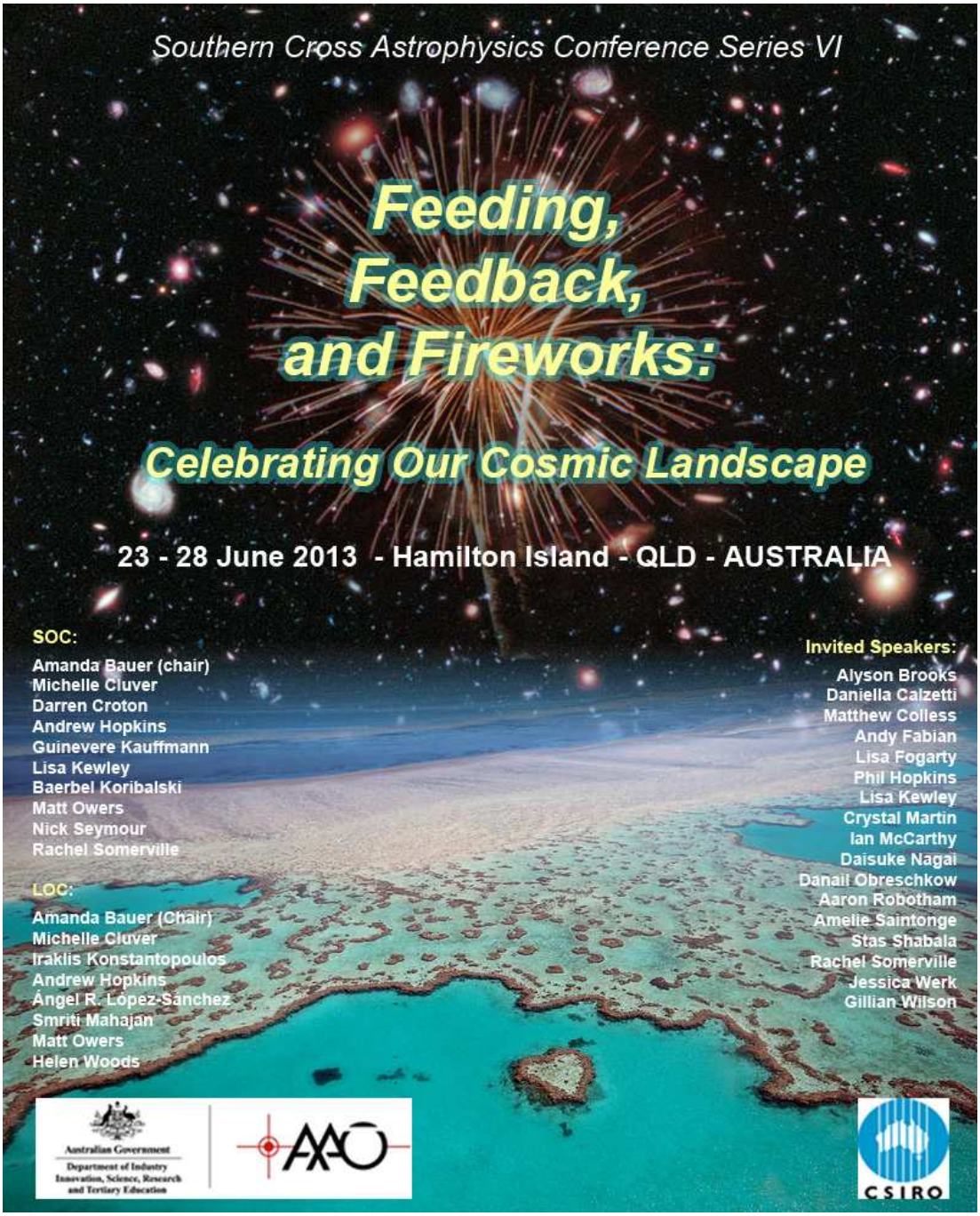

Schedule & Scientific presentations

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Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Hamilton Island, Queensland, Australia, 23 to 28 June 2013

Scientific Organising Committee:

Amanda Bauer (chair)
Michelle Cluver
Darren Croton
Andrew Hopkins
Guinevere Kauffmann
Lisa Kewley
Baerbel Koribalski
Matt Owers
Nick Seymour
Rachel Somerville

Local Organising Committee:

Amanda Bauer (Chair)
Michelle Cluver
Iraklis Konstantopoulos
Ángel R. López-Sánchez
Smriti Mahajan
Matt Owers
Helen Woods

The conference is supported by the following institutions:

Australian Astronomical Observatory,
a division of the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education
and
CSIRO Astronomy and Space Science

Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Hamilton Island, Queensland, Australia, 23 to 28 June 2013

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Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Hamilton Island Map

Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Hamilton Island, Queensland, Australia, 23 to 28 June 2013

Conference Program

Sunday, 23th June 2013

17:00-19:00 *Welcome Cocktail (Main Pool of the Reef View Hotel) and Registration. Poster installation.*

Posters

Imaging the Circumgalactic Medium in Ultraviolet Emission	**James Green**
High velocity clouds in the Galactic All Sky Survey	**Vanessa Moss**
The radio properties of mass selected IR Galaxies out to z=3	**Glen Rees**
The relationship between lobe luminosity and kinetic power of AGN jets	**Stas Shabala**

Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Monday, 24 June 2013

Session I		Chair: Amanda Bauer
09:00-09:05	Welcome	**Warrick Couch**
09:05-09:10	Announcements	**Amanda Bauer**
09:10-10:00	Feeding, Feedback and Fireworks: Setting the Scene **(I)**	**Lisa Kewley**
10:00-10:15	The Illustris Project: Populating the Hubble sequence in cosmological simulation	**Paul Torrey**
10:15-10:30	Astronomical Discovery in the PetaByte Era	**Ray Norris**
10:30-11:00	*Coffee break*	
Session II		Chair: Daniella Calzetti
11:00-11:25	Cosmological Simulations of Galaxy Formation: Lessons and Puzzles **(I)**	**Rachel Somerville**
11:25-11:40	Properties of Simulated Galaxies at z 4-7: an evolutionary scenario for the AGN feedback?	**Edoardo Tescari**
11:40-11:55	Galaxy Structure Across Time: A result of Feeding or Feedback	**Andy Green**
11:55-12:10	What does the Galaxy Main Sequence tell us about Feeding and Feedback	**Kai Noeske**
12:10-12:35	The Future of Galaxy Surveys **(I)**	**Lisa Fogarty**
12:35-12:40	*Poster Sparklers*	
12:40-15:00	*Lunch*	
Session III		Chair: Andrew Hopkins
15:00-15:25	Gas Dynamics in Galaxies **(I)**	**Danail Obreschow**
15:25-15:40	Probing Spiral Evolution via their neutral hydrogen content	**Virginia Kilborn**
15:40-15:55	Moving mesh cosmology: tracing cosmological gas accretion	**Dylan Nelson**
15:55-16:10	Fuel for Fireworks in Nearby Galaxies	**Baerbel Koribalski**
16:10-16:25	Fueling the Star-Making Machine: Exploring past to present star formation in Local Volume galaxies	**Thomas Jarrett**
16:25-16:50	*Coffee Break*	
Session IV		Chair: Michelle Cluver
16:50-17:15	Galactic Winds Across Cosmic Time **(I)**	**Crystal Martin**
17:15-17:30	OB Cluster Feedback and Molecular Cloud Formation: Supershells as Molecular Cloud Factories?	**Joanne Dawson**
17:30-17:45	The extra-planar ISM of Spiral Galaxies	**Peter Kamphuis**
17:45-18:00	Galactic Penumbrae	**Joshua Peek**
18:00	*End of today's talks*	

NOTE: **I** indicates **Invited Talk**, which are 20+5 minutes. Contributed talks are 12+3 minutes.

Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Tuesday, 25 June 2013

Session V — Chair: Lisa Kewley

09:00-09:05 General Announcements

09:05-09:30 Star Formation Tracers in Galaxies: A Multi-wavelength Perspective **(I)** — **Daniella Calzetti**

09:30-09:45 The Hα luminosity functions and and star formation rate history of the local universe — **Madusha Gunawardhana**

09:45-10:00 A Census of Oxygen in Star-Forming Galaxies in the Local Universe — **H. Jabran Zahid**

10:00-10:15 A Signature of Merger-Driven Star Formation in Spiral Galaxies — **Tim Dolley**

10:15-10:30 Star Formation and SNe in Luminous Infrared Galaxies — **Stuart Ryder**

10:30-11:00 *Conference Photo & Coffee break*

Session VI — Chair: Rachel Somerville

11:00-11:25 Understanding the Role of Feedback in Simulated Galaxies **(I)** — **Alyson Brooks**

11:25-11:40 Fuel and Fireworks in Inside-Out Disk Building — **Michelle Cluver**

11:40-11:55 Physical Conditions of Gas in an ALMA CII-identified Submm Galaxy at z=4.44 — **Minh Huynh**

11:55-12:10 Feeding Process by Clump Migration in Star-Forming Galaxies at $z > 2$ — **Ken-ichi Tadaki**

12:10-12:25 Feedback in Faint Galaxies at z$\sim$2-3: Inferences from Lyα emission — **Dawn Erb**

12:25-12:40 *Poster Sparklers*

12:40-15:00 *Lunch*

Session VII — Chair: Matt Owers

15:00-15:25 Hydrodynamical simulations of the formation of galaxy populations **(I)** — **Rob Crain**

15:25-15:40 SNe-driven Galactic Outflow Feedback in Cosmological Simulations of the Circumgalactic Medium — **Paramita Barai**

15:40-15:55 Modeling Mid-Infrared Diagnostics of Obscured Quasars and Starbursts — **Gregory Snyder**

15:55-16:10 Deconstructing Bimodality: Red ones and Blue ones, Live ones and Dead ones, Round ones and Flat ones — **Edward Taylor**

16:10-16:25 A discontinuous Galerkin method for solving the fluid and MHD equations in astrophysical simulations — **Philip Mocz**

16:25-16:50 *Coffee Break*

Session VIII — Chair: Phil Hopkins

16:50-17:15 Observations of AGN Feedback in Galaxies **(I)** — **Stas Shabala**

17:15-17:30 What drives the diversity in narrow-line AGN spectra? — **James Allen**

17:30-17:45 The Australia Telescope Large Area Survey (ATLAS): The composite properties of young AGN — **Kate Chow**

17:45-18:00 The new black hole scaling relations — **Nicolas Scott**

18:00 *End of today's talks*

19:00-22:00 *Conference Dinner (Outrigger restaurant)*

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Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Wednesday, 26 June 2013

Morning free (no lunch provided)

Session IX — Chair: Baerbel Koribalski

14:00-14:25	Galaxy Dodgems: Halo Scale Galaxy Feedback **(I)**	**Aaron Robotham**
14:25-14:40	Groups and Clusters as probes of cosmic feedback	**Trevor Ponman**
14:40-14:55	Shocks and Star Formation in Stephan's Quintet	**Iraklis Konstantopoulos**
14:55-15:10	Using HI to probe gas accretion and removal in galaxies	**Thijs van der Hulst**
15:10-15:25	Connection between blue early-type galaxies and local post-starburst galaxies	**Ivy Wong**
15:25-15:50	*Coffee Break*	

Session X — Chair: Rob Crain

15:50-16:15	Simulations of Galaxy Cluster Mergers **(I)**	**Daisuke Nagai**
16:15-16:30	Virial heating and inefficient galaxy formation	**Camila Correa**
16:30-16:45	Characterising the synchroton emission from the bullet cluster	**Tim Shimwell**
16:45-17:00	Abell 2034: A merger near the plane of the sky	**Matt Owers**
17:00-17:15	A star-bursting proto-cluster growing rapidly at z=2.53 iscovered by narrowband Hα imaging	**Masao Hayashi**
17:15-17:35	*Coffee Break*	

Session XI — Chair: Crystal Martin

17:35-17:50	ASKAP-FLASH: Observing the interplay between cold neutral gas and AGN	**James Allison**
17:50-18:05	Quasar Activity Near the Peak of Cosmic AGN Activity	**George Chartas**
18:05-19:00	*Discussion (Moderated)*	

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Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Thursday, 27 June 2013

Session XII — Chair: Aaron Robotham

09:00-09:05	General Announcements	
09:05-09:30	AGN Feedback in Galaxy Clusters (**I**)	**Andy Fabian**
09:30-09:45	The importance of major mergers in the build-up of stellar mass in brightest cluster galaxies	**Chris Lidman**
09:45-10:00	New results on star formation, cold molecular gas, and mechanical AGN feedback in Cool Core Brightest Cluster Galaxies	**Grant Tremblay**
10:00-10:15	Growing the most massive objects in the Universe: how well do galaxy formation models match observations?	**Paola Oliva-Altamirano**
10:15-10:30	Thermal Gas in the giant lobes of the radio galaxy Centaurus A	**Shane O'Sullivan**
10:30-11:00	*Coffee break*	

Session XIII — Chair: Ian McCarthy

11:00-11:25	Feedback, Feeding and Fireworks in Galaxy Clusters (**I**)	**Gillian Wilson**
11:25-11:40	A Keck Spectroscopic Survey of Cluster Galaxies at z=1.62	**Kim-Vy Tran**
11:40-11:55	Red Galaxies in a Young Universe: Star Formation, AGN Feedback, and Passive Evolution	**Chiara Tonini**
11:55-12:10	Dust-obscured star-formation in the outskirts of XMMU J2235.3-2557, a massive galaxy cluster at z=1.4	**Joana Santos**
12:10-12:25	Plunging Fireworks: starburst galaxies on cluster outskirts	**Smriti Mahajan**
12:25-12:40	The drivers of AGN activity in Galaxy Clusters	**Kevin Pimblett**
12:40-15:00	*Lunch*	

Session XIV — Chair: Daisuke Nagai

15:00-15:25	Star Formation, Black Holes, and Feedback in Galaxy Formation (**I**)	**Phil Hopkins**
15:25-15:40	Quasar Host Galaxies and the Mbh-sigma Relation	**Andy Sheinis**
15:40-15:55	Searching for Jet-Induced Feedback in Heavily Obscured & Extremely Luminous Quasars	**Amy Kimball**
15:55-16:10	AGN Feedback prescriptions in galaxy semi-analytic modelling	**Maksym Bernyk**
16:10-16:25	NGC 7130: Probing the starburst-AGN connection through analysis of starburst-AGN mixing	**Rebecca Davies**
16:25-17:00	*Coffee Break*	

Session XV — Chair: Amelie Saintonge

17:00-17:15	Multiwavelength Fireworks in Blue Compact Dwarf Galaxies	**Ángel López-Sánchez**
17:15-17:30	2D Kinematics and Physical Properties of Distant Galaxies	**Marie Lemoine-Busserolle**
17:30-17:45	Quenching of dwarf satellites assisted by internal feedback	**Matthew Nichols**
17:45-18:00	Joint Stripping of SNIa and AGB Ejecta from interacting dwarf galaxies	**Takuji Tsujimoto**
18:00-18:30	*Discussion (Moderated)*	
18:30	*End of today's talks*	

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Feeding, Feedback, and Fireworks: Celebrating Our Cosmic Landscape

Friday, 28 June 2013

Session XVI — Chair: Daniel Obreschkow

09:00-09:25	Confronting Planck Sunyaev-Zeldovich effect data with hydrodynamical simulations (**I**)	**Ian McCarthy**
09:25-09:40	Numerical Simulations of Mass Transport in Galactic Nuclei	**Andreas Escala**
09:40-09:55	Magnetized outflows from active galaxies	**Paul Sutter**
09:55-10:10	High-Redshift Cluster Formation via Galaxy Outflows in Cosmological Simulations	**Mark Richardson**
10:10-10:25	Radio Galaxy Morphology: "Nature" or "Nurture" ?	**Julie Banfield**
10:25-10:30	*Announcement: Saturday Barrier Reef Excursion Information*	**Matt Owers**
10:30-11:00	*Coffee break*	

Session XVII — Chair: Lisa Fogarty

11:00-11:25	Molecular gas as a probe of galaxy evolution (**I**)	**Amelie Saintonge**
11:25-11:40	What Lyman Alpha tells us about Galactic Winds at z=3	**Luke Barnes**
11:40-11:55	Tracing Outflows and Accretion using MgII Absorption	**Glenn Kacprzak**
11:55-12:10	Feedback and the Evolving Simulated CGM	**Molly Peeples**
12:10-12:25	Environmental Effects on Lyman Alpha Emitters at z=3	**Akila Jeeson Daniel**
12:25-12:40	[OIII] Emission and Gas Kinematics in a Lyman Alpha Blob at z=3	**Emily McLinden**
12:40-14:30	*Lunch*	

Session XVIII — Chair: Iraklis Konstantopoulos

14:30-15:55	Metal Distributions in Multiphase Gas across Disks and Halos (**I**)	**Jessica Werk**
14:55-15:10	The Redshift Evolution of the Relation between Stellar Mass, SFR, and Gas Metallicity	**Yuu Nino**
15:10-15:25	GAMA: A deeper view of the mass, metallicity, SFR, and HI relationships	**Maritza Lara-López**
15:25-15:40	Real or Interloper? The Redshift Likelihoods of Galaxies in the HUDF12	**Nor Pirzkal**
15:40-15:55	Galaxy Spectra from the Ultraviolet to the Mid-Infrared	**Michael Brown**
15:55-16:25	*Coffee Break*	

Session XIX — Chair: Andy Fabian

16:25-16:40	Removing Neutral Gas from Active Galaxies via Quasar-Photon Feedback	**Stephen Curran**
16:40-16:55	Time resolution in the feedback from radio galaxies and quasars	**Katherine Blundell**
16:55-17:10	Galaxy Evolution in Isolation	**Samantha Penny**
17:10-17:25	From GAMA to OMEGA: a short review of galaxy evolution from the Galaxy And Mass Assembly survey	**Andrew Hopkins**
17:25-17:50	Conference Summary (**I**)	**Matthew Colless**
17:50	*Farewell*	

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Talk abstracts

Monday 24 June, 09:10-10:00, Invited

Feeding, Feedback and Fireworks: Setting the Scene

Lisa Kewley, RSAA, ANU, Australia, *kewley@mso.anu.edu.au*

Monday 24 June, 10:00-10:15

The Illustris Project: Populating the Hubble sequence in cosmological simulations

Paul A. Torrey, Harvard University, U.S.A., *ptorrey@cfa.harvard.edu*
Co-authors: Mark Vogelsberger, Shy Genel, Debora Sijacki, Volker Springel, Lars Hernquist

Cosmological simulations are among the most powerful tools available to probe the non-linear regime of cosmic structure formation. They also provide one of the most powerful testbeds for understanding the impact that feedback processes have on the evolution of galaxies. In my talk, I will present new galaxy formation simulations that couple a powerful computational approach with explicit baryon feedback prescriptions. This results in galaxy formation models that reproduce a wide range of observational constraints including the galaxy stellar mass function, cosmic star formation rate density, and galaxy morphological diversity. I will discuss a few of the most central implications our results have on the currently accepted model for galaxy formation. Finally, I will discuss work-in- progress to increase the usability of our models by observers by coupling our simulations with stellar population synthesis models. This allows us to produce simulated galaxy catalogs which can be used to select galaxy populations with observational techniques and identify the past formation history or subsequent evolution of these galaxy populations.

Monday 24 June, 10:15-10:30

Astronomical Discovery in the petabyte era

Ray Norris, CSIRO Astronomy & Space Science, Australia, *raypnorris@gmail.com*

Over 50% of major astronomical discoveries are not the result of testing a falsifiable hypothesis, but are serendipitous discoveries of something quite unexpected. History shows that necessary elements of such discoveries include a deep familiarity with the data and the instrument, so that the discoverer is able to distinguish an important unexpected result from instrumental errors and artifacts. But with next generation instruments such as ASKAP and SKA, (a) the complexity of the instrument prevents any single individual from becoming familiar with the whole instrument, and (b) the data volumes are so large that science is extracted by obtaining specific answers to specific questions - nobody can browse through petabytes of data. So have we reached the end of the golden age of serendipitous astronomical discovery? Not if we can devise software that emulates a brilliant and knowledgeable researcher, distinguishing known types of source, and data errors, from potential new discoveries. Here I describe a project that aims to use data-mining algorithms on the phase-space of observables to locate unexpected new objects and phenomena. While targeted specifically at the ASKAP-EMU survey, the same approach and algorithms should be generally applicable to many next-generation telescopes and surveys.

Monday 24 June, 11:00-11:25, Invited

Cosmological Simulations of Galaxy Formation: Lessons and Puzzles

Rachel Somerville, Rutgers University, USA, *somerville@physics.rutgers.edu*

The past decade has seen enormous progress in our ability to simulate the fundamental physics that shapes galaxy formation. One of the main puzzles is why galaxy formation is so inefficient overall (only about 8% of the total baryons are in stars globally), and why the efficiency of converting baryons into stars seems to depend strongly on the mass of the host halo. The prevailing answer that has emerged is highly relevant to the topic of this meeting – we think that 'cosmic fireworks' in the form of stellar driven winds make star formation inefficient in low mass objects, while fireworks driven by accreting supermassive black holes do the job in massive halos. I will attempt to summarize the state of the art in the area of cosmological simulations, and the current status of these predictions when confronted with cutting edge observations of galaxy populations over cosmic history, including luminosity functions, morphologies, star formation activity, sizes, and chemical abundances.

Monday 24 June, 11:25-11:40

Properties of simulated galaxies at $z \sim 4-7$: an evolutionary scenario for the AGN feedback?

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Abstract: I will present the first results of the *AustraliaN GADGET-3 early Universe Simulations* (Angus) project. The aim of this project is to run state-of-the-art cosmological hydrodynamical simulations with an improved version of GADGET-3, to better understand the interplay between galaxies and intergalactic medium at redshifts ($z \geq 2$). In particular, I will discuss the results of two papers where we explored the star formation rate function (SFRF), the galaxy stellar mass function (GSMF) and the star formation rate−stellar mass relation of $z \sim 4-7$ galaxies. In our simulations both galactic winds and AGN feedback act simultaneously in a complex interplay. We find that at higher redshift the relative importance of supernovae driven winds increases. Most interestingly, the AGN feedback is important in shaping the low end of the SFRF and of the GSMF. This is in contrast to what happens at low redshift and suggests the existence of an evolutionary scenario for the AGN feedback.

Monday 24 June, 11:40-11:55

Galaxy Structure Across Time: A Result of Feeding or Feedback?

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Co-authors: K. Glazebrook, R. Bassett, P. McGregor, R. Sharp, M. Satterthwaite, E. Wisnioski, R. Abraham, I. Damjanov, G. Poole, M. Colless, L. Spitler, R. Crain, P. McCarthy, E. Mentuch-Cooper, D. Obreschkow, A. Popping

Star forming galaxies in the early universe tend to have clumpy, chaotic structures that are dramatically different from the smooth ordered structures of modern disc galaxies. Exotic mechanisms of gas feeding at high redshift have been proposed to explain this chaotic structure. However, our team has identified galaxies at low redshift with strikingly similar properties to the chaotic galaxies of the early universe. Using comparisons between our sample and early galaxies, I argue that feedback from active star formation dominates over mechanisms of gas feeding in determining the structure of galaxies in all eras. This conclusion eliminates the need for different feeding mechanisms in different eras.

Monday 24 June, 11:55-12:10

What does the Galaxy Main Sequence tell us about feeding and feedback?

Kai Noeske, ESA/STScI, USA, *noeske@stsci.edu*

The Galaxy Main Sequence is a tight relation between star-forming galaxies' (specific) star formation rates and their stellar masses. It persists to at least $z \sim 2$ and possibly to the highest observable redshifts. This relation indicates that star formation in galaxies over the past 10 billion years, and likely beyond, was predominantly regular and gradually declining over the past 10 billion years, and that star-forming galaxies of similar stellar and halo masses at a given redshift experienced similar star formation histories. The Galaxy Main Sequence provides us with an observational reference star formation history for normal star-forming galaxies, and can identify galaxies that are outliers in either a starburst or suppressed star formation mode. From this information, we can infer dominant feeding modes of galaxies at different cosmic times, and make quantitative predictions on star formation driven feedback and metal enrichment over galaxies' lifetimes. The presentation closes with an outlook on the challenges, and promising perspectives from new instrumentation, to quantify observational star formation histories robustly out to $z > 2$, and back into the era of early galaxy formation and reionization.

Monday 24 June, 12:10-12:35, Invited

The Future of Galaxy Surveys

Lisa Fogarty, University of Sydney, Australia, *l.fogarty@physics.usyd.edu.au*

With roots in the not-too-distant past, integral field spectroscopy (IFS) has rapidly become one of the most exciting and valuable techniques in modern astronomy. Important new science is accessible through the unique data sets produced by IFS observations. The field of galaxy evolution, in particular, has seen many recent advances and discoveries, from in-depth studies of local objects, to probes of the distant past of galaxies using high-redshift observations.

Now, for the first time, we can combine the power of IFS with multi-object instruments, ushering in a new era in galaxy surveys. This innovation allows large samples of galaxies to be observed in only a few nights. Australia and the SAMI team are at the cutting edge of this leap forward. The SAMI galaxy survey, a large-scale IFS survey, is already underway. Over the next several years we plan to observe 3000 galaxies, many times the number of objects than have been observed with IFS to date. Such a large IFS sample will explore a completely new parameter space, enabling in-depth studies of galactic physics.

In this talk I will present an overview of the importance of IFS to astronomy and highlight some significant results made possible by this technique. I will discuss new efforts towards large-scale IFS surveys, particularly the SAMI galaxy survey, which is already underway. I will also present the most recent science results from the SAMI galaxy survey, focussing on my own work on early-type galaxies.

Monday 24 June, 15:00-15:25, Invited

Gas Dynamics in Galaxies

Danail Obreschkow, International Centre for Radio Astronomy Research (ICRAR), Australia, *danail.obreschkow@icrar.org*

Recent detections and simulations of cold gas in galaxies paint a surprising picture, where cold gas dominates the baryonic mass in the key era of star formation at $z \approx 2-3$. In this era the gas turbulence seems to be significantly higher than today, with dispersion supported disks being quite common. Although not conclusively understood, this turbulence seems to be both a consequence and a defining factor of star formation. A linked phenomenon is a strong cosmic evolution in the mass ratio between molecular and atomic gas, predicted to scale as $(1+z)^{1.5-2}$ from $z=0$ to $z \approx 3$. Apart from playing a key role in galaxy evolution, cold gas, especially atomic hydrogen, also traces the motion and kinematics of galaxies. Modern applications range from small-scale studies of differential galaxy rotations, merger dynamics and feedback processes to large-scale cosmological applications. For instance, new data from the HIPASS and ALFAFA surveys, as well as modern high-resolution N-body simulations led to the first gas-based constraints on the nature of dark matter, and hydrogen maps produced by the future SKA promise to become the best tracer of cosmic structure all the way back to the Epoch of Reionization.

Monday 24 June, 15:25-15:40

Probing spiral galaxy evolution via their neutral hydrogen content

Virginia Kilborn, Swinburne University of technology, Australia, *vkilborn@swin.edu.au*
Co-authors: Helga Denes (Swinburne)

A key pursuit in extragalactic astronomy is to determine how galaxies are formed, and how they evolve. We have been using the neutral hydrogen (HI) line to find galaxies that are undergoing a major accretion, or stripping event, using their optical properties and the HI Parkes All Sky Survey data. Analysing the HI component of a spiral galaxy is an effective way to identify galaxies affected by external influences. The HI in spiral galaxies is typically more extended than the stellar component, and thus more susceptible to, for example, gravitational encounters. We are performing high resolution imaging of galaxies which contain either too much (HI-rich), or too little (HI deficient) HI, compared to a larger sample of galaxies. We will present our results, showing HI deficient galaxies that lie outside of galaxy clusters, and isolated HI-rich galaxies. The physical mechanisms occurring in these galaxies will be discussed.

Monday 24 June, 15:40-15:55

Moving mesh cosmology: tracing cosmological gas accretion

Dylan Nelson, Harvard University CfA, USA, *dnelson@cfa.harvard.edu*
Co-authors: Mark Vogelsberger, Shy Genel, Debora Sijacki, Dušan Kereš, Volker Springel, Lars Hernquist

We investigate the nature of gas accretion onto haloes and galaxies at $z = 2$ using cosmological hydrodynamic simulations run with the moving mesh code AREPO. Implementing a Monte Carlo tracer particle scheme to determine the origin and thermodynamic history of accreting gas, we make quantitative comparisons to an otherwise identical simulation run with the smoothed particle hydrodynamics (SPH) code GADGET-3.

Contrasting these two numerical approaches, we find significant physical differences in the thermodynamic history of accreted gas in massive haloes above $\simeq 10^{10.5} M_\odot$. In agreement with previous work, GADGET simulations show a cold fraction near unity for galaxies forming in massive haloes, implying that only a small percentage of accreted gas heats to an appreciable fraction of the virial temperature during accretion. The same galaxies in AREPO show a much lower cold fraction, for instance $< 20\%$ in haloes with $M_{\rm halo} \simeq 10^{11} M_\odot$. This results from a hot gas accretion rate which, at this same halo mass, is an order of magnitude larger than with GADGET, together with a cold accretion rate which is lower by a factor of two. These discrepancies increase for more massive systems, and we explain both trends in terms of numerical inaccuracies with the standard formulation of SPH. We note, however, that changes in the treatment of ISM physics – feedback, in particular – could modify the observed differences between codes as well as the relative importance of different accretion modes.

We explore these differences by evaluating several ways of measuring a cold mode of accretion. As in previous work, the maximum past temperature of gas is compared to either a constant threshold value or some fraction of the virial temperature of each parent halo. We find that the relatively sharp transition from cold to hot mode dominated accretion at halo masses of $\simeq 10^{11} M_\odot$ is a consequence of the constant temperature criterion, which can only separate virialised gas above some minimum halo mass.

Examining the spatial distribution of accreting gas, we find that the filamentary geometry of accreting gas near the virial radius is a common feature in massive haloes above $\simeq 10^{11.5} M_\odot$. Gas filaments in GADGET, however, tend to remain collimated and flow coherently to small radii, or artificially fragment and form a large number of purely numerical "blobs". These same filamentary gas streams in AREPO show increased heating and disruption at 0.25-0.5 $r_{\rm vir}$ and contribute to the hot gas accretion rate in a manner distinct from classical cooling flows.

Monday 24 June, 15:55-16:10

Fuel for Fireworks in Nearby Galaxies

Baerbel Koribalski, ATNF, CSIRO, Australia, *Baerbel.Koribalski@csiro.au*
Co-authors: Ivy Wong & Tobias Westmeier et al.

I will present the discovery of large-scale neutral hydrogen (HI) tails and streams associated with interacting/merging galaxies in nearby groups (D $\approx$ 20 Mpc). The HI structures, detected with the Parkes 21-cm multibeam system, span around 400 kpc and have HI masses of 1-5 x 10^8 Msun. Their dynamics will provide some insights into galaxy (trans)formation and evolution as well as fueling star formation. In one of the interacting galaxy systems we also identified a large stellar stream which is associated with the inner, high-density part of one of the HI tails. Our results suggest that many more large-scale HI and stellar structures will be uncovered in the near future.

Monday 24 June, 16:10-16:25

Fueling the Star-Making Machine: Exploring past to present star formation in Local Volume galaxies

Thomas Jarrett, Univ of Cape Town, South Africa, *jarrett@ast.uct.ac.za*
Co-authors: Ed Elson, Baerbel Koribalski, Priscilla Chauke, Michelle Cluver

We have initiated a galaxy evolution project that exploits the rich and complementary data sets provided by WISE and the Local Volume HI Survey (LVHIS). Utilizing the full capabilities of ATCA and Parkes, the LVHIS survey of nearby galaxies is a sensitive, (relatively) well resolved and statistically significant compilation of HI content and kinematic information for southern hemisphere galaxies, serving as the base "fuel" sample for the project. The whole-sky mid-infrared photometric survey, WISE, is designed to study both past evolution and the present star formation history of galaxies. Together these two data sets may be combined to study the complexities of star formation on spatially interesting (kpc) scales. We present global average and the detailed surface density results from a pilot sample of LVHIS galaxies, where we resolution-match data sets, cross-correlating and constructing star formation rate, efficiency and past-to-present histories.

Monday 24 June, 16:50-17:15, Invited

Galactic Winds Across Cosmic Time

Crystal Martin, UC Santa Barbara, USA, *cmartin@physics.ucsb.edu*

TBD closer to the conference date

Monday 24 June, 17:15-17:30

OB Cluster Feedback and Molecular Cloud Formation: Supershells as Molecular Cloud Factories?

Joanne Dawson, University of Tasmania, Australia, *joanne.dawson@utas.edu.au*
Co-authors: Naomi McClure-Griffiths, Yasuo Fukui, John Dickey, Tony Wong, Annie Hughes

The feedback from OB clusters is a vital component in the ecosystem of star-forming galaxies. It drives energy and mass exchange between disks and halos, injects energy to power turbulence, and contributes to the structural, physical and chemical evolution of the disk interstellar medium (ISM). Among the most interesting aspects of stellar feedback is its role in triggering the formation of new generations of stars. On the largest scales this can occur via the production of new star-forming material "from scratch", as the energy input from multiple stellar winds and supernovae accumulates and compresses the diffuse ISM into dense molecular clouds. In this talk I will first report CO(J=1–0) and HI 21 cm observations of the molecular and atomic ISM in two feedback-formed "supershells" in the Milky Way, which provide observational evidence of increased molecular cloud production in volumes of space affected by large-scale stellar feedback. I will then discuss recent work on the Large Magellanic Cloud (LMC), in which we have carried out the first quantitative measurements of feedback-triggered molecular cloud formation in an entire galactic system. Our results suggest that $\sim$ 12–25% of the molecular mass in LMC supergiant shell systems was formed as a direct result of large-scale stellar feedback, corresponding to $\sim$ 4–11% of the total molecular mass of the galaxy. While these numbers are an approximate lower limit, they nevertheless suggest that OB-cluster feedback is not a dominant driver of molecular cloud production in the LMC. Further work is now needed to extend this study to other galaxies.

Monday 24 June, 17:30-17:45

The extra-planar ISM of Spiral Galaxies

Peter Kamphuis, CSIRO/CASS, Australia, *peter.kamphuis@csiro.au*

In recent years it has become clear that the gas circulation above the plane of spiral galaxies plays a crucial role in their evolution. Studies of the extra-planar hydrogen can improve our understanding of this disk-halo interaction and continued star formation as well as accretion from the IGM. Kinematical information is of particular interest since it provides clues to the origin of the gas and helps to disentangle projection effects. Such kinematical studies have shown that the rotational velocities of the gas in massive spiral galaxies decline with increasing distance to the mid-plane, the so-called lag. In several cases, apart from the main disk, a large diffuse second component is observed in the vertical distribution of the gas. However, in which manner these thick disks and lags relate to eachother as well as their origins remain open questions. Currently large multi-wavelength surveys are undertaken to obtain the properties of the extra-planar gas for large samples of galaxies. One of these surveys is the WSRT Hydrogen Accretion in LOcal GAlaxieS (HALOGAS) Survey. This survey will, for the first time, provide us with the data to correlate the extra-planar gas properties with global galaxy properties and provide us with a consensus of cold gas accretion in the nearby Universe. Additionally, the search for extra-planar gas has recently been expanded to early type galaxies.

Galactic Penumbrae

Joshua Peek, Columbia Univeristy, USA, *goldstonp@gmail.com*
Co-authors: Brice Menard, David Schiminovich, Genevieve Graves

Dust suffuses our diffuse universe, obscures our view, and is a direct product of the formation of stars and galaxies. In this era of large area digital surveys it is both necessary and possible to explore dust in our universe at a level once unheard of. I will discuss new results on dust, both extreme in precision and extreme in position. In my discussion of high precision dust observations, I show how crucial accurate dust maps are to our understanding of cosmology, and I will introduce a new cosmological parameter: the opacity of the universe, τ_z. Perhaps even more interestingly, I will show new results on dust in low density environments, both at the surface of our own galaxy and filling the virial radii of galaxies throughout the universe. I will introduce the idea of exploring feedback from galaxies by studying their dust, and using these observations to constrain our models of galaxy formation.

Tuesday 25 June, 09:05-09:30, Invited

Star-Formation Tracers in Galaxies: A Multi-Wavelenght Perspective

Daniela Calzetti, Dept. of Astronomy, University of Massachusetts-Amherst, U.S.A.,
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The light from galaxies has been calibrated for use as star formation rate indicators at a variety of bands / wavelengths. I review common calibrations for both (or either) the integrated and the spatially-resolved light from galaxies, highlighting the conditions for appropriate use. In this case, I also discuss the accuracy of the star formation rate indicators, as currently understood, and the way forward for improving those accuracies and for exploring different calibrators.

Tuesday 25 June, 09:30-09:45

The Hα Luminosity Functions and Star Formation Rate History of the Local Universe

Madusha Gunawardhana, University of Sydney/Australian Astronomical Observatory, Australia, *mlpg@physics.usyd.edu.au*
***Co-authors*: A. M. Hopkins, J. Bland-Hawthorn** *et. al*

The low redshift star formation history has been traced using star formation rate (SFR) indicators across a broad wavelength range. Measurements of the cosmic SFR density indicates a large dispersion ($\sim$0.5 dex) in SFR densities at a given redshift, perhaps more intriguingly between individual measurements of the same SFR indicator. I will present the Hα luminosity functions (LFs), and the bivariate LFs based on GAMA (Galaxy And Mass Assembly) spectroscopic data, which provide significant insight in to explaining some of the discrepancies we see in the observed star formation history. The large range in SFR covered by this unique data set allows us not only to extend the low redshift LF by $\sim$1 order of magnitude in luminosity towards both fainter and brighter luminosities than other published results to date, but also, for the first time to observationally demonstrate that the Schechter function is not a good representation of star forming LFs. Instead they are best represented by the Saunders function, used to fit radio and infrared LFs for star forming galaxies.

Tuesday 25 June, 09:45-10:00

A Census of Oxygen in Star-Forming Galaxies in the Local Universe

H. Jabran Zahid, Institute for Astronomy, University of Hawaii, USA, *jabran@ifa.hawaii.edu*
Co-authors: G.I. Dima, L.J. Kewley, D.K. Erb & R. Dave

In this contribution we present the first census of oxygen in star-forming galaxies in the local universe. We examine three samples of galaxies with metallicities and star formation rates at $z = 0.07, 0.8$ and 2.26, including the SDSS and DEEP2 surveys. We infer the total mass of oxygen produced and mass of oxygen found in the gas-phase from our local SDSS sample. The star formation history is determined by requiring that galaxies evolve along the relation between stellar mass and star formation rate observed in our three samples. We show that the observed relation between stellar mass and star formation rate for our three samples is consistent with other samples in the literature. The mass-metallicity relation is well established for our three samples and from this we empirically determine the chemical evolution of star-forming galaxies. Thus, we are able to simultaneously constrain the star formation rates and metallicities of galaxies over cosmic time allowing us to estimate the mass of oxygen locked up in stars. Combining this work with independent measurements reported in the literature we conclude that the loss of oxygen from the interstellar medium of local star-forming galaxies is likely to be a ubiquitous process with the oxygen mass loss scaling (almost) linearly with stellar mass. We estimate the total baryonic mass loss and argue that only a small fraction of the baryons inferred from cosmological observations accrete onto galaxies.

Tuesday 25 June, 10:00-10:15

A Signature of Merger Driven Star Formation in Spiral Galaxies

Tim Dolley, Monash Centre for Astrophysics, Australia, *tim.dolley@monash.edu*
Co-authors: Michael Brown

Local galaxy star formation is thought to be dominated by secular evolution, but star formation triggered by mergers must also contribute. We have measured the clustering of spiral galaxies as a function of specific star formation rate (SSFR), for a morphology selected sample. We find that large scale clustering of spiral galaxies is independent of SSFR, which means that spiral galaxies with high and low SSFRs typically reside within the same mass dark matter halos. On intermediate scales (< 1 Mpc), spiral galaxies with high SSFRs have a deficiency in satellite companions, but an excess of satellite companions at smaller scales (< 100 kpc). This appears to be the signature of recent or ongoing mergers, where the suppressed correlation function at ~ 500 kpc scales is due to the infall of a satellite companion.

Tuesday 25 June, 10:15-10:30

Star formation and supernovae in Luminous Infrared Galaxies

Stuart Ryder, AAO, Australia, *sdr@aao.gov.au*
Co-authors: Seppo Mattila (Tuorla Obs.), Erkki Kankare (Tuorla Obs.) & Petri Vaisanen (SAAO)

We use Laser Guide Star Adaptive Optics on the Gemini North and Gemini South telescopes in order to ascertain whether the observed core-collapse supernova rates of Luminous Infrared Galaxies (LIRGs) are consistent with the high star formation rates implied by their far-infrared luminosities. Our findings have implications for current and future supernova surveys, including SkyMapper, KMTNet, LSST, Euclid, and JWST. Our diffraction-limited images of the LIRGs also enable us to study the K-band luminosity functions for their super star cluster populations, which differ from those of normal spiral galaxies.

Tuesday 25 June, 11:00-11:25, Invited

Understanding the Role of Feedback in Simulated Galaxies

Alyson Brooks, U Wisconsin, Madison, USA, *abrooks@astro.wisc.edu*

Much progress has been made in recent years in forming realistic disk galaxies in fully cosmological simulations. Computational advances have allowed for unprecedented resolution, which in turn allows for a more realistic treatment of star formation and energy feedback. I will review the current state of subgrid physics implementations (for star formation and subsequent feedback) used by varying modelers. I will highlight the successes of new high resolution cosmological galaxy simulations, such as naturally driving galaxy winds, as well as altering the dark matter structure of galaxies. A number of observational results, previously considered difficult to explain within CDM, can now occur naturally in simulated galaxies. Despite these successes, I will also note challenges yet to be overcome.

Tuesday 25 June, 11:25-11:40

Fuel and Fireworks in Inside-Out Disk Building

Michelle Cluver, AAO, Australia, *mcluver@aao.gov.au*
Co-authors: Thomas Jarrett, Renée Kraan-Korteweg, Philip Appleton, Baerbel Koribalski, Bjorn Emonts, Andrew Hopkins

As large and targeted surveys uncover the nature of the star-forming population at redshifts $1-2$, we continue to rely on spatially-detailed studies of nearby galaxies to understand the interplay between gas, dust and feedback from star formation. Nature has provided an ideal laboratory to study the kinematics and ISM chemistry of inside-out disk building: HIZOA J0836-43 is a local (z$\sim$0.036) HI-massive, luminous infrared galaxy undergoing elevated star formation spread across the inner third of its $\sim$130 kpc neutral gas disk, exhibiting PDR-dominated emission. Photometry and spectroscopy from Spitzer and Herschel, combined with high spatial and velocity resolution ATCA HI observations, will be discussed in connection to star formation in large, gas-rich star-forming disks with direct relevance to z$\sim$1 galaxy evolution.

Tuesday 25 June, 11:40-11:55

Physical Conditions of Gas in an ALMA [CII]-identified Submillimetre Galaxy at $z = 4.44$

Minh Huynh, ICRAR/UWA, Australia, *minh.huynh@uwa.edu.au*

We present ^{12}CO(2–1) (42.3 GHz) observations of the submillimetre galaxy ALESS65.1 performed with the Australia Telescope Compact Array. A previous ALMA study of submillimetre galaxies in the Extended *Chandra* Deep Field South detected [CII] 157.74 μm emission from this galaxy at a redshift of $z = 4.44$. No ^{12}CO(2–1) emission was detected but we derive a firm upper limit to the cold gas mass in ALESS65.1 of $M_{\rm gas} < 1.7 \times 10^{10}$ M$_\odot$. The estimated gas depletion timescale is < 50 Myr, which is similar to other high redshift SMGs, and consistent with $z > 4$ SMGs being the likely progenitors of massive red-and-dead galaxies at $z > 2$. The ratio of the [CII], ^{12}CO and far-infrared luminosities implies a strong far-ultraviolet field of $G_0 >\sim 10^3$, as seen in Galactic star forming regions or local ULIRGs. The observed $L_{\rm [CII]}/L_{\rm FIR} = 2.3 \times 10^{-3}$ is high compared to local ULIRGs and, combined with $L_{\rm [CII]}/L_{\rm CO} >\sim 2700$, it is consistent with ALESS65.1 having an extended [CII] emitting region or lower than solar metallicity.

Tuesday 25 June, 11:55-12:10

Feeding process by clump migarion in star-forming galaxies at $z > 2$

Ken-ichi Tadaki, National Astronomical Observatory of Japan, Japan, *tadaki.ken@nao.ac.jp*
Co-authors: Tadayuki Kodama, Ichi Tanaka, Masao Hayashi, Yusei Koyama and Rhythm Shimakawa

A theme of my presentation is the evolution of galaxy morphologies, that is, "Origin of Hubble sequence". Star-forming galaxies become increasingly irregular at $z > 2$ with clumpy structures as well as enhancements of star formation activities. How do such distant clumpy galaxies evolve? In numerical simulations, the clumps can migrate toward the galaxy center as a result of their mutual interactions and of dynamical friction against the host disk, and coalesce into a young bulge. On the other hand, strong stellar feedback, parameterized by momentum-driven galactic winds, can disrupt clumps before migrating towards the galaxy centers. In order to give observational constraints on the fate of the clumps, we have identified a lot of clumpy galaxies from a narrow-band imaging survey of H-alpha emitters (HAEs) at $z > 2$ with MOIRCS on Subaru Telescope in the SXDF-CANDELS field, where the high-resolution near-infrared and optical images by WFC3/ACS on HST are both publicly available. Interestingly, the colors of clumps are often significantly different: we find the trends of having redder colors in the galactic nuclei compared to the off-center clumps. Moreover, some clumpy HAEs are detected with MIPS 24μm image, which strongly suggests that dusty starburst is occurring within these galaxies. Therefore, our result implies that the intense star formation is on-going in the red clump near the galaxy center.

Dusty starburst activity in a nuclear clump supports the scenario that the clumps migrate to galactic center or merge with other clumps, and then such events induce an intense star-formation like a gas-rich merger process. The gas fueling to the galactic center by clump migration is also an important process in view of the co-evolution of galaxies and supermassive black holes (SMBHs). It is thought that the dusty star formation at the galaxy center accelerates the black-hole growth due to strong dissipation of gas and its further accretion towards the center. This scenario is preferable to account for the tight relationship between bulge and SMBH masses.

Tuesday 25 June, 12:10-12:25

Feedback in Faint Galaxies at $z \sim 2$-3: Inferences from Lyα Emission

Dawn Erb, University of Wisconsin Milwaukee, USA, *erbd@uwm.edu*
Co-authors: Chuck Steidel, Milan Bogosavljević, David Law, Max Pettini, Naveen Reddy, Alice Shapley

Because faint, low mass galaxies are numerous, their impact on the Universe is expected to be significant. They may host a substantial fraction of global star formation, provide many of the energetic photons needed to reionize the universe, and contribute to the enrichment of the intergalactic medium through the expulsion of metals in galactic outflows. The properties of these galactic outflows are likely to scale with mass and star formation rate, making the study of low mass galaxies at high redshifts particularly important. Because such objects are so faint, however, these studies involve considerable challenges. I will discuss the prospects and limitations of using Lyα emission to study outflows in galaxies too faint for absorption line spectroscopy, using a sample of faint LAEs at $z \sim$ 2-3 with systemic redshifts recently measured from near-IR spectroscopy with MOSFIRE, the new multi- object near-IR spectrograph on the Keck telescope.

Tuesday 25 June, 15:00-15:25, Invited

Hydrodynamical simulations of the formation of galaxy populations

Robert Crain, Leiden Observatory, Netherlands, *crain@strw.leidenuniv.nl*
Co-authors: Key collaborators: Joop Schaye, Tom Theuns, Richard Bower, Carlos Frenk, Ian McCarthy, Volker Springel, Simon White

Recommend that I post an abstract after the SOC finalises the title of the review. I propose to draw heavily on insight from the GIMIC, OWLS and forthcoming EAGLE simulations.

Tuesday 25 June, 15:25-15:40

SNe-driven Galactic Outflow Feedback in Cosmological Simulations of the Circumgalactic Medium

Paramita Barai, INAF - Osservatorio Astronomico di Trieste, Italy, *pbarai@oats.inaf.it*
Co-authors: Matteo Viel, Stefano Borgani, Edoardo Tescari, Luca Tornatore, Klaus Dolag, Madhura Killedar, Pierluigi Monaco, Valentina D'Odorico, Stefano Cristiani

Our study explores new models of galactic outflows in cosmological hydrodynamic simulations, and investigate the chemical and thermal history of baryons in the circumgalactic medium (CGM) over z = 2 - 4 (Barai et al. arXiv:1210.3582). We have numerically implemented a new observationally-constrained subresolution model of energy feedback by supernova-driven winds in the TreePM-SPH code GADGET-3, where the wind velocity correlates positively with distance from center of a galaxy (Steidel et al. 2010). We consider a further modification where the maximum outflow velocity is a function of circular velocity of the halo (Martin 2005). Using these models we perform hydrodynamical simulations of large-scale structure formation, including radiative cooling, star formation, chemical evolution, and multiple cases of SNe-driven winds. The impact of different feedback mechanisms on the global properties are analyzed: redshift evolution of the star formation rate, gas and stellar mass functions, metal enrichment of the CGM and IGM, radial profiles of gas properties around galaxy centers at z 2 - 3. We predict observational diagnostics to distinguish between different outflow scenarios.

Tuesday 25 June, 15:40-15:55

Modeling Mid-Infrared Diagnostics of Obscured Quasars and Starbursts

Gregory Snyder, Harvard University, United States, *gsnyder@cfa.harvard.edu*
Co-authors: Chris Hayward, Anna Sajina, Patrik Jonsson, Lars Hernquist

I will discuss efforts to combine hydrodynamical merger simulations with dust radiative transfer to analyze the link between active galactic nuclei (AGN) emission and mid-infrared flux in ultra-luminous infrared galaxies (ULIRGs). Focusing on the effects of galaxy dust, we evaluate diagnostics used to disentangle AGN emission and star formation, such as 9.7 micron silicate absorption, PAH emission, and SED slope as a function of time, dust model, and AGN strength in merger models meant to bracket the properties of ULIRGs. Depending on its mass and configuration, galaxy dust can reprocess the energy absorbed from AGN short-wavelength emission into nearly any mid-IR SED shape. Although generally consistent with previous interpretations, this implies that none of these indicators unambiguously estimate the AGN luminosity fraction in all cases. For a wide range in obscuration, we show that a JWST-accessible combination of these mid-infrared features can simultaneously constrain the AGN fraction and dust grain model.

Tuesday 25 June, 15:55-16:10

Deconstructing Bimodality: Red ones and Blue ones, Live ones and Dead ones, Round ones and Flat ones

Edward Taylor, the University of Melbourne, Australia, *ent@ph.unimelb.edu.au*

It has long been understood that there is an apparently fundamental dichotomy between 'developing' galaxies – the blue, star forming spirals, which tend to be less massive, and to be live in isolation or in small groups – and the 'developed' galaxies – the massive, red and dead ellipticals, which dominate the population in cluster environments. But there is still no good theoretical understanding of when, how, or why galaxies make the evolutionary transition from developing to developed. I will present new observational constraints on how this process proceeds. Using the technique of mixture modelling, which provides a means for objective classification, I have characterised the properties of the red/blue, quiescent/active, and bulge-/disk-like galaxy populations. These results are based on a $z < 0.12$ sample of $\log M_* > 8.7$ $M_\odot$ galaxies from the GAMA survey. Based on these results, I look at the overlaps between these different populations. The basic observational result is that all quiescent galaxies are also red, and all red galaxies are also bulge-like. There is no overlap between the red and the disk-like populations, nor between the blue and the quiescent populations. This implies an order of events. Galaxies go from disk-like to bulge-like *first*; that is, *the structural transition happens on the blue sequence*. Only after this process has completed do *galaxies migrate from the blue to the red populations, while remaining active*. And only then do galaxies become quiescent: that is, *quenching only happens to red sequence galaxies*. This empirical picture presents a major challenge to idea of AGN feedback being the mechanism behind star-formation quenching.

Tuesday 25 June, 16:10-16:25

New Discontinuous Galerkin Method for Cosmological MHD simulations on a Moving Mesh

Philip Mocz, Harvard University, United States, *pmocz@cfa.harvard.edu*
Co-authors: Lars Hernquist, Volker Springel

We develop a new 2nd order algorithm for solving the Euler and ideal MHD equations on a moving Voronoi mesh, based on the Discontinuous Galerkin method. The new algorithm uses a locally divergence-free representation of the magnetic fields, constraining the magnetic field's global divergence, which is typically difficult to accomplish for other, traditional, cell-centered approaches. The new method is shown to be more accurate than finite volume methods of the same order, and can readily be extended to higher-order accuracy without requiring extended stencils and thus is highly parallelizable. The method is also compatible with a hierarchical time-stepping scheme, making it ideal for high-resolution cosmological simulations with magnetic fields. We have implemented the new numerical method in the moving-mesh code AREPO, and present some simple test and first application problems.

Tuesday 25 June, 16:50-17:15, Invited

Observations of AGN feedback in galaxies

Stas Shabala, University of Tasmania, Australia, *Stanislav.Shabala@utas.edu.au*

Feedback from AGN is increasingly being recognised as an important process in galaxy formation and evolution. AGN feedback is held responsible for the lack of a cooling catastrophe in galaxy clusters and decline in the cosmic star formation since z=1. On the other hand, AGN may also enhance star formation, especially at high redshift.

I will review the observational evidence for AGN feedback, and discuss the different ways in which this feedback can be (and is) done. I will argue that mechanisms responsible for triggering AGN activity provide important clues about the nature of the feedback process. As a result, AGN must be considered together with their host galaxies and larger-scale environment. Observations of the complete AGN-galaxy-IGM ecosystem will play a key role in constraining the cosmological models of AGN feedback, and ultimately establishing the role this feedback plays in galaxy formation and evolution.

Tuesday 25 June, 17:15-17:30

What drives the diversity in narrow-line AGN spectra?

James Allen, University of Sydney, Australia, *j.allen@physics.usyd.edu.au*
Co-authors: Chris Richardson, Jack Baldwin, Paul Hewett, Gary Ferland

Active galactic nuclei (AGN) show a great diversity in their observed spectral properties, the separation into broad- and narrow-line objects being the most obvious example. But within narrow-line (type 2) AGN, a variety of different emission line flux ratios indicates a variety of physical conditions in different objects. I will show how large-scale surveys can be used to characterise the physical conditions that exist within AGN. The size of modern surveys allows new statistical techniques to be used to remove contamination by star formation, leaving pure AGN spectra. Additionally, large numbers of such spectra can be combined in order to measure weak emission lines, giving extra information that can be used to constrain physical properties; the strong lines on their own provide insufficient information. Using state-of-the-art photoionisation models we have explored the emission-line spectra predicted across a large parameter space, and compared these to measurements of many different emission lines in the pure AGN spectra. Our results show that much of the variety in AGN spectra can be explained by varying a single parameter. I will discuss the implications for AGN evolution and their connection to the host galaxy properties.

Tuesday 25 June, 17:30-17:45

The Australia Telescope Large Area Survey: The composite properties of young AGN

Kate Chow, CSIRO Astronomy and Space Science, Australia, *Kate.Chow@csiro.au*

The Australia Telescope Large Area Survey (ATLAS) is the widest deep radio survey attempted so far, covering $\sim$7deg^2 across its two fields, the Chandra Deep Field South (CDFS) and the European Large Area ISO Survey South 1 Region (ELAIS-S1). ATLAS has extensive multiwavelength data, including optical, infrared and X-ray, to complement its $\sim$15μJy rms 1.4 GHz radio data. At these faint radio flux densities, star-forming galaxies begin to dominate the source population, and there is likely a composite population of sources with ongoing star formation that also contain an AGN. Understanding these faint radio source populations is essential for understanding galaxy evolution and what role is played by the AGN. I present preliminary results investigating the faint population of Compact Steep Spectrum sources in ATLAS, thought to be one of the earliest stages of the AGN life-cycle and possibly composite AGN/star-forming objects. Exploring this population will aid us in understanding the evolution of AGN as a whole and help to shed light on what triggers AGN.

Tuesday 25 June, 17:45-18:00

The new black hole mass scaling relations

Nicholas Scott, Swinburne, Australia, *nscott@astro.swin.edu.au*
Co-authors: Alister Graham, James Schombert

Feedback from AGN is thought to be a driving force in regulating the growth of galaxy bulges. For more than a decade it has been thought that this resulted in a linear relation generating a near constant (black hole)-to-(bulge) mass ratio of around 0.2

Wednesday 26 June, 14:00-14:25, Invited

Galaxy Dodgems: Halo Scale Galaxy Feedback

Aaron Robotham, ICRAR / UWA, Australia, *aaron.robotham@uwa.edu.au*

The recently constructed G3C group catalogue, built using GAMA redshift data, contains robust halo masses across the largest dynamic range ever assembled. Here I present published and ongoing work that investigates the complex interplay between galaxy-galaxy interactions, halo mass and galaxy properties (morphology, star formation and colour). Galaxy-galaxy interactions produce the most dramatic effects on measurable galaxy properties, and this allows correlated evolution between central and satellite galaxies to be naturally explained.

Wednesday 26 June, 14:25-14:40

Groups and clusters as probes of cosmic feedback

Trevor Ponman, University of Birmingham, UK, *tjp@star.sr.bham.ac.uk*

The hot intergalactic medium in clusters and groups bears the marks of feedback from AGN and supernovae. AGN feedback can be seen directly in many systems, but equally interesting is the cumulative impact of energy injection which manifests itself in the structure and composition of the IGM.

I will discuss results arising from studies of the iron content and energetics of the hot gas and relate these to computational models involving feedback. This will include new results on (i) the entropy distribution in groups selected from the GAMA survey, (ii) the gas and baryon fractions in poor clusters, (iii) the energy requirements for raising the entropy to observed levels in groups and clusters if injected after or before cluster formation, and (iv) the evolution of the core properties in groups and clusters to $z \sim 1$.

Wednesday 26 June, 14:40-14:55

Shocks and Star Formation in Stephan's Quintet

Iraklis Konstantopoulos, AAO, Australia, *iraklis@aao.gov.au*
Co-authors: Phil Appleton, Pierre Guillard, Gelys Trancho, Michelle Cluver, Sarah Gallagher.

Stephan's Quintet, also known as Hickson Compact Group 92, is everybody's favourite high-energy astrophysics lab. Observations in the X-ray, UV, IR, and sub-mm regimes have revealed a tremendous amount of energy arising from pockets of shocked gas in the intra-group medium. This material was recently expelled from its parent galaxies in an interaction and is now being heated in a high-speed collision with a separate intruder galaxy.

While the existing multi-wavelength data have mapped out the flux of this emission according to wavelength (interestingly, the H_2 emission beats the X-rays by a fair margin), it is still a matter of debate where exactly the emission is originating. In order to answer that question, we obtained GMOS optical, multi-object spectroscopy of the system to map this emission in three dimensions. We were surprised to find out that, of ≈ 50 Halpha-emitting knots targeted, only a handful display shock-ionisation, with the vast majority resembling the normal fireworks of HII regions. This distinction is facilitated by the low metallicity of the expelled gas (which keeps model tracks of photoionisation and shock excitation separate) and is even present in new *HST* imaging across a carefully selected optical baseline.

I will present an in-depth view of the ionisation parameters in the bright gaseous clumps across the shock front, X-ray-bright region SQ-A, and elsewhere, and construct a toy model of the emission in three-dimensions.

Wednesday 26 June, 14:55-15:10

Using HI to probe gas accretion and removal in galaxies

Thijs (J.M.) van der Hulst, Kapteyn Astronomical Institute, University of Groningen, The Netherlands, *j.m.van.der.hulst@rug.nl*

I will briefly describe the current state of the art in HI imaging with particular emphasis on finding the evidence for gas removal and gas accretion processes. Current examples in the local universe will can be used as prototypes for finding evidence in future HI surveys using the various SKA pathfinders: APERTIF on the WSRT, ASKAP and MeerKAT.

Wednesday 26 June, 15:10-15:25

Connection between blue early-type galaxies and local post-starburt galaxies

Ivy Wong, CSIRO Astronomy & Space Science, Australia, *ivy.wong@csiro.au*
Co-authors: Schawinski, K and the Galaxy Zoo Team

Our recent study found that local post-starburst occupy a well-defined position on the low-mass end of the "Green Valley". Even though star formation has only recently turned off, their morphology already resemble those of the low-mass red sequence galaxies. In this talk, I will present our latest results on the possible link between local blue early-type galaxies and local post-starburst galaxies found in the Galaxy Zoo project (using galaxies from the SDSS survey).

Wednesday 26 June, 15:50-16:15, Invited

Quasar Feedback Near the Peak of Cosmic AGN Activity

Camila Correa, University of Melbourne, Australia, *correac@student.unimelb.edu.au*
Co-authors: A.R. Duffy, J.S.B. Wyithe

Virial shock heating of accreted gas is known to be an important ingredient in galaxy formation. Unfortunately modern hydrodynamics simulations of galaxy formation of sufficient size to study the galaxy population over cosmological volumes, do not have sufficient resolution to resolve the shock heating process. Using the Overwhelmingly Large Simulations (OWLS), we calculate the mass accretion history as a function of halo mass, and determine a halo mass scale at which the virial shock heating rate equals the cooling rate of gas at the virial radius. This mass represents an important critical mass scale in galaxy formation above which not all gas in a halo is available for star formation. We show that the critical mass scale corresponds to the luminosity L^* of the observed knee in the luminosity function at all redshifts, potentially alleviating the overcooling problem at high redshift where AGN feedback is not thought to be effective. As part of our analysis we provide fitting formulae for accretion rates as a function of mass and redshift.

Wednesday 26 June, 16:15-16:30

Simulations of Galaxy Cluster Mergers

Daisuke Nagai, Yale University, USA, *daisuke.nagai@yale.edu*

Wednesday 26 June, 16:30-16:45

Characterising the synchroton emission from the bullet cluster

Timothy Shimwell, CSIRO, Australia, *CSIRO*

Low surface brightness, steep spectrum, diffuse synchroton radiation has been observed to be associated with the intra-cluster medium of merging galaxy cluster systems. This emission is widely referred to as either a radio halo (if coincident with the X-ray emitting thermal electrons) or a radio relic (if on the periphary of the cluster). In the 50 years since the discovery of this diffuse emission it has been observed in less than 100 clusters and its origin remains hotly debated, although the favoured theory is that shock waves re-acclerate an existing population of relativistic electrons. The bullet cluster, widely known for its prominent bow-shock, provides us with an excellent opportunity in which to investigate possible formation scenarios. We examine the morphological, spectral and polarimetric properties of deep 1.1-3.1GHz ATCA observations of this cluster and present our preliminary results.

Wednesday 26 June, 16:45-17:00

Abell 2034: A merger near the plane of the sky

Matt Owers, AAO, Australia, *mowers@aao.gov.au*

The most extreme form of "feeding" in the Universe occurs when two massive clusters of galaxies merge to form a single entity. Mergers violently rearrange the cluster constituents and drive shocks into the intra-cluster medium. These shocks heat the intra-cluster medium, rapidly changing the galaxy environment which may significantly affect the cluster galaxies. Here, I present new Chandra X-ray and MMT/Hectospec data which show that Abell 2034 has recently experienced a major merger with the merger plane near to the plane of the sky. The Chandra data reveal a shock front, while the distribution of spectroscopically confirmed members reveal a local overdensity just ahead of the nose of the shock cone, similar to that seen in the Bullet cluster.

Wednesday 26 June, 17:00-17:15

A star-bursting proto-cluster growing rapidly at $z = 2.53$ discovered by narrowband Hα imaging

Masao Hayashi, ICRR, University of Tokyo, Japan, *masao.hayashi@nao.ac.jp*
Co-authors: T. Kodama, K. Tadaki, Y. Koyama, I. Tanaka, R. Shimakawa

We will present a discovery of a proto-cluster in vigorous assembly and hosting strong star forming activities which amount to star formation rates (SFRs) of $\sim 10^4$ $M_\odot$ yr^{-1}, associated with a radio galaxy USS 1558-003 at z=2.53, as traced by a wide-field narrow-band Hα imaging with MOIRCS on Subaru Telescope. This should be one of the notable sites where the progenitors of massive galaxies in the present-day clusters were in their vigorous formation phase. We have found 68 Hα emitting galaxies with SFRs down to 8.6 $M_\odot$ yr^{-1} and 42 Distant Red Galaxies (DRGs), showing the strongly clustered distribution which consists of three prominent clumps. These three systems at the same redshift are very likely to merge together in the near future and may grow to a single more massive cluster at later times. Interestingly, Hα emitters with red colors comparable to DRGs, i.e., dusty starburst galaxies which are thought to be in transitional phase, are located towards the faint end of the red sequence (but are still among most massive Hα emitters), and they tend to be located in the high density clumps. We do not see any statistically significant difference in the distributions of individual star formation rates or stellar masses of the Hα emitters between the dense clumps and the other regions. Also, the clump hosting the radio galaxy may contain less integrated star formation rate per unit stellar mass, suggesting it is more evolved system than the other clumps. Finally, comparing with other (proto-)clusters at $z > 1.5$ we have surveyed, we will discuss the appearance of environmental dependence in properties and its evolution for cluster galaxies.

Wednesday 26 June, 17:35-17:50

ASKAP-FLASH: Observing the interplay between cold neutral gas and AGN

James Allison, University of Sydney, Australia, *jra@physics.usyd.edu.au*
Co-authors: J. R. Allison, E. M. Sadler, S. J. Curran and S. N. Reeves

Absorption of 21 cm wavelength radiation in neutral atomic hydrogen (H I) provides the observer with a powerful tool to map the line-of-sight kinematics of neutral gas in galaxies. Morganti and colleagues have used the 21 cm transition to observe highly broadened and doppler-shifted lines towards radio-loud active galactic nuclei (AGN). The study of such absorption lines provides direct evidence of the presence of cold neutral gas in/out-flows, indicating that interaction between the AGN with the interstellar medium is common in distant galaxies. We have developed a novel technique to detect spectral lines in preparation for the First Large Absorption Survey in H I (FLASH) to be carried out on the Australian SKA Pathfinder (ASKAP). Recent application of this technique to data from existing facilities, such as the Australia Telescope Compact Array, has proved robust in detection of low S/N 21 cm lines, and has revealed the presence of an unusually broad and shallow H I absorption in an early-type host galaxy. Here we will discuss follow-up high-resolution observations of this detection and the implications for detecting cold gas towards AGN in future all- sky surveys.

Wednesday 26 June, 17:50-18:05

Quasar Feedback Near the Peak of Cosmic AGN Activity

George Chartas, College of Charleston, USA, *chartasg@cofc.edu*
Co-authors: Fred Hamann, Michael Eracleous, Toru Misawa, Massimo Cappi, and Margherita Giustini

Quasar winds are thought to be a major contributor to the enrichment of the interstellar and intergalactic medium and are important for feedback. X-ray observations of a handful of broad absorption line (BAL) quasars have revealed the presence of massive and near-relativistic outflows with velocities of up to ∼0.7 c. We report the discovery of a near-relativistic wind in the narrow absorption line (NAL) gravitationally lensed quasar HS 0810+2554. Its X-ray spectrum shows significant blueshifted high energy broad absorption lines implying the presence of a massive and ultrafast X-ray wind with v $\sim$ 0.4 c and a mass outflow rate of about 1 $M_{\odot}$ year^{-1}. A similar fast outflow has been recently reported in NAL quasar HS 1700+6416. Both HS 1700+6416 and HS 0810+2554 do not show any significant neutral absorber that could act to shield the outflows. It is possible, however, that the shielding gas is ionized and was therefore difficult to detect in these observations. The absence of a shielding gas, if confirmed, would imply that radiation driving is not a large contributor to the acceleration of the X-ray absorbing gas in these objects. The discovery of ultrafast outflows in two NAL quasars provides new insights into the opening angles of ultrafast X-ray winds of quasars and thus their importance for feedback.

Thursday 27 June, 09:05-09:30, Invited

AGN Feedback in Galaxy Clusters

Andy Fabian, University of Cambridge, UK, *acf@ast.cam.ac.uk*

Thursday 27 June, 09:30-09:45

The importance of major mergers in the build-up of stellar mass in brightest cluster galaxies

Christopher Lidman, AAO, Australia, *clidman@aao.gov.au*
Co-authors: Iacobuta, G., Bauer, A., & Wilson, G.

Using a sample of 18 distant galaxy clusters with over 600 spectroscopically confirmed cluster members between them, we searchfor the reasons why brightest cluster galaxies (BCGs) increase their stellar mass by a factor of almost two between z=1 and today. By examining the frequency of close pairs, we find that major merging is likely to be the mechanism by which these extraordinary galaxies build up most of their stellar mass.

Thursday 27 June, 09:45-10:00

New results on star formation, cold molecular gas, and mechanical AGN feedback in Cool Core Brightest Cluster Galaxies

Grant R. Tremblay, European Southern Observatory, Germany, *grant.tremblay@eso.org*

I present recent ALMA, *Hubble* , and *Chandra* results that advance our understanding of AGN heating and intracluster medium cooling in the central giant ellipticals of cool core galaxy clusters. Stunning new *HST* FUV continuum imaging reveals star formation on 30 kpc scales in clumpy, filamentary, and disk-like distributions, many of which exhibit strong evidence for both jet-triggered star formation as well as spatially structured residual cooling channels stemming from the ambient hot X-ray atmosphere. Highlights from recent *Chandra* results include three unique signatures of radio-mode AGN feedback, including what may be the first direct observational evidence in support of buoyant X-ray cavity heating models invoked to inhibit cooling flows at late epochs. Finally, I discuss exciting recent and forthcoming ALMA observations of the morphologically and kinematically complex cold gas reservoirs in cool core brightest cluster galaxies. Cool core clusters are thought to harbor the only observable, low-redshift analogues of cooling processes thought to drive galaxy growth at early epochs. The results I present here are therefore relevant not only for cool core physics, but for galaxy evolution as a whole.

Thursday 27 June, 10:00-10:15

Insignificant growth in Bright Cluster Galaxies: An analysis of BCGs stellar mass, position and star formation rate in the last 3.5 billion years

Paola Oliva-Altamirano, Swinburne University of Technology, Australia, *poliva@astro.swin.edu.au*
Co-authors: Sarah Brough, Chris Lidman, Warrick Couch, Edward Taylor

Brightest Cluster Galaxies (BCGs) represent the most luminous systems known at present epochs. The extent to which such extreme galaxies have acquired their particular properties from their privileged location at the centres of clusters and/or their high density environment is of key astrophysical interest. Unfortunately, the assembly history and evolution of these giant galaxies is still poorly understood.

We have analysed the growth of BCGs in the last 3.5 billion years using a large sample from the Galaxy and Mass Assembly Survey (GAMA), and compared our results with the Semi-Analytical Models (SAMs) of De Lucia & Blaizot (2007) and Tonini et al. (2012). We found no significant growth between redshift 0.3 and 0, whereas SAMs predict that BCGs have acquired 30% of their stellar mass over this period of cosmic time. We also found that around 14% of the BCGs are not lying at the centre of the dark matter halo potential well and this could be an indicator of recent cluster mergers. In a further analysis, we found that around 40% of the BCGs harbor on-going star formation, with rates in a range 0-4 $M_{\odot}$ per year, in agreement with the new recipes used in Tonini et al. (2012). While BCGs might not be completely dormant, the fraction of their mass being converted into new stars is still very low.

Thursday 27 June, 10:15-10:30

Thermal gas in the giant lobes of the radio galaxy Centaurus A

Shane O'Sullivan, University of Sydney, Australia, *s.o'sullivan@physics.usyd.edu.au*
Co-authors: I. J. Feain, N. M. McClure-Griffiths, R. D. Ekers, E. Carretti, T. Robishaw, S. A. Mao, B. M. Gaensler, J. Bland-Hawthorn, Ł. Stawarz

I will give an overview of recent radio, X-ray and γ-ray observations of the giant lobes of the nearest radio galaxy, Centaurus A. Through spectropolarimetric radio observations, we have discovered the presence of a substantial amount of thermal gas ($\sim 10^{10}$ $M_{\odot}$) mixed amongst the relativistic plasma of the lobes. X-ray observations have confirmed our results and also provide the temperature of the gas ($kT \sim 0.5$ keV), from which we find that the thermal gas pressure is in equipartition with the non-thermal pressure provided by the relativistic electrons and magnetic field. In summarising these observational results, I will discuss the particle acceleration fireworks that illuminate the structure, the negative feedback of the trapped gas within the lobes, and the potential restriction of the feeding of the supermassive black hole due to the expelled gas.

Thursday 27 June, 11:00-11:25, Invited

Feeding, Feedback and Fireworks in Galaxy Clusters

Gillian Wilson, University of California Riverside, USA, *gillianw@ucr.edu*
Co-authors: + SpARCS Collaboration

Between z = 2 and z = 1 the main progenitors of present-day massive clusters undergo rapid collapse and cluster members transform from actively star-forming to quiescent. The SpARCS survey is one of the largest surveys designed to detect clusters of galaxies at z > 1, and has discovered hundreds of IR-selected clusters in the 50 square degree Spitzer SWIRE Legacy Fields. I will present new spectroscopically-confirmed clusters and discuss what we are learning about galaxy evolution in these, the densest of environments.

Thursday 27 June, 11:25-11:40

A Keck Spectroscopic Survey of Cluster Galaxies at $z = 1.62$

Kim-Vy Tran, Texas A&M University, USA, *kimvy.tran@gmail.com*
Co-authors: Glenn Kacprzak, Casey Papovich

Gas fuels star formation, thus tracing how galactic gas reservoirs are depleted, replenished, and enriched is key to understanding how star formation is regulated over cosmic time. The cluster environment adds another dimension to the rich interplay between gas and stars in the form of the hot Intra-Cluster Medium (ICM). To determine if gas outflows combined with the growing hot ICM is how environment effectively quenches star formation, we present Keck/LRIS spectroscopy of an X-ray detected galaxy cluster at $z = 1.62$ (IRC 0218A). We identify star-forming members, map the large scale structure in which the cluster is embedded, and search for cool gas in and around cluster galaxies using bright background galaxies to probe the ICM.

Thursday 27 June, 11:40-11:55

Red galaxies in a young universe: star formation, AGN feedback and passive evolution

Chiara Tonini, Swinburne University of Technology, Australia, *ctonini@astro.swin.edu.au*
Co-authors: Darren Croton, Claudia Maraston, Daniel Thomas, Maxsym Bernyk

The evolution of red ellipticals is a challenge for hierarchical galaxy formation models, which need to implement AGN feedback as a suppressor of star formation to produce passive evolution. We investigate the evolution of Brightest Cluster Galaxies (BCGs) from redshift $z \sim 1.6$ to $z = 0$, focusing on their star formation history, to understand the nature of passive evolution in a hierarchical universe, and to produce more solid constraints for AGN feedback recipes.

We use the hierarchical semi-analytic model of Croton et al. (2006), upgraded with a new spectro- photometric model that produces realistic galaxy spectra, making use of the Maraston (2005) stellar populations and a new recipe for the dust extinction. We compare the model predictions of the K-band luminosity evolution and the J-K, V-I and I-K colour evolution with a series of datasets, including Collins et al. (Nature, 2009) who argued that semi-analytic models based on the Millennium simulation cannot reproduce the red colours and high luminosity of BCGs at $z > 1$. We show instead that the model is well in range of the observed luminosity and correctly reproduces the colour evolution of BCGs in the whole redshift range up to $z \sim 1.6$.

An analysis of the model BCGs shows an increase in mass by a factor $2 - 3$ since $z \sim 1$, and star formation activity down to low redshifts. While the consensus regarding BCGs is that they are passively evolving, we argue that this conclusion is affected by the degeneracy between star formation history and stellar population models used in SED-fitting, and by the inefficacy of toy-models of passive evolution to capture the complexity of real galaxies, especially those with rich merger histories like BCGs. Following this argument, we also show that in the semi-analytic model the BCGs show a realistic mix of stellar populations, and that these stellar populations are mostly old. In addition, the age-redshift relation of the model BCGs follows that of the universe, meaning that given their merger history and star formation history, the ageing of BCGs is always dominated by the ageing of their stellar populations. In a ΛCDM universe, we define such evolution as 'passive in the hierarchical sense'.

Thursday 27 June, 11:55-12:10

Dust-obscured star-formation in the outskirts of XMMU J2235.3-2557, a massive galaxy cluster at z=1.4

Joana Santos, European Space Agency (ESA/ESAC), Spain, *jsantos@sciops.esa.int*
Co-authors: B. Altieri, P. Popesso, V. Strazzullo, I. Valtchanov, S. Berta, H. Böhringer, L. Conversi, R. Demarco, A. C. Edge, C. Lidman, D. Lutz, C.R. Mullis, I. Pintos-Castro, M. Sanchez-Portal, T. D. Rawle, P. Rosati, M. Swinbank and M. Tanaka

Star-formation in the galaxy populations of local massive clusters is known to be less pronounced with respect to field galaxies, and also tends to be suppressed in the core region. Indications of a reversal of the star-formation-density relation have been observed in a few z > 1.4 clusters. Using deep imaging in the range 100-500μm from PACS and SPIRE onboard Herschel, we investigate the infrared properties of the spectroscopic and photo-z cluster members, as well as Hα emitters in XMMU J2235.3-2557, one of the most massive, distant, X-ray selected clusters known to date. Our analysis is based mostly on the ftting of the galaxies spectral energy distribution in the rest-frame 8-1000μm. The luminosity derived star formation rate (SFR) of 16 galaxies individually detected by Herschel ranges from 89-463 $M_{\odot}$/yr. This sample of cluster galaxies is located beyond the core region (r > 250 kpc). In addition to the study of the individual detections, we perform a stacking analysis of nine star-forming cluster members that are not detected by PACS, resulting in a corresponding SFR of 48±16 $M_{\odot}$/yr. Using a colour criterion based on the shape of the expected SED of a star-forming galaxy at the cluster redshift we select 41 PACS sources as candidate star-forming cluster members. In this study we characterize a population of highly obscured SF galaxies in the outskirts of XMMU J2235.3-2557. We do not find evidence for a reversal of the SF-density in this massive, distant cluster.

Thursday 27 June, 12:10-12:25

Plunging fireworks: starburst galaxies on cluster outskirts

Smriti Mahajan, University of Queensland, Australia, *s.mahajan1@uq.edu.au*
Co-authors: Somak Raychaudhury, Kevin Pimbblet

Several highly star-forming galaxies have been sighted on the outskirts of clusters in the past decade, challenging the traditional wisdom that star formation in galaxies decreases as a continuous function of environment. In this talk I will summarize observational evidence of how the star formation properties of galaxies evolve as they fall into clusters along supercluster filaments, and the insight this gives into the physical processes that may be responsible. As an example, we will look at the transformation of galaxies in the nearby Coma supercluster. I will also present some preliminary evidence in favor of galaxies being pre-processed in groups before they are accreted into larger clusters.

Thursday 27 June, 12:25-12:40

The Drivers of AGN Activity in Galaxy Clusters

Kevin Pimbblet, Monash University, Australia, *kevin.pimbblet@monash.edu*
Co-authors: Shabala, Haines, Fraser-McKelvie, Floyd

Active galactic nuclei (AGN) are typically found inside massive galaxies that exhibit significant fireworks: on-going or recent, star-formation. Mergers have frequently been cited as a method to fuel and feed AGN and a number of morphological studies claim an excess of post-merger systems in their AGN samples. Given that the fuel source for AGN is in the gas phase, any physical environmental mechanism that has the potential to disturb the morphology of a galaxy such as harassment may also produce an enhancement of AGN activity i.e. not simply mergers. But there exists a strong body of literature that also holds that environment plays little to no role in the incidence of AGN.

In this talk, I will present a new analysis of spectroscopically-identified optical AGN down to a cluster magnitude of $M^\star + 1$ in a sample of 6 self-similar SDSS galaxy clusters at $z \sim 0.07$. These clusters are specifically selected to lack significant substructure at bright limits in their central regions so that we are largely able to eliminate the local action of merging clusters on the frequency of AGN. I will detail how the AGN fraction varies with cluster position and in velocity phase-space as a function of mass, before turning to how AGN "retire" using the WHAN diagnostic to separate weak AGN from 'retired' galaxies in which the main ionization mechanism comes from old stellar populations. I will show that cluster AGN have no special position inside galaxy clusters they are neither preferentially located in the infall regions, nor situated at local maxima of galaxy density as measured with Σ_5. However, we find that the most powerful AGN reside at significant velocity offsets in the cluster, and this brings our analysis into agreement with previous work on X-ray selected AGN. Our results suggest that if interactions with other galaxies are responsible for triggering AGN activity, the time-lag between trigger and AGN enhancement must be sufficiently long to obfuscate the encounter site and wipe out the local galaxy density signal.

Thursday 27 June, 15:00-15:25, Invited

Star Formation, Black Holes, and Feedback in Galaxy Formation

Philip Fajardo Hopkins, Caltech, USA, *phopkins@caltech.edu*

TBD

Thursday 27 June, 15:25-15:40

Quasar Host Galaxies and the M_{BH}-σ_* Relation

Andrew Sheinis, AAO, Australia, *asheinis@aao.gov.au*

Co-authors: Andrew I. Sheinis, Marsha J. Wolf, Ángel R. López-Sánchez

We present the first direct measurements of black hole mass, M_{BH}, compared with the host galaxy stellar velocity dispersion, σ_*, for the hosts of 7 bright QSOs, $M_V < -24$, drawn from Sheinis et al. (2002), which were primarily selected from Bahcall et al. (1997) –hereafter B97–. Velocity dispersions are calculated directly by fitting a stellar template that has been convolved with a Gaussian profile to the off-nuclear, scatter-subtracted galaxy spectrum in pixel space using the code of Karl Gebhardt (Gebhardt et al. 2000b, Gebhardt et al. 2003). Black hole masses are calculated by analyzing the emission line profiles detected in deep optical spectra of quasars. The correlation of M_{BH} and σ_* suggests a fundamental relationship between galaxies and their supermassive black holes. The facts that all galaxies with a bulge contain supermassive black holes; that black hole mass, M_{BH}, is correlated with the host galaxy stellar velocity dispersion, σ_*,; and that the inclusion of AGN feedback, or an equivalent energetic source to quench star formation above a critical halo mass, in semi-analytic galaxy formation models matches the galaxy demographics and bimodality of properties observed in large surveys (SDSS; GOODS; DEEP/DEEP2; MUNICS; FIRES; K20; GDDS), all suggest that the growth mechanisms of the black hole and galaxy must be connected. This correlation of M_{BH} and σ_* has been tested on low-luminosity AGN and compared to many studies of quiescent galaxies. This is the first study to compare the brightest and most massive AGN.

Thursday 27 June, 15:40-15:55

Searching for Jet-induced Feedback in Heavily Obscured & Extremely Luminous Quasars

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Co-authors: Carol Lonsdale (NRAO), Mark Lacy (NRAO), Jim Condon (NRAO), Andrew Blain (U. Leicester), Chao-Wei Tsai (IPAC), Colin Lonsdale (MIT/Haystack), Minjin Kim (Carnegie Observatories/KASI), Dan Stern (JPL)

AGN-powered feedback of energy and momentum via radiation pressure ("quasar mode") on interstellar dust and jet momentum ("radio mode") from a supermassive black hole (BH) into its host galaxy regulates the evolution of both the BH and the galaxy. Feedback is likely to be strongest in the most luminous dust-obscured QSOs, particularly those containing radio sources too luminous to be powered by starbursts. According to merger-based galaxy evolution models, the most extreme feedback phase is short-lived (10–100 Myr), and objects in this phase are likely to be rare, with mid-infrared luminosities $L \sim 10^{14} L_{\odot}$. We have identified a unique sample of 150 of the most luminous and obscured AGNs in the Universe by combining the large-area NVSS radio survey with the all-WISE MIR survey, selecting those objects with steep MIR spectra and bright, compact radio counterparts. These sources are likely to be in the midst of feedback via young radio jets. We have found that these AGNs are significantly more dominant compared to starbursts than in far-IR/submillimeter-selected ULIRGs and SMGs where the starburst is usually more luminous than an AGN. We are undertaking an extensive follow-up program to understand the physical and evolutionary nature of these extreme feedback candidates.

Thursday 27 June, 15:55-16:10

AGN feedback prescriptions in semi-analytic modelling of galaxy formation

Maksym Bernyk, Swinburne University of Technology, Australia, *mbernyk@swin.edu.au*
Co-authors: Darren Croton, Stas Shabala, Chiara Tonini

We present new semi-analytic prescriptions of the radio-mode AGN feedback based on the observed evolution of the AGN duty cycle. These methods are reflecting the processes responsible for the quenching of star formation that occurs in massive galaxies around redshift 1. More advanced modelling of the feedback help to provide new constrains on the amount of energy injected by the jets into the interstellar medium.

Thursday 27 June, 16:10-16:25

NGC7130: Probing the starburst-AGN connection through analysis of starburst-AGN mixing

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The connection between starburst and AGN activity in galaxies is both well established and very mysterious. The tight relationships between M_{BH}-$M_\star$, M_{BH}-L and M_{BH}-σ seem to point to the co-evolution of black holes and their host galaxies; however, there is still much ambiguity as to the physical mechanisms which drive this. In this study we use the Wide-Field Spectrograph (WiFeS) on the ANU 2.3m telescope to investigate the power sources of the composite activity in the luminous infrared galaxy NGC7130. We show that NGC7130 is a spectacularly clean case of starburst + AGN activity. We observe clear and distinct rings of gas ionised by increasing fractions of AGN activity towards the nucleus. We use our data to robustly estimate the relative contribution of star-formation and AGN activity to the EUV radiation field in NGC7130, and our integral field data allow us to estimate the radius of the narrow line region. This analysis paves the way for a large investigation into the power mechanisms responsible for the composite optical class of galaxies.

Thursday 27 June, 17:00-17:15

Multiwavelength Fireworks in Blue Compact Dwarf Galaxies

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We are obtaining deep multiwavelength data of a sample of nearby blue compact dwarf galaxies (BCDGs). We are combining deep optical/NIR photometric and 1D/2D spectroscopic observations with HI and 20-cm radio-continuum data obtained using the Australian Telescope Compact Array (ATCA), plus UV (GALEX) and IR (Spitzer) data when available. We analyze the chemical and physical properties of young star-forming regions within these BCDGs and the intriguing kinematical features found in both the neutral and the ionized gas of these objects. The results reinforce the hypothesis that interactions with or between low-luminosity dwarf galaxies or HI clouds are the main trigger mechanism of the star-forming bursts in BCDGs (López-Sanchez 2010). In particular, I'll present the results of the multi-wavelength analysis of NGC 5253 (Lopez-Sanchez et al. 2012) and Tol 30 (López-Sanchez et al. 2013). These analyses are providing important clues to understand the star-formation processes and feedback, the fate of the neutral gas, the importance of galaxy interactions and the evolution of dwarf galaxies.

Thursday 27 June, 17:15-17:30

2D Kinematics and Physical Properties of Distant Galaxies

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Co-authors: F. Lamareille (LA2T, France), A. Bunker (University of oxford, UK), M. Kissler-Patig (ESO), and S.F. Sánchez (CSIC-MPI), Spain)

The study of the physical properties of high-redshift galaxies has become one of the major goals of extra-galactic astronomy. In particular the mass-assembly histories of galaxies have been the focus of many studies at redshift 1 to 3. We present recently published results obtained from Integral Field NIR Spectroscopy of a sample of 13 high-z ($1 < z < 4$) star-forming galaxies ($4 - 2304$ $M_{\odot}$/yr). We spatially resolved the kinematics using bright rest-frame optical emission lines, allowing studies of dynamical masses, SFRs, Tully-Fisher relations and metallicities at these "key" epochs. Using this data, we can set constrains on the formation and evolution of this galaxies, during an epoch of when we expect strong evolution in their masses and mass-to-light ratios. We found in particular relatively young stellar populations (age $4 < 1.5$ Gyr) in our objects and most of them have not yet converted the majority of their gas into stars (gas fraction ¿ 50 per cent). Finally we show that those of them which already have a stable disc will probably have their final stellar mass similar to the present-day spirals, to which these rotating systems can be seen as precursors. We will briefly present also an interesting result obtained for a comparable star-forming "clumpy" galaxy (A370-A5, $z = 1.341$) discovered as an arc behind the lens cluster Abell 370 ($z = 0.374$). The natural magnification due to massive galaxy clusters allows to spatially resolve and constrain the dynamics of young star forming galaxies 1 to 3 magnitudes fainter than those selected in blank fields. Thus, the study of lensed galaxies allows to probe a low mass regime of galaxies not accessible in standard observation. In this particular case, we found that the gas distribution and kinematics are consistent with a bipolar outflow with a range of velocities of $v \sim 100$ km/s. References: Lemoine-Busserolle M. & Lamareille, F., 2010, MNRAS, 402, 2291; Lemoine-Busserolle, M. et al., 2010, MNRAS 401, 1657L and Lemoine-Busserolle, M. et al., 2013, MNRAS in progress.

Thursday 27 June, 17:30-17:45

Quenching of dwarf satellites assisted by internal feedback

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Co-authors: Joss Bland-Hawthorn, Yves Revaz, Pascale Jablonka

Nearly all known nearby dwarf satellite galaxies retain little, if any, gas to fuel ongoing star formation. This deficiency is observed despite sometimes a long and complex star formation history, which is likely to have continued post-capture by the host galaxy. Therefore, interaction with the host galaxy is not sufficient to account for all the observed dwarfs.

I will demonstrate analytic models which examine the interaction of dwarf galaxies with the host halo around the Milky Way, M31 and M81. As stellar feedback heats gas inside dwarf galaxies, ram pressure stripping is able to more effectively remove this gas. Such feedback allows an upper limit to be set on the accretion time of dwarf galaxies to approximately $z \sim 10$ for the Local Group and $z \sim 3$ for the M81 group.

I will also show examples of feedback induced quenching occurring in highly detailed numerical chemodynamical models. In this model, tidal interactions lower the density of gas sufficiently to allow supernova feedback to expel any remaining gas, immediately quenching star formation inside a dwarf galaxy. As gas removed from the dwarf galaxies will eventually feed the Milky Way, this model allows a determination of the metallicity of a portion of the Galaxies infalling gas.

Thursday 27 June, 17:45-18:00

Joint stripping of SN Ia and AGB ejecta from interacting dwarf galaxies

Takuji Tsujimoto, National Astronomical Observatory of Japan, Japan, *taku.tsujimoto@nao.ac.jp*

We propose that the ejecta of prompt SNe Ia as well as of AGB stars that correspond to a major production site of N can be stripped from dwarf Irregular galaxies (dIrrs) that have undergone an interaction with a luminous galaxy. The physical process of its stripping is made up of two stages: (i) the ejecta of massive AGB stars in a dIrr are first merged with those of the bursting prompt SNe Ia and pushed up together to the galaxy halo, and (ii) subsequently through tidal interactions with its luminous host galaxy, these ejecta are stripped from a galaxy potential well. This scheme nicely explains (i) the different [Cr,Mn,Ni/Fe] features between the LMC and the Milky Way, and (ii) an unusually low N/O abundance ratio in H II regions exhibited by many dIrrs including the Magellanic Clouds.

Friday 28 June, 09:00-09:25, Invited

Confronting Planck Sunyaev-Zeldovich effect data with hydrodynamical simulations

Ian McCarthy, Liverpool JMU, UK, *i.g.mccarthy@ljmu.ac.uk*

The inverse Compton scattering of cosmic microwave background (CMB) photons by the hot gas haloes around massive galaxies and groups and clusters (the Sunyaev-Zeldovich effect, SZE) produces secondary anisotropies in the CMB. Recent measurements of the SZE angular power power spectrum by the South Pole Telescope and the Atacama Cosmology Telescope, and now Planck, have yielded interesting tensions with theoretical models of cluster growth and the intracluster medium. There is also an interesting tension (possibly related to that just mentioned) between cosmological parameters inferred from the SZE power spectrum and those inferred from the primary CMB anisotropy signal observed by Planck. In this talk, I will discuss these tensions in the context of our understanding of important sub-grid physics that shapes the thermodynamic state of the hot gas. I will present the results of a new suite of large-volume cosmological hydrodynamical simulations which systematically explore the effects of varying sub-grid prescriptions for feedback from supernovae and active galactic nuclei on the SZE signal. I will show that AGN feedback in particular can significantly affect the power spectrum on all scales measured so far and that this likely has an important role to play in resolving the aforementioned tensions. Finally, I will discuss the claimed recent detection of hot gas around individual galaxies from a Planck stacking analysis in the context of these new simulations.

Friday 28 June, 09:25-09:40

Numerical Simulations of Mass Transport in Galactic Nuclei

Andres Escala, Universidad de Chile, Chile, *aescala@das.uchile.cl*
Co-authors: Jose Utreras (U. de Chile), Fernando Becerra (Harvard U.)

Mass transport from galactic (>kpc) scales down to the vecinity of nuclear super-massive black holes (SMBHs) –the so-called 'fueling problem'–, is an unavoidable step in our understanding of the growth of SMBHs by accretion. Moreover, galactic- scale gas feeding can explain the MBH-galaxy correlation without requiring the presence of self-regulation by AGN feedback (Escala 2006, 2007; Angles-Alcazar et al 2013). For that reason, we have designed a set of AMR numerical simulation (ENZO-Code) which include most of the relevant physics (radiative cooling, SF and feedback from SN, etc), to study the angular momentum (and mass) transport from kpc-scales down to the BH's sphere of influence. We study a representative set of ISM configurations, ranging from "cloudy" disks to more "turbulence-dominated" ones. Our main focus is on the physical processes that controls the torques (and mass transport) on the different ISM configurations (e.g. gravitational vs viscous torques).

Friday 28 June, 09:40-09:55

Magnetized outflows from active galaxies

Paul Sutter, Illinois/IAP/OSU, USA, *sutter@iap.fr*
Co-authors: Ricker, P.M., Yang, K., Foreman, G., and Pugmire, D.

We present 3D adaptive mesh refinement MHD simulations of an isolated galaxy cluster that include injection of kinetic, thermal, and magnetic energy via a central active galactic nucleus (AGN) in order to study and evaluate the role that AGN may play in producing the observed cluster-wide magnetic fields. Using the MHD solver in FLASH 3.3, we compare several sub- resolution approaches to the evolution of AGN, specifically focusing on large-scale jet and bubble models. We examine the effects of magnetized outflows on the accretion history of the black hole and cluster thermodynamic properties, discuss the ability of various models to magnetize the cluster medium, and assess the sensitivity of these models to their underlying subgrid parameters. We find that magnetized jet-based models suffer a severe reduction in accretion rate compared to hydrodynamic jets; however, bubble models remain largely unaffected. While both jets and sporadically-placed bubbles have difficulty reproducing the observed strength and topology of cluster magnetic fields, models based on centrally-located bubbles come closest to observations. Finally, whereas jet models are relatively insensitive to changes in their subgrid parameters, the accretion rate and average magnetic field produced by the bubbles vary by as much as an order of magnitude depending on the grid resolution and accretion strength.

Friday 28 June, 09:55-10:10

High-Redshift Cluster Formation via Galaxy Outflows in Cosmological Simulations

Mark Richardson, Arizona State University, USA, *Mark.L.Richardson@asu.edu*
Co-authors: Evan Scannapieco, William J. Gray

The early Universe hosted a large population of small dark matter 'minihalos' that were too small to form stars on their own. These existed as static objects around larger galaxies until acted upon by some outside influence. Outflows, which have been observed around a variety of galaxies, can provide this influence in such a way as to collapse, rather than disperse the minihalo gas. Gray & Scannapieco performed an investigation in which idealized spherically-symmetric minihalos were struck by enriched outflows. I will describe high-resolution cosmological simulations that form realistic minihalos, which we then extract to perform a new suite of simulations of outflow-minihalo interactions including non-equilibrium chemical reactions and subgrid turbulent mixing. I show that, depending on the mass and orientation of the minihalo, as well as the parameters of the outflow, the outcome from this interaction is one or more small dense clusters of enriched, star-forming gas. These clusters will be observable with the next generation of telescopes, and they have properties remarkably like those of present-day halo globular clusters.

Friday 28 June, 10:10-10:25

Radio Galaxy Morphology: 'Nature' or 'Nurture'?

Julie Banfield, CSIRO Astronomy and Space Science, Australia, *Julie.Banfield@csiro.au*
Co-authors: Julie Banfield (CSIRO Astronomy and Space Science), Shane O'Sullivan (University of Sydney), & Bjorn Emonts (CSIRO Astronomy and Space Science)

There are many various types of morphological properties of radio galaxies and it remains unclear as to what causes these differences. Do the intrinsic properties of the central engine ('nature') mold and shape the radio source? Do the properties of the surrounding medium of the central engine and host galaxy ('nurture') cause these differences? Settling this 'nature vs nurture' debate for nearby radio galaxies will provide clues to the properties and evolution of radio galaxies throughout the Universe. In this talk we will present NGC 612 and provide evidence for interaction between the radio-lobe hot-spot and the HI bridge connecting NGC 612 to NGC 619. We will discuss how important lobe-HI interactions are for the morphology and dynamics of radio galaxy lobes.

Friday 28 June, 11:00-11:25, Invited

Molecular gas as a probe of galaxy evolution

Amelie Saintonge, MPE, Germany, *amelie@mpe.mpg.de*

Observations of molecular gas in distant galaxies are experiencing a coming-of-age, transitioning from a "discovery" to a "survey" mode. New and upgraded facilities are now making it possible to survey molecular gas efficiently in large galaxy samples, and these observations are proving to be critical in refining our general picture of galaxy evolution. In this talk, I will review recent results from the two largest surveys for molecular gas in normal star-forming galaxies, the z=0 IRAM-30m COLD GASS survey and the z=1-2 IRAM-PdBI PHIBSS survey, and show how they combine to lend strong support in favor of the "equilibrium" model for galaxy evolution, under which most of galaxy evolution is regulated by gas supply and the efficiency of the star formation process.

Friday 28 June, 11:25-11:40

What Lyman alpha tells us about galactic winds at $z = 3$

Luke Barnes, University of Sydney, Australia, *L.Barnes@physics.usyd.edu.au*
Co-authors: Martin Haehnelt (Cambridge), Edoardo Tescari (Melbourne), Matteo Viel (Trieste), Joss Bland-Hawthorn and Geraint Lewis (Sydney)

The Lyman alpha is the strongest spectral line of the most abundant element in the universe. It is the mother of all spectral lines. I will describe simulations of Lyman alpha emission from $z = 3$ galaxies, combining the results of cosmological hydrodynamical simulations with radiative transfer calculations. The spectra of high redshift Lyman alpha emitters suggest the influence of galactic winds, which remain an important but poorly understood ingredient in galaxy formation simulations. Recent observations also show that galaxy mergers may play an important role in the escape of Lyman alpha. I will show the results of recent simulations addressing these scenarios.

Friday 28 June, 11:40-11:55

Tracing Outflows and Accretion Using MgII Absorption

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Co-authors: Churchill, C. W., Nielsen, N. M., Bouché, N., Martin, C. L., Cooke, J., Bordoloi, R., Lilly, S.

We will discuss the series of observations that likely explain the origins of MgII absorption systems. We will present how the orientation of foreground absorbing galaxies influences the MgII absorption strengths and gas covering fractions as probed with background quasars/galaxies. We will show the bi-model distribution of galaxy positions angles, relative to the background source, demonstrating that the absorption arises along the projected galaxy minor and major axis. This suggests that the absorption arises from outflows along the minor axis and accretion along the major axis. We show how the predictions of simple outflow and inflow models are consistent with these observations. We present some of the first clues, including unpublished results, regarding the origins of MgII absorption lines systems: the holy grail that has been long overdue.

Friday 28 June, 11:55-12:10

Feedback and The Evolving Simulated CGM

Molly Peeples, UCLA / CGE, USA, *molly@astro.ucla.edu*
Co-authors: B. D. Oppenheimer, R. Davé, A. B. Ford, J. A. Kollmeier

The evolution of the circumgalactic medium through cosmic time traces the buildup and redistribution of metals and baryons as galaxies grow. Feedback and halo growth heat the galaxies' gaseous halos and affect the gas densities; with the evolving metagalactic UV background, these changes conspire to affect our observations of the CGM. Our group is using a suite of cosmological hydrodynamic simulations with varying feedback models and UV backgrounds to track these changes for the growth of hundreds of galaxies from $z = 3$ to $z = 0$. I will discuss our recent results, focusing on how feedback affects the dynamical physical state of the CGM in a model that matches the $z = 0$ galaxy stellar mass function.

Friday 28 June, 12:10-12:25

Enviroment Effects on Lyman Alpha Emitters at z=3

Akila Jeeson Daniel, University of Melbourne, Australia, *akila.jeeson@unimelb.edu.au*

The Hobby-Eberly Telescope Dark Energy Experiment (HETDEX) survey plan to observe 0.8 million Lyman Alpha Emitters (LAEs) at z=3 to study Dark Energy. Zheng et al 2010 showed that Lyα clustering measurements can be affected by radiativetransfer effects through a highly ionized IGM. Wyithe & Dijkstra 2011 proposed that large scale velocity flows and ionizing background might have an effect on Lyα radiative transfer. I will present the preliminary results of a detailed study into the effects of IGM environment on Lyα radiative transfer and their impact on clustering measurements. We use Gadget simulations and CRASHα to simulate LAEs.

Friday 28 June, 12:25-12:40

[OIII] Emission and Gas Kinematics in a Lyman-alpha Blob at z $\sim$ 3.1

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We present spectroscopic measurements of the [OIII] emission line from two subregions of strong Lyman-alpha emission in a radio-quiet Lyman-alpha blob (LAB). The blob under study is LAB1 at z $\sim$ 3.1 (Steidel et al. 2000). The [OIII] detections are from the two Lyman break galaxies embedded in the blob halo. The [OIII] measurements were made with LUCIFER on the 8.4m Large Binocular Telescope and NIRSPEC on 10m Keck Telescope. Comparing the redshift of the [OIII] to Lyman-alpha redshifts allows us to take a step towards understanding the kinematics of the gas in the blob. Using both LUCIFER and NIRSPEC we find velocity offsets between the [OIII] and Lyman-alpha redshifts consistent with 0 km s^{-1} in both subregions studied (ranging from 72 $\pm$ 42 – +6 $\pm$ 33 km s^{-1}). We discuss the possible implications of this result, as it could downplay the role of winds and outflows in powering the Lyman-alpha emission in this LAB, since a velocity offset between nebular emission lines and Lyman-alpha are often interpreted as evidence of large-scale outflows.

I'll also briefly discuss the HETDEX project of which I am member, and how this project will contribute to the study of galaxy evolution and gas kinematics in z = 2–4 galaxies.

Friday 28 June, 14:30-14:55, Invited

Metal Distributions in the Multiphase Gas across Disks and Halos

Jessica Werk, University of California, Santa Cruz, USA, *jwerk@ucolick.org*
Co-authors: J. Xavier Prochaska, Mary E. Putman, Jason Tumlinson, Todd Tripp, and Chris Thom

The most extended, gaseous components of galaxies relate closely to the gas inflows and outflows that are critical in driving galaxy evolution. In particular, the metal content of galaxies in their outermost regions − from their extended neutral gas (HI) disks to their diffuse, ionized halos − tells us about the interplay and connection between multiple gas phases across the disk and halo. In this talk, I will discuss three recent, related findings: (1) The outermost regions of galactic disks, as traced by outlying HII regions to 35 kpc, are far more metal rich than expected from simple assumptions based on current star formation rates and stellar yields; (2) There is significant absorption from metals in various ionization states (e.g. OVI, SiII, SiIII, CII, CIII) in the diffuse halos of galaxies out to 200 kpc; and (3) Only 25 − 50% of all the metals ever generated within a galaxy still reside in the galaxy disk. Connecting the dots between these three distinct results offers some tantalizing clues about the nature of galaxy- scale feedback and gas recycling.

Friday 28 June, 14:55-15:10

The Redshift Evolution of the Relation between Stellar Mass, Star Formation Rate, and Gas Metallicity of Galaxies

Yuu Niino, National Astronomical Observatory of Japan, Japan, *yuu.niino@nao.ac.jp*

We investigate the relation between stellar mass ($M_\star$), star formation rate (SFR), and metallicity (Z) of galaxies, so called the fundamental metallicity relation, in the galaxy sample of the Sloan Digital Sky Survey Data Release 7. We separate the galaxies into narrow redshift bins and compare the relation at different redshifts, and find statistically significant ($> 99\%$) evolution. We test various observational effects that might cause seeming Z evolution, and find it difficult to explain the evolution of the relation only by the observational effects. In the current sample of low redshift galaxies, galaxies with different $M_\star$ and SFR are sampled from different redshifts, and there is degeneracy between $M_\star$/SFR and redshift. Hence it is not straightforward to distinguish a relation between Z and SFR from a relation between Z and redshift. The separation of the intrinsic relation from the redshift evolution effect is a crucial issue to understand evolution of galaxies.

Friday 28 June, 15:10-15:25

GAMA: GAMA: A deeper view of the mass, metallicity, SFR, and HI relationships

Maritza Lara-López, Australian Astronomical Observatory, Australia, *mlopez@aao.gov.au*
Co-authors: Andrew Hopkins and the GAMA team

Using data from the Sloan Digital Sky Survey–Data Release 7 (SDSS–DR7), the Galaxy and Mass Assembly (GAMA), and the Arecibo Legacy Fast Arecibo L-band Feed Array (ALFALFA) surveys, we study the relationships and dependencies between SFR, Z, $M_\star$, and HI content as well as the Fundamental Plane for star-forming galaxies. We combine both surveys using volume-limited samples up to a redshift of $z \approx 0.36$. The GAMA and SDSS surveys complement each other when analyzing the relationships between SFR, $M_\star$ and Z. We present evidence for SFR and metallicity evolution to $z \sim 0.2$. We study the dependencies between SFR, $M_\star$, Z, and specific star-formation rate (SSFR) on the $M_\star$–Z, $M_\star$–SFR, $M_\star$–$SSFR$, Z–SFR, and Z–$SSFR$ relations, finding strong correlations between all. Based on those dependencies, we propose a simple model that allows us to explain the different behaviour observed between low and high mass galaxies. Our analysis allows us to confirm the existence of a Fundamental Plane, for which $M_\star = f(Z, \mathrm{SFR})$ in star-forming galaxies. Finally, we present a model based on the Z-SSFR relation that shows that at a given stellar mass, depending on the amount of gas, galaxies will follow opposite behaviours.

Friday 28 June, 15:25-15:40

Real or Interloper? The Redshift Likelihoods of Galaxies in the HUDF12

Nor Pirzkal, STScI, USA, *npirzkal@stsci.edu*
Co-authors: Nor Pirzkal, Barry Rothberg, Russell Ryan, Kai Noeske, Sangeeta Malhotra, James Rhoads

Over the last 15 years the ever increasing pace at which new, more sensitive detectors and larger telescope apertures have come online has spurred a fast and furious race to detect the most distant galaxies in the Universe. While detecting possible Lyman breaks with HST should be straightforward, assuming one collects a sufficient amount of photons and that there are no foreground interlopers which can mimic such breaks, confirming that these candidates are high-z galaxies and deriving properties (mass, stellar population ages, metallicity, internal extinction, star-formation rates, etc.) is far from simple. We present a new analysis of 13 of the most recent, faintest high redshift candidates to date. Using piMC2, we performed a Monte Carlo Markov Chain analysis of a series of 13 high redshift sources believed to be at z>8. We show that in fact all of these sources can be well fitted using models at z∼2. We also estimate that these sources have each a probability of about 25observations we cannot exclude that 25

Friday 28 June, 15:40-15:55

Galaxy Spectra from the Ultraviolet to the Mid-Infrared

Michael Brown, Monash University, Australia, *Michael.Brown@monash.edu*
Co-authors: John Moustakas, J.-D. T. Smith, Elisabete da Cunha, Tom Jarrett, Masatoshi Imanishi, Lee Armus, Bernhard R. Brandl

Galaxy spectral libraries are essential for studies of distant galaxies, enabling physical properties to be derived from observables. Commonly used spectral templates often have large systematic errors, limited wavelength coverage, and don't span the full range of galaxy types. Stellar population synthesis models often struggle to reproduce the spectra of galaxies with complex star formation histories, emission lines and dust obscuration. We present a new library of 100 galaxy spectral templates. Our library combines optical, Spitzer and Akari spectroscopy with MAGPHYS modelling constrained with matched aperture photometry from GALEX, SDSS, 2MASS, Spitzer and WISE. Our library contains more templates, spans a larger range of colours, spans a larger wavelength range and has smaller errors than existing libraries. We demonstrate that our new library produces significantly improved photometric redshifts, luminosities and rest-frame colours.

Friday 28 June, 16:25-16:40

Removing Neutral Gas from Active Galaxies via Quasar-Photon Feedback

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Co-authors: M. T. Whiting

Cool neutral gas has never yet been found in hosts of high redshift radio galaxies and quasars at $z >\sim 3$. The high redshift selection of targets biases surveys towards the most ultra-violet luminous objects in the Universe. In these, the feedback of ionising photons into the galaxy can be powerful enough to ionise the surrounding neutral gas, rendering it undetectable in atomic (H I 21-cm) and molecular (OH, CO, HCO^+ & HCN) absorption. We find that by placing a quasar within a galaxy of gas there is *always* an ultra-violet luminosity above which *all* of the gas is ionised and that the observed critical value ($L_{\rm UV} >\sim 10^{23}$ W Hz^{-1}) is just sufficient to fully ionise a large spiral galaxy. This has profound implications for the rôle of the super-massive black hole in suppressing star formation and the feedback processes within these galaxies.

Friday 28 June, 16:40-16:55

Time resolution in the feedback from radio galaxies & quasars

Katherine Blundell, Oxford University, UK, *kmb@astro.ox.ac.uk*

To understand and quantify the feedback that quasars and radio galaxies impart to their environments, we need time-resolved information on their activity and duty cycles. This has been challenging, but I will describe how "spectral binocular vision" from co-spatial low-frequency radio and X-ray observations of exemplar objects has confirmed recent key simulations. I will discuss how inverse Compton scattered X-ray lobes, arising via the up-scattering of both CMB photons and FIR photons from intense star formation, ionize the hydrogen surrounding powerful active galaxies. I will describe how these Lyman-α halos hinder gas cooling and hence throttle back on further star formation.

Friday 28 June, 16:55-17:10

Galaxy evolution in isolation: The GAMA void galaxy population

Samantha Penny, Monash University, Australia, *samantha.penny@monash.edu*
Co-authors: Kevin Pimbblet, Michael Brown, GAMA team

Cosmological voids with sizes > 10 Mpc are the most underdense regions of the Universe in which to study galaxy evolution, with a galaxy population that is theorised to have assembled its mass via star formation only. Due to their isolation, void galaxies are thought to be pristine, and their evolution is likely governed by internal processes. By examining their properties, we can therefore gain a better understanding of the internal feedback processes that govern low mass galaxy evolution in an environment where galaxy-galaxy interactions are likely uncommon. Using the Galaxy and Mass Assembly (GAMA) dataset, we identify a sample of galaxies residing in cosmological voids to $M_g = -18$ out to $z = 0.1$, with a population of void dwarfs found at low redshifts ($z < 0.05$). The majority of void galaxies are low mass, blue, star forming irregular or spiral galaxies with colours $(g - i) < 0.8$. However, a number of red, non star forming elliptical and S0 void galaxies are identified, suggesting a fraction of void galaxies have undergone major mergers and feedback processes that have ultimately shut off their star formation. I will also examine how void galaxies compare to field galaxies of comparable mass.

Friday 28 June, 17:10-17:25

From GAMA to OMEGA: a short review of galaxy evolution from the Galaxy And Mass Assembly survey

Andrew Hopkins, AAO, Australia, *ahopkins@aao.gov.au*

In just a few short years, the GAMA survey has already made substantial contributions to our understanding of the way that galaxies evolve. Here I will synthesise a number of key results that link together major elements of the galaxy evolution picture. I will focus primarily on the feeding and fireworks of galaxies, but feedback, peer pressure, and bad neighbourhoods will also feature.

Friday 28 June, 17:25-17:50, Invited

Conference Summary

Matthew Colless, ANU, Australia, *matthew.colless@anu.edu.au*

Invited summary talk for conference.

Poster abstracts

Listed Alphabetically by Author

Imaging the Circumgalactic Medium in Ultraviolet Emission

James Green, University of Colorado, USA, *james.green@colorado.edu*

Wide field, narrow band imaging low surface brightness objects in the ultraviolet is a powerful tool for understanding the structure and physics of the circumgalactic medium, and possibly, the intergalactic medium. I present an optical design and mission concept for a future explorer class mission that will allow selectable, narrow band imaging in the 900 - 2000 Å region.

High velocity clouds in the Galactic All Sky Survey

Vanessa Moss, University of Sydney/CSIRO Astronomy and Space Science, Australia,
vmoss@physics.usyd.edu.au
Co-authors: N.M. McClure-Griffiths, T. Murphy, D.J. Pisano, J.K. Kummerfeld and J.R. Curran

We present a catalogue of high velocity clouds from the second release Galactic All Sky Survey in neutral hydrogen. Our catalogue resolves for the first time the velocity width distribution of southern-sky HVCs, revealing a median FWHM of 19 km s^{-1}, and also probes further into the boundary between gas of Galactic and extragalactic origin than typical catalogues of HVCs. Our data was taken with the Parkes radio telescope and has been stray-radiation corrected, consisting of 57 mK sensitivity, 1 km s^{-1} velocity resolution and $16'$ angular resolution. The GASS catalogue of HVCs improves on previous studies with its unprecedented combination of spectral and angular resolution in an all-southern-sky survey, allowing us to investigate how the dynamic and interacting population of anomalous velocity clouds in the Milky Way can offer insights into HI gas at the bridge between the disk and the halo of our Galaxy.

The radio properties of mass selected IR Galaxies out to z=3

Glen Rees, Macquarie University & CASS, Australia, *glen.rees@students.mq.edu.au*

Using the newly observed ZFOURGE NIR photometric survey, we present a preliminary analysis of the radio characteristics of a high-z, stellar mass selected galaxy sample. Further, we attempt to use FIR binned, stacked radio observations to test the evolution of the FIR-Radio correlation out to a redshift of 3.

The relationship between lobe luminosity and kinetic power of AGN jets

Stas Shabala, University of Tasmania, Australia, *Stanislav.Shabala@utas.edu.au*
Co-authors: Leith Godfrey (Curtin University/ICRAR)

Accurate measurement of kinetic power of AGN jets is important to three areas of astrophysics: (1) jet generation mechanisms; (2) studies of jet dynamics; and (3) the role of AGN feedback in galaxy formation and evolution. However, measuring jet power is difficult. The lack of reliable empirical methods has resulted in the widespread use of radio luminosity as a proxy for jet power. We present a new method of measuring jet power in FR-II radio galaxies, based on the observed parameters of jet terminal hotspots. We compare the jet power - lobe luminosity relation derived for our sample with that obtained for FR-I radio galaxies based on X-ray cavity measurements. Somewhat surprisingly, we find approximate agreement between these relations, despite mounting evidence in the literature favouring vastly differing compositions and energy budgets in these two classes of radio galaxies. We use our hotspot measurements to show that FR-II radiative efficiency is sensitive to radio galaxy size, in agreement with predictions of dynamical models. Any observed jet power - radio luminosity relation is therefore sensitive to sample selection effects. This dependence explains, at least in part, the coincidence of the jet power - lobe luminosity relations for FR-I and FR-II sources. Our findings are important to interpretation of next-generation radio survey data.