Galaxy and Mass Assembly
(GAMA)

Jochen Liske
GAMA

A comprehensive, multi-wavelength, state-of-the-art survey of the low-redshift Universe, exploiting the latest generation of ground and space-based wide-field survey facilities to study galaxy formation and evolution.
Facilities contributing to GAMA

VISTA
UKIRT
AAT
HERSCHEL
VST
VISTA
UKIRT
AAT
HERSCHEL
VST
VISTA
UKIRT
AAT
HERSCHEL
VST
VISTA
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HERSCHEL
VST
VISTA
UKIRT
AAT
HERSCHEL
VST
VISTA
UKIRT
AAT
HERSCHEL
VST
# GAMA team and structure

## Working Groups and Heads

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<td>Baldry (LJMU)</td>
<td>Liske (ESO)</td>
<td>Driver (PI, St And)</td>
<td>Norberg (ROE)</td>
<td>Hopkins (AAO)</td>
<td>Loveday (Sussex)</td>
<td>Bamford (Portsmouth)</td>
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## Team Members

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<td>postdocs+students pending</td>
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## Affiliated Consortia

- UKIRT/LAS
- VST/KIDS
- VISTA/VIKING
- HERSCHEL-ATLAS
- DURHAM ICC
Status of GAMA imaging

- **GALEX**: observations ongoing, completed by 2010 (?)
- **VST**: KIDS (see K. Kuijken's talk)
- **VISTA**: VIKING (see K. Kuijken's talk)
- **UKIRT**: UKIDSS-LAS ongoing
- **HERSCHEL**: ATLAS to commence this year
- **ASKAP**: EoI submitted in Dec 2008
  invitation for full proposal received in Jan 2009
- **GMRT**: 1st round of observations completed, further obs required for full coverage
GAMA spectroscopy

- Fibre spectroscopy using AAT/AAOmega (2dF successor)
- Area: 240 deg$^2$ split over 5 regions
- Main sample: ~250K galaxies to $r < 19.8$ mag and $K_{\text{AB}} < 17.5$ mag (selected from SDSS and UKIDSS-LAS)
- $<z> \sim 0.25$
- $R = 1300$, $370 < \lambda < 880$ nm
- Science goal of GAMAz: study of structure on 1 kpc – 1 Mpc scales
  - CDM halo mass function of groups and clusters from group velocity dispersion
  - Galaxy stellar mass function to Magellanic Cloud masses by type and environment
  - Merger rate as a function of mass, mass ratio, type and environment
  - Properties of galaxy components (bulge-disk decomposition)
GAMA survey regions

GAMA 48 deg$^2$
survey regions
GAMA-N survey regions
GAMA in comparison
GAMA in comparison
GAMA spectroscopy

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The halo mass function

- Robust prediction of structure formation models.
- Measurement requires depth + resolution + high completeness in dense areas.
The stellar mass function

- Provides mass-dependent star-formation efficiency and constrains feedback.
The galaxy merger rate

- Mergers are a principal mode of galaxy assembly in CDM models of galaxy formation.

- Identify all stages of mergers by using dynamical pairs and morphological indicators.

- Explore merger rate as a function of mass ratio and merger type.

- Crucial: high completeness for close pairs, high-resolution imaging, depth.

Lin et al. (2008)
Properties of bulges and disks

Multi-$\lambda$ bulge-disk decomposition:

- Stellar mass functions to assess relative importance of different formation processes.
- Luminosity-size relations.

- Colour profiles.
- Dust in disks.
- Classical vs pseudo-bulges.
- ...
Properties of bulges and disks

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- Colour profiles.
- Dust in disks.
- Classical vs pseudo-bulges.
- ...
Status of GAMA spectroscopy

- 66 nights allocated (2008-2010)
- 21/22 clear nights in March-April 2008
  - 159 fields observed → all 3 GAMA-N regions covered almost entirely at least once to variable depths (including a deep strip to $r < 19.8$ mag)
  - 50,746 good quality redshifts at 96.6% (!) completeness
- 2009 campaign ongoing
- An additional ~90 nights are required to complete the survey: to be requested by an ASKAP/GAMA consortium in 2009/2010
GAMA example spectrum

C09_Y1_AX2.fits[292] G425770
mcg = 17.85, z = 0.08193, iq = 4 Em

Wavelength (Angstroms)
PCA sky subtraction

PCA Skysubtraction

Skysubtracted Spectrum

Wavelength (Angstrom)
GAMA year 1 redshift completeness
Spectral decomposition with GANDALF
GAMA year 1 redshift distribution
GAMA year 1 redshift cone
Redshift cone before GAMA Y1

GAMA etc.

March 2008

3° slice
100427 galaxies
Redshift cone after GAMA Y1

GAMA etc.

March 2008

3° slice

144928 galaxies
GAMA year 2 progress
GAMA year 2 progress
GAMA year 1 r-band LF

1/5\textsuperscript{th} of final sample!
GAMA photo-z improvement

SDSS estimates for GAMA objects
GAMA photo-z improvement

See J. Loveday's talk later today.
Spec-z vs photo-z

SDSS main sample
to $z < 0.2$: photo-z
Spec-z vs photo-z

SDSS main sample
to z < 0.2: spec-z
Colour bimodality vs redshift
SFR vs redshift
What's next?

Does the VLT have a role to play in studies of the low-redshift Universe?
What's missing?

Gas
- mass
- metallicity

Dust
- mass
- type
- distribution

Environment
- field
- groups
- clusters
- mergers

Stars
- mass
- stellar populations
- SFH
- SFR

Morphology/structure
- size
- concentration
- asymmetry
- B/D separation

AGN activity / SMBHs
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- Morphology/structure
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- AGN activity / SMBHs

Go deeper?

- Push the VLT to its limit, pre-selecting low-z gals
- Hard to get enough volume with VIMOS
What's missing?

Gas
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AGN activity / SMBHs

Kinematics
Some science drivers for a spatially resolved (1D), 'high' resolution spectroscopic VIMOS survey of low-redshift GAMA-selected galaxies:

- Dynamical mass function
- Fundamental Plane at $L \ll L^*$
- Tully-Fisher at $L \ll L^*$
- Gradients: abundances, extinction, SFR
- Stellar populations of (pseudo-)bulges and disks
- Joint photometric and kinematic bulge-disk decomposition
- ...
- See also L. Tresse's talk later today.
• VIMOS slits can be up to 30” long.
• VIMOS slits can be tilted.
• Highest resolution: 2000-2500.
• Number density of $r < 19.8$ galaxies is well matched to VIMOS.
• GAMA is an excellent starting point for selecting this sample (for many reasons)!
• 3h exposure time → S/N ~ 22 in the continuum at ~21.5 mag/arcsec$^2$ (in R).
• ~450 hours (incl overheads) would result in a sample of ~8000 galaxies!
GAMA+

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- GAMA is an excellent starting point for selecting this sample (for many reasons)!
- 3h exposure time $\rightarrow$ S/N $\sim 22$ in the continuum at $\sim 21.5$ mag/arcsec$^2$ (in R).
- $\sim 450$ hours (incl overheads) would result in a sample of $\sim 8000$ galaxies!

- Is this only the first step? See JBH's talk on FIREBALL tomorrow.
Conclusions

- In my view, the role of the VLT in the field of low-redshift galaxy surveys lies in opening up the domain of spatially resolved spectroscopy, which has largely been missing from past large (field) surveys.
- This is the last axis of observational parameter space that remains to be added to large low-z surveys.
- It would represent a major milestone in the campaign of obtaining a complete picture of the galaxy population at low redshift for comparison with high-z studies and theory.
- No competitor in sight (for now).
- 'Obvious' future development: full 3D spectroscopy.