Gas in Galaxies:
from Cosmic Web to Molecular Clouds

Abstract book

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TALKS

Analysis of galaxy halos using HI 21-cm emission and QSO absorption spectroscopy

Ben Bekhti Nadya
Argelander Institut für Astronomie

Recent observations show that spiral galaxies are surrounded by extended gaseous halos as predicted by the hierarchical structure formation scenario. The origin and nature of extra-planar gas is often unclear since the halo is continuously fueled by different circulation processes as part of the on-going formation and evolution of galaxies (e.g., outflows, galaxy merging, and gas accretion from the intergalactic medium). We use the Milky Way as a laboratory to study neutral and mildly ionized gas located in the inner and outer halo. Using spectral line absorption and emission measurements in different wavelength regimes we obtain detailed information on the physical conditions and the distribution of the gas. Such studies are crucial for our understanding of the complex interplay between galaxies and their gaseous environment as part of the formation and evolution of galaxies. Our analysis suggests that the column-density distribution and physical properties of gas in the Milky Way halo are very similar to that around other disk galaxies at low and high redshifts.

The connection between HI and QSO absorbers

Borthakur Sanchayeeta
Johns Hopkins University

Our understand of the HI distribution in the universe is quite patchy. 21 cm emission studies primarily focus on HI in the disks or tidal debris of galaxies, where as Lyman alpha studies have probe pencil beam regions around galaxies ($\sim$100-250 kpc). Unfortunately, there is no clear indication between how the gas seen as Lyman alpha absorbers in the extended disk and halos of galaxies is connected to the gas within the disks of galaxies. The biggest problem in connecting the two is that the low column density gas traced via Lyman alpha absorption probes regions that depends on the position of the background source. In this study, I'll talk about a study that aims to understand the cold gas distribution in the circulgalactic medium much closer to the galaxies (2-100 kpc). The study suggests that the gas in the outer regions ($<$10kpc) of the galaxies is possibly warm and haven't condensed into cold gas seen in the disks. I'll also discuss the possibility of neutral hydrogen in one of the dwarf galaxies to be mostly warm.

Cold Gas in Massive Galaxies: Results from the GALEX Arecibo SDSS Survey

Catinella Barbara
MPA Garching

The main obstacle to understanding the formation and evolution of galaxies is our limited knowledge of the role played by gas. In particular we still lack measurements of the HI gas, which is the reservoir for future star formation, for large and unbiased samples for which ancillary data on stellar and star formation properties are also available. To this end we are carrying out the GALEX Arecibo SDSS Survey (GASS), an ambitious programme to assemble the first unbiased inventory of atomic hydrogen in massive galaxies. Using the Arecibo radio telescope, we are acquiring HI spectra for 1000 galaxies selected uniquely by stellar mass ($M_* > 10^{10} M_\odot$) and redshift ($0.025 < z < 0.05$), covered by both SDSS spectroscopic and GALEX imaging surveys. Our selected stellar mass range allows us to probe the interesting region where galaxies transition from blue and star-forming to red and passively evolving. In this talk I will discuss how the gas content of massive systems depends on their structural and star formation properties. I will argue that gas scaling relations are not only necessary to characterize the average gas properties of the local galaxy population, but are also a very useful tool to identify objects that might be transitioning between blue, star-forming cloud and red sequence. In particular, objects with HI excess are good candidates for systems that might have recently accreted gas from the surrounding medium. Lastly, I will discuss baryonic mass-velocity and size-velocity relations for the GASS sample.

Cosmic Reionization

Ciardi Benedetta
MPA

In this talk I will present an overview on the theoretical modeling of the IGM reionization process, together with observational strategies to unveil its secrets.

The Last Eight-Billion Years of Cosmic CIV and SiIV Evolution

Cooksey Kathy
NSF Fellow, MIT Kavli Institute for Astrophysics & Space Research

The low-redshift ($z < 1$) IGM probes the last eight-billion years of metal enrichment from galactic feedback processes. Outflows and mergers return to the IGM enriched material for future generations of galaxies and stars. The signature of this process is etched in the recycled gas: metallicity, abundances, density, distribution, etc. Observations of intergalactic absorbers provide "end-product" constraints on the physics driving chemical evolution and, therefore, the physics adopted in cosmological hydrodynamic simulations. We conducted the largest survey for C IV and/or SiIV systems at $z < 1$, and we compare our results to those from high-redshift ($1.5 < z < 6$) studies. For example, we present the frequency distribution f(N) and mass density of C IV and SiIV absorbers in the HST archival spectra of 49 quasars. The changes in the properties of the low-redshift systems, compared to the high-redshift ones, indicate that CIV and SiIV more commonly trace circumgalactic gas at $z < 1$. Indeed, this agrees with simulated observations from several OverWhelmingly Large Simulations.

Simulations of Satellite Accretion

Cooper Andrew
MPA

Gas-rich satellite accretion is one possible source of 'fuel' for star formation in massive galaxies. Unfortunately we can't directly observe satellites that have already been accreted, only those that survive. Nevertheless, the remnants of past accretion events are still visible around galaxies in the local universe. Very deep observations of nearby galaxies reveal a wide variety of diffuse stellar haloes and tidal debris, often with complex substructure. I will talk about detailed cosmological simulations of galaxy assembly focused on the buildup of stellar haloes and their relation to the population of satellites destroyed inside a typical Milky Way-like dark halo. Comparing these simulations to observations provides a consistency check for the CDM model and our understanding of low-redshift minor mergers. This in turn may help to constrain the importance of satellites as a source of cold gas.

MHONGOOSE: The MeerKAT Nearby Galaxy Survey

de Blok Erwin
University of Cape Town

I will report on progress of MHONGOOSE, the MeerKAT Deep Survey of Nearby Galaxies. Goal of this survey of 6000 hours is to probe the outskirts of some 30 nearby galaxies to column densities of $\sim 10^{17}$ cm^{-2}. This will enable exploration of processes and features such as cold accretion, lagging haloes, and inflows and outflows into the galactic halos.

Cosmic ray driven galactic winds and magnetized galactic halos

Dettmar Ralf-Jürgen
Ruhr-University Bochum

Multiwavelengths studies making use of radio-, IR-, optical, and X-ray observations of the interstellar medium in galactic halos provide evidence for a large scale exchange of matter between galactic disks and halos driven by the star formation activity in the disk. In this context, radio continuum observations at several frequencies will be discussed to conclude that this large scale matter transport is supported by cosmic ray pressure. The observations also provide information on the halo magnetic field structure and allow us to constrain the small scale structure of magnetic fields by comparing diffusive and advective transport processes.

A dynamical HI study of the nearby spiral NGC 3521 – searching for extra-planar gas

Elson Edward
ICRAR

NGC 3521 is a nearby, moderately-inclined disk galaxy. Its rotation curve was presented by Casertano & Gorkom (1991) as being one of the first cases for which a declining H I rotation curve was found in a spiral galaxy. The system as since been observed at $\sim$ 14″ resolution with the VLA as part of The H I Nearby Galaxy Survey. The new high-sensitivity data show the galaxy's H I kinematics to be complex, and reveal the presence of a kinematically anomalous H I component which shows up in the line profiles as very extended wings. I present the results of a suite of detailed dynamical analyses of NGC 3521 aimed at characterising and quantifying the properties of the anomalous H I component, specifically its distribution and kinematics. An attempt is made at determining the origin of the anomalous emission, checking whether kinematic evidence exists for it being extra-planar gas that is 1) being ejected out of the disk by star formation, or 2) being accreted onto the disk from the inter-galactic medium. I also check whether the anomalous H I component is responsible for the previously-determined declining outer rotation curve, and whether a different form of the rotation curve is derived when excluding the kinematics of the anomalous H I. The sorts of analyses presented in this talk are particularly relevant to future large H I surveys that will be carried out with ASKAP, MeerKAT and the SKA. These instruments will ultimately allow us to study the full gas cycle in nearby galaxies, thereby refining our understanding of the roles played by ejected and accreted gas in a galaxy evolution context.

The HI Environments of Massive Galaxies from Stacking

Fabello Silvia
MPA

The neutral gas (HI) in galaxies is crucial to understand their evolution, but currently on-going blind HI surveys such as ALFALFA (Arecibo Legacy Fast ALFA) survey, even if will produce HI data over a cosmologically significant volume, will not detect a large fraction ($\sim 80\%$) of the high mass, gas-poor galaxies. This high mass range is crucial for understanding galaxy evolution at low redshifts, as it is the regime where galaxies seem to make a transition between blue and star-forming and red and passively-evolving. We make use of a stacking technique to exploit the wealth of data provided by the ALFALFA survey, with the aim of constraining the average HI content of the high-mass population. When accurate optical redshifts are available, stacking of galaxies that are individually not detected in HI allows one to recover the average neutral gas content of the selected population. We will summarize our results on the connection between gas content and galaxies properties (bulges and AGNs), and we will present the on-going analysis about the relation between gas and environment for these massive systems.

Simulating atomic and molecular gas in cosmological context

Feldmann Robert
Fermi National Accelerator Laboratory

There has been considerable progress in modeling molecular chemistry in cosmological simulations over the last years. In my talk I will discuss recent developments in this growing field. I will focus on modeling the transition of neutral to molecular hydrogen and highlight some implications of modeling star formation based on the presence of H2. I will further discuss ways to predict the large-scale H2-CO conversion factor with the help of cosmological simulations.

Detecting cold gas accretion in high-redshift galaxies: insights from numerical simulations

Fumagalli Michele
UCSC

Hydrodynamical cosmological simulations indicate that massive galaxies at high redshift are fed by extended streams of cold gas in a smooth component and in merging galaxies, but unambiguous evidences of this accretion mode are still lacking. To bridge the gap between observations and theoretical predictions, we present a study of the absorption characteristics of the gas in simulated galaxies and streams,in comparison with the statistics of observed absorption line systems. After post processing the simulations with a state-of-the-art radiative transfer code, we find that much of the gas in streams is highly ionized by UV radiation from background and local stellar sources and has a typical metallicity of $\sim 1\%$ solar. Despite the low covering factor, galaxies and their cold streams in the studied mass range ($M_{\rm vir} = 10^{10} - 10^{12}$ M$_\odot$) account for more than 30% of the observed population of optically thick absorbers, the rest possibly arising from smaller galaxies or the intergalactic medium. Our simulated galaxies reproduce the Lyα absorption profiles observed in the circumgalactic medium of $z \sim 2 - 3$ Lyman-break galaxies. On the other hand, they underestimate the strength of metal lines, suggesting that the latter should arise from outflows. We conclude that the observed population of metal poor Lyman limit systems are likely detections of the predicted mode of cold accretion.

LADUMA - HI out to z=1 with MeerKAT

Holwerda Benne Willem
ESA (ESTEC)

MeerKAT, a 64 × 13.5m dish radio interferometer, is South Africa's precursor instrument for the Square Kilometre Array (SKA), exploring dish design, instrumentation and the site in the Karoo desert. One of two approved, top-priority, Key Projects, is a single deep field, integrating for a total of 5000 hours with the aim to detect neutral atomic hydrogen through its 21 cm line emission out to redshift unity. This first ultra-deep HI survey will help constrain fueling models for galaxy assembly and evolution, the evolution of cosmic neutral gas density of the Universe over cosmic time, evolution in the star-formation law (the Schmidt-Kennicutt law), distance indicators such as the Tully-Fisher relation, and much more. I will present the specifications, timeline, and envisaged science case for this unique deep field, which encompasses the Chandra Deep Field-South (and the footprints of GOODS, GEMS and several other surveys) to ultimately produce a singular legacy multi-wavelength data-set.

Accretion as traced by structure and populations in stellar streams

Johnston Kathryn
Columbia University

Star-by-star studies of galaxies in the Local Group and beyond offer their own constraints on the baryon physical processes that formed them. In this talk I will overview ideas about how *substructure* in stellar distributions in both phase- and abundance- space can inform us about the nature of the progenitors of the Milky Way's stellar halo, and the build-up of baryonic material through accretion more generally.

The Magellan/MagE Survey for Molecular Hydrogen in High-Redshift Galaxies

Jorgenson Regina
Institute of Astronomy, Cambridge

We present the results of the first unbiased, blind survey for Molecular Hydrogen (H2) in high redshift (z $\sim$ 2-4) Damped Lyman alpha systems (DLAs). These are the most gas-rich quasar absorption systems and, since they contain the bulk of the neutral gas at high-z, may fuel star formation over much of the Hubble time. But despite H2 being the main molecular coolant and therefore an important ingredient for star formation, its covering fraction in DLAs is unknown, primarily because few H2-bearing DLAs have been found –mostly serendipitously – and disproportionately high column density (N(HI)) systems have been searched. To better understand the link between DLAs and high-z star formation we measured the H2-bearing DLA fraction and H2 covering fraction by exploiting the excellent UV throughput of the Magellan/MagE spectrograph in a relatively fast, medium resolution survey of $\sim$100 DLAs selected without N(HI) bias. We will present the results of this survey.

Warps and accretion in disk galaxies

Jozsa Gyula
ASTRON

Warps are a basic feature of disk galaxies. Usually they occur at radii where the optical disk fades and become most pronounced in the outermost gaseous disks. As such, warps present a massive reservoir to replenish star forming material in the inner, star forming disks. Furthermore, some possible excitation mechanisms for warps connect their formation to the accretion of extragalactic material. Interactions or mergers with gas-rich companions or the direct accretion of the ambient intergalactic medium might lead to the formation of warps, at the same time supplementing fuel to maintain star formation. I will present a number of HI studies of warped galaxies, to discuss whether the observed kinematics show evidence for a connection of warps and accretion of gas from the ambient medium and discuss the possible insights coming from warp studies employing large sky HI surveys.

Extended Halo Gas and Galaxy Disk Kinematics of MgII Absorption Selected Galaxies at z=0.1

Kacprzak Glenn
Swinburne University of Technology

Quasar absorption line studies enable cool circumgalactic gas to be probed over a wide range of redshifts, in a fashion that is complementary to forthcoming HI and metal-line emission surveys. Understanding the connection between the HI and metal absorption lines detected in background quasar spectra will simultaneously provide clues to the dynamical and chemical enrichment evolution processes within galaxy halos. Ions such as MgII probe a large range of hydrogen column densities, from 17$<$ log[N(HI)] $<$ 22, and thus also uniquely opens a window on the most diffuse gas in galaxy halos, unveiling structure at large galactocentric radii. We perform the first detailed comparison of the properties (i.e. colour, SFR, morphology, kinematics) of galaxies hosted by MgII absorption systems at z=0.1. This redshift range will be readily accessed by future HI emission line surveys such as Wallaby. We find MgII host galaxies have little-to-no star formation and reside in isolated environments, making them ideal test cases for differentiating between models of gas accretion and extended, dynamically-stable disks. We find that even at 100 kpc from the host galaxy, halo gas retains a clear signature of co-rotation with the host galaxy disk. However many systems exhibit distinct velocity components that are inconsistent with simple lagging halo models, and may be a signature of the cold mode accretion posited by gasdynamical simulations of galaxy formation.

Dichotomies of Galaxy Formation

Katz Neal
University of Massachusetts

There are several observed dichotomies relevant to galaxy formation: red sequence and blue cloud galaxies, bulges and disks, isolated dwarf galaxies that are blue and those that are red, hot core clusters and cool core clusters, etc. I will use hydrodynamic cosmological simulations to address some of these dichotomies in terms of theoretical dichotomies in cooling and feedback.

The Effelsberg-Bonn HI Survey: an outlook onto the Milky Way and extragalactic data

Kerp Juergen
Argelander-Institut fuer Astronomie

The Effelsberg-Bonn HI Survey (EBHIS) comprises and all-sky HI survey north of Dec $= -5^{\circ}$. In parallel the Milky Way HI distribution as well as the local volume HI is surveyed out to a red-shift of $z \leq 0.07$. The first complete coverage of the northern sky is expected to be finished in 2011. EBHIS will complement the Parkes multi-feed surveys. The first EBHIS coverage will reach the a comparable sensitivity as the Parkes Galactic All Sky Survey (GASS) and – smoothed to the same velocity resolution – HI Parkes All Sky Survey (HIPASS). We report on the recent status of the Effelsberg-Bonn HI Survey (EBHIS) and present early science results.

Results from the Local Volume HI Survey (LVHIS)

Koribalski Baerbel
CSIRO Astronomy & Space Science, ATNF

I will focus on the accretion of neutral gas onto nearby galaxies. Galaxies with large outer disks provide an excellent opportunity to study their environment and the physical processes shaping their gas distributions and kinematics. I will present examples of accretion, ram pressure stripping, tidal tails/streams as well as gas outflow and discuss these in detail.

Disk building processes in the HI massive LIRG HIZOA J0836-43

Kraan-Korteweg Renée
University of Cape Twon

HIZOA J0836-43 is the most HI-massive galaxy detected in the HIPASS volume (v <12,700 km s^{-1}). But, unlike typical, giant HI disks in the local universe which experience only quiescent star formation, it is a luminous infrared galaxy (LIRG) with an actively star-forming disk (>50 kpc) central to its large gas disk (∼130 kpc). A detailed analysis of this galaxy is rendered difficult due to its location behind the Milky Way ($A_B \approx$ 10mag). However, a NIR imaging survey shows it to reside in a region underdense in L* galaxies - consistent with the environment of other HI-massive galaxies. Given the star formation rate and efficiency, stellar mass, and gas fraction derived from Spitzer MIR and recent Mopra CO observations, HIZOA J0836-43 appears more like a scaled-up version of local spirals. Its properties are not consistent with those observed in merging and strongly interacting systems. Intriguingly, its evolutionary phase of star formation appears more characteristic of galaxies at redshift z∼ 1 when similarly large gas fractions were likely more common. HIZOA J0836-43 therefore provides an unprecedented opportunity to study disk building processes in the very nearby Universe (at z∼ 0.036), which may reveal key insights into the synergy between gas, dust and star formation in galaxies at z∼1, and when the universe was at its peak of star formation.

Gas in Void Galaxies: Observations and Simulations

Kreckel Kathryn
Columbia University

Void galaxies, occupying underdense regions within the cosmic web, are an environmentally defined population whose isolated nature provides an ideal sample to test theories of galaxy formation and evolution. Additionally, their existence poses a well defined observational constraint to Lambda-CDM cosmological models. I have examined the gas content of geometrically selected void galaxies in a new Void Galaxy Survey (VGS), and have found many individual void galaxies which may exhibit evidence of ongoing gas accretion. I have also analyzed the results of a new hydrodynamic cosmological simulation centered on a large void, which reproduces many observed galaxy properties but finds no strong distinction between void and field galaxies.

Gas accretion and spiral galaxy formation

Martig Marie
Swinburne University of Technology

Cosmological simulations have unveiled two main modes of galaxy growth: hierarchical growth by mergers and accretion of cold gas from cosmic filaments. However, these simulations struggle to take into account small-scale mechanisms, which govern internal evolution and are a key ingredient to understand galaxy formation and evolution. We have thus developed a new simulation technique, which consists in extracting the merger and accretion history of a galaxy in a cosmological simulation and performing a re-simulation of this history at high resolution (150 pc). The low computational cost of this technique makes it possible to perform statistical studies and to explore the parameter space of galaxy formation.

We have gathered a sample of 30 simulated spiral galaxies with halo masses between 10^{11} and 10^{12} Msun at z=0. We study the link between the z=0 properties and the merger and gas accretion histories. We find that the angular momentum of the accreted gas, and the way this angular momentum varies with time, are crucial factors for disk building. In particular, early gas accretion set the plane of the gas disk. The subsequent growth of the gas (and stellar) disk is facilitated when the direction of the angular momentum of the accreted gas does not change at later times. Quiet merger histories are thus a necessary but not sufficient condition for the formation of disk-dominated galaxies.

The Evolving HI Universe

Meyer Martin
ICRAR

How the HI content of galaxies evolves, and the factors that influence this, is one of the central questions driving a number of SKA pathfinder surveys. While the evolution of key optical galaxy formation properties, such as the star formation rate density, have been extensively studied, our understanding of how the cool gas content of galaxies evolves remains poorly understood. The SKA pathfinders will make significant inroads into this topic, both through the direct detection of HI emission from individual galaxies, as well as through statistical methods such as HI stacking and intensity mapping analyses. Key to maximising the scientific return of deep HI studies is the development of these techniques in the lead-up to the commissioning of pathfinder facilities. I will discuss recent HI stacking results derived from Parkes and HIPASS data, along with future prospects for studying the evolving HI universe with DINGO.

Reflections of Gas Accretion History in the Star Formation Rates and Stellar Populations of Galaxies

Moran Sean
Johns Hopkins University

Star-forming galaxies are known to host large reservoirs of cold gas which provide the fuel for continued star formation. Yet most galaxies will consume their entire observable reservoirs in only a few Gyr, suggesting that new gas must be acquired regularly, either in discrete events or through continuous accretion. Little is known observationally about this process, and even less is understood about how gas accretion is terminated as galaxies evolve onto the red sequence. I will present results from GASS, the GALEX-Arecibo-SDSS survey, which is aimed at addressing these questions through a joint study of the gas content and stellar populations of a mass-limited sample of galaxies at $0.025 < z < 0.05$. In particular, I will describe our discovery of a substantial population of massive spirals exhibiting low-metallicity star formation in their extreme outer disks. These low metallicity star-forming regions appear to be more common in spirals with elevated HI fractions, suggesting that the stellar mass growth is due to recent accretion of relatively pristine gas. These galaxies may therefore provide a detailed local glimpse of gas accretion processes that were more common during the prime epoch of disk galaxy formation at $z \sim 1$.

Star formation regulatory mechanisms in galaxies

Murray Norman
CITA

Diffuse gas will turn into stars unless the self gravity of the gas is opposed by some means, including thermal gas pressure, ram or turbulent gas pressure, radiation pressure, magnetic field pressure, and/or cosmic ray pressure. All have been advocated as candidates for regulating star formation. Absent some energy source, all these pressures decay with time, but gas pressure decays on the gas cooling time, which is much shorter than the dynamical time, typically tens of millions of years in star forming galaxies. Despite this mismatch in time scales, many current feedback schemes rely on thermal gas pressure, and so require large luminosities (or artificial suppression of cooling) to function. Such models work best in situations where the gas density is small, e.g., elliptical galaxies or in very low mass dwarf galaxies. In high density objects, such as star bursts, ULIRGs, or submillimeter galaxies, the cooling time is so short that it is hopeless to rely on thermal pressure support, since the entire luminosity of the galaxy can heat the gas only to several tens of Kelvin. Nevertheless, these objects all lie on the Kennicutt relation, along with normal galaxies. This suggests that thermal gas pressure support is not the main determinant of the star formation rate in star forming galaxies of any type.

Another popular model is that of turbulent pressure support. However, once a self-gravitating body of gas forms, it will tend to accrete gas out to its own Bondi radius; this leads to a pile-up of mass at high densities, which cannot be opposed by turbulence as has recently been demonstrated in high resolution numerical simulations. Some form of feedback, localized in the densest regions, would seem to be necessary. Radiation pressure from young stars provides feedback localized in the densest regions, and on the time scale of star formation. I will

argue that star formation in disks is regulated by radiative feedback from young stars, which operates on small scales. Over time, the feedback drives bubbles outward, leading to large scale turbulence, which tends to stabilize gas disks (on large scales).

Neutral hydrogen in early-type galaxies

Oosterloo Tom
Astron - Dwingeloo, NL

We have performed HI imaging observations of the volume limited ATLAS3D sample of early-type galaxies. We detect HI in about 50% of the field galaxies, with HI masses above a few x 10^6 $M_\odot$ while the detection rate in dense environments is only a few %. I will discuss the connection between HI kinematics and morphology with other characteristics such as stellar dynamics and stellar population. In about half the cases where we detect HI, it is found to be in a large, regularly rotating disk of low column density. In these galaxies, we can derive the total mass distribution to well beyond the optical image, in some cases to more than 10 effective radii. I will present an analysis of such rotation curves which demonstrates the presence of dark matter out to such large radii. I will also discuss the HI Tully-Fisher relation we derive for our sample.

Dust Beyond Disks

Peek Joshua
Columbia University

Interstellar dust has long been known to be a crucial aspect of galaxy structure, modifying radiation fields and tracing dense gas and spiral arms. Recently the importance of dust as product of star formation and as a sail for momentum-driven winds has come to the fore. In particular, the relevance of extra-planar dust as a tracer of the efficiency of feedback in disks may provide a rare constraint on hydrodynamic galaxy formation subgrid models. In this talk I will discuss new observations dust beyond galactic disks. The quest for dust detections in high-velocity clouds is ongoing and there are new and tantalizing results. There have also been an explosion of studies of dust that have been enabled by precision, industrial photometry, both to stars in the Galaxy and extra galactic objects. Finally, dust has been detected at Mpc scales beyond disks and out to z=1, and I will present new detections of dust in groups of galaxies and a new dependency of extragalactic dust distribution on halo mass.

The ISM of high redshift galaxies

Petitjean Patrick
Institut d'Astrophysique de Paris

I will summarize the results of our surveys: (i) to determine the HI content of the Universe and its cosmological evolution by detecting Damped Lyman-alpha systems (DLAS) in the SDSS (ii) to determine the molecular content of DLAS. The detection of H_2, HD and CO molecules in the diffuse ISM of high redshift ($z \sim 2-3$) galaxies makes it possible to derive the physical conditions (temperature, density, UV background) in the gas.

Cool Gaseous Outflows from Star-Forming Galaxies at 0.3<z<1.4

Rubin Kate
Max-Planck-Institut fuer Astronomie

Current models of galaxy evolution require that galactic-scale gaseous outflows play an integral role in shaping the observed galaxy stellar mass function. The implementation of winds in these models, however, has been primarily via *ad hoc* prescriptions, as the physics driving such outflows is not understood. In particular, theoretical studies suggest that high spatial concentrations of star formation activity may be physically responsible for the development of an outflow; however, the relationship between host galaxy star formation rate (SFR) surface density and outflow kinematics in distant galaxies remains poorly constrained. To address these unresolved issues, we present an analysis of absorption/emission line profiles for the MgII 2796, 2803 and FeII 2586, 2600 transitions in individual spectra of ~ 140 galaxies at $0.3 < z < 1.4$ selected from the GOODS fields and the Extended Groth Strip. We identify outflows of cool ($T \sim 10^4$ K) gas via the blueshift of the absorption lines, and measure equivalent widths and outflow velocities taking into consideration the effects of photon scattering on the observed profiles. Using high resolution HST/ACS imaging to estimate the size of star-forming regions in tandem with estimates of total SFR and stellar mass from analysis of optical and near-IR broad-band imaging, we present one of the first explorations of trends in outflow properties with individual host galaxy SFR, SFR surface density, and stellar mass at $0.3 < z < 1.4$. Our analysis uncovers a weak dependence of outflow velocity on SFR surface density, and reveals an increase in the maximum outflow velocities measured with increasing galaxy stellar mass and total SFR.

Global Star Formation and Gas Scaling Relations

Saintonge Amélie
MPA/MPE

While there exists an intricate and complex network of scaling relations relating the stellar properties of galaxies, the corresponding relations for their cold gas components are very scarce. Using a large and purely mass-selected sample of nearby galaxies for which optical, UV, HI and CO measurements are now available through the GASS and COLD GASS surveys, we are getting for the first time a complete picture of the partition of condensed baryons between stars, atomic gas and molecular gas in galaxies with $\log(M_*/Msun)>10$. We quantify how the atomic and molecular gas mass fractions depend on global galaxy parameters (stellar masses, mass surface density, concentration index,...) and on each other. These scaling relations are of value both for numerical simulations and for gas surveys at low and high redshifts. We also investigate the relation between gas and star formation. The breadth and size of the sample allow us to find variations in the molecular gas depletion timescale, with interesting consequences for the atomic-to-molecular transition. We also analyze these results in the context of studies of the global Kennicutt-Schmidt relation.

Modeling the gaseous cosmic web probed by QSO absorbers

Schaye Joop
Leiden

I will review some of the physics behind models of the cosmic web as traced by HI absorbers and discuss some recent results.

Gas and Star Formation in Nearby Galaxies: Highlights from the VLA/ANGST Survey

Skillman Evan
University of Minnesota

I will present results from the VLA/ANGST survey in which we have obtained VLA HI observations of more than 30 galaxies with HST observations of their resolved stellar populations. We have searched for narrow HI emission in these galaxies and we detect narrow HI emission in the vast majority of the galaxies in our sample. The narrow HI typically represents about 15% of the HI on the lines of sight where it is detected, so it never appears to be the dominant phase. When compared to spatially resolved, recent star formation histories we find that the narrow HI can be in the vicinity of recent star formation, but that it is never coincident with the recent star formation. Very preliminary results from comparisons like this yield estimates of a refractory period for the cold gas of order 100 Myr. Potentially, we are able to measure the timescale for the conversion from cold HI to cold molecular gas in a low metallicity environment.

Gas Around Galaxies with HST's Cosmic Origins Spectrograph

Tumlinson Jason
Space Telescope Science Institute

The Cosmic Origins Spectrograph, installed by as part of Servicing Mission 4 in May of 2009, has opened a new discovery space for HST in the gaseous halos of galaxies. In particular, the large increase in FUV sensitivity compared to prior HST spectrographs allows us to observe fainter QSOs and thus choose foreground galaxies with a predetermined range of properties. I will review recent progress in our understanding of gaseous galaxy halos, focusing on results from two large Cycle 17 programs to study gas in galaxy halos. I will also discuss major open questions that lend themselves to future investigations with COS and complementary ground-based facilities.

From voids to clusters: HI imaging surveys of galaxies in different environments

van Gorkom Jacqueline
Columbia University

Our understanding of the formation and evolution of galaxies and the large scale structure has advanced enormously over the last decade, thanks to an impressive synergy between theoretical and observational efforts. While the growth of the dark matter component seems well understood, the physics of the gas, during its accretion, removal and/or depletion is less well understood. Increasingly large scale optical surveys are tracing out the cosmic web of filaments and voids and mathematical tools have been developed to describe these structures and identify galaxies in specific environments. H I imaging surveys begin to answer the question: how do galaxies get and lose their gas. The best evidence for ongoing gas accretion is found in the lowest density environments, while removal of gas in the highest density environments stops star formation and reddens the galaxies.

Gas & galaxies: from the inner corona to Ly-alpha and OVI absorbers

Wakker Bart
University of Wisconsin-Madison

The Milky Way and other galaxies are surrounded by different forms of gas in many different phases, including a hot corona formed by the cumulative effect of supernovae, high-velocity clouds at heights of several to 10 kpc, tidal streams further out, and Ly-alpha forest adn WHIM absorbers at even larger distances. I will present new observational results of the properties of each of these components of the extended gaseous halo/corona of the Milky Way and other galaxies. This includes evidence that the hot gas in the Milky Way halo, HVCs and DLAs is subject to non-equilibrium ionization caused by radiative cooling, evidence that the Magellanic Stream is evaporating, direct evidence for the presence of 10^5 and 10^6 K gas around galaxies and evidence for the presence of a reservoir of gas that is larger than the amount of baryons inside galaxies.

X-raying Hot Gas in and around Galaxies

Wang Daniel
Univ. of Massachusetts

I will review recent observational and theoretical work on the global hot gas in and around nearby galaxies, especially normal ones like our own. The hot gas, tracing the interplay between the feedback and the accretion of these galaxies, is now routinely examined with observations with Chandra and XMM-Newton X-ray Observatories, in both imaging and spectroscopy (using grating instruments). This has led to the first characterization of the spatial, thermal, chemical, and kinetic properties of the gas in our Galaxy. The gas is concentrated around the Galactic bulge and disk on scales of a few kpc. The column density of chemically-enriched hot gas on larger scales is at least an order magnitude smaller, indicating that it may not account for the bulk of the missing baryon matter predicted for the Galactic halo according to the standard cosmology. Similar results have also been obtained for other nearby galaxies. The X-ray emission from hot gas is well correlated with the star formation rate and stellar mass, indicating that the heating is primarily due to the stellar feedback. However, the observed X-ray luminosity of the gas is typically less than a few percent of the feedback energy. Thus the bulk of the feedback (including injected heavy elements) is likely lost in galaxy-wide outflows. The results are compared with simulations of the feedback to infer its dynamics and interplay with the circum-galactic medium, hence the evolution of galaxies.

Inside-out Formation of Galactic Disks and their Subsequent Bar-Driven Evolution

Wang Jing
MPA

We analyze a sample of galaxies with stellar masses greater than $10^{10}M_{\odot}$ and with redshifts in the range $0.025 < z < 0.05$ from DR7 of the SDSS survey. For 1/3 of them HI mass measurements are available from the GALEX Arecibo SDSS Survey (GASS) or from the Arecibo Legacy Fast ALFA survey (ALFALFA). In order to identify those galaxy properties that are *causally connected with HI content*, we compare results derived for the HI sample with those derived for galaxies matched in stellar mass, size and NUV-r colour. The only photometric property that is clearly attributable to increasing HI content, is the colour gradient of the galaxy. Galaxies with larger HI fractions have bluer, more actively star-forming outer disks compared to the inner part of the galaxy. HI-rich galaxies also have larger g-band radii compared to i-band radii.Our results strongly support the "inside-out" picture of disk galaxy formation, which has commonly served as a basis for semi-analytic models of the formation of disks in the context of Cold Dark Matter cosmologies. The lack of any intrinsic connection between HI fraction and galaxy asymmetry suggests that gas is accreted smoothly onto the outer disk. We indentified bar structures in the face-on disk galaxies. We find the fraction of galaxies hosting bars and the strength of bars are strongly affected by the bulge component of galaxies. Bar hosted galaxies have higher star formation concentration compared to the control galaxies matched in stellar mass, size and $g - i$ colour only when they have strong bars. Our results indicate that the bar is important in the distribution of gas within the galaxies.

Neutral Gas and Dark Matter in the Sculptor Group

Westmeier Tobias
ICRAR / UWA

The new generation of radio telescopes and instruments (ASKAP, MeerKAT, WSRT/Apertif) will provide an unprecedented combination of large field of view and high sensitivity ideally suited to study nearby galaxy groups. Deep, wide-field HI observations of galaxy groups are an excellent tool to study the structure and evolution of galaxies and shed light on interaction and feedback processes in the group environment, such as tidal interaction, accretion flows, and ram pressure. In my presentation I will discuss the latest results of deep HI observations towards the Sculptor group galaxies NGC 55 and NGC 300 with the ATCA, including the detection of extended gas discs in both galaxies and the discovery of a population of extra-planar gas clouds around NGC 55. I will also present evidence for ram-pressure interaction between NGC 300 and the surrounding intergalactic medium and demonstrate how the effects of ram pressure forces on the outer discs of galaxies can be used to constrain the physical parameters of the IGM in galaxy groups. Finally, I will discuss the feasibility of deep HI studies of nearby galaxy groups with the different SKA precursor telescopes and introduce some of the future survey science projects that will utilise the 21-cm HI emission to study the structure and evolution of nearby galaxies.

HVC Complex GCN as seen by EBHIS and GASS

Winkel Benjamin
Max-Planck-Institut fuer Radioastronomie

Using Milky Way data of the new Effelsberg–Bonn HI Survey (EBHIS) and Galactic All-Sky Survey (GASS) we present a revised picture of HVC complex GCN. Due to the higher angular resolution of these surveys compared to previous studies (e.g., the Leiden Dwingeloo Survey) we resolve complex GCN into lots of individual tiny clumps, mostly having relatively high line widths of more than $15\,\mathrm{km\,s^{-1}}$. We do not detect a diffuse extended counterpart which is unusual for an HVC complex. Cold line components (i.e., $\Delta v_{\mathrm{fwhm}} < 7.5\,\mathrm{km\,s^{-1}}$) are found in about 5% only of the identified cloudlets. About 240 clumps were identified and parametrized allowing to statistically analyze the data. Our analysis reveals that complex GCN is eventually build up of several subpopulations which do not share a common origin.

Large Scale HI Survey with the Future FAST Telescope

Zhu Ming
National Astronomical Observatory of China

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 present an introduction to the FAST project and outline its major science goals, with emphasis on the proposed large scale survey of the neutral hydrogen content in the local university as well as at high redshifts.

POSTERS

Analysis of HI absorption in simulated ASKAP data

Allison James
University of Sydney

We present results from the analysis of HI absorption in simulated ASKAP data, in preparation for the First Large Absorption Survey in HI (FLASH).

Weakening dark-matter cusps by clumpy baryonic infall

Cole David
University of Leicester

We consider the infall of a massive clump into a dark-matter halo as a simple and extreme model for the effect of baryonic physics (neglected in gravity-only simulations of large-scale structure formation) on the dark-matter. We find that such an infalling clump is extremely efficient in altering the structure of the halo and reducing its central density: a clump of 1% the mass of the halo can remove about twice its own mass from the inner halo and transfer a cusp into a core or weaker cusp. Lighter clumps are even more efficient: the ratio of removed mass to clump mass increases slightly towards smaller clump masses. This process is the more efficient the more radially anisotropic the dark-matter velocities. While such a clumpy infall may be somewhat unrealistic, it demonstrates that the baryons need to transfer only a small fraction of their initial energy to the dark matter via dynamical friction to explain the discrepancy between dark-matter density profiles predicted and inferred from observations of dark-matter dominated galaxies.

Zero spacing correction, an approach to produce high quality wide field imaging data cubes

Faridani Shahram
Max-Planck-Institute for Radioastronomy & Argelander Institute for Astronomy

Radio interferometers equipped with multi-pixel receivers in the prime focus of medium sized radio dishes are going to start full sky surveys of the HI 21-cm line until 2015. The Milky Way galaxy emission as well as some galaxies within the local universe cover large angular areas. Depending on the separation of the radio interferometer dishes, the observational data lacks on information at low spacial frequencies . This leads to a very significant underestimate of the total flux. To overcome this limitation it is feasible to combine the single dish and radio interferometric data sets in order to fill the gap, the so called short spacing correction.

To main approaches are performed: combing the data sets in u-v domain or adding the data in image domain. We developed and tested within CASA a procedures for the short spacing correction, with the final aim to produce high quality wide field imaging data cubes. This poster illustrates all the required procedures to perform zero spacing correction in the image domain step-by-step and provides an outlook onto the final data reduction chain.

The Origin and Distribution of Cold Gas in the Halo of a Milky Way-sized Galaxy

Fernndez Ximena
Columbia University

We analyze a adaptive mesh refinement hydrodynamic cosmological simulation of a Milky Way-sized galaxy to study the cold gas in the halo. HI observations of the Milky Way and other nearby spirals have revealed the presence of such gas in the form of clouds and other extended structures, which could be evidence for on-going accretion. We use a high-resolution simulation to study the distribution of cold gas in the halo, compare it with observations, and examine its origin. The amount (10^8 M_{solar} in HI) and the spatial distribution of gas in the simulated galaxy at z=0 are consistent with existing observations. We find a significant fraction of cold gas originates from stripped gas from satellites. In addition, we see filamentary streams of cold gas at all redshifts. Part of the gas in these structures is able to cool and form clouds, which may survive and reach the disk. Placing constraints on these different scenarios will allow us to better understand how galaxies accrete gas at the present time.

Quantifying HI morphology

Holwerda Benne Willem
ESA (ESTEC)

The near-future all-sky HI surveys promise resolved information on many thousands of galaxies. Quantified morphology parameters, originally developed for optical images, can be applied to HI column density maps. The morphology of HI maps is singularly suited to identify early-stage ongoing gravitational interactions, leading up to a merger. From N-body/SPH models, we learn that visibility time-scales in HI are around a Gyr. From the future volume-limited surveys and this visibility time, one will be able to estimate local merger rates for spirals. To illustrate, the WHISP sample is used to compute a local volume merger rate of gas-rich galaxies. Because mergers are thought to be a major driver in galaxy evolution, especially the gas-rich and minor mergers, local reference values for the merger rate are invaluable. The coming HI surveys will be able to measure how often big spirals merge in the Local Universe.

Arecibo Ultra Deep Survey

Hoppmann Laura
ICRAR/UWA

The ALFA Ultra Deep Survey (AUDS) is an ongoing 21 cm spectral survey with the Arecibo 305m telescope. It uses Arecibos unique sensitivity to search for 21 cm H I line emission at redshifts between 0 and 0.16 to investigate the cosmic HI density $\Omega_{\rm HI}$ and its evolution with time. This poster will report on the current status of the observation and the data reduction as well as first results.

The LITTLE THINGS Survey

Hunter Deidre
Lowell Observatory

Dwarf irregular galaxies are the closest analogs in the nearby universe to the low mass dark matter haloes that formed after the Big Bang, and, in the Lambda-CDM model, it is in these entities that the first stars formed. Yet, we do not understand the processes that lead to star formation on galactic scales even in nearby dwarfs, the simplest, most pristine local environments. To remedy this situation we have assembled a complete data set on a sample of relatively normal, nearby gas-rich dwarf galaxies, tracing their stellar populations, gas content, dynamics, and star formation indicators, and using these data to test and modify star formation models.
This project is called LITTLE THINGS
(http://www.lowell.edu/users/dah/littlethings/index.html)
and it brings together deep, high spatial and high spectral resolution HI-line maps with optical, UV, and IR data of 41 dIm galaxies covering the range of galactic parameter space. I will present samples of the LITTLE THINGS survey and some early results.

Understanding the Scatter in the HI-based Star Formation Efficiency in Massive Galaxies

Lemonias Jenna
Columbia University

We present a statistical analysis of the star formation rates (SFR), stellar masses, and HI masses of over 400 massive galaxies obtained from the GALEX Arecibo SDSS Survey. Previous work on a subset of this sample revealed that the average HI-based star formation efficiency (SFE), defined as SFR/M_{HI}, is relatively constant across a range of stellar masses (Schiminovich et al. 2010). However, there is a wide range of SFEs at a given stellar mass that point to gas consumption timescales ranging from less than 1 Gyr to over 100 Gyr. Assessing the level of scatter in this relation yields insight into the physical mechanisms that dominate in a population of galaxies of a given mass, such as gas accretion or quenching of star formation. We quantify and interpret the scatter in this relation by parameterizing the relationships between the SFR, stellar mass, and HI mass for our sample. We also explore how these relationships vary with other physical properties. Finally, we compare our results to similar distributions that we derive from analyses of the Millennium Simulation and comment on possible reasons for discrepancies between the observed and simulated datasets.

ASKAP-FLASH: probing HI in galaxies at redshift 0.5 to 1

Sadler Elaine
University of Sydney

The wide field of view and large spectral bandwidth of the Australian SKA Pathfinder (ASKAP) will open up a completely new parameter space for large, blind HI absorption-line surveys using background radio continuum sources. Since the detection limit for such surveys is independent of redshift, absorption–line surveys can provide a unique and important measure of the neutral gas content of galaxies at higher redshift where the HI emission line is too weak to be detectable in individual galaxies.

The ASKAP-FLASH survey, which will begin in 2013, will cover the whole southern sky and target over 150,000 sightlines to bright continuum sources. This is an increase of more than two orders of magnitude over *all* previous HI absorption-line surveys (blind and targeted) made with radio telescopes.

We expect to detect several hundred intervening HI absorbers in the redshift range $0.5 < z < 1.0$. This will provide the first HI-selected galaxy sample at $z > 0.5$, and by comparing this with similar samples at low redshift we should be able to determine how the amount and distribution of neutral gas in galaxies has changed over the past 5-7 billion years.

Finding HI-Rich Dwarf Galaxies in Existing and Future Surveys

Warren Bradley
ICRAR, University of Western Australia

High HI mass-to-light ratio dwarf galaxies, which appear to maintain large quantities of unprocessed neutral hydrogen compared to their stellar content, are important outliers for near field galaxy evolution studies. Within these galaxies star formation may have been impaired or halted, has lacked stimulation, or has only recently begun. They may also suggest the existence of galaxies with even more extreme properties, un-evolved "dark" galaxies. However, to date only a handful if these unusually quiescent dwarf galaxies have been discovered, largely due to their low optical surface brightness, leaving large gaps in our understanding of their nature. I will discuss methods of uncovering more of these objects in existing data set such as blind HI surveys, and how future surveys will improve our knowledge of these elusive galaxies.

Converting Atomic Hydrogen into Stars in NGC 4214

Warren Steven
University of Minnesota

Cold HI is believed to be a necessary phase in converting the ubiquitous warm HI gas into cold molecular gas. Thus, identifying the cold HI gas most likely to form molecular gas, and subsequently stars, is crucial to our understanding of the star formation process. Narrow HI emission lines provide a potential tracer of the molecular phase by tracing the cold HI gas (e.g., Young et al. 1996, 1997). We report on a detailed study of the ISM in the actively star forming galaxy NGC 4214. We compare molecular material traced by Owens Valley observations of ^{12}CO(1-0) (Walter et al. 2001), Herschel observations of [CII] (Cormier et al. 2010), and Spitzer IRS spectral mapping of H_2 to locations of narrow line HI detections from VLA observations (Walter et al. 2008). We find that the areas associated with photo-dissociation regions traced by the Herschel observations are mainly devoid of cold HI as expected. However, the areas *surrounding* the recent star formation are teeming with cold HI. We conclude that the entire central region was filled with cold HI in the recent past that has been converted to molecular material and further into stars.

The WSRT HALOGAS Survey: HI Observations and Models of NGC 4244 and NGC 4565

Zschaechner Laura
University of New Mexico

We present 21-cm observations and models of the HI distribution and kinematics in NGC 4244, a nearby edge-on Scd galaxy observed as part of the HALOGAS survey. Our models focus on the detection of extra-planar gas as well as a negative gradient in rotational velocity with height above the disk (a lag). Our models show no halo and favor a warp component along the line of sight as an explanation for some of the observed thickening of the disk. We detect lags of -12±2 and -9±2 km s^{-1} kpc^{-1} in the approaching and receding halves respectively, which decrease in magnitude to -7±2 km s^{-1} kpc^{-1} near a radius of 9 kpc. Preliminary models of NGC 4565 will also be presented.

OTHER CONTRIBUTIONS

Through Thick and Thin - Neutral Hydrogen Absorbers in Cosmological Simulations

Altay Gabriel
Durham University, ICC

We investigate the column density distribution function of neutral hydrogen at redshift z = 3 using a cosmological simulation of galaxy formation from the OverWhelmingly Large Simulations (OWLS) project. The base simulation includes gravity, hydrodynamics, star formation, supernovae feedback, stellar winds, chemodynamics, and element-by-element cooling in the presence of a uniform UV background. Self-shielding and formation of molecular hydrogen are treated in post-processing, without introducing any free parameters, using an accurate reverse ray-tracing algorithm and an empirical relation between gas pressure and molecular mass fraction. The simulation reproduces the observed z = 3 abundance of Ly-A forest, Lyman Limit and Damped Ly-A HI absorption systems probed by quasar sight lines over ten orders of magnitude in column density. Self-shielding flattens the column density distribution for NHI $> 10^{18}$ cm^{-2}, while the conversion to fully neutral gas and conversion of HI to H2 steepen it around column densities of NHI = $10^{20.3}$ cm^{-2} and NHI = $10^{21.5}$ cm^{-2}, respectively.

The Origin of Neutral Hydrogen Clouds in Nearby Galaxy Groups: Exploring the Range Of Galaxy Interactions

Chynoweth Katie
Naval Research Lab

I will address the origin of HI clouds observed around nearby galaxies. In particular, this talk explores the role of galaxy-galaxy interactions as an originating mechanism for such clouds. We also place observational constraints on the possibility that HI clouds are tracers of dark-matter minihalos or cold accretion of gas onto galaxies. We are able to make specific predictions for the number and properties of HI clouds associated with dark-matter minihalos with embedded HI gas by analyzing several cosmological N-body simulations.

In order to fully explore the role of galaxy interactions in the generation of HI clouds, we have observed six galaxy groups (M81, M101, NGC 672, Canes I, NGC 2403, and NGC 45) with the Green Bank Telescope. The six groups span the range of galaxy interaction strength. We present the rough metric used to quantify the strength and time-scale of galaxy interactions within these groups. Our results indicate that HI clouds in our detection space are most likely to be generated through recent, strong galaxy interactions. We find no evidence of HI clouds associated with dark matter halos or cold accretion.

Simulating Neutral Hydrogen

Cunnama Daniel
University of the Western Cape

We have run the average density region of the GIMIC simulation to z=0 at the Centre for High Performance Computing in Cape Town. We explore prescriptions for simulating HI-skies for upcoming radio surveys such as those on MeerKAT and ASKAP. Science projects for these telescopes include measuring the HI-mass function at small HI-masses and estimating average HI-content at high redshifts. We use the simulation to investigate optimal approaches in these projects.

The Missing Cool Neutral Gas in High Redshift Galaxies

Curran Stephen
University of Sydney

From a survey for HI 21-cm in high redshift galaxies and quasars, we find a complete dearth of cool hydrogen at $z = 3-4$, although we would expect more of this raw material, required to form stars, at look-back times of $\gtrsim 11.5$ Gyr. Upon a thorough analysis of the optical photometry, however, we find that *all* of our targets have ionising ultra-violet luminosities of $L_{\rm UV} \gtrsim 10^{23}$ W Hz^{-1}, and so we attribute the non-detections to our high redshift selection biasing towards the most UV luminous objects, where the gas is excited beyond the detection thresholds of current instruments.

Currently, the vast majority of detections occur at $z \lesssim 1$, with the $\approx 50\%$ detection rate being attributed to unified schemes of active galactic nuclei (AGN), where only type-2 objects present a dense column of absorbing gas along our sight-line. However, the same UV luminosity threshold is seen at lower redshifts and, upon the removal of the $L_{\rm UV} \gtrsim 10^{23}$ W Hz^{-1} sources (all of which are type-1), *both* type-1 and type-2 AGN exhibit a 50% detection rate, meaning that the unified schemes have no relation to the incidence of detection.

Our new interpretation can naturally explain other observational properties of these objects and it is therefore apparent that we may have found an all encompassing effect which supersedes the unified schemes model. There are currently only two intervening and one associated HI 21-cm known at $z \gtrsim 3$ and, although we believe the hydrogen we have searched for at high redshift is being ionised by the strong UV radiation, until detected, the cool component of the gas may be regarded as missing. We therefore outline a search strategy with the Square Kilometre Array (and tts pathfinders/precursors), which will be the ideal instrument with which to find this

population of distant galaxies, which could remain unknown to optical instruments.

Baryonic effects on the dark matter

Dehnen Walter
Leicester University

I present analytical and semi-analytical investigations of the effect on the dark-matter halo profile of baryonic inflow and subsequent outflow. These processes likely occured (possibly several times) during the formation of dwarf galaxies which retained only a small fraction of their cosmic baryon fraction. As most likely neither inflow nor outflow is adiabatic, the dark-matter phase-space density, and consequently also its spatial density, is reduced. While this effect appears now to have be seen in some high-resolution simulations, it is usually contributed entirely to the stellar feedback driving fast outflows. However, the non-adiabaticity of the inflow, is of high importance – an adiabatic contraction of the dark matter followed by a fast wind has little effect on the inner dark-matter profile as shown by Gnedin & Zhao (2002).

The Detection of the Cosmic Web

Duffy Alan
ICRAR

The majority of baryons in the Universe is believed to lie in extended filaments of low density material stretching between the galaxies known as the Cosmic Web. This material is highly ionised which makes direct detection of the 21cm (Neutral Hydrogen) emission line challenging. However, the potential science gains from detecting this structure combined with a wealth of data from evermore powerful radio telescopes make it a tempting and potentially achievable goal. To that end we consider stacking the signal in an effort to increase the strength of the emission using a novel software tool developed at ICRAR. We will demonstrate the results from training the software on simulated cosmological volumes and initial results from existing catalogues.

The Extragalactic HI Sky with EBHIS

Flöer Lars
Argelander-Institut fr Astronomie

The Effelsberg-Bonn HI Survey (EBHIS) is the first full sky survey aiming for a survey of the Milky Way galaxy and the local universe in parallel ($z \leq 0.07$). The data release of the brightest galaxy catalog of the northern sky will be based on the first all-sky coverage of the EBHIS, expected to be finished in 2011.

We present the data reduction strategy, RFI mitigation and first results of the extragalactic part of EBHIS. The talk will elaborate on the value of single dish surveys of the neutral hydrogen in the era of interferometers and present examples of zero spacing correction on THINGS galaxies.

Super profiles of the THINGS galaxies

Ianjamasimanana Roger
UCT/ACGC

The identification of the different phases of the ISM has greatly contributed to our knowledge of the phase structure of the ISM. However, the lack of high resolution HI observations in a substantial sample of galaxies has limited our knowledge on the properties of these various phases. The completion of The HI Nearby Galaxy Survey (THINGS)enables us to study, at much higher resolution, the HI profiles of a significant sample of galaxies. This may give important clues towards understanding, e.g., the presence of different phases of the ISM and its influence on the properties of galaxies, the relation between gas content of galaxies and star formation and the different mechanisms that may regulate the star formation activity of a galaxy. In this talk, I will discuss a method analogous to the stacking method sometimes used in high redshift HI observations to study possible correlation between the phase structure of the ISM and star formation activity of galaxies.

Gaseous Halos in Spiral Galaxies

Kamphuis Peter
Ruhr Universitat Bochum, Germany

The properties of gas in the halos of galaxies constrain global models of the interstellar medium. Studies of the extra-planar ionized hydrogen as well as the neutral hydrogen have shown that gaseous halos can improve our understanding of the disk-halo interaction, accretion from the IGM and global magnetic fields; these are key elements in galaxy evolution and the interaction with their surroundings. Kinematical information is of particular interest since it provides clues to the origin of the gas and helps to disentangle projection effects. Such kinematical studies have shown that the rotational velocities of the gas in massive spiral galaxies decline with increasing distance to the mid-plane, the so-called lagging halos. However, whether all gaseous halos contain such a 'lag' as well as what is the origin of this vertical gradient in the rotational velocities remain open questions. Multi-wavelength studies could be key in solving these problems. In particular, X-ray observations can provide us with the physical conditions present in these halos. Currently large multi-wavelength surveys are undertaken to obtain the properties of gaseous halos for large samples of galaxies. This will, for the first time, provide us with the data to correlate halo properties with global galaxy properties and the interaction with the IGM.

GMRT observation of the COSMOS field

Klöckner Hans-Rainer
Oxford/MPIfR

I will provide an overview on the calibration issues regarding GMRT data and will present preliminary results of HI stacking at redshift z =1.

The mass-overdensity and flow-field in the Great Attractor region

Kraan-Korteweg Rene
University of Cape Twon

The controversy whether the Great Attractor (GA) is at rest with respect to the CMB radiation or itself is moving towards a much larger overdensity, the three times more distant Shapley Concentration is still not resolved. To try to address this question, a deep NIR imaging survey of 37.5 square degrees was performed along the most opaque part of the Great Attractor Wall. Independently an attempt was made at deriving the peculiar velocity flow fields around the nominal center of the GA from the near-infrared (NIR) Tully-Fisher relation of HI detected galaxies "in" the Zone of Avoidance. The imaging survey finds clear evidence for an overall density enhancement at the GA distance though no further clusters were identified apart from some at higher redshifts. A mass estimate of the GA Wall will be presented. The TF analysis shows some signature of back-flow, but it is too sparsely sampled to provide conclusive evidence. The Zone of Avoidance TF study was performed as a pilot project of what might be achieved with future deeper and more resolved NIR and SKA Pathfinders HI surveys in the ZOA.

A Comparison of the HI and CO Dispersions in Nearby Galaxies

Mogotsi Moses
University of Cape Town, ACGC

Understanding the relationship between HI and molecular gas in galaxies is very important for understanding star formation and turbulence in these galaxies. The HI Nearby Galaxy Survey (THINGS) and the HERA CO Extragalactic Line Survey (HERACLES) have provided high resolution and high sensitivity HI and CO observations of nearby galaxies. Data from these surveys is being used to compare the CO and HI dispersions in nearby galaxies. Pixel by pixel comparisons have been done for 7 galaxies, with initial results indicating that the CO has a lower dispersion than the HI. These results, their relation to star formation and other properties of the galaxies will be discussed in the presentation.

The Renaissance of Scaling Laws

Obreschkow Danail
ICRAR/UWA

Relationships between global galaxy properties encode more fundamental principles of nature. Such "scaling laws" therefore provide benchmarks for theories and simulations, which derive some emergent laws from deeper ones. Conversely, scaling laws have a wide range of direct applications in empirical science, for example by providing rulers for distance measurements in cosmology. The number of possible scaling laws grows exponentially with the number of distinct galaxy properties used to derive them. Therefore the current advances in the detection of gas properties (e. g. HI mass, molecular fraction) in large galaxy samples introduce a revolutionary era for scaling laws. In this talk, I will focus on selected examples of new and forgotten scaling laws involving the gas properties of galaxies. The talk will (1) explain the phenomenology of these scaling laws, (2) shine light on their potential origins, and (3) provide some examples of their applications.

The central slope of dark matter cores in dwarf galaxies: Simulations vs. THINGS

Oh Se-Heon
University of Cape Town

We present a direct comparison of the derived dark matter distributions between hydrodynamical simulations of dwarf galaxies assuming a Lambda CDM cosmology and the observed dwarf galaxies sample from the THINGS survey. The simulations form bulgeless galaxies with a dark matter core, and include the effect of baryonic feedback processes, such as gas cooling, star formation, cosmic UV background heating and most importantly physically motivated gas outflows driven by supernovae. Analyzing the simulations in exactly the same way as the observational sample allows us to address directly the so-called "cusp/core" problem in the Lambda CDM cosmology. The derived rotation curve shape and the inner density slopes of the simulated dwarf galaxies show a good agreement with those of the THINGS dwarf sample galaxies. This result confirms that the baryonic feedback processes included in the simulations are efficiently able to make the initial cusps predicted from dark-matter-only simulations shallower, and induce dark matter halos with a central mass distribution similar to that observed in nearby dwarf galaxies.

Signs of Accretion in HALOGAS Observations of NGC 5055

Patterson Maria
New Mexico State University

We present deep neutral hydrogen observations of the nearby galaxy NGC 5055 as part of the Westerbork Hydrogen Accretion in LOcal GAlaxieS (HALOGAS) survey. With 120 hours of integrated observing time per target, the HALOGAS data is sensitive to very faint neutral hydrogen in the galaxy outskirts, making it possible to search for possible accreting gas clouds. The galaxy NGC 5055 is a moderately-inclined spiral galaxy in the sample with a large warp of the extended gaseous disk. The HALOGAS observations of this galaxy show newly discovered clouds of anomalous hydrogen gas well outside of the disk or known dwarf companions. We present a tilted-ring model for the HI of this galaxy and discuss the outer HI clouds and streams as possible signs of accretion. In addition, we will discuss any signs of star formation in the outer disk and accretion material through a comparison of the HI data with GALEX. We are also in the process of analyzing other galaxies and will discuss those in the presentation.

Detecting diffuse neutral hydrogen

Popping Attila
ICRAR / UWA

Numerical simulations predict that galaxies and clusters in the Local Volume are connected by extended diffuse filaments of gas. Although most of this gas is ionised, the peaks of this Cosmic Web should be detectable in HI 21-cm emission at very low column densities. Exploring the circum- and inter galactic medium is very important to understand accretion and feedback processes, which determine the evolution of galaxies. I will discuss the latest results and efforts in detecting neutral hydrogen at very low column densities.

Resolving the Core-Cusp Problem in Spiral Galaxies: The Case of NGC 6822

Rhee George
Physics and Astronomy Dept: UNLV

We discuss two aspects of the core-cusp problem in spiral galaxies. The first is observational. In deriving rotation curves from HI data cubes it is essential to take into account, projection effects, non-circular motions due to bars and other deviations from axisymmetry and the effect of pressure gradients on the gas rotation velocity. While these effects may be small in themselves, the combined effect is significant as we demonstrate from our analysis of the galaxy NGC 6822. The second issue concerns the effect of gas flows on the survival of density cusps. These winds, created by multiple supernova explosions, selectively remove low angular momentum baryons from the center of galaxies. We demonstrate that supernova winds acting throughout the history of a dwarf galaxy can substantially reduce the baryonic and dark matter density in the centers of dwarf galaxies.

The Evolution of Gas in a few Unusual Systems

Rosenberg Jessica
George Mason University

I will present observations of some unusual gas-rich systems that have been identified in HI 21 cm surveys. These systems include a post-starburst galaxy with an HI disk that is ~ 25 times the size of the optical and a gas-rich galaxy group with a very extended gas distribution. Determining whether these features are due to infall or mergers and the length of time that these features can survive will be important to our understanding of the physical processes that regulate the efficiency of star formation in galaxies.

When it Rains, it Pours: An Abundance of New Small HI Clouds.

Saul Destry
Columbia University

The GALFA-HI Survey has allowed us to discover a wealth of small HI clouds in the vicinity of the Galaxy. Using machine vision algortihms, we identified approximately 2000 clouds smaller than 20 arcminutes and isolated from other gas with absolute velocities less than 700 km/s. The origins of these clouds are currently unknown, but there are many possibilites: low surface-brightness dwarf galaxies, stripping of high-velocity clouds, outflows from AGB stars, condensation from the hot halo, material ejected from the Galaxy, and others. In this talk I'll discuss our methods, the properties of our catalog, and how these clouds affect Galactic models.

MeerKAT/KAT-7 status

Schroeder Anja
SKA-SA/HartRAO

I will give an overview and update on the MeerKAT and KAT-7 projects.

Gas depletion and star formation rates in simulated dwarf galaxies

Simpson Christine
Columbia University

We present results of a new set of hydrodynamical cosmological simulations of dwarf galaxy formation and evolution with the adaptive mesh refinement (AMR) code Enzo. Our high-resolution simulations of an isolated 10^9 Msun halo have a comoving resolution of 11pc and include non-equilibrium H2 cooling down to a redshift of 0, both firsts for AMR simulations of dwarf galaxies. We explore the relative effects that reionization, Lyman-Werner photodissociation, supernovae feedback and dynamical heating from mergers and subhalo accretion have on the evolution of the halo's gas and star formation rate. All these effects play an important role, but photoevaporation at the epoch of reionization and subsequent harassment from minor mergers appear to play a key role. We find for our isolated halo that it is difficult to get significant star formation past a redshift of 4. This is in agreement with other simulations of dwarf halos at this mass, but may be contrary to observationally derived star formation histories of nearby Local Group dwarf galaxies. This discrepancy either points to problems with simulations of this type or to an undiscovered population of isolated gas poor and low-luminosity dwarfs with very old stellar populations.

Spectral scans towards red quasars: Discovery of the strongest 21 cm absorber to date

Tanna Anant
University of New South Wales

We are undertaking wide-bandwidth spectral scans towards optically faint but radio loud objects in search of the intervening galaxy responsible for the obscuration of the optical light. Towards the source J0414+0534, which has an extreme optical-infrared colour of V - K = 10.26, we have already detected two intervening HI 21 cm absorbers in addition to the absorption in the host galaxy. The first of these arises in the galaxy responsible for the gravitational lensing (z = 0.96) of the background quasar. We discuss the survey and the latest detection towards this source: the strongest 21 cm absorber yet discovered. In this survey this is also the first absorber found that is associated with a previously unknown object, although the redshift of z = 0.38 is consistent with previously published optical OIII lines. As such we may also have a redshift for the elusive "Object X" identified in the field of this complex lensing system. This method of absorber hunting may turn up many more unseen galaxies with the emerging and next generations of radio telescopes (ASKAP, ATA, SKA).