







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



Matt Owers +SAMI Galaxy Survey team







Correlation between galaxy properties and environment.

<u>Morphology-Density</u> relation (Dressler 1980)

<u>Fraction of SFR gals lower cf</u> <u>field (Lewis 2002)</u>



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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.

 Crowl & Kenney (2006, 2008): IFU spectra show stellar pop. ages outside truncation radius <500Myr -> rapid shutdown of star formation.



Handful of galaxies in Virgo cluster – representative? Need IFU data for larger sample across range of clusters.

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The SAMI Galaxy Survey

SAMI=Sydney-Australian-Astronomical-Observatory Multi-object Integral-Field Spectrograph

- Started in March 2013, ongoing (recently awarded time for 2017 & 2018).
- 3400 galaxies in ~200 nights.
- Around 1400 galaxies observed so far, including 548 cluster targets.
- Primary fields are the GAMA (Driver et al. 2011) regions.
 - Three 4x12 deg equatorial regions at 9hr, 12hr and 15hr RA.
 - Deep, complete, spectroscopy to r=19.8 to define environment.
 - Robust group catalogue (Robotham et al. 2011).
- 8 Cluster fields targeted to probe the highest density environments (~600 gals).





The SAMI Cluster Redshift Survey Owers et al. (in prep.)

- 7 nights using 2dF/AAOmega on the AAT.
- Collected ~21,000 spectra to $r_{petro} < 19.4$ and out to 2-3R₂₀₀.
- ~15,000 AAOmega redshifts, plus 6200 from other surveys (SDSS, 2dFGRS, WINGS, HeCs).
- Completeness ~95% to $r_{petro} = 19.4$, R<R₂₀₀.
- Around 2850 cluster members ($R < 2R_{200}$).





SAMI Cluster Properties

Name	R.A. (J2000) (deg.)	Decl. (J2000) (deg.)	Z	$ \begin{aligned} \sigma_v \\ (\mathrm{r} < R_{200}) \\ (\mathrm{km/s}) \end{aligned} $	$\begin{array}{c} R_{200} \\ (\mathrm{Mpc}) \\ \mathrm{Carl.} \end{array}$	$\begin{array}{c} \mathrm{M}(\mathrm{r} < R_{200}) \\ (\times 10^{14} \mathrm{M}_{\odot}) \\ \mathrm{Caustics} \end{array}$	${f M(r < R_{200})} \ (imes 10^{14} { m M_{\odot}}) \ { m Virial}$	$egin{array}{c} { m N_{mem}}\ r < { m R}_{200}/\ r < 2{ m R}_{200} \end{array}$	NZ	Completeness per cent R ₂₀₀ /2R ₂₀₀
APMCC 917	355.397880	-29.236351	0.0509	492 ± 47	1.19	$1.8 {\pm} 0.7$	$2.1{\pm}0.6$	86/119	218/570	96/91
Abell 168	18.815777	0.213486	0.0449	547 ± 29	1.33	$1.9{\pm}1.1$	2.9 ± 0.4	195/279	428/1262	94/95
Abell4038	356.937810	-28.140661	0.0293	597 ± 29	1.46	2.3 ± 1.4	2.9 ± 0.5	164/263	789/2089	96/89
EDCC 442	6.380680	-33.046570	0.0498	583 ± 39	1.41	$2.8{\pm}1.7$	3.6 ± 0.7	123/243	245/832	90/93
Abell3880	336.977050	-30.575371	0.0578	671 ± 50	1.62	$4.6{\pm}1.4$	5.2 ± 1.1	137/278	266/930	97/98
Abell2399	329.389487	-7.794236	0.0579	678 ± 32	1.63	4.3 ± 1.7	5.8 ± 0.7	232/317	475/1209	97/96
Abell 119	14.067150	-1.255370	0.0442	835 ± 36	2.02	8.4 ± 3.1	9.5 ± 1.1	370/576	811/2266	85/80
Abell 85	10.460211	-9.303184	0.0549	1002 ± 28	2.42	15.5 ± 3.7	17.0 ± 1.3	590/772	853/2153	98/93

Defining environment: cluster membership and mass



Projected-Phase-Space for SAMI clusters.

Oman+13 simulations show that infallers inhabit distinct regions of phase space (also Mahajan+13, Noble+13&16, Jaffe+14, Muzzin+14, Haines+15, Oman+16 and Allison Noble's talk this morning).



Spectroscopic Classification Maps

Emission line EWs and fluxes from I-Ting Ho's LZIFU fits (Ho et al. 2014)



Red-sequence is dominated by spectroscopially passive galaxies.

Passive galaxies: >90% spaxels have passive spectral type



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HDS galaxies in clusters

- In clusters, 8% of non-passive galaxies have >10% (HDS +PSB classified spaxels
- Less than 1% in GAMA show this (only one galaxy of 250 non-passives)





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Summary.

- SAMI galaxy survey targets 8 massive $(10^{14-15}M_{\odot})$ clusters.
- Redshift survey has 2850 cluster members for defining cluster properties.
- SAMI has observed >500 cluster galaxies with resolved spectroscopy.
- Preliminary results show that 8% of the non-passive cluster galaxies have evidence for young stellar populations in the absence of ongoing star formation in >10% of their spaxels.
- This population is essentially absent (<1%) from the non-cluster SAMI galaxies in the GAMA regions.
- These HDS galaxies are only found within 0.5R₂₀₀ (~20%) with hints of an increased fraction for high velocity galaxies (~31%) cf. lower velocity galaxies (11%).
- 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!

First data release

- 764 data cubes to be released in the coming months (GAMA regions only).
- Will include SFR maps, aperture spectra and other derived properties.
- Watch this space!



Image Credit: Jesse van de Sande