Durham-Edinburgh eXtragalactic Workshop IX

10-11 January 2013, University of Edinburgh

List of abstracts

Speaker **Ross McLure**
Affiliation University of Edinburgh
Talk title The Hubble Space Telescope HUDF12 campaign: The redshift 7-12 Universe.
Abstract The Hubble Space Telescope HUDF12 campaign was completed in September 2012 and provides the deepest ever near-IR imaging of the distant Universe. The primary science goals of the project were to provide the first robust sample of z>9 galaxies, to constrain the faint-end of the galaxy luminosity function at z=7 and z=8 and to study the spectral properties of 0.1L* galaxies at z=7. I will provide a brief overview of the first results from HUDF12, based on a series of recently submitted papers, including our analysis of a candidate galaxy at z∼12.

Speaker **Rebecca Bowler**
Affiliation University of Edinburgh
Talk title Discovery of bright z∼7 galaxies in the UltraVISTA survey
Abstract The recent wealth of ground and space-based near-IR surveys have hugely increased the number of $z > 6$ galaxies known, allowing the luminosity functions at these early epochs to be determined. However, there is a deficit in the number of bright galaxies known at these high redshifts due to the rarity of such objects over the typically small field covered, for example, by the Hubble Space Telescope. Hence the bright end of the luminosity function, where results from lower redshifts would indicate that there is an exponential cut-off in the number density, is still highly uncertain. With the degree-scale UltraVISTA survey, we have detected the brightest galaxies known at $z \sim 7$ and hence can provide a first look at the form of the luminosity function above L*. The multi-wavelength data also gives us a glimpse of the properties of these extremely luminous and therefore arguable massive galaxies at a time less than 1 billion years after the Big Bang.

Speaker **Peter Mitchell**
Affiliation Durham University
Talk title Stellar mass as a tool to constrain galaxy formation models: problems and pitfalls
Abstract The observed stellar mass function is often used to constrain hierarchical galaxy formation models. We use the semi-analytic model GALFORM in conjunction with the standard observational method of estimating the stellar mass of galaxies through broad-band SED fitting to demonstrate some of the various pitfalls that could be encountered with this approach. We explain how choices and assumptions regarding dust attenuation, chemical enrichment, star-formation and the IMF can all affect the relationship between the stellar mass function predicted by models and the mass function derived from observational studies.

Speaker **Emma Curtis-Lake**
Affiliation University of Edinburgh
Talk title Stellar populations of z∼6 LBGs

Abstract To pin down the stellar populations comprising high redshift Lyman-break galaxies that have been the subject of much debate in recent years, we study a sample of 13 spectroscopically confirmed, UV-luminous Lyman-break galaxies at z∼6. We use near-infrared HST/WFC3 CANDELS data and deep IRAC imaging to provide accurate photometry for SED fitting. Our results show that the stellar masses lie within the range $10\hat{9}$<M_*<$10\hat{1}0$ M_sun and inclusion of nebular emission leads to moderately smaller stellar mass estimates and correspondingly higher specific star formation rates. Derived ages are, however, strongly dependent on inferred star-formation histories and are, as expected, poorly constrained. Allowing for more general star-formation histories in our fitting, including increasing SFHs and two component models that allow for an older population as well as a recent starburst, we see no strong evidence for extremely young objects (<50Myrs) in our sample and none of the objects require stellar populations >300Myrs to explain the photometry.

Speaker **Russell Smith**
Affiliation Durham University
Talk title Systematic IMF variation in red-sequence galaxies
Abstract Independent lines of evidence - from stellar dynamics, strong lensing and spectroscopic stellar populations analysis - are converging to suggest that massive elliptical galaxies formed stars with an IMF enriched in low-mass stars, compared to the Milky Way. If these results are confirmed, the mass-to-light ratios of such galaxies would need to be revised systematically upwards by factors of 2-3, relative to those of MW-like galaxies. I will review recent developments, and present new work aimed at calibrating spectroscopic IMF indicators using low-z strong-lens systems. I will emphasize how KMOS will soon help us to address this issue.

Speaker **Richard Bower**
Affiliation Durham University
Talk title Feedback and Galaxy Formation
Abstract It is now widely appreciated that feedback from supernovae and black holes regulates that formation of galaxies. But it is much less clear how feedback depends on galaxy properties such as stellar mass. I will present a series of numerical experiments aimed at understanding how different assumptions about feedback change the galaxy population. Adopting a phenomenological approach, I will use observational data to understand how feedback must work in the real universe.

Speaker **Michelle Furlong**
Affiliation Durham University
Talk title The EAGLE Simluation
Abstract A fundamental test of our understanding of galaxy formation is to complete a hydrodynamical simulation that accurately reproduces observable data from the local Universe across many orders of magnitude in stellar mass. The <91>Evolution and Assembly of Galaxies and their Evolution<92> project aims to produce a data set from an SPH simulation with an accurate galaxy stellar mass function at redshift zero, with ∼$10\hat{4}$ Milky Way size galaxies, spanning four orders of magnitude in halo mass and mass resolution of $10\hat{6}$ solar masses, resolving below Jeans mass. This simulation will include subgrid galaxy formation prescriptions for star formation, stellar evolution and stellar feedback, as well as black hole physics, encompassing much of our understating of galaxy formation. Furthermore, advances in the modeling of gas in SPH simulations are included in the code.

Speaker **Yetli Rosas-Guevara**
Affiliation Durham University

Talk title Constraining the effect of the angular momentum on the black holes accretion in Cosmological simulations.

Abstract A fundamental open question in galaxy formation is the role that the black holes play in shaping the galaxy around them. The observed relations between the mass of the central supermassive black hole and the properties of the bulge indicate that there is an intimate connection between the growth of the central black hole and the growth of the bulge. Little is known about the nature of this connection. Recently, semi-analytic models are able to reproduce the break in the stellar mass function at z =0, however semi-analytic models are phenomenological and cosmological simulations are needed. In this talk, we will show the effects of the feedback from BHs on the stellar mass -halo mass function and the stellar mass function at z=0 in Cosmological Simulations at high resolution (particle mass ∼3e6 Msun). We show these effects varying the parameters of the subgrid BH physics implemented in EAGLE (modified Bondi accretion). We also show the effect of considering the angular momentum on the BH accretion rate.

Speaker **Fernando Buitrago**
Affiliation University of Edinburgh

Talk title Massive galaxies: born as disks, dead as spheroids

Abstract Present day massive ($M_{stellar} > 10^{11} M_{\odot}$) galaxies are composed mostly of early-type objects. To ascertain whether this was also the case at higher redshift, we have compiled over a thousand massive galaxies at $0 < z < 3$ with HST imaging and spectroscopic redshifts for the majority of them. We have further analyzed using 3D spectroscopy another sample of 10 massive galaxies at $z = 1.4$. Both works highlight the progressive change between a late-type/peculiar nature at $z > 2$ and a predominance of early-type morphologies only since $z = 1$.

Speaker **Victoria Bruce**
Affiliation University of Edinburgh

Talk title The Rise and Fall of Disk-Dominated Galaxies

Abstract I will present results from the largest Sersic light profile fitting bulge-disk decomposition analysis to date at 1<z<3, which has been conducted on the most massive galaxies within this redshift regime using the latest high resolution near-infrared imaging from HST WFC3/IR taken as part of the CANDELS treasury programme.

Speaker **James Mullaney**
Affiliation Durham University

Talk title The coevolution of BHs and their host galaxies

Abstract Observations of individual AGNs show no correlation between supermassive BH accretion and star-formation, begging the question: How have today's galaxies come to lie on the Magorrian relationship? Using X-ray stacking analyses we instead calculate ensemble average SMBH growth rates among star-forming galaxies. Our results show that, on average, SMBH growth has followed the same trends with host stellar mass and redshift as the star-formation rates (SFRs) of their host galaxies. More remarkably, we find that the ratio of SMBH growth rate to SFR is (a) flat with respect to galaxy stellar mass (b) not evolving with redshift and (c) close to the ratio required to maintain/establish a SMBH to stellar mass ratio of ∼10$\hat{3}$ as inferred from today's Magorrian relationship. These results show that SMBHs have grown in-step with their host galaxies since at least z∼2, irrespective of host galaxy mass, average accretion rate, SFR or AGN triggering mechanism. Our results imply that a profoundly tight relationship between the growth of SMBHs and galaxies has persisted throughout all massive galaxies since z∼2.

Speaker **James Aird**
Affiliation Durham University
Talk title An observationally-motivated model to connect the evolution of the AGN and galaxy populations out to z$\sim$1
Abstract I will present an observationally-motivated model to connect the AGN and galaxy populations at 0.2<z<1.0 and predict the AGN X-ray luminosity function (XLF). We start with new measurements of the stellar mass function of galaxies from the PRIMUS survey (a low-resolution spectroscopic survey providing $\sim$120,000 galaxy redshifts) and populate galaxies with AGNs using models for the probability of a galaxy hosting an AGN. Our model is based on recent measurements indicating that the probability of hosting an AGN, when defined in terms of specific accretion rate, is independent of the host galaxy stellar mass. We find that the predominant evolution of the AGN population since z$\sim$1 can be accounted for by a rapid drop in the AGN duty cycle for all potential host galaxies, mirroring the drop in specific star formation rates that dominates the evolution of the galaxy population.

Speaker **Chris Harrison**
Affiliation Durham University
Talk title Searching for observational evidence of the suppression of star formation by AGN
Abstract Predictions by theoretical models means that understanding the connection between black hole growth and star formation in massive galaxies has become an important observational challenge. Recent publications based on Herschel far infrared data have presented apparently conflicting results on the relationship between AGN luminosities and the mean star formation rates in host galaxies. I will present Herschel-SPIRE data in the CDF-N, CDF-S and COSMOS fields to reconcile these previous results and demonstrate that the mean star formation rates of the most X-ray luminous AGN are no different to those of the general star-forming population. However, these results do not rule out that star formation suppression by AGN is occurring in some systems. I will also present integral field spectroscopy of z$\sim$2 submillimetre luminous galaxies that host AGN activity. These systems, that may represent a key phase in the evolution of massive galaxies, display extreme gas kinematics with $\sim$1000 km/s outflows found over kpc scales. The velocities and estimated energetics of these outflows imply that gas is being removed from these galaxies, potentially disrupting future star formation.

Speaker **Jose Sabater**
Affiliation University of Edinburgh
Talk title Effect of interactions and environment on nuclear activity in a sample of 300000 galaxies.
Abstract Active galactic nuclei (AGN) are closely related to galaxy formation and evolution. The black holes that power AGN are found in all massive galaxies and their masses are tightly correlated with both the masses and the velocity dispersions of the stellar bulges. Furthermore, AGN may play an important role in the feedback mechanisms that control the growth of massive galaxies.

Speaker **Michael Hogan**
Affiliation Durham University
Talk title Brightest Cluster Galaxies: The Beast on the Radio

Abstract Within the cores of galaxy clusters there is strong inter-dependence between the properties of the intra-cluster medium (ICM) and that of the galaxies. In particular, the AGN activity of the Brightest Cluster Galaxy (BCG) is believed to play an important role in regulating the cooling of gas and maintaining the long-term state of the ICM. Radio observations are important for fully understanding this activity as they well trace the 'on' stage of the AGN. In this short talk I will introduce our work towards decomposing the BCG radio emission from a large sample of X-ray selected galaxy clusters into two components - one attributable to ongoing, core activity and the other, 'non-core' emission, which may result from past activity or alternative acceleration mechanisms within the core. Drawing connections with cluster properties derived from other wavelengths, we consider how these individual components both depend on and affect their environment and how they can be used to better constrain the activity cycle of the AGN.

Speaker **Jorge Penarrubia**
Affiliation University of Edinburgh
Talk title Dwarf spheroidal challenges
Abstract Dwarf spheroidal galaxies (dSph) sample the low-mass end of the galaxy mass function and as such play a key role in galaxy formation models. However, the masses inferred from the internal kinematics of these objects are difficult to reconcile within a cosmological context. In this talk I will review recent attempts to reproduce the kinematics of dSphs using collision-less and self-interacting CDM models of structure formation, restricted WDM N-body models, hydro-dynamical CDM simulations and MONDian analytical estimates. Thus far none of these theoretical prescriptions has been able to provide a satisfactory description of the data.

Speaker **Wojciech Hellwing**
Affiliation Durham University
Talk title Milky Way and it's massive satellites
Abstract Using newest state-of-the-art DM simulation -COCO- we revisit and re-evaluate the apparent problems with massive Milky Way satellites and the structure formation and halo assembly in hierarchical CDM cosmologies.

Speaker **Denija Crnojevic**
Affiliation University of Edinburgh
Talk title Galaxy evolution through resolved stellar populations in the nearby CenA group
Abstract The CenA/M83 group is a nearby dense complex ($\sim$4Mpc) dominated by a giant elliptical and a giant spiral, hosting more than 60 dwarf companions with a variety of morphological types and stellar contents. Our aim is to constrain galaxy evolution processes through the study of resolved stellar populations of galaxies in this group. Firstly, for dwarf members we characterize the recent star formation histories and metallicity content (by using optical and near-infrared data from ACS/HST and ISAAC/VLT), and compare them to what is known for Local Group dwarfs, underlining similarities and differences. Our results probe the fundamental interplay between nature and nurture in the evolution of dwarfs in such a dense environment. We furthermore present results from the first deep survey of resolved stellar populations in the remote outer halo of our nearest giant elliptical, CenA (VIMOS/VLT optical data). Tracing its halo structure (radial profile, extent and metallicity) out to a remarkable $\sim$14 Reff and comparing the halo stellar populations to those of CenA's dwarf companions enables us for the first time to constrain the mechanisms that contributed to the build-up of CenA in the context of cosmological galaxy formation models.

Speaker **Ben Lowing**
Affiliation Durham University

Talk title Making Mocks of Stellar Haloes

Abstract The diffuse stellar haloes surrounding galaxies such as the Milky Way contain only a small fraction of the total stars in the galaxies, but potentially hold a vast amount of information about their history and formation. The outer accreted component is made up of the debris from infalling satellites disrupted in the potential of the host galaxy and so offers a unique record of the galaxy<92>s assembly history. In this talk I will discuss a new method of creating mock catalogues of the accreted stars in stellar haloes and demonstrate how these can be used to test current and future observational strategies.

Speaker **Mark Lovell**

Affiliation Durham University

Talk title The properties of warm dark matter subhaloes

Abstract Different extensions to the Standard Model of particle physics suggest dark matter candidates with varying properties relevant for galaxy formation. In particular, the neutrino minimal standard model introduces a triplet of sterile neutrinos, the lightest of which would be realised as a warm dark matter particle. I simulate Milky Way-analogue dark matter haloes with a variety of dark matter models, in order to examine the effect of dark matter physics on the abundance and properties of the companion subhaloes. These results may transfer directly into the properties of the Milky Way's satellite galaxies.

Speaker **Cedric Lacey**

Affiliation Durham University

Talk title A multi-wavelength model of galaxy evolution

Abstract I will present latest results from our work on multi-wavelength modelling of the evolution of galaxies. The work combines a theoretical model of galaxy formation based on Lambda-CDM with a detailed radiative transfer calculation of the reprocessing of stellar emission by dust in galaxies. Our previous work implied the need for a top-heavy IMF in starbursts in order to explain the number counts and redshifts of sub-mm galaxies in this framework, once the observational constraints from the present-day galaxy luminosity function at optical and near-IR wavelengths were included. We have revisited this using an improved galaxy formation model, which includes a more realistic treatment of star formation, as well as feedback from AGN. We also impose the additional constraint that the model reproduces the observed evolution of the galaxy luminosity function at near-IR wavelengths. I will present results from our new model, and discuss the implications for our understanding of galaxy evolution.

Speaker **Joao Ferreira**

Affiliation University of Edinburgh

Talk title Understanding Galaxy Evolution Models using CANDELS data @ 1<z<2

Abstract Recent years have seen the parallel development of a LCDM concordance cosmology, increasingly sophisticated galaxy evolution codes, and reliable stellar population synthesis models, which combine to produce semi-realistic galaxy mock catalogs at optical wavelengths. The observables computed from these models can be compared with wide and deep multiwavelength photometric surveys like CANDELS. This is an excellent setting to improve our understanding of galaxy evolution from a demographic standpoint at the interesting 1<z<2 gas-rich stage of cosmic time, complementing local universe archeological studies and higher-z LAEs and LBGs. The comparison with CANDELS data is carried out at three levels, using a catalog of star formation history tables from various simulation codes. The first is to reproduce observed luminosity functions, which verifies the basic ingredients for galaxy formation included in the models. The second step is to compare broadband colour distributions to verify the accuracy, or otherwise, of stellar population models. Finally, a new method is used to optimally compress the full multiwavelength dataset in only two dimensions that represent physically meaningful (SFR, 4000A break) rest frame quantities. This allows us to parameterise the main features of the spectral energy distributions for all the redshifts in the considered range (1<z<2), and visualise them in a single plot. I will present results on the ubiquity of emission line contamination (OII, OIII), which is present over a wider range of galaxy mass than expected at z∼1.5 (Van der Wel 2011). Consistent with the estimated equivalent widths of line contamination, I will show that models lack a recent (10-100 Myr old) component of star formation. Confronting models with observations in such a way is particularly useful for validating/falsifying stellar population models, galaxy evolution mechanisms, quantifying line emission and so identifying the most immediate aspects to focus on in simulation efforts.

Speaker **Lingyu Wang**
Affiliation Durham University
Talk title Connecting stellar mass and star-formation rate to dark matter halo mass out to z ∼ 4
Abstract In the first half of the talk, we construct an extended halo model (EHM) which relates total stellar mass and star formation rate (SFR) to halo mass. An empirical relation between the distribution functions of total stellar mass of galaxies and host halo mass, tuned to match data over 0.1<z<2.0, is extended to include two different scenarios describing variation of SFR on halo mass. Combined with the halo accretion histories, we can trace the stellar mass growth and star-formation history. We find that: (1) The intensity of the star-forming activity in halos has decreased from z∼2 to 0; (2) The SFR - M_halo relation peaks around 10$\hat{1}$2 M_sun at z∼0 and increases with increasing redshift; (3) Galaxies that are forming stars most actively at z∼2 evolve into quiescent galaxies in today's group environments, strongly supporting previous claims that the most powerful starbursts at z∼2 are progenitors of today's elliptical galaxies.

Speaker **Jacob Head**
Affiliation Durham University
Talk title Quenching Timescales in Coma Cluster ETGs

Abstract The cores of galaxy clusters in the local universe are dominated by red-and-dead early-type galaxies (ETGs). The exact nature of the process(es) primarily responsible for switching off ("quenching") star formation remains unclear. Strong trends in galaxy morphology, colour, and age with cluster-centric distance highlight the importance of the cluster environment in this aspect of galaxy evolution. By disentangling the ages of the structural components of cluster galaxies, information can be gleaned on how and when these galaxies were quenched. In this work, we perform bulge-disc decompositions on Coma Cluster ETGs using deep u-, g-, and i-band (CFHT) imaging. We investigate whether the red sequence is a consequence of the colour-magnitude trends of bulges or discs. Using simple stellar population models, the measured colours are translated into ages (and metallicies). A component age difference constrains the timescales over which quenching occurs, and differentiates between "disc-fading" and "bulge-building" mechanisms. In this talk we present our initial findings and their interpretation.

Speaker **Michal Michalowski**
Affiliation University of Edinburgh
Talk title Redshifts, stellar masses and specific star-formation rates of submillimetre galaxies
Abstract Establishing redshifts, stellar masses, and specific star-formation rates of submillimetre galaxies (SMGs) is crucial for determining the role of such objects in the cosmic history of galaxy/star formation. I will show the latest results obtained with the wide-field AzTEC 1.1 mm survey delivering a highly complete redshift distribution of SMGs and the evidence for a large scale structure traced by these objects. Moreover, before we will be able to interpret the wealth of data delivered by ALMA, SCUBA2 and Herschel we need to understand the methods we use to derive stellar masses of SMGs. I will discuss the impact of the assumptions in the spectral energy modelling of SMG and will review current observational evidence for and against these alternatives. I will show that the choice of the star formation history (SFH) has a great impact on the derived stellar masses of SMGs, but this is the case only to a lesser degree for general population of star-forming galaxies. Using a realistic assumption of SFH I will show that SMGs are the most massive extension of the star-forming galaxies on the stellar mass - star formation rate diagram and therefore majority of them are not outliers with respect to the so-called main-sequence of star-forming galaxies.

Speaker **Sadegh Khochfar**
Affiliation University of Edinburgh
Talk title The onset of galaxy formation
Abstract In my talk I will show results from a high-resolution hydro simulation focused on the formation of the first galaxies in the Universe. I will show and discuss a few examples of how these proto-/baby-galaxies already affect their local environment and their subsequent growth.

Speaker **John Stott**
Affiliation Durham University
Talk title The mass, metallicity and merger rates of z=0.4-2.3 HiZELS galaxies
Abstract Using FMOS observations of HiZELS galaxies, we investigate the presence of a mass-metallicity-SFR plane at z=1-1.5, analogous to that seen in the local Universe by Manucci et al. 2010. Our findings appear to confirm that there is such a plane at this epoch and that it is surprisingly similar to that seen locally, while its shape ensures that it is still in agreement with other high redshift observations.

Speaker **Fergus Cullen**
Affiliation University of Edinburgh
Talk title The Mass-Metallicity Relation at z$\sim$2

Abstract I will discuss our latest results using the 3D-HST spectroscopic survey to study the mass-metallicity relationship at z∼2 via the strong emission line method. I will also discuss these results in the context of the fundamental mass- metallicity-star formation rate plane.

Speaker **Rachael Livermore**
Affiliation Durham University
Talk title Spatially resolved star formation within high-redshift lensed galaxies
Abstract Strong lensing by massive galaxy clusters allows us to study "typical" high-redshift galaxies in a level of detail that would otherwise have to wait until JWST or E-ELT. In addition, the spatial magnification enables us to reach source-plane resolution of ∼100pc, which approaches the size of individual giant HII regions. I will present the results from HST narrow-band imaging and VLT/SINFONI integral field spectroscopy programs, which map the star-formation and dynamics within high-z galaxies on scales of 100-1000pc. I will show that it is possible to identify individual star-forming HII regions on these scales, and measure their scaling relations. I will show that there is strong evolution in the mass function for clumps with redshift, and that this is a natural consequence of the rapidly evolving gas mass fraction for turbulent disks with redshift. By comparing these results for clumpy disks with simulations, I will show that there is no requirement for a different <91>mode<92> of star formation in high-redshift turbulent disks.

Speaker **Alice Danielson**
Affiliation Durham University
Talk title 13CO and C18O in a lensed star-forming galaxy at z∼2
Abstract I will be discussing recent observations of the typically optically thin molecular gas tracers, 13CO and C18O, in a gravitationally lensed z∼2 star-forming galaxy. These molecules allow us to probe the dense regions within the interstellar medium in which stars are forming and thus provide important constraints on the temperatures, densities and abundance ratios in this system. Deriving these properties provides a physical insight into the structure and origin of this galaxy.