

Paris workshop on Bayesian Deep Learning for Cosmology and Time Domain Astrophysics



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Type: Talk

COSMOPOWER: Deep Learning - accelerated Bayesian inference from next-generation cosmological surveys

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Next-generation Large-Scale Structure (LSS) and Cosmic Microwave Background (CMB) surveys will provide us with unprecedented levels of precision in the final constraints on our cosmological model. However, the computational challenges posed by these enormous datasets dangerously hinder their analysis within a Bayesian framework for rigorous uncertainty propagation – a condition necessary to ensure correspondingly high levels of accuracy in the final constraints.

In my talk I will present COSMOPOWER, an open-source Python framework for Deep Learning accelerated Bayesian inference from next-generation CMB and LSS surveys. COSMOPOWER provides orders-of-magnitude acceleration to the inference pipeline by training Deep Learning emulators of matter and CMB power spectra. I will show how these emulators meet the accuracy requirements for application to both currently available cosmological data, such as from the Kilo-Degree Survey (KiDS), as well as to simulated, next-generation data from e.g. a Euclid-like survey. The emulators always recover the fiducial cosmological constraints, while providing a speed-up factor up to $O(10^4)$ to the complete inference pipeline. Bayesian parameter contours can thus be recovered in just a few seconds on a common laptop, as opposed to the many hours, days or months of runtime on computer clusters required by standard methods. I will conclude with an outlook on extensions of this software that are currently being developed to extend COSMOPOWER into a fully differentiable library for cosmology.

Auteur principal: SPURIO MANCINI, Alessio (University College London)

Orateur: SPURIO MANCINI, Alessio (University College London)

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