Agenda for the *Postdoc & Engineer Day*

Time	Speaker	Title
	First Session (chair: Lukas Witkowski)	
10:00-10:05	***Opening***	
10:05-10:20	Jean-Grégoire Ducoin	**Follow up of gravitational waves events: a disappearing needle in a haystack**
10:20-10:35	Sophie Huot	**Development of the vis simulation for the Euclid space mission**
10:35-10:50	Thomas Flanet	**Software development for the Euclid space mission**
10:50-11:05	Aristide Doussot	**Improving the analysis pipeline of the South Pole Telescope**
11:05-11:20	Federica Guidi	**Constraining cosmology with the summer fields of the South Pole Telescope**
11:20-11:40	***Coffee break***	
	Second Session (chair: Federica Guidi)	
11:40-11:55	Louis Quilley	**Color bimodality of galaxies : bulge growth and disk quenching of morphological types across the Green Valley**
11:55-12:10	Pierre Boldrini	**No globular cluster progenitors in Milky Way satellite galaxies**
12:10-12:25	Shohei Saga	**Lagrangian perturbation theory around collapse: toward post-collapse theory**
12:25-12:40	Sadra Jazayeri	**Cosmological Bootstrap in Slow Motion**
12:40-12:55	Lukas Witkowski	**An ultraviolet view of inflation**
12:55-13:00	***Conclusion***	

Details of the talks

(Postdoc and Engineer Day)

20th May 2022

Jean-Grégoire Ducoin

Follow-up of gravitational waves events:a disappearing needle in a haystack

I will discuss the challenge of the ground based search for electromagnetic counterparts of gravitational waves events. I present the monitoring of these alerts within the GRANDMA and SVOM collaborations and the results of this follow-up during the O3 run of LIGO-Virgo as well as the current and future involvement we are developing at IAP for O4 (starting at the end of 2022).

Sophie Huot

Development of the vis simulation for the Euclid space mission

IAP is very active in the the Euclid project, the ESA space mission aiming to characterize dark energy. The laboratory is in charge of the simulation and the processing of the VIS instrument data (photometric imager). Simulation are crucial since it is the only source of data to train the ground segment before the launch. To be ready for the real data processing, simulated image need to be very accurate and realistic. At approximately one year of the telescope launch, we now have to add the real instrument models which directly come from the ground test of the spacecraft.

Thomas Flanet

Software development for the Euclid space mission

Développement, exploitation et maintenance de la chaîne logicielle de traitement des images de l'instrument VIS (canal visible) de la mission Euclid de l'Agence spatiale européenne (ESA). Intervention dans la conception, le développement, le test, l'intégration, la validation et la maintenance de cette chaîne de traitement au sein de l'équipe en charge du segment sol d'Euclid à l'IAP, sous la responsabilité du chef de projet technique.

Aristide Doussot

Improving the analysis pipeline of the South Pole Telescope

The South Pole Telescope (SPT) is a 10 meters diameter telescope based in the South Pole, observing the Cosmic Microwave Background (CMB). Currently its third generation "SPT3G" is one the most competitive for constraining cosmological parameters. During its first year of observations it produced constraints consistent with the Planck analysis. To obtain and further improve these constraints, the observed sky patch has been enlarged to 1500deg2. After presenting the analysis pipeline, I will show that this new performance comes with a price as some previous approximations fail and lead to artificial correlations. I will also present our current work on developing new approaches to more efficiently reach the statistical quantity on which the parameters constraint is based, namely the covariance matrix.

Federica Guidi

Constraining cosmology with the summer fields of the South Pole Telescope

The South Pole Telescope (SPT) is a 10-meters diameter telescope observing the Cosmic Microwave Background (CMB) from the South Pole, with angular resolution of arcminutes. A third generation camera (SPT-3G) was mounted on SPT in 2018, showing the remarkable performances of this experiment, which is currently one of the most competitive for CMB science. During the first observing season SPT-3G observed its baseline sky patch (1500 deg2) and obtained cosmological constraints consistent with those of the Planck mission. Deeper observations of the baseline field are currently ongoing, with the goal of achieving cosmological constraints as the Planck ones. In this talk I will present the ongoing analysis of an extension of the SPT-3G survey, which is a combination of the baseline SPT-3G field with the so-called "summer fields", which are additional 3000 deg2 that are observed during the Antarctic summer season. The SPT-3G summer data, combined with the SPT-3G baseline field and Planck data, are expected to provide even tighter cosmological constraints. I will present some preliminary results on the analysis of the SPT-3G summer fields, and forecasts on the constraints of cosmological parameters.

Louis Quilley

Color bimodality of galaxies : bulge growth and disk quenching of morphological types across the Green

Color-magnitude diagrams show a bimodality between the red passive galaxies and the blue star-forming ones. In between the Red Sequence and the Blue Cloud lies the Green Valley, a low density area of intermediate-color galaxies which has raised questions about the evolutionnary pathways of galaxies. By doing luminosity profile-fitting and SED model-fitting, I recreate those diagrams for nearby galaxies in the northern galactic cap. Using data from the EFIGI morphological catalog, I focus on the distribution of the different Hubble types in those diagrams, and complement them with quantitative parameters, such as bulge and disk absolute colors, bulge-to-total ratio, stellar mass or specific star formation rate. The observed trends provides insight on the evolution of galaxies and the build-up of the Hubble Sequence.

Pierre Boldrini

No globular cluster progenitors in Milky Way satellite galaxies

The origin of compact stellar clusters, also known as globular clusters, is one of the open questions in modern astrophysics. It was found that 62 of the present-day Milky Way globular clusters likely formed in the Milky Way, 55–65 have an extragalactic origin and the rest likely has a more heterogeneous origin.
In order to find the possible progenitors of Milky Way globular clusters, we perform orbit integrations to track the orbits of 170 Galactic globular clusters and the eleven classical Milky Way satellite galaxies backward in time for 11 Gyr in a Milky-Way-plus-satellites potential including the effect of dynamical friction on the satellites. Assuming that Milky Way globular clusters are and have been free of dark matter and thus consist of stars alone, we demonstrate that none of the globular clusters show any clear association with the eight classical dwarf spheroidal galaxies even though a large fraction of them are believed to be accreted.
I will describe our method, which allows us to decide whether or not a globular cluster was associated with a satellite galaxy in the past. Then, I will discuss the implications of our results in the context of galaxy

Shohei Saga

Lagrangian perturbation theory around collapse: toward post-collapse theory

The cold nature of dark matters suggests that the cold dark matter (CDM) distribution is concentrated on a three-dimensional sheet evolving in six-dimensional phase-space. At shell crossing, the phase-space sheet first self-intersects, the seeds of the first dark matter haloes are created. Since the shell-crossing is a singular point that appeared the first time, in which the convergence of the perturbation theory becomes worse, understanding the feature of shell-crossing is important to describe the subsequent post-collapse dynamics of CDM. Recently, we explore the structure around shell-crossing time of CDM protohaloes starting from a certain initial condition, by comparing Lagrangian perturbation theory (LPT) up to 10th order to high-resolution cosmological simulations performed with the public Vlasov code ColDICE. In particular, using very high order LPT solutions and studying their convergence properties, we can successfully describe the phase-space structure at shell-crossing accurately and develop a method to predict the post-collapse properties of CDM slightly beyond shell crossing. I will present my recent work on these subjects.

Sadra Jazayeri

Cosmological Bootstrap in Slow Motion

One of the main objectives of Cosmology in modern days is to measure the correlation function of density perturbations in order to unravel the microscopic mechanism behind inflation. Given a concrete quantum field theory description of the early universe, these correlations functions (especially the two- and three-point functions) are usually computed by the laborious work of chasing the dynamics of the system in time, which is additionally complex compared to Quantum Field Theory in flat space due to the lack of time translation symmetry in an expanding background. Recently, inspired from the tremendous successes of the S-matrix program, new formulations of these "boundary" correlators have emerged in which these quantities are bootstraped based on principles of locality, causality and unitarity. I will generalise these methods to some phenomenologically motivated setups where the inflaton field has a subluminal speed of sound and it has sizeable couplings to additional massive particles. The outcome will be novel analytical templates for non-Gaussianity which can be confronted with the forthcoming findings of the next generation of CMB and LSS experiments.

Lukas Witkowski

An ultraviolet view of inflation

Cosmic inflation is a proposed era of accelerated expansion of the very early universe that sets the initial conditions for the subsequent hot big bang era. But what is the mechanism behind inflation? We can learn about this era from observations, in particular of the cosmic microwave background, but potentially also from gravitational waves. In addition, there may also be important lessons to be learnt from theoretical considerations. Inflation is inherently ultraviolet-sensitive, i.e. physics at the very highest energies cannot simply be ignored when modelling inflation. In my research I analyse how aspects of high energy physics can be used to gain new insights into inflation, and what observations of inflationary observables can in turn teach us about the universe at the shortest scales.