	Monday 01/11	Tuesday 01/12	Wednesday 01/13
9:00-9:25	Uros Seljak - Intro	David Rubin	Stephen Feeney
9:25-9:50	Hans Kristian Eriksen	Alex Kim	Grigor Aslanyan
9:50-10:20	Break: Coffee/Discussions		
10:20-10:45	Keir Kwame Rogers	Francisco Kitaura	Jens Jasche
10:45-11:10	Phil Bull	Florian Beutler	Florent Leclercq
11:10-11:35	Hao-Yi Wu	Andreu Font	Zachary Slepian
11:35-1:30	Lunch Break		
1:30-1:55	Benjamin Racine	Michael Schneider	Gregory Green
1:55-2:20	Radek Stompor	Boris Leistedt	Franz Elsner
2:20-2:50	Break: Coffee/Discussions		
2:50-3:15	Federico Bianchini	Mohammadjavad Vakili	Marcel Schmittfull
3:15-3:40	Yu Feng	Jeff Regier	Dustin Lang
3:40-4:10	Discussion (Jeff Jewell	Discussion (M. Schneider)	Discussion (M. White)
4:30	Reception (6th floor)	Drinks (6th floor)	

Talks are 20 minutes + 5 minutes for questions.

Colors:	Introduction	Supernovae	Sampling Methods
	Break		
	CMB	LSS	

Name	Affiliation	Talk title	Talk abstract
Monday 01/11			
Uros Seljak	UC Berkeley	Introduction	
Hans Kristian Eriksen	University of Oslo	Gibbs sampling and the Planck experience	
Keir Kwame Rogers	University College London	An internal linear combination map for CMB polarisation using directional wavelets [1]	B-mode polarisation is a powerful cosmological observable which in principle allows the detection of a stochastic background of gravitational waves predicted by inflation, and gives strong constraints on the neutrino sector using the weak gravitational lensing of the cosmic microwave background (CMB). Astrophysical foregrounds present a formidable obstacle in extracting these signatures of new physics from CMB polarisation data. The foregrounds can be separated from the cosmological signal using their characteristic frequency, spatial and morphological signatures -- however, current component-separation algorithms do not make optimal use of the morphological information. I will present a novel form of internal linear combination (ILC) that uses directional wavelets to better localise the cleaning algorithm that removes foreground contamination using this extra information. Directional wavelets are non-axisymmetric on the sphere. When they are convolved with signals on the sphere, they separate filamentary structures, a characteristic of polarised foregrounds. In combination with the ILC, foreground signal and instrumental noise can be better removed to reveal the cosmological B-modes. I will present the results of the algorithm's application to temperature anisotropies, and discuss the prospects for CMB polarisation data. [2]
Phil Bull	JPL/Caltech	Reconstructing the KSZ effect	I describe a Bayesian method to measure the peculiar velocities of galaxy clusters from their kinetic Sunyaev-Zel'dovich effect imprint on the CMB. The method uses a Gibbs sampling approach to sample from the joint posterior distribution for a combined primary CMB + cluster profile + velocity field model. Marginal maps of both the reconstructed linear velocity field and primary CMB are a natural biproduct of the algorithm. This "double reconstruction" is valuable for reducing the variance of KSZ velocity estimators, and the marginal velocity map can be used as part of a multi-tracer analysis.
Hao-Yi Wu	Caltech	Optimizing future cosmic far-infrared background experiments	Cosmic far-infrared background (CFIRB) originates from high-redshift dusty star-forming galaxies and can be used to constrain the star formation history of the Universe. In this talk, I would like to discuss how we can optimize future CFIRB experiments to constrain star formation history, to complement UV/optical surveys, and to learn about galaxy evolution.
Radek Stompor	CNRS/APC, France	TBD	

Benjamin Racine	University of Oslo	Cosmological Parameters from CMB Maps without Likelihood Approximation	We propose an efficient Bayesian MCMC algorithm for estimating cosmological parameters from CMB data without use of likelihood approximations. It builds on a previously developed Gibbs sampling framework that allows for exploration of the joint CMB sky signal and power spectrum posterior, P(s,Cl|d), and addresses a long-standing problem of efficient parameter estimation simultaneously in high and low signal-to-noise regimes. To achieve this, our new algorithm introduces a joint Markov Chain move in which both the signal map and power spectrum are synchronously modified, by rescaling the map according to the proposed power spectrum before evaluating the Metropolis-Hastings accept probability. We apply our new algorithm to simplified simulations for which we can evaluate the exact posterior to study both its accuracy and performance, and find good agreement with the exact posterior; marginal means agree to less than 0.006 sigma, and standard deviations to better than 3%. The Markov Chain correlation length is of the same order of magnitude as those obtained by other standard samplers in the field.
Federico Bianchini	SISSA/ISAS	Toward a tomographic analysis of the cross-correlation between Planck CMB lensing and H-ATLAS galaxies	High-resolution Cosmic Microwave Background (CMB) measurements carried out both by space- and ground-based experiments enables us to reconstruct the CMB Lensing map which probes the matter distribution in the Universe out to high redshifts, hence encoding a wealth of cosmological information. On the other side, dusty star-forming galaxies (DSFG) at z > 1.5 are the biased signposts of the haloes that act as lenses for CMB photons. I will present the first cross-correlation analysis between CMB Lensing measured by Planck and the spatial distribution of the sub-mm selected high-z H-ATLAS galaxies, describing both datasets and technique exploited. The signal is detected with high significance even when analysis is performed on redshift bins. I will show constraints on galaxy bias inferred from jointly clustering and cross-correlation data, discussing possible systematics and future work needed in order to fully exploit upcoming CMB and galaxy surveys.
Yu Feng	UC Berkeley	fastPM: a particle mesh code for cosmological simulations	We introduce fastPM, a highly-scalable approximated particle mesh N-body solver. fastPM implements the vanilla particle mesh (PM) scheme and the COmoving-LAgrangian (COLA) particle mesh scheme for the calculation of accelerations and displacements of particles. Benefited from the 2-dimensional domain decomposing scheme, fastPM scales extremely well, reducing the wall-clock time nearly linearly with the number of CPUs. We explore the parameter space for the approximations with fastPM and found a scheme that produces a relatively accurate halo population down to M > 10^{12} h^{-1} M_\odot, using only 8 times of the computing time of 2LPT. Given the good parallel efficiency and the low cost of the scheme, we think fastPM can be useful for Monte Carlo Markov Chain calculations -- an application that we are actively investigating.
Tuesday 01/12			
David Rubin	LBNL, STScI	UNITY: Confronting Supernova Cosmology's Statistical and Systematic Uncertainties in a Unified Bayesian Framework	
Alex Kim	LBNL	Hierarchical Model for DES/LSST SN Surveys	

Francisco Kitaura	Leibniz Insitute for Astrophysics in Potsdam	Modelling and inference of the large-scale structure	I will discuss novel methods to model the large scale structure with effective galaxy bias models including nonlinear, stochastic and nonlocal contributions. I will further show how these models can be used in an inference analysis. Then I will present different Bayesian inference approaches to deal with redshift space distortions and density reconstructions.
Florian Beutler	LBNL	TBD	
Andreu Font	LBNL	3D power spectrum of the Lyman alpha forest: from an optimal to a realistic estimator	
Marcel Schmittfull	UC Berkeley/LBNL	Eulerian BAO reconstructions	
Boris Leistedt	New York University	3D weak lensing with spin wavelets on the ball	wavelets to robustly measure the 3D cosmic shear power spectrum and other weak lensing observables. The wavelets probe spin and directional features separately on the sky and along the line of sight. They can be used to robustly deal with angular or radial systematics, mask and selection effects, and also to only restrict the analysis to scales that can be accurately modelled. The wavelets are constructed on the Fourier-Laguerre transform, a 3D harmonic transform that is separable, admits an exact pixelisation/sampling theorem, and also has a direct analytical connection to the Fourier-Bessel transform.
Michael Schneider	LLNL	Hierarchical Probabilistic Inference of Cosmic Shear	I will describe high-dimensional samplers designed to infer gravitational lensing shear and convergence fields from galaxy ellipticity catalogs under a spatial process prior for the lensing potential. We simultaneously infer the covariance of morphologies and sizes for different galaxy classes with a hierarchical model for unlensed galaxy properties. I will summarize our plans to marginalize this joint information in a new cosmological parameter inference pipeline.
Mohammadjavad Vakili	New York University [3]	Application of Approximate Bayesian Computation in Large Scale Structure [4]	Approximate Bayesian Computation (known as ABC) is a method for deriving posterior probability distribution over model parameters of interest without assuming any likelihood function. We discuss how this technique, once equipped with adaptive importance sampling, can be used for parameter estimation in Galaxy Clustering, and Weak Lensing Cosmology. [5]
Jeff Regier	UC Berkeley	Celeste: Variational inference for a generative model of astronomical images	
Wednesday 01/13			
Stephen Feeney	Imperial College London		(I will provide more detail later, but I am planning to propose a talk on the cosmological applications of nested sampling and model selection, for example, searches for non-trivial topologies and anisotropic Bianchi cosmologies.)

Grigor Aslanyan	UC Berkeley	Learn-As-You-Go Acceleration of Cosmological Parameter Estimates	I will discuss a new machine-learning emulation algorithm for accelerating cosmological parameter estimation through statistical sampling. The main novelty in the emulator is that it includes an error estimation algorithm, which allows one to control the errors in emulation, as well as the error in the target posterior distribution. The algorithm builds the training set on the go, and uses it to do rapid emulation whenever the emulation error is smaller than a given threshold. The algorithm is completely independent of the statistical sampling algorithm and can be easily used with any sampler, for any problem. As an example, we have used the emulator for Lambda-CDM parameter estimates from the Planck data. It gives a speedup factor of 6.5 for Metropolis-Hastings and a factor of 3.5 for nested sampling through MultiNest. The code is publicly available through the Cosmo++ package at http://cosmopp.com.
Zachary Slepian	Harvard University	Using the 3-point correlation function to constrain dark energy	
Dustin Lang	University of Toronto	The Trator: Forward modeling for the measurement of astronomical objects	
Gregory Green	Harvard	Inferring Galactic Structure from a Billion Stellar Colors	I present a simple problem: current and upcoming large photometric surveys are set to provide colors for billions of stars in the Milky Way. Can we infer the structure of our Galaxy from these stellar colors alone? In principle, given a smooth model of the distribution of stars throughout the Galaxy, a model of the spectral energy distribution of different stars, and a model of how dust reddens stars, one can infer the distribution of both stars and dust throughout the Galaxy. We have done just this for the billion stars observed by Pan-STARRS 1, producing a three-dimensional map of Galactic dust and stars over three quarters of the sky. I will discuss this work, how it can be extended in the future, and how it can be used to improve foreground models for cosmological surveys.

Jens Jasche	Excellence Cluster Universe	Inferring past and present cosmic structures from observations	Presently proposed and designed future cosmological probes and surveyspermit us to anticipate the upcoming avalanche of cosmological informationduring the next decades. The increase of valuable observations needs to beaccompanied with the development of efficient and accurate informationprocessing technology in order to analyse and interpret this data.Besides traditional systematics and uncertainties such as surveygeometries and observational noise, modern data analysis needs to accountfor the complex statistical properties of gravitationally evolved matterfields and also has to provide corresponding uncertainty quantification.The analysis of the structure and evolution of ourinhomogeneous Universe therefore requires to solve non-linear statisticalinference problems in very high dimensional parameter spaces, involving onthe order of 10^7 or more parameters. For these reasons, in this talk Iwill address the problem of high dimensional Bayesian inference fromcosmological data sets via therecently proposed BORG algorithm. This method couples an approximate modelof structure formation to an Hybrid Monte Carlo algorithm providing afully probabilistic, physical model of the non-linearly evolved densityfield as probed by galaxy surveys. Besides highly accurate and detailedmeasurements of three dimensional cosmic density and velocity fields, thismethodology also infers plausible formation histories for the observedlarge scale structure. In this talk I will give an overview over thispromising path towardsBayesian chrono-cosmography, the subject of inferring the four dimensionalstate of our Universe from observations.
Florent Leclercq	Institute of Cosmology and Gravitation, Portsmouth, UK	Cosmic web analysis and information theory: some recent results	The BORG (Bayesian Origin Reconstruction from Galaxies) algorithm is an inference engine that derives the initial conditions given a cosmological model and the survey data, and produces physical reconstructions of the underlying large-scale structure by assimilating the data into the model. It explores the joint posterior distribution of all parameters involved via efficient Hamiltonian Monte Carlo sampling. I will demonstrate the application of BORG to real galaxy catalogs and describe the primordial and late-time large-scale structure in the volume covered by the Sloan Digital Sky Survey main galaxy sample. Building upon these results, I will present a detailed characterization of dynamic cosmic web type environments. These developments naturally bring in a connection between cosmic web analysis and information theory. In particular, I will discuss the Shannon entropy of the structure-type probability distribution and the information gain due to SDSS galaxies. I will also propose a decision criterion for classifying structures in the presence of uncertainty, and introduce utility functions for the optimal choice of a cosmic web classifier, specific to the application of interest.
Adam Mantz	Stanford University	Galaxy Clusters	If there's interest, I can give an overview of (statistical aspects of) the cosmological analysis of galaxy cluster counts. It's good fun.

Franz Elsner	University College London	Unbiased methods for removing systematics from galaxy clustering measurements	With the increasing sensitivity of current and future surveys, measurements of the angular clustering of galaxies are becoming a more and more powerful probe of cosmology. At the same time, however, contamination by observational and astrophysical systematics must be kept under control. In this talk, I review statistical methods that make use of externally supplied templates to remove the effect of systematics on galaxy clustering estimates. Based on analytical calculations and simulations, I find that some of the proposed techniques return biased results. I discuss approaches to correct for it and show that cleaning procedures generally result in weakened constraints on power spectra and angular correlation function measurements.

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