Postdoc Day-2019
Institut d'Astrophysique de Paris

Friday, April 12th, 2019

Program Schedule

Time	Session Chair	Speaker	Title of the talk
1000-1010	Raphael Duque	Frederic Daigne	Welcome speech
1010-1020		Florian Fuhrer	Postdoc's Intro
1020-1040		Stefano Anselmi	What from the Baryon Acoustic Oscillations? Why the Linear Point standard ruler?
1040-1100		Jacopo Chevallard	New insights into extreme star-forming galaxies: testing and calibrating new-generation spectral models for the JWST era
1100-1130		Tea/Coffee Break	
1130-1150	Sandrine Lescaudron	Luciano D. V. Bertoni	The effect of AGN feedback on the formation of SMBH binaries
1150-1210		Maxime Trebitsch	The contribution of AGNs to the Reionization of the Universe
1210-1230		Hassan Fathivavsari	Ghostly DLAs: Tracers of neutral gas close to quasars
1230-1400		Lunch	
1400-1420	Simon Rozier	Ricarda Beckmann	From seed to supermassive: the origin, evolution and impact of supermassive black holes
1420-1440		Florian Fuhrer	Bayesian reconstruction of the cosmological dark matter flow
1440-1500		Suvodip Mukherjee	Multi-messenger cosmology with astrophysical gravitational waves, CMB, and LSS
1500-1520		John Ronayne	Calculating the Bispectrum in Non-Canonical Multi-field Inflation
1520-1550		Tea/Coffee Break	
1550-1610	Francois Larrouturou	Anne Zilles	Effects of millisecond pulsar winds on binary companions
1610-1630		Jacopo Fumagalli	The Higgs boson in the early Universe
1630-1650		Sebastian Garcia-Saenz	Gauged galileons and massive gravity
1650-1720	Suvodip Mukherjee and Francois Larrouturou		Discussions
1720-	--	Cocktails	

Contents

What from the Baryon Acoustic Oscillations? Why the Linear Point standard ruler?

Stefano Anselmi

Baryon Acoustic Oscillations (BAO) are one of the most useful and used cosmological probes to measure cosmological distances independently of the underlying background cosmology. However, in the current measurements, the inference is done using a theoretical clustering correlation function template where the cosmological and the non-linear damping parameters are kept fixed to fiducial LCDM values. How can we then claim that the measured distances are model-independent and so useful to select cosmological models? Motivated by this compelling question we introduce a rigorous tool to measure cosmological distances without assuming a specific background cosmology: the Purely-Geometric-BAO. I will explain how to practically implement this tool with clustering data. This allows us to quantify the effects of the standard measurements assumptions. I will then focus on a new approach to the problem that leverages a novel BAO cosmological standard ruler: the Linear Point. Its standard ruler properties allow us to estimate cosmological distances without the need of modeling the poorly-known late-time nonlinear corrections to the linear correlation function. Last but not least, it also provides smaller statistical uncertainties with respect to the correlation function template fit.

New insights into extreme star-forming galaxies: testing and calibrating new-generation spectral models for the JWST era

Jacopo Chevallard

Current observations favour a Cosmic Reionization scenario in which young stars hosted in low-mass galaxies produce the bulk of ionizing photons necessary to reionize the Intergalactic Medium (IGM) by $z \sim 6$. This scenario, however, rests on several assumptions about the physical properties of high-redshift galaxies and their interstellar medium (ISM). The James Webb Space Telescope (JWST), scheduled for launch in March 2021, will provide the observational capabilities necessary to precisely characterise the properties of galaxies and of the ISM out to the Reionization Epoch. Extracting physical insights from the unique JWST data, however, will require the use of adequate interpretive tools, which must be tested and calibrated using existing facilities. In this talk, I will present the results of modelling HST/COS spectra of local analogues of low-mass high-redshift galaxies. By using the spectral modelling tool Beagle, along with state-of-the-art stellar population and photoionization models, I will show how the diverse UV and optical spectral features of these galaxies can be reproduced with a full self-consistent physical model. I will highlight the successes and failures of current generation of models, and discuss the future model developments required to maximise the science extracted from deep JWST spectra.

The effect of AGN feedback on the formation of SMBH binaries

Luciano D. V. Bertoni

Using N-body/smoothed particle hydrodynamics simulations we study the dynamical evolution of a pair of super massive black holes (SMBHs) embedded at the core of the remnant of a galaxy merger. In particular we explore how the differences between two models of AGN feedback, one where feedback is deliver only as thermal energy to the surrounding gas and other where also kinetic energy is delivered, can affect the SMBHs in-spiral and binary formation timescale. Also we study how a pre-existing stellar cluster (SC) bound to the SMBHs can affect the in-spiral timescale and the outcome of AGN feedback on the binary formation timescale. We find that the main process that drives the in-spiral of the SMBHs is stellar dynamical friction that acts onto them and their bound material, driving the SMBH binary formation on $\sim$ 40 -140 Myr. If the SMBH is initially naked, without a SC surrounding it, AGN feedback push gas away, preventing bound stars to form and therefore delaying the in-spiral on $\sim 10 - 20$ Myr by decreasing the material bound to the SMBH. However, if the SMBH is initially embedded in a SC, AGN feedback has a small effect on the total bound mass and therefore its effect on the in-spiral timescale is negligible. Also we have shown that both AGN models give the same results, making our conclusion on the effect of AGN feedback on the dynamical evolution of SMBHs and on the timescale for SMBH binary formation more robust.

The contribution of AGNs to the Reionization of the Universe

Maxime Trebitsch

Cosmic reionization is one of the last major milestones in the evolution of the Universe. In roughly one billion years, the bulk of the hydrogen in the Universe is fully ionized by the radiation produced by early galaxies and quasars. While significant progress has been made in the recent years, completing the census of these ionizing sources is still a major challenge on both the observational and theoretical sides. Current models suggest that the bulk of the photons responsible for reionizing the Universe were produced by massive stars in low mass galaxies, while the subsequent UV background is dominated by the emissivity from active galactic nuclei.

Quantifying this requires to study in detail how much radiation is produced by stars and AGN, as well how much of it escapes from the host galaxy to the intergalactic medium. Using a series of high resolution radiation-hydrodynamics cosmological simulations modelling simultaneously star formation, black hole growth, the associated feedback processes as well as the production and transport of ionizing radiation, I will discuss the contribution of AGN during and after reionization.

Ghostly DLAs: Tracers of neutral gas close to quasars

Hassan Fathivavsari

We recently searched the SDSS-DR12 spectroscopic database for damped Lyman alpha (DLA) systems at the redshift of the quasars. In some DLAs, the DLA absorption is not observed which hints at the significant partial coverage of the BLR. These absorbers are identified either by the presence of absorption from other Lyman series lines or by the presence of strong low-ionization absorption lines. In this talk I will present the results of our study of these interesting systems.

From seed to supermassive: the origin, evolution and impact of supermassive black holes

Ricarda Beckmann

Supermassive black holes have co-evolved with their host galaxy since the beginning of cosmic history. From the first seed black holes in mini-halos at high redshift, to Sagittarius A* at the center of the Milky Way, the evolution of galaxies and supermassive black holes is intricately linked by gas accretion and the energy input through active galactic nuclei feedback. I use hydrodynamical simulations to study this co-evolution of supermassive black holes and their host galaxies on a range of different scales, and in a range of different contexts. My work includes small-scale accretion simulation focused on gas dynamics around the black hole, simulations of black holes in low redshift clusters studying the impact of AGN jets on cluster heating and cooling cycles, and investigations into the origin of supermassive black holes in high redshift mini-halos using super-zoom simulations. In this talk, I will give a brief overview of my work on these subjects.

Bayesian reconstruction of the cosmological dark matter flow

Florian Fuhrer

TBD

Multi-messenger cosmology with astrophysical gravitational waves, CMB and LSS

Suvodip Mukherjee

Next generation missions in astrophysics and cosmology are going to explore the Universe over a wide range of redshifts using multi-messenger probes such as electromagnetic waves, gravitational waves, etc. This new provision brings a unique cosmological window to explore the fundamental laws of physics and to unveil cosmic history over a wide range of redshifts. In the talk, I will discuss the effect of gravitational lensing on astrophysical gravitational waves due to cosmic structures and will introduce a new multi-messenger cosmological probe which can measure this signal using the multi-frequency gravitational wave data from the upcoming ground-based and space-based missions such as five-detector network of LIGO-Virgo-KAGRA-LIGO-India, LISA, Cosmic Explorer and Einstein Telescope. This new cosmological probe to the Universe will open a window to study the theories of gravity and several aspects of fundamental physics from a vast range of cosmic redshifts.

Calculating the Bispectrum in Non-Canonical Multi-field Inflation

John Ronayne

We extend the transport framework for numerically evaluating the power spectrum and bispectrum in multi-field inflation to the case of a curved field-space metric. This method naturally accounts for all sub and super-horizon tree level effects, including those induced by the curvature of the field-space. We present a working open source implementation of our equations in an extension of the publicly available PyTransport code. Finally we illustrate the utility of our work when applied to examples of inflationary models with a non-trivial field-space metric

---

Effects of millisecond pulsar winds on binary companions

Anne Zilles

Binary systems of millisecond pulsars with evaporating remnant companions, so-called black widows and redback pulsars, offer a unique opportunity to understand the nature of pulsar winds. The companions in many of these systems are observed to be hotter on the pulsar-facing side of the companion, so the companion are acting as a beam dump for the pulsar wind. I will present results of our current study in which we investigate whether these systems can be used to constrain the particle composition and energy of the pulsar winds.

The Higgs boson in the early Universe

Jacopo Fumagalli

The inflationary paradigm, which assumes an exponential expansion of our Universe in its early stage, connects the features of the Cosmic Microwave Background to the quantum fluctuations produced during inflation. Relating something we can observe today to what could have happened at the very beginning of our Universe is one of the most fascinating aspects of cosmology, perhaps even of science in general. However, the rather small amount of data that needs to be explained has given rise to an explosion of proposals able to account for the CMB measurements. Motivated by this, we consider the minimal scenario in which the only scalar field discovered experimentally, i.e. the Higgs boson, drives the inflationary mechanism. This simple framework together with the appealing possibility of connecting inflation to present-day particle physics measurements force us to face the following challenges: can we consistently extrapolate physics between two energy regimes separated by many order of magnitude? Can the predictions be sensitive to the unknown physics in between the inflationary scale and those probed with collider physics?

Gauged galileons and massive gravity

Sebastian Garcia-Saenz

The interactions of a massive graviton are greatly simplified at energies far above the particle's mass — what is known as the decoupling limit of massive gravity — when a description based on massless spin-2, spin-1 and spin-0 fields becomes applicable. The spin-0 sector is particularly interesting, being described by a galileon theory, a property that is at the origin of many of the virtues of massive gravity. But also intriguing is the opposite story: given a galileon theory, can one *derive* massive gravity as a low-energy completion? In this talk I will answer this question in the affirmative, by showing how the *gauging* of the symmetry that defines the galileon yields all the necessary ingredients to construct theories of massive gravity.
