# Ateliers action Dark Energy / GDR CoPhy 2023

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IAP

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**Auteur correspondant** guilhem.lavaux@iap.fr

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## Jemu

**Auteur:** Jean-Eric Campagne[1]

[1] *LAL-IN2P3-CNRS and Univ. Paris 11*

**Auteur correspondant** campagne@lal.in2p3.fr

This is a brief introduction to “another” simple & non-official P(k,z) CLASS emulator designed in the context of jax-cosmo library.
After a flash on Jax-Cosmo lib, I will flash the design of the emulator based on Gaussian Processes, and gives sanity check results.
Summarizing, I will mention CosmoPower-JAX and the new initiative to standardize the emulator interface in the context of the Differentiable Universe Initiative.

**Contributions / 14**

## ESR and katz

**Auteur:** Deaglan Bartlett[1]

[1] *Institut d'Astrophysique de Paris (CNRS & Sorbonne Université)*

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Symbolic Regression algorithms learn analytic expressions which fit data accurately and in a highly interpretable manner. As such, these methods can be used to help uncover "physical laws" from data or provide simple and interpretable effective descriptions of complex, non-linear phenomena. In this talk I will present two codes aimed to address this task. The first, ESR, efficiently yet exhaustively searches through analytic expressions and selects the optimal fit using a novel information-theoretic criterion which balances accuracy with simplicity. The second, katz, builds on the model selection method used by ESR by constructing priors on functions using a language model. This method preferentially selections functions which contains combinations of operators which appear in previously seen equations, and thus aims to produce physically reasonable expressions.

**Contributions** / **15**

## JAX-LPT: differentiable Lagrangian Perturbation Theory simulator

**Auteur:** Axel Lapel[1]

[1] *Institut d'Astrophysique de Paris*

**Auteur correspondant** axel.lapel@iap.fr

This talk introduces JAX-LPT: a novel code implementing fast, GPU-compatible, and differentiable simulations based on first and second-order Lagrangian Perturbation Theory. JAX-LPT can facilitate the swift generation of initial conditions for N-body simulations and integrate effectively within Bayesian hierarchical models for field-level inference, contributing to a community-wide effort to develop a new generation of differentiable numerical tools for complex statistical inference problems (e.g. pmwd, JaxPM). The session will unpack the code's design and implementation, showcase basic utilization, and preview current and potential deployments in a few research projects.

**Contributions** / **16**

## CosmoFlow

**Auteurs:** Denis Werth[1]; Sébastien Renaux-Petel[2]

[1] *Sorbonne University – IAP*

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Correlation functions of primordial density fluctuations provide an exciting probe of the physics governing the earliest moments of our Universe. However, the standard approach to compute them is technically challenging. Theoretical predictions are therefore available only in restricted classes of theories, which can completely bias the interpretation of data.

In this talk, I will present the cosmological flow: a complete method to systematically compute tree-level primordial correlators in any theory, bypassing the intricacies of Feynman diagram computations. This framework enables one to capture all effects—including e.g. the imprints of additional particles and breaking scale-invariance—for the reason that it relies on following the time evolution of these correlators from the initial quantum vacuum state to the end of inflation.

I will then explicitly show with simple examples how to use the upcoming code CosmoFlow that will soon be publicly released.

**Contributions / 17**

## The e-MANTIS emulator: fast predictions for the non-linear structure formation in modified gravity

**Auteur:** Iñigo Sáez-Casares[1]

[1] *LUTH - Universté Paris Cité - Observatoire de Paris*

**Auteur correspondant** inigo.saez-casares@obspm.fr

In order to probe modifications of gravity at cosmological scales, accurate theoretical predictions are required. N-body simulations are needed to explore the non-linear regime of structure formation, but are very time consuming. This talk presents an emulator, dubbed e-MANTIS, that performs an accurate and fast interpolation between the predictions of a given set of cosmological simulations in f(R) modified gravity. We compute the matter power spectrum boost due to f(R) gravity B(k) = P_f(R) / P_LCDM and build an emulator using a Gaussian Process Regression method. Such an emulator could be used to constrain f(R) gravity with weak lensing analyses.

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## ECLAIR: a complete toolbox for cosmological inference

**Auteur:** Stéphane Ilic[1]

[1] *IJCLab*

**Auteur correspondant** ilic@ijclab.in2p3.fr

In this talk, I will present the ECLAIR (Ensemble of Codes for Likelihood Analysis, Inference, and Reporting) suite of codes, meant to be used as a general inference tool. It allows the sampling – via massively parallelizable MCMC techniques – of the posterior distribution of a set of parameters corresponding to a particular physical model, under the constraint of a number of recent datasets/likelihoods. Among its notable features are a powerful parser, a robust maximizer aimed for finding the best likelihood, and a Bayesian evidence calculator. The suite also include a series of plotting scripts, allowing to conveniently diagnose and check the convergence of a chain, as well as produce summary statistics on the parameters of interest.

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## A quick introduction to the RayGal data for the investigation of relativistic effects

**Auteur:** Yann RASERA[1]

[1] *LUTH/Obs. de Paris/Univ. de Paris*

**Auteur correspondant** yann.rasera@obspm.fr

In this talk I will make a quick presentation of RayGal data : https://cosmo.obspm.fr/public-datasets/ . They can be used to investigate the impact of relativistic effects on the apparent shape/distribution of large scale structures (e.g. dipole of the halo cross-correlation, magnification bias, cross-correlation of two distant shells, ISW-RS effect, gravitational redshift, etc.)

**Contributions / 20**

# LyAl-Net: a neural network emulator for Lyman-α forest simulation

**Auteur:** Chotipan Boonkongkird[1]

[1] *Sorbonne University*

**Auteur correspondant** chotipan.boonkongkird@iap.fr

I will present a demo of LyAl-Net, an emulator for cosmological simulation which has been trained on Horizon-noAGN at z-2.43. It is designed to emulate hydrogen temperature and density from any dark matter simulation with the resolution of ~0.0976 Mpc/h in the field level.