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## ITSO Symposium 2017

**16<sup>th</sup> May Tuesday**

- |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11.00am | REGISTRATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 12.30pm | LUNCH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 1.30pm  | WELCOME                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1.40pm  | <b>Stuart Ryder, AAO</b><br>ITSO Overview                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2.00pm  | <b>Mita Brierley, AAL</b><br>"Australian National Access to 8m Optical Telescope Facilities"<br>An update on national access to 8-metre class optical telescope facilities for Australian-based astronomers in 2018 and beyond.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 2.20pm  | <b>Chris Tinney, UNSW</b><br>"Brown Dwarf Science with Magellan"<br>The combination of super imaging facilities (with FourStar) and infrared spectroscopic facilities (with FIRE) have made Magellan a world leader in the follow-up science of the coolest brown dwarfs from WISE. I'll present spectra for new Y dwarfs found by our observing programs, and astrometry for those Y dwarfs from FourStar that tells us the distances and luminosities of these sub-300K systems. Finally I'll present a direct dynamical mass determination for the two brown dwarf components of the Luhman 16 binary - the first astrometric dynamical mass measurement for a brown dwarf binary. |

2.40pm

**Nikki Nielson** , Swinburne U.

"The Geometry and Kinematics of Circumgalactic Gas with Galaxy Orientation"

The baryon cycle is key to understanding the observed global properties of galaxies and plays a large part in governing galaxy evolution. Signatures of the baryon cycle such as IGM accretion, minor mergers, and stellar-driven outflows and fountains are best probed in gaseous halos, i.e., the circumgalactic medium (CGM). We use Keck, VLT, and HST spectra of background quasars to examine the geometric and kinematic properties of the multiphase, metal-enriched CGM of galaxies at  $0.08 < z < 1.0$ , focusing on the low-ionization MgII and high-ionization OVI absorption doublets. By examining the velocity dispersions of absorbers in the context of the host galaxy color and orientation, we find that the low-ionization gas strongly traces expected baryon cycle processes. In contrast, high-ionization gas tends towards broader kinematics at larger distances from the host galaxy independent of galaxy color and orientation. These results hint that the low- and high-ionization phases may trace different components of the CGM and provide observational constraints on simulations to accurately model the baryon cycle and its role in galaxy evolution.

3.00pm

**Martin Asplund**, ANU

"Are open clusters chemically homogeneous?"

Observing the ISM conditions and metallicity since the earliest times in the universe is crucial to understanding galaxy formation and evolution. We use the new generation of stellar population synthesis and photoionization models to develop a toolkit of new self-consistent ISM and metallicity diagnostics from the UV to the IR. We apply our new toolkit to our Keck ESI and MOSFIRE observations to understand how the star formation conditions and chemical abundances changed in galaxies across cosmic time and within different environments.

3.20pm

**Stephanie Bernard**, U. Melbourne

"Keck spectroscopy of  $z \sim 7$  galaxies: probing the physics of reionisation"

When and how did reionisation occur in the first billion years? What are the properties of the sources that contributed to the process? Spectroscopy of sources during reionisation can provide insights into this period, by setting constraints on the evolution of the neutral gas fraction with redshift, and on the topology of hydrogen reionisation. As they are extremely faint and their spectra are highly redshifted to near-infrared wavelengths, observing galaxies during reionisation is challenging; nevertheless, the Keck MOSFIRE instrument has been used to detect Lyman-alpha emission from a handful of intrinsically bright galaxies all the way to  $z = 8.7$ . These bright sources, however, are not expected to be representative of the galaxy population that existed at the time. I will present our program to use MOSFIRE to observe intrinsically faint, gravitationally-lensed galaxies during reionisation, identified in the large Grism Lens-Amplified Survey from Space (GLASS) program conducted using the Hubble Space Telescope. I will also present spectroscopic confirmation of the faintest galaxy yet discovered during the reionisation epoch.

3.40pm

AFTERNOON TEA BREAK

4.10pm

**Chris Curtin**, Swinburne

"DECam detection and Keck Spectroscopy of Ongoing High Redshift Superluminous Supernovae"

The combination of super imaging facilities (with FourStar) and infrared spectroscopic facilities (with FIRE) have made Magellan a world leader in the follow-up science of the coolest brown dwarfs from WISE. I'll present spectra for new Y dwarfs found by our observing programs, and astrometry for those Y dwarfs from FourStar that tells us the distances and luminosities of these sub-300K systems. Finally I'll present a direct dynamical mass determination for the two brown dwarf components of the Luhman 16 binary - the first astrometric dynamical mass measurement for a brown dwarf binary.

4.30pm

**Jeff Cooke**, Swinburne U.

"Resolving a 40 year-old mystery on the nature of gas clouds in the early Universe"

The damped Lyman alpha systems (DLAs) are dense, cold, self-shielded clouds of neutral gas and ideal reservoirs for star formation. Moreover, they contain the bulk of all neutral hydrogen in the Universe at any redshift and a sufficient amount to form most of the stars seen in disk galaxies today. Spectra of DLAs in QSO sightlines yield a wealth of information, such as their chemical abundances, ionisation states, and gas kinematics. However, because QSOs only probe a small fraction of a  $\text{pc}^2$  of the absorbers, the two fundamental properties needed to understand the nature of DLAs - their mass and size - have remained elusive for over 40 yrs. Interpretations include small dense clouds to proto-galaxies spanning many kpc. To solve this problem, we search for DLAs in high-redshift galaxy spectra, thereby providing extended background sources and more than 100 million-fold increase in the measurement of their spatial extent. I will present very deep Keck and VLT spectroscopic results from our program that include  $z \sim 2$  DLAs covering the full luminous extent of the background galaxies. In addition, I will show our Hubble Space Telescope images of the first of a sample of DLAs that enable accurate size measurements of their background galaxies. These data indicate that DLAs have contiguous spatial extents of a minimum of  $\sim 5 \text{ kpc}^2$ . Surveys for DLAs in high- $z$  galaxy spectra will become the dominant method in the era of 30m telescopes and will enable a full 3-D tomographic mapping of the neutral gas distribution at high redshift."

4.50pm

**Devika Kamath**, Macquarie U. /AAO

"A Newly Discovered Binary Stellar Evolutionary Class: Dusty Post-RGB Stars"

The dusty post-Red Giant Branch (post-RGB) stars are a newly discovered class of low-luminosity, low-metallicity objects that have dust excesses and stellar parameters similar to post-Asymptotic Giant Branch (post-AGB) stars. However, they have luminosities lower than the tip of the Red Giant Branch (RGB). We suspect that they have evolved off the Red Giant Branch (RGB) instead of the AGB due to binary interaction. Our recent studies on dusty post-RGB objects in the LMC and SMC include the first radial velocity monitoring of these objects and also investigations of their photospheric chemistry, both of which are excellent tracers for binarity. In this talk, I will present our efforts and new results on revealing their true evolutionary nature, formation channels and connection to other evolved binaries. I will also discuss the implications of this new class of objects on the widely accepted theories of stellar (binary) evolution in low- to intermediate-mass stars.

5.10pm

**Matthew Colless, ANU**

"MANIFEST destiny - why MOS and IFS instruments are needed on ELTs"

I will discuss why multi-object spectroscopy (MOS) and integral field spectroscopy (IFS) instruments will play a major role on the coming generation of Extremely Large Telescopes (ELTs). I will outline the science that MOS/IFS will enable on ELTs, and discuss some of the instruments being designed and built for the Giant Magellan Telescope, Thirty Meter Telescope, and European ELT. I will particularly focus on the capabilities of the MANIFEST fibre system on the GMT.

## 17<sup>th</sup> May Wednesday

9.30am

**Lisa Kewley, ANU**

"The chemical & star formation history with Keck "

Observing the ISM conditions and metallicity since the earliest times in the universe is crucial to understanding galaxy formation and evolution. We use the new generation of stellar population synthesis and photoionization models to develop a toolkit of new self-consistent ISM and metallicity diagnostics from the UV to the IR. We apply our new toolkit to our Keck ESI and MOSFIRE observations to understand how the star formation conditions and chemical abundances changed in galaxies across cosmic time and within different environments.

9.50am

**Igor Andreoni, Swinburne U.**

"The present and the future of the DWF program"

From 2014, the Australian "Deeper Wider Faster" (DWF) program grew at impressive rate. At present, DWF successfully coordinates simultaneous observations with major facilities across the whole electromagnetic spectrum, including Parkes, Molonglo, and ATCA in the radio, REM in the infrared, the 4m-Blanco and SkyMapper in the optical, and the Swift satellite in the ultraviolet and at high energy. Thousands of variable and transient sources were detected to date: rapid spectroscopy with Gemini and AAT allowed most valuable follow up of elusive fast transients. The future of the DWF program involves large northern-hemisphere telescopes such as Subaru and Keck, along with a stronger synergy with the LIGO/Virgo collaboration for the detection and follow up of transients associated with gravitational wave discoveries.

10.10am

**Rebecca Allen, Swinburne**

"The Size Evolution of Star-forming Galaxies to  $z\sim 7$  Using ZFOURGE"

The size growth of star-forming galaxies is an important observable for constraining a galaxy's primary growth mechanisms with time. In this talk, I will present results of the first mass complete study of the size evolution of star-forming galaxies to  $z\sim 7$ . To date, mass-complete analyses have been limited to redshifts below  $z\sim 3-4$  due to brightness limitations. However, the sizes of star-forming galaxies have been measured out to redshifts as high as  $z\sim 10$  by using Lyman break galaxies (LBGs) exclusively. LBG samples are selected via filter drop-out techniques, and are biased towards bright UV magnitudes and low

stellar masses and are therefore not mass complete. By using the ZFOURGE survey, I make mass complete (stellar masses  $> 10^{10}$ ) samples of star-forming galaxies out to  $z \sim 7$ . I will discuss the rate of size growth we measure and how it compares to those measured from previous mass complete and LBG samples. Furthermore, I will outline possible explanations for differences we see, and the importance of constraining the LBG growth rate at redshifts below  $z \sim 3$ .

10.30am

**MORNING TEA BREAK**

11.00am

**James Allison, CASS**

"ASKAP and ITSO: Understanding feedback and fuelling radio galaxies"

Cold neutral gas is the fuel that drives star formation and supermassive black hole growth in galaxies. By using the unique field of view and radio quiet environment of the Australia Square Kilometre Array Pathfinder (ASKAP) we are carrying out the largest survey of cold neutral gas in more than 1000 powerful radio galaxies, back to half the age of the Universe. The HI 21-cm line, seen in absorption against radio source, enables us to determine the gas kinematics with respect to the AGN, directly revealing the presence of infalling neutral gas or outflows driven by jet-cloud interaction. However, we need optical spectroscopy to ensure confirmation of association and a frame of reference, as well as ionised emission line-ratio diagnostics to tie the physical state and geometry of the AGN to the observed behaviour of the neutral gas. I will present our early results from ASKAP and the vital role that ITSO has played in interpreting our data.

11.20am

**Tiantian Yuan, ANU**

"The Formation of Spiral Arms at High-redshift through IFS Observations"

After 50 years of study, we are still uncertain about the necessary and sufficient conditions for spiral arm formation. Models have centered on variations of the classic density wave theory and swing amplifications. However, the progress in these modeling work is stagnant and usually focuses on local galaxies where spiral arms are already formed and settled. Breakthroughs can come from observations of rare high-redshift spiral galaxies where spiral arms are in their initial stages of formation. In this talk, I will show the first result from our project on finding and constraining the most ancient spiral galaxies. Based on NIFS/Gemini data, we show that physical property of the most ancient spiral galaxy at  $z=2.54$  is consistent with a dynamically cool rotating disk. We suggest that there is a population of rare, non-merger triggered spiral galaxies at  $z > 2$  that could be used to constrain the interplay among gas accretion, metal distribution and angular momentum built-up.

11.40am

**Tho Duy Do, ADFA**

"Silicates in the embedded YSOs and the ISM revealed by Mid-IR spectroscopy"

Utilising a range of instruments on 4-8 m telescopes, including Michelle in Gemini North and T-ReCS in Gemini South, we have observed a large sample of objects in the mid-infrared (8-13  $\hat{\mu}\text{m}$ ) including a few OH/IR stars, several envelopes or disks of embedded Young Stellar Objects (YSOs) and diffuse sight-lines of the interstellar medium (ISM). In all objects we detect the typical absorption feature of amorphous silicates around 9.7  $\hat{\mu}\text{m}$  but clearly apparent in most objects is a second

absorption band centred around  $11.1 \text{ \AA}\mu\text{m}$ . Using a variety of approaches we confidently assign this feature to crystalline olivine, and probably the Mg-rich end-member forsterite. In some targets which have very high S/N we also detect features around  $10.4$  and  $11.9 \text{ \AA}\mu\text{m}$ , confirming the forsterite identification. Modelling using a mixture of dust components and sizes shows that in most YSO and ISM cases the abundance of forsterite is around 1-2% however, several sources show much stronger features and thus higher abundances. This includes the BN Object in Orion, the archetypal cold molecular cloud source, the massive YSO AFGL 2591, as well as the supposed Herbig Be star AFGL 2789 (V645 Cyg). We propose that crystalline silicates are essentially ubiquitous in the embedded YSO phase. Especially intriguing is the first ever detection of crystalline silicate in the diffuse ISM, toward the Wolf-Rayet star AFGL 2104. We discuss the significance of our findings in the context of the cosmic dust life-cycle.

12.00pm

**Sarah Sweet**, Swinburne U.

"The  $z=1$  stellar mass - size relation with better-than-Hubble resolution from the Gemini multi-conjugate adaptive optics"  
Galaxy evolution in clusters, traced by the stellar mass - size relation, requires measurements that are 1) sub-kpc to probe the inner parts of galaxies and accurately measure their sizes, 2) at rest-frame wavelengths to trace the light of the underlying old stellar population, 3) wide-field to achieve a statistically significant sample. The Gemini multi-conjugate adaptive optics system is uniquely able to address all of these criteria. I will present the stellar mass - size relation for 49 galaxies belonging to the  $z=1.067$  cluster SPT-CL J0546-5345, measured at FWHM  $\sim 80$ -120 mas in Ks-band. I will show that the relation at  $z=1$  is offset from the local relation, corresponding to a growth proportional to  $(1+z)^{-1.25}$ . I will also show that the slope of the relation is unchanged, indicating that the amount of size growth from  $z=1$  to the present day is constant with stellar mass: galaxies in massive clusters grow via minor mergers and/or adiabatic expansion, rather than by major mergers.

12.20pm

**Erik Kool**, Macquarie U.

"First results from Project SUNBIRD: Supernovae UNmasked By InfraRed Detection"  
A substantial number of core-collapse supernovae are expected to be hosted by starbursting luminous infrared galaxies (LIRGs). However, so far very few supernovae have been found in LIRGs, most likely as a result of dust extinction and lack of contrast in the typically luminous and complex nuclear regions. I present the first results of Project SUNBIRD (Supernovae UNmasked By InfraRed Detection), where we aim to uncover dust-obscured nuclear supernovae by monitoring over 25 LIRGs, using near-infrared Laser Guide Star Adaptive Optics imaging on the Gemini South and Keck telescopes. Such discoveries are vital for determining the fraction of supernovae, which will be missed in the nuclear regions of galaxies by current and future optical surveys.

12.40pm

**Rob Wittenmyer**, USQ

"Super-Earth or mini-Neptune? Understanding the nature of planets discovered by the K2 mission"  
Sub-Neptune-size planets, or "super-Earths" are extremely common, with thousands discovered to transit by the NASA Kepler Mission. These types of planets are the most common in the galaxy, but no examples exist in our Solar system. Hence, the

transition between rocky (Earth-like) and icy (Neptune-like) worlds is poorly understood. While transits provide estimates of planetary radii, little is yet known about the masses, and hence the interior structure, of these planets. Both are critical for understanding their formation. I describe the results of a collaborative effort using the Magellan Planet Finding Spectrometer to determine the masses of transiting super-Earths from the K2 mission.

1.00pm

LUNCH BREAK

2.00pm

**Anna Marino, ANU**

"Multiple stellar populations in NGC6934"

I will review the chemical properties of multiple stellar populations in globular clusters and present new results obtained with Gemini for the globular cluster NGC6934.

2.20pm

**Duncan Forbes, Swinburne**

"The SLUGGS Survey"

The SLUGGS survey uses DEIMOS on the Keck Telescope to study nearby early-type galaxies and their globular cluster systems. I will give an overview of the survey and highlight some recent results.

2.40pm

**Anshu Gupta, ANU**

"Origin of a cluster-scale gradient in the gas-phase ISM metallicity"

The interstellar medium (ISM) metallicity provide a powerful constrain on the complex interplay of star formation and the galactic inflow/outflow, in understanding the factors affecting galaxy evolution. Disentangling the effect of internal (stellar mass) and external (environment) processes on the galaxy evolution is difficult because high mass galaxies tend to exist in dense environments. For the past decade, the difference between mass-metallicity relations in the cluster versus field environment has been used to disentangle the effect of internal/external processes. Current observations of the mass-metallicity relation show minimal dependence on the large-scale environment. In this talk, I will present the radial distribution of interstellar medium (ISM) metallicity in galaxy clusters, as an alternative method to study the impact of environment on galaxy evolution. I will present the first observation of cluster-scale negative abundance gradients in two CLASH clusters at  $z \sim 0.35$ : MACS1115+0129 and RXJ1532+3021. Our observation presents the highest metallicity enhancement observed in a galaxy cluster on the mass-metallicity relation to date. Most strikingly, we discover that neither the radial metallicity gradient nor the offset on the mass-metallicity relation show any obvious dependence on the stellar mass of cluster members. I will comment on the different physical processes in the cluster environment such as disk truncation due to ram-pressure stripping and self-enrichment due to strangulation that can lead to the observed cluster-scale negative abundance gradient in ISM metallicity. We have performed simulations of the disk-truncation in cluster environment using a sample of CALIFA galaxies. Our analytical model of disk-truncation is based on the ram-pressure stripping of the cold gas component of the infalling galaxy in the cluster

environment. I will present the simulated radial metallicity gradient in the cluster, purely due to the truncation of the outer-galactic disk as the galaxy moves closer to the cluster center.

3.00pm

**David Yong, ANU**

"Chemical Abundances from Spinstars"

The stellar system omega Centauri is the most massive Galactic globular cluster. It has experienced extended star formation and chemical self-enrichment and is regarded to be the core of a disrupted dwarf galaxy. We have recently studied one star, ROA 276, which is arguably the most chemically peculiar object in the most chemically diverse cluster. This star exhibits remarkably high abundances, with respect to Fe, for the elements from Cu to Mo along with normal abundances for the elements from Ba to Pb. This chemical pattern is best explained as originating from a fast-rotating massive star and offers the most definitive proof to date that fast-rotating massive stars contributed to the production of heavy elements in the early Universe.

3.20pm

AFTERNOON TEA BREAK

3.50pm

**Steven Janowiecki, ICRAR/UWA**

"Do HI-rich galaxies at  $z \sim 0.2$  have turbulent disks?"

In the local Universe, it is well established that the cold interstellar medium is generally not turbulent (i.e., with gas velocity dispersions of 10-20 km/s). In the last years, observations of galaxies at redshift 1 and 2 have unveiled a large population of so-called 'turbulent disks', where the gas velocity dispersion can reach values of 60-100 km/s. The current expectation is that this high turbulence is related to the significantly higher gas fractions (gas-to-stellar mass ratios close to 1) of high redshift galaxies compared to those observed in our local Universe. With such high gas fractions, only high turbulence can keep a star-forming disk marginally stable against collapse. However, until now, such a scenario has not been properly tested as measurements of BOTH turbulence and cold gas content of galaxies are still very rare. In this talk, we will use Keck and ALMA observations of galaxies in the HIGHz sample to discuss the link between gas fraction and turbulence in massive, gas-rich galaxies. HIGHz is a survey of galaxies with stellar masses  $\sim 10^{11}$  Msun carried out with the Arecibo telescope. It not only includes some of the highest-redshift detections of HI emission from individual galaxies to date, but also it is the only sample of field galaxies at  $z \sim 0.2$  for which direct estimates of both atomic and molecular hydrogen reservoirs are available. This sample is representative of the main sequence of star-forming galaxies and - as such - it represents the best dataset to prove (or disprove) the casual connection between turbulence and gas content.

4.10pm

**Carolina Salgado, ANU**

"Investigating globular cluster abundance anomalies in SMC Intermediate-Age Star Clusters"

One of the main unsolved problems in the stellar population field is the origin of the observed abundance anomalies in globular cluster stars. An important contribution to its solution is to know if the anomalies are restricted solely to massive star clusters

formed at earliest epochs or if they can occur in younger massive star clusters. The SMC is an ideal location to explore this question because it hosts massive star cluster with ages between 6 and 11 Gyr. Using VLT/FORS2 observations we have investigated the anti-correlation and distribution of CH and CN band strengths through the measurement of CH ( $\lambda > 4300$ ) and CN ( $\lambda > 3880, 4215$ ) in red giants in Lindsay 1 and NGC 339. The metallicity and luminosity of these clusters is comparable to Galactic globular clusters (GGCs) but they are notably younger, their ages are  $\sim 7.5$  and  $\sim 6$  Gyr respectively. Due to the possibility of evolutionary mixing on the red giant branch, the existence of CN-CH anti-correlation is not sufficient in itself to indicate the presence of abundance anomalies. Consequently, we have investigated the Na, CN correlation through the measurement of sodium D-lines using data from GMOS-S observations. These data provide crucial additional information to establish the existence or absence of the abundance anomaly phenomenon in these younger objects. Our results will provide an accurate context for studying the problem of the origin of the anomalies by constraining the age dependence in the unexplored 6-11 Gyr age range.

4.30pm

**Garry Foran**, Swinburne U.

"The Lyman-alpha Project: Exploring relationships between key spectroscopic features and galactic properties over cosmic time"

Lyman-alpha (Lya) is the strongest feature in the rest frame UV spectrum of high redshift galaxies. The potential utility of Lya radiation to elucidate the details of galactic evolution in the early Universe is tantalising, and some relationships between Lya equivalent width (EW) and galactic properties have been established with various significance, i.e., relationships with ISM line strength, UV continuum slope, gas outflows, morphology and galaxy clustering behaviour. We aim to statistically explore Lya EW relationships with more than 10 different intrinsic and extrinsic properties and interpret the results in a holistic manner. I will discuss our current work using Keck spectroscopy to investigate the relationship between Lya EW and galaxy kinematics for  $z \sim 2$  and  $\sim 3$  LBGs. Even with the relatively small sample currently available, it is clear that LBGs with Lya dominant in absorption (aLBGs) tend to be disc-like (rotating) and that LBGs with Lya dominant in emission (eLBGs) tend to be dispersion-dominated or non-rotating. This high-redshift result is consistent with the same relationship reported recently for high-redshift galaxy analogs in the local Universe. Future Keck OSIRIS IFU observations with adaptive optics will help secure this relationship. Finally, I will discuss an ongoing project exploring Lya EW and large-scale clustering of LBGs in super-structures that is indicative of the morphology-density relationship observed in the modern-day Universe.

4.50pm

**Luca Casagrande**, ANU

"Investigating the age structure of the Milky Way disc"

Setting the timeline of the events which shaped the Milky Way disc through its 13 billion year old history is one of the major challenges in the theory of galaxy formation. It is possible to achieve this goal using late-type stars, which in virtue of their long lifetimes can be regarded as fossil remnants from various epochs of the formation of the Galaxy. I present recent attempts in this direction using asteroseismic ages, and discuss how the age distribution of long-lived stars suggests a mostly quiescent evolution for the Milky Way disc since a redshift of about two. I stress the importance of dealing with survey selection

functions, and target selection effects to derive unbiased inferences in stellar population studies, and present Keck follow-up studies of a few peculiar targets.

7.00pm

SYMPOSIUM DINNER

## 18<sup>th</sup> May Thursday

9.30am

**Blair Conn, ANU**

"The true nature of newly discovered ultra-faint Milky Way satellites"

The ultra-faint dwarf galaxy candidates being uncovered in the Southern skies represent a wide variety of stellar systems and raise fundamental questions regarding their origin and nature. An increasing number of these systems are found within relative proximity to the Magellanic Clouds suggesting they might be part of an infalling group. The relatively shallow nature of the discovery observations leaves crucial questions unanswered and so the Stromlo Milky Way Satellite Survey team has embarked on an ambitious project to physically and chemically characterise these stellar systems. I will demonstrate how DECam, Magellan and Gemini all play an important role in the discovery and characterisation of these new objects. Our deep data from Gemini are now revealing how unique each of these systems are, and in particular, I will show some preliminary results from our analysis."

9.50am

**Anna Zovaro, ANU**

"Breaking free: jets, gas and star formation in young, nearby radio galaxies"

Powerful jets emerging from the black holes in active galactic nuclei (AGN) interact with the interstellar medium (ISM) as they leave the nucleus, dramatically influencing the evolution of the host galaxy. In particular, star formation is thought to be either enhanced (positive feedback) or suppressed (negative feedback) by this process. Simulations have shown that both positive and negative feedback processes may occur; however, the dominant feedback mechanism is influenced by both the precise structure of the ISM and the power of the jet, making it difficult to predict which mechanism will dominate, and in turn whether overall star formation is enhanced or suppressed. Gigahertz Peak Spectrum (GPS) and Compact Steep Spectrum (CSS) sources are young, relatively low-power radio sources with compact and often distorted morphologies resulting from the interaction of jets with a dense, inhomogeneous ISM. Potential progenitors to FR I & II radio sources, GPS/CSS sources are believed to be in an intermediate stage of evolution in which the jets have not yet broken free of the ISM and are actively suppressing or enhancing star formation. Spatially resolved observations of GPS and CSS sources on the kpc scale can therefore provide us with a valuable insight into these jet-ISM feedback processes. We present NIFS H- and K-band spatially-resolved integral field spectroscopy of the two radio sources 4C31.04 and 4C14.82. The morphology, structure and kinematics of the central gas has been analysed in conjunction with indicators of current and historical star formation to search for signatures of positive or negative feedback.

10.10am

**Keith Bannister, CASS**

"Optical constraints on Extreme Scattering Events"

Extreme scattering events are distinctive variations in the radio light curves of active galactic nuclei. I will describe the Extreme Scattering event of PKS 1939-315, which we discovered in real-time with the ATCA using a novel technique. The real-time discovery enabled us to trigger optical follow-up with Gemini. I will describe the discovery technique, the optical constraints, and implications for MACHO surveys.

10.30am

MORNING TEA BREAK

11.00am

**Uros Mestric, Swinburne U.**

"Selection and characterization of Lyman Continuum Galaxies"

The transition of the Universe from neutral to ionized state began at  $z \sim 10-15$  and finished around  $z \sim 6$ . This period is known as the epoch of cosmic reionization (EoR). The source of ionization during the EoR is still under debate. Young star forming galaxies are most likely the main contributors to the global emissivity of the ionizing photons. To detect and estimate the escape fraction (fesc) of Lyman continuum (LyC  $< 912\text{\AA}$ ) photons, we need to know how to select galaxies with LyC flux. We examine the selection method for Lyman continuum galaxies (LCGs) proposed by Cooke et al (2014) in the redshift range  $3 < z < 5$ . Many of the LCGs with expected moderate and strong LyC reside outside the standard colour selection region for Lyman break galaxies (LBGs). Our sample is selected outside of the standard LBG selection region for which ZFOURGE  $\sim 30$  band photometric data and HST imaging are available. I will present and briefly discuss: individual relative fesc of a subset of deep Keck LRIS spectra; average relative fesc from stacked spectra, where spectra of the LyC candidates are stacked based on strength of the Ly $\alpha$  line and relation between strength of the Ly $\alpha$  line and LyC flux.

11.20am

**Tiantian Yuan, ANU**

"ZFIRE: spectroscopic survey of galaxies at  $z > 2$  in field and cluster environment"

I will give an update talk on a few key science outputs of our ZFIRE survey, including the spectroscopic identification of the cluster at  $z=2.1$  with the largest number of Confirmed cluster members to-date, the environmental imprint on the ISM and the mass-metallicity relation, the SFR-mass relation, and the kinematics of  $z \sim 2$  SF galaxies.

11.40am

**Paul Fred Robert, Swinburne U.**

"Title Analyses of near-pristine gas clouds detected with Keck-HIRES"

Lyman limit systems (LLSs) may be promising probes of near-pristine environments, polluted only by the ejecta from PopIII stars. Such LLSs will have a very-low metallicity  $\log Z/Z_{\text{sun}} \leq -3$ , and show weak metal absorption lines against a background quasar's continuum. There are currently two known LLSs consistent with this picture. Yet, not enough metal lines are detected to conclusively distinguish between abundance signatures of PopIII, or PopII stars. Similar LLSs with higher NHI might provide more lines, and help to better discriminate their origin scenario by comparison with theoretical yields of

nucleosynthetic models. Following this idea, I will present new analyses of LLSs which low-resolution spectra indicated were good candidates for such near-pristine clouds. With new high-resolution quasar spectra obtained with Keck-HIRES, I derive physical properties such as abundance ratios through photoionization modeling, and determine if these systems contains remnants of PopIII stars.

12.00pm

**Dougal Mackey, ANU**

"The Magellanic Periphery Survey"

The Large and Small Magellanic Clouds constitute a unique laboratory for understanding how interactions between galaxies shape their evolutionary histories. I will present the latest results from our DECam project to map the extreme outskirts of the Magellanic system for the first time at ultra-low surface brightness. We have discovered a spectacular array of structural distortions in the periphery of the LMC that are likely due to a recent close encounter between the Clouds. In addition, our survey is providing new insights into the unusual low-density low-metallicity star formation occurring in the Magellanic Bridge of stripped HI gas.

12.20pm

**Christina Baldwin, Macquarie U.**

"Early-Type Galaxy Stellar Populations in the Near-Infrared"

The near-infrared is a little-studied, but information-rich, regime for understanding the stellar content of galaxies. It contains tracers of important but poorly understood phases of stellar evolution, such as the Thermally Pulsating Asymptotic Giant Branch phase, as well as tracing the faint low-mass stars that, by number and combined mass, dominate the stellar populations of galaxies. We have obtained high quality near-infrared spectroscopy using the GNIRS spectrograph on Gemini North to study a subset of galaxies from the ATLAS3D Survey, with the aim of characterising their near-infrared properties. In this talk, I will present the results of full-spectral fitting of these data, as well as the measurement of a number of spectral indices. Specifically, I will compare and contrast the star-formation histories derived from the near-infrared and optical regimes, and compare predictions from different stellar population models. Preliminary results comparing the IMF measured from these spectra with that inferred from dynamical modelling will also be presented if time permits.

12.40pm

**Juan Madrid, CASS**

"The faintest galaxies"

The recent analysis of early commissioning data obtained with the Australian Square Kilometer Array Pathfinder (ASKAP) revealed the existence of two galaxy-size clouds of neutral hydrogen HI in the galaxy group IC 1459 without any documented optical emission (Serra et al. 2015) and in close proximity to the spiral galaxy IC 5270. Each of these two large HI accumulations have the characteristic mass ( $10^9$  solar masses) of galaxies but, intriguingly, have no optical counterpart in the Digital Sky Survey data. We recently carried out a follow-up of these two clouds with the Gemini Multi Object Spectrograph (GMOS) on Gemini South in order to image these two fields to much fainter magnitudes. We find that our targets are among the faintest galaxies, or at the very least, galaxies with very high gas to light ratios.

1.00pm

**Mike Ireland, ANU**

"Young circumstellar environments at high angular resolution: The curious case of LkCa15"

Since the discovery of circumstellar emission from the young transitional disk LkCa15 in 2011 consistent with a newly formed exoplanet, this system has been monitored as part of several Keck programs, and has been the subject of significant observational campaigns at Magellan, VLT and Subaru. The emission mechanisms remain mysterious, although forward scattering by dust species with unusual properties explains many of the observations. I will focus on the system's variability, which has masqueraded as orbital motion, and summarise the current evidence for ongoing planet formation in this enigmatic system.

1.20pm

SUMMARY

1.30pm

CLOSING LUNCH