Schedule & Scientific presentations

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Southern Cross Astrophysics Conferences Series VIII: Multiwavelength Dissection of Galaxies
Coogee Beach, Sydney, Australia, 24 - 29 May 2015

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The conference is supported by the following institutions:

Australian Astronomical Observatory, a division of the Department of Industry and Science and CSIRO Astronomy and Space Science
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Southern Cross Astrophysics Conferences Series VIII: Multiwavelength Dissection of Galaxies

Coogee Beach Map

Coast Walk to Bondi Beach (5 km)

Conference Venue

Bus stop: 374 to/from Randwick, Sydney CBD

Bus stop: M50, 373 to/from Randwick, Sydney CBD

Bus tickets: Coogee Beach News, 252 Arden St.

Coast walk to Maroubra Beach (3 km)
<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
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Conference Program

Sunday, 24th May 2015

14:00-15:30  Public Event at Powerhouse Museum
            The Story of Light - The Astronomer’s Perspective

17:00-19:30  Welcome cocktail cruise at Darling Harbour
Session I

09:00-09:10 Welcome from AAO and CSIRO/CASS: Warrick Couch & Simon Johnston

09:10-09:35 The Structure of the Milky Way (R): Rosemary Wyse

09:35-10:00 A review of extragalactic integral-field spectroscopic surveys (R): Richard McDermid

10:00-10:15 Edge of the Milky Way stellar halo: are we there yet?: Prajwal Kafle

10:15-10:30 Globular cluster members as testbeds for Galactic surveys: Borja Anguiano

10:30-10:45 Globular Cluster Systems or why do we care about colour gradients on small AND large scales: Maren Hempel

10:45-11:15 Coffee break

Session II

11:15-11:40 Neutral gas in and around the Milky Way (R): Naomi McClure-Griffiths

11:40-11:55 Multi-frequency surveys of Magellanic Clouds: Miroslav Filipovic

11:55-12:10 MAGPHYS: Modelling the ultraviolet-to-infrared spectral energy distributions of galaxies: Elisabete da Cunha

12:10-12:25 GAMA: MAGPHYS analysis of 221,000 galaxies: Angus Wright

12:25-12:35 A direct estimate of the radial growth of stellar discs: Gabriele Pezzulli

12:35-12:45 Multi-Wavelength Properties of Dwarf Galaxies in the Local Volume: Tye Young

12:45-13:45 Lunch

Session III

13:45-14:10 The Stellar Kinematics of Galaxies in the SAMI Galaxy Survey (I): Lisa Fogarty

14:10-14:25 The KMOS-3D Survey: Tracking the Evolution of Resolved 5 kinematics and Star-Formation from Redshift 0.7 to 2.: Kaushala Bandara

14:25-14:40 Dynamical M/L & Common Bar Gas Signatures: Gerald Cecil

14:40-14:55 Action-based multi-components equilibrium models for CALIFA’s galaxies: Lorenzo Posti

14:55-15:10 Insights into the evolution of S0 galaxies using the CALIFA survey: Jairo Mendez Abreu

15:10-15:40 Coffee Break

Session IV

15:40-16:05 Diffuse gas in and around galaxies (R): Baerbel Koribalski

16:05-16:15 The HIX galaxy survey: Katharina Lutz

16:15-16:30 Hunting for the Smallest Substructures: Ultrafaint Galaxies as Satellites of Known Local Group Dwarfs: Coral Wheeler

16:30-16:45 The Stellar and Gas Kinematics of Three LITTLE THINGS: Megan Johnson

16:45-17:00 HI discs in real and simulated fast- and slow rotators: Paolo Serra

17:00 End of Monday’s talks

(I) = Invited talk. (R) = Review talk. Both 20 + 5 min. Contributed talks are 12 + 3 min, or 8 + 2 min.
Session V

Chair: Claudia Lagos

09:00-09:25  Ionized gas in the Milky Way (R)  César Esteban
09:25-09:50  The Chemical Properties of the ISM of Nearby Galaxies (R)  Evan Skillman
09:50-10:05  Measuring the chemical abundances of nearby spiral galaxies with CHAOS  Richard Pogge
10:05-10:20  Results from CHAOS: Implications of Electron Temperature Discrepancies  Danielle Berg
10:20-10:35  Dissecting the ISM Heating and Cooling in Nearby Galaxies  Brent Groves
10:35-11:05  Coffee break

Session VI

Chair: Richard McDermid

11:05-11:30  Chemical evolution models of galaxies including the Milky Way (I)  Mercedes Mollá
11:30-11:45  The Magnetized Interstellar Medium in the Center of the Milky Way (and Beyond)  Cornelia Lang
11:45-12:00  A multiwavelength view of the disk-halo interface in spiral galaxies  Ralf-Juergen Dettmar
12:00-12:15  Stellar metallicity gradients as a function of mass, morphology and environment  Nicholas Scott
12:15-12:30  Resolving the metallicity gradients of intermediate redshift galaxies with MUSE  David Carton
12:30-12:45  Carbon abundances and radial gradients in nearby spiral galaxies  Laura Toribio San Cipriano
12:45-13:15  Lunch

Session VII

Chair: Megan Johnson

13:45-14:10  Future HI Surveys (I)  Martin Meyer
14:10-14:25  First results of the COSMOS HI Large Extragalactic Survey (CHILES)  Attila Popping
14:25-14:40  What is stripping HI-deficient galaxies in groups?  Helga Denes
14:40-14:55  The stellar and gas content of double bars unveiled by optical 3D spectroscopy  Adriana de Lorenzo-Cáceres
14:55-15:10  Shocks in SAMI Galaxies  Anne Medling
15:10-15:40  Coffee Break

Session VIII

Chair: César Esteban

15:40-16:05  Measuring Gas Accretion and Outflow Signatures with MaNGA (I)  Christy Tremonti
16:05-16:30  Evidence for gas accretion from the cosmic web feeding star formation in the local Universe (I)  Jorge Sánchez Almeida
16:30-16:45  A WiFeS & MUSE view of HCG 91c: pre-processing caught in the act?  Frédéric Vogt
16:45-16:55  Gas Dynamics in Low-Mass Galaxies: from Starbursts to Tidal Dwarf Galaxies  Federico Lelli
16:55-17:10  Dwarf star-forming galaxies and the assembly of spiral galaxies  Ángel R. López-Sánchez
17:10  End of Tuesday’s talks

17:30  Wine Tasting & Pizza
Session IX  

9:00-09:25 The Apache Point Galactic Evolution Experiment (APOGEE) and The Galactic disc viewed from the Open Clusters perspective: the OCCASO survey (I)  
Ricardo Carrera  

9:25-09:50 Galactic Archeology in the Local Group (I)  
Geraint Lewis  

9:50-10:15 Spatially resolved stellar population properties in galaxies: the CALIFA survey (I)  
Rosa González Delgado  

10:15-10:30 MESA Isochrones and Stellar Tracks (MIST): A new tool for dissecting stellar populations  
Aaron Dotter  

10:30-10:45 Dissecting galaxies with ELTs  
Matthew Colless  

10:45-11:15 Coffee Break  

Session X  

Chair: Rosemary Wyse  

11:15-11:40 Introduction to the GALAH Survey (I)  
Sarah Martell  

11:40-11:55 VSearching for extra-tidal stars of globular clusters with the GALAH Survey  
Jeffrey Simpson  

11:55-12:10 The detailed stellar and gas kinematics in the central region of M31  
Michael Opitsch  

12:10-12:25 The SAMI Galaxy Survey: Asymmetry in Gas Kinematics  
Jessica Bloom  

12:25-12:35 Characterizing the kinematics of bars in CALIFA galaxies  
Lindsay Holmes  

12:35-12:50 Taipan and the future of multiplexed spectroscopic surveys (I)  
Andrew Hopkins  

12:50-13:05 HECTOR: a new multi-object IFU instrument for the AAT (I)  
Julia Bryant  

13:05 Conference photo  

13:10 End of Wednesday’s talks & lunch  

18:15 Visit to Sydney Observatory
Session XI

09:00-09:25 Star formation in the Milky Way and implications for other galaxies (I) Jill Rathborne
09:25-09:50 The dust emission properties of nearby galaxies after Herschel (R) Alessandro Boselli
09:50-10:05 Quenching: I do not think it means what you think it means... Edward Taylor
10:05-10:20 Revised Calibration of Star Formation Rate Indicators Michael Brown
10:20-10:35 Are We Correctly Measuring Star-Formation Rates? A Multi-wavelength Perspective from STARBIRDS Kristen McQuinn

10:35-11:05 Coffee break

Session XII

11:05-11:30 Evolution of molecular and atomic gas and stars in galaxies and scaling relations (I) Claudia Lagos
11:30-11:45 The ultra-massive black hole in NGC 1277 probed via CO kinematics and multi-wavelength analysis Julia Scharwaechter
11:45-12:00 The (resolved) 'main sequence' of galaxy formation Yago Ascasibar
12:00-12:15 How greedy are Brightest Cluster Galaxies? Sarah Brough
12:15-12:30 Galactic winds in the local Universe as revealed by the SAMI Galaxy Survey I-Ting Ho
12:30-12:45 Star formation in nearby galaxies: combining IFS and radio data Sarah Leslie
12:45-13:15 Lunch

Session XIII

13:45-14:10 News about the interstellar medium in galaxies from the CALIFA survey (I) Jakob Walcher
14:10-14:25 Using CO to trace the ”dark” gas and spiral arms of the Milky Way Catherine Braiding
14:25-14:40 Scaling relations of CO resolved structures in nearby spiral galaxies, and what we can learn from the Carina Nebula David Rebolledo
14:40-14:55 Massive, gas rich, turbulent disk galaxies in the nearby Universe David Fisher
14:55-15:10 The spatial distribution of star formation in distant and nearby galaxies Maryam Shirazi
15:10-15:40 Coffee Break

Session XIV

15:40-16:05 Resolving the mysteries of AGN feedback: radio jets, galaxies and citizen science (I) Stas Shabala
16:05-16:15 Kinematics of luminous type II AGN Rebecca McElroy
16:15-16:30 The Close AGN Reference Survey (CARS) Bernd Husemann
16:30-16:45 Probing the early Universe with sub-millimeter observations of quasar host galaxies Amy Kimball

16:45 End of Thursday’s talks
18:30 Conference dinner
Southern Cross Astrophysics Conferences Series VIII: Multiwavelength Dissection of Galaxies  
Friday, 29th May 2015

Session XV  
Chair: Naomi McClure-Griffiths

09:00-09:25  Near Field Cosmology (R)  Joss Bland-Hawthorn
09:25-09:50  The Gaia-ESO survey (I)  Martin Asplund
09:50-10:05  The Sagittarius Stream and Core: Structures Extraordinaire  Elaina Hyde
10:05-10:20  The kinematics, stellar populations and gas content of E+A galaxies  Michael Pracy
10:20-10:35  Spectroscopic decomposition of bulge and disc star-formation histories  Evelyn Johnston
10:35-11:05  Coffee break

Session XVI  
Chair: Jakob Walcher

11:05-11:30  The EAGLE Universe (I)  Richard Bower
11:30-11:45  Environmental quenching of star formation with SAMI  Adam Schaefer
11:45-12:00  The SAMI Galaxy Survey: Cluster properties and the impact on galaxy star formation  Matt Owers
12:00-12:15  IGM and CGM in the EAGLE simulation  Alireza Rahmati
12:15-12:25  Dense, circum-nuclear molecular gas in starburst galaxies  Claire-Elise Green
12:25-12:35  The Central Molecular Zone: Our Galactic Nucleus Up Close in CO  Rebecca Blackwell
12:35-13:45  Lunch

Session XVII  
Chair: Baerbel Koribalski

13:45-14:10  SAMI Science (I)  Lisa Kewley
14:10-14:25  Violent Competition or Harmonious Synergy? A 3D perspective on the Starburst-AGN Connection  Rebecca Davies
14:25-14:40  The origin of the mysterious Hα emission along the Magellanic Stream  Thorsten Tepper-García
14:40-14:55  Islands of star formation in the large HI disk of ESO215-G?009  Jing Wang
14:55-15:10  The Relation between Dynamical Mass-to-Light ratio and Color for Massive Quiescent Galaxies  Jesse van de Sande
15:10-15:40  Coffee Break

Session XVIII  
Chair: Andrew Hopkins

15:40-16:05  A Multiwavelength View of the Circumgalactic Medium (I)  Molly Peeples
16:05-16:15  SCABS: A Survey of Centaurus A’s Baryonic Structures  Matthew Taylor
16:15-16:30  Poster winners
16:30-17:00  Conference summary  Sarah Martell & Ángel R. López-Sánchez
17:00  Farewell
**Southern Cross Astrophysics Conferences Series VIII:**
**Multiwavelength Dissection of Galaxies**

**Posters list**

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Talk abstracts

Monday 25th May, 09:10 - 09:35, Review

The Structure of the Milky Way
Rosemary Wyse, Johns Hopkins University, USA, wyse@jhu.edu

I will give an overview of our current understanding of the structure of the stellar components of the Milky Way, including possible relations between them and how structure relates to formation.

Monday 25th May, 09:35 - 10:00, Review

A review of extragalactic integral-field spectroscopic surveys
Richard McDermid, Macquarie University / AAO, Australia, richard.mcdermid@mq.edu.au

In this invited review, I will attempt to provide an overview of the several large extragalactic integral-field spectroscopic (IFS) surveys currently planned, underway, or drawing to a close. These surveys vary considerably in sample size and observational characteristics, with corresponding implications for the resulting science goals. I will take a closer look at some of the scientific highlights of these surveys, and try to explore areas where "next generation" IFS surveys may build upon these findings.

Monday 25th May, 10:00 - 10:15

Edge of the Milky Way stellar halo: are we there yet?
Prajwal Kafle, ICRAR, University of Western Australia, Australia, prajwal.kafle@uwa.edu.au

The outerskirts of the light distribution of our Galaxy is relatively unexplored. Utilising the stellar parameters of blue horizontal branch and giant stars provided by SDSS/SEGUE we pushed further our understanding of the overall properties of the Galactic halo. In this talk, I will summarise recent efforts to measure key properties of the Galaxy namely, its overall mass and the spatial and kinematical profiles of its surrounding halo stars. Our initial results comprise the most distant sample of halo stars with velocity measurements to date, reaching out to an unprecedented 120 kpc. Our study reveals that the outermost halo stars have low velocity dispersion interestingly suggesting a truncation of the stellar halo number density. An important finding from this work is that the mass of the Galaxy is comparatively smaller than what have been thought previously. I discuss its implications.
Globular cluster members as testbeds for Galactic surveys
Borja Anguiano, Macquarie University, Australia, borja.anguiano@mq.edu.au

We present the identification of potential members of nearby Galactic globular clusters using radial velocities from the RAdial Velocity Experiment Data Release 4 (RAVE-DR4) survey database. Our identifications are based on three globular clusters – NGC 3201, NGC 5139 (ω Cen) and NGC 362 – all of which are shown to have $|RV| > 100$ km s$^{-1}$. The high radial velocity of cluster members compared to the bulk of surrounding disc stars enables us to identify members using their measured radial velocities, supplemented by proper motion information and location relative to the tidal radius of each cluster. The identification of globular cluster stars in RAVE DR4 data offers a unique opportunity to test the precision and accuracy of the stellar parameters determined with the currently available Stellar Parameter Pipelines (SPPs) used in the survey, as globular clusters are ideal testbeds for the validation of stellar atmospheric parameters, abundances, distances and ages.

Globular Cluster Systems or why do we care about colour gradients on small AND large scales
Maren Hempel, Pontificia Universidad Catolica de Chile, Chile, maren551@gmail.com

We present the results of our multi-color observations of the Globular Cluster System of the early type galaxy NGC 4365, which features a color distribution that does not only differ from the expected bi-modal distribution found in most early -type galaxies, but which also shows a radial gradient. The comparison with 2 other galaxies (M 84, M 86), differing in environment, mass, dynamical structure from our primary target indicates that the long standing paradigm of 'Red & Dead' early-type galaxies is as inaccurate as our image of Globular Clusters as Single Stellar Populations. If we are to study galaxy formation in dependence of various galaxy parameters we will hence have to combine the Globular Cluster color distributions with prior determination of how stellar populations are distributed in individual Globular Clusters and how this will affect the integrated GC colors, and how this puts constrains on the required color selection.
Neutral gas in and around the Milky Way
Naomi McClure-Griffiths, ANU, Australia, naomi.mcclure-griffiths@anu.edu.au

The Milky Way and the nearby Magellanic System provide us with the closest laboratories for studying the gas cycle of galaxies, including how galaxies acquire fresh gas to fuel their continuing star formation, how they circulate gas and how they turn warm, diffuse gas into molecular gas and ultimately, stars. The dominant constituent of the interstellar gas, hydrogen, traverses an amazing cycle from the circum-galactic medium, through its various warm, unstable and cold states on its way to becoming molecular star-forming gas - and then reversing back through all those phases, states and locations. A significant portion of the gas cycle in galaxies is traced by HI emission and absorption, which together give critical information about the density, temperature and dynamics of interstellar gas in the Milky Way. In this talk I will give an overview of the hydrogen cycle within the Milky Way and Magellanic system, following gas on its flow through the interstellar medium.

Multi-frequency surveys of Magellanic Clouds
Miroslav Filipovic, University of Western Sydney, Australia, m.filipovic@uws.edu.au

This is an exciting time for the study of nearby galaxies other than our Milky Way. Nearby external galaxies offer an ideal laboratory, since they are near enough to be resolved, yet located at relatively known distances. Various new generation surveys of Magellanic Clouds through the entire waveband reflect a major opportunity to study different objects and processes in the elemental enrichment of the interstellar medium (ISM).

I will review most recent science outcomes from various new high resolution (∼1") and sensitivity surveys of the Magellanic Clouds such as XMM-Newton (X-rays), Herschel and Spitzer (IR), MCELS (optical) and ATCA/MOST (radio).
MAGPHYS: Modelling the ultraviolet-to-infrared spectral energy distributions of galaxies

Elisabete da Cunha, Swinburne University of Technology, Australia, edacunha@swin.edu.au

The spectral energy distributions (SEDs) of galaxies contain important signatures of the physical processes that shape their evolution. Integrated multi-wavelength observations spanning the full ultraviolet to radio spectral range have recently become available for large samples of galaxies in the local Universe and at increasingly high redshifts. In order to understand these observations in the context of galaxy evolution theories, we use SED models that translate the observed light into physical properties such as stellar mass, star formation rate, metallicity, and dust content.

In this talk I will describe MAGPHYS (multi-wavelength analysis of galaxy properties), a publicly-available, physically-motivated SED model that is designed to interpret the emission by stellar populations in the ultraviolet to near-infrared range consistently with the emission by dust in the mid-infrared to sub-millimetre range, via a simple energy balance argument. This model is versatile enough that it can be used to derive statistical constraints on the physical parameters of large samples of galaxies using a Bayesian approach. I will describe recent updates to the MAGPHYS code, including self-consistent modelling of the nebular emission and progress in modelling the contamination by active galactic nuclei (AGN). Finally, I will discuss the potential of MAGPHYS as a tool to interpret spatially-resolved multi-wavelength observations of nearby galaxies.

GAMA: MAGPHYS analysis of 221,000 galaxies

Angus Wright, ICRAR/UWA, Australia, wright.angus@gmail.com

We use new novel code to construct 21 band photometry of 221,000 nearby galaxies extending from the far-UV to the far-IR. These data are derived from deep observations with GALEX, VST, VISTA, WISE and Herschel and together sample the young and old stars, warm dust, and cold dust content of a cosmologically representative sample of the nearby galaxy population. The sample is unprecedented and unique. Using the MAGPHYS energy balance code we model the individual spectral energy distributions and derive key physical quantities such as stellar mass, unattenuated star-formation rate, dust mass, dust temperatures, and dust opacities. Using the extensive GAMA database we then explore how these properties depend on stelar mass, halo mass, environment, morphology and in some cases the internal dynamics using SAMI IFU observations of selected GAMA galaxies. The view of galaxies that we see is significantly affected by their dust contents, typically only half the photons produced by galaxies emerge into the IGM. The GAMA multi-wavelength dataset is providing our first insight into the unobscurred properties of nearby galaxies.
A direct estimate of the radial growth of stellar discs
Gabriele Pezzulli, University of Bologna, Italy, gabriele.pezzulli@unibo.it

Multiple lines of evidence, from cosmology to chemistry to resolved stellar populations, indicate that spiral galaxies are growing inside-out, but the actual measurement of their radial growth rate has so far probed to be very challenging. However, the evolution of galaxy discs is an ongoing process, which can be directly probed by the UV light emitted by newly born stars. We show that, if stellar discs are exponential with a time-varying scalelength, then their star formation rate surface densities must follow a universal radial profile, which depends in a very simple and readily measurable way on the radial growth rate of the underlying disc. We have tested this theoretical prediction on a sample of 35 nearby spiral galaxies, using multiwavelength data from FIR to FUV to simultaneously trace stellar mass, star formation and dust extinction. In almost all (32/35) cases, we detected the clear signal of inside-out growth and we measured the radial growth rate for each individual object. For the first time, we have seen that the radial growth rates of spiral galaxies lie in a quite narrow range, which resembles much the distribution of the sSFR in the "main sequence" of star-forming galaxies, but with a downwards shift by a factor 3. Furthermore, we found a linear relationship between the mass and the radial growth rates of stellar discs; this is a novel and powerful diagnostics for the study of scaling relations of disc galaxies and it can be used to put tight constraints on their possible evolution with cosmic time.

Multi-Wavelength Properties of Dwarf Galaxies in the Local Volume
Tye Young, RSAA, ANU, Australia, tyeyoung@hotmail.com

We present a compiled catalogue of multi-wavelength properties for 79 Local Volume low-mass galaxies. This sample is primarily composed of irregular and dwarf galaxies. Deep H-band data obtained using the AAT allowed us to accurately estimate their stellar mass, while HI data provide information about the amount of gas still available in these galaxies. We compare the broad-band colours in ultraviolet, optical and near-infrared with stellar population synthesis models to constrain the star-formation history of the galaxies. We recompute star formation rates and HI with the modern distance values and explore various relationships, such as the Kennicutt-Schmidt law and SFR-mass relation, particularly noting any deviations from more massive galaxies.
The Stellar Kinematics of Galaxies in the SAMI Galaxy Survey

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

The kinematics of galaxies provide a unique insight into the different dynamical processes driving galaxy formation. By exploring galaxy kinematics for ever larger samples of galaxies, integral field spectroscopic surveys are providing the next step in our understanding of these dynamical processes and the ways in which they shape galaxies.

I will present recent results from the SAMI Pilot Survey, investigating the kinematics of a sample of 106 galaxies. I find galaxies with varied kinematic morphology, which I classify according to angular momentum content as fast or slow rotators (FRs/SRs). SRs are often found in cluster cores and may be formed there by dynamical processes dominant in clusters. I find evidence in this sample that the events that shape cluster SRs do not have to occur in clusters - some SRs are found already formed in in-falling groups. This points to groups as important galaxy formation systems, where myriad dynamical transformations can take place.

The full SAMI Galaxy Survey provides an unprecedentedly large sample with which to further explore galaxy formation in groups. I have analysed the first 1000 galaxies of the SAMI Galaxy Survey, 150 of which were found to live in groups. Many central group galaxies were found to be SRs, much like in clusters. I will present this work and discuss what this means for dynamical processes in galaxy formation in both groups and clusters.

The KMOS-3D Survey: Tracking the Evolution of Resolved Kinematics and Star-Formation from Redshift 0.7 to 2.5

Kaushala Bandara, Max Planck Institute for Extraterrestrial Physics, Germany, kaushi@mpe.mpg.de

Near-IR IFU studies at $z \sim 1-3$, using 8-10m class telescopes, have been a key element in exploring the baryonic mass assembly and star formation of galaxies. This talk will discuss the first results of the KMOS-3D survey, a multi-year program using the K-band Multi Object Spectrograph (KMOS) at the VLT, which will obtain IFU follow-up for a homogenous sample of $\sim$600 galaxies over 5 Gyrs of cosmic history ($0.7 < z < 2.5$). Throughout the survey period, KMOS-3D will measure spatially resolved kinematics, star formation rates, outflows and metallicities of this sample which will enable us to constrain the processes that drive mass growth, feedback and star formation shutdown of galaxies. Combined with complementary multi-wavelength observations from ground- and space-based surveys, KMOS-3D will allow us to track the evolution of galaxies from the peak of the cosmic star formation rate density down to its decline.
Dynamical M/L & Common Bar Gas Signatures
Gerald Cecil, University of North Carolina, USA, cecil@unc.edu

133 disky galaxies were mapped across the mass range of the SAMI Galaxy Survey. Circular speed curves (CSCs) from gas and stars separately were derived from non-parametric fits to a flat disk at radii mostly to 1.5\(r_e\) but with a few to 3.5\(r_e\). The effects of SAMI beam smearing were quantified. Weaker bars were identified as residuals in a minority of the 120 galaxies having Sersic radial profile fits by GAMA to SDSS r-band and VIKING Z-band images. CSCs + m=2 kinematical asymmetries were fit to those. By approximating the vertical mass distribution as nested homeoids of constant density, each profile was integrated to predict its CSC squared when scaled by M/L. Both constant-with-radius and variable M/L were fitted. \(\sim 1/4\) of the sample were fitted well with just maximal starlight of reasonable M/L within the SAMI aperture. Dark mass outside was assessed by comparing SAMI CSCs to ALFALFA H I profiles and did not increase the CSC beyond SAMI’s peak in several of the maximal starlight systems. Various Universal Rotation Curves were fitted.

Action-based multi-components equilibrium models for CALIFA’s galaxies
Lorenzo Posti, University of Bologna, Italy, lorenzo.posti@unibo.it

The advent of integral field spectrographs has rejuvenated the study of the internal dynamics of elliptical galaxies in the last decades. Kinematic information must be exploited in order to get successful mass modeling of early-type galaxies either via orbital superposition or methods based on the Jeans’ equations or via equilibrium dynamical models. We present the first systematic study on modeling early-type galaxies in the CALIFA survey with novel equilibrium models defined with a distribution function which depends on the action integrals. Varying a handful of free parameters, we are able to generate self-consistent, multi-component, flattened and rotating equilibrium models with a very fast algorithm which allows us to fit the CALIFA’s high-resolution kinematics out to \(\sim 2-3\) Re and to make predictions on the velocity distribution of both luminous/dark components. If compared to other popular dynamical models, our method is very competitive and in the future it will be an invaluable complement to them in the study of the internal dynamics of galaxies.
Insights into the evolution of S0 galaxies using the CALIFA survey
Jairo Mendez Abreu, University of St Andrews, United Kingdom, jairomendezabreu@gmail.com

The relevance of galaxy bulges as central pieces in the study of galaxy formation is nowadays well settled. This role is still more manifest in lenticular (S0) galaxies where, by definition, bulges account for a significant fraction of the galaxy mass. Despite the huge amount of literature on S0 galaxies several basic questions still need to be answered: are S0 galaxies formed by major mergers of galaxies, or did they form through slow galaxy processes including minor satellite accretion or secular evolution?; are they the final steps in the evolution of late-type galaxies due to environmental mechanisms? In this talk, I will present the first results of a project aimed at fully characterising the 2D photometric and kinematic properties of the S0 bulges present in the CALIFA survey. A careful morphological analysis has been carried out using available SDSS images in order to obtain robust measurements of the bulge photometric structure. We found that S0s encompasses a zoo of morphological structures (single and double bars, broken exponential profiles, lenses,..) and their bulges follow this diversity in terms of a wide range in mass and concentration (i.e., Sersic index). Therefore confirming that they cannot be considered as a homogeneous class of objects. Their stellar kinematic properties, as obtained from the 2D spectroscopy of the CALIFA survey, show also a variety of behaviours when referring to the angular momentum. We found both slow and fast rotators bulges in our sample. This diversity, together with a lack of correlation between the photometric and kinematics properties, suggests a complex scenario for the formation of S0s. I will discuss the most likely mechanisms compatible with the observations in this talk.

Diffuse gas in and around galaxies
Baerbel Koribalski, Australia Telescope National Facility, CSIRO, Australia, Baerbel.Koribalski@csiro.au

I will provide an overview of the diffuse hydrogen gas in the outskirts of galaxy disks and within galaxy groups/clusters as detected using the 21-cm spectral line of neutral hydrogen (HI). The largest known HI streams span many hundreds of kpc and contain up to $10^9$ solar masses of atomic hydrogen alone. These gas-dominated streams are seen as bridges between galaxies, stripped debris in clusters, or ejecta near merging galaxy pairs. I use their morphology, kinematics, and mass together with numerical simulations to look for clues as to their likely origins.
The HIX galaxy survey
Katharina Lutz, Swinburne University of Technology &
Australia Telescope National Facility, CSIRO, Australia, klutz@swin.edu.au

When comparing the gas content of galaxies with their current star formation rate, it has been found that the
gas consumption time scale is much smaller than the age of galaxies. This discrepancy leads to the conclusion
that galaxies must replenish their gas reservoirs by accretion. In order to investigate the process of gas accretion
in more detail we target galaxies that contain at least 2.5 times more atomic hydrogen (HI) than expected from
their optical properties using scaling relations. For this set of galaxies, we are building a multiwavelength
data set consisting of deep ATCA HI interferometry, SSO 2.3m WiFeS optical integral field spectroscopy and
publicly available photometry from GALEX (ultraviolet), WISE (infrared) and DSS-II (optical). This rich data
set will enable us to distinguish between multiple scenarios that might lead to an excess in HI content, among
them a phase of elevated gas accretion, minor mergers or an inefficient conversion of gas into stars as well as
investigating gas accretion in great detail.

In my talk I will first compare the HI excess galaxies to the general galaxy population with respect to star
formation, stellar mass and gas phase oxygen abundance and then present first results of the kinematic analysis
of the ATCA HI data combined with the optical WiFeS spectroscopy.

Hunting for the Smallest Substructures:
Ultrafaint Galaxies as Satellites of Known Local Group Dwarfs
Coral Wheeler, UC Irvine, USA, crwheele@uci.edu

In the currently favored cosmological paradigm, all galaxies are embedded within dark matter halos that are
themselves filled with smaller dark matter clumps in a hierarchical manner. Observationally verifying the
existence of these small clumps is one of the most important goals in modern cosmology. We expect that the
smallest should be largely free of stars because the ambient ionizing background prevents them from accreting
much gas. But below what mass do we expect all subhalos to be completely dark? We run ultra-high resolution
zoom-in simulations of isolated dwarf galaxies with GIZMO (Hopkins 2014), a state-of-the-art code that utilizes
the highly sophisticated FIRE (Feedback in Realistic Environments) recipes (Hopkins et al. 2014) for converting
gas into stars and capturing the energy fed back from those stars into the surrounding medium. Using these
simulations, we predict that ultra-faint satellites (M* ∼ 3,000 Msun) should exist around isolated dwarf galaxies
(Mvir ∼ 10^{10} Msun). These satellites survive the ionizing background radiation by forming their stars in the
first billion years after the Big Bang. Importantly, we show that these tiny galaxies should be observable in the
local universe, particularly with new telescopes coming online in the next few years. If these tiny satellites are
detected, it would provide evidence that low-mass dark matter halos contain substructure, as predicted in the
standard paradigm.
The Stellar and Gas Kinematics of Three LITTLE THINGS

Megan Johnson, CSIRO, Australia, megan.johnson@csiro.au

We present the stellar and gas kinematics of NGC 1569, DDO 46, and DDO 168 from the LITTLE THINGS survey and determine their respective $V_{\text{max}}/\sigma_z$ values. We used long-slit spectroscopy to acquire spectra along four position angles by placing the slit over the morphological major and minor axes and two intermediate position angles. We determined a central stellar velocity dispersion perpendicular to the disk, $\sigma_z$, of 21 +/- 4 km/s for NGC 1569, 13.5 +/- 8 km/s for DDO 46, and 10.7 +/- 2.9 km/s for DDO 168. We then derived the maximum rotation speed in the galaxies using the LITTLE THINGS HI data. We separated bulk motions from non-circular motions using a double Gaussian decomposition technique and applied a tilted-ring model to the bulk velocity field. We corrected the observed HI rotation speeds for asymmetric drift and found a maximum velocity, $V_{\text{max}}$, of 50 +/- 10 km/s, 77.4 +/- 3.7 km/s and 67.4 +/- 4.0 km/s for NGC 1569, DDO 46 and DDO 168, respectively. Thus, we derived a kinematic measure, $V_{\text{max}}/\sigma_z$, of 2.4 +/- 0.7, 5.7 +/- 0.6, and 6.3 +/- 0.3 for NGC 1569, DDO 46 and DDO 168, respectively. Comparing these values to ones determined for spiral galaxies, we find that dIrrs have $V_{\text{max}}/\sigma_z$ values indicative of thin disks, which is in contrast to minor-to-major axis ratio studies.

HI discs in real and simulated fast- and slow rotators

Paolo Serra, CSIRO ATNF, Australia, paolo.serra@csiro.au

One quarter of all early-type galaxies (ETGs) outside Virgo host a disc/ring of HI with size from a few to tens of kpc and mass up to a few $10^9$ $M_{\odot}$. As part of the Atlas3D project we investigate whether this HI is related to the presence of a stellar disc within the host making use of the classification of ETGs in fast- and slow rotators (FR/SR). We find a large diversity of HI masses and morphologies within both families. Surprisingly, SRs are detected as often, host as much HI and have a similar rate of HI discs/rings as FRs. Accretion of HI is therefore not always linked to the growth of an inner stellar disc. By exploiting the 3D nature of both our stellar and HI data we confirm the weak relation between HI and stellar disc by revealing their frequent kinematical misalignment in FRs, including cases of polar and counter-rotating gas. In SRs the HI is usually polar. This complex picture highlights a diversity of ETG formation histories which may be lost in the relative simplicity of their inner structure and emerges when studying their outer regions. By applying similar 3D observational techniques to a sample of simulated galaxies we find that LCDM hydrodynamical simulations have difficulties reproducing the HI properties of ETGs. The gas discs formed in simulations are either too massive or too small depending on the star formation feedback implementation. Kinematical misalignments match the observations only qualitatively. The main point of conflict is that nearly all simulated FRs and a large fraction of all simulated SRs host co-rotating HI. This establishes the HI properties of ETGs as a novel challenge to simulations. This work is presented in Serra et al. (2014). Future IFU and SKA-pathfinder surveys will make it possible to carry out this type of analysis on much larger galaxy samples.
Ionized gas in the Milky Way

César Esteban, Instituto de Astrofísica de Canarias & Departamento de Astrofísica, Universidad de La Laguna, Tenerife, Spain, cel@iac.es

HII regions are tracers of the current star formation and chemical composition in galaxies. In this talk, I will overview some aspects about this kind of object in the context of the Milky Way. Firstly, I will summarize the status of the most recent studies about the spatial distribution and main physical properties of HII regions in the spiral arms and the nucleus of our Galaxy. Due to their closeness, we can study the intimate structure of Galactic HII regions, and some lessons can be learned from them in order to better understand extragalactic nebulae, specially for the derivation of physical conditions and chemical abundances. Finally, I will discuss about the radial abundance gradients of O and other heavy elements across the Galactic disk derived from the spectra of HII regions and their comparison with those provided by other indicators as planetary nebulae, massive stars, open clusters or cepheids. The time variation and possible external flatness of the gradients will be also addressed.

The Chemical Properties of the ISM of Nearby Galaxies

Evan Skillman, Minnesota Institute for Astrophysics, USA, skillman@astro.umn.edu

The ISM chemical abundances of nearby galaxies show two general patterns: a metallicity-luminosity relationship, (a projection of a metallicity-luminosity-star formation rate relationship) and radial metallicity gradients (for large galaxies). I will review the evidence for these relationships and discuss the proposed responsible physical mechanisms. In closing, I will comment on the need for future work on nearby galaxies and implications for studies at higher redshifts.
Measuring the chemical abundances of nearby spiral galaxies with CHAOS

Richard Pogge, The Ohio State University, Department of Astronomy, USA, pogge.1@osu.edu

The elemental abundances of the interstellar medium in galaxies can be determined through analyzing the emission-line spectra of HII regions. However, after decades of observations, the present-day measurements of these abundances have unacceptably high uncertainties. In this talk I will present results from the CHemical Abundances Of Spirals (CHAOS) project, which is using the Large Binocular Telescope and Multi-Object Double Spectrograph (MODS1) to obtain high signal-to-noise UV to near IR spectra of nearly 500 HII region spectra in 9 spiral galaxies drawn from the SINGS sample. We measure at least one of the classic temperature-sensitive auroral lines (O++, S++, and N+) in more than half of the HII regions in our sample, and two or more in many of these, permitting us to use multiple emission-line diagnostics to determine the physical conditions in the HII regions, and derive absolute and relative chemical abundances with uncertainties less than 0.2 dex. These large samples HII regions allow us to explore azimuthal trends and the observed scatter about the radial gradients, and refine the empirical abundance calibration in nearby massive galaxies which will help better estimate abundances in more distant massive galaxies.

Results from CHAOS: Implications of Electron Temperature Discrepancies

Danielle Berg, University of Wisconsin Milwaukee, USA, bergda@uwm.edu

The CHemical Abundances of Spirals (CHAOS) project leverages the combined power of the Large Binocular Telescope (LBT) with the broad spectral range and sensitivity of the Multi Object Double Spectrograph (MODS) to measure "direct" abundances (based on observations of the temperature-sensitive auroral lines) in large samples of HII regions in spiral galaxies. I will present the details of the first target in CHAOS, NGC 628, for which we compared temperatures from multiple auroral line measurements, and found: (1) a strong correlation between temperatures based on [SIII] λ6312 and [NII] λ5755; and (2) large discrepancies for temperatures based on [OII] λλ7320,7330 and [OIII] λλ4360. Both of these trends are consistent with other observations in the literature, yet, given the widespread use and acceptance of [OIII] λλ4360 as a temperature determinant, the magnitude of the T[OIII] discrepancies still came as a surprise. This result has implications for electron temperature and metallicity determinations in galaxies both near and far, as well as subsequent investigations of molecular gas formation, star formation, polycyclic aromatic hydrocarbon emission, and the initial mass function as a function of chemical abundance. Further, CHAOS seeks to create a new abundance diagnostic independent of biases by measuring physical quantities, (i.e., ionization, temperature, density), metallically, etc. over a large range in parameter space. Such a diagnostic has application to high redshift galaxies, where physical conditions are often significantly different than their local counterparts. Most recently, observations of a lensed galaxy at redshift z = 3.77 have permitted us to measure a direct temperature and oxygen abundance. This milestone makes it the highest redshift galaxy to date with a direct abundance measurement and provides a normalization point for the CHAOS abundance diagnostic.
Dissecting the ISM Heating and Cooling in Nearby Galaxies
Brent Groves, RSAA, ANU, Australia, brent@mpia.de

The temperature and corresponding phase transitions of the interstellar medium (ISM) play key roles in the formation of stars, and thus galaxy evolution. However the physical processes involved are still not fundamentally understood: the cooling of the ISM to enable star formation, and the in turn heating of the ISM by the stars that form. Using a combination of optical and FIR IFU maps, and photometry from the UV to sub-mm on a large sample of nearby galaxies (KINGFISH), including the nearest massive galaxy Andromeda, I will demonstrate the close connection between the multiple phases of the ISM, and trace the heating sources of the various ISM phases. These sources include not only the bright O stars, but longer lived B stars and even more evolved stars in some circumstances. With the spatially resolved Integral Field maps we are now determining the reach of these stars in heating the ISM.

Chemical evolution models of galaxies including the Milky Way
Mercedes Mollá, CIEMAT, Spain, mercedes.molla@ciemat.es

We will review the state of the art of chemical evolution of spiral and low mass galaxies. In particular we will present the new multiphase chemical evolution models calculated as an update from those by Mollá & Daz 2005. In particular the consequences of different stellar yields, infall rate laws and star formation prescriptions in the evolution of the Milky Way Galaxy in terms of time/redshift evolution of the abundances radial distributions will be analyzed and compared with the most recent data. Results for other type of galaxies will be also described.
The Magnetized Interstellar Medium in the Center of the Milky Way (and Beyond)

Cornelia Lang, University of Iowa/University of Tasmania, USA/Australia, cornelia-lang@uiowa.edu

The magnetic field plays an important role in the nuclear region of galaxies both in the structure and feedback of material in this extreme region. We have recently undertaken a spectro-polarimetric Faraday study using the upgraded capabilities of the Very Large Array of the Galactic Center Radio Arc non-thermal filaments, one of the most prominent magnetized structures in the Milky Way. This study has produced some of the highest resolution and most sensitive images of the unusual bundle of magnetized filaments to date. Polarization and Faraday properties help to constrain the properties of the intervening magnetized medium and also the magnetic field structure in the Galactic center. The connection of the non-thermal filaments in the Radio Arc to larger Galactic Center lobe-like structures and the Galactic Center "Spur" and large Galactic bubbles will also be discussed. Recent VLA 1.4 GHz and Parkes 8 GHz polarization studies reveal magnetized structures on larger scales and provides a more complete understanding of large-scale Galactic processes. Searching for organized, magnetized structures in the cores of nearby galaxies using the current and next generation of interferometers will provide an even broader understanding of the magnetized interstellar medium in normal galactic nuclei.

A multiwavelength view of the disk-halo interface in spiral galaxies

Ralf-Juergen Dettmar, Ruhr-University Bochum, Germany, dettmar@astro.rub.de

The disk-halo interface provides a diagnostics for the global state of the dynamical ISM in star-forming disk galaxies. A multiwavelengths comparison from X-ray observations to radio-continuum studies allows us to discuss the importance of outflows and infall. Special emphasis is given to the role of cosmic rays and magnetic fields since these components contribute significantly to the pressure of the ISM. First results from the "Continuum HAlos in Nearby Galaxies – an EVLA Survey (CHANG-ES)" of 35 edge-on galaxies will be discussed in this context.
Stellar metallicity gradients as a function of mass, morphology and environment
Nicholas Scott, University of Sydney, Australia, nscott@physics.usyd.edu.au

The stellar population of a galaxy constitutes a fossil record of its assembly history. Spatially resolving this record allows us to discriminate between several competing formation scenarios for massive galaxies. In particular, changes in stellar metallicity gradient with radius are thought to be a strong discriminator between in-situ and merger-driven assembly.

The SAMI Galaxy Survey is an integral field spectroscopy study of nearby galaxies that spans a broad range in mass and environment. Using the first 1000 galaxies from this survey we derive spatially resolved stellar population parameters from both absorption line indices and a full spectral fitting technique. This large sample allows us to isolate the effects of mass, environment and morphology on stellar metallicity gradients, and therefore infer the role of in- versus ex-situ assembly across the full breadth of the nearby galaxy population.

Resolving the metallicity gradients of intermediate redshift galaxies with MUSE
David Carton, Leiden Observatory, Netherlands, carton@strw.leidenuniv.nl

MUSE has already proven to be an effective integral field spectrograph having already obtained some of the deepest spectroscopic data ever observed, reaching emission-line surface brightness limits of $1 \times 10^{-19}$ erg s$^{-1}$ cm$^{-2}$ arcsec$^{-2}$. With the ongoing MUSE GTO programme we are targeting galaxies across the field and group environments. This allows us for the first time to measure the resolved properties of a significant number of $0.5 < z < 0.8$ galaxies. I will present early results of this work, focusing on the gas-phase metallicity gradients of these galaxies. For metallicity is an especially interesting probe of galaxy evolution, tracing the effects of gas accretion and wind-driven outflows. With MUSE’s 1’×1’ FOV we are also able to explore the local ($< 200$ kpc) environments surrounding these galaxies. With this new instrument we will study the influence of major and minor interactions during this epoch, bridging the current gap between high and low redshift IFU studies.
Tuesday 26th May, 12:25 - 12:35

**Carbon abundances and radial gradients in nearby spiral galaxies**
Laura Toribio San Cipriano, Instituto de Astrofísica de Canarias (IAC), Spain, ltoribio@iac.es

HII regions are indicators of the current composition of heavy-elements in the interstellar medium. The study of their chemical content is essential to understand the nuclear processes in stellar interiors and the chemical evolution of galaxies. In this work, we present results of the study of HII regions in several nearby spiral galaxies: M31, M33, NGC300 and M101, in order to explore their C/H and C/O radial abundance gradients. Although carbon (C) is the second most abundant heavy-element in the Universe, there are very few determinations of its abundance in extragalactic HII regions. The available C abundances are mainly derived from UV collisionally excited lines (CELs) of C III] 1907+09 Å, which intensity is strongly affected by interstellar reddening and uncertainties in the electron temperature. Our group has been pioneer measuring C abundances in HII regions with an alternative method based on the faint C II 4267 recombination line (RL). Precise C abundance determinations are necessary because it is an important source of opacity and energy production in stars as well as major constituent of interstellar dust and organic molecules, not to mention its paramount biogenic importance. Since the main sources of C-enrichment in galaxies are still a matter of debate, the C abundance determinations in HII regions, combined with chemical evolution models, are necessary to disentangle the origin and evolution of C in the disk of spiral galaxies. We have obtained C/H, O/H and C/O ratios from RLs in several HII regions of each galaxy from very deep OSIRIS at GTC, UVES at VLT and HDS at Subaru optical spectra. Our main aim is to investigate the slope of the C/H radial gradient compared with that of O/H in order to check previous results found the Milky Way and explore possible slope changes across the galactic disks and its dependence with the average metallicity and the mass of the galaxy.

Tuesday 26th May, 13:45 - 14:10, Invited

**Future HI Surveys**
Martin Meyer, ICRAR/UWA, Australia martin.meyer@uwa.edu.au

Understanding the role of HI in galaxy evolution is a prime research goal for many of the upcoming large surveys planned with the SKA pathfinders. Extending from wide areas surveys of the Galaxy and the nearby Universe, to deep single-pointing studies at intermediate redshifts, these programs will offer orders of magnitude improvement over existing datasets. The planned surveys will also open new areas of parameter space for aligned multiwavelength research. I will explore some of the central science goals and strengths of these upcoming survey programs, as well as the broader outlook for HI survey science in the era of the re-baselined SKA.

In this invited review, I will attempt to provide an overview of the several large extragalactic integral-field spectroscopic (IFS) surveys currently planned, underway, or drawing to a close. These surveys vary considerably in sample size and observational characteristics, with corresponding implications for the resulting science goals. I will take a closer look at some of the scientific highlights of these surveys, and try to explore areas where ”next generation” IFS surveys may build upon these findings.
First results of the COSMOS HI Large Extragalactic Survey (CHILES)

Attila Popping, ICRAR / UWA, Australia, attila.popping@uwa.edu.au

Hydrogen (HI) is the most abundant element in the Universe, and surprisingly, we know very little about the neutral hydrogen beyond $z \sim 0.08$. The recently upgraded VLA makes it now possible to image the HI in galaxies beyond the local Universe. We are using the broad bandwidth of the VLA to instantaneously probe HI from $z = 0$ to $z = 0.5$ in one pointing of the COSMOS field for a total integration time of 1000 hours. Once CHILES is complete, we will have HI images of 300 galaxies across cosmic time in different environments. This survey is the ultimate precursor of future HI surveys on ASKAP and other SKA pathfinders. In this talk we will present the first data-cubes of the survey and show some preliminary results after observing the first few hundred hours of the survey.

What is stripping HI-deficient galaxies in groups?

Helga Denes, CSIRO, ANU, Australia, helgadenes@gmail.com

The environment of a galaxy can play a major role in its evolution. Late-type gas-rich galaxies can be transformed into gas-poor early-type galaxies in dense environments. Observations show that spiral galaxies in galaxy cluster tend to have on average less neutral hydrogen (HI) than galaxies of the same type and size in the field. Recently there is accumulating evidence that HI-deficient galaxies are also relatively frequent in galaxy groups. An important question is, which mechanisms are responsible for the gas deficiency in galaxy groups? I will present high-resolution HI observations of six newly identified HI-deficient galaxies, from which five are in galaxy groups and one is in the outskirts of a cluster. The HI observations show truncated and warped HI disks and lopsided HI distributions. I will discuss the possible gas stripping mechanisms for these galaxies using archival optical, infrared and UV data in combination with the new HI observations.
The stellar and gas content of double bars unveiled by optical 3D spectroscopy

Adriana de Lorenzo-Cáceres, University of St Andrews, United Kingdom, adrianadelorenzocaceres@gmail.com

Double-barred galaxies are structurally complex objects, as the two bars show random orientations and independent pattern speeds. This fact has greatly hampered the study of these objects, even though inner bars are considered a main driver of gas inflow to the central regions of galaxies, where it may feed the AGN and/or promote the secular formation of bulges. NIR and optical integral-field spectroscopy has turned out to be the essential technique to analyse double-barred galaxies. In this talk I will show how optical 3D spectroscopy has allowed us to study in detail the stellar and gas content of double bars, their particular properties with respect to single- and non-barred galaxies, and even how to identify new double-barred systems previously unknown. Finally, a complete picture of the formation and evolution of double-barred galaxies will be given by linking their 2D kinematics and stellar population properties to an analysis of their star formation histories.

Shocks in SAMI Galaxies

Anne Medling, ANU, Australia, anne.medling@anu.edu.au

The SAMI Galaxy Survey is a large optical integral field spectroscopy survey of (when completed) more than 3000 galaxies (redshift<0.1), covering a broad range of stellar masses and environment. The high spectral resolution of SAMI (R≈4500) enables the decomposition of emission line profiles, which is extremely valuable for identifying shocks. Shocked gas, which often traces inflowing or outflowing gas, is characterized by elevated velocity dispersions and emission line ratios such as [N II]/H α, [S II]/H α, and [O I]/H α. With the 3D information provided by SAMI, we produce maps of shock excitation that provide an unprecedented level of detail for comparison to e.g., local star formation rates, AGN excitation, and kinematics. We will present a summary of shocked galaxies in the current SAMI sample and discuss the physical conditions of the shocked gas and the mechanisms at work.
Measuring Gas Accretion and Outflow Signatures with MaNGA

Christy Tremonti, University of Wisconsin-Madison, USA, tremonti@astro.wisc.edu

A central issue in galaxy evolution is understanding the cycling of baryons between galaxies and their halos. One way to probe both gas accretion and ejection is by looking for their impact on the gas phase oxygen and nitrogen abundance gradients in disk galaxies. To distinguish gas flows from normal secular evolution it is critical to obtain spatially resolved measurements of both the gas-phase metallicity and the gas mass fraction. I will present early results from the SDSS-IV/MaNGA survey which is obtaining IFU spectra of 10,000 nearby galaxies. Using indirect gas mass estimates based on the dust optical depth, we show that local galaxies have far more metals in their outer disks than expected based on simple chemical evolution models. We suggest that galactic fountains play a role in redistributing metals from galaxy centers to their outskirts. We also show preliminary evidence for metal-poor accretion in low mass galaxies.

Evidence for gas accretion from the cosmic web feeding star formation in the local Universe

Jorge Sánchez Almeida, Instituto de Astrofísica de Canarias, Spain, jos@iac.es

Numerical simulations of galaxy formation predict gas accretion from the cosmic web to be the main driver of star formation over cosmic history. Except in very dense environments where galaxy mergers are also important, galaxies are feeding from streams of cold gas from the web that penetrate the dark matter haloes and reach to the central galaxy where the gas is partly converted to stars. Although these theoretical predictions are unambiguous, their observational support has been tenuous. I will report spectroscopic evidence for this process in extremely metal poor galaxies (XMPs), taking the form of localized starbursts associated with drops in metallicity. Chemical abundance analysis based on spatially resolved GTC(*) optical spectra reveals that XMPs are metal-rich thick disks hosting a few large star forming regions of low metallicity that dominate the integrated light of the galaxies. Because gas mixes in a rotation timescale (a few hundred Myr), the observed metallicity inhomogeneities are only possible if the metal-poor gas producing stars reached the disk recently, leaving no obvious alternative explanation except for the gas infall predicted by numerical models. Our XMP observations show the predicted gas accretion from the cosmic web to be at work in the local Universe. They also provide a new method for measuring cosmic web properties, since the gas in XMPs traces the cosmic web in their surroundings.

(*) Gran Telescopio Canarias (GTC) is the 10.4m telescope operated at ORM, La Palma.
A WiFeS & MUSE view of HCG 91c: pre-processing caught in the act?

Frédéric Vogt, The Australian National University, Australia, frederic.vogt@anu.edu.au

The galaxy HCG 91c was observed with the WiFeS & MUSE integral field spectrograph as part of our ongoing campaign targeting the ionized gas physics and kinematics inside star-forming members of compact groups. I will report on the discovery of HII regions with kinematic and abundance offsets in the star-forming spiral HCG 91c: specifically, an oxygen abundance $\sim 0.15$ dex lower than expected from their immediate surroundings and from the overall abundance gradient present in the disk of HCG 91c, and a lag of 5-10 km/s with respect to the local circular rotation of the gas. HI observations of HCG 91 from the Very Large Array and broadband optical images from Pan-STARRS suggest that HCG 91c is caught early in its interaction with the other members of HCG 91. Follow-up MUSE observations have confirmed the existence of a bi-modal distribution of star-forming regions in the outer regions of HCG 91c. I will show that evidence altogether point towards infalling and collapsing extra-planar neutral gas clouds at the disk-halo interface of this galaxy - likely as a consequence of this galaxy’s environment.

Gas Dynamics in Low-Mass Galaxies: from Starbursts to Tidal Dwarf Galaxies

Federico Lelli, Case Western Reserve University, USA, federico.lelli@case.edu

Dwarf galaxies are the most abundant type of galaxies in the Universe and play a crucial role to understand the process of star formation. We use interferometric HI observations and multiband photometry to study the link between gas dynamics and star formation in these low-mass objects. Specifically, we focus on two key types of galaxies: starburst dwarfs and tidal dwarf galaxies (TDGs). For a sample of starburst dwarfs in the Local Universe, we find that (i) their inner rotation curves rise more steeply than those of typical dwarf irregulars (dIrrs), pointing to a close link between the intense star formation and a centrally concentrated mass distribution (baryons and dark matter), and (ii) they have gas fractions similar to typical dIrrs, indicating that stellar feedback did not eject large amounts of gas out of their potential wells. For a sample of putative TDGs around interacting/merging galaxies, we find that (i) they are associated with rotating gas discs, pointing to local potential wells, and (ii) they may be nearly devoid of dark matter, as predicted by numerical simulations, although the dynamical equilibrium of the disc remains an open issue. I discuss the implications of these results for the formation and evolution of dwarf galaxies.
Dwarf star-forming galaxies and the assembly of spiral galaxies
Ángel R. López-Sánchez, AAO/MQ, Australia, Angel.Lopez-Sanchez@aa.gov.au

In this talk I will present my multi-wavelength analysis of star-forming dwarf galaxies combining deep optical/NIR, UV, and 21-cm HI data and how this study has led me to get conclusions about the mass assembly in nearby, gas-rich, spiral galaxies. First I will show some particular results in blue compact dwarf galaxies (BCDGs), such as NGC 5253 or Tol 30, that 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. Then, I will present the results of the analysis of the ionized and neutral gas in the interacting galaxy pair NGC 1512 / 1510. NGC 1510 is a BCDG and NGC 1512 is a spiral galaxy which hosts hundreds of UV-bright stellar clusters in its outskirts. The analysis of many of these knots was possible thanks to the 2dF/AAOmega instrument at the 3.9m AAT. We confirm the detection of ionized gas in the majority of these UV-rich regions and characterize their physical properties, chemical abundances, and kinematics. When combined with the available UV and HI results our new optical data are providing key clues about local star-formation processes in galaxies, the interplay between the ISM and the IGM, the metal redistribution in the outer gaseous discs of spiral galaxies, and the role of interactions with dwarf galaxies in the evolution of the spiral galaxies.
The Apache Point Galactic Evolution Experiment (APOGEE) and The Galactic disc viewed from the Open Clusters perspective: the OCCASO survey

Ricardo Carrera, Instituto de Astrofísica de Canarias, Spain, rcarrera@iac.es

The Apache Point Galactic Evolution Experiment (APOGEE), a 3-year high-resolution (R ~ 22,500) high signal-to-noise (> 100) survey of red giants across the Milky Way Galaxy, concluded in summer 2014. The survey data, over half a million spectra for some 150,000 stars, have been publicly released in SDSS DR12 in January. Data products include atmospheric parameters and chemical abundances of 15 elements for most targets. APOGEE used an innovative 300-fiber H-band (1.5-1.7 μm) cryogenic spectrograph, fed from the SDSS 2.5m telescope at Apache Point Observatory, or from the New Mexico State University 1m telescope on the same site. The project has now been extended to the period 2014-2020 on the SDSS telescope, and a copy of the spectrograph will be deployed in 2016 at the 2.5m du Pont Telescope in Las Campanas, Chile, for parallel access to the Southern hemisphere. This talk will describe the instrument, software pipelines, and the main science results obtained to date.

Open Clusters (OCs) have been widely used to constrain the formation and evolution of the Milky Way disc. However, these studies are hampered by the lack of large and homogeneous studies. For this reason, OCs have been included among the targets of the Galactic spectroscopic surveys performed from the ground such as APOGEE, GES, or GALAH. They are providing radial velocities and chemical abundances. Moreover, OCs are also sampled from the space by the Gaia and Kepler missions. The first will provide accurate parallaxes, from which distances will be derived, and proper motions, and the second is providing accurate photometry. APOGEE is the only survey sampling the northern hemisphere, which includes some interesting OCs such as the most metal-rich, and the oldest, several systems towards the Galactic anti-centre or those observed by the Kepler mission. However, APOGEE is based on observations in the infrared without optical counterpart. The Open Cluster Chemical Abundances from Spanish Observatories survey (OCCASO) has been designed to derive chemical abundances in a sample of 20 to 25 OCs using the high-resolution spectroscopic facilities available at Spanish observatories complementing part of the GES observations. The OCCASO aim is to obtain chemical abundances in a handful of red clump stars per cluster with the final goal of studying the existence of trends in the Galactic disc. In this talk I will present the survey design, the observational strategy, the analysis methods used and the results after two years of operations.

Galactic Archeology in the Local Group

Geraint Lewis, The University of Sydney, Australia, geraint.lewis@sydney.edu.au

The properties of the Local Group are imprinted with the physics of its formation and evolution, and with wide-field surveys we are revealing the these in unprecedented detail. I will review our latest observations of the Local Group, focusing upon the results from the Pan-Andromeda Archeological Survey, our first true panoramic view of the halo of a large galaxy. Through the detection of extensive tidal debris we can confirm the hierarchical build up of galaxies, other properties of the halo of our nearest companion present a challenge to our cosmological ideas.
Spatially resolved stellar population properties in galaxies: the CALIFA survey

Rosa González Delgado, Instituto de Astrofísica de Andalucía / CSIC, Spain, rosa@iaa.es

Various different physical processes contribute to the star formation and stellar mass assembly histories of galaxies. One important approach to understand the significance of these different processes on galaxy evolution is the study of the stellar population content of today’s galaxies in a spatially resolved manner. The aim of this talk is to characterize in detail the radial structure of stellar population properties of galaxies in the nearby universe, based on a uniquely large galaxy sample considering the quality and coverage of the data. The sample under study was drawn from the CALIFA survey and contains more than 400 galaxies observed with integral field spectroscopy. These cover a wide range of Hubble types, from spheroids to spiral galaxies, and a wide range in stellar masses range. We apply the fossil record method based on spectral synthesis techniques to recover the spatially star formation histories, and the following physical properties for each spatial resolution element in our target galaxies: the stellar mass surface density, stellar extinction, light-weighted and mass-weighted ages, and mass-weighted metallicity. To study mean trends with overall galaxy properties, the individual radial profiles are stacked in seven bins of galaxy morphology (E, S0, Sa, Sb, Sbc, Sc and Sd). We confirm that more massive galaxies are more compact, older, more metal rich, and less reddened by dust. Additionally, we find that these trends are preserved spatially with the radial distance to the nucleus. Deviations from these relations appear correlated with Hubble type: earlier types are more compact, older, and more metal rich for a given stellar mass, which evidences that quenching is related to morphology, but not driven by mass. Negative gradients of ages are consistent with an inside-out growth of galaxies, with the largest age gradients in Sb–Sbc galaxies. Overall we conclude that quenching processes act in manners that are independent of mass, while metallicity and galaxy structure are influenced by mass-dependent processes.

MESA Isochrones and Stellar Tracks (MIST): A new tool for dissecting stellar populations

Aaron Dotter, RSAA/ANU, Australia, aaron.dotter@gmail.com

I will present details of a new stellar evolution database called MESA Isochrones and Stellar Tracks (MIST). It is designed to: provide comprehensive coverage for all stellar masses and all phases of stellar evolution, use state-of-the-art stellar physics, be open and transparent, and be flexible and extensible for the future. Our knowledge of stellar physics improves over time and the database will adapt to new developments. This is achieved by the use of the modern, open-source stellar evolution code, MESA. I will present examples of MIST models applied to a wide variety of applications in stellar populations research.
Dissecting galaxies with ELTs
Matthew Colless, ANU, Australia, matthew.colless@anu.edu.au

The next generation of extremely large telescopes (ELTs) offer exciting prospects for dissecting galaxies with integral field spectroscopy. I will explore the range of scientific opportunities that these facilities bring within reach, and review the technical capabilities of the various integral field spectrographs proposed for the Giant Magellan Telescope (GMT), Thirty Meter Telescope (TMT) and European Extremely Large Telescope (E-ELT). As specific examples, I will examine in some detail the capabilities and scientific goals of the GMT Integral Field Spectrograph (GMTIFS), an adaptive-optics-fed imager and spectrograph, and MANIFEST, an extremely versatile fibre feed system for the GMT.

Introduction to the GALAH Survey
Sarah Martell, University of New South Wales, Australia, s.martell@unsw.edu.au

The GALAH Survey is a major Australian observational project aimed at understanding the history of star formation, chemical enrichment, minor mergers and migration in the Milky Way. Using the HERMES spectrograph and the 2dF fibre positioner at the Anglo-Australian Telescope, we will determine stellar parameters and abundances for up to 29 elements per star, for one million stars. In the first year of observations we have acquired spectra for over 90,000 stars. I will present the science goals and current status of the survey, and discuss specific ways in which GALAH data and results will connect to extragalactic studies.

Searching for extra-tidal stars of globular clusters with the GALAH Survey
Jeffrey Simpson, Australian Astronomical Observatory, Australia, jeffrey.simpson@aao.gov.au

The GALAH Survey is spectroscopically observing a million stars to probe the disc of the galaxy to understand its chemical history. Due to our very simple selection function, we have also serendipitously observed globular clusters and their surroundings. With our ability to determine radial velocities, overall metallicities and the abundances of sodium, oxygen, we have the opportunity to identify stars in regions around globulars that are likely gravitationally lost stars of globular clusters. In this talk I will present results from the search so far for these stars and the possibilities for the rest of the survey.
The detailed stellar and gas kinematics in the central region of M31

Michael Opitsch, Max Planck Institute for Extraterrestrial Physics, Germany,
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We present maps of the stellar and gas kinematics in M31 of unprecedented detail, obtained with the optical IFU spectrograph VIRUS-W, which has a spectral resolution of 9000, corresponding to 15 km/s. Our observations thoroughly cover the bulge of M31, whereas the disk is sampled along six different position angles, reaching roughly one scalelength (5.5 kpc) along the major axis. We derive stellar line-of-sight velocity distribution maps by fitting the absorption line spectra, and gas velocity and velocity dispersion maps by fitting the emission lines Hβ, [OIII] λλ 4959, 5007 and [NI] λλ 5198, 5200. The stellar velocity field is fairly regular, showing a slight twist along the minor axis, pointing to triaxiality of the bulge and/or the existence of a stellar bar. Furthermore, we find that the gas shows irregular morphology and is not settled in a simple thin disk. For a large fraction of our observed spectra, each emission line has two separate peaks with different corresponding kinematics. The lines are split by up to 150 km/s in some areas of the bulge. This is similar to what has been observed in HI and CO. We are currently investigating the origin of the double peaks, with a warped gas disk being the most likely scenario, where velocities from the outer regions appear projected into the center. The analysis of the Lick indices and of the intensity of the emission lines is currently under way.

The SAMI Galaxy Survey: Asymmetry in Gas Kinematics

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Tracing the formation history of galaxies is one of the primary goals of modern astrophysics. The role of mergers in determining the formation history of galaxies is a significant open question, in particular the relationship between merger history and galaxy environment.

Asymmetry in gas kinematics can be used as a tracer of dynamical disturbance in high redshift galaxies. Using the large amount of data provided by the SAMI Galaxy Survey, we are able to make statistically robust statements about the proportion and nature of kinematically disturbed galaxies within the sample. These measurements can be used to answer questions about the formation history of galaxies. We fit the emission line kinematics of SAMI Survey galaxies, and measure deviations from a simple rotating disk model using the quantitative technique of kinemetry (Krajnovic et al., 2007).

We are able to show that kinematic analysis is a better tracer of disturbance than comparable automated methods based on morphology, and provide a perturbed fraction of 21% ± 7% for our sample. We also see that perturbed galaxies tend to be bluer than normal galaxies, and have higher rates of star formation. Finally, we investigate the relationship between environment and perturbation.
Characterizing the kinematics of bars in CALIFA galaxies

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We carry out the first direct search for bar-like non-circular flows in the Hα velocity fields of a large sample of nearby galaxies, in a project to characterize both the kinematic and photometric properties of galactic bars. Using DiskFit, we attempt to fit both rotation-only and bisymmetric flow models to the 49/100 intermediate-inlination, gas-rich systems in CALIFA DR1, and find satisfactory models for 37 of them. We then use both statistical tests and residual plots to determine the optimal kinematic model for each galaxy, and compare this to its photometric bar classification. We find that DiskFit is sensitive to bar-like flows with amplitudes greater than 15 km/s across at least two independent radial bins in the fit, or ~2 kpc at the characteristic CALIFA DR1 galaxy distance. We detect almost no bar-like flows in galaxies with “AB” optical classifications: our detection threshold therefore represents an upper limit to the amplitude and extent of the non-circular flows in these systems. By contrast, we detect bar-like flows in all of the photometrically barred galaxies with intermediate bar angles and sufficient central Hα emission to enable a search, implying that the bars in CALIFA galaxies have characteristic non-circular flow amplitudes of ~20 km/s over a ~4 kpc radial range. Finally, we discuss the few exceptions to these rules that our search has revealed, and constrain the incidence of oval distortions in late-type disks and photometrically unbarred galaxies that harbour strong bisymmetric non-circular flows.

Taipan and the future of multiplexed spectroscopic surveys

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The Taipan galaxy survey is a next-generation Southern hemisphere spectroscopic survey. It will be carried out with a refurbished UK Schmidt Telescope at Siding Spring Observatory using novel “starbug” positioning technology and a new spectrograph, with observations beginning in 2016. The scientific goals of the survey are threefold: (1) A 1% precision measurement of Hubble’s constant, \( H_0 \); (2) The largest peculiar velocity survey to date to measure the bulk flows in the local Universe and constrain cosmology; and (3) measurement of the lowest-mass galaxies in the local Universe to robustly quantify galaxy environments and study galaxies in transition. The same facility will be used for a 2 million star survey, called Funnelweb, to be carried out in bright time in parallel with the Taipan galaxy survey. The telescope refurbishment, new spectrograph and new fibre positioner are all funded, and construction and development is underway and on-track for commissioning activities in late 2015.

The combination of the Taipan survey redshifts and spectroscopic measurements with other southern hemisphere surveys underway and planned will provide an enormous opportunity to characterise the evolution of galaxies from a broad multiwavelength perspective. These include the numerous optical/IR photometric surveys with SkyMapper, VISTA, and VST, the existing WISE mid-infrared survey, the GALEX All-sky Imaging Survey, and the planned ASKAP radio continuum and HI surveys, EMU and WALLABY. Taipan will provide the key redshift and spectroscopic measurements to unify and enhance this diverse collection, optimising studies of the Southern hemisphere for the coming decade. Future massively multiplexed integral field surveys, such as those proposed with HECTOR, will be able to draw on targets characterised by Taipan.
HECTOR: a new multi-object IFU instrument for the AAT
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HECTOR will be the new massively-multiplexed IFU spectrograph for the Anglo-Australian Observatory in Australia and the next main dark-time instrument for the observatory. Based on the success of the SAMI instrument, which is undergoing the largest galaxy survey done to-date, the hexabundle technology underpinning SAMI is being improved to a new innovative design and scaled up in numbers to give 50-100 IFU imaging bundles across a 2 or 3-degree field. ‘Starbug’ robots will position the hexabundles across the field plate and several thousand fibres will then be fed into new replicable spectrographs. HECTOR will allow a survey of 100,000 nearby galaxies, sufficient to dissect intertwined processes, in order to investigate the build up of angular momentum in galaxies and how gas gets into and out of galaxies. This 5-year galaxy survey with HECTOR is expected to begin in 2020.
Star formation in the Milky Way and implications for other galaxies

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The past decade has provided a wealth of new observational information about star formation on all scales. The key physical processes that determine how molecular clouds contract to form stars can only be investigated in detail up close in the Galaxy, and much of this knowledge has come from in-depth case studies of individual star-forming regions. In contrast, extragalactic studies have focused on the collective effects of star formation, integrated over entire star-forming regions or, often, over entire galaxies. As a result, much of our empirical knowledge of star formation on these scales consists of scaling laws and other parametric descriptions. Fortunately, considerable work is underway to connect these efforts. In the coming decade, ALMA will be transformational for this purpose: it will reveal dense structures within molecular clouds in other galaxies and enable a direct comparison to dense clumps found within Milky Way clouds. In this talk I will discuss results from recent surveys of star formation in the Milky Way that are relevant for making the connection to understanding star formation on galaxy-wide scales. I will also showcase recent results from ALMA that provide the first empirical evidence that the current theoretical understanding of molecular cloud structure derived from clouds in the solar neighbourhood also holds in extreme, high-pressure environments. As such, these theories may be relevant for understanding rapidly star-forming galaxies, like those in the early Universe.

The dust emission properties of nearby galaxies after Herschel

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The Herschel Space Observatory was designed to study the emission of galactic and extragalactic sources in 55 to 672 microns spectral domain. At these wavelengths the continuum emission of galaxies is dominated by the dust produced after the aggregations of metals injected into the ISM by massive stars and heated by the interstellar radiation field. Dust emission is thus tightly connected to several physical processes (metal production, gas cooling, star formation...) that regulated the formation and the evolution of galaxies. I will review the most recent results on the study of nearby galaxies obtained thanks to the excellent sensitivity, angular, and spectral resolution of the Herschel 3.5m telescope and discuss the implication of these results in the study of galaxy evolution.

Quenching: I do not think it means what you think it means...

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Using data from the recently completed Galaxy And Mass Assembly (GAMA) survey, I reconsider the apparent dichotomy between galaxies with generically ‘red’ and ‘blue’ stellar populations. First, I show how the dominant uncertainty in existing measurements of the ‘red’ galaxy mass function is tied to how ‘red’ galaxies have been selected/defined. This is important, inasmuch as there is not even agreement about the qualitative shape of the red/blue mass functions, which has important ramifications for ideas of ‘quenching’. I will describe how I have attempted to redress this problem, using a mixture modeling/objective classification approach. Further, I will show results from work in progress, where I look at how the red- and the quiescent-galaxy fractions vary with both mass and with environment. These results suggest that the separability of so-called mass- and environment-quenching mechanisms has been overstated, as has the incidence of quenching in general.
Revised Calibration of Star Formation Rate Indicators
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One of the principal means of measuring galaxy growth is via star formation rates derived from ultraviolet, mid-infrared and radio continuum imaging. We present revised calibrations of these star formation rate indicators using an atlas of 129 galaxy spectral energy distributions. The spectral energy distributions combine spectra and matched aperture photometry to consistently measure spectral energy distributions over a broad wavelength range. We find that star formation rate calibrations must be systematically revised upward by 10 to 30 percent, relative to the commonly used calibration of Kennicutt et al. (2009).

Are We Correctly Measuring Star-Formation Rates? 
A Multi-wavelength Perspective from STARBIRDS
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Integrating our knowledge of galaxies to form a holistic picture of structure evolution is becoming possible from the growing number of multi-wavelength surveys. The panchromatic STARBurst IRregular Dwarf Survey (STARBIRDS) is one such holistic survey focused on nearby starburst dwarf galaxies. STARBIRDS was designed to map the lifecycle of starburst events in low-mass galaxies, from identifying the trigger mechanism, to measuring the spatial and temporal characteristics of the burst, to determining the impact of the event on the host-galaxy and its environs from starburst driven driven winds. The data set includes GBT observations of the HI 21 cm line, Spitzer near- and mid-infrared imaging, HST optical imaging, GALEX UV images, ground-based Halpha imaging, and Chandra X-ray imaging.

As part of the STARBIRDS survey, we have focused on integrating our knowledge of star formation traced by observations at different wavelengths, which is essential for correctly interpreting and comparing star formation activity in a variety of systems and environments. In this talk, I will introduce the STARBIRDS survey and discuss new results comparing extinction corrected integrated ultraviolet (UV) emission from resolved galaxies with optical color-magnitude diagram (CMD) based star formation rates (SFRs) derived from resolved stellar populations and CMD fitting techniques. Interestingly, the integrated near ultraviolet (UV) fluxes predicted from the CMD based SFRs using four different models agree with the measured, extinction corrected, integrated near UV fluxes from GALEX images, but the far UV predicted fluxes do not. Further, there is a systematic deviation between the SFRs based on integrated far UV luminosities and existing scaling relations, and the SFRs based on the resolved stellar populations. This offset is not driven by different star formation timescales, variations in SFRs, UV attenuation, or stochastic effects. This first comparison between CMD-based SFRs and an integrated FUV emission SFR indicator suggests that the most likely cause of the discrepancy is the theoretical FUV SFR calibration from stellar evolutionary libraries and/or stellar atmospheric models. Using the STARBIRDS sample, I will present an empirical calibration of the FUV-based SFR relation for dwarf galaxies, with uncertainties, which is 65% larger than previous relations.

I will also mention results from two additional surveys on nearby dwarf galaxies, SHIELD and DUSTiNGS, which probe the star-formation process in very low-mass galaxies (6 < log (M/Msun) < 7.5) using HI, optical, Halpha, and UV imaging (SHIELD Survey), and which identify, for the first time, populations of dust-producing evolved stars in very low-metallicity environments (DUSTiNGS).
Evolution of molecular and atomic gas and stars in galaxies and scaling relations

Claudia Lagos, ESO, Germany & ICRAR, Australia, claudia.lagos@icrar.org

The latest observations of the carbon monoxide and atomic hydrogen contents of local and high-redshift galaxies, coupled with how these correlate with star formation activity, have revolutionized our ideas about how to model star formation in a galactic context. A successful theory of galaxy formation has to explain some key facts: (i) high-redshift galaxies have higher molecular gas fractions and star formation rates than local galaxies, (ii) scaling relations show that the atomic-to-stellar mass ratio decreases with stellar mass in the local Universe, and (iii) the global abundance of atomic hydrogen evolves weakly. I will show how modern cosmological simulations of galaxy formation attempt to put together these pieces and highlight how hydro-dynamic simulations and semi-analytic models differ and complement each other. I will show observable predictions from both techniques, what we think we have learned so far and what still needs to be done in simulations to allow robust testing by the new observations expected from e.g. ALMA, PdBI, MeerKAT, SKA.

The ultra-massive black hole in NGC 1277 probed via CO kinematics and multi-wavelength analysis

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NGC 1277, a lenticular galaxy in the Perseus Cluster, has been reported by van den Bosch et al. to host an ultra-massive black hole (BH) of $1.7 \times 10^{10} M_\odot$. With such a large BH mass, NGC 1277 constitutes an extreme outlier from the empirical correlations between supermassive BHs and their host spheroids. The BH mass is based on stellar kinematics and has been discussed controversially. Here, we present millimeter interferometric observations of NGC 1277 carried out using the IRAM Plateau de Bure Interferometer with the aim to obtain an independent BH mass estimate based on molecular-gas kinematics in the CO(1-0) line. The emission in the CO(1-0) line and 2.6 mm continuum is interpreted with the help of ancillary multi-wavelength data (optical, near-infrared, radio, X-ray). We draw conclusions for the BH mass and discuss the role of NGC 1277 in view of the BH-galaxy correlations and the BH fundamental plane.
The (resolved) 'main sequence' of galaxy formation

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Galaxies display a remarkable degree of correlation between their physical properties, leading to many well-known scaling relations. Some of them, such as the mass-metallicity or the metallicity-star fraction relations, have recently been shown to hold on scales of the order of one kpc. This talk will review the observational evidence supporting the case for a galactic 'main sequence', including both star-forming and passive galaxies (or regions within them), and interpret it in terms of chemical evolution models.

How greedy are Brightest Cluster Galaxies?

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Observations of the mass growth of Brightest Cluster Galaxies (BCGs) over the most recent 3 billion years are discrepant with model predictions. While observations of the evolution of BGG stellar mass between $0.5 < z < 1.5$ show continuous growth, the evolution for $z < 0.3$ remains unclear. The latest generation of models of galaxy formation predict BCG growth to continue to the present day. In contrast, observations show little growth, such that by $z \sim 0$ there is a discrepancy with the models.

BCGs are frequently observed to have the close companion galaxies necessary to increase their mass through merging. However, analyses to date of the mass in the companion galaxies have not had a sample complete in redshift to make an accurate measurement. I will show constraints on the fraction of the stellar mass of a present-day BCG that could be assembled by mergers since $z \sim 0.3$ from the highly complete GAMA survey. These results will be compared to model catalogues giving a direct comparison between the observations and the models.

Galactic winds in the local Universe as revealed by the SAMI Galaxy Survey

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For the first time, we uncover the prevalence of galactic winds in local star-forming galaxies using a statistical sample from the SAMI Galaxy Survey. Using strong optical emission lines and our photoionisation and shock models, we show that we can cleanly separate gas excited by radiative shocks induced by galactic winds from that excited by HII regions. We demonstrate that a combination of velocity dispersion, emission-line ratios and velocity maps can be used as a powerful diagnostic tool to census galactic winds. By searching for shock excited emission lines above and below galactic discs, we will show the first results of our systematic investigation of the fraction of shocked winds in star-forming galaxies.
Star formation in nearby galaxies: combining IFS and radio data
Sarah Leslie, Affiliation RSAA ANU, Australia, sarah.k.leslie@gmail.com

Despite decades of study, the relationship between radio continuum emission and star formation remains poorly understood. Integral Field Spectroscopy (IFS) allows the spatially resolved study of stellar populations, gas, and dust in galaxies. By combining the wealth of information available through the IFS surveys SAMI and CALIFA, we start to shed some light on what is causing the radio emission in star-forming galaxies (not just star-formation!). Shocked gas associated with stellar winds and SNe is identified in a large fraction of the radio-bright star-forming galaxies in our sample. We will present evidence that these shocks are likely re-accelerating galactic cosmic rays, resulting in an increased radio emission.

News about the interstellar medium in galaxies from the CALIFA survey
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I will review recent results from the CALIFA survey on the properties of the ISM and derived properties, in particular abundance gradients in galaxies. The talk will cover a broad range of topics, from the ISM in early-type galaxies, over excitation conditions in typical HII regions to the identification of a universal abundance gradient in disk galaxies.

Using CO to trace the ”dark” gas and spiral arms of the Milky Way
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Over the past decade studies of our Galaxy in infrared have painted a wonderfully detailed picture of the dust in the interstellar medium, telling us where the stars and gas are found. However, our understanding of the composition and dynamics of the interstellar clouds is much more limited due to the paucity of high-resolution molecular maps of the Milky Way. To rectify this we present the latest data from the Mopra CO Southern Galactic Plane Survey, which now spans 60 square degrees of the 4th quadrant of the Milky Way at an order of magnitude better spatial and spectral resolution (i.e. 0.6 and 0.1km/s) than the Dame et al. (2001) survey commonly used.

In particular, we examine a filamentary molecular cloud about 5 kpc distant along the l=328 sightline that has been observed in both CO and [C I] (using the HEAT telescope in Antarctica), and at other wavelengths. The G328 filament is constrained to be cold ($T_{Dust} < 20$ K) by the lack of far-IR emission, to show no clear signs of star formation, and to only be mildly turbulent from the narrow line width.
Scaling relations of CO resolved structures in nearby spiral galaxies, and what we can learn from the Carina Nebula

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We report high spatial resolution observations of Giant Molecular Clouds (GMCs) in the nearby spiral galaxies NGC6946, M101 and NGC 628 obtained with the Combined Array for Research in Millimeter-wave Astronomy (CARMA). We observed CO(1-0) over regions with active star formation extending from 2 kpc to 15 kpc galactocentric radius. Higher resolution observations of CO(2-1) toward the brightest regions observed in CO(1-0) have allowed us to resolve some of the largest GMCs. Using a Bayesian fitting approach, we generate scaling relations for the properties of the structures identified in this work. We do not find evidence for a power law relation between size and line width in our sample of galaxies. We analyze the scaling relation between the ΣSFR and ΣH2, known as the Kennicutt-Schmidt (K-S) relation. We find super-linear K-S relations for the identified structures for the three galaxies. The K-S relation is sub-linear when we use an uniform grid to define the regions. For NGC 6946 and M101 we find regions where the star formation efficiency (SFE) shows marked peaks at specific galactocentric radii. On the other hand, the distribution of SFE in NGC 628 is more contiguous. As a Galactic counterpart analysis, we have mapped the 12CO, 13CO & C18O lines over the the Carina Nebula using the Mopra telescope. With the CO map in hand, we now are able to fully characterise the molecular environments of the Carina Nebula, obtaining their masses and kinematic properties. We will present preliminary results of the analysis performed on Mopra CO images which combined with far-infrared data from the Herschel space telescope allow us to determine the fraction of the dust-derived gas mass that is in molecular form and investigate the spatial variation of the XCO factor across this active star forming region. The integrated properties of star forming complexes in nearby galaxies will be able to be compared to the picture we determine for Carina.

Massive, gas rich, turbulent disk galaxies in the nearby Universe

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In this talk I will discuss properties of extremely gas rich, turbulent disk galaxies in the DYNAMO survey. DYNAMO is an IFU survey of Hα in ~100 galaxies at z ~ 0.1. DYNAMO galaxies are selected to have the highest Halpha luminosity at their redshift, yet are not AGNs, and have large masses (stellar mass > 10^{10} Msun). Follow up results from HST, and kinematic maps from Keck and Gemini show that many DYNAMO galaxies are clumpy, rotating disks, with large internal velocity dispersion, similar to galaxies at z=1-2. In this talk I will show that gas fractions in DYNAMO galaxies are 20-40%, much higher than typical local Universe galaxies (1-8%). The gas fraction of DYNAMO galaxies is similar to that of z = 1 – 2 disks (eg. PHIBBS survey). The DYNAMO galaxies offer a sample of galaxies gas rich, clumpy, turbulent disks at z ~ 0.1. Using DYNAMO galaxies we can therefore constrain the properties of individual clumps with much higher precision than in z = 2 galaxies. I will also show that in gas rich disk galaxies the sizes of clumps is directly linked to the gas fraction and velocity dispersion of the disk, both predictions of the theory that instabilities lead to clumpy disks. Finally I will present preliminary results showing that the stellar initial mass function in clumps appears to be different than that of typical galaxies.
The spatial distribution of star formation in distant and nearby galaxies

Maryam Shirazi, ETH Zurich, Switzerland, maryam.shirazi@phys.ethz.ch

I present the results from studying the differences between the spatial distributions of star formation in nearby (SDSS) and distant galaxies (HUDF) that have similar global properties. I show that high-z galaxies that I studied have more concentrated stellar content but their star formation is more extended compared to galaxies with the same global properties at z~0. High-z galaxies are also more clumpier in their star formation distributions than their local analogs. I discuss higher gas surface densities at high-z is responsible for the slightly more unstable disks which results in a more clumpy morphology at high-z. I also show that distant galaxies that I studied have a median of 231 higher clump mass than their SDSS analog galaxies.

Resolving the mysteries of AGN feedback: radio jets, galaxies and citizen science

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Observed correlations between the properties of supermassive black holes and their host galaxies are amongst the most intriguing in astrophysics. Not only do black holes somehow "know" about their host galaxy, but they are also sometimes observed to impart significant amounts of energy to their surroundings. This process of AGN feedback is held responsible for stopping runaway cooling in galaxy clusters and limiting the growth of the most massive galaxies for the last half of the Hubble time.

AGN feedback can be imparted by either synchrotron-emitting jets (through the so-called kinetic mode) or thermal pressure from the black hole accretion disk (the radiative mode). On galactic scales, this energy injection supplies turbulence to the molecular gas and drives large-scale outflows. On larger scales, jet-inflated radio lobes can severely limit gas cooling by shock heating and uplifting hot gas away from the centre of the gravitational potential well where cooling times are short. The nature of each feedback process depends sensitively on the detailed properties of the AGN, and the interaction between the AGN and its environment.
Kinematics of luminous type II AGN
Rebecca McElroy, University of Sydney, Australia, rmcelroy@physics.usyd.edu.au

We present IFS observations of 17 luminous, log($L\text{[O III]}/L_\odot) > 8.7$, local, $z < 0.11$, type II AGN, and demonstrate that winds are ubiquitous within this sample and have a direct influence on the ISM of the host galaxies. We use both non-parametric (e.g. line width and asymmetry) and multi-Gaussian fitting to decompose the complex emission profiles close to the AGN. We find line widths containing 80% flux in the range $400 – 1600$ km s$^{-1}$ with a mean of $790 \pm 90$ km s$^{-1}$, such high velocities are strongly suggestive that these AGN are driving ionized outflows. Additionally, multi-Gaussian fitting reveals that 14/17 of our targets require 3 separate kinematic components in the ionized gas in their central regions. The broadest components of these fits have FWHM = $530 – 2520$ km s$^{-1}$, with a mean value of $920 \pm 50$ km s$^{-1}$. By simultaneously fitting both the H$\beta$/[O III] and H$\alpha$/[N II] complexes we construct ionization diagnostic diagrams for each component. 13/17 of our galaxies show a significant (¿ 95 %) correlation between the [N II]/H$\alpha$ ratio and the velocity dispersion of the gas. Such a correlation is the natural consequence of a contribution to the ionization from shock excitation and we argue that this demonstrates that the outflows from these AGN are directly impacting the surrounding ISM within the galaxies. In addition, we use stellar absorption features to measure kinematics for these AGN host galaxies and those of a control sample selected from the SAMI Galaxy Survey to search for evidence of these luminous AGN being preferentially hosted by disturbed or merging systems.

The Close AGN Reference Survey (CARS)
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We present the first results obtained from the Close AGN Reference Survey (CARS). It is an ongoing project to obtain a unique spatially-resolved multi-wavelength dataset for a well-defined sample of 40 luminous unobscured AGN at $z < 0.06$. Panoramic integral-field spectroscopy with the brand-new MUSE instrument at the VLT represent is the heart of the survey. MUSE provides high-spatial resolution to resolve the properties and kinematics of the ionized gas and stellar population across the entire host galaxies down to scale of 300–800pc. Besides the existing archival all-sky surveys, dedicated single-dish CO line observations and deep K-band imaging are currently complementing the MUSE data. We highlight the potential of the survey with a few showcases to demonstrate the various science cases that can be addressed. Those range from studying the evidence for quenching of star formation, incidence and physics of AGN-driven outflows, the kinematic signatures of interactions to large scale gas fueling. In the near future, we aim to add spatially-resolved X-ray (Chandra), radio (VLA), MIR/FIR (SOFIA), and molecular line (ALMA) maps to provide the most complete picture of the AGN-host galaxy connection to date and a reference for luminous AGN at higher redshifts.
I will present ALMA observations of the host galaxies of some of the most luminous quasars known (more luminous than $10^{14} \, L_{\text{sun}}$), investigating their far-infrared emission and discussing an extremely broad and luminous [CII] line in a quasar at redshift $z = 4.6$. ALMA continuum observations allow us for the first time to probe the far-infrared properties of this extremely luminous population. The broad [CII] line observed in one host galaxy indicates a massive rotating disk around a very massive black hole that was already established at high redshift. In contrast with previously published claims based on [CII] observations of other high-redshift sources, we show that this source is either consistent with the locally determined $M$-sigma relation, or that its black hole may even be under-massive. This result suggests, counter to previous claims, that super-massive black holes at high redshift do NOT grow more quickly than their host galaxies.
Near Field Cosmology
Joss Bland-Hawthorn, University of Sydney, Australia jbh@physics.usyd.edu.au

Our Galaxy, the Milky Way, is a benchmark for understanding disk galaxies. It is the only galaxy whose formation history can be studied using the full distribution of stars, i.e. from white dwarfs to supergiants. The oldest components provide us with unique insight into how galaxies form and evolve over billions of years. We can learn about the physics and chemistry of the first stars, about the impact of reionization on galaxy formation, on the build up of mass and the chemical elements. We can also learn about secular processes that redistribute mass, metals and angular momentum over cosmic time. Galactic studies will continue to play a fundamental role far into the future because there are measurements that can only be made in the near field and much of contemporary astrophysics depends on such observations.

The Gaia-ESO survey
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I will present the Gaia-ESO survey carried out on ESO’s Very Large Telescope. The five year Gaia-ESO survey has been allocated 300 nights, making it the largest survey ever approved on any 8-10m telescope. The scientific goals are to measure the chemistry and kinematics of all of the main stellar populations in the Milky Way: bulge, halo, thin/thick disk as well as open clusters across the Galaxy. The Gaia-ESO survey has galvanized the European stellar spectroscopic community, bringing together more than 400 astronomers to work together. Much efforts have been devoted to ensure that the spectroscopic analysis is performed to the highest of standards using a variety of techniques and codes. In this talk I will give a summary of the philosophy behind the survey with lessons to be learned for all types of large-scale surveys as well as some of the scientific highlights obtained to date.

The Sagittarius Stream and Core: Structures Extraordinaire
Elaina Hyde, University of Western Sydney, Australia, E.Hyde@uws.edu.au

This talk will wrap around the Milky Way, following the Sagittarius stream. This is one of the dominant substructures in our halo. We use statistical selection method to identify 106 highly likely members of the Sagittarius stream. Spectroscopic analysis of metallicity and kinematics of all members provides us with a new mapping of the Sagittarius stream. The Sagittarius trailing arm exhibits a metallicity gradient, ranging from -0.59 dex to -0.97 dex over 142 degrees. This is consistent with the scenario of tidal disruption from a progenitor dwarf galaxy that possessed an internal metallicity gradient. We note high metallicity dispersion in the leading arm, causing a lack of detectable gradient and possibly indicating orbital phase mixing. We additionally report on a potential detection of the Sextans dwarf spheroidal in our data.
The kinematics, stellar populations and gas content of E+A galaxies
Michael Pracy, University of Sydney, Australia, mpracy@gmail.com

E+A galaxies, possessing a significant young stellar population but no ongoing star-formation, are a population of galaxies seen in the midst of rapid evolution in their star formation rate. Such galaxies likely represent a transitional population between blue star-forming galaxies and quiescent red sequence galaxies. Understanding the processes responsible for this transformation is an important part of understanding the overall galaxy population. We have used Integral field spectroscopy over a range of environments, redshifts and galaxy properties to measure the stellar kinematics and the geography of the stellar populations. For local samples, in which the E+A galaxy core is well resolved, we have demonstrated that a centrally concentrated post-starburst population and significant radial gradients in the stellar populations are ubiquitous. This is consistent with the predictions from models of mergers and tidal interactions which funnel gas into the galaxy core. The kinematics of the E+A population are indistinguishable from the early-type galaxy population as a whole, being dominated by fast rotators and consistent with the Faber-Jackson relation after taking into account the transient brightening from the young stellar population. We have followed-up the lowest redshift E+A galaxies at 21-cm using the Green Bank Telescope (GBT) and the Jansky Very Large Array (JVLA). Roughly half of the E+As studied so far have detectable HI-21cm emission. The gas fractions of these galaxies, measured with respect to their stellar mass, are between 1 and 10 per cent and are at the high end of the gas fractions measured in gas-bearing early-type galaxies and typically lower than seen in late-type galaxies with comparable stellar masses. This is consistent with the idea that E+As are currently evolving from the blue cloud to the red sequence.

Spectroscopic decomposition of bulge and disc star-formation histories
Evelyn Johnston, ESO, Chile, ejohnsto@eso.org

Spiral galaxies typically display ongoing star formation throughout their discs while their bulges host older stellar populations. However, recent studies of lenticular galaxies, which are often considered to be evolved spirals, have found old stellar populations throughout their discs along with evidence of more recent star formation in their inner regions. Such results suggest that in disc galaxies of different morphologies, the bulges and discs have followed different evolutionary paths. In order to understand how the stellar populations in these two components have evolved into what we measure today, we have developed a new technique for spectroscopic bulge-disc decomposition, in which the light from a disc galaxy is separated wavelength-by-wavelength into bulge and disc components. This technique has been successfully applied to IFU data from the MaNGA survey to produce datacubes representing purely the light from the bulge and disc of the decomposed galaxy, which can then be analysed to determine their independent star-formation histories. In this talk, I will present an overview of the process and our preliminary results.
The EAGLE Universe

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The EAGLE (Evolution and Assembly of Massive Galaxies and their Environments) computer simulations generate a virtual Universe, creating a laboratory in which we can explore and understand galaxy evolution. The simulations, include the full range of baryonic physics including metal dependent gas cooling star formation, supernovae, black hole formation. The resolution of the simulations is sufficient to resolve the onset of the Jeans instability in galactic disks, allowing us to study the formation of galaxies in detail. At the same time the largest calculation simulates a volume that is 100 Mpc on each side, allowing us to study galaxy formation across the full range of galaxy environments from the isolated dwarves to rich galaxy clusters. The outputs reproduce the observed galaxy and black holes populations spectacularly well, making the simulation a powerful tool for interpreting resolved galaxy datasets, and observations at radio and sub-mm wavelengths. I will present some of the latest results from these comparisons.

Environmental quenching of star formation with SAMI

Adam Schaefer, University of Sydney, Australia, adam_schaefer@hotmail.com

The role of the local environment in the formation and evolution of galaxies is not well understood. While previous surveys (e.g. Lewis et al. 2002, Patel et al. 2009, von der Linden et al. 2010, Wijesinghe et al. 2012) agree on a decline in the global star formation rate within galaxies at higher environment densities, the quenching timescales and mechanisms that affect this relationship remain elusive. Some have argued that this trend is driven by the changing fraction of star forming galaxies in high density environments, while others claim the overall level of star formation is reduced in these objects. We use extinction corrected H-alpha measurements from the Sydney-AAO Multi-object Integral Field Spectrograph (SAMI) to quantify the spatial distribution of star formation in \( \sim 300 \) galaxies. This sample covers three orders of magnitude in both mass and environment and is the largest of such samples that has been made to date. For each galaxy, drawn from the GAMA survey regions, we compute the total integrated star formation rate and radial profile from the 2D distribution of H-alpha. Our data suggest that both the star forming fraction and the star formation rate in star forming galaxies declines in higher density environments. In addition, we see little evidence for a change in the radial star formation gradient due to the environment and discuss this in the context of current galaxy formation models.
The SAMI Galaxy Survey:
Cluster properties and the impact on galaxy star formation
Matt Owers, Macquarie University and Australian Astronomical Observatory, Australia, matt.owers@mq.edu.au

The SAMI Galaxy Survey will provide resolved spectroscopy for around 3000 galaxies. Of those galaxies, ~600 have been selected to be members of eight massive clusters of galaxies. These eight clusters were the subject of a deep redshift survey using the AAOmega multi-object spectrograph with the aim of characterising the cluster dynamical properties (galaxy membership, cluster mass and substructure). Seven of the clusters also have existing Chandra and/or XMM-Newton X-ray data. In this talk I will describe the global characteristics of the clusters, such as the total masses and merging status, which have been measured using the combination of the redshift and X-ray data. These data are also used to provide a more physical description of galaxy environment local to the SAMI targets. Preliminary results will be presented on the environments of galaxies with evidence for environmentally impacted star formation properties, as indicated by the resolved information provided by the SAMI data.

IGM and CGM in the EAGLE simulation
Alireza Rahmati, University of Zurich, Switzerland, ali.rahmati@gmail.com

Modern state-of-the-art cosmological simulations of galaxy formation have become indispensable tools for probing the main processes that are shaping the formation and evolution of galaxies and they can be used to learn about the cycle of gas in galactic ecosystems. In this talk, I will present the main results of analysing the distribution of neutral hydrogen and metals in the IGM and CGM in the EAGLE cosmological simulation (Schaye et al. 2015; Crain et al. 2015). I will compare the simulation results with observations and discuss how this comparison can help us to learn about the role of feedback in shaping the distribution of HI and metals around galaxies. Moreover, I will discuss the inferences we can obtain from cosmological simulations to better understand the relation between observed absorption systems and galaxies.

Dense, circum-nuclear molecular gas in starburst galaxies
Claire-Elise Green, UNSW/CSIRO, Australia, claire.elise.green@gmail.com

Understanding the relationship between star formation and active galactic nuclei (AGN) is central to the study of galaxy formation and evolution. Our collaboration has undertaken a survey of the dense, circum-nuclear molecular gas traced by HCN, HCO\(^+\) and HNC (1–0) of 11 starburst galaxies with the aim of studying the interplay between starbursts and AGN. The results of this project will be presented here. Particular focus will be given to the discussion of the identification of chemically distinct regions in these galaxies: photon-dominated regions (PDRs) and X-ray dominated regions (XDRs). The presence of these regions can tell us whether the starburst or central black hole has the dominant effect on the circum-nuclear molecular gas. Robustly identifying these regions and their cause is a challenge, and I will discuss issues surrounding this topic.
The Central Molecular Zone: Our Galactic Nucleus Up Close in CO
Rebecca Blackwell, University of Adelaide, Australia, rebecca.blackwell@adelaide.edu.au

As the closest galactic nucleus that we can see, our own Milky Way centre affords a unique opportunity for study. Presented here is the Mopra Radio Telescope survey of the Central Molecular Zone (CMZ), in the four strongest isotope lines of Carbon Monoxide (CO). The central region within $358.5° < l < 3.5°$, $-0.5° < b < +1.0°$ has been mapped at unprecedented spatial and spectral resolution of $35''$ and $0.1$ km/s, with extensions to $l = 358.0°$ and $b = -1.0°$ ongoing.

The diffuse emission traced by these lines reveals new complex and filamentary structure in our Milky Way centre. This dataset allows us to probe our closest galactic nucleus across a wide scale and broad spectral range, investigating dynamics, flows, and substructures that were previously unresolved. Multiwavelength analysis incorporating tracers of dense and neutral gas will inform models of the life-cycle of our galactic nucleus, and the processing of molecular matter in the Milky Way.

SAMI Science
Lisa Kewley, RSAA/ANU, Australia lisa.j.kewley@gmail.com

I will present the latest science highlights from the SAMI survey. The SAMI Galaxy Survey began in March 2013, and aims to obtain integral field spectroscopy of 3000 galaxies across a large range of environment and masses. The SAMI survey aims to answer the following key science questions: (1) What is the physical role of environment in galaxy evolution? (2) What is the relationship between stellar mass growth and angular momentum development in galaxies? and (3) How does gas get into and out of galaxies, and how does this drive star formation? I will present early results on these three topics and discuss future directions for the SAMI and other large IFS surveys.

Violent Competition or Harmonious Synergy?
A 3D perspective on the Starburst-AGN Connection
Rebecca Davies, Australian National University, Australia, Rebecca.Davies@anu.edu.au

Resolved optical studies of star formation rates (SFRs) in the host galaxies of active galactic nuclei (AGN) will provide significant insight into the spatially dependent impact of AGN feedback on star formation (SF). However, contamination of SF by AGN activity confounds the relationship between Hα luminosity and SFR. We show that using line ratios and integral field data, we can cleanly separate SF from AGN activity for every emission line in every spaxel. This method is extremely powerful, allowing us, for the first time, to study the properties of SF without AGN contamination (and vice versa). We apply our method to galaxies from the Siding Spring Southern Seyfert Spectroscopic Snapshot Survey (S7), and successfully recover the intrinsic star forming and AGN components of each spaxel. We investigate the distribution and rate of star formation in each galaxy as a function of the luminosity and accretion rate of the AGN and the shape and extent of the AGN extended narrow line region. This dissection offers a very promising method for investigating the starburst-AGN connection.
Friday 29th May, 14:25 - 14:40

The origin of the mysterious H\( \alpha \) emission along the Magellanic Stream
Thorsten Tepper-García, Sydney Institute for Astronomy (SIFA),
University of Sydney, Australia, tepper@physics.usyd.edu.au

The origin of the bright (> 200 mR) optical emission observed along the HI Magellanic Stream has remained a mystery since its discovery by Weiner and Williams in 1996. In this talk, I will present some insight into the possible mechanisms that lead to ionisation of much of the Stream’s gas, and discuss two competing models that aim to explain its origin.

Friday 29th May, 14:40 - 14:55

Islands of star formation in the large HI disk of ESO215-G?009
Jing Wang, ATNF, CSIRO, Australia, j.wang@csiro.au

We report a multi-wavelength study of the 1-kpc scale star formation in the low surface brightness galaxy ESO215-G?009. This galaxy has a very high HI mass to light ratio \((M_{HI}/L_B = 24)\) and very high HI to optical size ratio \((R_{1HI}/R_{26\mu m} = 12)\). Patchy star formation is detected throughout the large neutral hydrogen disk, with little optical light. We measure the HI-star formation efficiency \((SFR/HI)\) in these patches, and compare to different theoretical star formation models. Our results support a picture of dark matter gravity regulated star formation.

Friday 29th May, 14:55 - 15:10

The Relation between Dynamical Mass-to-Light ratio and Color for Massive Quiescent Galaxies
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The relation between the mass-to-light ratio \((M/L)\) and rest-frame color of galaxies has been widely used to estimate ”cheap” stellar masses. The combination of the \(M/L\) and color is furthermore a powerful tool for studying the shape of the stellar initial mass function (IMF) near one \(M_\odot\). The \(M/L\) versus color relation, however, has been derived using stellar population synthesis (SPS) models, which suffer from large uncertainties due to assumptions regarding the star formation history, metallicity, IMF, and SPS code. I will present an empirical relation between the dynamical \(M/L\) and rest-frame color derived from a sample of massive quiescent galaxies out to \(z \sim 2\). We find that there is a strong, approximately linear correlation between the \(M/L\) for different wavebands and rest-frame color. The root-mean-scatter scatter in log \(M/L\) residuals implies that it is possible to estimate the \(M/L\) with an accuracy of \(\sim 0.25\) dex from a single rest-frame optical color. I will show that SPS models with a Salpeter stellar IMF can not simultaneously match \(M/L_g\) vs. rest-frame \((g - z)\) and \(M/L_K\) vs. rest-frame \((g - K)\). By changing the slope of the IMF we are still unable to explain the \(M/L\) of the bluest and reddest galaxies. I will show that variations between different SPS models are comparable to the IMF variations, and that improved stellar libraries and stellar evolution models are needed to provide a more accurate constraints on the IMF.
**A Multiwavelength View of the Circumgalactic Medium**

Molly Peeples, Space Telescope Science Institute, USA, molly@stsci.edu

The bulk of cosmic baryons and metals are not in galaxies, but outside them, in the circumgalactic medium (CGM). In this talk, I will describe how a comprehensive, multi-wavelength view of the CGM is crucial to understanding how galaxies evolve. I will present a recent census of metals and baryons in galaxies and the CGM, and show that these new analyses have opened many questions into how galaxies acquire gas, build up their metals, and redistribute this material into their environs.

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**SCABS: A Survey of Centaurus A’s Baryonic Structures**

Matthew Taylor, Pontificia Universidad Catolica de Chile/ESO, Chile, address mtaylor@astro.puc.cl

First results of the "SCABS: A Survey of Centaurus A’s Baryonic Structures” project will be presented. SCABS utilizes the Dark Energy Camera on the 4m Victor Blanco telescope to image NGC 5128 (Centaurus A) in the optical $u'g'r'i'z'$ bands to depths of $u'=24.50$, $g'=23.72$, $r'=23.12$, $i'=22.95$ and $z'=22.75$ AB mags out to the 300 kpc virial radius for the first time at these depths. These observations will identify >99% of globular clusters (GCs), ultra-compact dwarfs, and low-surface brightness features (e.g. dwarf galaxies and tidal streams) associated with NGC 5128 down to $\sim$25 mag/sq. arcsec in the V-band. These data will place strong constraints on the assembly/merger history of NGC 5128 by identifying GC spatial over-densities, low-surface brightness tidal features and unique GC age/metallicity distribution functions. SCABS will also present new near-field cosmological applications via the 10-100 new dwarf galaxies expected to be in the region. Additionally, new high redshift background targets will be identified for future follow-up studies, making SCABS applicable to many areas of research. This talk will summarize the data, present preliminary results from colour-colour diagrams and propose the myriad applications of SCABS for various astrophysical fields of study.
P01

GALAH + CoRoT: where high-resolution spectroscopy meet asteroseismology

Borja Anguiano, Macquarie University, Australia, borja.anguiano@mq.edu.au

GALAH collaboration with the CoRoT group provides an outstanding opportunity to get better stellar ages as Asteroseismology opens a new era for dating the Galactic disk. Without abundance information, the uncertainty of the inferred ages for the CoRoT giants is about 30%. With abundances information from the GALAH spectra, the uncertainty on the ages drops to less than 15% (Miglio et al. 2013). With 15% age errors, a precise age-metallicity and age-velocity relations can be measured. I will give an update of the status of this project.

P02

Early-Type Galaxy Stellar Populations in the Near-Infrared

Christina Baldwin, Macquarie University, Australia, christina.baldwin@students.mq.edu.au

Stellar population synthesis (SPS) models are key to interpreting the spectral energy distributions (SEDs) of galaxies. While current models typically agree at optical wavelengths, these same models make vastly different predictions in the near-infrared due to different treatments of late-stage stellar evolution, in particular, the thermally-pulsing asymptotic giant branch (TP-AGB) phase. Models including a large TP-AGB contribution, when applied to the integrated SEDs of intermediate age populations, result in derived ages and masses a factor of two lower than those obtained using models with a lesser TP-AGB contribution.

In an effort to resolve this discrepancy, we have tested three popular SPS models, with a focus on evaluating the differing treatments of this phase. We fit the models to high quality near-infrared spectroscopy of a sample of galaxies with well-known spectral properties. We find that none of the models can accurately recover the optically-derived ages of the sample, indicating all models have certain fundamental inaccuracies in the near-infrared regime.

P03

Local Analogs for High-redshift Galaxies: Resembling the Physical Conditions of the Interstellar Medium in High-redshift Galaxy

Fuyan Bian, Australian National University, Australia, fuyan.bian@anu.edu.au

We present a sample of local analogs for high-redshift selected in the Sloan digital sky survey (SDSS). The physical conditions of interstellar medium (ISM) in these local analogs resemble those in high-redshift galaxies. These galaxies are selected based on their positions in the nebular emission-line diagnostic diagram (BPT diagram). This type of local analogs share similar physical properties with high-redshift galaxies, including high specific star formation rates (sSFRs), flat UV continua, compact galaxy sizes and high SFR surface density. Especially, the ionization parameters and electron densities in these analogs are comparable to those in $z \sim 2 - 3$ galaxies, but much higher than those in normal SDSS galaxies. These galaxies provide a great opportunity to understand the evolution of the ISM conditions from high-z galaxies to low-z galaxies.
Is gas-phase metallicity in a local star-formation regulated equilibrium?

David Carton, Leiden Observatory, Netherlands, carton@strw.leidenuniv.nl

We present our results on the radial metallicity profiles of galaxies from the Bluedisk project. With this sample of 50 nearby late-type galaxies we have studied the gas-phase metallicity of galaxies in the context of their HI content by splitting the population into HI-rich and HI-'normal' samples. We find that the metallicity gradient of a galaxy is strongly correlated with its HI mass fraction (M(HI)/M∗). We identify steep outer metallicity drops in many galaxies. Contrary to a previous study, these outer drops are not exclusive to the HI-rich sample of galaxies. To explain the outer metallicity drops we adopt a simple analytical models that assumes that the metallicity is in a local equilibrium, regulated by star-formation. Using such a model we are able to explain the variety of metallicity profiles observed. The success of this model, could provide insight into the observed local mass-metallicity relation.

Constraints on the Efficiency of Radial Migration in Spiral Galaxies

Kathryne Daniel & Rosemary F.G. Wyse, Johns Hopkins University, USA, wyse@jhu.edu

A transient spiral arm can permanently rearrange the orbital angular momentum distribution of the stellar disk without inducing kinematic heating, leading to “radial migration. Should radial migration be an efficient process it could cause a large fraction of disk stars to experience significant changes in their individual orbital angular momentum - and hence mean orbital radius - over the lifetime of the disk. This would have strong implications for the chemical, structural and kinematic evolution of disk galaxies. We have undertaken an investigation into how the efficiency of radial migration depends on stellar kinematics and on the parameters of the spiral structure. The first stage of the process of radial migration is for a star to be trapped near the corotation resonance of a (transient) spiral pattern. We present our analytic derivation of a “capture criterion that describes this trapping, applicable for stars on non-circular orbits. We show that the star’s guiding centre radius is the the crucial parameter governing whether or not it meets this criterion. orbits. We apply our capture criterion to a model of an exponential disk galaxy with a flat rotation curve to investigate (1) the radial distribution of the fraction of stars initially trapped and (2) the dependence of the total fraction of trapped stars in the disk on the radial component of the stellar velocity dispersion (σR) and on the amplitude of the spiral perturbation to the underlying potential at corotation. We find that the initial fraction of stars trapped in horseshoe orbits falls with increasing velocity dispersion as e−σR.
Multiwavelength study of NGC 4068 galaxy

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The results of the multiwavelength study of gas kinematics and star formation in NGC 4068 dwarf galaxy are presented. We performed 3-D spectroscopy of the galaxy in H-alpha line with scanning Fabry-Perot interferometer at the SAO RAS 6-m telescope and compared the obtained information about ionized and neutral (by WSRT 21 cm data) gas kinematics. We found evidence of tidal perturbation in the outer part of the gaseous disk might be caused by recently experienced a minor-merging event. In the optical and UV spectral ranges we detected a number of ongoing star formation sites and kpc-sized shell-like structures in the H-alpha emission line. The results of optical long-slit spectroscopy of several of them as well as the energy budget analysis are presented. We found that the energy distribution in optical and UV ranges shows the signs of triggering star formation occurring in most of the star formation complexes.

 Ionized supershells inside the supergiant HI shells in nearby Irr galaxies

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The neutral gas distribution in the large number of nearby galaxies appears as complexes of shells and supershells with a size up to 1-2 kpc (so-called supergiant shells, SGS). According to modern understanding these structures were created by stellar winds and supernova explosions from multiple star formation events over the lifetime of the SGS. The SGSs expansion may trigger the new bursts of star formation in their rims. As the result, the ionized gas structure in such galaxies appears as HII complexes located mostly in the walls of the giant HI supershells. The Hα emission also observed inside the small HI shells, but never before giant ionized shells were observed inside the HI SGSs. We performed the observations with scanning Fabry-Perot interferometer as well as with narrow-band filters at 6-m telescope of SAO RAS and for the first time detected the presence of the ionized kpc-sized supershells in Hα line inside the HI SGSs in IC 2574 and Holmberg II galaxies. Here we present the results of observations and discuss the possible nature of these structures.
Detecting the progenitor stars of different types of supernova (SN) directly would require a census of stars in nearby galaxies. Alternatively, the study of the environment once the supernova faded has proved to be successful in constraining the properties of their progenitors. We used optical Integral Field Spectroscopy of nearby SN host galaxies ($0.005 < z < 0.03$) provided by the Calar Alto Legacy Integral Field Area (CALIFA) Survey with the goal of finding correlations in the environmental parameters at the location of different SN types. With this approach we are going further than using simply aperture spectrum centered at the galaxy core, or a spectrum from slit positioned at a SN explosion, since we have 2-dimensional spectroscopic information of the whole extent of the galaxy. The total sample consists of 128 SNe of all types in 113 galaxies. We focused on the properties related with star formation and the SN environmental metallicities, for which wide-field IFS enables proper comparisons of different approaches, and their impact on the determination of the SN type.

Clumpy Star Formation in Dwarf Galaxies

Gregory Goldstein, Macquarie University, Australia, gregory.goldstein@students.mq.edu.au

Star-forming galaxies (SFGs) at high-redshift often display giant kpc-scale clumps that are foci of intense star formation. These clumps are thought to be primarily the result of smooth streams of gas flowing onto unstable disks rather than a result of mergers, and simulations show these clumps are important in the formation of galaxy bulges. The blue clumpy structure, asymmetry, and lack of central concentration of these high-z clumpy galaxies are also features of some local star-forming dwarf galaxies, suggesting similarities in the physical mechanisms at work. We use 190 dwarf galaxies from the SAMI survey to explore this connection, with the aim of determining whether clumps in dwarf galaxies are also primarily the result of smooth streams of gas flowing onto unstable disks, or a result of mergers. Taking full advantage of the unique SAMI IFU data, we apply techniques typically used for imaging studies to make a quantitative study of the star-formation morphology in our galaxies, and explore how this varies with other galaxy parameters. Here we report on preliminary findings from our study.
Kinematics of Star Formation in Evolving Galaxies

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Integral-field spectroscopy of highly star forming galaxies from SDSS reveals high gas fractions, clumpy star formation, and a relationship between star formation and turbulence. A deficit in stellar mass in highly star forming galaxies can be seen statistically using the Tully-Fisher relation. This deficit is made up for by high gas fractions in these galaxies. Furthermore, highly star-forming galaxies tend to have higher velocity dispersions, both in the star forming gas, and in the resultant stellar population, than more quiescent galaxies. These findings for low redshift galaxies match many properties of z ~ 2 and higher galaxies, raising interesting questions about the nature of star formation in such galaxies. New large Integral-field spectroscopic surveys, such as The SAMI Galaxy Survey, enable resolved kinematics of star forming galaxies over a large range of stellar mass, star formation rate, and environment. The high spectral resolution of SAMI in particular, as well as new methods for parameterising kinematics, offers an opportunity to see how the kinematic nature of star formation changes in different regimes.

Writing Software in Teams

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Increasingly, the software we use to reduce and analyse data for astronomy is more than a what a single person can write. This poster reviews the tools available to help astronomers write software in small teams, and reviews our experience using these tools in the SAMI Galaxy Survey.

Intensity ratios: a cautionary tale

Claire-Elise Green, UNSW/CSIRO, Australia, claire.elise.green@gmail.com

Molecular line intensity ratios can be used as diagnostic tools to examine the effect of the active galactic nuclei (AGN) or central black hole on circum-nuclear gas. These intensity ratios allow the identification of X-ray dominated regions (XDRs) and photon-dominated regions (PDRs), which facilitates determination of whether the star formation or AGN has the dominant effect on the gas. The chemistry of these regions is dependent upon the type of radiation, thus they are differentiated by the relative intensity of their rotational molecular lines, HCO⁺/HCN and HNC/HCN (1–0). The ratio of the intensity of these molecular lines can be calculated in an unexpectedly large variety of ways. I present a cautionary tale regarding the calculation and interpretation of these ratios and a recommendation on how this calculation should be performed in the identification of XDRs and PDRs.
Dust as a tracer of gas mass

Brent Groves, RSAA, ANU, Australia, brent@mpia.de

Measuring the total gas mass at high z using HI 21cm and CO lines is observationally difficult, even with new telescopes. Using a nearby sample of 36 galaxies with Herschel IR, HI and CO observations, we show that the sub-mm continuum linearly traces both the total gas mass (HI+H2) and gas surface density. This comparison provides a simple empirical relationship without introducing the uncertainty of dust model fitting. Accounting for the gas-phase metallicity in these relations means they can be extended to both low-mass galaxies and high z. However, the sub-mm emission will not trace the (mostly HI) gas mass in the outskirts of galaxies beyond \( \sim 0.7 \) R25. Thus, for the bulk of the baryonic mass in disk-like galaxies, the total gas masses can be accurately inferred from sub-mm continuum measurements when the HI and CO lines are unavailable.

Star Formation Rate and Gas Relations in the Arp 299 Merger from the VIXENS Survey

Amanda Heiderman, University of Virginia/ NRAO, USA, heiderman@virginia.edu

We highlight first results from the VIRUS-P Investigation of the eXtreme ENvironments of Starbursts (VIXENS) integral field unit survey. We investigate the relationship between star formation and gas content in late interaction phase merger Arp 299 from VIXENS. By comparing H-alpha, Pa-alpha and 24\( \mu \)m images to CO(1-0), CO(2-1), HCN(1-0), HCO\(^+\)(1-0), and HI maps, we explore the relation between the star formation rate and gas surface densities on spatially resolved \( \sim \)kpc scales. We find that the SFR-gas relations for Arp 299 are discrepant from known extragalactic spatially resolved relations in nearby spiral galaxies, disk-averaged relations in high-z mergers, and Galactic regions.

Radio continuum observations of starburst galaxies

Josh Marvil, CSIRO, Australia, josh.marvil@csiro.au

I will present a suite of high-resolution radio continuum images of two starburst galaxies, M82 and NGC 2146, at frequencies from 1 to 46 GHz. Variations in the radio spectrum are detected across the face of each galaxy, demonstrating the composite nature of the integrated spectrum and emphasizing the importance of resolved observations. I will propose a multi-zone model to explain these radio sources, using elements including a star-forming disk and galactic superwind.
Sailing under the Magellanic Stream: A DECam View of Carina

Brendan McMonigal, Sydney Institute for Astrophysics (SIFA), University of Sydney, Australia, b.mcmonigal@physics.usyd.edu.au

The standard cosmological model, ΛCDM, explains the formation of galaxies via hierarchical structure formation, the gradual build up of systems through the accretion of smaller systems. Battaglia et al. (2012) found evidence of tidal debris around the Carina Dwarf in recent CTIO/MOSAIC II deep field observations, indicating significant tidal interactions with the Milky Way (MW). We examine the existence of such debris with deep optical photometry from the DECam imager on the 4m Blanco telescope of over 12 square deg around the dwarf spheroidal using a Poisson-based matched filter analysis to identify different stellar populations.

A survey of Wolf-Rayet populations in galaxies via IFS using CALIFA data

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We present the resulting catalogue of a systematic search for Wolf-Rayet (WR) features in galaxies belonging to the Calar Alto Legacy Integral Field Area (CALIFA) survey, observed with integral field spectroscopy (IFS). These data allow us to search spatially the location of WR stars within galaxies and therefore study the properties of these WR-rich regions. The detection technique is based on the identification of the blue (around He II λ4686 and mainly associated to nitrogen-rich WR stars, WN) and red (around C IV λ5808 and associated to carbon-rich WR stars, WC) WR bumps using a pixel-by-pixel analysis, which maximizes the number of independent regions within a given galaxy. From an initial sample of 558 galaxies we have identified 44 WR regions distributed in 25 galaxies. The red WR bump was identified only in 5 regions. The oxygen abundance of the ionized gas of the WR regions ranges between 0.25 Z⊙ and Z⊙. Most of the WR regions are located within one effective radius from the galaxy centre, and around 1/3 are located within 1 kpc or less from the centre. The majority of the galaxies hosting WR populations are involved in some kind of interaction process. Half of the host galaxies share some properties with gamma-ray burst (GRB) hosts where WR stars, as potential candidates to being the progenitors of GRBs, are found. Finally, we have compared the WR properties derived from the CALIFA data with stellar population synthesis models, and confirm that simple star models are not always able to reproduce the observations. We conclude that other effects are very likely affecting the derived WR properties, and hence they should be used to compute more realistic models of WR stars.

Galaxy Bulge and Disk Evolution in the Environmental Context

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We employ a recently expanded sample of nearly 8,000 galaxies with by-eye morphological classifications available within the GAMA Survey and further quantify the bulge/disk properties of these galaxies with a large-scale automated procedure for fitting 2D, multi-component galaxy structure models. We examine the overlap between traditional visual morphology classifications, the results of our quantitative bulge/disk decompositions, and indicators of rotation/random-motion dominance derived from spatially resolved kinematics. We then analyse the structural properties of galaxies in concert with their star formation and environmental characteristics, where galaxy environment is quantified on multiple scales from membership in filaments through groups/clusters and down to local pairings, in order to understand the effects of environmental conditions on the formation and evolution of galaxy bulge and disk structures.
The star formation-AGN connection from the CALIFA survey perspective

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Gas dynamics plays an essential role in galaxy evolution. Gas flows are common to a pair of key important phenomena: star formation and AGNs. Are then both phenomena connected? If so, what is the nature of such a connection? Our research is addressed to look for robust evidence to clarify on this.

We are working on data from the CALIFA survey which has proved to be the largest and most comprehensive wide-field IFU survey of galaxies carried out to date. With that two dimensional spectral info, we are studying several galaxy sub-samples, essentially of star formation, AGN and of transition nature taking into account the role of their morphology and environment (e.g. distorted/influenced, non-distorted/influenced, distorted/isolated and non-distorted/isolated).

We will compare their properties in base of stellar velocity distribution, ionized gas (structure and excitation nature) and star formation history. Generally, main goals are to confirm if BHs had an influence on the star formation histories (or vice versa), to figure out how gas is transported to galaxy centres and to measure the influence of environment. Finally, if AGN feedback works whether quenching, triggering or even enhancing star formation in all AGN classes.

Dependence of SNe Ia absolute magnitudes on the host galaxies’ elemental gas-phase abundances

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The metallicity of the progenitor system producing a type Ia supernova could play an important role on the estimation of the maximum luminosity of the explosion. This dependence may modify the usual calibration between the light curve parameters of SN Ia and its absolute magnitude. To test this hypothesis first, we have observed and analyzed a sample (28) of local galaxies having distance measurements using different techniques from SN Ia methods (i.e Tully-Fisher, Cepheids), in order to see if a direct dependence between SNe Ia absolute magnitude and host galaxies metallicity does exist. This analysis is based on measuring their emission-line intensity ratios and estimating their oxygen abundances following the well known empirical calibrations.
High-cadence high-resolution imaging beyond one micron

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Historically, the high readout noise intrinsic to near-infrared detector technologies has prevented high cadence observations of astronomical sources at wavelengths longer than 1 micron. With the new generation of large format near-infrared Avalanche Photo-Diode (APD) devices now available, observations are possible at frame-rates up to 1 kHz. We are deploying such a device at the ANU 2.3m telescope as a Lucky Imager designed to record diffraction-limited near-infrared images without the severe guide-star restrictions imposed by classic AO observations. The high resolution and good surface brightness sensitivity of the system will be used to provide detailed structural decomposition of the starlight from the older stellar populations in galaxies from the SAMI integral field spectroscopy galaxy survey.

An adaptive optics view
of the morphological evolution of galaxies during $1 < z < 2$

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While local galaxies fall into two dominant populations (passive, red, pressure-supported spheroids, and blue, star-forming disks), these familiar Hubble-type classifications do not apply as readily to high-redshift galaxies, the most massive of which are compact and red. Logically, these high-$z$ galaxies likely become the elliptical population at $z=0$, but they must grow by 3-5 times in size in the interim. It is proposed that the size evolution of galaxies either occurs by accretion of smaller galaxies, whereby the compact core remains, or by adiabatic expansion due to mass-loss winds, whereby the entire galaxy expands. The key to distinguishing between these two scenarios is the accurate measurement of the size-mass relation. This requires sufficient resolution to measure effective radii and Sersic indices of the most compact galaxies over a wide field of view, at rest-frame optical wavelengths to avoid bias due to small-scale localised star-formation.

In this talk I will describe our project using the Gemini South Adaptive Optics Imager, with its unique capability of diffraction-limited near-infrared wide-field imaging, to image the cores of galaxy clusters over the redshift interval $1 < z < 2$. I will present our results from the first two galaxy clusters, as well as our methodology for processing the complex data from this new instrument (including successful correction for the quasi-static off-axis distortion, varying PSF and image ghosting).
Galactic Winds Radiating to 10 K: Gas Properties at Different Mass Loadings and Mechanical Luminosities

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Our three-dimensional hydro-dynamical simulations examine how formation of a galactic wind depends on driving luminosity, mass loading, and the temperature floor of the radiative cooling prescription.

We find that cooling to 10 K vs. $10^4$ K does not affect the kinematics of wind-blown structures, but does increase the mass fraction in cold neutral and hot X-ray while decreasing that in warm Hα by 99%. Cold mass entrained into the halo does not depend on the strength of the starburst. Warm filaments persist where bubbles contact and when there is a mass loading anchor. A starburst with many star forming complexes has more contacts and anchors, hence faster filaments. Cold material can show a sawtooth absorption profile, with space velocities in a tail up to 1500 km/s wrt galaxy systemic.

Decoding the physics of radio Active Galactic Nuclei

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Galaxy formation models routinely invoke feedback from radio-loud Active Galactic Nuclei to explain the observed masses and red colours of the most massive galaxies since $z \sim 1$. Whether or not the observed AGN population can provide the required feedback, however, is an open question.

We present a new dynamical model that relates AGN physical parameters to the observed properties of radio AGN. This model provides the theoretical framework for interpreting AGN observations in existing and next-generation radio surveys. It combines a traditional approach to modeling radio AGN with a semi-analytic description of AGN environments. The model reproduces a number of key features of the observed radio AGN populations, and we determine the energetics (specifically, jet kinetic powers and AGN lifetimes) of the observed local ($z<0.1$) radio AGN population, as a function of host galaxy properties.

We find a broad distribution of jet powers that is largely independent of host galaxy mass, consistent with the idea that these radio AGN are fed by gas cooling from hot haloes in near heating-cooling equilibrium. On the other hand, the duration of the AGN phase appears strongly mass-dependent: massive galaxies host AGN that are longer-lived, and can therefore impart feedback for longer and on larger spatial scales. These findings provide important insights into the mechanisms responsible for AGN triggering and feedback. In the near future we plan to extend our analysis of AGN energetics to higher redshifts.

LAMBDAR: Lambda Adaptive Multi-Band Deblending Algorithm in R

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The GAMA survey has compiled 21 Band photometric imaging from the far-UV to the far-IR. These data are derived from deep observations with GALEX, VST, VISTA, WISE and Herschel and together sample the young and old stars, warm dust, and cold dust content of a cosmologically representative sample of the nearby galaxy population. The sample is unprecedented and unique. We present a dedicated code to analyse these images such that we can extract consistent and robust photometry for the complete GAMA galaxy sample. The resultant photometry can then be reliably analysed using, for example, the MAGPHYS energy balance code.