Kick off TOSCA meeting

jeudi 13 avril 2023 - jeudi 13 avril 2023

Hotel Le Saint Paul, Nice, France

Recueil des résumés

Contents

1

Introduction from all participants

1 slide each, same format, including name/expertise/WP in which they plan to be involved. This info will be needed for the website.

2

Work Package 1: from visibilities to galaxy shapes (André Ferrari)

We will build catalogues of individual galaxy shapes, which will be used as the inputs for WP2.
PhD in Nice.
Supervisor(s): André Ferrari + Simon Prunet
Collaborators: Cédric Richard, Jean-Luc Starck, Sam Farrens

3

Work Package 2 - from shapes to convergence maps (Jean-Luc Starck)

We will use Deep Learning for dark matter mass map reconstruction, either from radio WP1 inputs or from an optical shape catalogue such as Euclid.
1 Postdoc working with: Jalal Fadili, Jean-Luc Starck
Collaborators: Sam Farrens and Francois Lanusse

4

Work Package 3: synergy and cosmological parameters

Auteur correspondant valeria.pettorino@cea.fr

1 Postdoc (3 yeras)
Collaborators: Martin Kunz, Martin Kilbinger

5

General questions, if any

6

SKAO Science Data Processor (Shan Mignot)

SKA computing challenge and on-going developments

7

tbd (Simon Prunet)

8

tbd (Sam Farrens)

9

tbd (Jean-Luc Starck)

10

Francois Lanusse

11

Benjamin Remy

14

Unbiased shear estimation with forward modeling

Auteur: Benjamin Remy[1]

[1] *CEA Paris-Saclay*

As the volume and quality of modern galaxy surveys increase, so does the difficulty of measuring the cosmological signal imprinted in galaxy shapes. Weak gravitational lensing sourced by the most massive structures in the Universe generates a slight shearing of galaxy morphologies called cosmic shear, key probe for cosmological models. Modern techniques of shear estimation based on statistics of ellipticity measurements suffer from the fact that the ellipticity is not a well-defined quantity for arbitrary galaxy light profiles, biasing the shear estimation. I will present how a hybrid physical and deep learning Hierarchical Bayesian Model, where a generative model captures the galaxy morphology, enables us to recover an unbiased estimate of the shear on realistic galaxies, thus solving the model bias. (https://arxiv.org/abs/2210.16243)

15

Weak Lensing Mass Mapping in the Context of Cosmological Inference

Auteur: Francois Lanusse[1]

Co-auteur: Benjamin Remy [2]

[1] *{CNRS}UMR7158*

[2] *CEA Paris-Saclay*

In this review talk I will present the state of the art in the field of weak lensing mass-mapping, as well as discuss the important and desirable properties in the perspective of performing cosmological inference.
Specifically, I will review the most advanced mass-mapping method to date (Remy et al. 2022) which was shown to enable proper sampling of the full Bayesian posterior of the mass-mapping problem, using a combination of physical priors and Diffusion Models.
But I will also detail how mass-mapping is only one intermediate stage of a problem when concerned with constraining cosmological parameters, and demonstrate that mass-mapping is not actually required with Simulation-Based Inference techniques, which directly extract the full information content from the shear field itself.

16

The ARGOS Project

Auteur: Samuel Farrens[1]

[1] *CosmoStat, CEA Paris-Saclay*

In this talk I will introduce the ARGOS project, a concept for a leading-edge, low-cost, sustainable "small-D, big-N"radio interferometer to be constructed in Crete. I will provide an overview of the current plans for building the interferometer as well as explaining how ARGOS aims to bring the radio regime into the era of multi-messenger astronomy by probing the nature of transient sources, such as Fast Radio Bursts (FRBs). Finally, I will present the challenges of reconstructing radio interferometric data and how CosmoStat aims to use state-of-the-art signal processing and machine learning tools to address them.

17

Astronomical Image Deconvolution : From Wavelets to Deep Learning

Auteur: Jean-Luc Starck[1]

[1] *CosmoStat, CEA Paris-Saclay*

We will present an overview of our recent work in the last years, in the context of astronomical image deconvolution. We will address both the case optical and radio galaxies deconvolution.

18

SKA: Overview of the Data Processing Challenges and Development of the Science Data Processor

Auteur: Shan Mignot[1]

[1] *Université Côte d'Azur, CNRS, OCA, Laboratoire Lagrange*

Radio-telescopes fundamentally rely on massive data processing to form observables after the radio waves have been digitized. For the SKA telescopes, the number of antennas and of frequency channels lead to considerable amounts of raw data which first need to be combined to form beams or visibilities so that temporal or spatial data reduction can be carried out to form data products that scientists can ultimately analyse. The design for the SKA relies on a number of processing facilities in the field, at a national scale and worldwide with specific requirements in terms of data flow, power, diversity of tasks and accessibility. This talk will describe SKA's overall computing design and then focus on the Science Data Processors where data reduction occurs in the light of delivering high performance computing at an unprecedented scale and in a context which is not that of an HPC project.