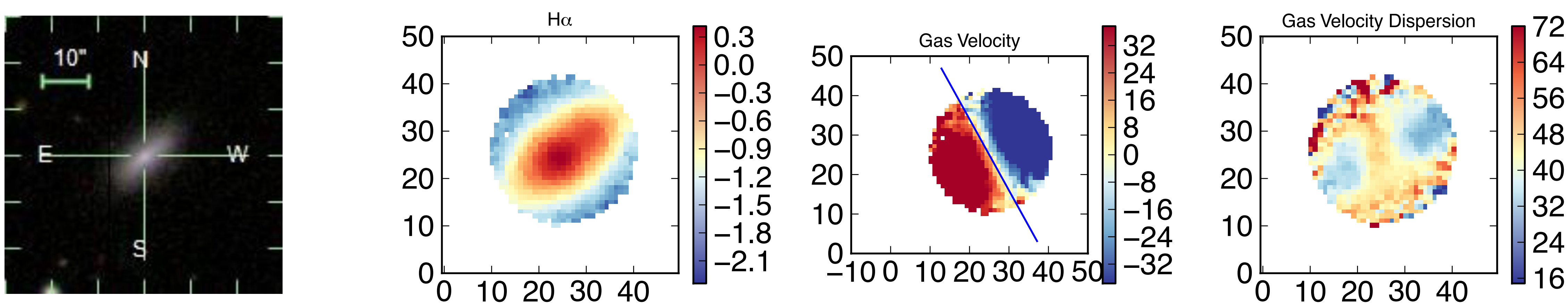
Extending the SAMI survey to z~1

Chris Lidman



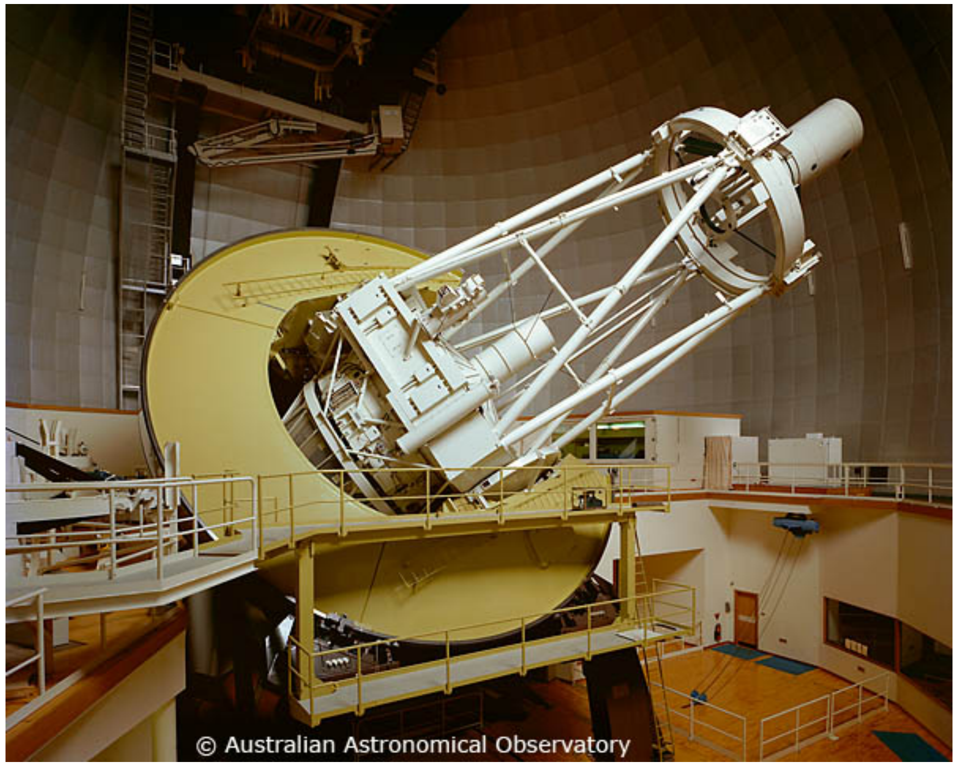
With help from Julia Bryant and Scott Croom

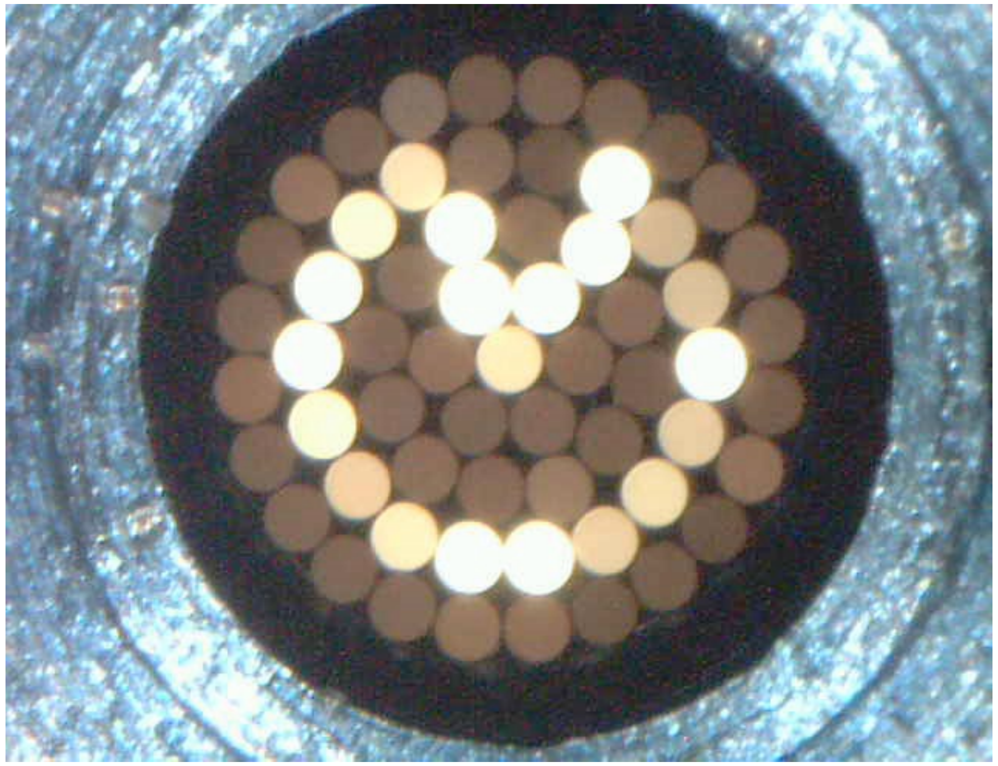
SAMI key science topics

- **What are the physical processes responsible for galaxy transformations?**
  - Morphological and kinematic transformations; internal vs. external; secular vs. fast; ram pressure stripping; harassment, strangulation; galaxy–group/cluster tides; galaxy-galaxy mergers; galaxy-galaxy interactions…
- **How does mass and angular momentum build up?**
  - The galaxy velocity function; stellar mass in dynamically hot and cold systems; galaxy merger rates…
- **Feeding and feedback: how does gas get into galaxies, and how does it leave?**
  - Winds and outflows; feedback vs. mass; triggering and suppression of SF; gas inflow; metallicity gradients; the role of AGN…

The SAMI Instrument

- Located at the prime focus of the AAT
- 1 degree diameter f-o-v.
- 13 x 61 fibre IFUs using hexabundles (Bryant, Bland-Hawthorn et al.).
- 15” diameter IFUs, 1.6” diameter fibre cores.
- Feeds AAOmega, a bench mounted optical spectrograph (42m fibre cable)
- Spectral resolution R~1700 (blue), R~4500 (red).
- A forerunner to HECTOR @ AAT - a 100,000 galaxy survey from 2020-2025

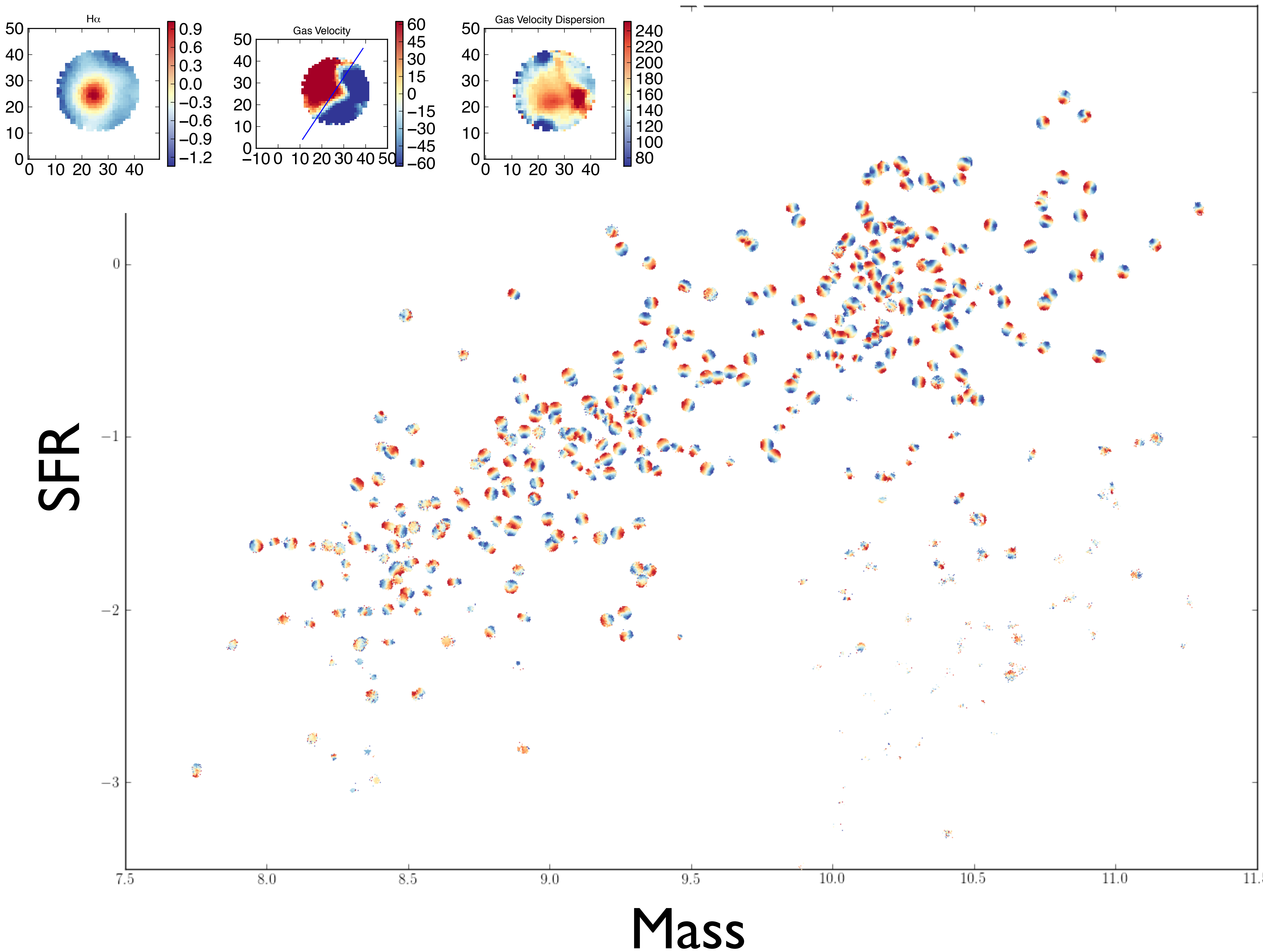




The SAMI survey

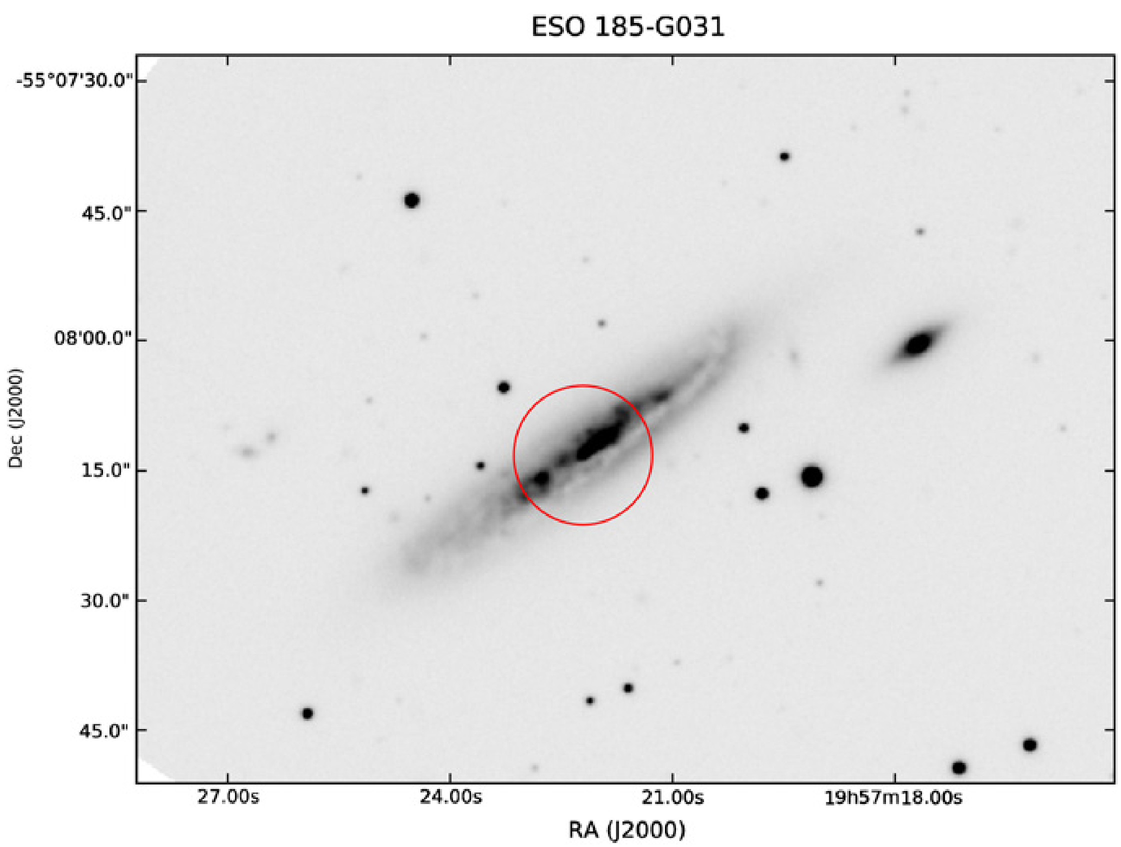
- 3,400 galaxies
- Median redshift z~0.05 (low redshift)
- Primary fields are the Galaxy And Mass Assembly (GAMA) regions.
- Specific galaxy cluster fields are targeted to probe the highest density environments.
- Started in March 2013 (completion in 2018)
- First data release: http://sami-survey.org/edr

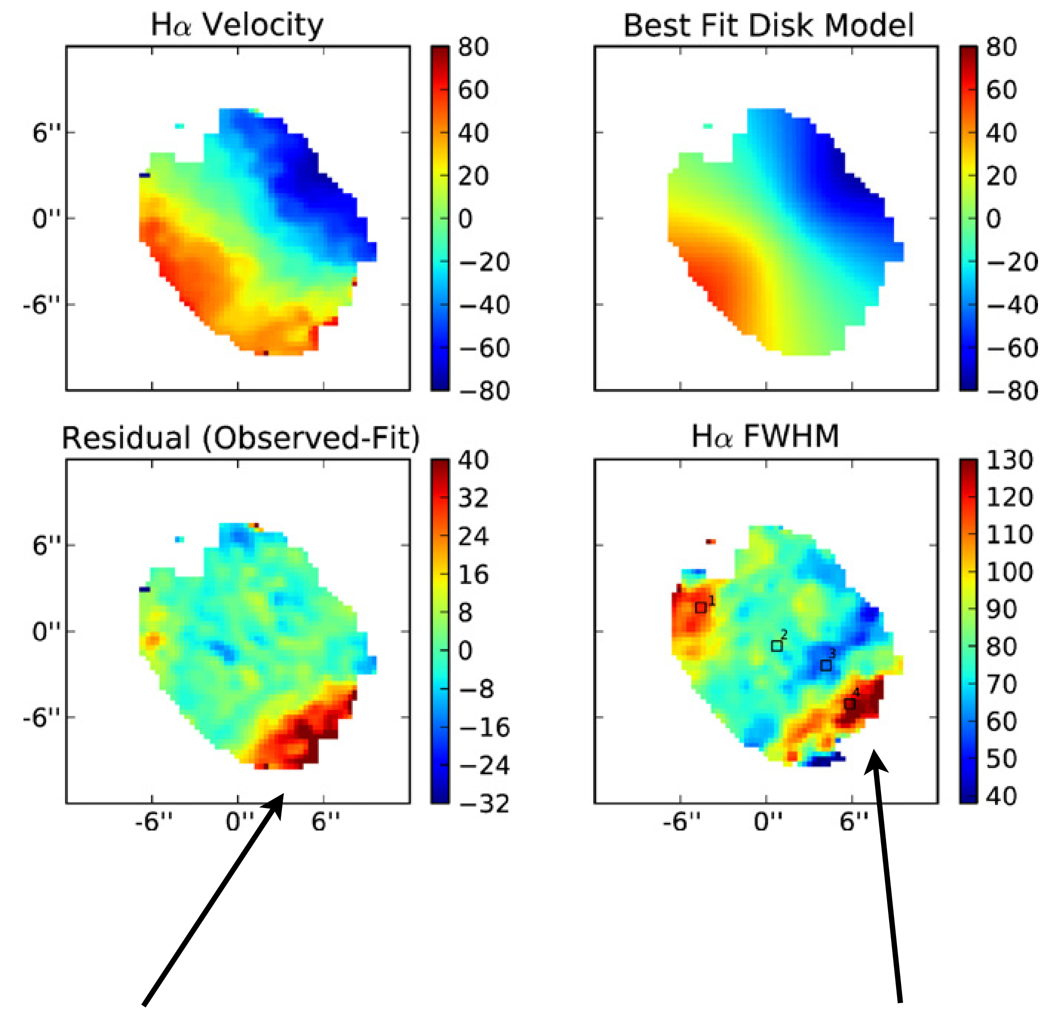
The SAMI survey (as of Nov. 2015)



Early SAMI results - Galactic winds

Fogarty et al.



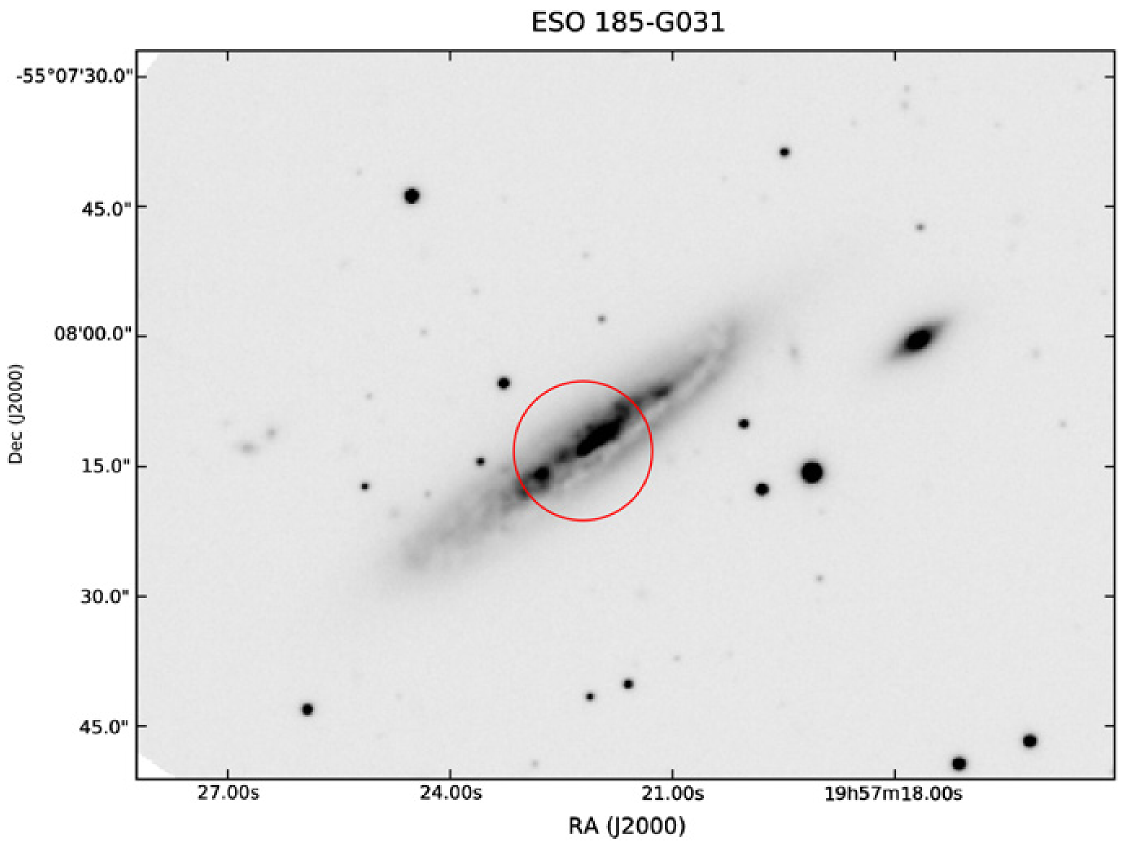


Excess in the residual map

Broad component

Can be done with a single line Hα

Early SAMI results - Galactic winds



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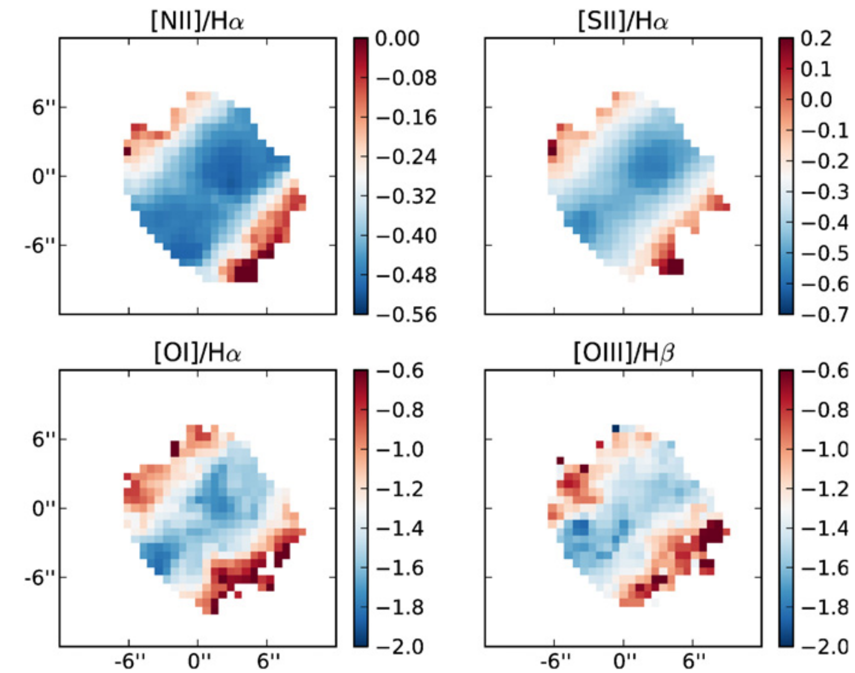
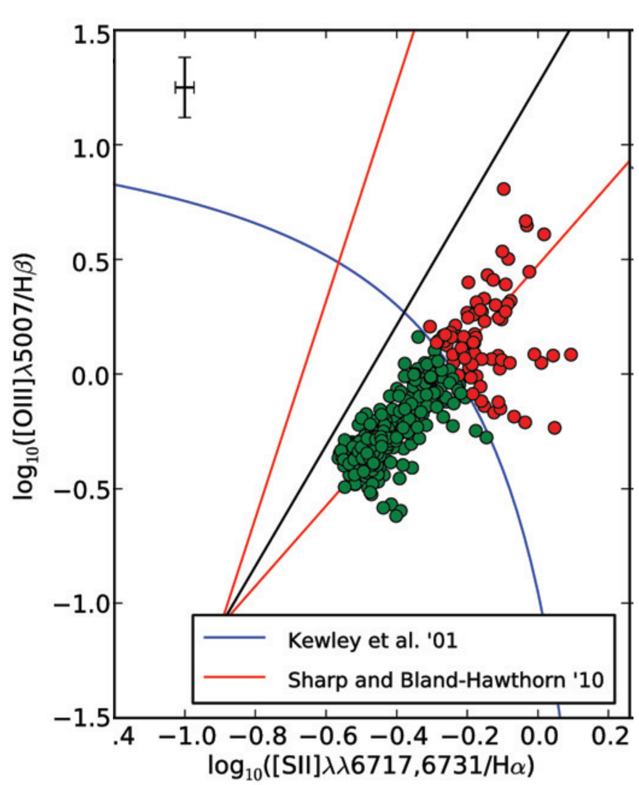
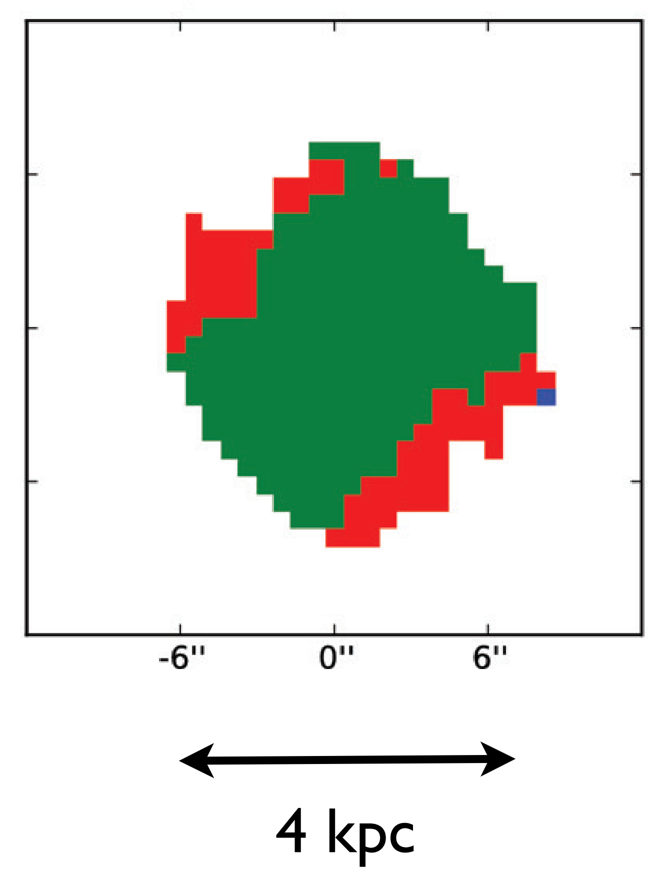




AGN

shocked

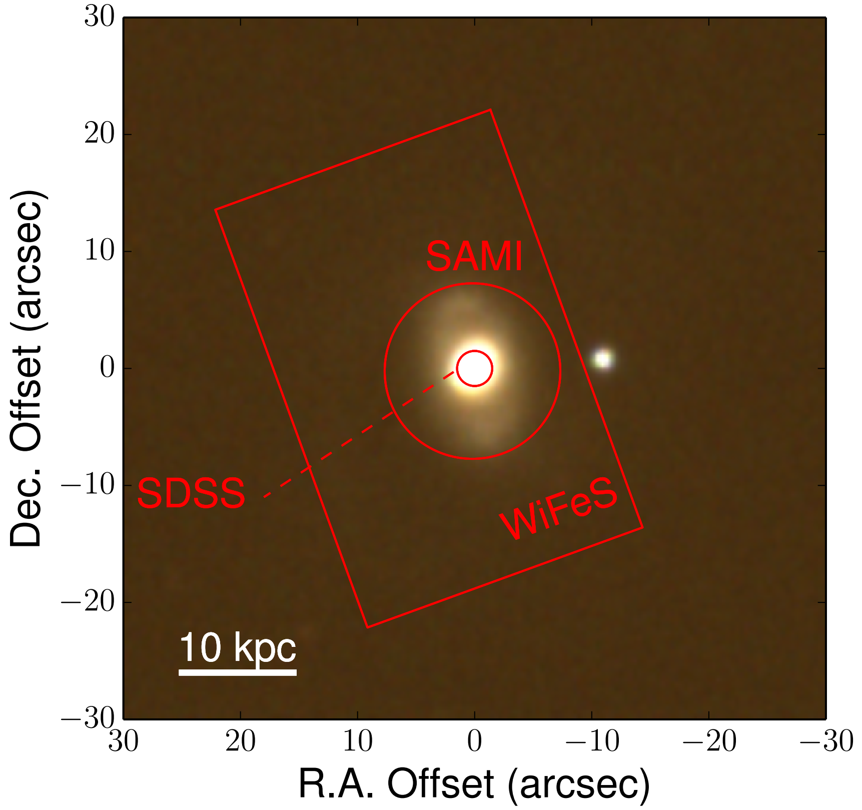
star formation

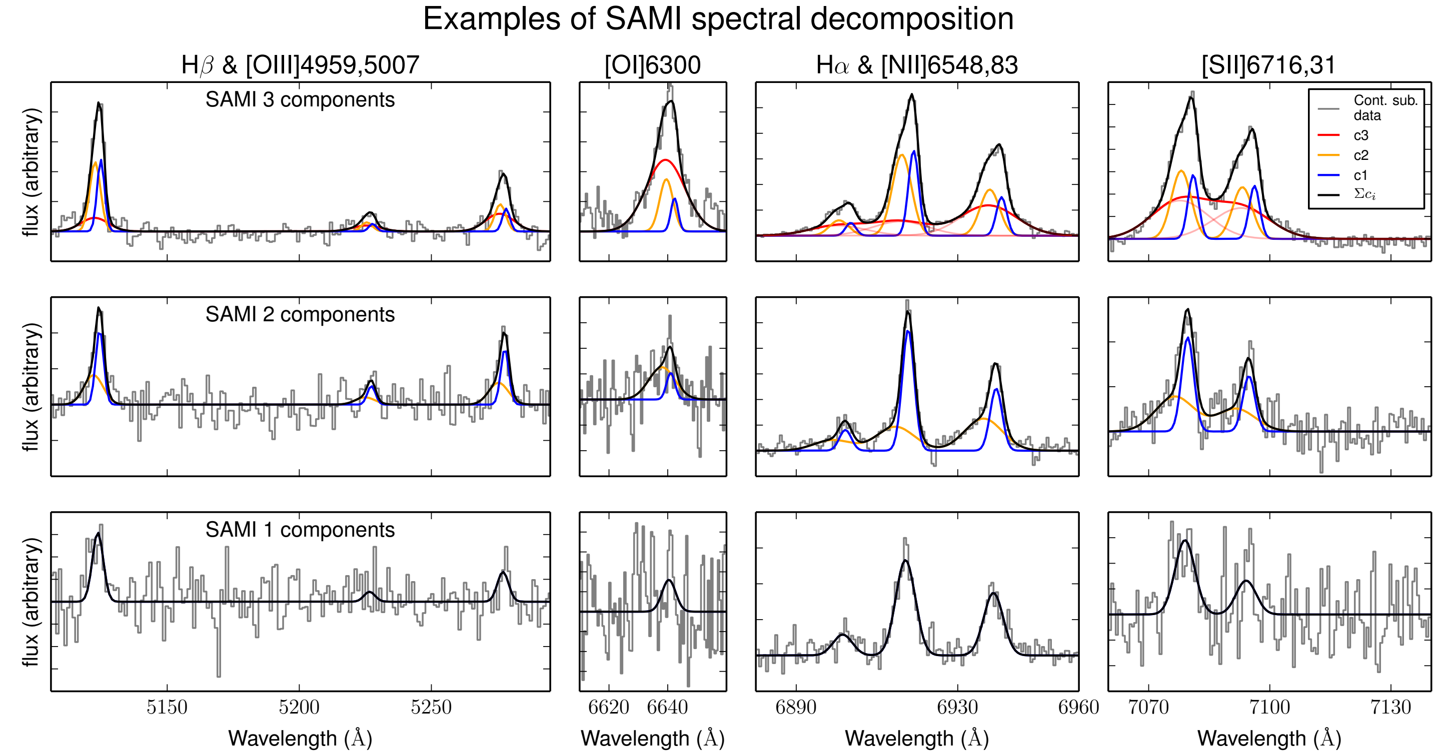


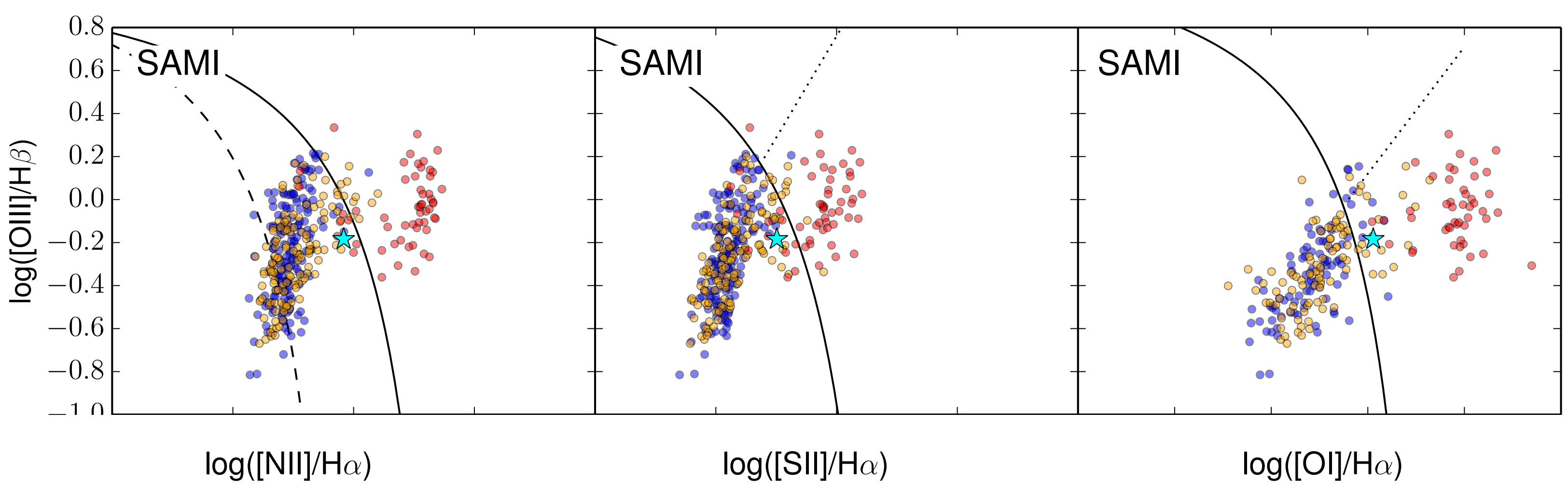
Requires a broad wavelength interval

Early SAMI results - Shocks and outflows

Ho et al. 2014, Leslie et al.







Narrow (C1)

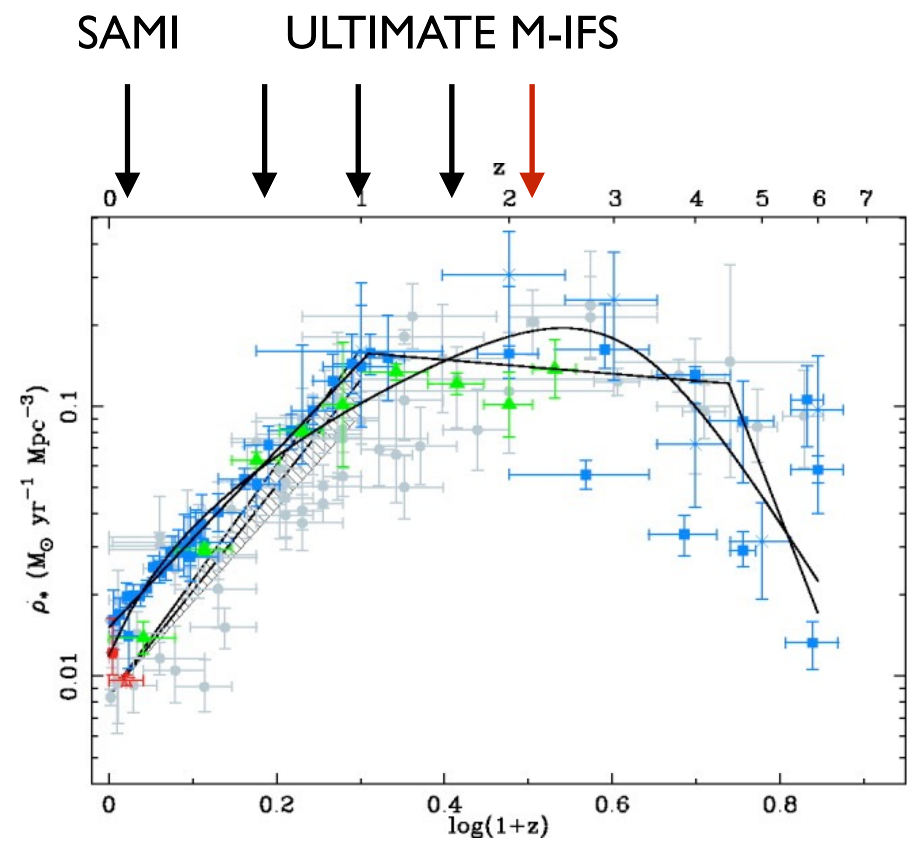
Broad (C3)

Intermediate (C4)

Requires moderate resolution over a broad wavelength interval

The Universe at z=1

- It is 7.8 billion years younger (middle age)
- It is 8 times denser
- The SFR density is 10 times higher, i.e. more SNe
- The AGN number density is ~100 times higher
- Galaxy clusters are a factor of 3 less massive



How do the processes that shape galaxies at z=1 differ in importance from the ones we see today?

For example, one might expect galaxy scale winds to be far more common

ULTIMATE Multi-object IFU Galaxy Survey

A SAMI-like at three (four) redshift intervals: z~0.6, 0.9, and1.4 (2.2)

- 3000 galaxies over 50 nights
- Targets from the COSMOS and SXDF-UDS fields (HSC ultra-deep survey and forerunner ULTIMATE imaging surveys)
- Limited to star-forming galaxies (10 solar masses / year)

Four main questions

- How does feedback work and how does it change with cosmic time (S)
- What causes quenching and what is the influence of the environment (S)
- How does gas accretion change with time (M)
- What drives galaxy transformations (S)

SAMI and ULTIMATE M-IFU

Characteristic	SAMI @ z~0.05	ULTIMATE @ z~1
Number of IFUs	13	13
FoV of positioner	3.6 Mpc (60') diameter	7.2 Mpc (15') diameter
FoV of IFU	15 kpc (15")	11.0 kpc (1.35")
Number of fibres per IFU	61	61
Fibre pitch	1.6 kpc (1.6")	1.2 kpc (0.15")
Minimum sep.	30kpc (30")	160 kpc (20")
Spectral resolution	1,700-4500	3,000-5,000

Questions from the organisers

Q1. Key science questions

Quenching, what causes it, when does it happen, and where does it happen, and how (if at all) does it change with redshift?

Q2. First priority instrument

WFC to create an optimal target catalogue for follow-up with up with the IFU, but please allow the possibility to add a multi-object IFU later

Q3. Could GLAO + nuMOIRCS be used

Yes, but a dedicated near-IR spectrograph (more IFUs and optimised for IFU spectroscopy) would be better

Q4. Which survey is best?

E, of course, and A.

Q7. Spectrograph design?

Yes, but see comment above.

Q8. Non-GLAO (natural seeing) mode?

Yes, but for Galactic science

Instrumental issues that affect the survey

I. New grisms in MOIRCS

II. Closer fibre spacing (how close can we pack them?)

III. New IR spectrograph with more detector real estate

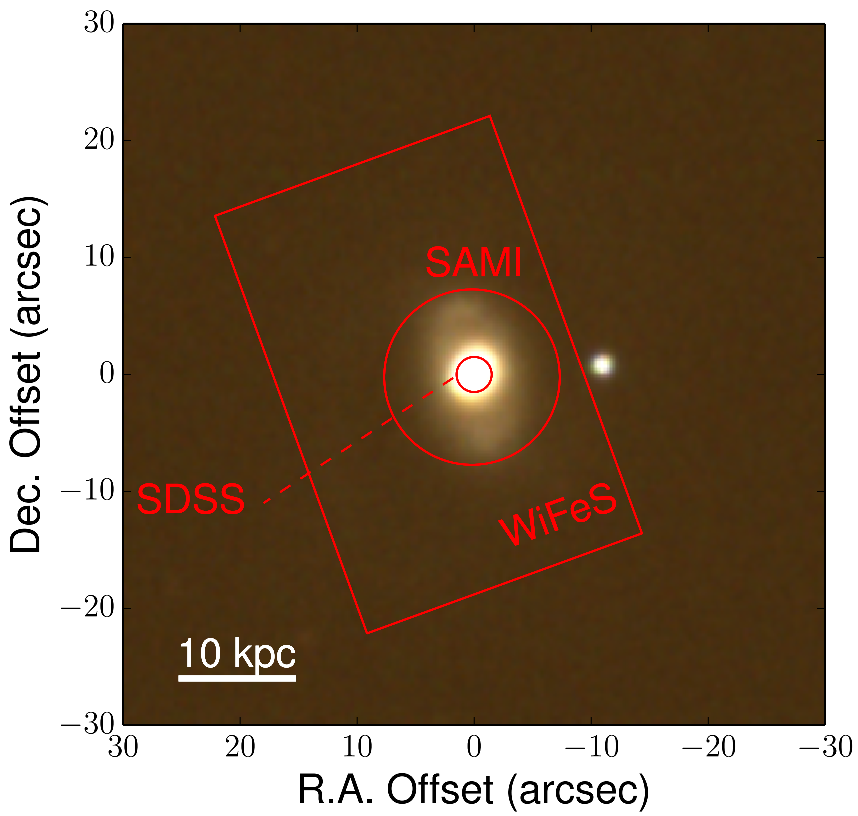
IV. The availability of the K band

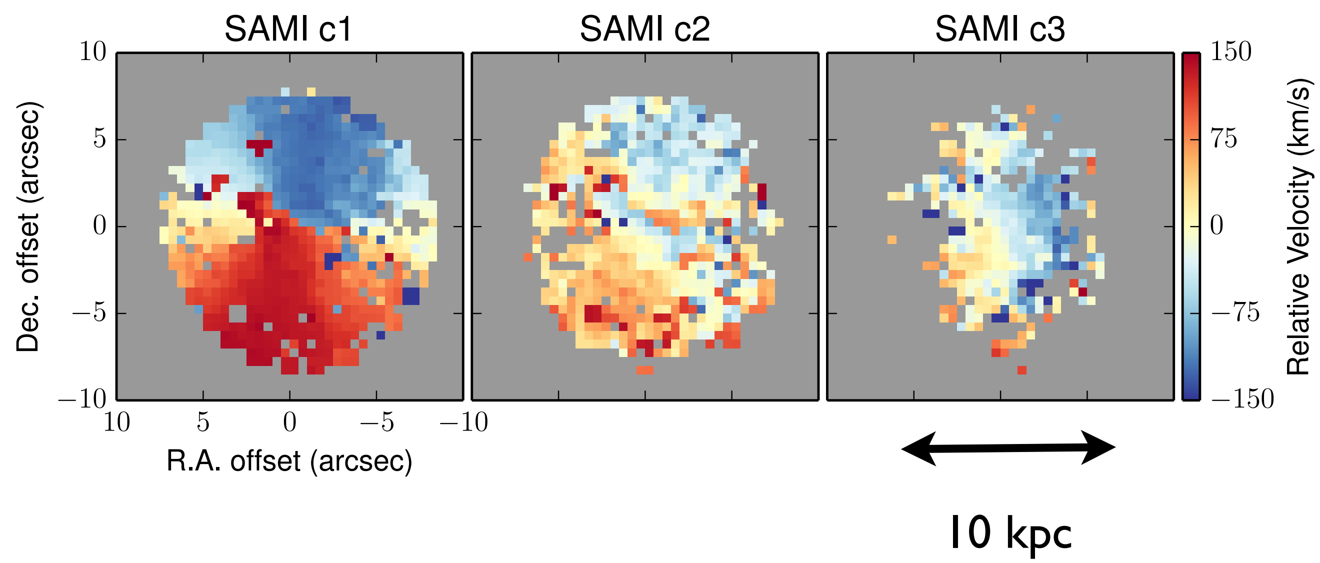
VI. An ADC

Additional slides

Early SAMI results - Shocks and outflows

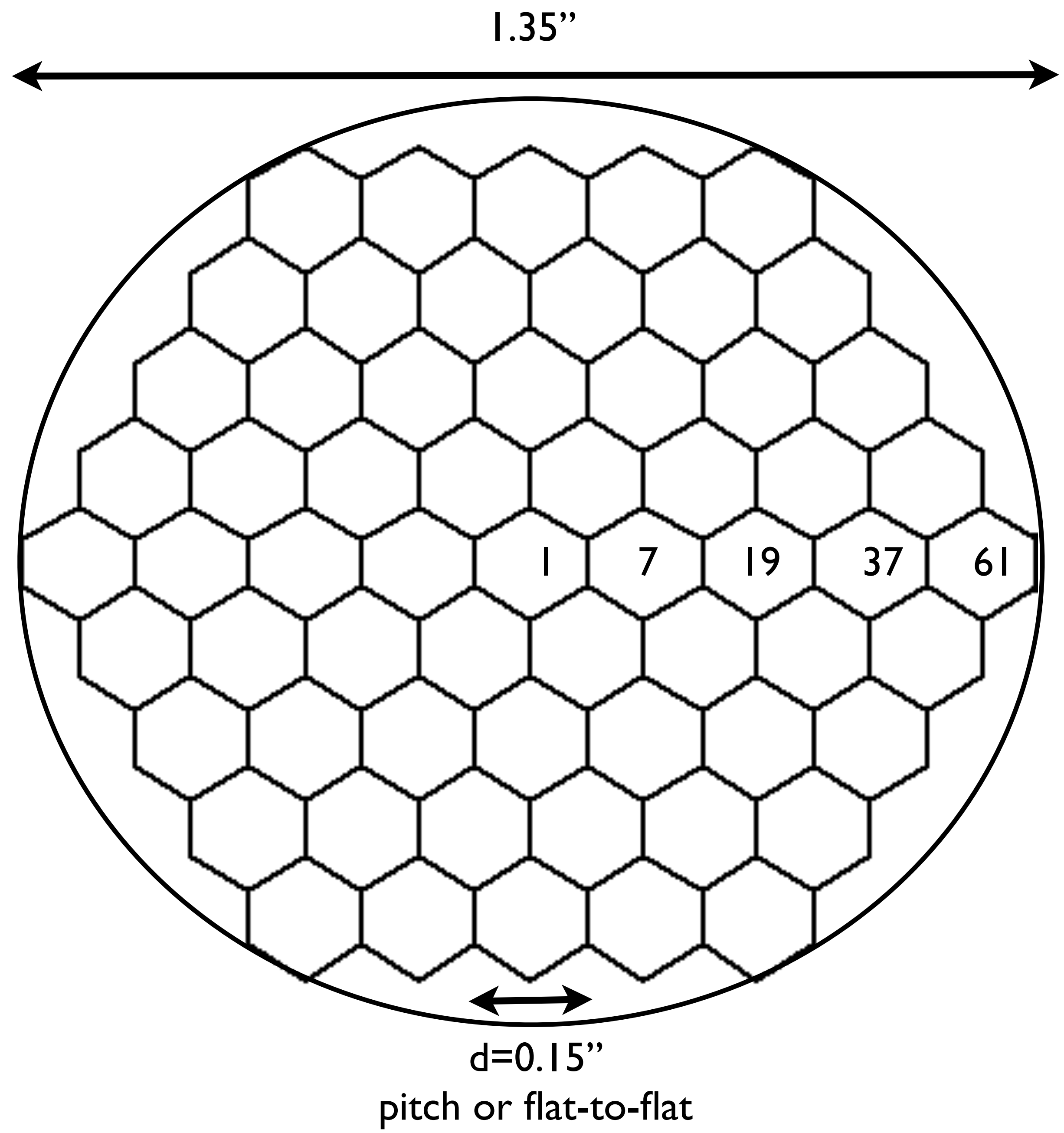
Ho et al. 2014





Outflow driven by a starburst
Excitation from UV photons from star formation and shocks

Hexagonal tiling



Area= 61 1.5 $d^2 / \sqrt{3}$

=

1.18 sq. arc seconds