Swiss Cosmology Days 2015 - University of Geneva - Program & Abstracts

Time	*Speaker*	*Org.*	*Title*	*Abstract*
February 5				
09.45-10.15			*Coffee Break*	
10.15-10.30			*Introduction*	
			Lensing	
10.30-10.50	Kacprzak, Tomasz	ETH	Weak lensing in the Dark Energy Survey	In this talk I give an overview of Dark Energy Survey (DES) as a cosmological probe, give updates about the survey status and early science results. I will focus on weak gravitational lensing and discuss observational challenges, control of the systematics and cosmological inference.
10.50-11.10	Rexroth, Markus	EPFL	Measuring weak lensing flexion	Flexion is the weak gravitational lensing effect which is responsible for the arclike appearance of lensed sources. Due to its stronger signal at intermediate separations from the lens center and its orthogonality to the shear field, flexion provides valuable additional information for constraining dark matter halos. Furthermore, it is ideally suited for detecting substructure and small clumps of dark matter. We present an automated flexion measurement pipeline and its results for the Hubble Frontier Fields clusters.
11.10-11.30	Shan, HuanYuan	EPFL	Weak lensing measurement on CFHT/Stripe82 Survey	With ~170 square degrees CFHT/Stripe Survey (CS82), we measure the shape of faint galaxies and generate the dark matter mass map. Here, we present some science work with CS82, including weak lensing peak statistics, the mass-concentration measurement and also galaxy-galaxy lensing measurement of satellite halo mass.
11.30-11.50	Paraficz, Danuta	EPFL	A PCA-based search for galaxy-scale strong lenses	I will present results from a systematic search for strong gravitational lenses in the CFHTLS data. The search is based on our automatic PCA - lens finder algorithm that uses machine learning technique - Principal Component Analysis (PCA) which subtract galaxies from imaging data and finds strong, galaxy-scale gravitational lenses in the resulting residual image. The combined method is optimized to find full or partial Einstein rings.
11.50-12.10	Birrer, Simon	ETH	Strong lens modelling and the properties of Dark Matter	The CDM model predicts a numerous amount of substructure. The luminous counterparts of these predicted substructures have been investigated for more than a decade. Many questions remain uncertain, known as "missing satellite problem" or "too big to fail problem". A more direct attempt to measure the substructure content is by strong gravitational lensing. I will show recent progresses in modelling galaxy size strong lens systems and its potential to capture features in the data which can potentially constrain the substructure content of the lenses.
12.10-12.30	Coupon, Jean	UNIGE	Cluster lensing profiles from redshift enhancement behind galaxy clusters	This talk aims to present an alternative technique to shear (or shape) measurement used for measuring galaxy cluster lensing profiles, known as magnification bias. However, instead of using the local density fluctuation of background galaxies behind clusters to probe lensing magnification, I will present the first measurement of the mean redshift enhancement of spectroscopic redshifts from the BOSS/SDSS survey. I will explain why by making use of future large scale "BAO" surveys, this technique will be especially advantageous for its high redshift potential to probe cluster masses and constrain the halo mass function beyond z=1. At lower redshifts, the low systematic error budget of this method may appear crucial as a complement to and perhaps calibration tool for traditional shear lensing techniques.
12.30-12.50	Küng, Rafael	UNIZH	Modelling gravitational lenses in Space Warps	In the last three decades some 400 strong gravitational lenses have been discovered, and the number is set to increase 100-fold over the next decade. These new lenses will need mass models, and the traditional mode of professional astronomers modelling lenses individually will not be feasible. We have developed a new approach to lens modelling, which enables experienced but non-professional volunteers to make lens models collaboratively. The Space Warps citizen-science project, which originally aimed only to find lens candidates, now has a small community of citizen-modellers as well. Do you plan to attend the meeting dinner on 5 February 2015?

12.50-14.20			*Lunch*	
			Dark matter & more	
14.20-14.40	Eckert, Dominique	UNIGE	Cosmology with the XMM-XXL survey	XMM-XXL is the largest observing program undertaken by XMM-Newton, Europe's cornerstone X-ray observatory. This program covers an area of 50 square degrees at a nearly uniform depth and aims at detecting roughly 500 galaxy clusters out to redshift ~2. The program was completed at the end of 2013 and the first set of results will be published at the end of the year. I will give an overview of the program and of the expected cosmological constraints, and present some of the first results which will be published in the first batch of papers.
14.40-15.00	Garny, Mathias	CERN	Interplay of indirect, direct and collider searches for WIMP dark matter	Out of many well-motivated possibilities, the WIMP paradigm still stands out as a convincing explanation for the particle physics origin of cold dark matter. The associated weak-scale interaction strength with the Standard Model particles has triggered major experimental activities in all search strategies, which are becoming increasingly sensitive to the expected range of cross sections. In order to rule out or identify certain classes of models, the interplay of indirect, direct and collider searches is important. We discuss current constraints and prospects in the context of representative simplified models.
			DE & MG	
15.00-15.20	Nesseris, Savvas	UNIGE	Reconstruction of the null-test for the matter density perturbations	We systematically study the null-test for the growth rate data first presented in [S. Nesseris and D. Sapone, arXiv:1409.3697] and we reconstruct it using various combinations of data sets, such as the $f\sigma 8$ and H(z) or Type Ia supernovae (SnIa) data. We perform the reconstruction in two different ways, either by directly binning the data or by fitting various dark energy models. We also examine how well the null-test can be reconstructed by future data by creating mock catalogs based on the cosmological constant model, a model with strong dark energy perturbations, the f(R) and f(G) models, and the large void LTB model that exhibit different evolution of the matter perturbations. We find that with future data similar to an LSST-like survey, the null-test will be able to successfully discriminate between these different cases at the 5σ level.
15.20-15.40	Sawicki, Ignacy	UNIGE	Towards a minimal description for modified gravity	I will discuss an approach for describing structure formation in modified theories of gravity which is minimal and yet preserves the fixed scale-dependent structure necessitated by general covariance and dynamical consistency. This sort of approach will allow for a measurement of the physical properties of dark energy and therefore give us an understanding of what dark energy is.
15.40-16.10			*Coffee Break*	
16.10-16.30	Guarato, Pietro	UNIGE	Perturbations for massive gravity theories	A theory of massive gravity depends on a non-dynamical 'reference metric' which is often taken to be the flat Minkowski metric. We examine the theory of perturbations on a background with a physical metric which does not coincide with the reference metric. We derive the mass term for general perturbations on this background and show that it generically is not of the form of the Fierz-Pauli mass term. We explicitly compute it for some cosmological situations.
16.30-16.50	Motta, Mariele	UNIGE	Instabilities in bimetric gravity	In this talk we would like to discuss instabilities in massive bigravity. In particular, we identify a self-accelerating bigravity model, the infinite-branch bigravity (IBB), which exhibits both viable background evolution and linear perturbations which do not reduce to the standard ?LCDM result during matter domination. We argue that in this model the initial perturbations of the scalar sector should be fine-tuned in order to be compatible with observations at early times. Finally, we comment on how non-linearities of the scalar modes can affect the tensor ones.
16.50-17.10	Cusin, Giulia	UNIGE	Bi-metric cosmology: is there an instability in the tensor pertrubation sector?	We study gravitational wave perturbations in a cosmological setting of bigravity which can reproduce the ΛCDM background and large scale structure. We show that in general gravitational wave perturbations are unstable and only for very fine tuned initial conditions such a cosmology is viable. We quantify this fine tuning. We argue that similar fine tuning is also required in the scalar sector in order to prevent the tensor instability to be induced by second order scalar perturbations. Finally, we show that due to this power law instability, models of bigravity can

				lead to a large tensor to scalar ratio even for low scale inflation.
17.10-17.30	Dirian, Yves	UNIGE	Observational constraints and parameter extraction in nonlocally modified General Relativity	We study the cosmological predictions of two recently proposed non-local modifications of General Relativity. Both models have the same number of parameters as ΛCDM, with a mass parameter m replacing the cosmological constant, and describe in particular a dynamical phantom dark energy. We implement the cosmological background and perturbations of the non-local models into a modification of the CLASS Boltzmann code, and we make a full comparison to CMB, BAO and supernova data. We find that the non-local models fit these datasets as well as ΛCDM. Parameter estimation using {\em Planck}\,+BAO+JLA data gives for both non-local models a value of H_0 higher than that in ΛCDM, and in agreement with the values obtained from local measurements.
19.00			*Dinner*	
February 6				
			LSS	
09.20-09.40	Bonvin, Camille	CERN	Three-point phase correlations: a new measure of non-linear large-scale structure	In this talk I will present a new observable, the line correlation function, which allows to probe the large-scale structure in the non-linear regime. The line correlation function is constructed from the three-point function of the phase of the density field. In the linear regime, where the density field is Gaussian, all the information is contained in the amplitude of the density field. The phases are randomly distributed and uncorrelated. In the non-linear regime however, non-Gaussianities generate correlations between the phases, that can be exploited to probe the non-linear evolution of the density. I will derive an analytical expression for the line correlation function, valid in the mildly non-linear regime, and I will discuss the advantage of this observable with respect to standard observables, like the density bispectrum.
09.40-10.00	Blas, Diego	CERN	Variations on non-linear corrections in the large scale structure	In my talk I will revisit the computation of the non-linear corrections to the matter power spectrum. I will emphasise the role of the equivalence principle and how its violation (either by the approximation scheme or by a fundamental violation) enhances the influence of modes with short wavelengths on those with long wavelengths.
10.00-10.20	Biagetti, Matteo	UNIGE	Scale-dependent bias from an inflationary bispectrum: the effect of a stochastic moving barrier	With the advent of large scale galaxy surveys, constraints on primordial non-Gaussianity (PNG) are expected to reach a precision of measurement of the non-linearity parameter f_NL ~ 1. In order to fully exploit the potential of these future surveys, a deep theoretical understanding of the signatures imprinted by PNG on the large scale structure of the Universe is necessary. In this paper, we explore the effect of a stochastic moving barrier on the amplitude of the non-Gaussian bias induced by local quadratic PNG. We show that, in the peak approach to halo clustering, the amplitude of the non-Gaussian bias will generally differ from the peak-background split prediction unless the barrier is flat and deterministic. For excursion set peaks with a square-root barrier, which reproduce reasonably well the linear bias and the halo mass function of SO haloes, the non-Gaussian bias amplitude is 40% larger than the peak-background split expectation for haloes of mass 10^13 solar masses at redshift z=0. Furthermore, we argue that the effect of PNG on squeezed configurations of the halo bispectrum differs significantly from that predicted by standard local bias approaches. Our predictions can be easily confirmed, or invalidated, with N-body simulations.
10.20-10.50			*Coffee Break*	
10.50-11.10	Marozzi, Giovanni	UNIGE	Galaxy number counts to second order via geodesic light-cone coordinates	In the near future cosmology will enter a new era in which the use of Newtonian gravity will no longer be sufficient in studying large scale structure (LSS). The next generation of LSS survey will probe the Universe with high precision and at very different scales, where non-linear and relativistic effects can play a key role. In this talk, I will present a new coordinate system, called geodesic light-cone (GLC) coordinates, useful to take in account such non-linear effects. I will show how, using the GLC gauge, one can solve non-perturbative the geodesic deviation equation, obtain an exact solution of the Jacobi Map and, through a coordinate transformation, obtain perturbative expression for cosmological observables in the Poisson gauge.

				In particular, I will present the evaluation of the galaxy number counts to second order in cosmological erturbation theory.
11.10-11.30	Montanari, Francesco	UNIGE	Galaxy number counts to second order: bispectrum	We propose to determine the truly observed two- and three-point statistics in terms of the angular power spectra. The fully relativistic expression for number counts is considered up to second order in perturbation theory. We show that neglecting integrated relativistic terms brings significant bias on cosmological parameters constraints for future large-scale and deep-redshift galaxy surveys.
11.30-11.50	Norena, Jorge	UNIGE	The squeezed limit of the LSS bispectrum	It is often remarked that the three-point function of galaxies contains many more modes than the one of CMB temperature fluctuations, which renders it ideal for constraining gravity and non-Gaussianity to unprecedented precision. However, much of this information is contained in highly non-linear scales that prove hard to model analytically to say the least. Nevertheless, exploiting simple physical principles like the fact that a constant gravitational potential is not physical or equivalence principle it is possible to write a fully relativistic and non-perturbative expression for the large scale structure bispectrum in the limit in which one of the momenta is small. This expression is expected to hold even to arbitrarily small scales in the other two momenta and can thus lend itself to be used for example in constraining the local non-Gaussianity parameter fNL
11.50-12.10	Stadel, Joachim	UNIZH	Euclid Precision Cosmology Simulation with the PKDGRAV3 Code	The ESA Euclid mission will require an unprecedented precision in the theory of structure formation in the Universe. I will discuss the problem of attaining a precision of 1% or better in the power spectrum to a k of about 10 h/Mpc while at the same time reaching the volume of this survey. What is required is a here-to-fore never achieved level of agreement between simulation codes on the largest simulations that are currently possible. These have of order a trillion particles and are among the largest calculations run at current supercomputer centres. The PKDGRAV3 code maximizes the use of both the CPUs and GPUs in simulations using tens of thousands of nodes in such supercomputers and has the best throughput amongst current codes for such large simulations. The PKDGRAV3, GADGET3 and RAMSES simulation codes are all well tested, state of the art simulation codes which now show exceptional agreement in the non-linear regime. This is certainly an encouraging result showing that the level of theoretical precision required by the Euclid mission is not out of reach in the coming years.
			+Baryons	
12.10-12.30	Mohammed, Irshad	UNIZH	Analytic model of the matter power spectrum, its covariance matrix, and baryonic effects	We develop a model for the matter power spectrum as the sum of Zeldovich approximation and even powers of k, i.e., $A_0 - A_2k^2 + A_4k^4 - ...$, compensated at low k. With terms up to k^4 the model can predict the true power spectrum to a few percent accuracy up to $k\sim 0.7 h \rm{Mpc}^{-1}$, over a wide range of redshifts and models. We write a simple form of the covariance matrix as a sum of Gaussian part and A_0 variance, which reproduces the simulations remarkably well. We explore the sensitivity of these coefficients to baryonic effects using hydrodynamic simulations. We find that because of baryons redistributing matter inside halos all the coefficients A_{2n} for $n>0$ are strongly affected by baryonic effects, while A_0 remains almost unchanged, a consequence of halo mass conservation. Our results suggest that observations such as weak lensing power spectrum can be effectively marginalized over the baryonic effects, while still preserving the bulk of the cosmological information contained in A_0 and Zeldovich terms.
12.30-14.00			*Lunch*	
14.00-14.20	Atek, Hakim	EPFL	Did galaxies reionize the Universe? New constraints from the strong lensing of the Hubble Frontier Fields	The identification of the first generation of galaxies and the possible sources of cosmic reionzation is one of the foremost challenges in modern astrophysics. Great progress has been made in characterizing galaxy populations at redshift z=6-7 through photometric observations in blank fields. A complementary approach is to exploit the power of gravitational lensing offered by massive galaxy clusters, which gives access to the faintest sources at high redshift. I will discuss the first results of the Hubble Frontier Fields program that aims at peering deeper into the distant Universe. Using the first HFF

				clusters A2744 and MACS0416, I will show how combining HST capabilities with gravitational telescopes can be an efficient way to study the faintest galaxy populations ever observed at those red- shifts. We can now put constraints on the faint-end slope of the UV luminosity function at z ~ 7 down to an absolute magnitude of MUV = −15.5, which is about 0.01L⋆, and two magnitudes deeper than the deep blank fields. I will also discuss the implications of the new constraints on the galaxy UV luminosity density on the cosmic reionization.
14.20-14.40	Mayer, Lucio	UNIZH	Baryonic physics in galaxy formation modifies the nature of cold dark matter halos	In the last five years galaxy formation simulations in the context of the Lambda Cold Dark Matter model have made tremendous progress. After two decades of persistent inability to explain the formation of galaxies with masses and sizes as observed, leading to a cold dark matter crisis, they can now reconcile the global properties of galaxies with the underlying structure formation driven by cold dark matter density fluctuations. Challenges remain, but they are not fundamental anymore. Instead, for the first time a prediction, rather than a verification, has emerged from numerical simulations. Namely, impulsive baryonic outflows driven by supernovae and stellar feedback, that are key to explain the emergence of large, angular momentum rich galactic disks, can turn into nearly constant density cores the dark matter cusps naturally fabricated by cold collapse in CDM. This prediction is becoming more and more intriguing and testable as the effect depends on observables such as the star formation history and stellar mass build up in galaxies. I will describe the current status of this important result that, if true, might by itself solve all the issue that CDM has been facing, including the so-called substructure problem.
			Inflation	
14.40-15.00	Orani, Stefano	UNIBAS	Wall-crossing at the end of hilltop inflation	The end of hilltop inflation is characterized by tachyonic growth of the inflaton fluctuations. Using lattice simulations, we study tachyonic preheating in hilltop inflation and show that wall-crossing can happen while the universe reheats.
15.00-15.20	Cefala, Francesco	UNIBAS	False vacuum energy dominated inflation with large r and the importance of \kappa_s	We investigate to which extent and under which circumstances false vacuum energy (V_0) dominated slow-roll inflation is compatible with a large tensor-to-scalar ratio r = O(0.1), as indicated by the recent BICEP2 measurement. With V_0 we refer to a constant contribution to the inflaton potential, present before a phase transition takes place and absent in the true vacuum of the theory, like e.g. in hybrid inflation. Based on model-independent considerations, we derive an upper bound on the possible amount of V_0 domination and highlight the importance of higher-order runnings of the scalar spectral index (beyond \alpha_s) in order to realise scenarios of V_0 dominated inflation. We study the conditions for V_0 domination explicitly with an inflaton potential reconstruction around the inflaton field value 50 e-folds before the end of inflation, taking into account the present observational data. To this end, we provide the up-to-date parameter constraints within ΛCDM + r + \alpha_s + \kappa_s using the cosmological parameter estimation code Monte Python together with the Boltzmann code CLASS.
15.20-15.40	Rubio, Javier	EPFL	Living beyond the edge: Higgs inflation and acuum metastability	The measurements of the Higgs mass and the top Yukawa coupling indicate that we live in a very special Universe, at the edge of the absolute stability of the electroweak vacuum. If fully stable, the Standard Model can be extended all the way up to the inflationary scale and the Higgs field, non-minimally coupled to gravity with strength ξ, can be responsible for inflation. We show that the successful Higgs inflation scenario can also take place if the SM vacuum is not absolutely stable. This conclusion is based on two effects that were overlooked previously. The first one is associated with the effective renormalization of the SM couplings at the energy scale M_P/ξ, where M_P is the Planck scale. The second one is a symmetry restoration after inflation due to high temperature effects that leads to the (temporary) disappearance of the vacuum at Planck values of the Higgs field.
15.40-16.00	Nolde, David	UNIBAS	Implications of large tensor modes for small-field models of slow-roll inflation	With the indications for r ~ O(0.1) by BICEP2, there have been discussions about whether all small-field models of inflation could be ruled out due to the Lyth bound, or if the Lyth bound can be evaded by specific choices of the inflation potential. We

				show that in single-field slow-roll inflation, it is impossible to reconcile r ~ 0.1 with field excursions \Delta \phi << M_pl, independently of the form of the potential. We also briefly discuss how this bound can be generalized to multi-field slow-roll models, and mention two ways in which multi-field models can dodge this bound.
16.00-16.30			*Discussion/Conclusion*	
16.30-17.00			*Coffee Break*	