The SAMI Galaxy Survey: The impact of the cluster environment on the star formation of infalling galaxies

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Matt Owers @ EWASS 2017, S08- Ram pressure stripping and galaxy evolution
Resolved spectroscopy for 3400 galaxies -> 2200 galaxies to date (see Bryant+2015 for survey details)

1. Primary fields from GAMA (http://www.gama-survey.org).
   - Three 4x12 deg equatorial regions at 9hr, 12hr & 15hr
   - Deep, complete, spectroscopy to r=19.8
   - Robust group catalogue (Robotham et al. 2011).
   - 21-band photometry: far UV to far IR (Driver+2016).

2. Wavelength coverage/resolution:
   - Blue: 3700-5800A, R~1750, σ=70km/s
   - Red: 6300-7400A, R~4500, σ=30km/s

3. 8 Clusters targeted (~880 gals -> ~700 to date).
The SAMI Cluster Redshift Survey
(OWERS+2017)

- 7 nights using 2dF/AAOmega on the AAT.
- ~21,000 spectra to $r_{\text{petro}} < 19.4$, $R < 2-3R_{200}$.
- Completeness ~95% to $r_{\text{petro}} = 19.4$, $R<R_{200}$.
- Around 2850 cluster members ($R<2R_{200}$).

Cluster members

Caustics trace escape velocity profile.

Non-members
Correlation between galaxy properties and environment.

Fraction of SFR gals lower cf field (Lewis 2002)

Decline in SFR with radius (von der Linden 2010)
Correlation to Causation: Identifying environment-driven transformation.

- Koopmann & Kenney (2004) show 50% of spiral galaxies in Virgo cluster have truncated Hα distribution.
Moving from Correlation to Causation.


10 galaxies in Virgo cluster – representative? Answer with IFU data for large sample across range of clusters.
SAMI data: Resolved Spectroscopic Classification

Passive

Hδ strong

Starforming/Starbursting

Non-Starforming

Absorption line

PAS: EW(Hδ) > -3Å

Emission line

EW(Hδ) < -3Å

Emission in at least Hα + 1 other

Line ratio -> SF ionising src

Line ratio -> nonSF ionising src

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Also, Non-SF HDS

• Strong Balmer with non-SF emission lines:

$$\text{EW (H} \delta \text{)} = -4.7 \text{Å}$$

$$[\text{NII} 6583]/\text{H} \alpha = 1.16$$

$$[\text{OIII} 5007]/\text{H} \beta = 1.00$$
Red-sequence is dominated by spectroscopically passive galaxies.

Passive galaxies: >90% spaxels have passive spectral type

Clusters $f_{\text{pas}} = 71\%$
(29\% in GAMA regions)
Clusters: 11% of non-passive galaxies have >10% HDS classified spaxels.

Cluster galaxies

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GAMA: Only 2% non-passive galaxies have >10% HDS classified spaxels.
Projected-Phase-Space: a metric for environment.

Oman+13 simulations: infallers inhabit distinct regions of phase space (also Mahajan+13, Noble+13, Jaffe+15, Muzzin+14, Haines+15, Oman+16).

Infalling galaxies

Virialised region

$T_0$ at $2.5R_{\text{vir}}$

$T_{\text{cross}} \sim 3.5\text{Gyr}$
PPS for non-passive cluster galaxies

JO201 Jellyfish

R/R_{200} < 0.5
|V|/σ > 1.5
6/14 -> 43 (31-56)% HDS

0.5 < R/R_{200} < 1.
|V|/σ > 1.5
0/7 -> 0 (0-20)% HDS

R/R_{200} < 0.5
|V|/σ < 1.5
6/51 -> 12 (9-18)% HDS

0.5 < R/R_{200} < 1.
|V|/σ < 1.5
0/41 -> 0 (0-4)% HDS

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pressure stripping and galaxy evolution
Summary.

• 11% of non-passive cluster galaxies have evidence for young stellar populations with no ongoing star formation in >10% of their spaxels.

• This population is rare (~2-3%) in the non-cluster SAMI galaxies in the GAMA regions.

• The HDS galaxies are only found within $0.5R_{200}$ (~19%) with an increased fraction for high velocity galaxies (~43%) cf. lower velocity galaxies (12%).

• Consistent with ram-pressure stripping of gas leading to outside-in truncation of star formation as the galaxy traverses the cluster.

• Stayed tuned for full sample!
Extra slides