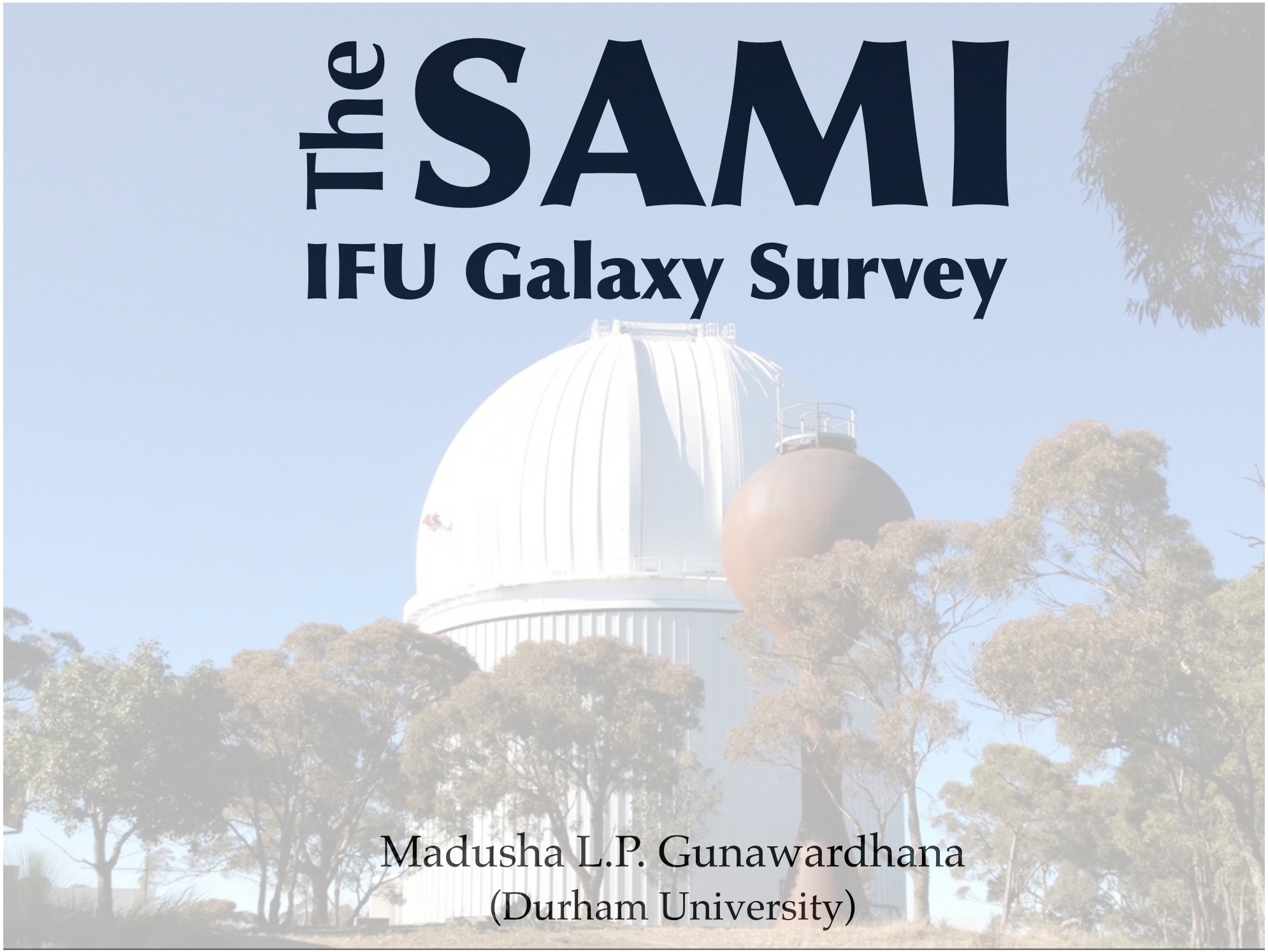


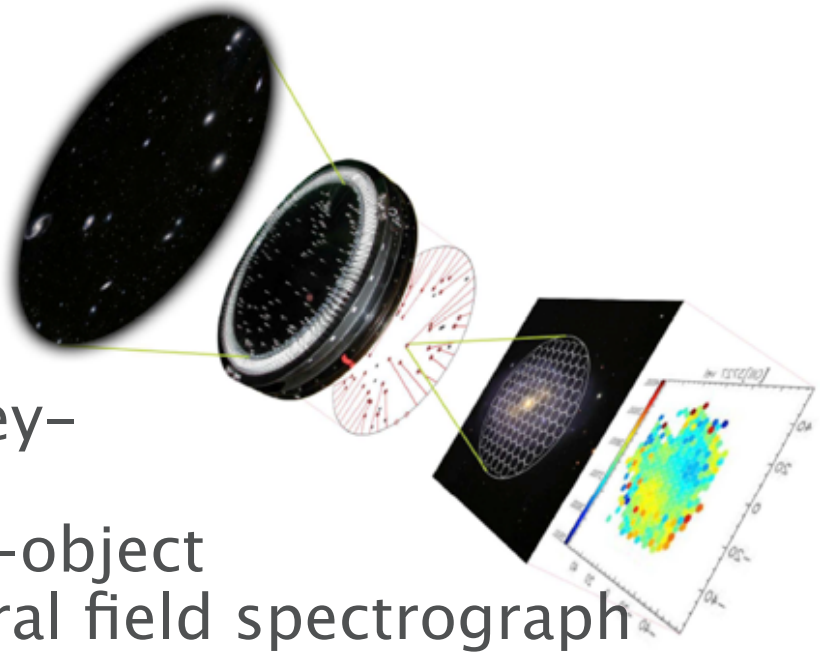
The SAMI IFU Galaxy Survey

Madusha L.P. Gunawardhana
(Durham University)

Overview

- ★ The need for multi-object IFU surveys
- ★ What is SAMI?
- ★ SAMI galaxy survey
- ★ SAMI science
- ★ SAMI simulations
- ★ Beyond SAMI...

sami galaxy survey



Sydney–
AAO
Multi–object
Integral field spectrograph

The Sydney-AAO Multi-object Integral-field spectrograph (SAMI)

Scott M. Croom[1,2⋆], Jon S. Lawrence[3,4], Joss Bland-Hawthorn[1], Julia J. Bryant[1], Lisa Fogarty[1], Samuel Richards[1], Michael Goodwin[3], Tony Farrell[3], Stan Miziarski[3], Ron Heald[3], D. Heath Jones[5], Steve Lee[3], Matthew Colless[3,2], Sarah Brough[3], Andrew M. Hopkins[3,2], Amanda E. Bauer[3], Michael N. Birchall[3], Simon Ellis[3], Anthony Horton[3], Sergio Leon-Saval[1], Geraint Lewis[1], Á. R. López-Sánchez[3,4], Seong-Sik Min[1], Christopher Trinh[1], Holly Trowland[1]

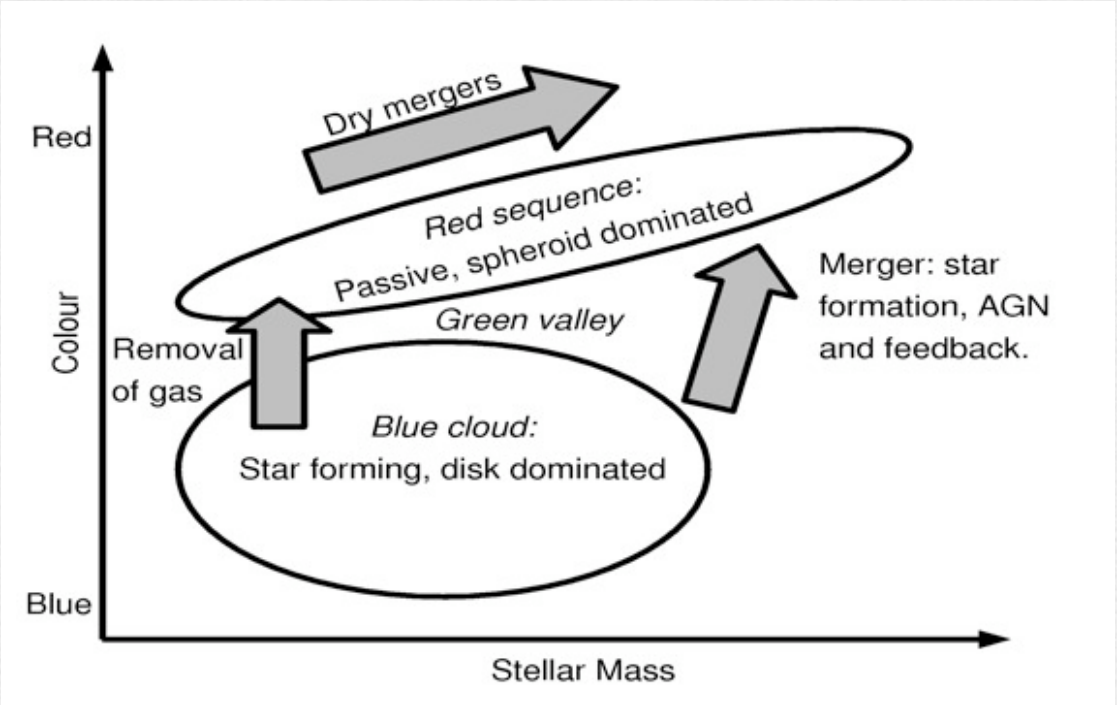
[1] *Sydney Institute for Astronomy (SIfA), School of Physics, University of Sydney, NSW 2006, Australia*
[2] *ARC Centre of Excellence for All-sky Astrophysics (CAASTRO)*
[3] *Australian Astronomical Observatory, PO Box 296, Epping, NSW 1710, Australia*
[4] *Department of Physics and Astronomy, Macquarie University, NSW 2109, Australia*
[5] *School of Physics, Monash University, Clayton, VIC 3800, Australia*

Why do we need multi-object IFUs?

- 2dFGRS, SDSS, GAMA and other single fibre surveys have supplied over 1.5 million redshifts in the local Universe

- But there is a large range of critical information which is simply not available from single fibre surveys

- Multi-object IFU surveys is the natural next step



★ The physics of galaxy formation

★ Which processes dominate in which regimes?

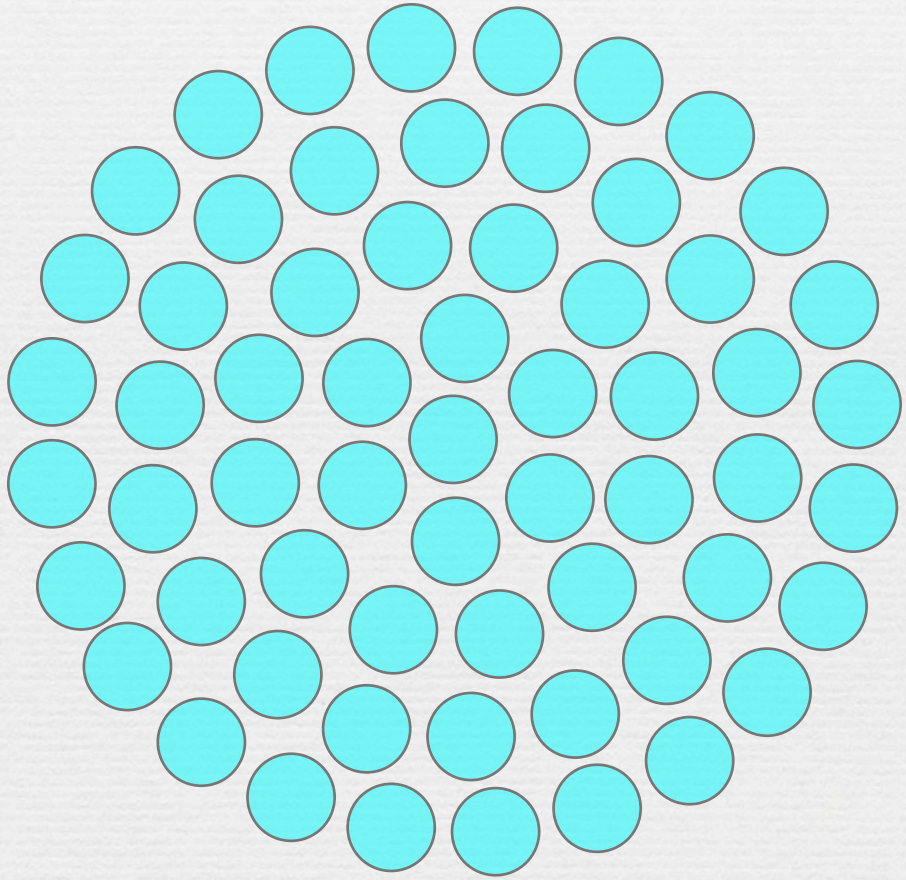
★ Moving from properties to processes….

SAMI 'hexabundle'

SDSS fibre

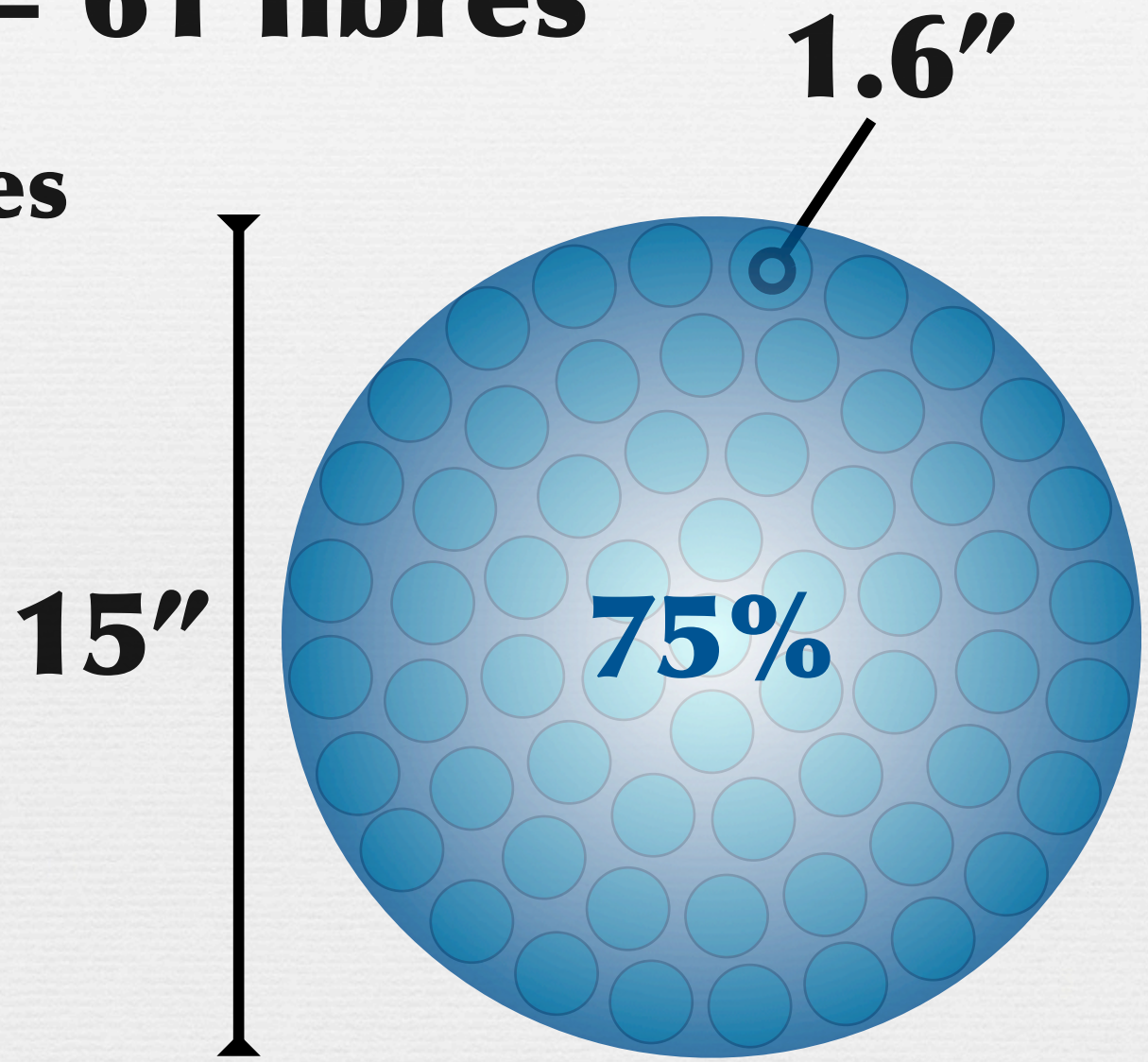
2dF fibre

SAMI bundle



SAMI 'hexabundle'
= 61 fibres

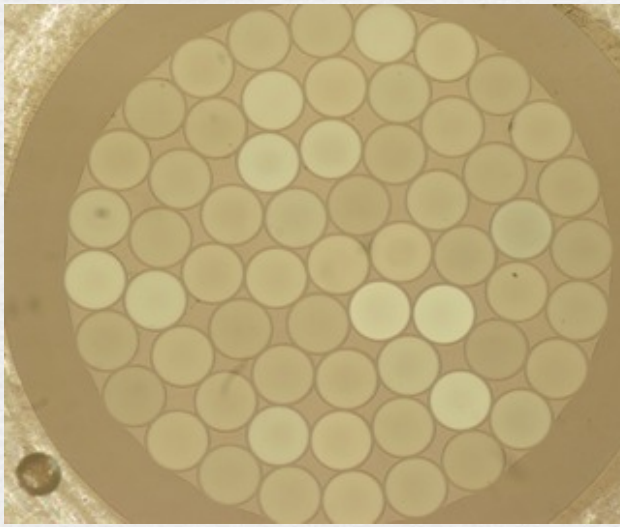
13 hexabundles in total

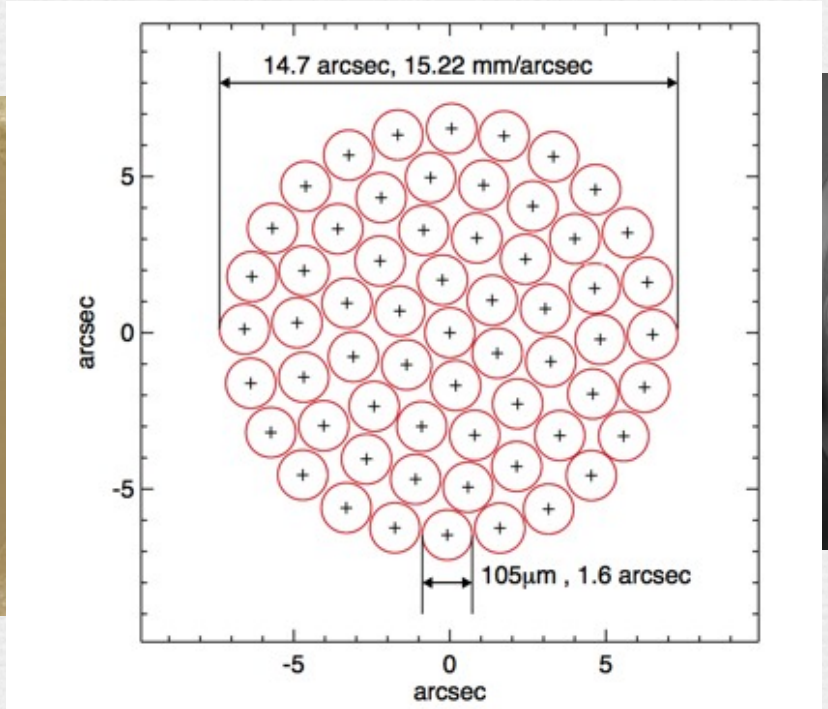


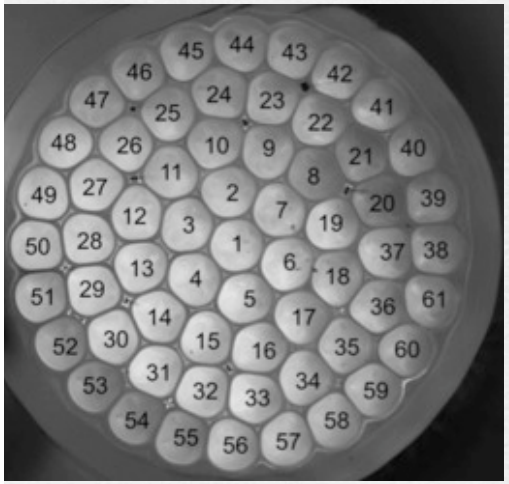
SAMI 'hexabundle'

- 13 x 61 fibre IFUs using hexabundles (Bryant et al. 2011; Bland-Hawthorn et al. 2011)

- Fibre IFUs without lenslet arrays that have high fill factor and can be handled similarly to single fibre (MOS) systems

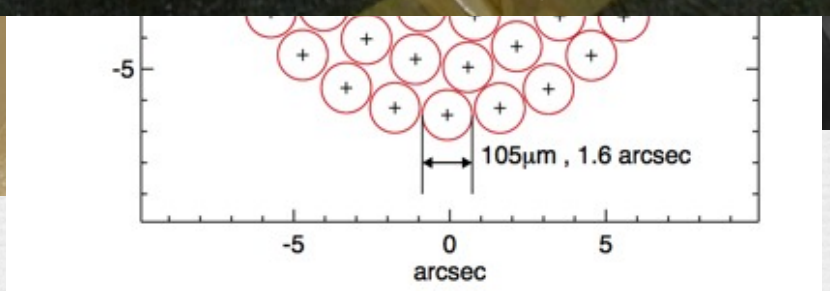


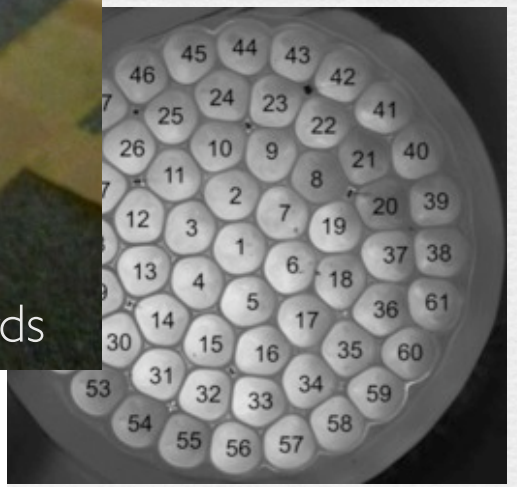




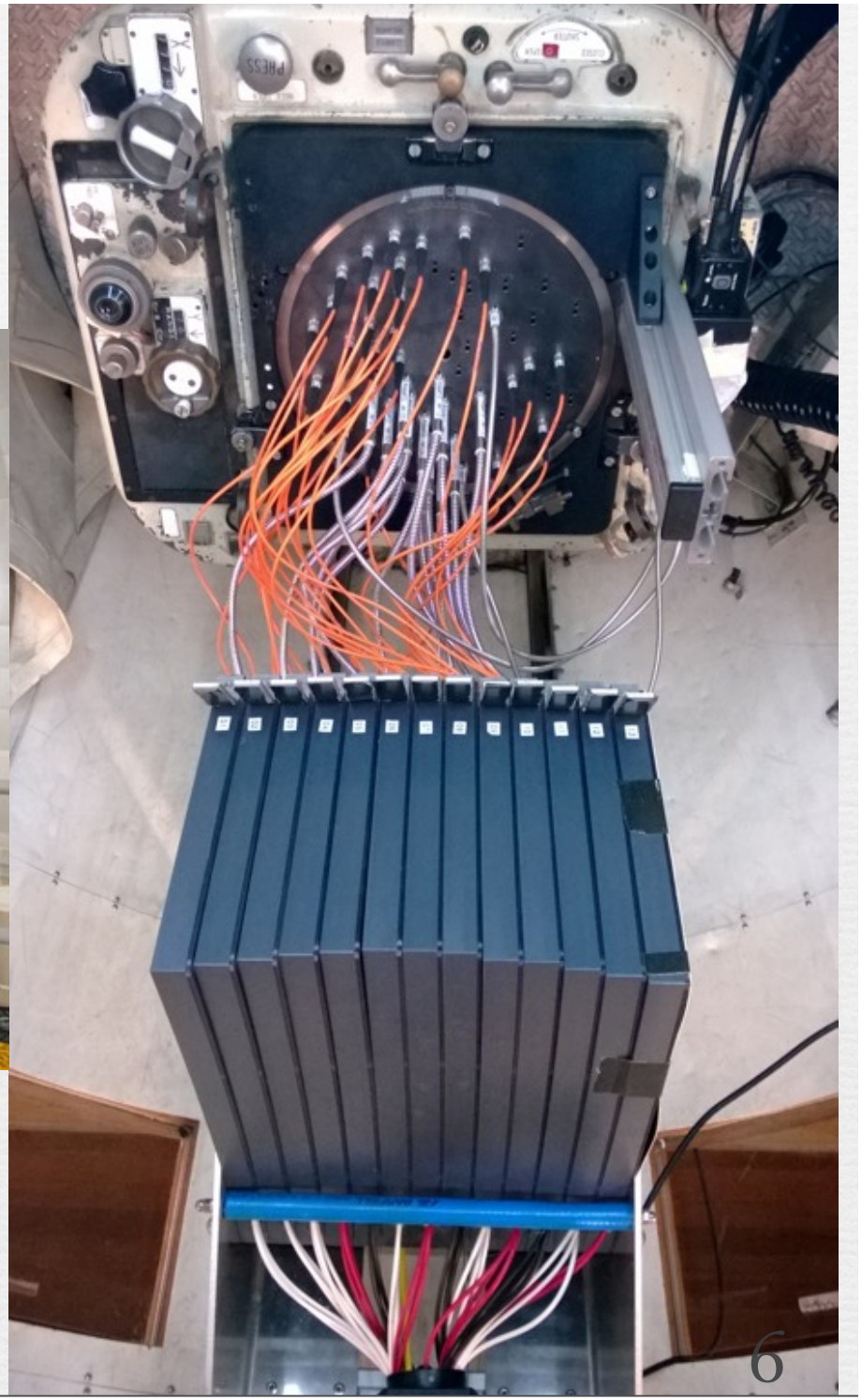
SAMI 'hexabundle'

- 13 x 61 fibre IFUs using hexabundles (Bryant et al. 2011; Bland-Ha
- Fi or and can be ha

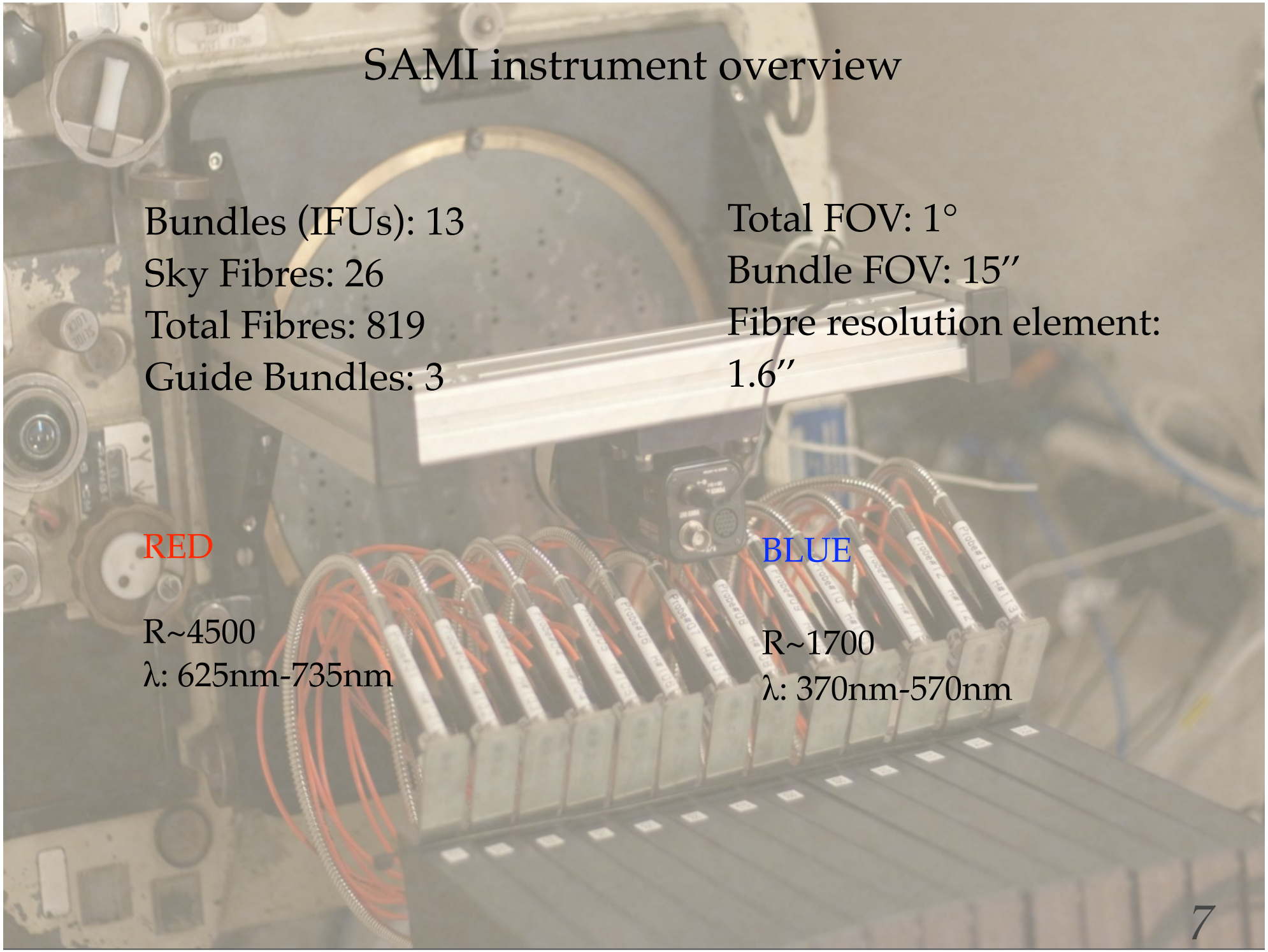




SAMI at the AAT



SAMI instrument overview



Bundles (IFUs): 13
Sky Fibres: 26
Total Fibres: 819
Guide Bundles: 3

Total FOV: 1°
Bundle FOV: 15″
Fibre resolution element: 1.6″

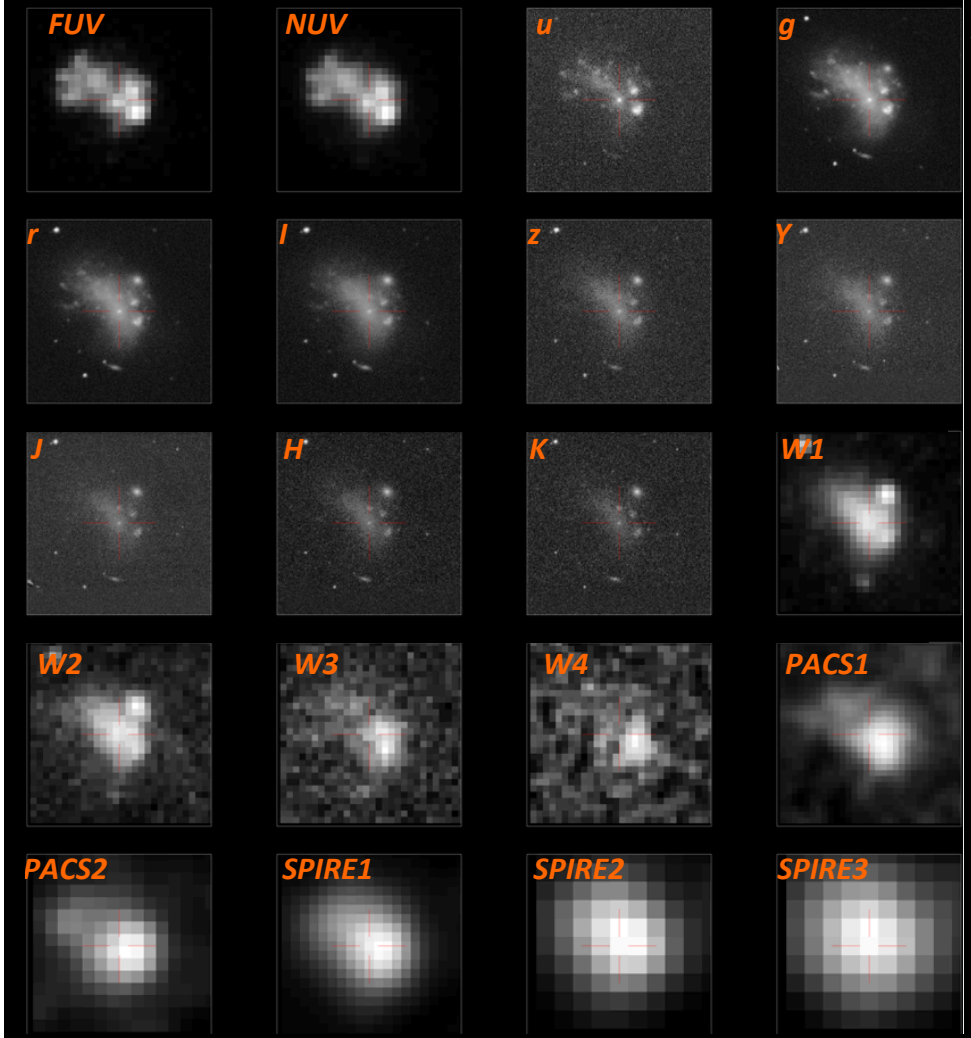
RED

R~4500
λ: 625nm-735nm

BLUE

R~1700
λ: 370nm-570nm

SAMI survey design



GAMA Galaxy G144491 (z=0.005, r_{AB}=14.08)
[GALEX+SDSS+UKIDSS+WISE+HERSCHEL]

★ Primary fields are the Galaxy And Mass Assembly (GAMA; Driver et al. 2010) regions

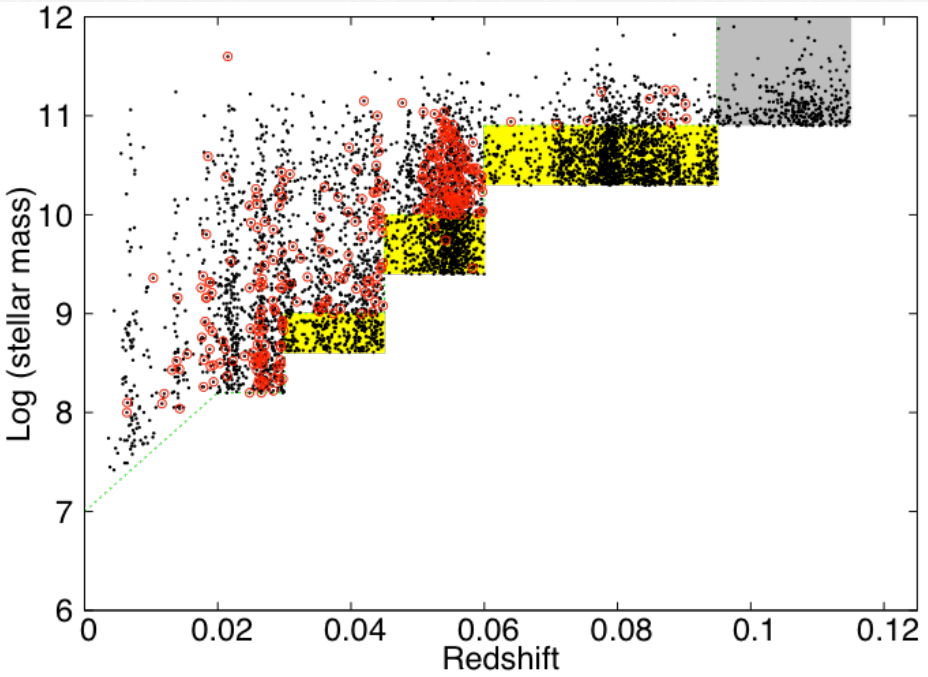
- Three 5x12 deg equatorial regions at 9hr, 12hr and 15hr RA
- Deep, complete, spectroscopy to r=19.8 to define environment
- Robust group catalogue (Robotham et al. 2011)
- FUV, NUV, ugriz, YJHK, WISE, HERSCHEL
- HI 21cm from ALFALFA (half the area), and in the future ASKAP

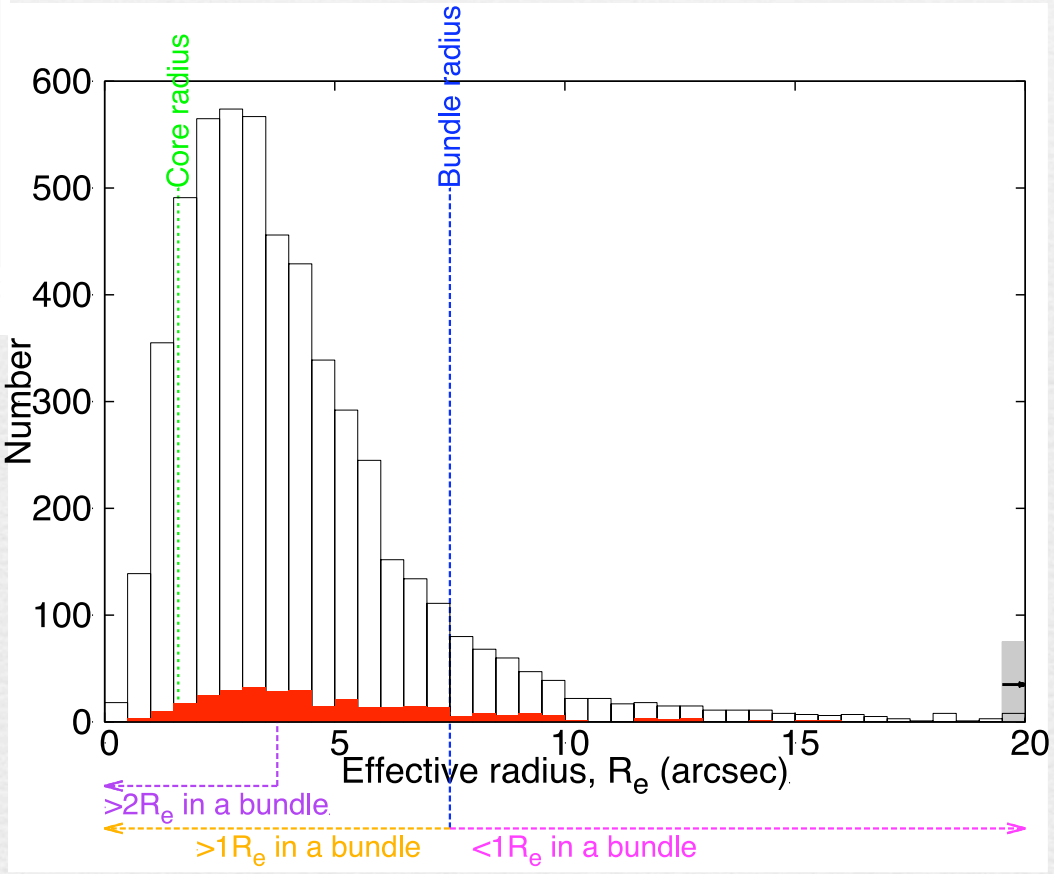
★ Specific galaxy cluster fields targeted to probe the highest density regions

- Cluster sample drawn from 2dFGRS and SDSS

SDSS 2dFGRS GAMA

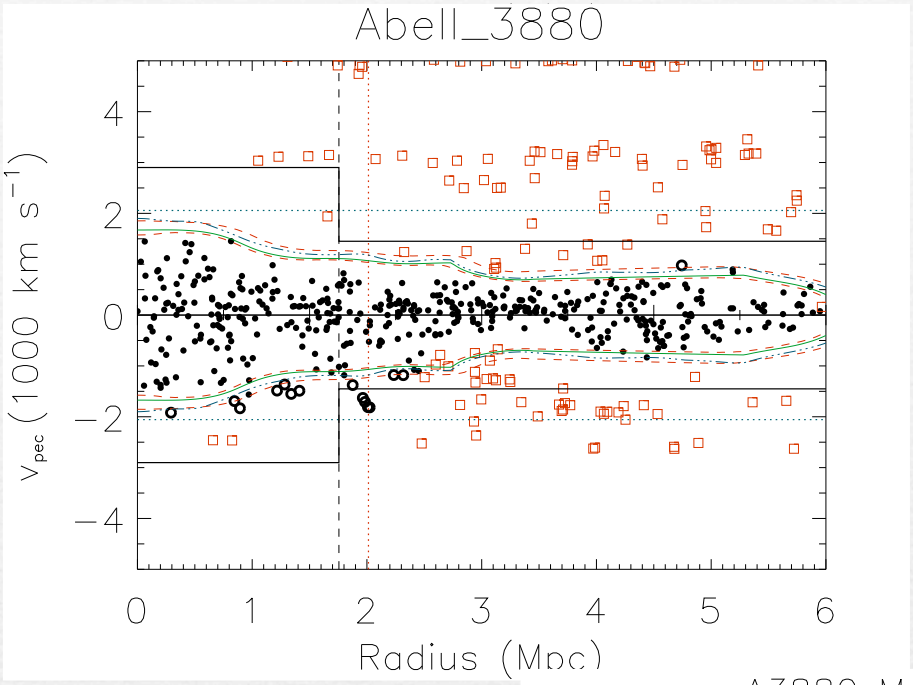
SAMI main galaxy survey

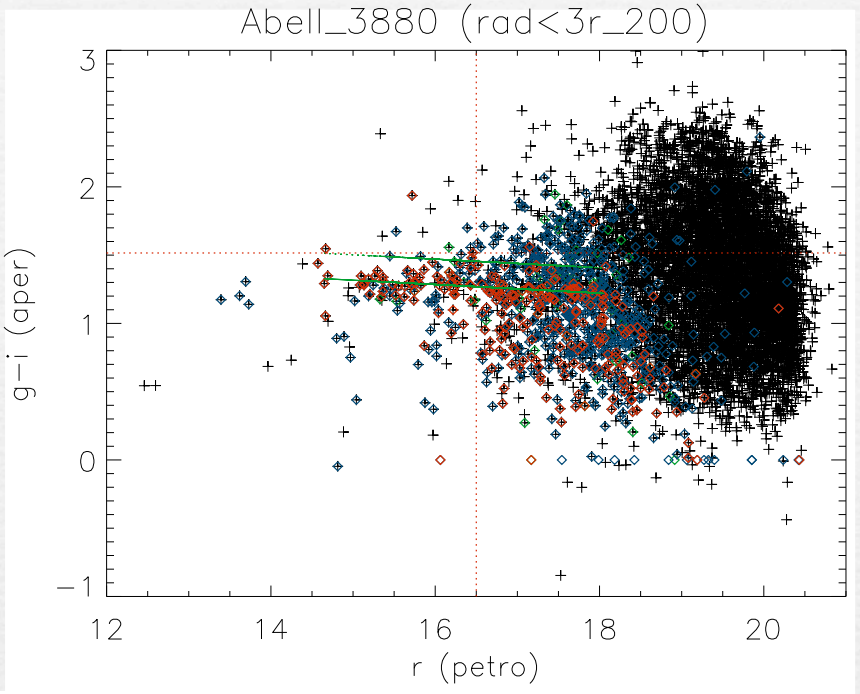


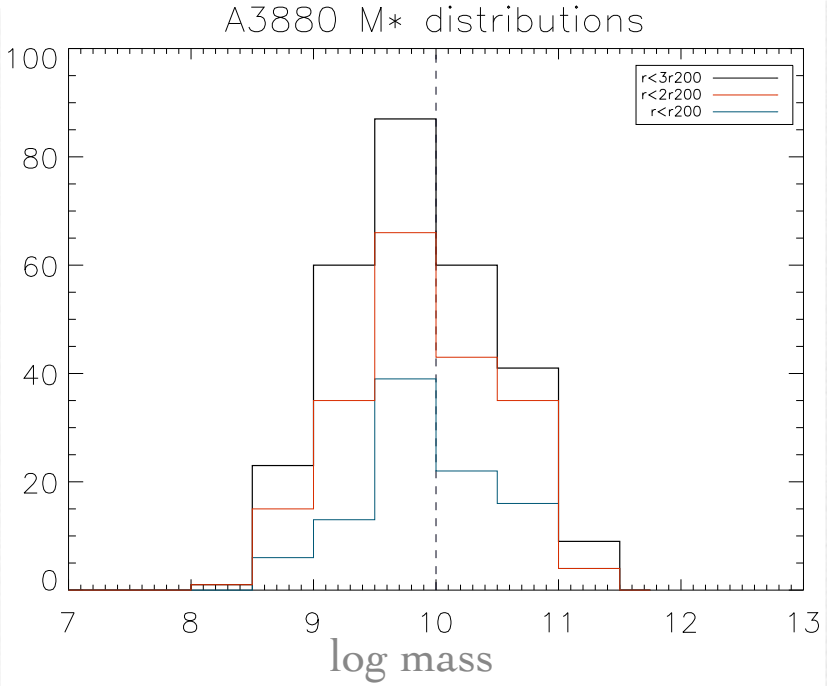


Slide from Julia Bryant (USyd)

SAMI cluster redshift survey







The goals of the SAMI galaxy survey

★ The physical processes responsible for environmental transformations:

- Ram pressure stripping; harassment, strangulation; galaxy–group/cluster tides; galaxy-galaxy mergers; galaxy-galaxy interactions…

★ 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; the role of AGN…

- Important synergies with ASKAP HI surveys

★ Build up of mass and angular momentum:

- Stellar mass in dynamically hot and cold systems; "total" dynamical mass; lensing mass from velocity field shear; Tully-Fisher relation…

★ Location of star formation

★ Stellar ages & metallicities, gas phase metallicities

★ Mapping the impact of dust via extinction and reddening

★ Fixing the biases in single fibre spectroscopy

SAMI: Team Affiliations and Structure

PI: A/Prof. Scott Croom (USyd) **Science coordinator:** Prof. Lisa Kewley (ANU)

Working groups/Heads

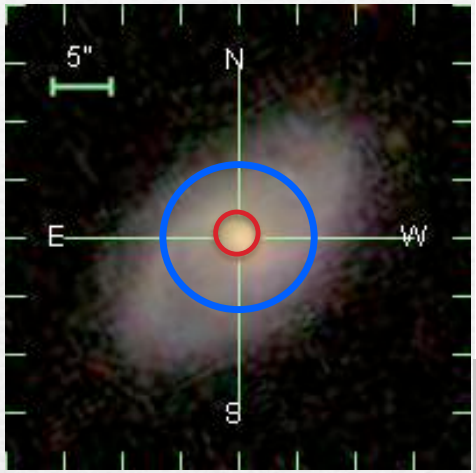
Data reduction	Target selection	Science strategy	Simulations	Quality control	Database
Dr Rob Sharp (ANU)	Dr Julia Bryant (USyd)	A/Prof Scott Croom (USyd)	Prof Geraint Lewis (USyd) +	Dr Jakob Walcher (AIP)	Dr Iraklis Konstantopoulos (AAO)

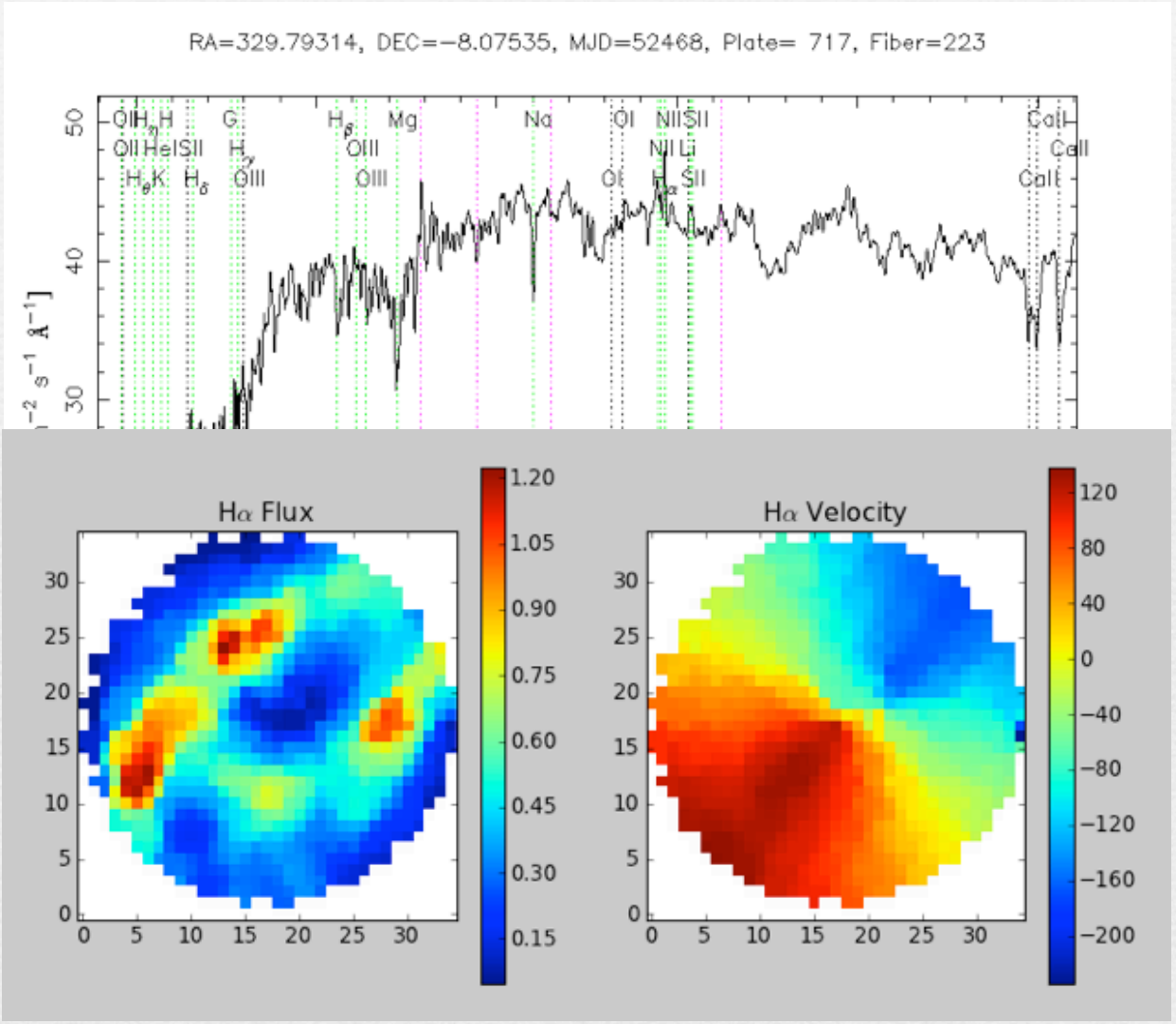
75 members

Team affiliations

Australian Astronomical Observatory (AAO)
Australian National University (ANU)
Australia Telescope National Facility, CSIRO
European Southern Observatory (ESO)
Durham University, ICC
Instituto de Astrofisica de Andalucia
Leibniz-Institut fuer Astrophysik Potsdam (AIP)
Leiden Observatory
LERMA, Observatoire de Paris
Liverpool JMU
Macquarie University
Rutgers University
Swinburne University of Technology
University of Sydney (USyd)
University of Western Australia
University of Wisconsin, Madison
University of North Carolina
University of Cape Town
University of Oxford
University of Melbourne
University of Queensland
University of Hawaii

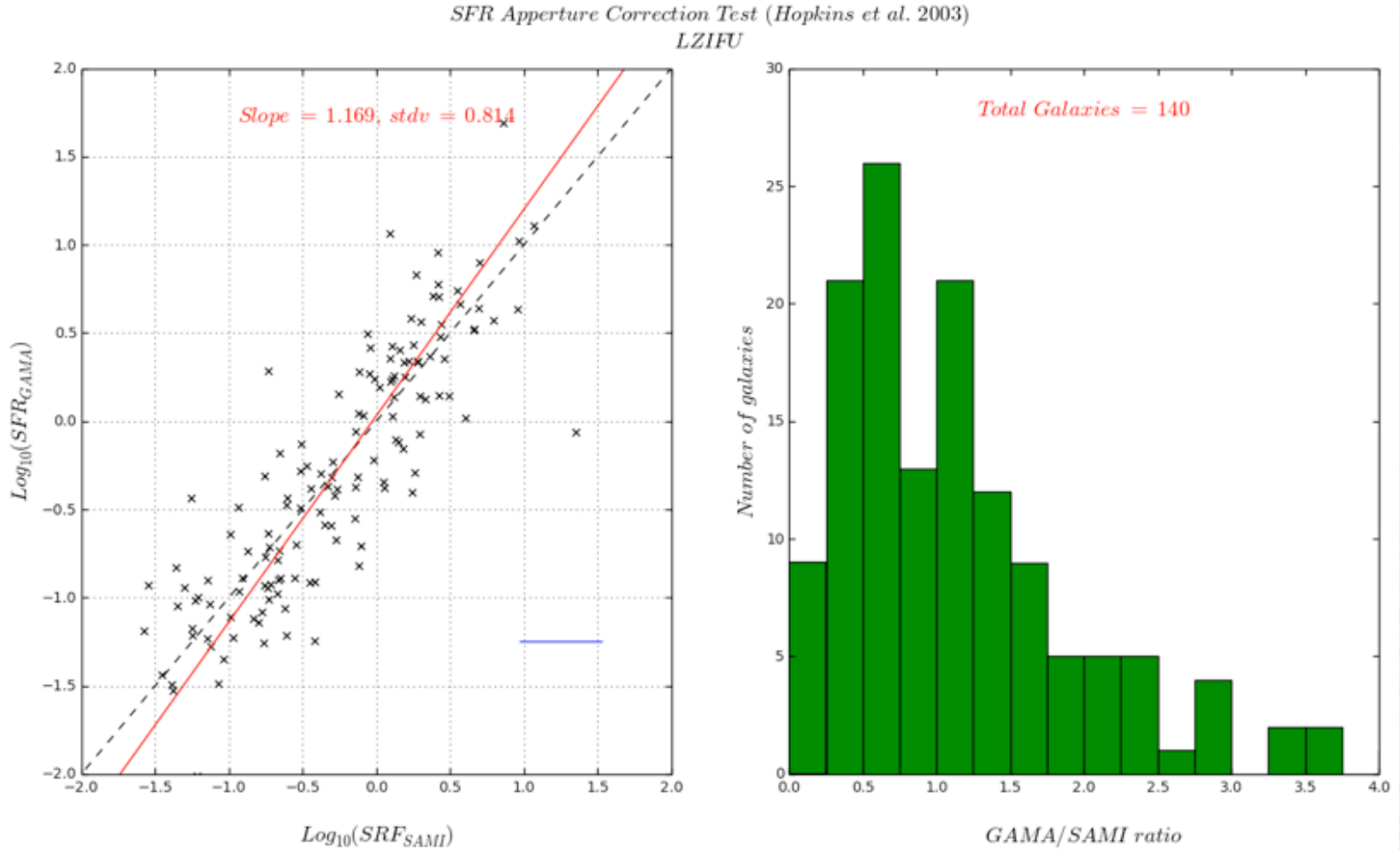
Location of star formation



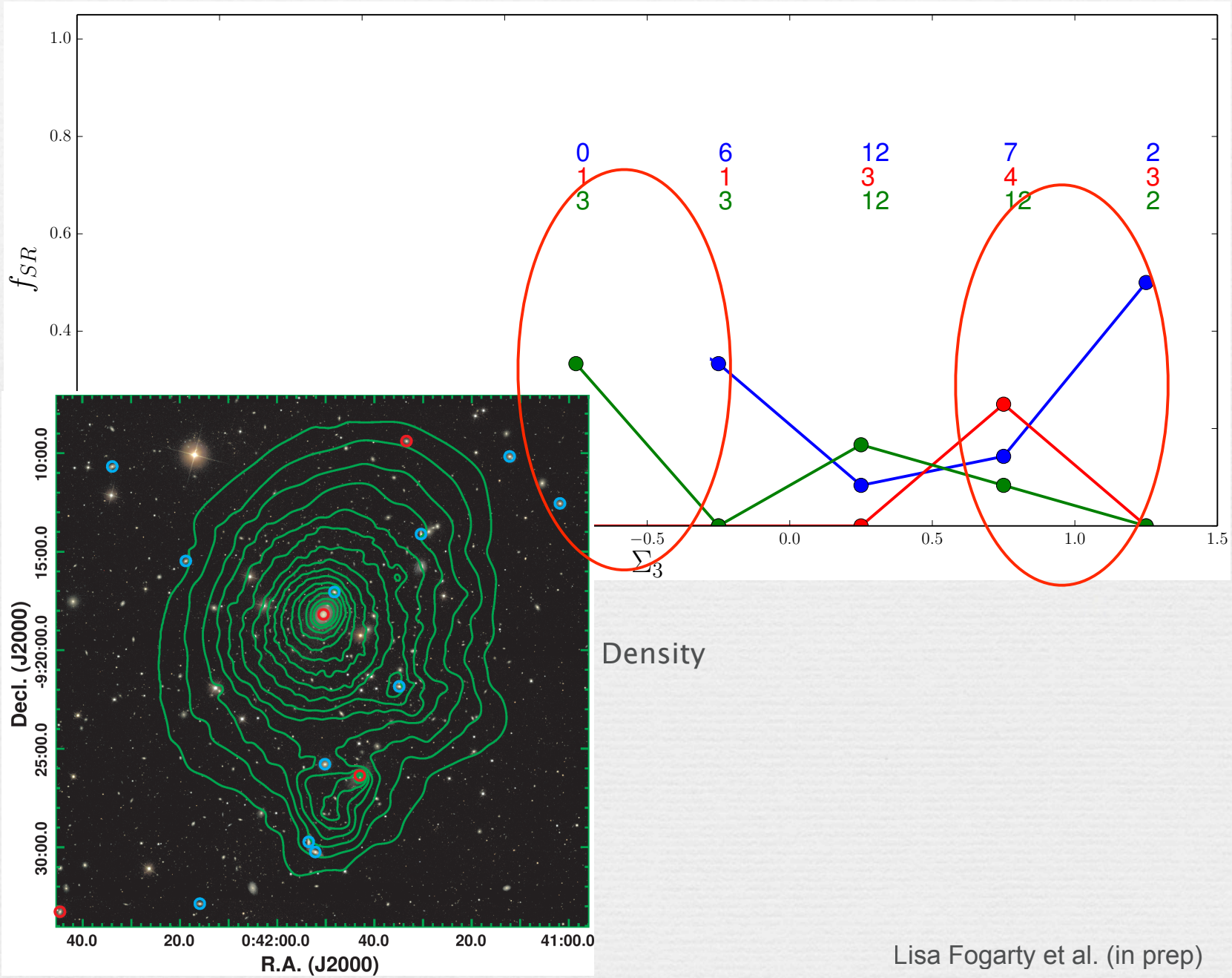


Probing the aperture corrections with SAMI

Samuel Richards et al. (in prep)



Kinematic morphology-density relation



Lisa Fogarty et al. (in prep)

Probing the prevalence of the shocks and outflows in star forming galaxies

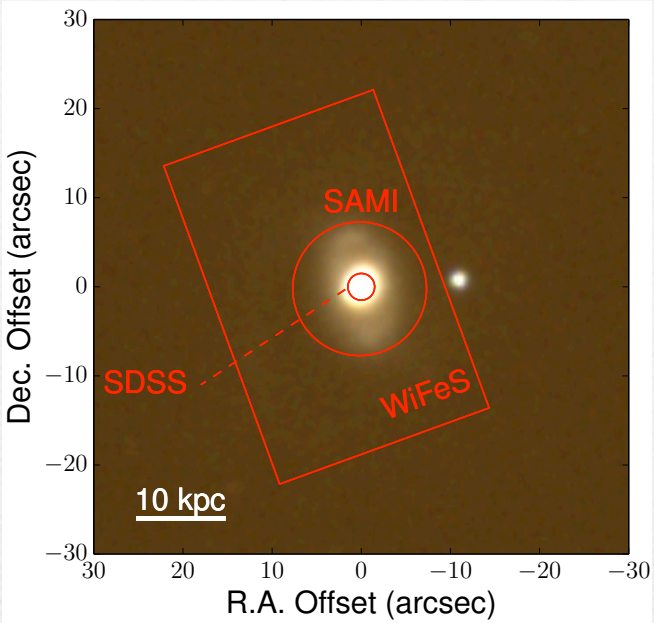
THREE-DIMENSIONAL INTEGRAL FIELD OBSERVATIONS OF 10 GALACTIC WINDS. I. EXTENDED PHASE ($\gtrsim$10 Myr) OF MASS/ENERGY INJECTION BEFORE THE WIND BLOWS

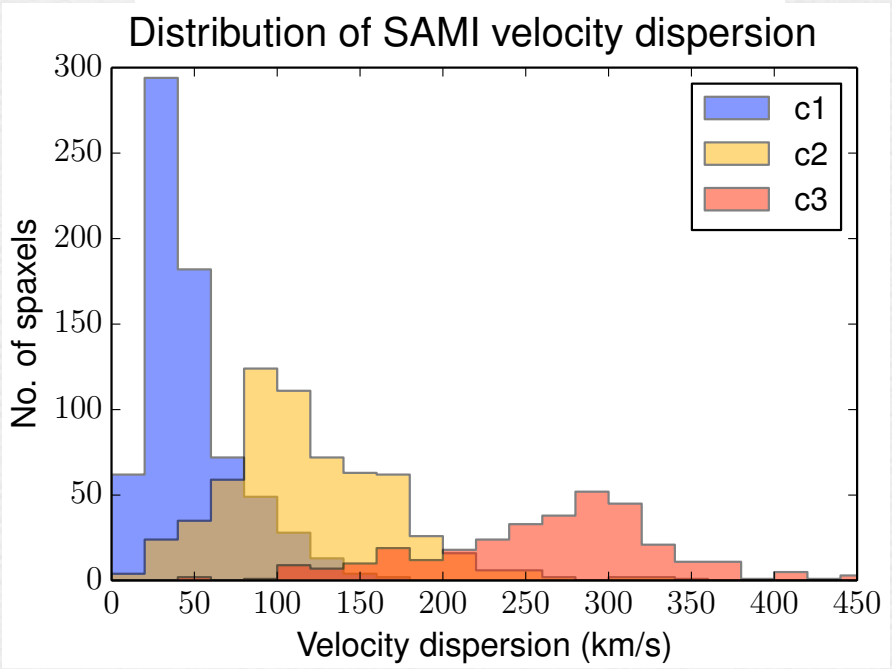
R. G. SHARP[1] AND J. BLAND-HAWTHORN[2,3,4]
[1] Anglo-Australian Observatory, P.O. Box 296, Epping, NSW 1710, Australia; rgs@aao.gov.au
[2] Sydney Institute for Astronomy, School of Physics A28, University of Sydney, NSW 2006, Australia
[3] Physics Department, University of Oxford, 1 Keble Rd, Oxford, OX1 3RH, UK; jbh@physics.usyd.edu.au
Received 2009 April 11; accepted 2010 January 25; published 2010 February 18

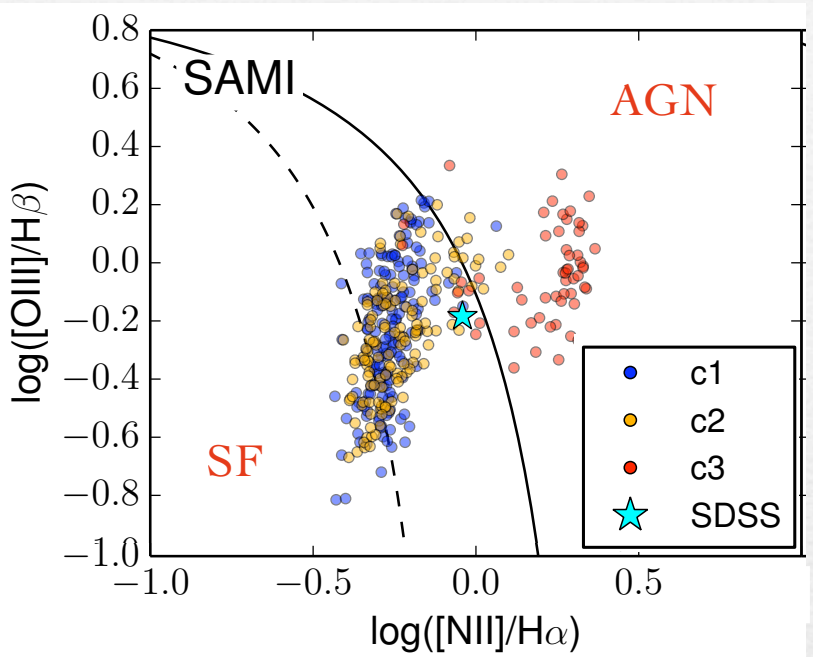
ABSTRACT

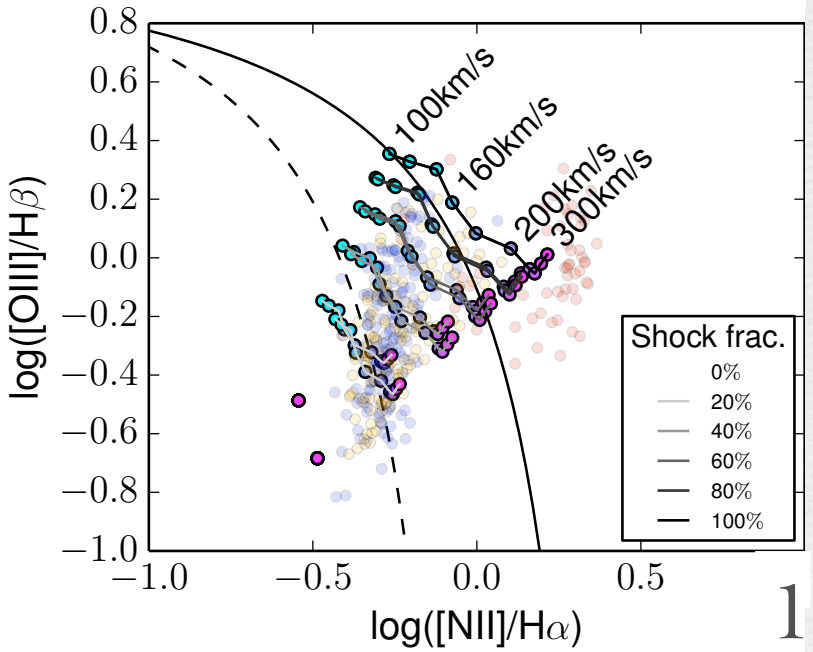
In recent years, we have come to recognize the widespread importance of large-scale winds in the life cycle of galaxies. The onset and evolution of a galactic wind is a highly complex process which must be understood if we are to understand how energy and metals are recycled throughout the galaxy and beyond. Here we present three-dimensional spectroscopic observations of a sample of 10 nearby galaxies with the AAOmega-SPIRAL integral-field spectrograph on the 3.9 m Anglo-Australian Telescope, the largest survey of its kind to date. The double-beam spectrograph provides spatial maps in a range of spectral diagnostics: [O III]5007, Hβ, Mg *b*, Na D, [O I]6300, Hα, [N II]6583, [S II]6717, 6731. We demonstrate that these flows can often separate into highly ordered structures through the use of ionization diagnostics and kinematics. All of the objects in our survey show extensive

Probing the prevalence of the shocks and outflows in star forming galaxies









I-Ting Ho et al. (in prep)

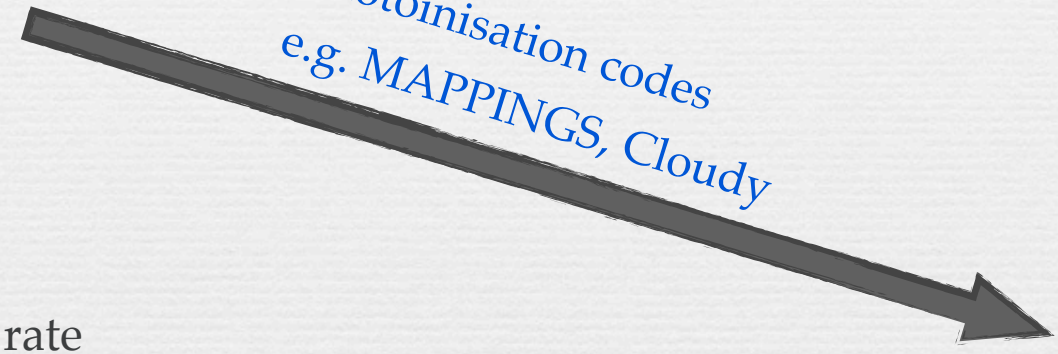
SAMI Simulations: Synthetic SAMI pipeline

★ Connecting the abundance of spatial and spectral information in SAMI observations with the detailed predictions of spatial, kinematic and thermal properties of gas and stars in simulations

Simulation snapshot:

Gas:

- kinematics
- composition
- temperature
- star formation rate

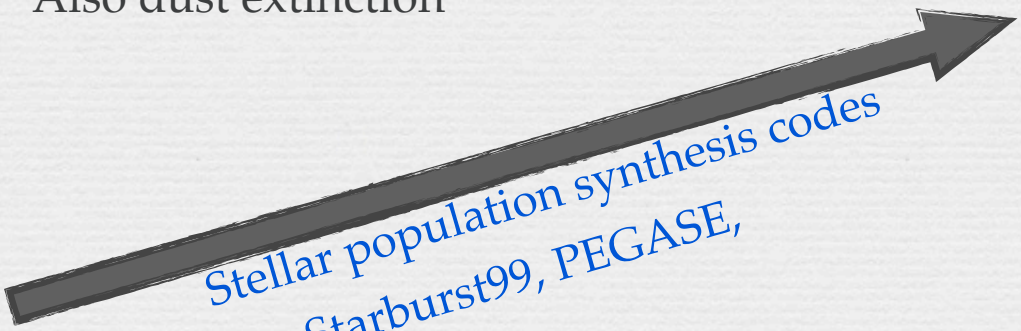


Also dust extinction

Synthetic Datacube

Stars:

- kinematics
- metallicity
- age

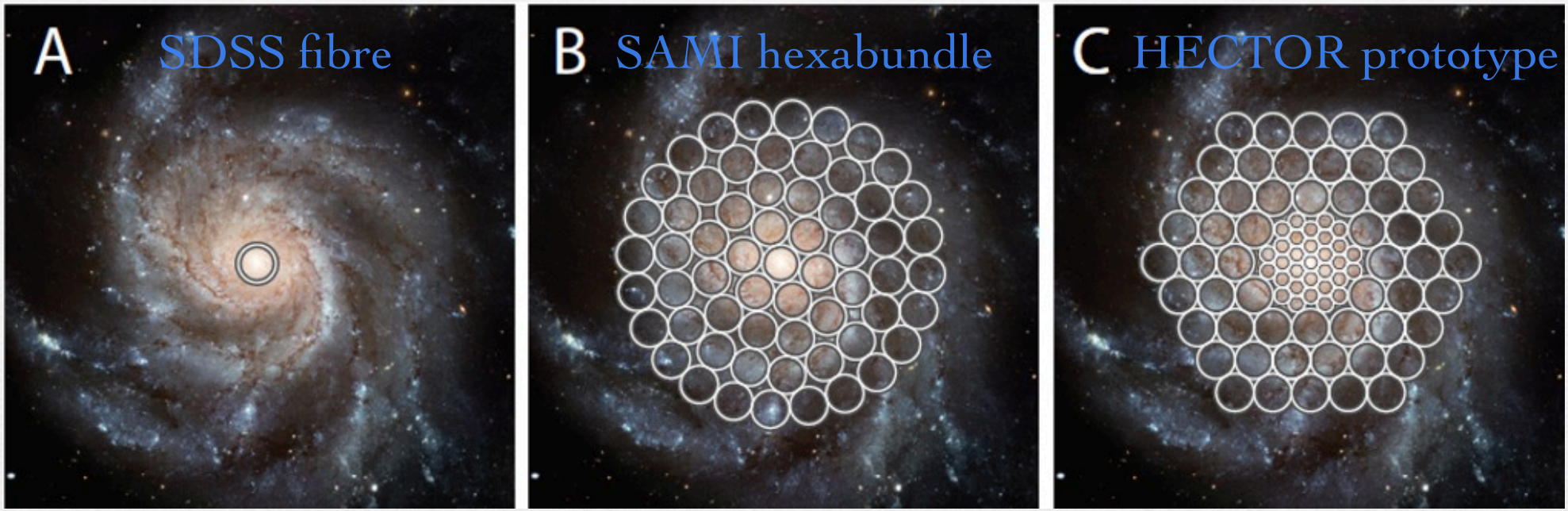


Slide from Luke Barnes (USyd)

SAMI: Current status

- ★ Commenced in May 2013
- ★ 3 year survey with ~175 nights awarded on AAT to observe 3400 galaxies, 4 hours exposure per field
- ★ ~650 galaxies already observed!, with 24 more nights in semester 14A
- ★ Over 50 SAMI and joint SAMI/GAMA science projects underway

Beyond SAMI... HECTOR

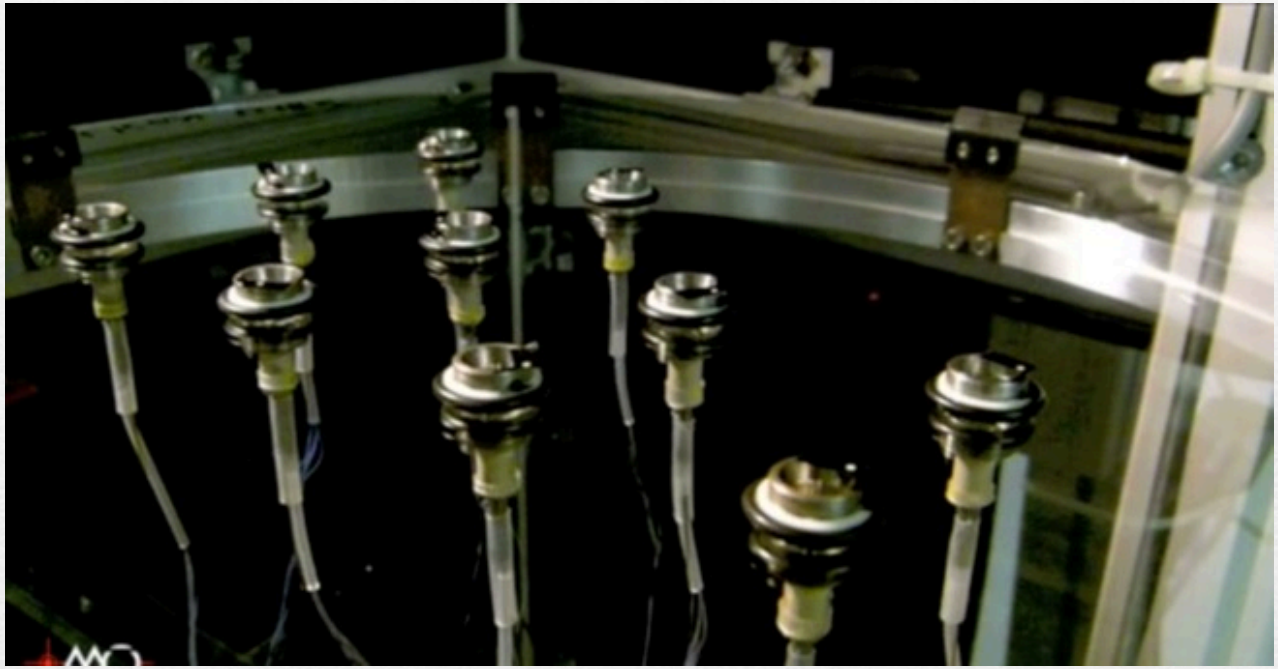


★ SAMI hexabundle (61 fibres x 13 bundles) 1.6″ per fibre

★ First HECTOR prototype (85 fibres x 12 bundles) 1.6″ outer and 0.8″ inner

★ Planned to be on sky by 2016A

Beyond SAMI... HECTOR



★ HECTOR bundles are carried by `starbugs' that move around a glass plate

★~100+ IFUs per pointing to obtain a goal of >100,000 galaxies

★ ~100 (IFUs) x 4 (fields per night) x ~400 (nights) x 0.66 (weather) ≈ 106,000 galaxies

The SAMI galaxy IFU survey

A/Prof. Scott Croom (Sydney University) and the SAMI team

★ What is SAMI?

- A new generation multi-object IFU survey
- Has multi-wavelength data from GAMA and VST/ATLAS

★ SAMI update

- SAMI commenced on May 2013
- ~650 galaxies observed so far
- 24 more nights of observing to go in this semester

★ How you can get involved:

- First SAMI data release is planned for later this year
- SAMI website: www.sami-survey.org