IRN CCD2030 Kick-off 2024: combining cosmological data.

Monday, June 10, 2024 - Wednesday, June 12, 2024

IAP

Book of Abstracts

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Cosmology with multiple halo sparsities

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The dark matter halo sparsity, i.e. the ratio between spherical halo masses enclosing two different overdensities, provides a non-parametric proxy of the halo mass distribution which has been shown to be a sensitive probe of the cosmological imprint encoded in the mass profile of haloes hosting galaxy clusters. Mass estimations at several overdensities would allow for multiple sparsity measurements, that can potentially retrieve the entirety of the cosmological information imprinted on the halo profile. Here, we investigate the impact of multiple sparsity measurements on the cosmological model parameter inference. For this purpose, we analyse N-body halo catalogues from the Raygal and M2Csims simulations and evaluate the correlations among six different sparsities from Spherical Overdensity halo masses at Δ=200/500/1000 and 2500 (in units of the critical density). Remarkably, sparsities associated with distinct halo mass shells are not highly correlated. This is not the case for sparsities obtained using halo masses estimated from the Navarro-Frenk-White (NFW) best-fit profile, which artificially correlates different sparsities to order one. This implies that there is additional information in the mass profile beyond the NFW parametrisation and that it can be exploited with multiple
sparsities. In particular, from a likelihood analysis of synthetic average sparsity data, we show that cosmological parameter constraints significantly improve when increasing the number of sparsity combinations, though the constraints saturate beyond four sparsity estimates. We forecast constraints for the CHEX-MATE cluster sample and find that systematic mass bias errors mildly impact the parameter inference, though more studies are needed in this direction.

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CMB lensing, from Planck to CMB-S4

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I will start reviewing CMB lensing signal extraction techniques and the most recent lensing maps and cosmological results from Planck and ACT. I will then discuss prospects for CMB lensing measurements in the future (Simons Observatory, CMB-S4)

What additional information cross-correlations between surveys bring. / 5

An example of the joint use of two surveys

Author: Alain Blanchard[1]

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Euclid will provide imaging and spectroscopy over the same sky area. This provides examples of the joint use of surveys with the 3*2 pt and with the combination of the 3*2 pt with the spectocopic sample.

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GAUSS: a next generation cosmological survey

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GAUSS is a projet that has been submitted to Voyage 2050 as a space mission to improve constraints on dark energy by one order of magnitude.

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Cosmology and Fundamental Physics from DESI-2 and Spec-S5

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Advances in experimental techniques make it possible to map the high redshift Universe in three dimensions at high fidelity in the near future. This will increase the observed volume by many-fold, while providing unprecedented access to very large scales, which hold key information about early-Universe physics. In addition, such measurements can directly probe the Dark Energy density throughout cosmic history. The precision of these measurements, combined with CMB observations, also has the promise of greatly improving our constraints on the physics of the dark sector, the masses of neutrinos, the amount of spatial curvature, and potential modifications to General Relativity. In this talk, I will explain how DESI-2 and Spec-S5 will address these fundamental questions and open up a new window on the Universe, greatly enhancing the potential for new discoveries. Finally, I will highlight synergies between spectroscopic surveys and CMB experiments and talk about recent progress in combining DESI data with ACT and Planck.

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Euclid

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Cosmologicla constraints from DESI

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Using DESI in combination

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First measurement of the Weyl potential evolution from DES Y3 data

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In this talk I will present a new methodology to measure the Weyl potential, which is the sum of the spatial and temporal distortions of the Universe's geometry, in a model independent way. I will then present how combining galaxy clustering and galaxy-galaxy lensing data from DES Y3 we can provide the first direct measurement of the evolution of the Weyl potential at four different redshifts. I will end by showing the forecast precision of such measurements with stage IV surveys and the interest of combining these with data coming from spectroscopic galaxy surveys.

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A new screening mechanism and its cosmological consequences

What additional information cross-correlations between surveys bring. / 13

KIDS

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The Kilo-Degree survey measures cosmic shear, and has been combined with galaxy clustering information. I will review our results and prospects, with particular attention to the probe combination and sky footprint aspects.

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Euclid cross CMB

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TBD

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Field Level Inference and Simulation-Based Inference

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More than the sum of its parts: joint analysis of LSS and CMB experiments

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Through weak lensing and galaxy clustering measurements, future large-scale galaxy surveys will provide unprecedented constraints on the late Universe. On the other hand, high-quality CMB observations (Planck and future CMB experiments) can – and already do – put tight constraints on the early Universe. In this talk, I will show that combining these two sources of cosmological information can yield a significant lever arm and improve tremendously the constraints on our cosmological model. Moreover, I will also address the cross-correlation of those two types of signals, which can yield additional and significant constraints especially on extensions to the standard cosmological model. As a part of my talk, I will present in particular forecasts of the future Euclid x CMB cross-correlation constraints, performed by the CMB-cross correlations Science Working Group of the Euclid Collaboration.

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Cosmology with z<2 galaxies at WST

The wide-field spectroscopic survey telescope (WST) project is 12-metre wide-field spectroscopic survey telescope with simultaneous operation of a large field-of-view (3 sq. degree), high-multiplex (20,000) multi-object spectrograph (MOS) and a giant 3⊠3 arcmin integral field spectrograph (IFS).

WST is designed to probe a large volume of the Universe with a galaxy density sufficient to measure the extremely-large-scale density fluctuations required to explore primordial non-Gaussianity and therefore inflation. In addition, combining the spectroscopic surveys with the next generation CMB experiment, WST can provide the first 4sigma measurement of neutrino mass and the first 5sigma confirmation of the neutrino mass hierarchy from astronomical observations. Finally, these high-redshift measurements will probe a Dark Matter dominated era and test exotic models where Early Dark Energy properties vary at high redshift.

We propose to use Lyman Break Galaxies (LBGs) in the 2.0<z<5.5 redshift range as tracers of the matter. These galaxies are selected by using a u/g/r-dropout approach based on a very deep u/g/r-bands that can be provided by imaging surveys such as LSST. In addition, we will present the results of pilot surveys observed in COSMOS and XMM fields by DESI from 2021 to 2024. We will show that we can achieve both the LBG densities and the redshift accuracy required for future spectroscopic surveys such as WST.

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Cosmology with z>2 galaxies at WST

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Combining Spectro & Photometric probes

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