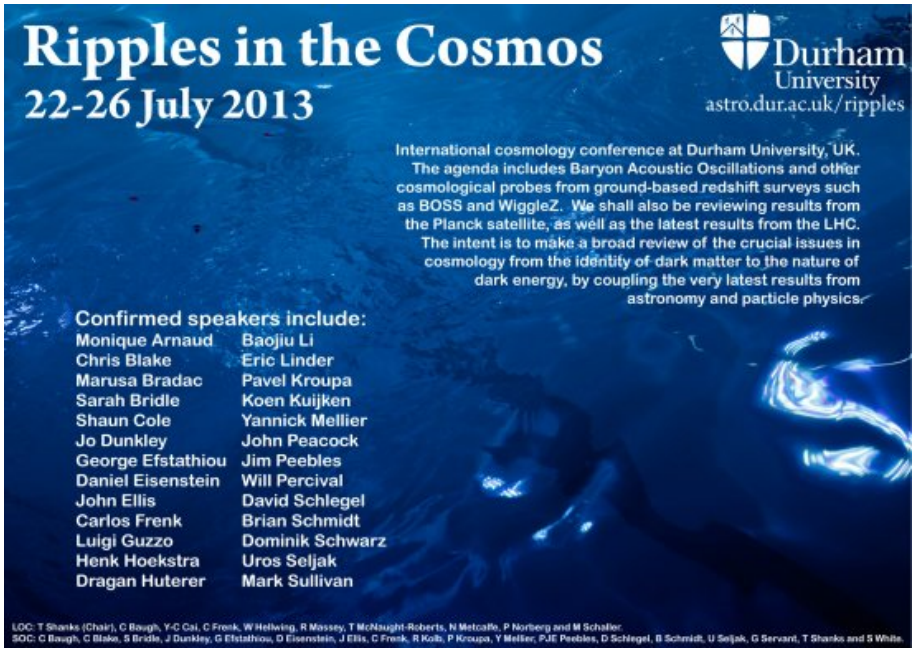
RIPPLES IN THE COSMOS

A Conference at Durham University, July 22-26 2013



ABSTRACT BOOKLET

(R) - review speaker, (T) - targeted speaker

CMB primary and secondary backgrounds + polarisation

09.05 J Dunkley (Oxford): (R) The cosmic microwave background

09.35 GP Efstathiou (IoA): (T) Cosmology from Planck

I will present a summary of the first cosmological results from Planck. The results agree spectacularly well with the basic six parameter Lambda CDM cosmology. To high accuracy, we find no evidence for non-Gaussianity, tensor modes, or departures from a purely adiabatic primordial fluctuation spectrum. Adding observations of baryon acoustic oscillation experiments to the Planck data, we find no evidence for additional neutrino like particles or for evolving dark energy.

10.05 D Scott (UBC): Other Things from Planck

I will discuss some Planck results which were not already covered.

10.25 I Szapudi (IfA, Hawaii): Phase Coherence of WMAP and Planck

We compare the generalized phases of the newly released Planck temperature maps with WMAP 9 and 7 year maps. The phase coherence of the maps is complementary to the power spectrum, and it gives us interesting clues on the repeatability of the non-isotropic and/or non-Gaussian information that can be recovered from CMB temperature maps.

11.10 DJ Schwarz (Bielefield): (T) Anomalies?

The microwave sky, as seen by the WMAP and Planck missions, reveals several unexpected features on large angular scales. Some of them challenge fundamental principles of modern cosmology, especially the statistical isotropy. I'll review several anomalies and conclude that they are real.

11.40 T Shanks (Durham): Testing WMAP and Planck beams via radio sources

We have analysed the stacked profiles of radio point sources from WMAP and Planck. In WMAP data we continue to find profiles that are more extended in the W band than expected from the Jupiter beam profiles. From WMAP we also find a scale error between WMAP fluxes and ground-based/Planck fluxes in the W band and this non-linearity may be connected with the extended W beam profile. In Planck data we find different beam profiles at low and high ecliptic latitudes with the former being more extended than the latter. For Planck we are investigating whether this latitude dependence is consistent with the variation expected for the Planck beam profile across the sky. We discuss the implications for cosmology.

12.00 W Watson (Sussex): Simulating the ISW with the Jubilee simulation

12.20 Y Cai (ICC): Imprints of superstructures on the CMB

At the late epoch of a LCDM universe, super-clusters and voids leave their imprints of slight hot and cold spots on the CMB via the Integrated Sachs-Wolf effect. Such a signal may have been detected by the stacking of superclusters and voids found in the SDSS galaxy field, but the amplitude of the signal seems to be too high compared to what LCDM would expect. To understand this possible tension with the LCDM model, N-body simulation have been employed to explore the non-linear ISW contribution, and similar analysis has been repeated using newly available data. I will summarize recent development in this field, which includes our inputs.

Dark matter candidates and constraints - direct + indirect + LHC

14.15 J Ellis (CERN): (R) Casting Light on Dark Matter?

The implications for cosmology of LHC results on the Higgs boson and searches for physics beyond the Standard Model will be reviewed, together with the prospects for non-accelerator searches for dark matter.

14.45 CS Frenk (ICC): (T) The Milky Way and the Identity of the Dark Matter

The identity of the dark matter is imprinted on certain properties of the Milky Way. In particular, the abundance and structure of satellite galaxies provide strong constraints on cold and warm dark matter. I will show that if the mass of the Milky Way halo is too large, cold dark matter is ruled but, if the mass of the Milky Way halo is too small, then warm dark matter is ruled out.

15.15 C Boehm (IPPP): Impact of Planck Data on DM searches

I will review the impact of PLANCK data on dark matter searches. In particular I will discuss the importance of the measurement of Neff, the damping tail and reionization on DM scenarios.

15.35 M Lovell (ICC): Galaxy Formation with WDM

The LCDM paradigm has been very successful at predicting the properties of the large scale (>~10Mpc) Universe, but has recently struggled to explain phenomena observed on small scales, such as the central densities of satellite galaxies. One possible solution to these problems is to consider the possibility that the dark matter instead be made up of sterile neutrinos: these particles would have masses of ~1-10keV and behave as 'warm' dark matter (WDM), with consequences for the formation of galaxies. In this talk I will discuss the impact that of WDM would have on galaxy formation theory, and consider observational tests including the dynamics of satellite galaxies.

16.25 C McCabe (IPPP): The Unbearable Lightness of Being: CDMS v XENON

The CDMS-II collaboration has reported 3 events in a Si detector, which are consistent with being nuclear recoils due to scattering of Galactic dark matter particles with a mass of about 8.6 GeV and a cross-section on neutrons of about 2 x 10^-41 cm^2. While a previous result from the XENON10 experiment has supposedly ruled out such particles as dark matter, we find by reanalysing the XENON10 data that this is not the case. Some tension remains however with the upper limit placed by the XENON100 experiment, independently of astrophysical uncertainties concerning the Galactic dark matter distribution. We explore possible ways of ameliorating this tension by altering the properties of dark matter interactions. Nevertheless, even with standard couplings, light dark matter is consistent with both CDMS and XENON10/100.

16.45 M Tarbutt (Imperial): Measurement of the electron's electric dipole moment

For an elementary particle to possess a permanent electric dipole moment (EDM), time-reversal symmetry must be violated. In most models of particle physics this implies the violation of CP symmetry. The Standard Model predicts an exceedingly small value for the electron EDM, but many extensions to the Standard Model predict EDMs near the current experimental limits. For example, some supersymmetric models are already strongly constrained by the need to keep the predicted values of EDMs small. We have made the most precise measurement of the electron EDM by measuring how the spin-precession rate of YbF molecules changes in an applied electric field. The polar molecule enhances the sensitivity to the EDM. I will describe the experiment, our result, its implications, and our future plans for improving the sensitivity.

17.05 T Davis (UQ): Cosmological particle physics

Relativistic particles effect structure formation in the early universe and their signature can still be seen in the ripples in the cosmos. I'll review the evidence for neutrinos from the cosmic microwave background and baryon acoustic oscillations, and show the strongest constraints come from additionally combining those with matter power spectra data. Extra neutrino species are still slightly preferred, even after Planck, and the sum of the mass of the neutrinos is now constrained to be 0.05eV< Sum(masses) < 0.15eV, where the lower limit comes from particle physics and the upper from cosmology. The next generation of cosmology experiments should be able to distinguish between natural and inverted neutrino mass hierarchies.

17.25 M Medvedev (Kansas): Cosmological Simulations with 2 component CDM

A number of dark matter candidates (such as neutralinos, axions, sterile neutrinos, etc.) are flavor-mixed particles. The dynamics of non-relativistic particles with quantum flavor mixing has been shown to be rather unusual. For example, conversions of the particle mass-eigenstates which are initially gravitationally trapped in a potential well, can cause their irreversible escape from it. This effect has been referred to as the `quantum evaporation'. So far, CDM cosmology has not accounted for the possible flavor-mixed nature of dark matter particles. In the present work we explored this possibility from the first principles via extensive LambdaCDM cosmological simulations with Gadget2, which was modified to incorporate the relevant physics. We obtained that the simplest model with two-component mixing and small mass-degeneracy provides a remarkably good fit to astronomical data at both large and small scales. The simulations show substantial reduction of substructure and softening of central cusps in dark halos whereas the large-scale structure remains intact. This simultaneously resolves two outstanding problems of CDM cosmology: the substructure and core/cusp (and the possibly related to-big-to-fail) problems, yet it does not contradict apparent counter-examples and observational constraints. The model also makes predictions for direct and indirect detection dark matter experiments.

Large scale structure in galaxies + clusters + primordial non-Gaussianity

09.00 M Arnaud (CEA): (R) The SZE view of galaxy clusters and cosmology

The Sunyaev-Zeldovich effect has become an important probe of cluster physics, large-scale structure and the cosmological model. I will highlight recent results based on SZ surveys (ACT, Planck and SPT) and their multi-wavelength follow-up programs. I will also discuss high resolution SZ imaging of clusters.

09.30 J Mohr (Munich): SPT galaxy cluster cosmological constraints

A sizeable sample of SPT clusters is now available for cosmological analysis, and the key remaining challenge is in the mass calibration of the sample. Our ongoing effort to obtain velocity dispersion based mass estimates has delivered approximately 60 new mass constraints extending to beyond z=1. We convert the velocity dispersions to cluster mass estimates by using large scale structure formation based simulations, effectively carrying out mock spectroscopic observations with selection similar to our selection in the real SPT systems. These mass constraints from velocity dispersions suggest that SPT clusters are more massive than our previous best estimates, which were based on X-ray Y_X measurements calibrated at z~0.3. Two complementary efforts are focused on obtaining weak lensing mass constraints of 19 z~0.3 SPT clusters using ground based Magellan imaging and 14 0.5<z<1.35 SPT clusters using HST imaging for shapes and VLT imaging for galaxy colors. We present the cosmological constraints from the SPT cluster sample using this new mass information, examining both wCDM models and LCDM models where the growth rate of structure is assigned an additional free parameter.

09.50 K Romer (Sussex): XMM clusters through DECAM eyes

Using data from the Scientific Verification phase of the Dark Energy Survey, we will present results derived from deep, multi-colour, images of XMM clusters made using the DECam instrument. The methods used to generate XMM images of more than 600 clusters/cluster candidates that overlap with the DES-SV region (these methods have been adapted from those used in the XMM Cluster Survey, XCS). Some of these objects are well known (e.g. The Bullet Cluster), but many of these clusters have been confirmed for the first time using DECam data. DECam images and preliminary optical to X-ray scaling relations, will be shown.

10.10 M Neyrinck (Johns Hopkins): Tracking the flow of cosmic information

At early times, the initial fluctuations were as though imprinted on the cold-dark-matter density sheet. As these fluctuations grow, some get stretched out in voids, and in other places they bunch together and fold to build structures, in rough analogy to origami. In these structures, the small-scale fluctuations become obscured obscured from viewing in the coarse-grained density field. I will discuss some new insights into the dynamics of this process, obtained by "ringing" the initial conditions at different wavenumbers, and observing the effect in final-conditions power spectra, of both the usual density and transformations of it.

10:30 J Yoo (Zurich): Wide-angle effects in Galaxy Surveys

Current and future galaxy surveys cover a large fraction of the entire sky with a significant redshift range, and the recent theoretical development shows that general relativistic effects are present in galaxy clustering on very large scales. This trend has renewed interest in the wide angle effect in galaxy clustering measurements, in which the distant-observer approximation is often adopted. Using the full wide-angle formula for computing the redshift-space correlation function, we show that compared to the sample variance, the deviation in the redshift-space correlation function from the simple Kaiser formula with the distant-observer approximation is negligible in the SDSS and is completely irrelevant in future galaxy surveys such as Euclid and the BigBOSS, if the theoretical prediction from the Kaiser formula is averaged over the survey volume and the non-uniform distribution of cosine angle between the line-of-sight and the pair separation directions is properly considered. We also find corrections to the wide-angle formula and clarify the confusion in literature between the wide angle effect and the velocity contribution in galaxy clustering. However, in contrast to the redshift-space correlation function, substantial deviations, larger than the sample variance, are present in the redshift-space power spectrum, because the non-uniform distribution of cosine angle is not considered in the present power spectrum analysis. In particular, the traditional FKP method cannot be used to estimate the quadrupole and the hexadecapole power spectra, as it imposes one line-of-sight direction to all galaxy pairs, though this issue can be readily addressed by using pair-dependent line-of-sight directions. Since galaxies are sufficiently far away from the observer in galaxy surveys, especially beyond the SDSS, the distant-observer approximation is accurate and the wide angle effect is negligible. However, further refinement of power spectrum estimators will be needed to avoid significant systematic errors in future surveys.

11.20 D Huterer (Michigan): (R) The Quest for Primordial non-Gaussianity

Standard single-field, slow-roll inflationary theory predicts that primordial fluctuations in the universe were nearly Gaussian random, although some well-motivated models specifically predict observably large non-Gaussianity. Measurements of primordial non-Gaussianity therefore represent a rare window into the physics moments after the big bang. I first review the history of measurements of non-Gaussianity from the cosmic microwave background (CMB) anisotropies over the past two decades. I then review results obtained over the past five years showing the signatures of primordial non-Gaussianity in the large-scale structure (LSS). I finally discuss the current and forecasted future constraints on classes of models for primordial non-Gaussianity from the combination of the CMB and LSS.

11.50 T Giannantonio (LMU): Non-Gaussianity from galaxy clustering and ISW

I will present the latest constraints on primordial non-Gaussianity from the scale-dependent bias, obtained using a compilation of the newest available galaxy catalogs, including SDSSIII-BOSS. I will show a detailed analysis of the possible systematics, to assess the reliability of the data. I will conclude with an extension to the clustering of galaxy clusters and an outlook to ongoing and future surveys. [arXiv:1303.1349, arXiv:1303.0287]

12.10 F Castander (Barcelona): MICE simulations - a tool for cosmological surveys

The MICE simulations have produced large galaxy mock catalogues with which one can analyse and interpret future cosmological surveys. The catalogues contain the galaxy clustering and lensing patterns and therefore are ideal to study the performance of same sky clustering and lensing surveys. We will review the catalogue construction and their application to the DES, PAU and Euclid surveys.

12.30 M Crocce (Barcelona): Z-space distortion from combined photometric samples

In this talk I will discuss the possibility of measuring redshift space distortions from angular auto-correlations in photometric surveys such as DES or PanSTARRS, if galaxies are selected in photometric redshift bins. In particular I will discuss the gains (e.g. in constraining the growth rate of structure) obtained from including as observables also the cross-correlations between bins, that introduce radial information. And show that further improvements can be achieved by combining two galaxy populations with different biases over the same photometric sky area. In all, our findings show that a survey such as DES should constrain the evolution of f(z) x sigma_8(z) in few bins beyond z~0.8-0.9 at the 10% level per-bin. This is perfectly compatible with recent constrains from lower-z spectroscopic surveys and highlights a new and exciting application of upcoming photometric data.

Large scale structure in dark matter - lensing

14.00 H Hoekstra (Leiden): (R) Weak lensing by large-scale structure

Intervening structures in the universe give rise to small distortions in the shapes of distant galaxies. By measuring this tiny coherent signal, we can study the mass distribution in the universe directly, without relying on baryonic tracers. This makes weak lensing a key tool to measure masses of collapsed objects, from galaxies to clusters of galaxies. Another key application is the measurement of the signal from the large-scale structure, which is a powerful probe of cosmology, although it has recently been shown that baryon physics does affect the interpretation of the results. I will review the topic of weak lensing and discuss how the signal is extracted from the data. I will present some highlights from the recently completed CFHTLenS.

14.30 T Collett (IoA): Constraining DE with double source plane strong lenses

The Einstein radius of a strong lens system depends on the redshift of lens and source, the mass distribution in the lens galaxy and the underlying geometry of the universe. In systems where there are two background sources at different redshifts (DSPLs), one can measure the ratio of Einstein radii. For a galaxy-scale lens, this quantity is only weakly dependant on the mass distribution of the lens and independent of the Hubble constant, but is sensitive to the dark energy equation of state. Here I will describe the cosmological constraints possible from a population of galaxy-scale DSPLs. I will present constraints from the first known galaxy-scale DSPL and detail how DSPLs can evolve from a niche measurement today to a powerful cosmological probe over the next decade.

14.50 C Heymans (Edinburgh): Testing the laws of gravity with CFHT-Lens

The Canada-France-Hawaii Telescope Lensing survey (CFHTLenS) is a wide and deep 154 square degree multi-band optical survey that has been optimised for the measurement of weak gravitational lensing. This powerful technique can map dark matter structures from their gravitational effects alone and probe dark energy through its effect on the growth of these structures. From an observational perspective, I'll discuss the challenges and successes of this unique technique showing the cosmological parameter constraints from a finely-binned tomographic analysis of the CFHTLenS data. Combining the lensing data with measurements of redshift space distortions from the Wiggle-Z redshift survey, I will present our analysis which tests whether we need to go beyond Einstein with our current model of gravity.

15.10 T Kitching (UCL): Cosmology using 3-D Cosmic Shear

In this presentation I will explain how redshift and position information of weakly lensed galaxies can be used to reconstruct a fully three dimensional cosmic shear power spectrum. Such an approach allows uncertainties in theoretical predictions and systematic effects to be controlled in a rigorous way, and doesn't bin the data in the redshift direction. I will present forecasts for future surveys using this method, and also present cosmological parameter constraints from an application of this method to CFHTLenS.

15.30 F Courbin (EPFL): Strong lensing + qso time delays for precision cosmology

The measurement of time delays in strong lensed lensed quasar can be used to efficiently constrain the cosmological parameters, in particular Ho and the \Omega_k. I will show 1- that the COSMOGRAIL lens monitoring program, with 10-year long quasar light curves, allows to measure time delays with 1-2% accuracy, 2- that these time delays can be used in combination with HST imaging to set constraints on Ho and \Omega_k. With one single object, constrains are already competitive with BAO alone and well complementary with Planck+BAO constrains. These new results of COSMOGRAIL are highlighted in the Planck #16 paper on cosmological parameters. I propose here to develop further on how to use time delays in the Planck area.

15.50 A Choi (Edinburgh): Cosmic shear in RCS2

We present a cosmic shear analysis of the Red Sequence Cluster Survey 2 (RCS2), an optical survey using MegaCam on the CFHT with lensing quality resolution (seeing~0.7), medium depth (r~24), and wide area (>500 degrees with 4-band photometric redshifts). We have reduced and catalogued the data using the same pipeline applied to CFHTLenS, including data processing with THELI, shear measurements with Lensfit, photometric redshifts with BPZ, and an extensive range of systematics tests. We also cross-correlate the spatial positions of spectroscopic galaxies from WiggleZ with photometric galaxies from RCS2 to test the robustness of our photo-z selections for shear tomography.

16.40 M Bradac (UC Davis): (T) Studying Dark Matter with Cosmic Supercolliders

The cluster of galaxies 1E0657-56 has been the subject of intense research in the last few years. This system is remarkably well-suited to addressing outstanding issues in both cosmology and fundamental physics. It is one of the hottest and most luminous X-ray clusters known, and is unique in being a major supersonic cluster merger occurring nearly in the plane of the sky, earning it the nickname "the Bullet Cluster". I will present our newest measurements of the composition of this system, show the evidence for existence of dark matter, and describe limits that can be placed on the intrinsic properties of dark matter particles. In this talk I will also present new results from a much larger sample of Bullet-like cluster, MACSJ0025-1222, A520, and DLSCL J0916.2+2951 among others. Although they do not contain a low-entropy, high density hydrodynamical `bullet,' these clusters exhibits many similar properties to the Bullet Cluster.

17.10 D Harvey (Edinburgh, S,P):Measuring the cross-section of DM in clusters

Making order of magnitude estimates on the dark matter interaction cross section have been limited to rare events of merging clusters. I will present a novel method which statistically stacks offsets from many in-falling sub halos as they are accreted on to galaxy clusters. I will support this innovative method with measurements made on realistic galaxy cluster simulations showing fully how one should be able to make a detection in real data.

17.30 R Massey (ICC): EUCLID

ESA's Euclid space telescope will be part of the Cosmic Visions programme and is planned for launch in 2020. From its stable vantage point far beyond the Earth's turbulent atmosphere, Euclid will obtain sharp, high-resolution images of billions of distant galaxies across a third of the sky. The positions and shapes of these galaxies are essential for mapping the history and evolution of the dark Universe, through a combination of BAO and weak lensing measurement. It will also supply a legacy of high resolution imaging and spectroscopy for a huge variety of science. Euclid requires some of the largest digital cameras ever built and launched into space, able to accurately measure such faint galaxies. The Euclid Consortium is the largest astronomical collaboration ever to exist, bringing together over a thousand physicists and engineers from across Europe and beyond.

Galaxy formation challenges and bias

09.00 SM Cole (ICC): (R) Challenges to Lambda-CDM

A review of the challenges facing the LCDM model on small scales along with speculation on possible ways some of these might be resolved.

09.30 P Kroupa (Bonn): (T) Satellite galaxies: beyond the standard model of cosmology

Assuming the LCDM description is a representation of cosmological reality, this representation can be tested on the scales of the Local Volume of galaxies down to individual galaxies. It is found that each test applied to date shows the LCDM description to fail. In particular, the Dual-Dwarf-Galaxy Theorem, which must be true in the standard model, is falsified. The data suggest a different cosmological model, but a definite final description is yet to be found.

10.00 A Ferguson (Edinburgh): Substructure in the M31 Satellite System

The CFHT Pan-Andromeda Archaeological Survey (PAndAS) has mapped individual red giant branch stars over 400 square degrees around M31, sampling the galaxy out to a projected radius of 150 kpc. It has uncovered numerous new dwarf galaxies, outer halo globular clusters and a faint extended underlying stellar halo. I will discuss some recent results from this survey, including the discovery of puzzling anisotropies in the satellite distribution.

10.20 M Schaller (Durham): Impact of baryons on the internal structure of haloes

We use high resolution cosmological simulations to generate a realistic catalogue of galaxies which match the observed population of objects in the local universe. Haloes ranging from 10^9 to 10^14 solar masses are then analysed and general properties are derived. We study the density profiles and concentration for all haloes at all redshifts and show that they are well fit by a universal profile and follow closely the well-known DM only profiles in the outer regions. Mass-concentration relations for different redshift ranges are then derived. We also compare our baryon+DM haloes to an equivalent DM only run and infer the impact of baryons on the matter distribution properties. This allows us to estimate the mass bias between the two simulations and the potential impact of the discrepancies on future surveys is discussed.

11.10 RG Bower (ICC): The Cosmic Star Formation recession

In the last 7 Gyr of cosmic time, the average level of star formation in the Universe has suffered a dramatic recession. The decline in star formation is accompanied by surprisingly rapid evolution of the galaxy stellar mass function. At first sight, the evolution in the galaxy population is trivially understood --- as star formation declines the stellar mass builds up. But a quantitative examination reveals deep tensions within the data that are difficult to reconcile with current theories of galaxy formation that are built on the Lambda-CDM cosmological model. In my talk, I will discuss the origin of the decline of star formation and explore the roles that galaxy environment, halo growth and feedback from supernovae and AGN play in shaping the present-day properties of the Universe and their evolution. I will highlight recent results from the EAGLE hydro-dynamic simulations of galaxy formation.

11.30 J Loveday (Sussex) GAMA: Evolution of the mass-size relation

We use data from the Galaxy and Mass Assembly survey to determinate the bivariate distribution of galaxy stellar mass and size, its evolution, and its dependence on galaxy type and environment.

11.50 N Padilla (Catolica): Effects of stochasticity of AM acquisition in galaxy evolution

Dark matter (DM) haloes, the cradles where galaxies form and evolve, acquire angular momentum in a stochastic way which results in a final non-zero DM adimensional spin parameter. We will see how this process translates into the ability of the galaxy, living in this DM halo, to form stars. To do this we will first measure this stochasticity from the Millennium II simulation and will combine these results with a semi-analytic model to see how it affects the properties of the galaxy disc. We will see that the smooth infall of matter comes in chunks with almost, but not quite, random angular momenta, which affects the ability of a disc to form stars and also the frequency of instabilities in the disc leading to the formation of bars and pseudo-bulges, constituting an episodic disc creation.

Dark energy evolution - the SNIa Hubble diagram

13.30 BP Schmidt (Stromlo): (R) SN Ia and Cosmology

Type Ia supernovae have made pioneering work in measuring the Expansion Rate of the Universe from $0 < z < 2$. I will overview the current state of the art of using Type Ia supernovae to measure distances, and critically reflect on the known unknowns that limit the precision of measurement now, and how these are trying to be addressed into the future. Interpretation of the results from the Planck Experiment appear to be in disagreement with SN Ia measurements. I will argue that the discrepancies between the two sets of experiments on the values of H0, Omega_M and Omega_Lambda are significant, and need to be resolved.

14.00 M Sullivan (Southampton): (T) Supernova cosmology and physics from large surveys

The Supernova Legacy Survey (SNLS) was a 5 year program to discover ~400 high redshift type Ia supernovae (SNe Ia) at the Canada-France-Hawaii Telescope with high-quality multi-colour light curves. I'll present the latest cosmological constraints from SNLS and an overview of the main systematic uncertainties in the measurement. I'll also present results from SNLS and other large surveys on the nature of SN Ia progenitors and physics, and discuss their potential impact on future cosmological measurements.

14.30 RC Nichol (Portsmouth): The DES Supernova Survey

The Dark Energy Survey (DES) has started including a new multi-epoch survey to find unto 4000 Type Ia SNe over the next 5 years, to a redshift of z=1.2. The DES SN Survey is predicted to be an order of magnitude better than SNLS and will not be superseded until LSST. To maximise the potential of this survey, we will need to control the systematic uncertainties to a much greater level than previously achieved, especially photometric calibration, SN classification and host galaxy correlations. In this talk, I will review the recent progress of DES and our plans to mitigate the aforementioned systematics.

14.50 R Keenan (Taiwan): Evidence for a 300Mpc underdensity in local galaxy distribution

Galaxy counts and recent measurements of the luminosity density in the near-infrared have indicated the possibility that the local universe may be underdense on scales of several hundred megaparsecs (Mpc). The presence of a large-scale underdensity in the local universe could introduce significant biases into the interpretation of cosmological observables, and, in particular, into the inferred effects of dark energy on the expansion rate. We have measured the K-band luminosity density as a function of distance from us to test for such a local underdensity. We find a local ($z < 0.07$, $D < 300$ Mpc) luminosity density that is in good agreement with previous studies. At distances greater than 300 Mpc ($z > 0.07$), we detect a rising luminosity density that reaches a value of roughly ~1.5 times higher than that measured locally beyond 400 Mpc ($z>0.1$). K-band luminosity is a good tracer of stellar mass, which suggests that the stellar mass density follows a similar trend. Assuming that luminous matter traces the underlying dark matter distribution, this implies that the local mass density of the universe may be lower than the global value on a scale and amplitude sufficient to introduce significant biases into the determination of basic cosmological observables, such as the expansion rate. An under-density of roughly this scale and amplitude would be sufficient to resolve the apparent tension between direct measurements of the Hubble constant and those inferred by Planck.

15.30 E Linder (LBNL): (T) Models of Cosmic Acceleration

15 years after discovery of the acceleration of the universe, where does our understanding of the physics stand, and what lies ahead? Beyond the equation of state of dark energy we need to explore its persistence and degrees of freedom; beyond characterizing expansion there is gravity and growth of structure. Established probes and new ones - redshift space distortions, CMB lensing, strong lensing time delays - will revolutionize the dark energy landscape and greatly improve tests of cosmology, gravity, and neutrino mass.

16.00 M Moresco (Bologna): Cosmic chronometers: a new approach to expansion history

The determination of the expansion history of the Universe is one of the most crucial measurements for cosmology, since the rate at which it decelerates/accelerates directly depends on the energy components which characterize it (and, in particular, the "dark energy", in case of an accelerated expansion). It is therefore fundamental to measure it, i.e. the Hubble parameter H(z), very precisely. In this talk I will present an innovative method to obtain direct constraints on H(z) from the differential age evolution of cosmic chronometers. I will provide the basic theoretical background of this approach, and I will as well discuss its dependence on assumptions and systematics. The "cosmic chronometers" approach has been recently used to obtain new high-accuracy measurements of H(z) up to z~1.1 from the analysis of a large sample of massive and passive ETGs. I will present these results, focusing the attention in particular to their cosmological consequences, showing the potentiality of this technique to discriminate amongst different cosmologies. I will also demonstrate that this approach can be not only complementary, but also competitive with the other "standard" probes, i.e. SNe and BAO.

16.20 M Hudson (Waterloo): Testing LSS and gravity using cosmic flows

Cosmic flows are one of the only ways to test the very large-scale distribution of dark matter and gravitational growth in the nearby Universe. Some recent studies have suggested that there is large-scale bulk motion which might indicate a potential problem for LCDM on very large scales. I will review and update these results using new data from Type Ia SNe, as well as kinetic Sunyaev-Zeldovich constraints from WMAP and Planck. I will show that, on quasi-linear scales, peculiar velocities can be used to set strong constraints on deviations from GR. Finally, I will compare the observed motion of the Local Group with the gravity field predicted from the nearby galaxy distribution of 2MASS-selected galaxies, based on a new deep all-sky redshift compilation.

16.40 M Pieri (Portsmouth): Probing DE with the LyA forest

I will present the recent first detection of baryon acoustic oscillations at high redshift using the Lyman-alpha forest. This has been made possible by the ongoing BOSS survey which is providing a sufficient density on the sky to probe structures across multiple lines of sight. We report the first detection of a matter dominated universe and find the characteristic deceleration followed by acceleration expected within a concordance cosmology.

Dark energy evolution - baryon acoustic oscillations

09.00 DJ Eisenstein (Harvard): (R) Measuring the Cosmic Distance Scale with SDSS-III

I will present the latest cosmological results from the Sloan Digital Sky Survey III (SDSS-III) Baryon Oscillation Spectroscopic Survey (BOSS), focusing on the measurement of the cosmic distance scale from baryon acoustic oscillations. BOSS is the world's largest redshift survey, including a dense sampling of massive galaxies out to z=0.7 and a large set of quasars at z>2.1 that probe the 3-dimensional structure of the intergalactic medium via the Lyman-alpha forest. The acoustic peak has now been detected in both data sets, yielding a high-precision view of the cosmic expansion history from z=0.3 to 2.5.

09.30 C Blake (Swinburne): (T) Cosmology with the WiggleZ Survey and beyond

I will summarize cosmological tests based on large-scale structure in the WiggleZ Dark Energy Survey, including measurements of cosmic expansion, growth and neutrino mass constraints from power spectrum shape. I will then present a series of new results leveraging this dataset, including testing gravity using cross-correlations with 400 sq deg of RCS2 lensing measurements, topological statistics such as Minkowski functionals, and joint multiple-tracer analyses using the overlap region of WiggleZ and the Baryon Oscillation Spectroscopic Survey.

10.00 F Beutler (LBNL): BAO and the Local Hubble Constant

The large-scale correlation function of the 6dF Galaxy Survey (6dFGS) allows the detection of a Baryon Acoustic Oscillation (BAO) signal. The low effective redshift of 6dFGS makes it a competitive and independent alternative to Cepheids and low-z supernovae in constraining the Hubble constant. It also depends on very different (and arguably smaller) systematic uncertainties. We found a Hubble constant of H_0 = 67 +/- 3.2 km/s/Mpc in agreement with the current standard cosmological model LCDM. I will also talk about predictions for future low redshift BAO constraints which will improve upon the 6dFGS result.

10.20 E Kazin (Swinburne): Reconstructed BAO measurements of WiggleZ and BOSS

In this talk I will present recent measurements of expansion rates H(z) and angular diameter distances Da(z) obtained with WiggleZ and BOSS. I will discuss improvements of constraints by application of the reconstruction technique, which sharpens the baryonic acoustic feature by reducing non-linear effects, and hence improving its performance as a standard sphere.

10.40 WJ Sutherland(QM): Moderate z BAO surveys : proving acceleration and N_eff

I present two results available from a near all-sky z ~ 0.3 BAO survey: firstly, a verification of cosmic acceleration which is independent of CMB, flatness and GR. Secondly, I present a new accurate relation between D_V(z) and D_L(4z/3); this can be used to measure the absolute (not relative) BAO length, and hence probe the radiation density N_eff.

11.30 WJ Percival (Portsmouth): (T) From current to future BAO measurements

Current BAO measurements such as those from BOSS are already demanding advanced careful and statistically rigorous analyses. This talk will review some of these techniques and their application to BOSS, and look ahead to the next generation of surveys, reviewing some of these and looking ahead to the necessary improvements required.

12.00 NP Ross (LBNL): QSO-Lyman-alpha forest cross-clustering

Using a sample of 50,000 quasars, baryon acoustic oscillations (BAO) were recently detected in the Lyman-alpha forest of BOSS quasars at redshift z=2.3. This was the first detection of the BAO signature at z>1, and provided a further stringent test of the fiducial LCDM model. With this new measurement of the three dimensional correlation function of the transmitted flux fraction now in hand, further high-z BAO determinations and crosschecks are warranted. Here, using nearly 100,000 quasars and Lyman-alpha forests, we present the large-scale cross-correlation of quasars with the LyA forest, and the first detection of the BAO in the cross-correlation of large scale tracers. The subsequent cosmological implications are also presented.

12.20 M Viel (INAF/OATS): Matter power spectrum on small scales

A warm dark matter candidate can be invoked in order to solvesome small scale discrepancies that arise in the standard cold dark matter scenario.In this talk, I will update the constraints on the coldness of cold dark matter at small scales by using a new set of high-resolution quasar spectra and new hydrodynamic simulations. I will use the Lyman-alpha one-dimensional flux power spectrum at z>4 in order to probe the non-linear small scale regime.These constraints are very tight and leave no room for a mass of a warm dark matter thermal relic below the 2keV limit.Furthermore, I will show how non-linearities in the matter power spectrum develop in a massive neutrino universe and how to use these features to constrain the neutrino mass fraction by using present and future data sets.

12.40 RB Metcalf (Bologna): Gravitational lensing with 21cm intensity mapping

The same technology that is being developed to measure the distribution of HI at very high redshift and the baryon acoustic oscillations at z ~ 1 can be used to measure weak gravitational lensing at a broad range of redshifts without the need to resolve individual galaxies. This greatly reduces the required size of a radio telescope array. Such a survey would be capable of measuring weak lensing at redshifts that are not accesible to weak lensing surveys in the visible and with much lower noise than lensing of the CMB. Dark energy measurements could be pushed to higher redshift in this way.

Tests of Einstein and modified gravity - gravitational growth

14.15 U Seljak (Zurich): (R)

14.45 L Guzzo (Milan): (R) Probing the Growth of Structure with Z-Space Distortions

The past five years have seen a renaissance of our interest in the well-known effect of redshift-space distortions (RSD). In a redshift survey, measurements of the growth history of structure through RSD provide the natural complement to estimates of the global expansion rate using Baryonic Acoustic Oscillations as a standard ruler. This combination should ideally allow us to unveil the origin of cosmic expansion, lifting the degeneracy existing between dark energy and modifications of General Relativity as its primary cause. Fairly precise (<10%) measurements of the growth rate are already being delivered by ongoing surveys at z<1. This new level of precision calls for an improved level of control over systematic effects, which is related to our ability to model the RSD signal. Systematic errors have been shown to be comparable or even larger than the levels of statistical precision achieved today, due to an insufficient description of nonlinear effects. Considerable efforts are currently ongoing to improve this situation, by both finding new ways to combine/use the redshift data and developing improved models of RSD. In my talk, I will review this situation, with particular emphasis on recent results from new surveys and on the implications for the future of RSD as a cosmological probe.

15.15 F Marin (Swinburne): Constraining cosmic growth with the WiggleZ 3-point functions

Higher-order clustering statistics are a useful and complementary tool for obtaining information on the non-gaussian evolution and morphology of large-scale structure in the Universe. I will present measurements of the three-point correlation function (3PCF) for 187,000 galaxies in the WiggleZ spectroscopic galaxy survey. We explore the WiggleZ 3PCF scale and shape dependence at three different epochs z=0.35, 0.55 and 0.68. Using N-body simulations to predict the clustering of dark matter, we constrain the linear and non-linear bias parameters of WiggleZ galaxies with respect to dark matter, and marginalise over them to obtain constraints on sigma_8 and its evolution with redshift. These measurements of sigma_8(z), which have 10-20% accuracies, are consistent with the predictions of the LCDM concordance cosmology and test this model in a new way.

15.35 A Sanchez (MPIE): Cosmological implications of the BOSS-CMASS clustering wedges

The clustering wedges, xi_tr(s) and xi_pa(s), are defined by averaging the full two-dimensional correlation function, xi(mu,s), over the ranges 0<mu<0.5 and 0.5<mu<1, respectively. While angle-averaged BAO measurements are only sensitive to the combination D_A(z)^2/H(z), anisotropic clustering measurements, such as the clustering wedges, allow us to obtain separate constraints on D_A(z) and H(z). In this talk we describe the cosmological implications of the full shape of the clustering wedges of the CMASS sample of the Baryon Oscillation Spectroscopic Survey (BOSS). These results illustrate the additional constraining power of anisotropic clustering measurements with respect to that of angle-averaged quantities.

15.55 J Whitbourn (Durham): The Local Hole detected in 6dFGS, SDSS and 2MASS

We have examined K and r limited galaxy n(z) and n(m) from 6dFGS/2MASS+SDSS to investigate a proposed local under-density, the `Local Hole'. Comparing galaxy n(z) distributions to homogeneous models in 3 large regions of the sky, we find evidence for ~10-30% under-densities in all 3 regions out to scales of ~150h-1Mpc. Using GAMA/UKIDSS-LAS to check the galaxy n(K) normalisation at fainter magnitudes we then find evidence for a large-scale ~15% under-density extending to ~300h-1Mpc in the deeper SDSS region. We have further used the redshift data to map peculiar velocities over these 3 regions. We find the data reject at the ~4sigma level the idea that we have recovered the CMB rest frame in the volume probed. There is therefore consistent evidence from galaxy counts and Hubble diagram for a local ~150h-1Mpc mass under-density that deeper counts and redshifts suggest may extend beyond ~300h-1Mpc.

16.45 B Li (ICC): (T) Modified gravity and large-scale structures

Modified gravity theories are considered as alternatives to the LCDM paradigm to explain the observed accelerated cosmic expansion. Such theories are required to reduce to the GR limit so that their effects are hidden in local environments, making cosmological scales an ideal place to looks for their observational implications. I will review recent progresses in the studies of the cosmological structure formation in several leading candidates of modified gravity theories, and discuss potential future works.

17.15 W Hellwing (ICC): The modified gravity smoking gun

Modified theories of Gravity (MoG) present a broad class of modifications of Einstein's GR with non-negligible effects at cosmological scales. This area has been a subject of intensive research in the past few years. Most of the work focuses on either on theoretical studies or on potential MoG observational effects with respect to density field/clustering statistics. We show and discuss the potentially very powerful probe of MoG for cosmology. We show that the delicate MoG effects seen in the density field (both in configuration and the redshift space) are accompanied by a significantly larger effects in all the observables related to the peculiar velocity field of galaxies. We discuss the observables like velocity power spectrum, high-order hierarchical amplitudes, pairwise velocities, bulk flows, velocity dispersion and velocity correlation functions. We suggest that despite a much poorer observational velocity data the overall gain in the strength of a MoG signal make the velocity field related observables a potential smoking gun for modified gravity.

Co-spatial cosmology surveys

09.00 JA Peacock (Edinburgh): (R) Multiple tracers of cosmological structure

This talk will review the background to the use of different probes of large-scale structure that occupy overlapping volumes. The idealised case of large-scale linear bias allows the cosmic variance limit to be evaded: either the bias signal, or the underlying matter fluctuations themselves, can be measured with a precision limited only by shot noise. But for many applications, nonlinear effects and stochastic bias limit the available gains. Some examples of recent results are given, covering redshift-space distortions, and cross-correlation of galaxies and data from lensing and peculiar velocities.

09.30 N Kaiser (IfA, Hawaii): Gravitational redshifts in clusters

09.50 C Duncan (Edinburgh): On the complementarity of cosmic shear with clustering using magnification bias

As well as changes in the observed ellipticity of galaxies, gravitational lensing by foreground structure also causes a change in the size and magnitude of background sources. Magnification bias concerns the change in the observed number counts of objects in a flux limited survey due to this effect. With many upcoming and current surveys such as Euclid, CFHTLenS, KiDS, HSC, and DES for which accurate photometry will be taken as part of a shear analysis, it is important to question what gains there are to be made in considering the other half of the lensing signal. WIth this in mind, in this talk I consider how parameter constraints can be improved by adding clustering information to a shear analysis, with particular emphasis on how much constraining power comes from the induced correlation in number density due to magnification bias, and how much comes from the intrinsic clustering of sources, for a Stage 3 ground survey and Stage 4 space based survey. Finally, I question just how much measured cosmological parameters may be biased by incorrectly ignoring magnification using a photometric clustering analysis.

10.10 E-M. Mueller (Cornell): Constraining modified gravity with z-space distortions

We explore the strength of redshift space distortion measurements in combination with other cosmological probes like weak lensing to constrain modifications to General Relativity for upcoming surveys such as Euclid, LSST, BigBOSS and DES. We are using an model-independent phenomenological description for modifications of gravity as-well as the Effective Field Theory approach for General Relativity. The latter applies the concept of effective field theory to cosmological perturbations to form a unifying framework of modified gravity theories. In collaboration with Eanna Flanagan and Jolyon Bloomfield we are constraining the free parameters in this approach with current data and forecast constraints from future surveys.

10.30 F Prada (Granada): Large-scale halo clustering and bias from the new suite of BigMultiDark Planck simulations

I'll present the new suite of BigMultiDark Planck simulations with large volume and high enough resolution to resolve the distinct and subhalo dark matter halo population that host BOSS galaxies. This allows for the first time to have a precise measurement of the halo BAO shifts and dumping, and scale-dependent bias, which result very relevant for the interpretation of current and future galaxy surveys.

11.20 S Bridle (T) The Dark Energy Survey: First Results

During fall 2012 the Dark Energy Survey (DES) collaboration installed and commissioned DECam, a 570 mega-pixel optical and near-infrared camera with a large 3 sq. deg. field of view, set at the prime focus of the 4-meter Blanco telescope in CTIO, Chile. In the course of the next five years DECam will map an entire octant of the southern sky to unprecedented depth, measuring the position on the sky, redshift and shape of over 200 million galaxies, together with thousands of galaxy clusters and supernovae. With this data set, DES will study the properties of dark energy using four main probes: galaxy clustering on large scales, weak gravitational lensing, galaxy-cluster abundance, and supernova distances. A 'Science Verification' (SV) period of observations, lasting until late February 2013, followed the DECam commissioning phase, and provided science-quality images for over 150 sq. deg. at the nominal depth of the survey. The talk will present the first results from the SV observations, and will summarize the plans and goals for the upcoming years.

11.50 H Murayama (Berkeley/Kavli IPMU): SuMIRE/PFS

12.10 G Hutsi (MPIA): Clustering of AGN in eROSITA all-sky survey

The full four year all-sky survey with eROSITA telescope will detect in the soft X-ray band (0.5-2.0 keV) ~3 million AGN with a median redshift of z~1 and a typical luminosity of ~10^44 erg/s. With such a large AGN sample it becomes feasible for the first time to perform detailed studies of AGN clustering as a function of redshift and AGN luminosity. This in turn allows one to gain substantial insights to AGN triggering mechanisms, their evolution as a function of cosmic environment along with a detailed mapping of the supermassive black hole activity throughout the history of the Universe. Even though not designed for that purpose, complementing the large number of AGN detected by eROSITA with spectroscopic or high quality photometric follow-up, allows one to achieve a high signal-to-noise measurement of BAO at z~1-2.

12.30 F Simpson (Edinburgh): The Clipped Power Spectrum

I will present a method which suppresses contributions from higher order terms in perturbation theory. In an evolved cosmological density field the highest density regions are responsible for the bulk of the nonlinear power. By suitably down-weighting these problematic regions the one- and two-loop terms are typically reduced in amplitude by 70% and 95% respectively. This greatly facilitates modelling the shape of the galaxy power spectrum. I will demonstrate how this technique enables the galaxy bias to be determined from two-point statistics on conventionally nonlinear scales, k<0.7 h/Mpc.

Future cosmology projects

13.50 K Kuijken (Leiden): (T) Future (and current) cosmology surveys at ESO

With two dedicated imaging survey telescopes, the VST and VISTA, ESO has a powerful facility for cosmology from the Southern hemisphere. I will briefly describe the ongoing public surveys for cosmology, and then focus on the KiDS+VIKING project, which is a weak lensing tomographic survey that will cover 1500 square degrees of sky. The KiDS survey recently completed its first 200 square degrees, making it the largest medium-deep (median redshift beyond 0.5) weak lensing survey to date.

14.20 D Schlegel (LBNL): (T) DESI: The Dark Energy Spectroscopic Experiment

The Dark Energy Spectroscopic Experiment (DESI) has selected the Kitt Peak Mayall 4-m telescope after a site alternatives study this spring. The project will obtain spectra and redshifts for at least 20 million emission line galaxies, luminous red galaxies and quasars spanning all redshifts. I will describe the status of the instrument conceptual design, target selection and capabilities.

14.50 P Coles (Sussex): (T) Concluding remarks leading to Panel discussion