

The Environments of Galaxies

Crete 2004

Poster Program



SESSION 1.

1.1 Asymmetries within Optical Discs of Spiral Galaxies

Philippe Amram

Abstract: Non-axisymmetric disturbances, such as bars, oval distortions, spiral structures, triaxial haloes in disk galaxies are often seen in the optical 2D velocity fields but are usually ignored and azimuthally averaged in the rotation curves (RCs). These effects may lead to asymmetric RCs and to an erroneous determination of the galactic mass distribution and of the dark-to-luminous matter distribution. Asymmetries in RCs are more frequent in low mass and LSB galaxies than in high mass and HSB galaxies.

1.2 Mapping the Structure of the Milky Way Halo with 2MASS-Selected BHB Stars

Warren Brown

Abstract: We map the structure of the Milky Way halo with 1500, 2MASS-selected blue horizontal branch (BHB) candidates. Our radial velocity survey covers the north Galactic cap $b > 60^\circ$ plus a wide strip down to $b > 35^\circ$ to a depth of $d_{Sun}=10$ kpc. BHB stars are excellent tracers of the stellar halo because they are relatively luminous and have a small dispersion in luminosity that is primarily a function of metallicity. We show that two-color 2MASS photometry can select BHB stars with $\sim 50\%$ efficiency.

Our primary goal is to detect the presence of star streams and test the hierarchical picture for galaxy formation. While there is no structure in surface number density maps of the BHB candidates at high Galactic latitudes (Brown et al. 2004), star streams from past satellite mergers may remain visible in velocity space. Many of the 2MASS-selected BHB candidates are included in existing proper motion catalogs which allows us to obtain six-dimensional information for the stars.

Interestingly, at low Galactic latitudes a two-point angular correlation analysis reveals spatial structure on angular scales $\theta \lesssim 1^\circ$. This structure is apparently associated with stars in the thick disk, and has a physical scale of 10–100 pc. Such structure is expected by cosmological simulations that predict the majority of the thick disk may arise from accretion and disruption of satellite mergers. We expect our spectroscopic identifications and radial velocities will elucidate the nature of this thick disk structure.

1.3 Disentangling stellar populations with 3D spectroscopy

Nicolas Cardiel

Abstract: One of the outstanding problems when facing the history of galaxy formation and evolution is the interpretation of the stellar content of galaxies. The analysis of spectral features, and their comparison with stellar population model predictions, is the key to compare the "real world" with the theoretical framework. The use of new spectroscopic indicators, like the Calcium Triplet (CaT) at around 8500 Angstroms, is providing new insights into this subject. In particular the sensitivity of this spectral feature to the physical parameters of composite stellar populations, namely age, metallicity and IMF, is providing fresh clues to unveil their star formation history. We are presenting new 3D spectroscopic observations of early-type galaxies performed with PMAS, an integral field unit that, in combination with the technique of nod and shuffle, has allowed an extraordinary good removal of the dense sky line forest in the near-infrared. In this sense we have been able, for the first time, to measure reliable CaT gradients in this kind of galaxies. In this work we will present the results, and discuss their implication when trying to understand the differences in the stellar content of galaxies in different environments, with special emphasis on the the physical extension of the differences

1.4 Probing MACHO's in M31

Jelte de Jong

Abstract: From observations, little is known about the nature and structure of galaxy halos. Stellar streams have been found around the Galaxy and our nearest neighbour, M31, presumably remnants of past accretion events. These represent only a very small fraction of the total mass of the dark halos. From micro-lensing surveys towards the Magellanic Clouds there are indications that part of the Galactic halo might consist of dark compact objects, but the exact amount is uncertain. M31 provides a significantly better target for a micro-lensing survey than the Magellanic Clouds. Due to the lensing geometry and the availability of lines-of-sight through very dense parts of the M31 halo, the micro-lensing rates are greatly enhanced. The Micro-lensing Exploration of the Galaxy and Andromeda (MEGA) is performing a large-scale micro-lensing survey towards M31 using several telescopes. We present micro-lensing events from the combined data of the INT and KPNO4m telescopes and the implications for the shape and compact object content of the M31 halo.

1.5 Probing stellar and gas kinematics in field and cluster galaxies with SAURON

Jesus Falcon-Barroso

Abstract: I will present the latest results from the SAURON survey of nearby galaxies. I will show the highlights of the complete set of 48 elliptical (E) and lenticular (S0) galaxies, and also 24 spiral bulges (Sa). The main focus of the talk will be on the stellar and gas kinematics of the whole sample. This unique dataset demonstrates that early-type galaxies display significant and varied structure in their kinematic properties. The number of E/S0/Sa galaxies showing evidence for nebular emission is significant. Including a large fraction of them showing counter-rotation with respect to the stellar component. I will also present results that show a clear dichotomy between (a) galaxies that have a clear sense of rotation and a radial velocity that keeps increasing within the SAURON FOV, and (b) galaxies that rotate little, show kinematic twists and often contain kinematically decoupled cores. I will relate these features with their surrounding environments (cluster and field).

1.6 The nature of the G1 clump in M31

Daniel Faria

Abstract: Significant substructure has recently been discovered in the halo of M31 (Ferguson et al. 2002). One of the over-dense regions, the G1 clump, is some ~ 35 kpc in projected distance from the nucleus and is in close proximity to the globular cluster G1. This possible connection with G1 has made this region the target of several recent studies (ie. Rich et al. 2004 and Reitzel et al. 2004) but its nature is still unclear.

As part of a large HST ACS Cycle 11 program (PI Ferguson) studying the halo substructure of M31 we have obtained and analysed deep F606W and F814W observations of the G1 clump. Our photometry, the deepest in this region to date, reaches ~ 2 magnitudes below the horizontal branch and shows a very well populated color-magnitude diagram with several interesting features, such as a blue plume, red clump, and wide red giant branch. Using these features we investigate the ages and metallicities of the stellar populations in the G1 clump and in the M31 outer disk, thus furthering our understanding of this disturbed region in the M31 halo.

1.7 A GMOS-IFU survey of early-type galaxies in the Fornax Cluster

Bettina Gerken

Abstract: We present first results from a GMOS-IFU survey of elliptical and S0 galaxies in the Fornax cluster, aimed at understanding the assembly history of these galaxies. For NGC1427, NGC1380 and NGC1381, we obtained spatially resolved spectroscopy covering the central 5x7 arcseconds of each galaxy. The observations were carried out in November 2003 with the GMOS-IFU at Gemini South. In the 2-slit mode the IFU provides 1000 spectra of each galaxy centre which were taken in a spectral range of $\sim 400\text{--}550\text{nm}$ at a resolution of 1.8\AA pix and a spatial sampling of 0.29 arcseconds. The spectral range allows us to use high order Balmer lines and sensitive metal lines in order to carry out a sophisticated stellar population analysis. Linked to the internal dynamics, this provides a key to understand the origin and nature of secondary star-formation in early-type galaxies. Particularly, we address important questions such as: a) When was the last star-formation event? b) Where did the star-formation take place? c) What are the dynamics? Were the young stars formed in disks? d) How much mass was involved? e) What physical process caused the secondary star-formation? Was it merger induced or from the quiescent accretion of gas? Answering these questions will be an essential step in understanding the assembly history of galaxies and to test models of hierarchical galaxy formation.

1.8 Age Sub-Populations in Globular Cluster Systems of Early-Type Galaxies

Maren Hempel

Abstract: We present the results on our photometric study (optical, near-infrared) to derive age distributions in globular cluster systems in early-type galaxies and to set constraints on their relative size and age. With respect to the ongoing discussion about how and when these galaxies formed the majority of their stars this will add further evidence for one of the various formation scenarios. Especially for the merger scenario the environment of the galaxy (cluster/group, isolated) plays an important role, given by a different probability for merger events. So far we investigated a set of 8 galaxies in different environment. In three of these galaxies (found in group environment), namely NGC 5846, NGC 4365 and IC 4051 we find a significant fraction of clusters with ages between 1 and 5 Gyrs. This adds further evidence to a formation of globular clusters in early-type galaxies which is not restricted to the first epochs of structure formation but still ongoing.

1.9 Stellar populations in the far outer disk of M31

Rachel Johnson

Abstract: The origin of thin galactic disks within the 'standard' hierarchical picture of galaxy formation is still a matter of debate. The fragility of disks to mergers and satellite accretion, suggests that the thin disk must form after the bulk of the mergers are complete (i.e. at $z < 1$ or $\sim 7\text{--}8\text{Gyr}$ for popular cosmologies). Observations of our Galaxy however find old ($\sim 14\text{Gyr}$) stars in the solar neighbourhood. Refinements to the basic models have been suggested to account for the observations (e.g. Abadi et al 2004), but clearly more observational data are required.

Our previous work on the outer disk of M31 (Ferguson & Johnson, 2001), using colour-magnitude diagrams (CMDs) from WFPC2 data, showed the possibilities of CMDs for probing the ages and metallicities of the constituent stellar populations, and provided a tantalising hint of an old stellar population via the detection of old horizontal branch stars.

As part of our Cy11 HST ACS observations of the outer regions of M31 (PI A.Ferguson) we have observed two new positions in the outer disk. Our new observations go deeper than our WFPC2 CMD, allowing us to probe the main sequence turn-off for intermediate age populations. Crucially

for the detection of old stellar populations, the increased field of view of ACS vs WFPC2 significantly increases the number of stars at each position in the CMD, allowing quantitative results on sparsely populated features such as the old horizontal branch.

1.10 Kinematics of warped disk galaxies

Gyula Jozsa

Abstract: A large fraction of theories explaining warps make a misalignment of a non-spherical Dark Matter halo with the disk responsible for their formation. The misalignment is frequently excited or maintained by cosmic infall or gravitational interactions with companions. If the misalignment hypothesis is correct, the orbits of the gas in the disk deviate from circularity. By measuring the kinematics and hence the deviations via spectroscopy in individual systems and contrasting them with photometric observations, one can put constraints on the three dimensional shape of the halo, as well as on the formation mechanisms of the warps in these systems. We present deep HI synthesis observations and photometry of a sample of five galaxies, three of which show extreme but regular warps, as well as our first results from the analysis of their kinematics obtained by fitting a modified tilted-ring-model to the data-cube.

1.11 Keck Spectra of NGC 1052 Globular Clusters

Michael Pierce

Abstract: We have obtained spectra for 16 globular clusters (GCs) associated with the E4 merger remnant NGC 1052, which is at the centre of a loose group. We fit the ages, metallicities and abundance ratios of the GCs to Bruzual and Charlot (2003) simple stellar populations (SSPs) using a multi-index minimum chi-squared method described by Proctor & Sansom (2002). These SSP fits are compared to the empirical metallicity calibration of Brodie & Huchra (1990) and to photometrically calculated metallicities. Issues relating to fitting clusters with strong blue horizontal branches are investigated. A comparison of the GCs to the long-slit spectrum of the galaxy is made and a basic analysis of cluster kinematics allows us to investigate the dark matter halo.

1.12 Recent HST/Keck Results on Extragalactic Globular Clusters

Jay Strader

Abstract: I will present recent results from HST/ACS imaging and Keck/LRIS spectroscopy of extragalactic globular cluster systems. The cluster properties derived from these studies (including ages, metallicities, and radial distributions) increasingly represent important constraints on theories of galaxy formation and evolution.

1.13 Numerical Simulation of a Disk Galaxy

Elizabeth Tasker

Abstract: The formation of galaxies is still an area full of unknowns. In this research, we simulate the evolution of the gas component in a quiescent, isolated disk system. We start with a simple exponential disk in a fixed dark matter potential motivated by cosmological simulations. At first, only gas was included in the disk. Then, star formation and feedback mechanisms were added in order to examine the resulting structure of the gas, paying particular attention to the formation of disk instabilities. In order to resolve the shocks and multi-phase interstellar medium that result, we use an adaptive mesh refinement method.

1.14 A quest for general descriptors of galaxy morphology

Gilles Theureau

Abstract: How do the structural and physical descriptors of galaxies vary with redshift and environment ? Is galaxy location in Tully-Fisher or Faber-Jackson plane related to its merging history ? What is the physical meaning of the usual morphological typology inherited from Hubble, de Vaucouleurs or Van den Bergh ?

Today there exist many methods and algorithms to classify galaxies according to their apparent structures, brightness profile, color, spectral features ... without offering a synthesized overview.

We present a general statistical study of galaxy properties in the local universe from multi-parametric information stored in HYPERLEDA and all sky 2D photometry extracted from DSS, DENIS and 2MASS imaging surveys. We use 4 samples, 3 real, one mock corresponding to different observational and database constraints: 1) a pure photometric 2D sample of 800,000 galaxies, providing us with magnitudes (BIJHK), colors, and structural information (bulge to disc ratio, concentration index, symmetry index, shape classe...), 2) a 3D sample of 100,000 galaxies with redshift and thus intrinsic luminosity and size measurements, 3) a 4D sample of 20,000 objects with internal kinematics information (gas rotational velocity and/or star velocity dispersion) and partially (two third) HI mass measurement. 4) a mock catalogue build with Galics hybrid simulation containing 20,000 galaxies with in particular merging history available.

1.15 Spectral synthesis at moderately high resolution in the optical range

Alexandre Vazdekis

Abstract: Absorption line-strengths have allowed us to carry out a comprehensive analysis of the stellar populations of nearby galaxies. Furthermore these studies are providing strong constraints to current galaxy formation scenarios. We present here a new modelling effort for predicting full spectra in the range 3500-7500Å for simple stellar populations at moderately high resolution. The model employs a new empirical stellar spectral library (MILES) composed of 1000 stars with an unprecedented parameter coverage. The synthetic spectra provide excellent fits to both, line-strengths and full spectra of a sample of representative early-type galaxies.

1.16 Satellites and Halo Streams of the Andromeda Galaxy as Seen by SDSS

Daniel Zucker

Abstract: In a hierarchical Universe, giant galaxies such as the Milky Way grow through the relatively smooth accretion of dark matter and associated gas, and through mergers of dark matter haloes; this latter mechanism most often occurs as interactions between a large galaxy and its much more numerous dwarf counterparts. In the past decade, stellar streams – signatures of such interactions – have been detected in both the Milky Way and M31. In order to probe M31's accretion history, we have been analysing an 18 x 2.5 degree stripe observed by the Sloan Digital Sky Survey (SDSS) along the galaxy's major axis, searching for stellar substructure and streams in M31's halo. Our early results are very encouraging: so far we have found a new giant stellar structure ~ 3 degrees from the center of M31, and a new dwarf spheroidal satellite of M31 that appears to be the faintest, lowest surface brightness galaxy in the Local Group. We discuss these discoveries in the context of current studies of the halo of M31 and hierarchical models of disk galaxy formation, and show how SDSS can be an invaluable tool for studying the outer regions and environments of galaxies in the Local Volume.

1.17 Internal Kinematics of Coma Early Type Galaxies

Ana Matkovic

Abstract: We present spectroscopic observations and velocity dispersion measurements for 70 faint early-type galaxies in the central 30×30 arcmin² of the Coma cluster, spanning $-22 < M_R < -17.5$ mag. This is currently the largest homogeneous, statistically representative sample with velocity dispersion measurements for this magnitude range. We examine the L – velocity dispersion relation for our sample, and compare it to that of giant ellipticals from the literature. The slope of the faint early-types is shallower, yielding $L \propto \sigma^{2.01}$. We discuss rotation and varying M/L ratios as possible causes for this change but find that neither is solely responsible. We also investigate the color - sigma relation for our galaxies and find that they follow a continuous relation with the gEs, although the gEs may be slightly redder on average. Using the scatter in this relation, we constrain the minimum ages for various galaxy formation scenarios, as well as maximum secondary starburst strengths. These are just preliminary results of a larger study intended to test the galaxy harassment scenario by comparing the internal kinematics and stellar populations of the early-type galaxies inside the virial core of the Coma cluster to those of the outskirts.

1.18 Brightest Cluster Galaxy peculiar velocities and cluster growth

Glen Mackie

Abstract: The dynamics of 46 clusters (33 Abell, 4 APM and 9 EDCC) to $cz \sim 33,000$ km/s observed in the 2dF Galaxy Redshift Survey are analysed. These clusters have secure Brightest Cluster Galaxy (BCG) identifications and redshifts and BCG peculiar velocities (v_{pec}) are derived. The dynamical parameter, $v_{pec}/\sigma_{clus.}$ is used to indicate the current rate of growth of each cluster. Thirteen of 46 clusters (28%) have $v_{pec}/\sigma_{clus.} > 0.75$ suggesting recent sub-cluster mergers. Since substructure should diminish within a few cluster crossing times, it appears that $\sim 30\%$ of nearby clusters are still substantially evolving.

SESSIONS 2, 3, & 4.

2.1 The hot ISM of the Antennae observed with Chandra: discovery of chemical enrichment

Alessandro Baldi

Abstract: We present an analysis of the properties of the interstellar medium (ISM) in the Antennae merging pair of galaxies (NGC4038/39), performed using the entire 411 ks Chandra ACIS-S data set. These deep observations and Chandra's high angular resolution allow us to investigate the properties of the Antennae ISM with unprecedented spatial and spectral resolution. We find an extremely wide variety of temperatures, densities and especially of metal abundances (from very low sub-solar values to several times the solar abundance), which may be explained in a Type-II Supernovae enrichment scenario. Moreover, the data shows the presence of extended low surface brightness bubble-like structures (10 kpc in diameter), as well as a more extensive low surface brightness halo. This work was supported in part by NASA contract NAS8-39073 and NASA grants GO1-2115X and GO2-3135X.

2.2 Neutral hydrogen in the halo of NGC 6946 and NGC 253

Rense Boomsma

Abstract: Recent observations have provided new insight into the disk-halo connection in spiral galaxies. Multi-wavelength observations of nearby galaxies have shown that neutral and ionised gas are present up to a few kpc from the disk and that star formation and supernovae probably play an important role in bringing gas into the halo. We have obtained very sensitive HI observations of the face-on galaxy NGC 6946 and the nearly edge-on galaxy NGC 253. These give us a detailed picture of the HI gas flows from the disk into the halo. In both galaxies there seems to be a close connection between the star-forming disk and the halo HI. In the outer parts of NGC 6946 accretion of gas has been detected. Accretion of such gas complexes is a likely mechanism for triggering massive star formation in these galaxies.

2.3 NGC 4535, a barred spiral galaxy in the Virgo cluster

Albert Bosma

Abstract: We report on a detailed study of the interstellar medium of the spiral galaxy NGC 4535, a member of the Virgo cluster, on spatial scales ranging from 300 pc to 1.5 kpc. This galaxy provides the opportunity to search triggers of star formation acting on large spatial scales, including disturbances caused by interactions with the intra-cluster medium. We examine in turn emission from the ionised hydrogen, from small dust particles emitting in the mid-infrared, from molecular and atomic gas, and from stars, bringing to the fore various logical links between these phases: in particular, the respective validity of $H\alpha$ and dust emission as star formation tracers, analysed as a function of gas density, and star formation efficiencies. High-resolution CO kinematics in the central regions and HI kinematics in the rest of the disk enable us to derive a rotation curve over the whole disk and a model of the mass distribution, and to study velocity perturbations. The properties of the three brightest HII complexes, namely the circumnuclear region, a complex in one of the main spiral arms and another complex located in an arm fragment, are emphasised.

2.4 The Galaxy population in X-ray selected groups of galaxies at $0.2 < z < 0.5$

Rodrigo Carrasco

Abstract: Most galaxies in the Universe are concentrated in groups. For intermediate redshifts, $z \sim 0.2-0.5$, while clusters of galaxies have been widely studied, the intermediate-mass systems, those between loose groups and rich clusters of galaxies have received comparatively little attention, either in the X-rays or in the optical.

To study the galaxy population, the group properties and understand the galaxy evolution in low-density environments, we have started a program to obtain images and spectroscopy of a X-ray selected sample of groups in the redshift range of $0.2 < z < 0.5$. In this work we present the first results of this study based on the observations of three groups. The groups were selected from the ROSAT All-Sky survey sample of Vikhlinin et al. with X-ray luminosity $\text{Log}(L_x) \leq 43.5$. The imaging and spectroscopic observations were done with Gemini Multi-object Spectrograph mounted at the 8.2m Gemini South telescope. The groups we observed are a factor of 10–100 less luminous in X-ray than clusters identified at the same redshift and are meant to represent the most common types of environments inhabited by galaxies.

2.5 The environment of galaxies in hybrid simulations of galaxy formation

Andrea Cattaneo

Abstract: GalICS (Galaxies In Cosmological Simulations) is a hybrid model of galaxy formation that uses N-body simulations for the dark matter and a semi-analytic approach for the baryons. GalICS was developed by a research team at the Institute d'Astrophysique Paris.

I shall describe the assumptions of the GalICS model and the main set observational data used to constrain the model. Particular emphasis will be given to the predictions that GalICS makes for the environment of galaxies as a function of luminosity, colour, morphology, merging history, etc.

2.6 Evolution of the IGM/Galaxy-Halo Interface to $z=2$

Chris Churchill

Abstract: Weak MgII Absorbers are sub-Lyman limit gaseous structures with moderately high hydrogen densities ($\sim 0.1 \text{ cm}^{-3}$). Their direct connection with galaxies remain uncertain, but what is certain is that they probe gaseous structures enriched by stars in the highly extended regions of galaxies and/or in the Lyman alpha-forest. We have extended the previous survey of weak MgII systems ($0.4 < z < 1.4$, Churchill et al 1999, ApJS, 120, 51) to $z=2$ using ~ 50 QSO spectra obtained with HIRES/Keck. This redshift region brackets the cosmic epoch when the background UV ionising spectrum is known to evolve dramatically, as seen in the evolution of the Lyman-alpha forest lines. We report new results on the evolution of weak MgII systems over the redshift range 0.4–2.0 and discuss the implications for metallicity enrichment of the IGM/galaxy-halo interface and its evolution.

2.7 First Results of the VLA High-Resolution HI Survey of SINGS Galaxies

Erwin de Blok

Abstract: The VLA High-Resolution HI Survey of SINGS Galaxies is a VLA Large Programme to image 39 nearby galaxies with the highest quality possible at the VLA ($6''$, 5 km/s). The aim is to investigate key characteristics related to their morphology, mass distribution and evolution across the Hubble sequence. The VLA HI data will be complemented by the products of SINGS, the Spitzer/SIRTF Nearby Galaxy Survey Legacy project. Together with other supplemental data this will lead to a full picture of the small scale structure of the ISM, its 3D structure, the dark matter distribution, the processes (at 90–270 pc linear scales) leading to star formation, and most importantly, the variation of each of these properties as a function of galaxy environment.

2.8 The Complex Star Formation History of NGC 6822: Environmental Effects

Erwin de Blok

Abstract: NGC 6822 is the nearest non-interacting dwarf irregular galaxy. Its stellar population can be resolved from the ground, and its ISM can be studied at linear scales of ~ 20 pc. We combine high-resolution observations with deep, wide-field SUBARU photometry of the entirety of the HI disk. Star formation is found throughout the entire HI disk. However, a study of CMDs shows significant differences in star formation history in different locations, most likely related to local environment (such as the observed infall of gas clouds). We make a preliminary analysis of the local conditions for star formation in NGC 6822.

2.9 Molecular gas in Hickson Compact Group spirals

Antonis Georgakakis

Abstract: We explore the nature of the interactions occurring in the dense group environment by studying the properties and distribution of the molecular gas clouds (H₂) of individual group members. Our sample comprises spiral galaxies belonging to compact groups catalogued by Hickson. Observations of the molecular gas of these galaxies have been carried out using the CO(1–0) emission line as tracer of the underlying hydrogen cloud distribution. These high resolution radio (3mm) observations combined with multi-wavelength data (optical, radio, X-ray) are used to study the interactions in compact groups.

2.10 Hydrogen Molecules and Dust in High-Redshift Environments

Hiroyuki Hirashita

Abstract: Hydrogen molecules (H₂) often trace star-forming regions in galactic environments. For high redshift, H₂ quasar absorption line observations in damped Ly-alpha clouds (DLAs) provide us with good opportunities to trace high-redshift molecular clouds. To interpret H₂ abundance in DLAs, we theoretically treat H₂ formation and destruction. The key processes are photodissociation by internal/external ultraviolet radiation and H₂ formation on dust grains. By estimating typical rates of those two processes for high-redshift environments, we successfully explain the relation between molecular fraction and dust-to-gas ratio in a recent DLA sample. In particular, the paucity of H₂ detection for dust-poor DLAs is well explained by small cross section of H₂ rich regions, and the strong enhancement of the molecular fraction for dust-rich DLAs is explained by self-shielding against the dissociating photons. Finally we also theoretically predict the star formation rates in high-redshift galaxies, which are consistent with the rate derived from the internal UV radiation field of DLAs.

2.11 Search for hot gas in irregular dwarf galaxies with XMM-Newton

Michael Kappes

Abstract: We present XMM-Newton observations of the three irregular dwarf galaxies Holmberg I, IC 2574, and Sextans A. All three dwarf galaxies show up with a highly structured interstellar medium (ISM). The aim of our project is to investigate the origin of the holes and shells within the ISM by searching for associated diffuse soft X-ray emission. Here we present evidence that the “standard model” coupling the stellar activity and the presence of holes cannot be verified by our XMM-Newton X-ray data. However, we detect significant diffuse X-ray emission most probably associated with coronal gas within the halo of two of the dwarf galaxies. Because of the low baryonic mass, the amount of the coronal gas constrains the dark matter content of the dwarf galaxies of interest.

2.12 The warm ISM in Fornax dEs

Dolf Michielsen

Abstract: We present deep H α + [NII] narrow-band and R-band imaging of three Fornax Cluster dwarf ellipticals (dEs) : FCC032, FCC206 and FCCB729. Although classified as dE, these galaxies show significant H α + [NII] emission, with a luminosity of the order of 10^{32} W. The total ionised-gas content of the galaxies is estimated at a few 10^3 solar masses.

The emission in FCCB729 is concentrated in the nucleus and could be explained as photo-ionisation by post-AGB stars in an old population, although a contribution from star-formation cannot be ruled out. In FCC032 and FCC207 however, the emission is distributed over several resolved emission regions

with diameters of the order of 30 – 100 pc and luminosities of the order of 10^{31} W, comparable to supernovae remnants or nebulae around Wolf-Rayet stars. Hence, these galaxies are clearly undergoing star-formation.

2.13 Gas kinematics of Mrk 533 and neighbouring galaxies

Alexi Moiseev

Abstract: The panoramic spectroscopy data for Seyfert galaxy Mrk 573 and two companion galaxies are presented. Velocity fields of stars and ionised gas, continuum and emission-line images were constructed from a panoramic spectroscopy observations carried out at the 6m telescope of SAO RAS, with MPFS spectrograph and scanning Interferometer Fabry-Perot. Attention is focused on the interpretation of observed non-circular motions of gas and stars in circumnuclear regions as well as in the outer disk of Mrk 533. A connection non-circular motions with a tidal interaction is considered.

2.14 The Circumnuclear Environment of Nearby Seyfert Galaxies

Agatino Rifatto

Abstract: We report the first results of a spectroscopic and narrow-band imaging survey of a spectroscopically selected sample of nearby Seyfert galaxies ($v < 15000$ km/s). The aim of this work is to study the physical properties and the starburst activity in their nuclear and circumnuclear regions. In particular, some basic open questions we can effectively tackle, are: i) how often are Seyfert nuclei accompanied by extended NLRs?; ii) are there differences between the circumnuclear environments of Seyfert-1 and Seyfert-2 galaxies?; iii) how often are Seyfert nuclei accompanied by significant circumnuclear star formation (starbursts)?; iv) is the circumnuclear star formation rate in Seyfert galaxies higher than in normal galaxies?; v) what is the metallicity of these circumnuclear HII regions?

2.15 Warps and the intergalactic medium

Javier Sánchez-Salcedo

Abstract: There is still no consensus as to what causes galactic disks to become warped. One of the most accepted theories concerns the operation of gravitational torques by cosmic infall. In this contribution we consider the viability of alternative models that invoke non-gravitational torques, namely intergalactic accretion flows onto the disk or intergalactic magnetic fields. Our main goal is to find out whether all these mechanisms could be simultaneously in action or, on the contrary, some of them are favoured. Amongst other virtues, models invoking the ubiquitous intergalactic medium could be able to explain the frequent occurrence of warps in quite isolated galaxies and the possible alignment of the warps of different galaxies in the local supercluster. However, a much closer inspection shows that these warping mechanisms are clearly flawed.

2.16 Dust Emission from Very Young Galaxies: Metal Enrichment and Dust Formation

Tsutomu Takeuchi

Abstract: We discuss some possible observational signatures of the “first dust enrichment” in the history of galaxy evolution based on some recent theoretical frameworks. It is known that dust grains play an important role in galaxy evolution. In particular, dust absorbs stellar light and reprocesses it into infrared. Therefore, we mainly focus on the infrared spectral energy distribution of galaxies in the

epoch of the first dust enrichment. We also discuss some observational samples of galaxies possibly experiencing their first dust enrichment. We finally overview some future strategies for detecting dust enrichment at high redshift.

2.17 The intriguing X-ray emission from the Cartwheel ring

Ginevra Trinchieri

Abstract: The tight association between the outer star forming ring and very bright X-ray sources in the Cartwheel galaxy is confirmed with new high resolution X-ray observations with Chandra. Each source has a luminosity greater than $\geq 10^{39}$ erg/s that classifies them as Ultra Luminous X-ray sources (ULX). The brightest is possibly the most luminous individual non nuclear source observed so far, with $L_X \sim 10^{41}$ erg/s (at $D=122$ Mpc). The luminosity function of the individual X-ray sources extends about an order of magnitude higher than previously reported in other star-forming galaxies, and suggests a star formation rate of 20–30 $M_\odot \text{ yr}^{-1}$. A diffuse component is also present in the ring proper, and might extend also in the inner regions.

2.18 The Fantabulous Gassy Galaxies and the Places They Hide

Brad Warren

Abstract: Dwarf galaxies are known to be very sensitive to the environment in which they exist. While the galaxy cluster environment is well known to have a strong effect on dwarf galaxy evolution, in less dense environments (groups and the field) the effects are for the most part more subtle.

We have been undertaking an extensive multi-wavelength study (optical, near-infrared, radio) of numerous high and low HI mass-to-light ratio dwarf galaxies in the Local Universe selected from the HIPASS Bright Galaxy Catalog. The sample includes galaxies which appear to be in isolation as well as members of groups such as Centaurus A and Sculptor. Some of these objects are confirmed to have extremely high HI mass-to-light ratios ($M_{\text{HI}}/L_B > 20 M_\odot/L_\odot$), such as might normally be expected of galaxies at very high redshift in the process of formation. They appear to be part of a class of unexplored gas-rich dwarf galaxies. In my talk I will present the first results of our study. I will compare these in the context of the environment of the galaxies in order to determine if this has affected their ability to processed their neutral hydrogen gas into stars.

2.19 X-ray emitting hot gas driving the outflow in M82 and other starbursts

Richard R.E.Griffiths

Abstract: Analysis of Chandra observations of the starburst galaxy M82 has shown that plasma with temperature 40 MK fills the inner kpc, far hotter than the 1-2 MK ISM component in the Milky Way. Produced by a burst of supernova activity, this central region is overpressurized and drives M82's prominent galactic wind into the IGM. The X-ray emitting wind, extending tens of kpc perpendicular to the disk of M82, is generated by this central hot gas and a lower temperature gas which pervades the superstarclusters. The central hot component, shown to be thermal by the presence of an iron line, is shown to be not in hydrostatic equilibrium and is the basic driving force behind the outflowing wind. Such high temperature plasmas in the cores of starburst galaxies may be the basic drivers for the chemical enrichment of the IGM and the ICM within clusters of galaxies. A comparison is made between the conditions in the core of M82 and those in other starburst galaxies which have also been observed with the Chandra X-ray observatory.

SESSIONS 5 & 6.

3.1 What Shapes the Luminosity Function of Galaxies

Andrew Benson

Abstract: The luminosity function is perhaps the most basic statistical measure of the galaxy population, and yet its origins are still poorly understood. I will present results from a continued study of the effects of different physical mechanisms on the shape of the luminosity function, employing state of the art galaxy formation models to incorporate this physics within a realistic cosmological framework. The relative importance of many of these processes is strongly dependant on the environment in which a galaxy forms, from the field to clusters. This results in significant differences in the formation paths, and observational properties of galaxies as a function of environment. I will described our latest theoretical predictions and, where possible, contrast these with the available observational data.

3.2 Star formation in different environments at redshift 3

Nicolas Bouche

Abstract: Using deep wide field ground-based data from Kitt-Peak 4m/MOSAIC covering 0.31 deg² or $\sim 40 \times 40 \sim$ Mpc co-moving at redshift $z = 3$, we cover a total of 1 deg² and our sample contains $\sim 3,000$ LBGs with photometric redshifts between 2.8 and 3.5. We will present results on our study on the averaged star formation rate as a function of environment.

3.3 An HST/ACS Survey of Edge-on Spiral Galaxies

Roelof de Jong

Abstract: We present preliminary results from a Cycle 12 HST/ACS snapshot imaging survey of 16 nearby edge-on spiral galaxies. The closest of these galaxies are well-resolved into stars and color-magnitude diagrams clearly show the upper portions of the RGB and main sequence, as well as the AGB and helium burning sequences. From these color-magnitude diagrams we derive tip of the RGB distances. Furthermore, we study the stellar populations as a function of scale-height. We present evidence in one galaxy for an older thick disk component which appears to be moderately metal-poor. Further investigation of these galaxies stellar populations will enable us to determine the presence and relative ages of thick and thin disk components.

3.4 Multirange investigations of Blue Compact Dwarf Galaxies: mapping their young and old stars

Luz Marina Cairos

Abstract: The photometric structure and star-formation history of Blue Compact Dwarf (BCD) Galaxies are central issues in dwarf galaxy research. In this talk, I will present, in first place, results from a deep multiband photometric analysis of a large sample of BCDs. Particular emphasis has been given to the study of the structural properties and evolutionary status of the low-surface brightness (LSB) stellar host, underlying the actual starburst. Secondly, the deep photometric data in the optical and in the NIR are combined with spectroscopic information in order to derive the properties of the different stellar populations in BCDs.

3.5 The Environment of Very Luminous Galaxies

Alberto Cappi

Abstract: We discuss the nature of systems associated to the Very Luminous Galaxies ($M_B \leq -21$), in our volume-limited SSRS2 catalog. VLGs have a clustering amplitude significantly larger than L^* galaxies, a fact which could be due to their association to large mass dark halos. Redshifts from the 2dFGRS final catalog allowed us to identify many fainter members around VLGs, and to determine their global properties. We confirm our previous results that the larger clustering amplitude of VLGs depends on luminosity and not on morphology, and that late-type VLGs are mainly in small groups comparable to our own Local Group.

3.6 Abundance ratios in early-type galaxies as a function of their environment

Conrado Carretero

Abstract: We present the values of CN2 and Mg over-abundances with respect to Fe, for early-type galaxies in several clusters over a range of richness and morphology. Spectra were taken from the SDSS DR1 spectroscopic data base, and from WHT and CAHA observations. Abundances were derived from absorption lines and SSP models. We find a clear anti-correlation between [CN2/Fe] values and cluster X-ray luminosity. No correlation was observed for [Mg/Fe]. This behaviour is expected, given varying formation scale times for CN2, Mg and Fe, combined with a different star formation history in early-type galaxies as a function of their environment.

3.7 Early-Type Galaxies in low-density environments

Maela Collobert

Abstract: I will present measurements of the age, metallicity & abundance ratios for a carefully chosen sample E/S0 galaxies in low-density environments. The galaxies were selected from the 2dFGRS to be as isolated as possible by counting the number of companions in their neighbourhood. The 'isolated' galaxies have less than one companion (which has the same absolute magnitude as the candidates) within 1 Mpc h^{-1} & less than 5 within 2 Mpc h^{-1} . We selected 30 such galaxies for spectroscopic observations, and from their spectra measured Lick indices and used stellar population models to study their characteristics. Combinations of indices were selected to solve the age-metallicity degeneracy. We confirm their large age scatter and use the overabundance in α -elements to explore their star formation history. We use galaxies from the Fornax cluster as a comparison sample to probe environmental effects.

3.8 Environmental Dependence of Galaxy Properties from $z \sim 0$ to $z \sim 1$

Michael Cooper

Abstract: In the local universe, galaxy properties depend on the local environment in a variety of ways. However, if we are to understand how those trends developed and discern their causes, it is vital not only to study nearby galaxies, but also their counterparts in the distant past. Until recently, though, samples at $z \sim 1$ have been limited to the most extreme X-ray clusters, along with hundreds of galaxies in a few tiny fields, unsuitable for measurements of environments. I will present initial results on the relationship between galaxy properties and environment in the DEEP2 Redshift Survey, which is using the new DEIMOS spectrograph at Keck II to study a sample of $\sim 50,000$ galaxies at $0.7 < z < 1.4$ over 3.5 square degrees of sky; the survey is more than halfway completed. In particular, I will discuss how measurements of galaxy environments in this survey, especially when combined with similar studies of the recently completed 2dF Galaxy Redshift Survey, will allow us to build a comprehensive picture of the evolution of environmental trends over half the age of the universe.

3.9 Evidence for an environmental influence on the evolution of dwarf elliptical galaxies

Sven De Rijcke

Abstract: In the course of an ESO Large Program, we have used FORS2 on the VLT to collect photometry and deep major and minor axis spectra of a sample of 15 dwarf ellipticals (dEs) in both group and cluster environments. These data allow kinematics to be extracted out to 1–2 effective radii. Many dEs appear to be fast-rotating with a significant fraction of them consistent with being isotropic oblate rotators. We discovered evidence for embedded stellar disks and spiral arms in some dEs. The strength of the CaII triplet feature suggests that dEs do not form a chemically homogeneous population. These features, including the kinematically decoupled cores (KDCs) we discovered in two dEs, all support the idea that a significant fraction of all dEs stem from small late-type galaxies that have been transformed by high-speed gravitational interactions in the dense cluster environment. Thus, the environment has had a decisive influence on the evolution of dEs.

3.10 Properties of the HI in galaxies as a function of isolation

Daniel Espada

Abstract: I will present an analysis of the properties of the atomic gas (HI) for a large sample of isolated galaxies. The sample includes nearly 800 isolated galaxies, members of the Catalogue of Isolated Galaxies (Karachentseva, 1973) Since the number of objects in our sample is much larger than any HI data compilation of really isolated galaxies presented before, we will be able to improve substantially the statistical studies done up to now. The data have been obtained both from the bibliography and by our own observations done by means of the Nanay, Effelsberg, Arecibo and GBT radiotelescopes.

The results given here will emphasize the study of the symmetry level of the profiles and the HI content of the galaxies. As we have calculated a parametrization of the isolation for the whole sample, we will be able to show the correlation of the isolation degree with the symmetry level of the profiles. Several quantitative measures of asymmetry have been applied to assess the occurrence of lopsidedness in the HI profiles, whose origin cannot be explained by pointing offsets, but by asymmetries in the HI mass distribution, the velocity field or the presence of HI clouds with a weak optical counterpart. Finally, a comparison of the HI content will be shown in isolated galaxies referred to galaxies in denser environments (clusters and groups), which will give us a better comprehension of the HI deficiency that occurred in places with high density of recent interactions.

3.11 Star formation activity of intermediate redshift cluster galaxies out to the infall region

Bettina Gerken

Abstract: We present a spectroscopic analysis of two galaxy clusters out to ~ 4 Mpc at $z \sim 0.2$. The two clusters VMF73 and VMF74 identified by Vikhlinin et al. (1998, ApJ, 502, 558) were observed with MOSCA at the Calar Alto 3.5m telescope. Both clusters lie in the ROSAT PSPC field R285 and were selected from the X-ray Dark Cluster Survey (Gilbank et al. 2004, MNRAS, in press) that provides optical V- and I-band data. VMF73 and VMF74 are located at respective redshifts of $z=0.25$ and $z=0.18$ with velocity dispersions of 671 km/s and 442 km/s, respectively. The spectroscopic observations reach out to ~ 2.5 virial radii. Line strength measurements of the emission lines $H\alpha$ and [OII]3727 are used to assess the star formation activity of cluster galaxies which show radial and density dependences. The mean and median of both line strength distributions as well as the fraction of star forming galaxies increase with increasing clustercentric distance and decreasing local galaxy density. Except for two galaxies with strong $H\alpha$ and [OII] emission, all of the cluster

galaxies are normal star forming or passive galaxies. Our results are consistent with other studies that show the truncation in star formation occurs far from the cluster centre.

3.12 Environmental effects on the global properties of galaxies in the cluster A209

Chris Haines

Abstract: We present the results of a study into the environmental effects on the global photometric properties of galaxies for the cluster A209 at $z=0.2$. Using wide-field optical data, we show that the galaxy luminosity function is strongly dependent on environment, as measured by the local galaxy surface density, with the faint-end slope becoming shallower with increasing density. We explain this as a combination of the morphology-density effect, and dwarf galaxies being cannibalised and/or disrupted by the cD galaxy and the ICM in the cluster core. We measure the inhibitory effect of the cluster environment on star-formation, through examining the mean B-R galaxy colours as a function of spatial position, and show that this is dependent primarily on the local density rather than cluster-centric radius. We also find the cluster red sequence to be dependent on environment, appearing 0.02 mag redder in the cluster core than the periphery, indicative of their stellar populations being marginally older or more metal-rich. This may be due to the galaxies themselves forming earliest in the rarest overdensities marked by rich clusters, or their star-formation being suppressed earliest by the ICM. These results show the strong effects of cluster dynamics and environments on galaxy evolution, and we try to gain insight to the physical processes which cause these transformations.

3.13 Stellar populations of cluster galaxies at high redshift

Claire Halliday

Abstract: The ESO Distant Cluster Survey (EDisCS) is a photometric and spectroscopic survey of galaxies in 20 clusters at redshifts 0.5 to 0.8 selected from the Las Campanas Distant Cluster Survey. The project is investigating galaxy stellar populations, star formation histories, morphologies, structures and masses, as a function of both redshift and cluster environment, and cluster mass distribution and substructuring. This project is the first comprehensive and homogeneous study of galaxy clusters at a redshift as high as 0.8 and is providing superior insights at lower redshift.

Our VLT FORS2 spectroscopy probes the stellar evolutionary histories of cluster galaxies by the interpretation of absorption line-strength indices and emission line equivalent widths using spectrophotometric models, and by measurement of the Fundamental Plane and Tully-Fisher scaling relations.

We present first results for our analysis of cluster galaxy stellar populations. Preliminary results for the constraint of the age and metallicities of our cluster absorption-line galaxies and the study of the cluster k+a population will be presented.

3.14 The Environmental Impact on Bulge-less Flat Galaxies

Stefan Kautsch

Abstract: In this investigation we study the environment of flat galaxies. Flat (or superthin) galaxies are late-type edge-on spiral systems that exhibit large axial ratios, small stellar disk scale heights and no distinct spheroidal bulge component. This type of galaxy appears to be a pure disk system with an extended blue stellar disk probably embedded in a thick red layer. Flat galaxies are very common objects with low star formation rates, low metallicities, low optical surface brightness but high neutral gas fractions. Their rotation curves resemble those of dwarf and irregular galaxies. These simple disk systems offer the unique opportunity to constrain galaxy disk evolution in under-evolved galaxies in the nearby Universe. They are also an evolutionary puzzle since merger scenarios do not predict the formation of pure disks. Using the Sloan Digital Sky Survey, we have compiled a

complete sample of flat galaxies covering an area of 2099 square degrees. We are using this sample to study the colors and morphological parameters of these objects, to investigate their environment and to study possible interrelations.

3.15 Scaling relations of early-type galaxies in groups

Habib Khosroshahi

Abstract: Photometric scaling relations among early-type galaxies in nearby groups are presented. Large number of galaxies belonging to groups with various X-ray properties are studied using a two dimensional bulge-disk decomposition technique which assumes a Sersic model for the bulge and an exponential profile for the disk component. Galaxies in X-ray bright groups tend to be larger and more luminous than those in groups with low X-ray luminosities. Both normal and dwarf elliptical galaxies in the core of the groups are found to have cuspier profiles than their counterparts in the outskirts of the groups. Instead, a distinction between dwarf and normal elliptical galaxies is apparent in terms of an offset between their 'Photometric Planes' in the space defined by the parameters involved in the Sersic model. Dwarf elliptical galaxies define a curved surface with remarkably low scatter somewhat similar to the surface of constant entropy. Normal ellipticals are distributed in a direction of higher specific entropy. This may indicate that the two population are distinguished by the action of galaxy merging on larger galaxies.

3.16 A Search for the Lowest Mass Galaxies: First Results

Katarina Kovac

Abstract: Current cosmological models predict the existence of more small galaxies than is observed. Recent work addressing this discrepancy suggests that the small galaxies contain a relatively smaller amount of luminous matter than larger galaxies. In that case, statistics based on the luminous matter do not represent statistical properties of the mass. To investigate this possibility, we designed an HI survey in nearby Universe to reveal the existence of small faint galaxies with HI masses below 10^7 solar masses. Existing radio surveys are sensitive to detect objects with masses above 10^7 HI solar masses, while the studies around the Galaxy and M31 have identified a population of compact HI clouds with HI masses up to 10^6 solar masses. Closing the gap between 10^6 and 10^7 HI solar masses will give us information about the amount and nature of these objects, which will provide input for models of galaxy formation and epoch of reionization. For this study it is chosen to observe an area of about 100 square degrees in CVn region. In this poster, we present results from the first set of observations, which covers about 39 square degrees.

3.17 Semianalytical galaxy formation in cluster and void environments

Christian Maulbetsch

Abstract: High-resolution dark-matter simulations of cluster and void regions are combined with a semianalytical scheme of galaxy formation. We extract the merger tree of dark-matter halos from the simulations and gauge the modeling with the present average luminosity function. The models are applied to the most extreme cosmic environments of large voids and massive clusters for which we derive the distribution of light, color, morphology and the star formation rate as function of the environment.

3.18 N-body/SPH study of the evolution of dwarf galaxies in a cluster environment

Dolf Michielsen

Abstract: Dwarf elliptical galaxies are mostly believed to be gas-poor systems, having lost their gas either through a galactic wind or by ram-pressure stripping in a dense group/cluster environment. However, recent observations show that some dwarf ellipticals in cluster environments are able to retain some of their gas and are actively forming stars. Using an N-body/SPH code, we explore the scenario in which a dwarf elliptical is subjected to ram-pressure stripping due to the intracluster medium. Radiative cooling, star-formation and stellar feedback are included to realistically capture the effects of the compression of the interstellar medium. The first results of this investigation will be presented at the conference.

3.19 Luminosity Functions of Groups of Galaxies

Trevor Miles

Abstract: The luminosity function (L.F.) of 25 nearby groups of galaxies has been obtained at optical wavelengths and shows significant bi-modality in certain groups. Investigations at infra-red wavelengths with 2mass data confirm the bi-modal feature in the L.F. of these same groups. Elementary modelling has shown how a bi-modal feature may develop in groups via galaxy mergers. A follow-up study looking at higher redshift 2dF groups has commenced using the new IMACS instrument on the Carnegie Institution's 6.5m Magellan Baade telescope. Results from this work will also be presented.

3.20 The Tully-Fisher relation of high redshift spirals in different environments

Bo Milvang-Jensen

Abstract: We present results from studies of high redshift cluster and field spirals. The aim is to shed light on the processes governing the evolution of galaxies in clusters, in particular the processes responsible for the morphological transformation of spiral galaxies into S0s. The main diagnostic used is the Tully-Fisher relation, which links rotation velocity (\sim mass) with luminosity.

In a pilot project targeting the rich cluster MS1054-03 at $z=0.83$, rotation velocities were obtained for 7 cluster spirals and a similar number of field spirals using VLT spectroscopy of spatially resolved emission lines. Some evidence was found that the cluster spirals on average were brighter than the field spirals at a fixed rotation velocity. This could be due to the cluster spirals experiencing a period of enhanced star formation while falling into the cluster.

We are now increasing the number of clusters and galaxies studied by more than an order of magnitude. The clusters and data are part of the ESO Distant Cluster Survey (EDisCS), which is a study of 20 clusters at $0.5 < z < 0.8$. Deep imaging has been obtained using the VLT (optical) and NTT (NIR), and the 10 highest redshift clusters have furthermore been imaged by the HST. Deep VLT spectroscopy has been obtained currently for 13 clusters, investing 1–2 nights per cluster. The clusters are optically selected and therefore span a large range in masses, with velocity dispersions from 400 to 1000 km/s. This gives access to a large range of environments. Results on the Tully-Fisher relation for a number of the EDisCS clusters will be presented.

3.21 Exploring the Environmental Dependence of the Mass-Metallicity Relation at $0.4 < z < 0.8$

John Moustakas

Abstract: We investigate the evolution of the mass-metallicity relation by comparing our results at intermediate redshift for both the cluster and field environment with previous studies at lower redshift. Our study is based on deep optical/near-infrared imaging and spectroscopy of twenty clusters from the ESO Distant Clusters Survey (EDisCS). EDisCS has spectroscopically identified large numbers of cluster members (~ 50 per cluster) while simultaneously providing a substantial field sample over $0.4 < z < 0.8$. We use state-of-the-art population synthesis models to correct for stellar absorption, estimate the reddening from high-order Balmer emission lines, and compute gas-phase abundances for our sample of emission-line galaxies.

3.22 The effects of group environment on the star-formation history of elliptical galaxies

Louisa Nolan

Abstract: Most elliptical galaxies reside in groups, where their interaction with the group environment shapes their formation and evolution. Understanding the star formation history of group-member galaxies allows us to investigate precisely how these processes of formation and evolution are influenced by environment. We have shown that, in fitting multi-component stellar population models across high S:N, long-baseline (near UV-optical) spectra, sufficient data is present to lift the age-metallicity degeneracy and determine unambiguously the star-formation histories of elliptical galaxies. Here, we present the results of the spectroscopic determination of the ages, metallicities and relative baryonic masses of a sample of near-by elliptical galaxies residing in a variety of well-studied group environments. The sample is a subset of the Group Evolution Multi-wavelength Study (GEMS) sample. GEMS, a collaboration involving groups at Birmingham, Swinburne and Liverpool John Moores universities, is combining data taken in a variety of wavebands (x-ray, UV, optical, infrared and radio), to produce a comprehensive study of the way in which galaxies evolve within the environment in which they are most commonly found. The multi-wavelength data allows us to examine the relationship between star formation history, the local environment (X-ray gas density), the group gravitational potential (X-ray temperature) and the photometric plane.

3.23 Ages and Metallicities of Galaxies in a Range of Environments

Rob Proctor

Abstract: Model predictions of galaxy ages and metallicities generally include a dependence on environment. To test such predictions a large number (approx 20) Lick indices are used to derive estimates of both central and spatially resolved age, Fe and alpha-element abundances of galaxies in a variety of environments (field, Virgo cluster and Hickson compact groups). The sample includes early-type (E/S0) galaxies as well as late-type (spiral bulges). We show that while correlations between central parameters are consistent across the range of environments, the data can not be described by a single set of relations. Rather, elliptical galaxies, S0s and spiral bulges each show a characteristic set of behaviours with age and mass. The spatially resolved analysis detects the presence of both age and metallicity gradients. Correlations between these gradients and central parameters are then investigated.

3.24 Spatially resolved spectroscopy of early-type galaxies in different environments

Patricia Sánchez-Blázquez

Abstract: Absorption line-strength gradients of elliptical galaxies are a fossil and an alive record of the galaxy formation history. They trace the amount, speed and timescale of the dissipation process, and they are also sensitive to the relative effects of possible mergers and interactions during and after galaxy formation. Also, they allow to reduce the usual bias toward central properties when deriving and studying important relations like the color-magnitude relation, the mass-metallicity-age relation and all derivatives of the fundamental plane of elliptical galaxies. Recently, we have found striking differences in the C4668 and CN absorption line-strengths between galaxies in different environments. The most convincing interpretation of these results is that they represent a difference in abundance ratios arising from distinct star formation and chemical-enrichment histories of galaxies in different environments. These evolutionary differences between galaxies should indeed be reflected in the radial distribution of their stellar population. Here, for the first time, we present line-strength gradients of 20 Lick indices measured over a sample of 98 galaxies in the field and in the Coma cluster. We interpret the results at the light of the different mechanism proposed to explain the observed differences between galaxies as a function of the environment.

3.25 Infalling Dwarf Starburst Galaxies in Abell 851

Taro Sato

Abstract: We report on multi-slit spectroscopic studies of the redshift $z = 0.41$ cluster Abell 851 (Cl 0939+4713). Cl 0939+4713 is known for its apparent filamentary structures (Kodama et al., 2001), along which the member galaxies are believed to be assembling onto the cluster core through hierarchical accretion. In an earlier study, the candidates for star-forming dwarf galaxies were catalogued via narrow-band imaging survey of [OII]3726,3729 line emission over a wide field of view, 4Mpc by 4Mpc (Martin et al., 2000). Our Keck LRIS and DEIMOS spectra, with about 300 targets, yield direct estimates via $H\alpha$ emission of star formation rate of faint star-forming galaxies ($g < 24$). Balmer lines are used to correct for reddening of [OII]3726,3729, $H\beta$, and [OIII]4959,5007, from which we derive metallicities of the target dwarf galaxies. The transformation of the infalling cluster member galaxies are discussed in view of star formation rate, history, and local environment.

3.26 The luminosity-metallicity relationship of dIrr galaxies in different group environments

Ivo Saviane

Abstract: In the course of the last three years we've been collecting homogeneous optical spectroscopy and near-IR imaging of a sample of dwarf irregular galaxies in the nearby Sculptor and M81 groups. Based on these data, we compute oxygen abundances of the interstellar medium and total H luminosities of all target galaxies. Our homogeneous samples and the advantage of near-IR over blue luminosities as tracers of mass allow us to discuss the effect of the very different environment in the two groups on the luminosity-metallicity relationship.

3.27 Environmental Effects on Small Scale Systems of Galaxies

Laura Tanvuia

Abstract: Using recent large redshift surveys, galaxy groups of different richness have been identified (e.g. Ramella et al. 1997, AJ 113, 483) whose physical reality and evolution is rather uncertain. Within these associations simulations of galaxy encounters show how easily galaxies could merge (see e.g. Barnes 1996, Saas-Fee 26, 275) leaving as a debris objects resembling an elliptical galaxy in a low-density environment. In a hierarchical evolution scenario, pairs of interacting galaxies with elliptical members in small-scale structures could represent a way station in the process of coalescence of a group. Alternatively they could be long lasting physical aggregates or even unbound encounters. Understanding galaxy evolution in the field is one of the crucial topics in modern cosmology. The latest results from large spectroscopic surveys (Lewis et al. 2002, MNRAS, 334, 673; Gomez et al. 2003 ApJ 584, 210 based on the Sloan Digital Sky Survey) conclude that environmental influences on galaxy properties are effective well outside of the cluster cores, at local galaxy densities more typical of the group environment. Given that such environments today contain a substantial fraction of the mass in the Universe, this fact would imply that local environment would strongly affect the evolution of most galaxies. Whether it is the cluster or the group environment that most strongly affects galaxy evolution is still an open and debated question. In particular, our knowledge of galaxy evolution within poor groups (the defining aggregates of the field) is still very poor. The understanding of galaxy-galaxy interaction phases and the evolution of cosmic structures are deeply interconnected. Galaxy encounters in small systems of galaxies (SSSGs) are less frequent than in galaxy clusters, but the low velocity dispersion of the SSSG may lead to efficient merging episodes. Interactions could severely alter the properties of a galaxy up to modify the original morphological class and then re-direct the evolution of a galaxy triggering various phenomena going from star formation to galaxy activity. In this picture, the environment plays a key role since it dictates the predominant type of encounters. In order to understand which parameters dominate in galaxy interactions, we started a study of SSSGs, defined in 3D redshift space. SSSGs have been selected in a low density environment, i.e. they appear as overdense systems with respect to the average galaxy distribution. I will present photometric and spectrophotometric data for the main members of a sample of SSSGs. Within the picture described above, dominant galaxies in SSSG have potentially the power of revealing the history and evolutionary phase of the respective SSSG. Elliptical galaxies may be at the center of the potential well of a SSSG as suggested by X-ray observations and could present fine structures reminiscent of past interaction events. Spiral galaxies in mixed pairs could be the last un-digested member of a pre-existing group and could reveal their on-going interaction not only through morphological distortion but also in their possibly triggered activity.

3.28 CG J1720-67.8: Dynamics of the interaction through the group's velocity field

Sona Temporin

Abstract: Groups whose members are caught in the act of merging are extremely rare to observe. In fact, within the famous Hickson's sample of compact groups, only one group is thought to be presently in such a state (HCG 31, Mendes de Oliveira et al., in preparation). CG J1720-67.8 is another example of this kind (Temporin et al. 2003). This group is an extremely dense system characterised by strong undergoing tidal interactions and widespread star formation activity. To gain a global view of CG J1720-67.8, we mosaiced it with the integral field spectrograph SPIRAL mounted on the AAT. We present here these new data that allow us to analyse the distribution of the H α emission across the group and to obtain at the same time a velocity field of the ionised gas with a spatial scale of 0.7 arcsec/pixel and a spectral resolution of ~ 80 km/s. According to our preliminary analysis of the data, the velocity field shows a global rotation of the whole group. The kinematic axis of the central spiral

galaxy seems to be coincident with the kinematic axis of the group, although the kinematic center of the whole system is significantly displaced from the center of the spiral galaxy, most probably as a consequence of the undergoing merging process. By means of these new observations we expect to gain information on the 3-dimensional configuration of the group and its most likely future evolution.

3.29 On the dynamics of poor groups and evolution of member galaxies

H. Tovmassian

Abstract: We show that the USGC groups of galaxies are extremely flattened prolate-like systems. Significant correlations exist between group ellipticity and the major and minor axis of the fitted spheroid. These correlations could well be reproduced by the random group orientations with respect to the line of sight and they are expected only in the case of the groups being true physical systems and not artifacts of projection effects.

We also find correlations between the group ellipticity and their velocity dispersion, with flatter systems having lower velocity dispersion. This is expected in the framework of the hierarchical formation scenario, where virialization will tend to sphericalize the initially dispersed and anisotropic distribution of galaxies. However, even in the case where groups are quasi-stable prolate-like systems with radial galaxy orbits, their random orientation with respect to the line of sight could produce a similar correlation.

Furthermore, we have found that:

(a) the relative number of E and S0 galaxies is about the same in groups with different membership number, and is about two times higher than in a sample of isolated galaxies;

(b) the mean K-band absolute magnitude of E and S0 galaxies in groups with different membership number is roughly the same, and on average one magnitude brighter than that of isolated E and S0 galaxies. No such difference is found for group and isolated spirals.

These facts show that E and S0 galaxies in groups may be the outcome of merging of two galaxies (spirals) of about the same luminosity.

3.30 Quantifying the environment of the most isolated galaxies

Simon Verley

Abstract: The role of the environment on galaxy evolution is still not fully understood. In order to quantify and set limits on the role of nurture one must identify and study an isolated sample of galaxies.

The AMIGA project “Analysing the Interstellar Medium of Isolated Galaxies” is doing a multiwavelength study of a large sample of isolated galaxies in order to examine their star formation activity and interstellar medium. It is not enough to identify a small number of the “most isolated” galaxies. Instead one wishes to evaluate the slope of the nurture function as it approaches zero.

We begin with $n=950$ galaxies from the Catalogue of Isolated Galaxies (-CIG-, Karachentseva, 1973) and reevaluate isolation using an automated star-galaxy classification procedure (to $m_B = 18$) on large digitized POSS-I fields surrounding each CIG galaxy. We define, compare and discuss various criteria to quantify the degree of isolation for these galaxies: e.g. Karachentseva’s revised criteria, local surface density computations, estimation of the external tidal force affecting each isolated galaxy. We also apply our pipeline to Abell Clusters and Hickson compact groups which serve as control samples.

We begin with a large sample of reasonably isolated galaxies and end with refined subsamples reflecting degrees of isolation. Comparison of multiwavelength ISM measures (e.g. H α , HI, FIR, radio continuum) for these subsamples will allow us to search for the slope of nurture induced effects as it approaches zero.

SESSION 7.

4.1 Mergers of Spirals and the Fundamental Plane of Ellipticals

Hector Aceves

Abstract: One of the strongest objections to Toomre's proposal that ellipticals might be the result of mergers of spirals is how to explain the tight correlations ellipticals have in some of their properties; in particular, their Fundamental Plane.

Here we study by means of collision-less self-consistent N-body simulations whether mergers of spirals, sampled out of their own fundamental plane, can reproduce the Fundamental Plane of ellipticals.

4.2 Effects of minor and miniscule mergers on the dynamical evolution of barred galaxies

E. Athanassoula

Abstract: I will discuss the effect of mergers on the dynamical evolution of barred galaxies. Minor mergings, with objects of mass of the order of a few tenths of the target cause major morphological changes, which I will discuss with the help of N-body simulations. Miniscule mergers stay in the halo, yet can potentially cause substantial changes to the bar by scattering halo particles from resonant orbits. This may hinder, at least temporarily, the angular momentum transfer between the bar and the halo and thus influence the dynamical evolution of the barred galaxy as a whole.

4.3 Is there a conflict with phase-space density in the secular bulge formation scenario?

Alejandro Carrillo

Abstract: Several observational pieces of evidence tend to support the secular bulge formation scenario, at least for late type galaxies. However, the fact that the observational measure of phase-space density, f_{obs} , is significantly larger for the bulge than for the inner disk of Milky Way (and some other spirals), poses an apparent difficulty for the collisionless secular mechanism of bulge formation. We have investigated the evolution of f_{obs} in a high-resolution disk+halo N-body simulation. A bulge-like structure forms in the disk. As expected from the Liouville's theorem, f_{obs} never increases. However inside the bulge-like structure f_{obs} ends being significantly larger than in the inner disk, in agreement with observations from the Milky Way. We have also estimated f_{obs} for the bulge and the inner disk of other galaxies spanning several Hubble types. We conclude that the collisionless secular scenario seems to work in the correct direction regarding phase-space density evolution.

4.4 Merging of low-mass systems and the origin of the Kormendy relation

Ekaterina Evstigneeva

Abstract: We present a new set of dissipationless simulations to examine the possibility of formation of bright ellipticals, following the Kormendy relation, by hierarchical merging of early-type dwarf galaxies. Also a study of the evolution of mergers in the $mu_e - R_e$ plane (effective surface brightness versus effective radius) is presented. We investigate the merging of one-component galaxies, two-component galaxies with dark halo, and ultracompact dwarf galaxies. We find that the merger remnants move down and right in the $mu_e - R_e$ plane and fail to reach the Kormendy relation, regardless of the orbital parameters and models we consider. This global trend shows that invoking of a large amount of dissipation represents the only way to merge dwarfs and obtain bright ellipticals. The same trend suggests the possibility of making dwarfs by merging ultracompact dwarfs.

4.5 Cold and warm dust in a merging galaxy sequence

Antonios Georgakakis

Abstract: In this study we combine SCUBA archival data with IRAS and ISO observations of a merging galaxy sequence comprising both pre- and post-mergers. This sample is used to explore the evolution of cold (sub-mm) and warm (FIR) dust during disc galaxy interactions. We find that besides the warm FIR-emitting dust all galaxies in our sample have concentrations of cold dust probed at sub-mm wavelengths.

4.6 HST detection of spiral structure in Coma cluster dwarf galaxies

Alister Graham

Abstract: We report the discovery of spiral-like structure in Hubble Space Telescope images of two dwarf galaxies (GMP 3292 and GMP 3629) belonging to the Coma cluster. GMP 3629 is the faintest such galaxy detected in a cluster environment, and it is the first such galaxy observed in the dense Coma cluster. The large bulge and the faintness of the broad spiral-like pattern in GMP 3629 suggests that its disk may have been largely depleted. We may therefore have found an example of the “missing link” in theories of galaxy evolution which have predicted that dwarf spiral galaxies, particularly in clusters, evolve into dwarf elliptical galaxies.

4.7 Coalescing supermassive black holes and the merger history of galaxies

Alister Graham

Abstract: The collisional-construction of galaxies from the merger of lesser galaxies is thought to be a common occurrence in the Universe. Coupled with the presence of a supermassive black hole (SMBH) at the heart of most galaxies, such encounters may explain the damaged nuclei of giant galaxies. Although some core-depletion is due to the central SMBH(s) dining on stars that ventured to close, it is primarily from the gravitational slingshot effect that the coalescing SMBHs - from the pre-merged galaxies - have on stars while they themselves sink to the bottom of the potential well of the newly wed galaxy. Theory predicts that the orbital decay of two such SMBHs should eject a core mass roughly equal to the combined black hole masses. However, current estimates are an order of magnitude larger than the central SMBH mass, suggesting that most elliptical galaxies have undergone multiple ($\sim 8-10$) significant mergers. Here we show why these estimates are high, and we obtain new results consistent with the (single) binary black hole merger scenario and having implications for the galactic merger history of the Universe.

4.8 Cosmic Evolution of Elliptical Galaxies

Thais Idiart

Abstract: Elliptical galaxies are key objects to understand the formation of structures at Mpc scales, within the hierarchical scenario. Elliptical galaxies are mainly found in galactic clusters but also in the field. Therefore, the study of their detailed morphology, kinematics and star formation properties in different environments are necessary to discover the path leading to the formation of these objects.

The study of the stellar populations constituting elliptical galaxies is a powerful tool to constraint alternative scenarios describing their formation and evolution. In this work, recent upgraded models in the context of the “monolithic” scenario (Idiart et al. 2003) are presented, able to predict chemical and spectrophotometric evolution of these galaxies. These models take into account the presence of

a galactic wind at the early evolutionary phases, and include the possibility of having a later star formation activity, either by accretion of intergalactic gas or by capture of smaller satellites.

The spectrophotometric predictions are compared to new data consisting of: a) Gunn-Thuan colors of elliptical galaxies in about 300 clusters with redshifts between 0.02 and 0.3; b) Spectroscopic indices H β 4861, Mg215170, Mg β 5170 and Fe λ 5270,5335 of ellipticals in Abell clusters with redshifts between 0.12 and 0.4. Color and index gradients were measured, imposing reliable constraints on model parameters.

4.9 Constraining galaxy evolution through the internal colour gradients of early-type galaxies.

Francesco La Barbera

Abstract: We perform for the first time a detailed analysis of the relation between the optical/NIR internal colour gradients of early-type galaxies and their K-band luminosity (luminous mass). The properties of this diagram set strong constraints on galaxy formation scenarios, and are investigated by using a large sample ($N \sim 300$) of cluster galaxies at redshift $z \sim 0.3$. We estimate colour gradients from optical/NIR images of excellent quality, and select cluster members by the photometric redshift technique, using a large wavelength baseline (VLT and NTT UBVR λ IJK data). We show that the colour gradient vs. mass diagram strongly favours a hierarchical merging scenario of galaxy formation, constraining the possible variation of dark matter content in galaxies of different luminosities.

4.10 An Imaging Survey of Satellite Galaxies: Do Satellites Survive in Minor Mergers?

Seppo Laine

Abstract: One of the most important factors affecting disk galaxy evolution is the merger of satellite galaxies with a disk galaxy. Such an interaction may induce heating of the disk, and facilitate the buildup of the bulge, the halo and the globular cluster system. However, whether or not a satellite galaxy actually triggers these processes depends critically on its disruption or survival during the merger. Simulations suggest that dense and compact satellites wreak havoc on the primaries, while fluffy and extended satellites do little damage. We have made B-band, V-band and I-band observations of satellite galaxies which lie around isolated disk galaxies, using the satellite sample of Zaritsky et al. (1997). We present preliminary light and mass profiles of these satellites and describe our study of the survival or disruption of satellite galaxies in minor mergers.

4.11 Probing galaxy evolution through the internal colour gradients, the Kormendy relations and the Photometric Plane of cluster galaxies at $z \sim 0.2$.

Paolo Merluzzi

Abstract: We present a detailed analysis of the photometric properties of galaxies in the cluster A 2163B at redshift $z \sim 0.2$. R-, I- and K-band structural parameters, (half light radius, mean surface brightness, within this radius, and Sersic index) are derived for $N \sim 60$ galaxies, and are used to study the internal colour gradients. For the first time, we derive the Kormendy relation from the optical to the NIR and the Photometric Plane at $z \sim 0.2$ in the K band. Colour gradients are negligible at optical wavelengths, and are negative in the optical-NIR, amounting on average to -0.48 ± 0.06 . This result is in agreement with our previous measurements of colour gradients at intermediate redshifts, and imply a metallicity gradient in galaxies of ~ 0.2 dex per radial decade. The slope of the Kormendy relation increases from the optical to the NIR, implying that colour gradients do not vary or even

become less steep in more massive galaxies. This result is in sharp contrast with a monolithic collapse scenario, while it can be well understood within a hierarchical merging framework. Finally, we derive the first NIR Photometric Plane at $z \sim 0.2$, accounting for both the correlations on the measurement uncertainties and the selection effects. The Photometric Plane at $z \sim 0.2$ is consistent with that at $z \sim 0$, with an intrinsic scatter significantly smaller than the Kormendy relation but significantly larger than the Fundamental Plane.

4.12 Revisiting the Toomre Sequence with HST/NICMOS: the nuclear regions in merging galaxies

Joern Rossa

Abstract: We present new results of an HST/NICMOS imaging mini-survey of all 11 interacting and merging galaxies known as the "Toomre Sequence". These galaxies feature prominent tidal tails and complex morphologies on various scales. While tidal tails within these systems have been studied in quite some detail, the nuclear regions have only gathered scant attention in the past. However, the most stringent signatures as the result of galaxy interactions take place in the circumnuclear regions, which can be studied now with high angular resolution.

NIR broadband imagery in three filter bands (J,H,K) was performed with the NIC2 camera to study the morphology, colors, dust absorption and surface brightness profiles. Previous WFPC2 observations have shown us that some of the nuclei are hidden behind huge dust layers. With NICMOS we detect all nuclei of the Toomre Sequence, and some of the nuclear regions (e.g., NGC520 NUC1) reveal a quite spectacular and very different morphology as opposed to in the optical regime. We detect a double nucleus in NGC7764A, consistent with the general perception of this galaxy as an intermediate-stage merger prior to coalescence.

Color maps and two-color diagrams are presented. We discuss the results which are quantified both as function of merging stage in the Toomre Sequence, and as function of galactocentric distance within each interacting system. This allows us to assess whether the Toomre Sequence forms an evolutionary sequence, and to study in detail the physical processes involved. We are also supplementing this work by kinematical and stellar population studies based on HST/STIS data.

4.13 On the Dynamical Evolution of Cuspy Triaxial Galaxies in a Cluster Environment

Christos Siopis

Abstract: A cluster of galaxies can influence the dynamical evolution of individual members in a number of ways. If the gravitational potential of a member galaxy admits a significant fraction of chaotic orbits, its evolution can involve processes which would not be present if motion were (near-)integrable. This work investigates the statistical properties of chaotic orbit ensembles in realistic triaxial galaxy models characterised by a central density cusp, and possibly by a supermassive black hole. Such models exhibit a complex phase space structure, admitting large measures of both regular and chaotic orbits. The orbit ensembles were also subjected to low-amplitude perturbations modelled as dynamical friction, white or coloured noise, and/or periodic driving. These perturbations can mimic the influence of internal substructures, such as giant molecular clouds and star clusters; and/or the influence of an external environment, such as one or more satellite galaxies, or "harassment" by other galaxies in a cluster. One striking result was that a large fraction of the orbits manifest extreme "stickiness", which persists even in the presence of small-amplitude perturbations. This stickiness could have important implications for the stability and evolution of cuspy triaxial systems. For example, it is possible that a triaxial galaxy would evolve slowly through a sequence of near-equilibria without reaching an exact equilibrium or becoming more nearly axisymmetric. It is shown that it may be possible to test this scenario using data from the Sloan Digital Sky Survey.

4.14 The Effects of Interactions on the ISM of Spirals

Lisa Young

Abstract: A galaxy can be considered as a complex ecosystem – stars and gas affect each other through a web of gravitational processes, star formation, and stellar feedback. The state of the system can also shift in response to external influences. In this work we investigate the response of a spiral galaxy to an encounter with another galaxy. Specifically, we present both observations and simulations of an off-center collision between NGC 4647 (spiral) and NGC 4649 (elliptical; M60). The spiral is a highly asymmetric, one-armed galaxy with a flat rotation curve on one side and nearly solid-body rotation on the other. Though the atomic gas is symmetrically distributed, molecular gas is found on only one side of the galaxy. We also present a movie of numerical simulations (N-body + SPH) of off-center collisions between spirals and ellipticals, similar in form to that experienced by the real system. These simulations include heating and cooling, allowing us to track the evolution of the phases of the interstellar medium as the collision-induced shock wave propagates through the spiral. This type of encounter is probably a common type of galaxy-galaxy collision, and we discuss its implications for the origin of asymmetries in kinematics and in the phase structure of the interstellar medium.

4.15 Chandra observations of nearby mergers

Andreas Zezas

Abstract: We present results from Chandra observations of the nearby merger galaxies NGC 3256, Arp 299 (NGC 3690/IC 694) and NGC 3310. All three galaxies show significant diffuse emission and a number of discrete sources. In NGC 3256 and Arp 299 we detect the nuclei from both merging galaxies. In the case of Arp 299 we identify the nucleus of NGC 3690 with a heavily obscured AGN. In all three systems the X-ray emission is closely correlated with recent star-forming activity. The diffuse emission appears to be complex with several spectral components and in the case of NGC 3256 is consistent with a starburst driven wind. We finally compare these three objects with other systems of interacting galaxies observed with Chandra and we discuss the connection between galactic X-ray emission and galaxy interactions.

4.16 Evidence for past mergers in elliptical galaxies with very weak fine structure : Chandra observations of NGC 4261 and NGC 4697

Andreas Zezas

Abstract: We present Chandra observations of the elliptical galaxies NGC4261 and NGC4697 which show evidence that the spatial distribution of their bright X-ray sources is inconsistent with their optical morphology. We propose that the X-ray sources responsible for the non-uniform distribution are associated with young stellar populations and we discuss possibilities for the origin of the recent star-formation in the context of models of merging galaxies (e.g. fallback of material in tidal tails onto the relaxed merger remnant or shock-induced star formation along the tidal tails). We finally present similar studies of a larger sample of galaxies spanning a range of fine structure parameter.

4.17 Environmental effects in hierarchical structure formation; the origin of dwarf spheroidals

Lucio Mayer

Abstract: We present results of high resolution N-Body/SPH simulations which study the evolution of realistic models of dwarf galaxies subject to tidal stirring and stripping, ram pressure and photoionization by the cosmic UV background at high redshift as they orbit within the dark halo of

the primary system. Both the individual and the combined effect of all these mechanisms is studied for the first time, including radiative cooling and star formation. As a complimentary approach, we also study a population of satellites in a full cosmological galaxy formation simulation. We show that tidally induced non-axisymmetric instabilities turn rotationally supported disk dwarfs into pressure supported systems resembling dwarf spheroidals. The combination of stripping by tides and ram pressure, together with gas consumption by star formation, dramatically lowers the gas content, matching the values found for dSphs even for systems whose mass is high enough to be barely affected by the UV background. Extended star formation histories with periodic bursts triggered by tidal shocks at pericenters of their orbits occur in dwarfs orbiting at larger distances for which stripping is not so efficient. The latter dwarfs are also those that accrete later in cosmological simulations. The properties of the dSph satellites of the Milky Way are thus naturally explained as a result of these environmental mechanisms once we place them in the context of hierarchical structure formation.

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SESSION 8.

5.1 The Pattern Speeds of M100 (NGC 4321) from its Haph Philippe Amram

Abstract: The Tremaine-Weinberg method was used to measure the bar, spiral and inner ring pattern speeds of the Virgo Cluster Galaxy M100 (NGC 4321) using its H α Fabry Perot velocity field, H α monochromatic, 2MASS K-band and SPITZER 3.6 mm images. The results are in good agreement with previous determinations in the literature.

5.2 Clustering of galaxies around Damped Absorbers on scales 5–10Mpc

Nicolas Bouche

Abstract: We studied the cross-correlation of Lyman break galaxies (LBGs) around three damped Lyman absorbers (DLAs) at $z \sim 3$ from deep *UBVI* KPNO 4m/MOSAIC images. The large area of the MOSAIC images, 0.31 deg^2 , allows us to probe the clustering of LBGs on scales up to 20 Mpc co-moving.

We find that the DLA-LBG cross-correlation is most significant on scales $5 - 10 \sim \text{Mpc}$. The amplitude corresponds to a correlation length of $r_o = 5 \pm 4.5h^{-1}$ (co-moving).

We will discuss the implications of these results in the light of numerical simulations.

5.3 Clustering of Red Galaxies around MgII absorbers at $z=0.5$ in SDSS

Nicolas Bouche

Abstract: We present results on the clustering Luminous Red Galaxies (LRG) around a large sample of MgII absorbers from SDSS. From the angular cross-correlation function, we find a strong clustering from 1kpc to 10Mpc. The amplitude of the cross-correlation is close to the auto-correlation of the LRGs. We discuss the implications for the MgII absorbers.

5.4 Star formation in merging galaxy clusters

Chiara Ferrari

Abstract: In the framework of the hierarchical model of structure formation, galaxy clusters form through the accretion and merging of substructures of smaller mass. Merging clusters are a privileged laboratory to test the physics of evolutionary effects on their galaxy members. Shock waves in the ICM driven by the merging event may trigger star formation (Evrard 1991). Other physical mechanisms could trigger star formation within clusters: the infall of galaxies in the high pressure ICM (Dressler & Gunn 1983), the encounters and interactions between galaxies (Lavery & Henry 1988), the rapid variation of the gravitational tidal field (Bekki 1999). On the other side, gas stripping in galaxies due to ram pressure exerted by the ICM could weaken the star-burst phenomenon during cluster collision (Fujita et al. 1999). So far it is not yet clear which one of these competing effects is the dominant one. In this picture, we will present our analysis of the star formation properties of different merging clusters based on the comparison of new optical and radio observations with numerical simulation results.

5.5 A New Look at Brightest Cluster Galaxies

Anthony Gonzalez

Abstract: Brightest cluster galaxies (BCGs) constitute a dynamically distinct class of objects. There is strong observational evidence that the properties of BCGs are closely coupled to the formation and evolution of the host cluster, and consequently observations of these systems provide valuable information about the physical processes that impact both BCG and cluster formation. I will present results from a systematic study of the structural properties of a sample of 30 local BCGs out to radii of 300 kpc. With our data we find strong evidence for two physically distinct components with scale lengths that differ by roughly a factor of ten. The properties of these two components place interesting constraints upon the process driving the formation of the BCG, which I will explore in this presentation.

5.6 Searching for High Redshift Clusters

Carlos Gutierrez

Abstract: Distant clusters of galaxies provide a powerful method to study the formation and evolution of galaxies, the large scale structure of the Universe, and to determine parameters of the cosmological models. However, the number of known clusters at high redshift is still very reduced. Here, we present our work to identify such structures in wide optical and near IR surveys. We plan to build a large and homogeneous sample for studies with the Spanish 10 m GTC telescope.

5.7 Environment effects on star formation in merging galaxy clusters

Sophie Maurogordato

Abstract: We would like to present new results obtained from our program of multi-wavelength analysis of merging galaxy clusters (MUSIC). Multi-band wide-field imaging and multi-object spectroscopy has been obtained at ESO and CFHT by our group on a sample of nearby clusters at different stages of the merging process and combined to X-Ray spectro-imaging obtained with Chandra or XMM. We have addressed the star forming properties of the galaxies as a function of the environment, and have detected a clear enhancement of star forming and post-starburst objects in the region where the merging process has occurred, identified by hot spots in the temperature map due to the compression of the gas. This suggests that star formation has been enhanced by the merging processes occurring during the formation of the clusters.

5.8 Dynamical Evolution and Galaxy Populations in the Cluster ABCG 209 at $z \sim 0.2$

Amata Mecurio

Abstract: With the aim of investigating the origin and evolution of different galaxy populations in the cluster environment, we analyse the properties of luminous galaxies ($R < 20.0$) in the rich Abell cluster ABCG 209 at redshift $z \sim 0.21$, on the basis of spectral classification of 102 member galaxies. We take advantage of available structural parameters (Sersic index) to study the properties of bulge-dominated and disk-dominated galaxies separately. The star formation histories of the cluster galaxy populations are investigated by using line strengths and 4000 Angstrom break, through a comparison to stellar population synthesis models. The dynamical properties of different spectral classes are examined in order to infer the past merging history of ABCG 209. The results of this analysis support a scenario in which ABCG 209 is characterised by the presence of two components: an old galaxy population, formed very early ($z_f > 3$), and a younger population of in-falling galaxies. We find a strong correlation between the positions of young blue post-starburst galaxies and substructures in the hot intracluster medium, while red post-starburst galaxies seem to be aligned with the overall filamentary structure of the cluster. We find indication that the latter galaxy population may be the remnant of an in-falling group of galaxies that have experienced a merging with the cluster, 1 or 2 Gyr ago.

5.9 Galaxy evolution in compact groups

Emanuela Pompei

Abstract: Compact groups are association of 4–8 galaxies with high spatial densities ($\delta\rho \sim 10\text{--}20$), but low velocity dispersion. According to current dynamical models, galaxies belonging to such systems should interact violently and merge on a relatively short time scale (see eg. Carnevali et al. 1981). Therefore compact groups are an ideal laboratory to study interaction and merging between galaxies. We present here the results from spectroscopic and photometric observations of a new sample of compact groups in the Southern Sky, selected by an automatic detection algorithm applied to a digitised galaxy database.

5.10 A multi-wavelength study of the galaxy content and environmental effects in the dense group of galaxies around of IC 65

Jaana Vennik

Abstract: In framework of a larger program for studying the photometric properties of nearby groups of galaxies we have carried out surface photometry of four bright known members and a number of new possible LSB companions of the IC 65 (LGG 16) group of galaxies. The purpose of the present study is twofold: (a) search for new LSB dwarf members and measuring their global photometric characteristics, and (b) search for possible effects of mutual interactions on the morphology and photometric characteristics of luminous and faint group members.

This study is based on our own *BRI* CCD observations performed with the 1.23 m and 2.2 m telescopes at Calar Alto, which were supplemented with the deep *gri* frames obtained from the Second Palomar Digital Sky Survey (DSS 2), and the NIR *JHK* frames from the 2MASS database. In addition, we have used the HI imaging data from literature and the results of new pilot HI observations of selected dwarf-galaxy candidates kindly made by W. Huchtmeier with the Effelsberg 100 m radio telescope.

In total 105 galaxies have been detected with SExtractor software on the linearized DSS 2 $60' \times 60'$ blue and red frames centered on LGG 16, and classified by their surface brightness, colour and

morphological grounds. We discovered four new probable LSB dwarf members of the group, two of which have been marginally detected in HI.

The isophotal analysis in optical wavelengths revealed the presence of minor disturbances in the outer isophotes of some bright regular member galaxies. The HI emission appears generally more disturbed, compared to the emission in the optical passbands. The new dwarf companion candidates (with $-14.5 < M_B < -16.1$) generally contain of blue star-forming regions with typical (Cousins) colours of $B - R = 0.65 \pm 0.15$, $R - I = 0.2 \pm 0.2$. The drift of optical isophotes together with the warping of HI isophotes outside the optical image of regular galaxies, as well as evidence for the enhanced star-forming activity in fragile dwarf galaxies is indicative that this dense group of at least 8 late type galaxies is gravitationally bound and mutually interacting.

5.11 Dynamical Structure and Evolution of the Rich Clusters of Galaxies A1650 and A3558

Koujun Yamashita

Abstract: We have analyzed X-ray images and spectra of A1650 ($z=0.0845$) and A3558 ($z=0.0482$) observed by XMM-Newton. Both clusters have a cD galaxy at the center and show centrally-concentrated and elongated X-ray surface brightness distribution with the ellipticity of 0.3 and spatial extent of 3 Mpc. The average temperature and abundance over a cluster were obtained to be 5.62 keV and 0.36 solar for A1650 and 5.31 keV and 0.33 solar for A3558, respectively. The spatial distributions of temperature and abundance are derived from the hardness ratio (HR) map and X-ray spectra obtained in subdivided regions. HR is defined as the ratio of counts between two energy bands in 0.8–10 keV region. They are patchily distributed over the cluster in the range of 4–7 keV and 0.2–0.6 solar with the size of a few 100 kpc. There show steep decrease of temperature and increase of abundance in the central region. The distinct difference of their properties is the detected number of AGN-like objects! in a cluster and the spatial correlation between temperature and X-ray surface brightness distributions. We discuss on the dynamical structure and evolution of two clusters in the context of the in-falling of groups of galaxies to the main body of a cluster taking account of the environmental effect and optical observations.

5.12 The Velocity Dispersion of Poor Groups of Galaxies

Marc Zimer

Abstract: We used a subsample of 10 poor groups of galaxies from the Mulchaey et al. (2003) X-ray catalogue to study intensively the physics of the velocity dispersion. This sample consists as well spiral rich groups as early type dominated systems. We find that X-ray bright groups have more members and higher velocity dispersions on average. However every group have at least 20 members down to -16 in R-magnitude. Using the fainter group members we investigated on the relationship of the velocity dispersion from N_{grp} , abs. magnitude and radial distances. We found that these variables depend on the type of the group (e.g. the behaviour of spiral rich groups differ systematically from those who are dominated by ellipticals). At least for the more massive, early-type dominated groups we define the number of group members required to calculate a robust velocity dispersion. Finally we used the gained knowledge of this study on the entire Mulchaey-catalogue to make constraints on the X-ray scaling laws for a better understanding of the relationship between the kinematics of the hot gas and galaxies in these common environments.