The 2nd International Symposium on Cosmology and Ali CMB Polarization Telescope

Saturday, 7 September 2019 - Monday, 9 September 2019

北京师范大学

Book of Abstracts

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Galactic synchrotron emission with Gaussian random magnetic field realisation

Authors: Jiaxin Wang[1]; Tess Jaffe[2]

Co-authors: Piero Ullio [1]; Torsten Ensslin [3]

[1] *SISSA*

[2] *NASA*

[3] *MPA*

Corresponding Author: jiaxin.wang@sissa.it

I would like to present my numerical work in simulating
the Galactic synchrotron emission, with the hammurabiX package,
where we have proposed fast generators for realizing
the Galactic magnetic turbulence with physical motivations
and modelings.
We find out the synchrotron B/E ratio is related to both the
spatial and spectral structure of the magnetic turbulence.
In addition, I would also like to share our work in the
IMAGINE consortium towards inferring the Galactic components
with Bayesian analysis, and our idea of the consistent numerical
approach to simulating the Galactic emissions.

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Searching for patchy reionization from the cosmic microwave background

Author: Chang Feng[1]

[1] *University of Illinois at Urbana-Champaign*

Corresponding Author: cfenguiuc@gmail.com

Reionization is a unique epoch in Cosmology and studies of the epoch of reionization (EoR) can tell us important information about ionization history, first luminous objects, and structure formation in the early Universe. However, the EoR is still poorly understood so far. At millimeter wavelengths, next-generation cosmic microwave background (CMB) experiments could detect the EoR signatures, which were produced by scattering between CMB photons and free electrons stripped from neutral hydrogen atoms by ultraviolet radiation. In this talk, I will show a few newly developed techniques for detecting the EoR signatures using CMB fluctuations.

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Foreground removal pipeline in AliCPT

Author: Le Zhang[1]

[1] *SJTU*

Corresponding Author: lezhang@sjtu.edu.cn

In this talk, I will give a short summary of the foreground removal pipeline in AliCPT. which includes a description of all foreground-removal methods used in our data analysis. I will also report the latest results by applying all these methods into the real Planck data maps and simulated future-like maps with very low noise level.

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The power of CMB-lensing: AliCPT X DESI and more…

Author: Ji Yao[1]

[1] *Shanghai Jiao-Tong University*

Corresponding Author: ji.yao@outlook.com

The polarization map of AliCPT can be combined together with the Planck temperature map to reconstruct the CMB lensing map. The benefit is the quality of AliCPT polarization. The reconstructed CMB lensing map can be apply to either auto-correlation or cross-correlation with other LSS surveys (galaxy survey or shear survey).
We introduce the current status of CMB lensing cross-correlations, and the gain with AliCPT X DESI as well as other surveys. We present the forecast of AliCPT X DESI, as well as some preliminary results on pipeline development, with data from Planck X DESI legacy surveys. We discuss the impact from different systematics and how to improve the status.

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New Directions in Non-Gaussianity

Author: Martin Bucher[1]

[1] *APC/CNRS*

Corresponding Author: bucher@apc.univ-paris7.fr

Most of the emphasis so far on connecting CMB observations to theories of the primordial universe has focused
on exploiting the primordial power spectrum. However the constraints established on the maximum amount of
non-Gaussianity allowed severely limit the scope for alternative models. I will review these developments as
well as the prospects for improving on current observations. I will also present some new ways in which the
presently available data can be analyzed.

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The hemispherical power asymmetry after Planck

Author: Shamik Ghosh[1]

[1] *University of Science and Technology of China*

Corresponding Author: shamik@ustc.edu.cn

In this talk we will briefly summarise the current status of the hemispherical power asymmetry after the 2018 Planck data release. In particular, we will focus on the CMB polarisation results. We will look at preliminary and simplified cases for a power asymmetry signal in CMB polarisation as seen with AliCPT and a possible south-pole-based ground CMB polarisation experiment.

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Testing significance of the large angular scale CMB anomalies

Author: Pawel Bielewicz[1]

[1] *National Centre for Nuclear Research*

Corresponding Author: pawel.bielewicz@ncbj.gov.pl

Studies of the statistical properties of the CMB maps at large angular scales gives a unique opportunity to pose important questions about very fundamental assumptions made in the standard cosmological model such as statistical isotropy and Gaussianity of the initial fluctuations. Since the COBE and WMAP data releases, considerable effort has been spent on testing these properties. Remarkably, this effort has resulted in several reports of a breaking of statistical isotropy, as established by many qualitatively different methods. Recently, these observations has been confirmed for the Planck temperature data. I will present studies of the anomalies for the 2018 Planck polarisation maps and prospects of testing the anomalies using Ali CMB Polarisation Telescope data.

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Future cosmic microwave observations from space: a European perspective

Author: Jacques Delabrouille[1]

[1] *APC*

In this talk, I will present the scientific promises of future CMB observations from space, based on an overview of white papers submitted in answer to the call for preparation of the 2035+ science programme at ESA.

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Propagation of the gravitational waves in a cosmological background

Author: Xian Gao[1]

[1] *SYSU*

Based on the framework of spatially covariant gravity, we derive the general quadratic action for the gravitational waves in a cosmological background. Special attention is paid to the propagation speed of the gravitational waves. In particular, we identify a large class of spatially covariant gravity

theories with parity violation, in which both the polarization modes propagate in the speed of light. Our results imply that there are more possibilities in the framework of spatially covariant gravity in light of the propagation speed of the gravitational waves.

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CMB lensing and Minkowski Functionals

Author: Jan Hamann[1]

[1] *T*

Minkowski Functionals can be used to describe the morphological structure of a map, and, unlike the power spectrum, are sensitive to higher-order correlations. I will discuss the application of Minkowski Functionals to maps of the CMB lensing potential for the purpose of cosmological parameter estimation.

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The Probe of Inflation and Cosmic Origins (PICO)

Author: Shaul Hanany[1]

[1] *U*

PICO is a probe-class space mission that will be considered for implementation by the US Astro2020 decadal panel. Probe-class missions have a cost window of $400M-1000$M. The mission is designed to give a next-decade millimeter/sub-millimeter survey of the sky in intensity and polarization with depth equivalent to more than 3000 Planck missions. I will describe the science objectives of the mission, the hardware implementation, and the forthcoming steps in its evaluation toward implementation.

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TBD by Zhiqi Huang

Author: Zhiqi Huang[1]

[1] *S*

TBD

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Current status of AliCPT

Author: Congzhan Liu[1]

[1] *Department of Engineering Physics, Tsinghua University, Beijing*

In this talk, the current status of AliCPT construction will be reported.

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TBD by Yongjie Zhang

Author: Yongjie ZHANG Yongjie[1]

[1] *Institute of High Energy Physics, CAS*

TBD

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RECONSTRUCTING SIMULATED CMB POLARIZATION POWER SPECTRA WITH THE ANALYTICAL BLIND SEPARATION METHOD

Author: Larissa Santos[1]

[1] *Y*

We applied the Analytical Blind Separation (ABS) method, that extracts CMB signal from its contaminants, to simulated sky polarization maps, in order to test its ability to recover CMB E− andB−mode power spectra in the presence of two polarized foreground components, namely synchrotron and thermal dust, and an uncorrelated Gaussian distributed instrumental noise. We used multi- frequency Q and U microwave sky simulations, considering a hypothetical experiment operating in ten frequency bands in the 30-321GHZ range. Full and partial sky samplings were considered in our analysis. For the full sky case, making no prior assumption about polarized CMB foregrounds, the ABS estimator analytically recovered the E-mode and B-mode power spectra, considering tensor-to-scalar ratios r = 0 and r = 0.05, with a relative error below 20% with respect to the input CMB power spectra for the full multipole range considered ($2 \le l \le 1050$). For the partial sky analysis, the results were comparable to the full sky case. We found that the ABS method is able to estimate both CMB E-mode and B-mode power spectra within 1-σ at all scales for a full sky analysis, and for most of the scales ($50 \le l \le 1050$), for a partial sky analysis. For low-order multipoles ($l \le 50$), a noticeable divergence occurs in the partial sky analysis due to the uncertainties originated from both the ABS method and the pseudo power spectrum recovering. Thus, for low-order multipoles, a more detailed analysis for the partial sky case is needed in order to resolve the primordial B-mode. Despite this limitation, the ABS method was found to be a useful and reliable tool to extract CMB polarized signal from foreground and instrumental noise contaminated CMB data sets.

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General review of AliCPT

Author: Hong Li[1]

[1] *IHEP*

In this talk, the general review of AliCPT progress will be reported.

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TBD by Yang Liu

Author: Yang Liu[1]

[1] *KEK-Sokendai*

TBD

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TBD by Siyu Li

Author: siyu Li[1]

[1] *IHEP*

TBD

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TBD by Xiaodong Li

Author: Xiaodong Li[1]

[1] *SYSU*

TBD

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CMB lensing reconstruction in AliCPT

Author: Bin Hu[1]

[1] *Beijing Normal University*

Corresponding Author: bhu@bnu.edu.cn

I will report our progress in the lensing reconstruction, including noise level estimation, simulation, and spectrum reconstruction.

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General solutions of the leakage in integral transforms and applications to the EB-leakage and detection of the cosmological gravitational wave background

Author: Hao Liu[1]

[1] *NBI*

For an orthogonal integral transform with complete dataset, any two components are linearly independent; however, when some data points are missing, there is going to be leakage from one component to another, which is referred to as the "leakage in integral transforms" in this work. A special case of this kind of leakage is the EB-leakage in detection of the cosmological gravitational wave background (CGWB). We first give the general solutions for all integral transforms, prove that they are the best solutions, and then apply them to the case of EB-leakage and detection of the CGWB. In the upcoming decade, \blue{most likely, new cosmic microwave background (CMB) data are from ground/balloon experiments}, so they provide only partial sky coverage. Within this context, the EB-leakage becomes inevitable. We show how to use the general solutions to achieve the minimal error bars of the EB-leakage, and use it to find out the maximum ability to detect the CGWB through CMB. The results show that, \blue{when focusing on the tensor-to-scalar ratio r (at a pivot scale of 0.05 Mpc^{-1})}, 1% sky coverage ($f_{sky} = 1\%$) is enough for a 5σ-detection of $r \geq 10^{-2}$, but is barely enough for $r = 10^{-3}$.
If the target is to detect $r \sim 10^{-4}$ or 10^{-5}, then $f_{sky} \geq 10\%$ or higher is strongly recommended to enable a 5σ-detection and to
reserve some room for other errors.

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Implications for Discovery of Strong Radial Magnetic Field at the Galactic Center

Author: Qiu-he Peng[1]

[1] *Department of Astronomy, Nanjing University*

An abnormal strong radial magnetic field near the Galactic Center (GC) is detected[1] . The lower limit of the radial magnetic field at r=0.12 pc from the GC is .
Its Possible scientific significance are following:
The black hole model at the GC is incorrect. The reason is very simple as follows.
the radiations observed from the region neighbor of the GC are hardly emitted by the gas of accretion disk which is prevented from approaching to the GC by the abnormally strong radial magnetic field[2].
This is an anticipated signals for existence of magnetic monopoles(MM)[3].
The lower limit of the detected radial magnetic field is quantitatively in agreement with the prediction of the paper "An AGN model with MM" [4].
Magnetic monopoles may play a key role in some very important astrophysical problems using the Robakov-Callen effect that nucleons may decay catalyzed by MM
Taking the RC effect as an energy source, we have proposed an unified model for various supernova explosion[5] , including to solve the question of the energy source both in the Earth core and in the white dwarfs.
We may explain the physical reason of the Hot Big Bang of the Universe with the similar mechanism of supernova explosion by using the RC effect as an energy source.
We shall point out that the problem on the increasing mass for the black hole model of quasars / AGN is an unavoidable difficult question. But no problem is for our AGN model with MM.

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The AliCPT-1 cryostat receiver

The AliCPT-1 cryostat receiver

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Jinyi Liu

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Review of Planck inflation result

TBD

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Effective field theory of small r

In this talk, I will utilize the effective field theory approach to explore the general features of cosmological models in the early universe that give rise to small tensor-to-scalar ratio, which is favored by current (and probably future) observations.

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Lixin Xu's student

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AliCPT-1 Control and Data system design

Author: Yongjie ZHANG Yongjie[1]

Co-authors: Congzhan Liu [2]; Jingyan SHI Jingyan [3]; Siyu Li [4]; Zhi CHANG [3]

[1] *Institute of High Energy Physics, CAS*

[2] *Department of Engineering Physics, Tsinghua University, Beijing*

[3] 高能所

[4] *Associate professor*

Corresponding Author: zhangyj@ihep.ac.cn

The observation control of AliCPT-1, including hardware, software, user interface. The data acqusition, including data stream, data buffering, data transmission, data center.

Summary:

The engineering process of AliCPT-1 contorl system, including hardware, software, and user control logic.

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Future constraints from the gravitational wave standard siren data

Authors: Lixin Xu[1]; 明辉杜 [2]

[1] *Dalian University of Technology*

[2] 大连理工大学

Corresponding Author: angelbeats@mail.dlut.edu.cn

The detection of gravitational waves (GW) by the LIGO and Virgo collaborations offers a whole new range of possible tests and opens up a new window which may shed light on the nature of gravitaion, dark energy and dark matter, etc. Recently, our group investigate how future gravitational wave standard siren (GWSS) data could help to constrain different cosmological models. In particular, our forecastings are based on a reasonable estimation of binary merger rate and the expected configuration of the third-generation gravitational wave detector, the Einstein Telescope. Our analyses show that the inclusion of the GWSS data from the Einstein Telescope can improve the contraint on the parameter spaces of different cosmological models.

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Testing Dark Matter Energy Injection in CMB Measurements

Author: Gao, YuNone

The precision cosmic microwave background (CMB) measurement tells us a lot about the CMB propagation
during the dark and reionization eras of the Universe. Beside a significant boost towards precision cosmology,

this newly acquired understanding of the CMB signals can be turned into a powerful test of potential imprints

on to the post-recombination temperature and ionization history from beyond the Standard Model physics: injection

of the energy from the annihilation, decays of dark matter or other new physics. The upcoming CMB polarization

experiments and 21cm measurements, like ALiCPT, can enhance the prospective detection sensitivity to such

new physics processes.

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Auto- and cross-correlation of the cosmic microwave background

lensing and infrared background measured by Planck and Herschel

Authors: Yan Gong[1]; Ye Cao[1]

[1] *NAOC*

Corresponding Author: caoye@nao.cas.cn

The primary objective of this paper is to measure the auto- and cross-power spectrum of the CIB from Herschel and CMB lensing from Planck. To achieve this, we analyze the Herschel-SPIRE HerMES Large Mode Survey field, which is about 280 square degree. we use Madmap algorithm to merged the the Herschel Level 1 timeline data as the CIB maps using by Herschel Interactive Processing Environment (HIPE), and use 3σ flux cut to remove the contamination from the bright sources. The CMB lensing data was obtained form the 2013 release of data from the Planck mission. The calculation and correction of the auto- and cross-power spectrum is based on the work of Cooray et al. (2012). Then we performed a MCMC analysis using a simple parametric SED model, with a redshift-independent linear bias. All these steps above, we analyze the Herschel data at three bands: 250, 350 and $500\mu m$, and calculate the auto-power spectrum of CIB anisotropies from $100 \leq \ell \leq 2048$ and the cross-power spectrum of CIB and CMB lensing from $200 \leq \ell \leq 20000$.

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Constructing unbiased estimator for CMB polarizations in the optimal way

Author: Wen Zhao[1]

[1] *USTC*

In this talk, I will introduce the method to restruct the unbiased estimators of CMB polarizations with the method a quadratic maximum likelihood (QML), and how to combine it with the E-B separation methods. By simulations, we study the uncertainties of these estimators, and the possible E-B leakages. By comparing with the results of pseudo-Cl methods, we show the necessity of QML in the low multiplied.

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Data analysis pipeline and noise simulation for AliCPT

Author: Siyu Li[1]

[1] *IHEP*

In this talk I will report a prototype of map-making pipeline by the AliCPT science team, then present the simulated noise maps and part of the results on the scientific forecast

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the cosmic infrared background

the cosmic infrared background (CIB) is the cumulative radiation from all galaxies along the line-of-sight, including those too faint to resolve in galaxy surveys. CIB is useful in reconstructing the full cosmic star formation history. I will review the theoretical models for the CIB, and present the forecast for CIB cross-correlations with others, e.g., lensing and emission line intensity mapping.

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Analysis techniques for CMB B-mode experiments

Author: Ben Wandelt[1]

[1] *Flatiron*

The hunt for CMB polarization B-modes is on. Many obstacles lie along the way besides the obvious cost driver of high sensitivity. Instrumental, atmospheric, and astrophysical systematics are challenges that can be addressed with sophisticated analysis techniques. I will advertise a series of recent results that break through several of these obstacles: optimal and efficient B-mode purification; Bayes-optimal polarized B-mode de-lensing with Lenseflow, and simulation-based approaches to inference using pyDelfi and Information Maximizing Neural Networks that are flexible enough to incorporate machine learning approaches into both the sky model and the analysis chain.

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CMB and the origin of our Universe

Co-author: YIFU CAI [1]

[1] *University of Science and Technology of China*

TBD

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Deep learning the cosmic large scale structure

Author: Xiao-Dong Li[1]

[1] *SYSU*

Corresponding Author: lixiaod25@mail.sysu.edu.cn

We use the deep CNN to map the complex, non-linear cosmic large-scale structure to the underlying cosmological parameters Ω_m, σ_8. In the ideal case, we can achieve a constraint 6 times better than the Planck CMB results, just using a $(256\text{Mpc/h})^3$ box of dark matter density field with 2 Mpc/h resolution. Machine learning may play a very important role in the future astronomical data mining.

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The AliCPT-1 cryostat receiver

Author: Maria Salatino[1]

[1] *Stanford University*

Corresponding Author: marias5@stanford.edu

AliCPT-1 will be the first telescope observing the CMB from the Tibetan plateau.
AliCPT-1 will observe the sky in two frequency bands centered at 95 and 150GHz, with a focal plane populated by thousands of polarization sensitive Transition-Edge Sensors (TESes) cooled down to 300mK.
The detector arrays will be read out with a microwave multiplexing architecture.

The cryostat has been designed at Stanford University.
The detector arrays and readout system are being developed at NIST and Arizona State University, respectively. The cryostat is currently under fabrication.
The cryostat receiver is expected to be deployed in 2020.

In this talk I will present the design of the cryostat receiver, underlying how the instrument design meets the expected performance.

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Primordial Fluctuations and Rare Objects in the Universe

Author: Zhiqi Huang[1]

[1] *Sun Yat-Sen University*

Corresponding Author: huangzhq25@mail.sysu.edu.cn

I will discuss an intermittent type of primordial non-Gaussianity that arises from modulated preheating models and inflationary models with non-perturbative features. The non-Gaussianity has little impact on global statistics of the Universe. It produces or helps produce rare objects, such as CMB cold/hot spots and supermassive black holes at high redshift. The environment of rare objects may be used to distinguish the model from statistical flukes.