Galaxy Mass And Assembly – GAMA

John Peacock  DEX 2008  Edinburgh 4 Sept 2008
Cosmology after 2dFGRS

220,000 z’s 1997-2003
Open questions

• Fundamental cosmology issues
  – Baryon oscillations
  – Evolution of dark energy
  – Testing modified gravity

• Formation of galaxies and nonlinear structures
  – Hierarchical collapse & nature of DM
  – Feedback and galaxy downsizing
  – Environmental context

  – Require new deeper survey
Galaxy assembly: upside-downsizing

Pérez-González et al. (2007)
Opposite to buildup of virialized haloes ($\rho = 200 \langle \rho \rangle$)
The halo mass function

- CDM (1GeV)
- WDM (1keV)
- WDM (0.1keV)
- HDM (10eV)

Plot showing the halo mass function with different regions for CDM, WDM, and HDM.
Measuring the Halo Mass Function: Area requirement
2PIGG: Groups in 2dFGRS

Eke, Frenk, Cole, Baugh + 2dFGRS 2003
2PIGG: empirical halo galaxy contents

Eke et al. 04: Factor of 4 decrease in M/L from rich clusters to poor groups

But really want to probe behaviour below total mass $M = 10^{12.5} M_{\text{sun}}$ – and evolution

$N_{\text{min}} = 2$, $z_{\text{max}} = 0.07$

Long $\tau_{\text{cool}}$

Feedback

Data

Group luminosity

ideal

sim
Symptom 1: the Stellar Mass function

![Graph showing the Stellar Mass function with various data points and curves representing different datasets. The y-axis is labeled as "number density (dex^{-1} Mpc^{-3})" and the x-axis as "stellar mass: log (M/M_\odot)".]
Symptom 2: environment and LFs

Croton et al. 2005: as $f(\text{density in 8 Mpc/h spheres})$
GAMA science goals & strategy

- **COMPREHENSIVE**
  - 250 SQ DEGREES (5X50 SQ DEG. CHUNKS), 250K GALAXIES (25X MGC)

- **GENERAL SCIENCE:**
  - A STUDY OF STRUCTURE ON 1KPC-1MPC SCALES, WHERE BARYON PHYSICS CRUCIAL

- **SPECIFIC GOALS:**
  - THE CDM HALO MASS FUNCTION FROM GROUP VELOCITY DISPERSIONS
  - THE STELLAR MASS FUNCTION INTO THE INTERMEDIATE MASS REGIME
  - STELLAR CONTENT AS FUNCTION OF GROUP HALO MASS
  - BUILDING TOTAL SEDS FOR GALAXIES AND THEIR COMPONENTS AT Z < 0.5

- **MASSIVE MULTI-WAVELENGTH LEGACY:**
  - UV (GALEX)
  - OPTICAL: UGRI (VST, SDSS), SPECTRA (AAT)
  - NEAR-IR: ZYJHK (VISTA, UKIRT)
  - FAR-IR (HERSCHEL), SUB-MM SCUBA-II
  - RADIO: 21CM (ASKAP)
Survey strategy: wedding cakes
GAMA: key facts

• 250 deg$^2$ in 5 fields
• to $r < 19.4$ – cf. SDSS 17.8
• $r < 19.8$ (GAMA deep) in one field
• SDSS selection; deep field overlaps MGC
• Awarded 66 AAT nights 2008 – 2010
• First season:
  – 22 nights mar/apr 08 – 20 clear
  – 50746 z’s out of 52557 spectra: 96.6% success
  – bright regions currently to $r < 19.0$
2dF/AAΩ on the AAT
$\text{AAΩ: new VPH spectrographs}$
# GAMA Team

## Working Groups/Heads

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peacock (ROE)</td>
<td>Baldry (LJMU)</td>
<td>Liske (ESO)</td>
<td>Driver (PI, St And)</td>
<td>Norberg (ROE)</td>
<td>Hopkins (USyd)</td>
<td>Loveday (Sussex)</td>
<td>Bamford (Nott.)</td>
</tr>
</tbody>
</table>

## Team Members

- Bridges (AAO)
- Bland-Haw’n (U.Syd)
- Cameron (St And)
- Conselice (Nott.)
- Couch (Swin.)
- Croom (U.Syd)
- Cross (Edin.)
- Frenk (Durham)
- Graham (Swin)
- Hill (StA)
- Edmonson (Ports)
- Jones (AAO)
- Kuijken (Leiden)
- Lahav (UCL)
- Nichol (Ports.)
- Oliver (Sussex)
- Parkinson (Edin.)
- Phillipps (Bristol)
- Popescu (UCLan)
- Eales (Cardiff)
- Ellis (USyd)
- Prescott (LJMU)
- Proctor (Swin.)
- Sharp (AAO)
- Staveley-Smith (UWA)
- Sutherland (Camb.)
- Tuffs (MPIK)
- van Kampen (Innsbruck)
- Warren (Imperial)
- Dunne (Nottingham)

## Team Affiliations:

- UKIRT/LAS, VST/KIDS, VISTA/VIKING, HERSCHEL-ATLAS, DURHAM ICC

## Website:

http://www.eso.org/~jliske/gama/
GAMA = FIVE
4X12.5 DEG CHUNKS
STARTED 01/08/08
G09 = 20% DONE
G12 = 20% DONE
G15 = 10% DONE
PCA sky subtraction
GAMA: year 1 cone diagram

GAMA etc.

March 2008

3° slice
144928 galaxies
Completeness and surface brightness
The GAMA luminosity function

GAMA r LF z < 0.1: only 1/5 th of final dataset

\[ \phi(h^3 \text{Mpc}^{-3} \text{mag}^{-1}) \]

\[ M_{r_{\text{GAMA}}} - 5 \log h \text{ (mag)} \]

\[ M^*_{r_{\text{GAMA}}} - 5 \log h \]

G09, G12, G15, G12D, G09+G12+G15

Fit \( M = -20.84, \alpha = -1.17 \)

SDSS (Blanton et al 2005)
Improved SDSS photo-z’s

SDSS web

GAMA-calibrated

Hannah Parkinson
GAMA: multiwavelength legacy