6th International PHISCC Workshop 19-21 June 2013
Abstracts

Wednesday 19 June 2013

Dr Minh Huynh (ICRAR/UWA)

Latest Developments on the SKA
I will give an update on the status of the Square Kilometre Array. Specifically, the SKA1 Baseline Design was released with the Request for Proposals. I will give an overview of the baseline design and discuss the implications for HI surveys. Future plans for the project and the way forward with the baseline design will also be presented.

Dr Tim Shimwell (CSIRO)

ASKAP

I will present a brief overview of the ASKAP instrument, followed by a summary of what we have accomplished in the project to date and our goals for the coming year. I will include, amongst other things, a description of: the instantaneous field of view; the sensitivity of the phased array feeds; phase closure measurements; beam forming tests; the first images; the proposed build order; and the test fields we plan to observe.

Prof. Claude Carignan (University of Cape Town)

Meerkat

Prof. Tom Oosterloo (Astron)

Apertif

Prof. Ming Zhu (NAOC)

FAST

Dr Baerbel Koribalski (CSIRO ATNF)

Gas in Galaxies

Prof. Thomas Jarrett (University of Cape Town)

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

We have initiated a galaxy evolution project that exploits the rich and complementary data sets provided by WISE and the Local Volume HI Survey (LVHIS). Utilizing the full capabilities of ATCA and Parkes, the LVHIS survey of nearby galaxies is a sensitive, (relatively) well resolved and statistically significant compilation of HI content and kinematic information for southern hemisphere galaxies, serving as the base "fuel" sample for the project. The whole-sky mid-infrared photometric survey, WISE, is designed to study both past evolution and the present star formation history of galaxies. Together these two data sets may be combined to study the complexities of star formation on spatially interesting (kpc) scales. I will present an overview of the project and how it relates to the larger SKA-effort to understand galaxy evolution.

Dr Ed Elson (University of Cape Town)

Quantifying star formation in LVHIS - a WISE perspective

Understanding the links between star formation and gas content is of major astrophysical importance in the context of galaxy evolution. A quantitative measure of the efficiency with which galaxies convert their gas into stars is highly desirable; serving as input to galaxy evolution simulations. We have initiated a programme to combine high-quality HI-line and far-IR imaging from the LVHIS and WISE surveys, respectively, in order to further study the star formation law and star formation models.

Comprised of all HIPASS-detected galaxies within 10 Mpc, the morphologically diverse LVHIS sample probes a large range of HI masses, surface densities, star formation rates, etc. The HI-line cubes allow us to study the HI distribution and kinematics on length-scales of a few tens of pc. WISE imaging at 12 and 4.6 micron provides us with sensitive measures of the star formation rates and stellar masses, respectively.

We have developed a pipeline to cross-correlate and compare these complementary data sets. In this talk we describe the technical details of our methods and present some of our preliminary results for a handful of galaxies. Our goal is to use our pipeline to study the star formation process in as many of the LVHIS galaxies as possible.

Dr Kelley Hess (University of Cape Town)

Evolution in the HI Gas Content of Galaxy Groups: Pre-processing and Mass Assembly in the Current Epoch

We present an analysis of the neutral hydrogen gas content and distribution of HI rich galaxies in groups as a function of their parent dark matter halo mass. Over 740 galaxy groups have been identified in the volume of sky common to the SDSS and ALFALFA surveys. We have assigned HI detections a group membership based on an existing magnitude/volume-limited SDSS DR7 group/cluster catalog. Additionally, we assigned

group ``proximity'' membership to HI detected objects that fall below the limiting optical magnitude--thereby not contributing substantially to the estimate of the group stellar mass, but significantly to the total group HI mass. We find that only 25% of all HI detected galaxies reside in groups or clusters, in contrast to approximately two-thirds of all optically detected galaxies, and that low HI mass objects lose their gas first in the group environment. Further, we stack optical and HI detections in groups as a function of group dark matter halo mass to reveal strong evidence for evolution in the gas content and spatial distribution of HI detected members, with gas rich objects already preferentially residing on the outskirts of intermediate sized groups. To further understand the mechanisms for gas pre-processing in groups we have begun complementary Halpha Fabry-Perot observations and present those preliminary results.

Dr Lisa Harvey-Smith (CSIRO/ATNF)

Report from the HI RFI Workshop

Professor Thijs van der Hulst(University of Groningen, Kapteyn Astronomical Institute)

Challenges for the analysis of future HI surveys

I will briefly describe the experience with existing high resolution HI surveys and reflect on the challenges posed by the big HI surveys of the future.

Dr Tobias Westmeier (ICRAR / UWA)

SoFiA: The new HI source finding pipeline

In collaboration with several other international HI projects, the WALLABY and DINGO source finding teams have been actively involved in developing and testing novel techniques for the automatic detection and parametrisation of galaxies in large, blind HI surveys in preparation for ASKAP and the SKA. Several data filtering, source finding and parametrisation techniques developed over the past few years have now been combined into a new, stand-alone HI source finding pipeline, called "SoFiA" (Source Finding Application). SoFiA comes with a modern, easy-to-use graphical user interface allowing the user to read, write, and manipulate parameter files and launch the pipeline with a single mouse click. In my talk I will present and demonstrate the SoFiA interface and discuss the individual components and algorithms that constitute the pipeline. Based on examples, I will illustrate the great improvement of some of SoFiA's components over existing source finding and parametrisation algorithms.

Prof. Oleg Smirnov (Rhodes University)

Dr Sidelobes: How I learned to stop worrying and love simulations

Radio interferometers are complex and above all counter-intuitive instruments, and were constantly pushing the envelope of their performance with increasingly sophisticated science experiments. This is particularly true for deep HI surveys with SKA pathfinders. The combination of these two circumstances can produce some real surprises most of

them of the unpleasant variety. I will present some examples of surprising observational limitations, both in real-world and simulated data (DDEs, calibration ghosts, sidelobe confusion, calibration noise, HI stacking limitations) and discuss their possible impact on HI surveys.

Thursday 20 June 2013

Dr Lisa Fogarty (University of Sydney)

Velocity Fields with SAMI

The SAMI galaxy survey is an integral field spectroscopy survey aiming to observe ~ 3000 galaxies over the next several years. This unique and rich data set will pave the way to new physical insights into the formation and evolution of galaxies.

I will give a brief overview of the SAMI galaxy survey, focussing on science cases dependent on galaxy kinematics. In addition I will present two recent results based on SAMI velocity field, measure from both the gas content and the stellar content of galaxies.

Prof. Geraint Lewis (Sydney Institute for Astronomy)

The Velocity Function: SAMI's view of the Universe

Galaxy surveys with SAMI will reveal the kinematic properties of thousands of systems, allowing us to determine the velocity function of populations and sub-populations of galaxies. A more robust measure of the underlying mass distribution than the traditional luminosity function, the determination of the cosmic evolution may provide a new probe of our underlying cosmology.

Dr Kristine Spekkens (Royal Military College of Canada)

DiskFit: A Model-Based Approach to Measuring Disk Galaxy Structure

As we enter an era of large optical and HI spectroscopic surveys, it is increasingly important to measure the kinematic structure of disk galaxies using robust techniques. Accordingly, adopting a model-based approach to fitting disk galaxy velocity fields holds significant promise for extracting parameters closely related to the underlying physical structure of the disk, as well as producing statistically meaningful uncertainties on these parameters. DiskFit is a new, publicly available code that embraces this approach while imposing as few assumptions on the data as possible. Because the basic algorithm can be applied to either velocity fields or photometric images, DiskFit is a particularly powerful tool for understanding the physical structure of galaxies for which both types of data are available. In this talk, I will introduce DiskFit and describe its advantages over standard tilted-ring techniques. I'll then illustrate the algorithm's utility in analysing the products of large kinematic surveys by presenting results from automated velocity field fits to the Halpha kinematics of CALIFA DR1 galaxies.

Prof. Jacqueline van Gorkam (Columbia University)

CHILES, a VLA HI deep field

Dr Attila Popping (ICRAR/UWA)

HI source finding using optical systems

Most of HI source finding has concentrated on blind searches, where no prior information is used to detect objects. In recent years there has been an increasing number of optical surveys providing a large number of galaxies with optical positions and spectra. This information can be used to detect neutral hydrogen in these galaxies to lower flux levels than is feasible with blind searches. We have developed a method to detect HI galaxies in an automatic fashion for a given optical catalogue. First tests on HIPASS data have already revealed more detection than listed in the HIPASS catalogue. The results provide a direct comparison between optical and HI surveys and allow to do multi-frequency science.

Ms Laura Hoppmann (ICRAR/UWA)

Deep 21-cm HI Observations with the Arecibo Telescope

The star formation rate (SFR) in galaxies, as measured by optical, UV and far-infrared observations, appears to increase by an order of magnitude over the redshift interval of $z=0$ to $z\approx1$. However, little accurate information about the co-evolution of neutral hydrogen is available. Measurements are limited to sparse and model-dependent observations of damped Lyman-α systems at high redshifts or to observations of 21-cm radio emission line at very low redshift. However, the unique sensitivity of the Arecibo telescope can be used to directly detect 21cm HI emission from galaxies at cosmological distances.

Previous detections have involved optically pre-selected galaxies and are therefore biased in their selection criteria. Here we present our latest results from the Arecibo Ultra Deep Survey (AUDS) which is a blind 21-cm survey with the Arecibo L-band Feed Array (ALFA). We use data from AUDS to accurately derive the HI mass function and constrain the cosmic HI density ΩHI at redshifts greater than zero for the first time

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Dr Ivy Wong (CSIRO)

Large-scales HI Streams

Observations of diffuse gas external to galaxies are still somewhat limited even though one of the key unknowns (in our understanding of galaxy formation) is how galaxies accrete gas and build up its baryonic content. Using the new HIPASSv2 maps, we present evidence for a large-scale diffused neutral intergalactic medium within the GH 58 galaxy group which consist of several compact sub-groups of galaxies. Most notably, we find a large HI stream extending ~ 500 kpc between HCG44 and NGC 3162. Compared to the currently-published version of the HI Parkes All-Sky Survey (HIPASS), the newly-reprocessed version (HIPASSv2) presents an improvement in the noise RMS by a factor of 1.5. I will also present some early results from the search for large-scale diffused HI streams within the nearby Universe using HIPASSv2. Such large-scale diffused emission may otherwise remain undetected via interferometric observations

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Dr Paolo Serra (ASTRON)

Kinematically misaligned HI in early-type galaxies

Recent work as part of the Atlas3D project demonstrates that HI is relatively common in early-type galaxies (ETGs). In particular, 1/4 of all ETGs outside clusters host a disc (or ring) of low-column-density HI with size from a few to tens of kpc. In this talk I will show that these gas discs are often misaligned relative to the stellar kinematics of the host based on an analysis of HI and stellar velocity fields, and I will compare these results to predictions of LCDM hydrodynamical simulations of galaxy formation.

Prof. Claude Carignan (University of Cape Town)

First HI Observations with KAT-7

New HI observations obtained with the Karoo Array Telescope (KAT-7), combined to previous VLA data, are used to analyze the mass distribution of the Magellanic-type spiral NGC 3109. While a dark matter model can reproduce very well the observed rotation curve, a MOdified Newtonian Dynamics (MOND) model cannot fit the data, even when allowing the universal constant a0 to vary. This result is valid for all the proposed interpolation functions between the Newtonian and the MOND regime. Different distances or HI content cannot reconcile MOND with the observed kinematics.

Dr Peter Kamphuis (CASS)

Automated Tilted Ring Fitting of the Extremes

For decades now tilted ring fitting has been a major tool in the analysis of galaxy HI data and velocity fields. However, the construction of such models has always required a significant amount of human interaction and errors are ill understood, hence creating them is a subjective process. As we are moving towards an era where large HI surveys, such as WALLABY and WNSHS, will become available a standardized and more objective way of fitting these models becomes crucial. The WALLABY Kinematics group is therefore putting a significant effort into fully automating existing codes such as ROTCUR, Velfit or TiRiFiC. A main hurdle in this process is to understand the errors in fits done by each code and where the strengths and weaknesses of the various codes lie, e.g. speed vs precision. Where a 2D fit to the velocity field will likely suffice for the well resolved intermediately inclined galaxies a 3D analysis will be required for the more extreme cases. Here I will present the first results of such an automated 3D fitting code based on TiRiFiC.

Dr Se-Heon Oh (ICRAR/UWA)

WALLABY kinematic parametre extraction: A sub-pipeline for 2D tilted-ring fits

The WALLABY kinematics working group has defined a detailed strategy to parameterise the kinematics of spatially resolved disk-donomited galaxies from the ASKAP WALLABY and DINGO surveys. We designed a conceptual pipeline for extracting reliable galaxy kinematics, utilising three algorithms: ROTCUR and DISKFIT

which operate on 2D velocity fields, and TIRIFIC which operates on 3D data cubes. In this talk, I will present a sub-pipeline for ROTCUR program which implements 2D tilted-ring fits, and discuss its performance test results using a set of sample galaxies from nearby galaxy surveys (e.g., LVHIS, LITTLE THINGS) as well as WALLABY-like model galaxies.

Prof. Ming Zhu (NAOC)

Large scale HI survey with the future FAST telescope

The Five hundred meter Aperture Spherical radio Telescope (FAST) is a Chinese mega-science project that is currently under construction, with the aim to build the largest single dish radio telescope in the world. In this talk I will give a general introduction to the FAST technology and its science goals, and then report the latest status of the FAST project and discuss in more details on the HI large sky survey which is one the key science project for FAST.

Dr Chris Springob (UWA/ICRAR)

WALLABY and the next generation of galaxy peculiar velocity surveys

In addition to detecting ~ 500,000 galaxies in HI, WALLABY will provide Tully-Fisher distances and peculiar velocities for tens of thousands of galaxies. We discuss the prospects for using WALLABY Tully-Fisher peculiar velocities for cosmology, and how it fits in with other Australian-led peculiar velocity surveys, including 2MTF, 6dFGS, and TAIPAN.

Dr Tao Hong (National Astronomical Observatories, China)

2MASS Tully-Fisher Survey

As a precursor to the Wallaby Tully-Fisher (TF) survey, the 2MASS Tully-Fisher Survey (2MTF) aims to measure Tully-Fisher distances for all bright inclined spirals in the 2MASS Redshift Survey (2MRS) using high-quality HI widths and 2MASS photometry. Compared with previous peculiar velocity surveys, 2MTF provides more accurate width measurements and more uniform sky coverage. HI observations were obtained from the GBT, Arecibo and Parkes telescopes. With these new redshift-independent distances, we will significantly improve the understanding of the mass distribution of the local Universe. In this talk, I will briefly review the 2MTF observations, discuss the HI width measurements and a new error estimation method and introduce a new infrared Tully-Fisher template based on 2MTF sample and WISE magnitudes. Finally, I will present an initial analysis of the peculiar velocity field.

Dr Danail Obreschkow (UWA/ICRAR)

Tully-Fisher Science without optical counterparts

In measuring a Tully-Fisher relation (TFR), the rotational velocity of disk galaxies is normally calculated from the HI linewidth, corrected by the optical inclination of the disks. However, in forthcoming HI blind surveys with the SKA pathfinders, optical counterparts may be unavailable or yield insufficient resolution for inclination measurements. This talk presents a novel method to compute the TFR of galaxy samples without inclination measurements. Surprisingly, this inclination-free method is so robust that most of the classical applications of the TFR remain possible without resolved optical imaging. I'll illustrate the most important applications using the HIPASS data without optical data.

Mr Scott Meyer (ICRAR)

HI Stacking and the Tully-Fisher Relation

I will present an investigation of the Tully-Fisher relation constructed using stacked HI profile widths. We expect to find a correlation between the width of a stacked HI profile and the maximum rotational velocity of the galaxies used in the stack. We propose that this correlation could be used to construct a Tully-Fisher relation from a set of stacked profiles that mimics the Tully-Fisher relation produced by the input galaxies. We have investigated analytical galaxies, simulated galaxies and the HIPASS data set. We find that there is a possibility that HI stacked profiles can be used in place of individual profiles for use in the Tully-Fisher relation

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Ms Jacinta Delhaize (ICRAR)

Detection of HI in Distant Galaxies Using Spectral Stacking

As next-generation radio telescopes draw closer to reality, our attention turns to techniques for high-redshift HI data analysis. Over the past few years, spectral stacking has emerged as a successful method for overcoming sensitivity limitations in studies of the distant Universe. I will show how stacking can be used to efficiently probe the HI properties of field galaxies within larger volumes than ordinarily possible, resulting in an accurate measurement of the cosmic HI mass density out to z=0.13

Mr Jonghwan Rhee (RSAA, ANU)

HI gas measurement of field galaxies at z~0.1 and 0.2 using HI stacking technique

HI stacking is a promising technique for future HI surveys to measure HI gas in galaxies at high redshift as well as to overcome the limitation of radio telescopes currently available. We measure the HI gas content of field galaxies at intermediate redshifts of z ≈¼ 0.1 and z ≈¼ 0.2 using HI 21-cm emission lines observed with the Westerbork Synthesis Radio Telescope (WSRT). HI emission spectra from multiple galaxies, optically selected by the CNOC2 redshift survey project, are co-added to measure the average HI mass of galaxies in the two redshift bins. We calculate the cosmic HI gas densities at the two redshift regimes and compare those with measurements at other redshifts to investigate the global trend of the HI gas density over cosmic time. These are the most reliable measurements made with the HI emission stacking technique beyond the local universe, and the highest signal-to-noise measurements of HI gas density at intermediate redshift, bridging the gap between high-z damped Lyman-α observations and blind 21-cm surveys at z = 0. We find that our measurements of HI gas density at z ≈¼ 0.1 and 0.2 are consistent with the neutral gas density increasing by a factor of two between z = 0 and z > 1.

Dr Natasha Maddox (University of Cape Town)

Comparison of HI and optical redshifts of galaxies - The impact of redshift uncertainties on spectral line stacking

Accurate optical redshifts will be critical for spectral co-adding techniques used to extract detections from below the noise level in ongoing and upcoming surveys for HI, which will extend our current understanding of gas reservoirs in galaxies to lower column densities and higher redshifts. We have used existing, high quality optical and radio data from the SDSS and ALFALFA surveys to investigate the relationship between redshifts derived from optical spectroscopy and HI spectral line observations. We find that the two redshift measurements agree well, with a negligible systematic offset and a small distribution width. Employing simple simulations, we determine how the width of an ideal stacked HI profile depends on these redshift offsets, as well as larger redshift errors more appropriate for high redshift galaxy surveys. The width of the stacked profile is dominated by the width distribution of the input individual profiles when the redshift errors are less than the median width of the input profiles, and only

when the redshift errors become large, ~ 150 km/s, do they significantly affect the width of the stacked profile. This redshift accuracy can be achieved with moderate resolution optical spectra. We provide guidelines for the number of spectra required for stacking to reach a specified mass sensitivity, given telescope and survey parameters, which will be useful for planning optical spectroscopy observing campaigns to supplement the radio data.

Dr James Allison (University of Sydney)

A search for 21cm absorption in the HI Parkes All-Sky Survey

We have carried out a search for associated 21cm absorption in nearby radio galaxies using the first-generation HI Parkes All-Sky Survey (HIPASS). We obtain new detections of cold gas, not seen in the HIPASS 21cm emission or previous absorption searches. Interestingly our HI detections appear to be associated with radio galaxies that exhibit water mega-maser activity. I will discuss our results in the context of strategies for finding absorption in real all-sky data, and provide a comparison with results from other pre-SKA pathfinder surveys.

Dr Stephen Curran (Sydney Institute for Astronomy)

Observational Considerations in the Search for Redshifted Atomic and Molecular Absorption

With the SKA and its pathfinders, we expect to uncover a large number of HI, as well as the very rare OH, absorption systems at high redshift. These can be used to address many important issues such as measuring baryonic content of the Universe, probing large-scale structure and galaxy evolution, as well as obtaining independent measurements of various combinations of fundamental constants at large look-back times. Here we outline the survey strategies expected to significantly increase upon the small number of current detections

1. HI 21-cm in galaxies intervening more distant quasars - how, from the geometry of an expanding Universe, we expect a large detection rate at $z < 1$, the range probed by ASKAP.
2. HI absorption associated with the host galaxy/quasar - how the traditional optical selection of targets, particularly at high redshift, greatly reduces the 21-cm detection rate. The large instantaneous bandwidths which will be available will dispense with our current reliance on optical redshifts, leading to a vast increase in redshifted 21-cm detections.
3. OH 18-cm absorption - how through colour selection we expect to significantly increase the number of redshifted OH absorbers above the paltry five currently known.

Dr Aeree Chung (Yonsei University)

Dynamics of Ram Pressure Stripped Gas Disks

I like to present the velocity fields of galaxies that have been ram pressure stripped by intra-cluster medium in the cluster environment and discuss how it will change the galaxy evolution.

Ms Sarah Reeves (University of Sydney)

A search for intervening HI absorption in HIPASS galaxies

The 21cm HI absorption-line provides an ideal probe of the neutral gas in galaxies well beyond the local universe ($z > 0.3$). However, we currently lack the understanding to infer galaxy properties from absorption-line data alone. To address this, we are conducting a search for intervening HI absorption in a sample of 20 nearby, gas-rich galaxies (selected from the HIPASS Bright Galaxy Catalogue). By targeting nearby galaxies, we are able to detection both HI emission and absorption (if present) from all of the galaxies in our sample. We make detailed measurements of the HI distribution and kinematics, from HI emission-line maps, and use this to investigate the expected detection rate of HI absorption with impact parameter (i.e. distance from the centre of the galaxy). In this talk I will present our results to date, as well as discussing implications for future absorption-line surveys.

Mr. Moses Mogotsi (University of Cape Town)

Probing the kinematics of the SINGG-SUNGG star forming galaxies

The SINGG-SUNGG survey is a H-alpha, R-band and UV survey of nearby HI selected star forming galaxies to study star formation. We are performing optical spectroscopic studies of the galaxies in the sample using the WIYN SparsePAK (> 64 galaxies) and WiFeS (> 88 galaxies) multi-fiber and IFU spectrographs. These studies are being used to determine the kinematic properties of these galaxies in order to test our star formation models, to study the links between star formation and gas dynamics, to study the metallicities of the galaxies, the ISM and gas outflows. The kinematics, star formation and metallicity studies will be used to characterize the MHONGOOSE precursor sample and help with the determination of the final sample of galaxies that will be observed with MeerKAT (observations of the MHONGOOSE precursor sample are being performed using WiFeS). I will present the initial results of our surveys. Properties of the velocity profiles and velocity fields and comparisons with HI and CO will also be discussed.

SIfA Seminar, 2pm Friday 21 June

Dr. Rob Crain (Leiden Observatory)

Title: Eagle: Evolution and Assembly of Galaxies and their Environments

I will introduce "Eagle", a new flagship suite of cosmological hydrodynamic simulations of galaxy evolution that adopt the new Planck cosmogony. Eagle incorporates element-by-element radiative cooling, stellar evolution and chemical enrichment, gas recycling, the growth and merging of black holes (BH), and feedback from stars & active galactic nuclei. Eagle also adopts a new formulation of the SPH algorithm that significantly improves the treatment of macroscopic fluid instabilities. I will demonstrate how calibration of the metallicity-dependence of the fraction of the stellar feedback energy that is lost on subgrid scales yields a fiducial model that reproduces the present day galaxy mass function (plus many other key observables). This calibration is based on local gas properties, and so avoids the commonplace coupling of interstellar medium physics to physically unrelated quantities such as halo mass or dark matter velocity dispersion. Moreover, the simulations do not require the ad-hoc or unphysical schemes that are often used to boost the 'numerical efficiency' of feedback in hydro simulations. Eagle therefore represents a valuable new model with which to interpret observational datasets and to assist our understanding of the complex, dynamic physics of galaxy formation.
