many such models have been proposed, none are currently strongly favoured by data. This highlights the critical role of upcoming CMB experiments, which aim to achieve higher precision in measuring small-scale acoustic peaks and polarization signals, in detecting or constraining deviations from ΛCDM.
We present a phenomenological parameterization based on the generalized dark matter framework and specifically tailored for Simons Observatory. We show that this model is able to reproduce a wide range of theoretical models and forecast how well Simons Observatory will be able to constrain it.
When applied to Planck data, we find good consistency with the ΛCDM model, but the data also allows for a large Hubble parameter, especially if the sound speed of the additional component is not too different to that of radiation. This approach offers a flexible and general framework to interpret data from upcoming CMB experiments, providing valuable insights into potential resolutions of the Hubble tension.

Author: KOU, Raphaël (University of Sussex)

Co-auteur: Prof. LEWIS, Antony (University of Sussex)

Orateur: KOU, Raphaël (University of Sussex)

Classification de Session: CMB analysis and results

ID de Contribution: **15** Type: **Non spécifié**

Characterisation of Cosmic Ray interactions with new detectors for future CMB projects

mercredi 18 décembre 2024 11:30 (20 minutes)

Not long after the Planck space mission launch, it appeared that signals from the detectors operated at 100 mK of one of its instruments, HFI, were affected by cosmic rays. The heat dissipation in the detectors due to these particles hits created spurious signals appearing as glitches in the data. Further post-launch studies have allowed for most of these glitches to be removed.
Several space missions and balloon-borne instruments making use of highly sensitive 100 - 50 mK detectors are being planned. In order to avoid similar problems, prototype detectors need to be tested before for particle hits susceptibility, so that their design could be adapted for better immunity if needed, and the future data analysis can be planned for.
A large cryogenic facility has been developed for this purpose, allowing to irradiate cryogenic detectors and part of focal planes with particles such as protons of various energies with either an internal radioactive source or by coupling it to a particle accelerator. Our facility DRACuLA (Detector irRAdiation Cryogenic faciLity for Astrophysics) has been operated in front of the ALTO particle accelerator for a first test run in September 2022. A new test campaign has happened in may 2024 to study such effects by irradiating particles with different energy levels on transition-edge sensors (TES) prototypes.
We present this facility together with preliminary experimental results of the detector tests.

Author: BESNARD, Anaïs (Institut d'Astrophysique Spatiale (IAS))

Co-auteurs: MAFFEI, Bruno (IAS); SAUVAGE, Valentin; Dr STEVER, Samantha L. (IAS)

Orateur: BESNARD, Anaïs (Institut d'Astrophysique Spatiale (IAS))

Classification de Session: Space missions and balloons

ID de Contribution: **16** Type: **Non spécifié**

Parametric component separation on filtered maps in Simons Observatory.

jeudi 19 décembre 2024 09:40 (20 minutes)

One of the main scientific goals of the Simons Observatory (SO) Small Aperture Telescopes (SATs) is to measure traces of inflation in the primordial B-modes in the CMB polarization. This signal is expected to be extremely faint. Its detection therefore depends on the removal of contaminating signals emitted by Galactic foregrounds and an exquisite control of systematic effects, such as the impact that filtering spurious signals out of the data has on the reconstructed maps.
I will present the parametric map-based method that we are developing as one of the pipelines for foreground cleaning in the SATs. This approach allows us to handle complex foregrounds, inhomogeneous noise, and has been used in previous SO forecasts (Wolz et al. 2024). To manage the filtering, we are adapting it by using an observation matrix-based technique (Ade et al. 2016), which is directly incorporated into the foreground cleaning. For a survey as large as SO and observing from Chile, this matrix will be large and complex. This method has never been used under such conditions, necessitating the development of new algorithms to handle it.

Author: JOST, Baptiste (IPMU)

Orateur: JOST, Baptiste (IPMU)

Classification de Session: Ground-based observatories #1

ID de Contribution: **17** Type: **Non spécifié**

Searching for Cosmological Collider in the Planck CMB Data

mercredi 18 décembre 2024 16:50 (20 minutes)

New heavy particles during inflation can leave imprints in the primordial perturbations and subsequently in the observed CMB anisotropies. This remarkable detection channel allows us to probe new physics at extremely high energies. I present our recent work on the first extensive search for cosmological collider signals with the CMB data. We utilise the publicly available CMB bispectrum estimator code CMB-BEST to study various analytic templates guided by the cosmological bootstrap, providing the most stringent constraints to cosmological collider signals to date.

Author: SOHN, Wuhyun (APC / CNRS)

Orateur: SOHN, Wuhyun (APC / CNRS)

Classification de Session: CMB analysis and results

ID de Contribution: **18** Type: **Non spécifié**

FURAX: a modular JAX toolbox for solving inverse problems in science

jeudi 19 décembre 2024 10:20 (20 minutes)

The quest for primordial B-mode polarisation in the cosmic microwave background poses significant analysis challenges. Because the signal is so faint, robust measurements (or constraints) require a particular attention to systematic effects, astrophysical foregrounds, as well as the interplay between the two. This task is made even more difficult by the volume and complexity of the datasets collected by modern observatories. We present FURAX (Framework for Unified and Robust data Analysis with JAX), an open-source Python library designed to address these challenges by providing flexible tools for data modeling, while benefitting from cutting-edge optimisation and GPU utilisation from the JAX library. Examples include map-making, component separation, gap-filling of time-ordered series, and incorporation and non-ideal instrumental components.

Author: BIQUARD, Simon (APC / CNRS)

Orateur: BIQUARD, Simon (APC / CNRS)

Classification de Session: Ground-based observatories #1

ID de Contribution: **19** Type: **Non spécifié**

Absolute Reference for Microwave Polarization Experiments. The COSMOCal Project.

jeudi 19 décembre 2024 11:30 (20 minutes)

In the context of future experiments measuring the polarization of the Cosmic Microwave Background (CMB), COSMOCal proposes a method independent of laboratory calibration of CMB instruments and cosmological model assumptions to calibrate next-generation millimeter-wave telescopes. The primary objective is to achieve polarization angle calibration with a precision better than 0.1 degrees. This absolute calibration, required for accurate measurements of CMB B-modes according to leading inflationary models, may also enable an unbiased detection of Cosmic Birefringence by disentangling instrumental effects from the physical process naturally converting E-modes into B-modes.

The key challenge is to distinguish between E and B modes in the CMB and the Galactic foreground emissions, requiring precise control over E-to-B leakage. COSMOCal's ambition extends beyond absolute angle calibration: deploying an artificial, well-characterized calibration source in the sky enables the study and mitigation of instrumental systematics in ground-based telescopes, including beam distortions and polarization efficiency.

The selected telescopes for this project are so far the IRAM 30m telescope, the Sardinia Radio Telescope (SRT), and the Simons Observatory LAT. Once these telescopes are accurately calibrated, they will observe astrophysical sources to create a catalog of standard candles for other telescopes operating in the same frequency range, both terrestrial and space-based. This will allow the cross-calibration of different data sets. The COSMOCal prototype was successfully tested at the IRAM 30m telescope in October 2024.

This presentation will provide an overview of the COSMOCal project, detailing its goals and outlining the future development roadmap.

Authors: Dr RITACCO, Alessia (CNRS-LPSC); COLLBORATION, on behalf of the COSMOCal

Orateur: Dr RITACCO, Alessia (CNRS-LPSC)

Classification de Session: Ground-based observatories #1

ID de Contribution: **20** Type: **Non spécifié**

Implementation of HWP Intensity to Polarization Leakage in LiteBIRD simulation framework

mercredi 18 décembre 2024 10:50 (20 minutes)

Future satellite missions focusing on the tensor-to-scalar ratio r will likely include a rotating half-wave plate (HWP) device in order to precisely recover the B-mode polarization signal. Patanchon [2023] modeled the effect of HWP systematic imperfections leading to Intensity to Polarization (IP) leakage on the measurement of the B-mode signal. This model is now implemented in the LiteBIRD Simulation Framework (LBS), a comprehensive simulation framework developed for the data acquisition from the LiteBIRD spacecraft.

Authors: HIVON, Eric (Institut d'Astrophysique de Paris); GOMES, Miguel (Institut d'Astrophysique de Paris)

Orateur: GOMES, Miguel (Institut d'Astrophysique de Paris)

Classification de Session: Space missions and balloons

ID de Contribution: **21** Type: **Non spécifié**

Developing a Closed-Cycle Dilution Refrigerator for future CMB space missions

mercredi 18 décembre 2024 12:10 (20 minutes)

Experimental cosmology is always in needs of innovative more performant technology for longer and more sensitive observations. Cooling systems can be a limitation in term of the mission lifetime and temperature stability of the sub-K detection chains. A Closed-Cycle Dilution Refrigerator (CCDR), providing continuous cooling at ultra-low temperatures (100 mK) using helium isotopes 3He and 4He, designed for space applications, and therefore future Cosmic Microwave Background (CMB) projetcs, is being developped. Unlike its Open-Cycle counterpart (OCDR) used in missions like Planck-HFI, the CCDR operates without depleting helium supplies, enabling indefinite mission durations. The cooling power is generated by separating the helium mixture into 3He and 4He, re-circulating them through the system. Compared to OCDR, CCDR delivers greater cooling power (>2 μW vs. <0.2 μW) and longer observation periods (>3 years vs. <2.5 years) with consistent temperature stability (20 nK·Hz -0.5). The CCDR is being developed for microgravity environments. Within the system, a porous sponge separates liquid and gas phases in the "still." A circulator pumps the gaseous 3He, while a fountain pump extracts superfluid 4He, ensuring perpetual cooling. Laboratory tests confirm its feasibility, achieving Technology Readiness Level (TRL) 4. Transitioning to TRL 5 for space missions requires further validation through an Engineering Model (EM). This presentation will emphasize the CCDR design and provide an update on the progress and developments undertaken by our team.

Author: SAUVAGE, Valentin

Co-auteurs: BESNARD, Anaïs (Institut d'Astrophysique Spatiale (IAS)); MAFFEI, Bruno (IAS)

Orateur: SAUVAGE, Valentin

Classification de Session: Space missions and balloons

ID de Contribution: **22** Type: **Non spécifié**

A consistent, physical, and analytic model for CMB observables of reionisation

jeudi 19 décembre 2024 16:15 (20 minutes)

The Epoch of Reionisation imprints its history and morphology on the Cosmic Microwave Background temperature and polarisation anisotropies through two effects: The kinetic Sunyaev Zel'dovich (kSZ) effect and Thomson scattering. I present an analytical approach to derive consistently the angular power spectra of the three main resulting imprints that are the spatial fluctuations of the Thomson optical depth, the patchy kSZ effect, and the scattering and screening B-modes, as well as their cross-spectra. The approach differs from existing (unphysical) models, as it is calibrated on high-resolution hydrodynamical simulations. I will show how each observable constrains different parameters describing the reionisation history or morphology (in the limit of their detectability), to illustrate the potential of their joint analysis to get a global picture of reionisation. This analytical but physical model will be a powerful tool in the analysis of upcoming CMB data, either alone or in combination with independent datasets such as measurements of the high-redshift 21cm power spectrum.

Author: GORCE, Adélie (IAS, Université Paris-Saclay)

Orateur: GORCE, Adélie (IAS, Université Paris-Saclay)

Classification de Session: Ground-based observatories #2

ID de Contribution: **23** Type: **Non spécifié**

LiteBIRD status

mercredi 18 décembre 2024 10:00 (30 minutes)

I will present the status of the LiteBIRD JAXA mission, after it entered in reformation period since September 2025.

Author: MONTIER, Ludovic (IRAP)

Orateur: MONTIER, Ludovic (IRAP)

Classification de Session: Space missions and balloons

ID de Contribution: **24** Type: **Non spécifié**

Improved kSZ modelling with the LoReLi simulations

jeudi 19 décembre 2024 16:35 (20 minutes)

Historically disregarded as a foreground contaminant, the kinetic Sunyaev-Zel'dovich (kSZ) effect has seen a surge of interest in recent years as an additional cosmological probe. Arising from interactions between CMB photons and free electrons in ionised bubbles, the kSZ signal contains information about the timeline and morphology of Reionisation, a critical, yet poorly understood, period during which the universe transitioned from neutral to ionised. Because the kSZ field is sourced by highly non-linear physics it can be difficult to model, however its two-point correlation function can be related to that of the free electron overdensity field, or more simply the electron power spectrum. We present early results for characterising the electron power spectrum, and thus the kSZ spectrum, as a function of five astrophysical parameters using the LoReLi database, a set of ~10,000 three-dimensional radiative hydrodynamical simulations originally developed to model the 21cm field.

Authors: MC BRIDE, Elizabeth (Institut d'Astrophysique Spatiale); DOUSPIS, Marian (IAS); GORCE, Adélie (IAS, Université Paris-Saclay)

Orateurs: MC BRIDE, Elizabeth (Institut d'Astrophysique Spatiale); GORCE, Adélie (IAS, Université Paris-Saclay)

Classification de Session: Ground-based observatories #2

ID de Contribution: **25** Type: **Non spécifié**

Latest/last constraints on the Epoch of Reionization from Planck

mercredi 18 décembre 2024 17:10 (20 minutes)

The cosmic microwave background provides a crucial window into the early universe's evolution, offering insights into the epoch of reionization (EoR). In this talk, I will present new constraints on the reionization history derived from the final Planck data release (Public Data Release 4, PR4). Leveraging the enhanced sensitivity and reduced systematic uncertainties of the PR4 data, we explore a comprehensive suite of reionization models to reconstruct the EoR with greater precision. By meticulously accounting for the implicit priors associated with each model, we aim to minimize biases in our inference of the reionization history. Our findings provide tighter constraints on the timing and duration of reionization, offering deeper insights into the sources and processes that governed this transformative epoch.

Author: ILIC, Stéphane (IJCLab)

Orateur: ILIC, Stéphane (IJCLab)

Classification de Session: CMB analysis and results

ID de Contribution: **26** Type: **Non spécifié**

Detection of distant galaxy clusters with the NIKA2 camera via the SZ effect

jeudi 19 décembre 2024 15:05 (20 minutes)

Clusters of galaxies, formed at the latest stages of structure formation, constitute unique cosmological probes and are sensitive to cosmological parameters related to structure formation like the rms of matter fluctuations. With the advent of large CMB surveys like those from the Planck satellite, the ACT and SPT telescopes, we now have access to large catalogs of galaxy clusters detected at millimeter wavelength via the thermal Sunyaev-Zeldovich (tSZ) effect. However, they do not offer the high angular resolution needed to resolve and/or detect the lowest mass, high redshift clusters. This can be achieved by using millimeter cameras operated in large millimeter telescopes, like the NIKA2 camera installed in the IRAM 30–m telescope in Pico Veleta, Spain. Combining a 6.5 arcmin diameter field of view and sub-arcminute (17.6”at 150 GHz) angular resolution, NIKA2 is capable of resolving the SZ effect towards clusters up to high redshifts.

In this talk, I will highlight NIKA2’s capabilities for SZ clusters studies. I will focus on the blind detection of galaxy clusters in the COSMOS field using the NIKA2 Cosmological Legacy Survey (N2CLS) Large Program observations. I will describe the candidate cluster sample we have obtained, and discuss its properties.
I will demonstrate that NIKA2 and the IRAM 30–m telescope are sensitive to the lowest mass clusters at intermediate and high redshift.

Authors: CHEROUVRIER, Damien (LPSC, Grenoble); MACIAS-PEREZ, Juan Francisco (LPSC)

Orateurs: CHEROUVRIER, Damien (LPSC, Grenoble); MACIAS-PEREZ, Juan Francisco (LPSC)

Classification de Session: Ground-based observatories #2

ID de Contribution: **27** Type: **Non spécifié**

SPT-3G: Results and updates

jeudi 19 décembre 2024 13:45 (20 minutes)

SPT-3G, the third-generation camera on the South Pole Telescope, observes cosmic microwave background (CMB) anisotropies with arcminute resolution and 4.5muKarcmin coadded noise in temperature. Recent analyses of polarization data from the 2019 and 2020 seasons have yielded the most precise reconstruction of the E-mode spectrum above ell = 2000 and the CMB lensing spectrum above L = 350. From these measurements, we constrained ΛCDM cosmological parameters, finding results consistent with Planck while indicating a 5.4 sigma tension with distance ladder estimates of H0. We also observe a slight tension in S8 with low-redshift probes. Ongoing efforts toward forthcoming SPT-3G analyses, which feature the temperature of the main field and wider observations in both temperature and polarization, will further enhance the constraining power on cosmological parameters, providing robust, independent tests of the ΛCDM model and exploring potential hints of physics beyond the standard model. For the main field particularly a detailed analysis will be published in a forthcoming study.

Author: CAMPHUIS, Etienne (Institut d'Astrophysique de Paris)

Orateur: CAMPHUIS, Etienne (Institut d'Astrophysique de Paris)

Classification de Session: Ground-based observatories #2

ID de Contribution: **28** Type: **Non spécifié**

r forecasts for the Probe of Inflation and Cosmic Origins (PICO) with realistic noise

mercredi 18 décembre 2024 11:10 (20 minutes)

PICO is a space mission concept submitted by NASA to the Astro2020 Decadal Review panel as a candidate Inflation Probe (IP) and such a probe was selected for implementation. In the original submission the team showed that with 5 years of observations PICO would be able to place more than 20 sigma constraint on r=0.003 and reject r=0.0005 with 5 sigma confidence. These tight constraints were achieved through calculations based on extrapolations of simplifying assumptions about noise. I will present new quantitative assessment of PICO's performance based on end-to-end simulations of noise and as-observed inhomogeneous sky coverage in the presence of a range of foreground models and different levels of low-frequency noise.

Author: RUSSIER, Elisa

Orateur: RUSSIER, Elisa

Classification de Session: Space missions and balloons

ID de Contribution: **29** Type: **Non spécifié**

Overview of the Taurus experiment

mercredi 18 décembre 2024 11:50 (20 minutes)

Taurus is a balloon-borne CMB experiment, planning to launch in 2027. It will fly from Wanaka, New Zealand, as the payload of a NASA Super Pressure Balloon in the stratosphere of the Southern Hemisphere, giving it a view of more than half of the sky. By imaging at night for several weeks with its three refractor telescopes, Taurus will map the polarized microwave emission of the sky in four bands centred around 150, 220, 280 and 350GHz with around 10000 cryogenic TES detectors in total. The large sky fraction, the scanning strategy and design choices will enable Taurus to determine the E-mode spectrum at these four frequencies on large angular scales (l<30). Thanks to the low atmospheric loading in the stratosphere, we expect the high-frequency bands of Taurus to give us the best estimates of the dust power spectrum on those large angular scales, enabling us to break the degeneracy between As and τ, the optical depth of reionization. We forecast that, alone or combined with other data, Taurus will reach a smaller uncertainty on τ than Planck, giving future experiments like CMB-S4 a critical element to determine the sum of neutrino masses.

Author: ADLER, Alexandre (UC Berkeley/LBNL)

Orateur: ADLER, Alexandre (UC Berkeley/LBNL)

Classification de Session: Space missions and balloons

ID de Contribution: **30** Type: **Non spécifié**

Mapmaking pipelines comparison from Chile for CMB-S4

jeudi 19 décembre 2024 17:15 (20 minutes)

CMB-S4 will collect data in the form of continuous time-ordered data streams spanning years of observation time with hundreds of thousands of detectors, which must be combined into maps of sky emission, a process known as mapmaking.
The baseline mapmaking pipeline for CMB-S4 relies on timestream filtering to reduce long-term drifts of various origins. This impacts the measurement of large scale modes, and therefore may not be optimal for the future observatory.
I will present an alternative map-making pipeline that uses the cross-linking of Chilean scans and compare the performance of these two approaches on simulated data streams.

Author: TANG, Julien

Orateur: TANG, Julien

Classification de Session: Ground-based observatories #2

ID de Contribution: **31** Type: **Non spécifié**

CCAT

jeudi 19 décembre 2024 15:55 (20 minutes)

I will introduce the CCAT collaboration which has built the Fred Young Submillimeter Telescope (FYST, pronounced feast). I'll provide an overview of the first generation instruments being deployed on FYST and their science goals. I'll conclude with a discussion of the state of the CCAT collaboration and our timelines.

Orateur: BATTAGLIA, Nicholas

Classification de Session: Ground-based observatories #2

ID de Contribution: **32** Type: **Non spécifié**

CMB-S4 update and options for a Chile-only design

jeudi 19 décembre 2024 16:55 (20 minutes)

CMB-S4 is conceived by a broad community as the path forward to realizing the enormous potential of CMB measurements for understanding the origin and evolution of the Universe, from the highest energies at the dawn of time through the growth of structure to the present day. The most efficient strategy to reach these science goals is to combine two complementary sky surveys: an ultra-deep over a small fraction of the sky to test models of inflation; and wide-deep survey covering the largest possible fraction of the sky to address a broad range of topics in astrophysics and fundamental physics. Owing to restrictions that NSF has imposed on the deployment of new experiments to the South Pole at the present time, the funding agencies have requested that the CMB-S4 project develop a instrument configuration in which both surveys can be conducted from the high Atacama desert in Chile. CMB-S4 is performing simulations and design studies to reconfigure the experiment. In this talk, we discuss ongoing work, future prospects, and outline a potential Chile-only design that could achieve the CMB-S4 science goals.

Orateur: DELABROUILLE, Jacques (IN2P3)

Classification de Session: Ground-based observatories #2

ID de Contribution: **33** Type: **Non spécifié**

CMB Spectral Distortions and Their Synergies

mercredi 18 décembre 2024 14:00 (25 minutes)

Orateur: CHLUBA, Jens (Jodrell Bank Center for Astrophysics at the UoM)

Classification de Session: CMB in Space (Situation & Discussion)

ID de Contribution: **34** Type: **Non spécifié**

Spectral distortions (Mission Proposals)

mercredi 18 décembre 2024 14:25 (25 minutes)

Orateur: AGHANIM, Nabila (Institut d'Astrophysique Spatiale)

Classification de Session: CMB in Space (Situation & Discussion)

ID de Contribution: **35** Type: **Non spécifié**

LiteBIRD and ESA call

mercredi 18 décembre 2024 14:50 (10 minutes)

Orateur: MONTIER, Ludovic (IRAP)

Classification de Session: CMB in Space (Situation & Discussion)

ID de Contribution: **36** Type: **Non spécifié**

Discussion

mercredi 18 décembre 2024 15:00 (1 heure)

Classification de Session: CMB in Space (Situation & Discussion)