International Centre for Radio Astronomy Research

Lister Staveley-Smith

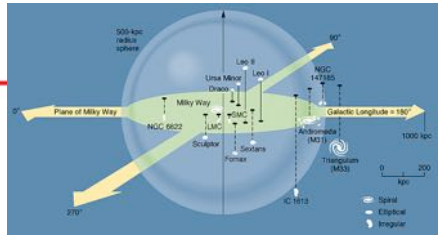
wallaby-survey.org

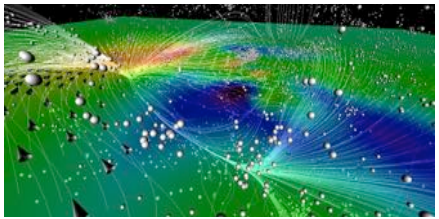
Outline

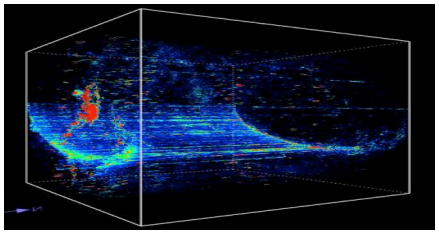
- HI surveys – science goals
- Wallaby
- Cosmic flows
- Northern counterparts
- TAIPAN synergies

Wallaby goals

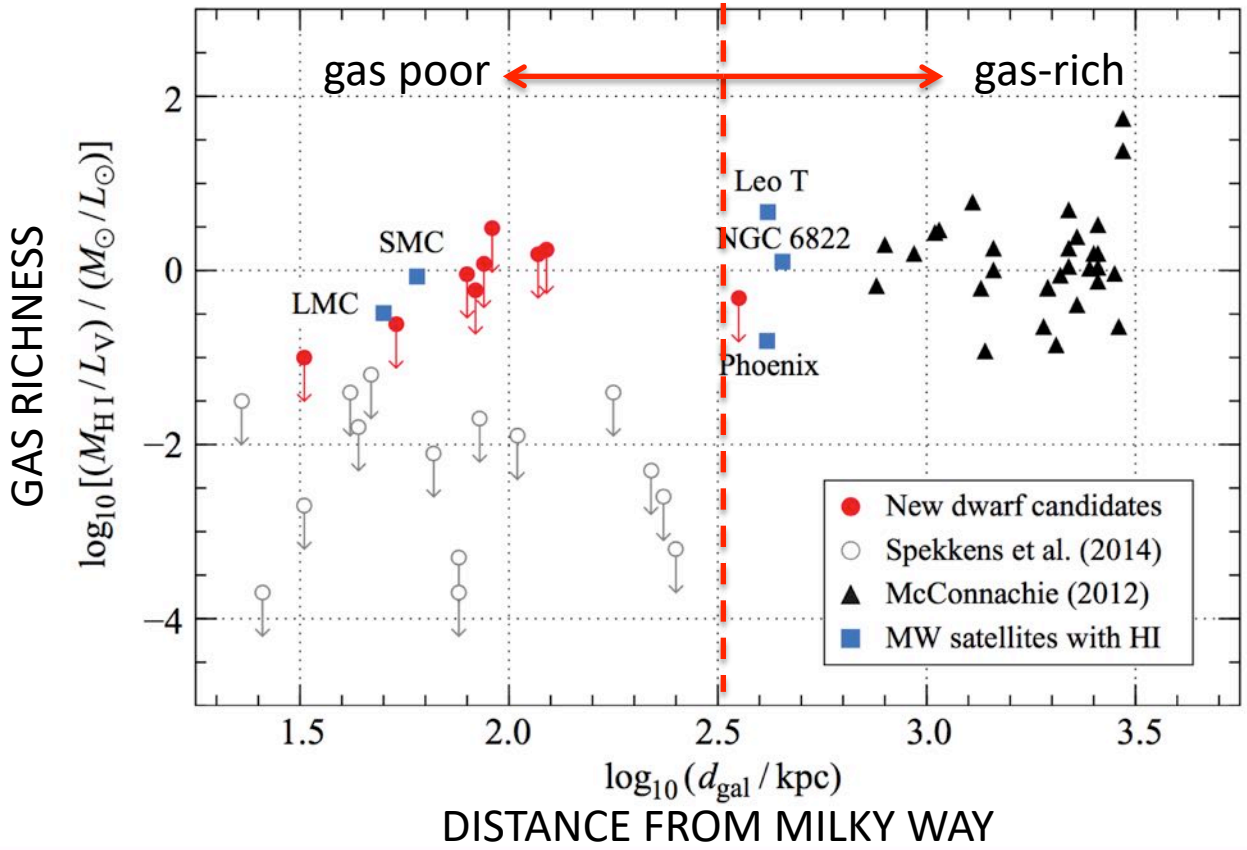
- **Local Group/Volume**
- Understanding Galaxies
- Cosmology
- Legacy







Environmental suppression



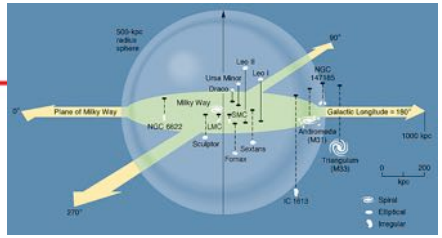
No transition (gas-bearing) galaxies within 300 kpc of Milky Way:

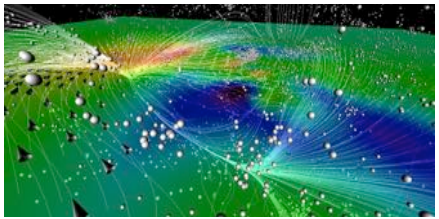
- stripping or ionization?

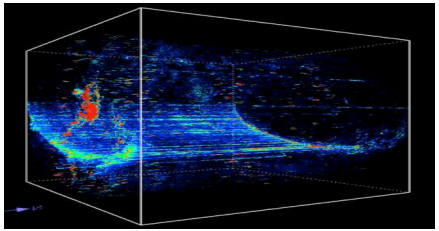
(Westmeier et al. 2015; Spekkens et al. 2014)

ASKAP Wallaby

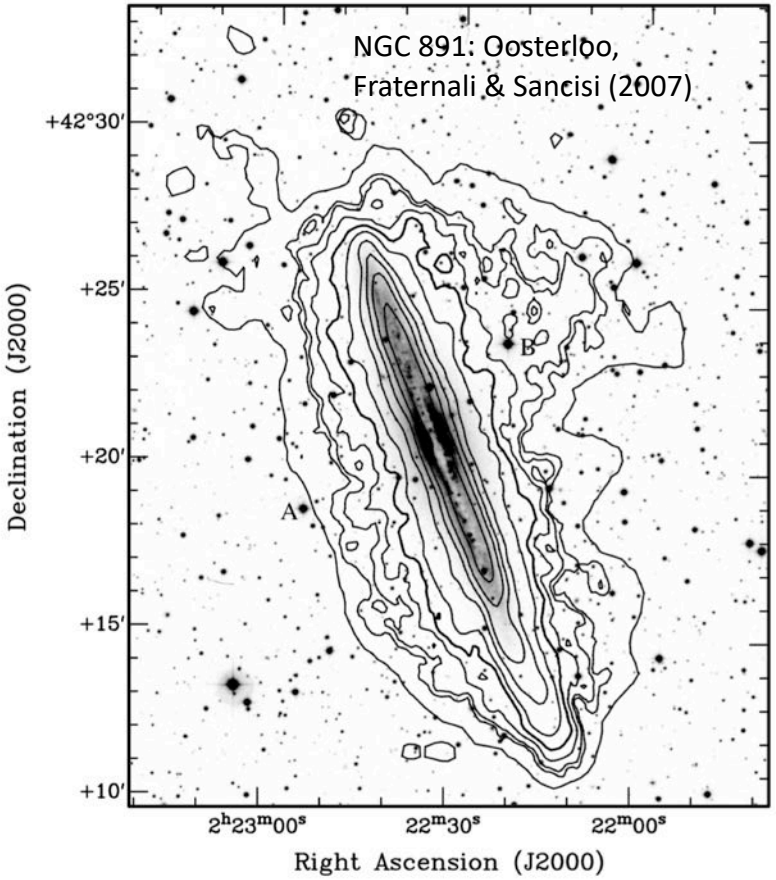
- Local Group/Volume
- **Understanding Galaxies**
- Cosmology
- Legacy

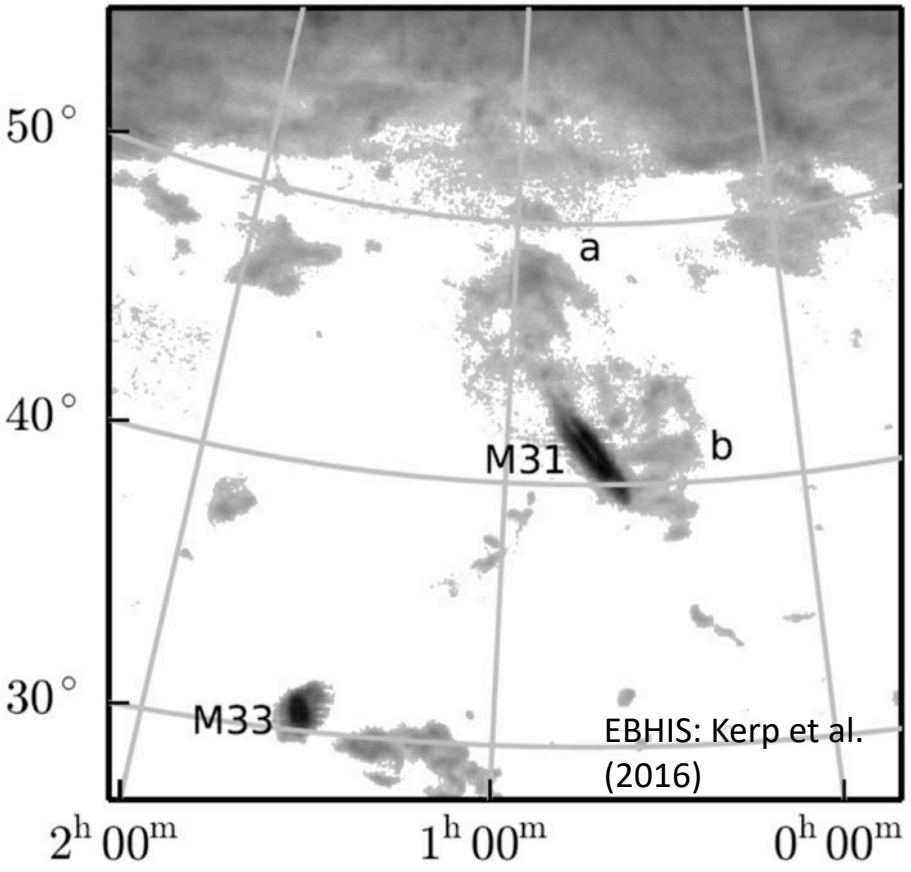




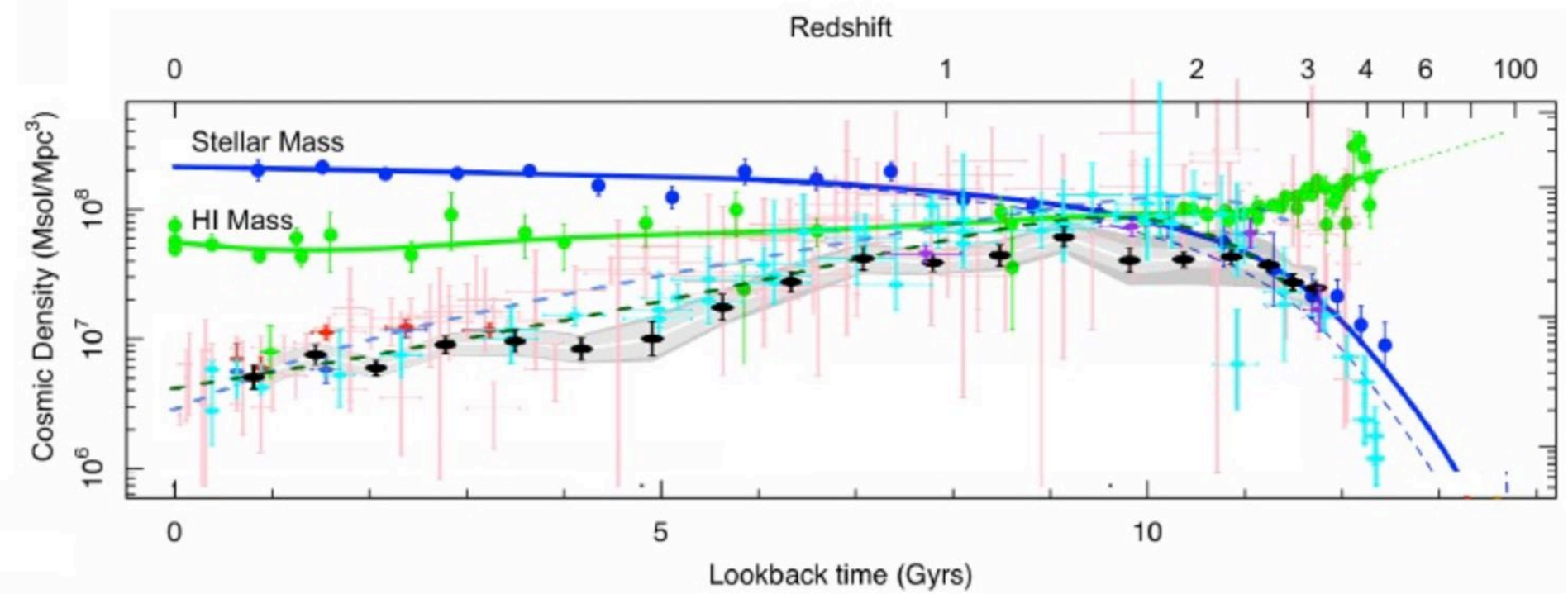


Gas accretion onto galaxies





Galaxy evolution



Driver et al. (2018)

ASKAP Wallaby

- Local Group/Volume
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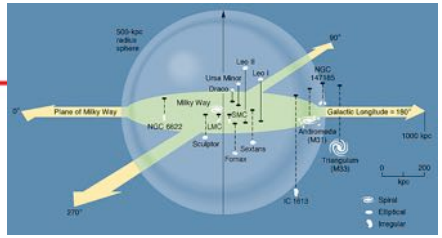
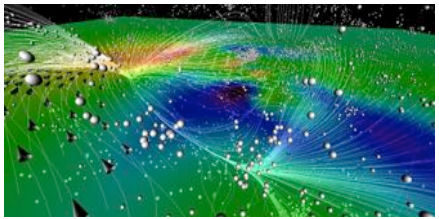
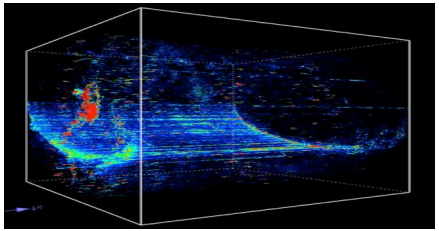
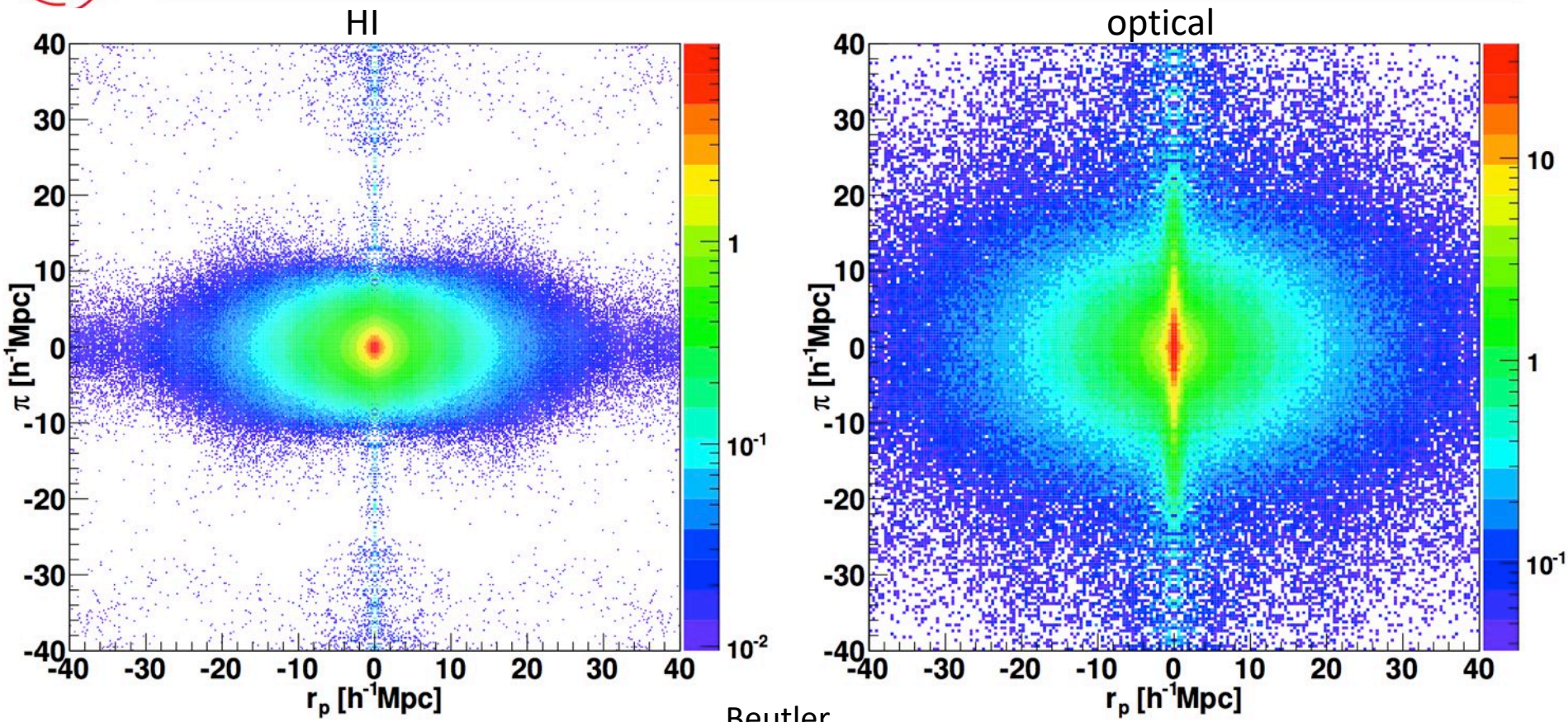
- **Cosmology**
- Legacy







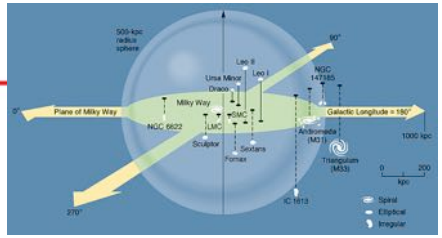
Redshift-space distortions

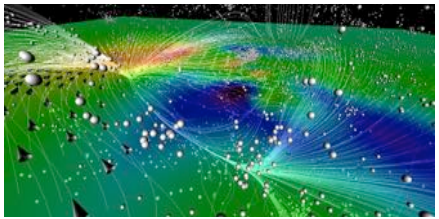


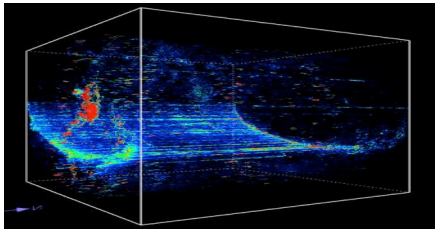
Beutler

ASKAP Wallaby

- Local Group/Volume
- Understanding Galaxies
- Cosmology
- **Legacy**





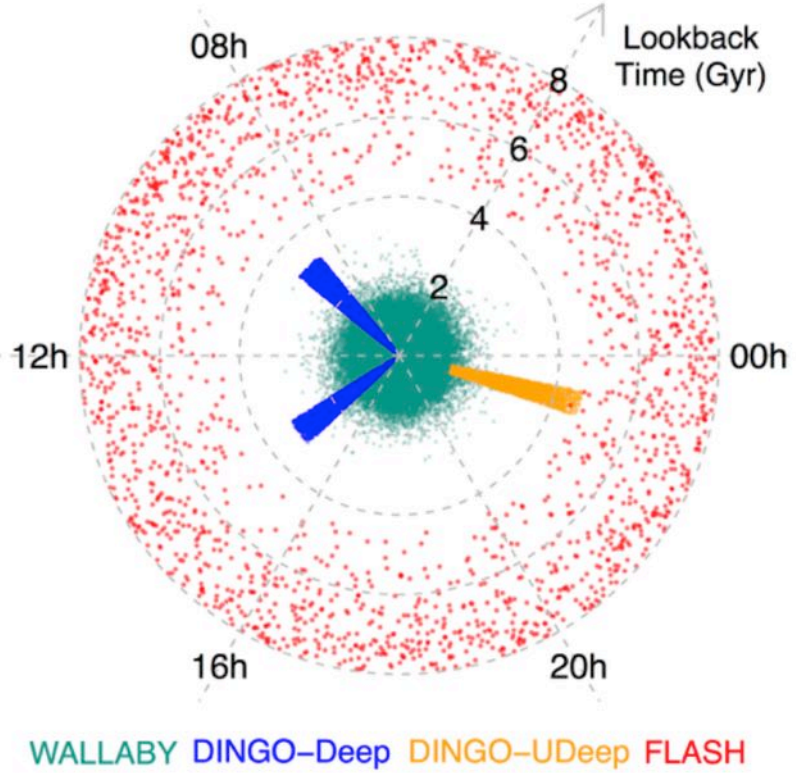


Comparison with other legacy surveys

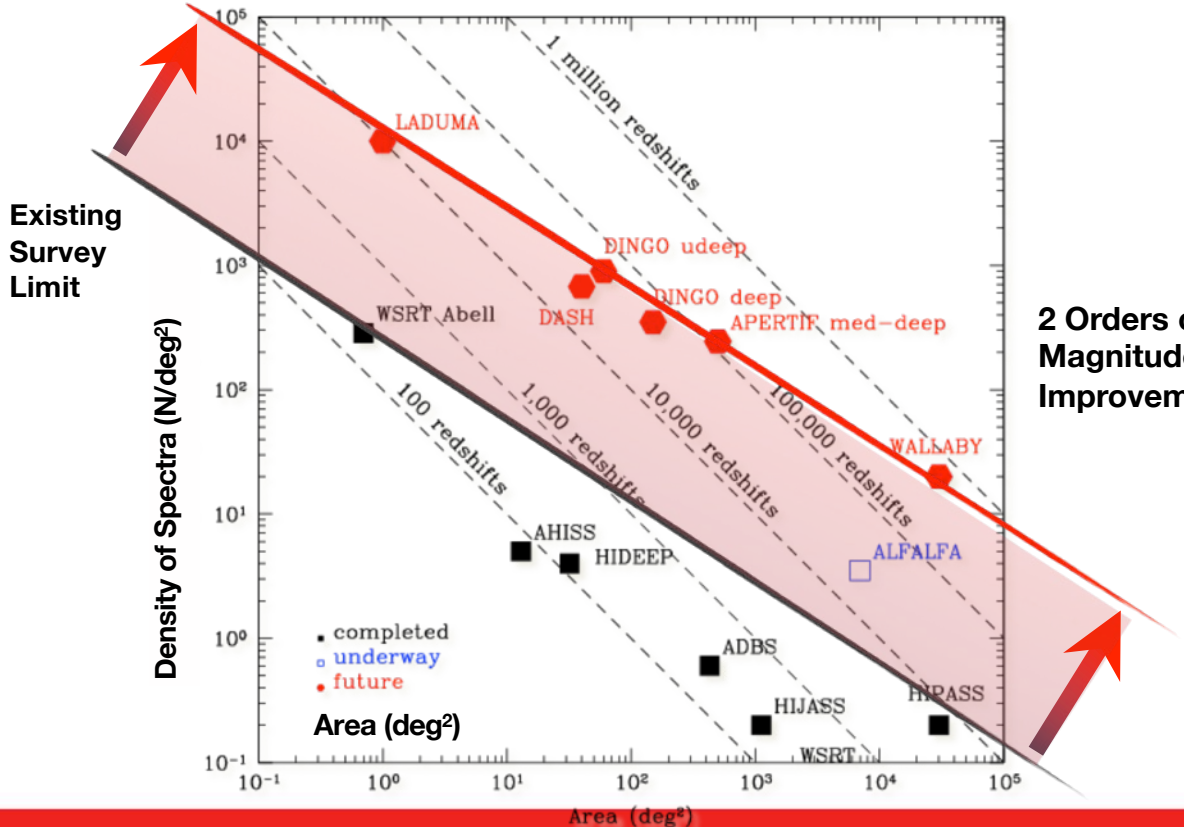
	WALLABY	HIPASS	ALFALFA
Area	3 π	2.8 π	0.7 π
Redshift	0 - 0.26	0 - 0.04	0 - 0.06
$rms_{20\ km/s}$	0.7 mJy/beam	13 mJy/beam	1.5 mJy/beam
Res	30 arcsec, 4 km/s	15 arcmin, 18 km/s	3.5 arcmin, 5 km/s
N_{det}	500,000	5,000	30,000

Wallaby = Widefield ASKAP L-band Legacy All-sky Blind surveY

ASKAP HI surveys

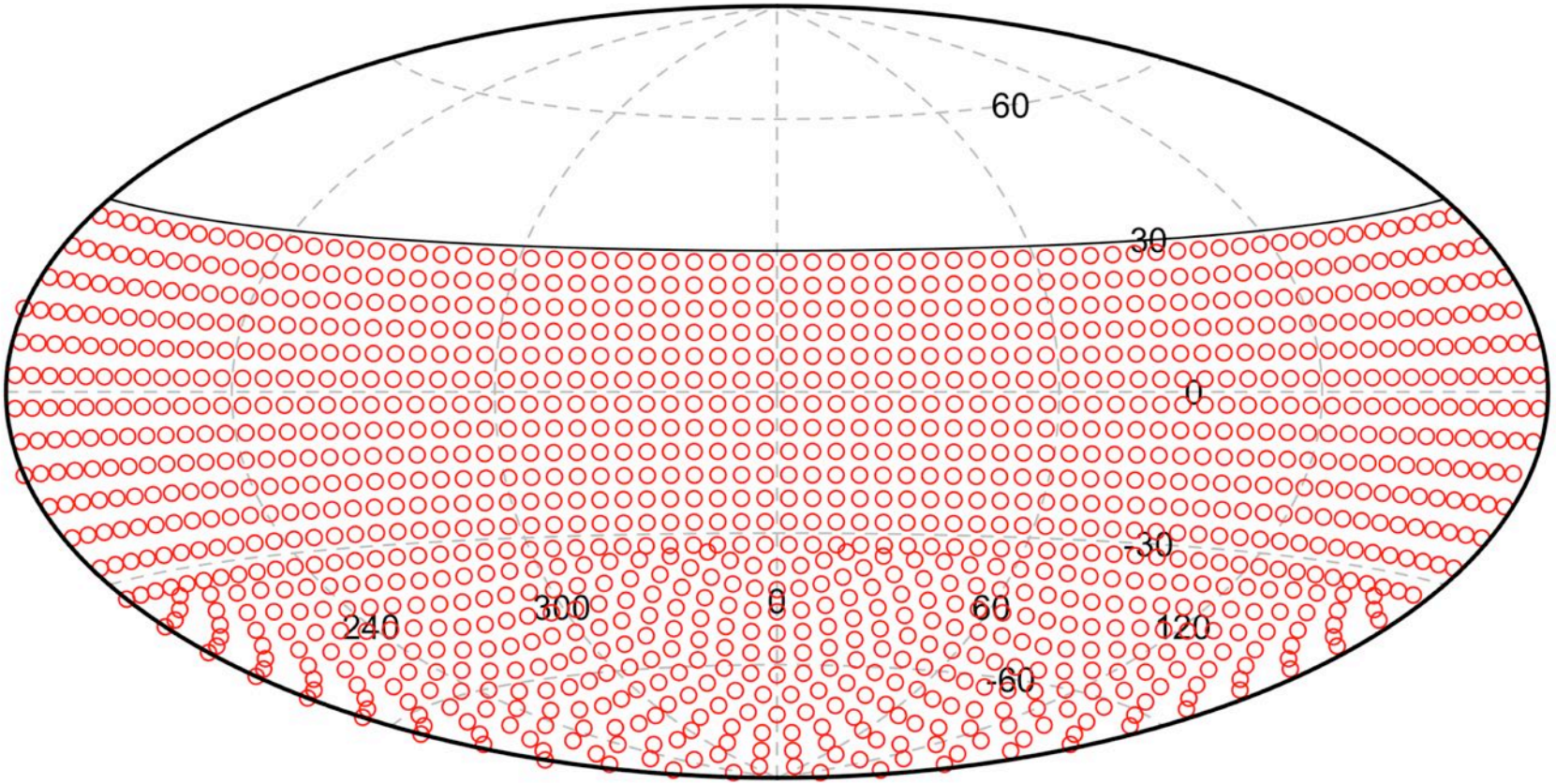


SKA pathfinder HI surveys:

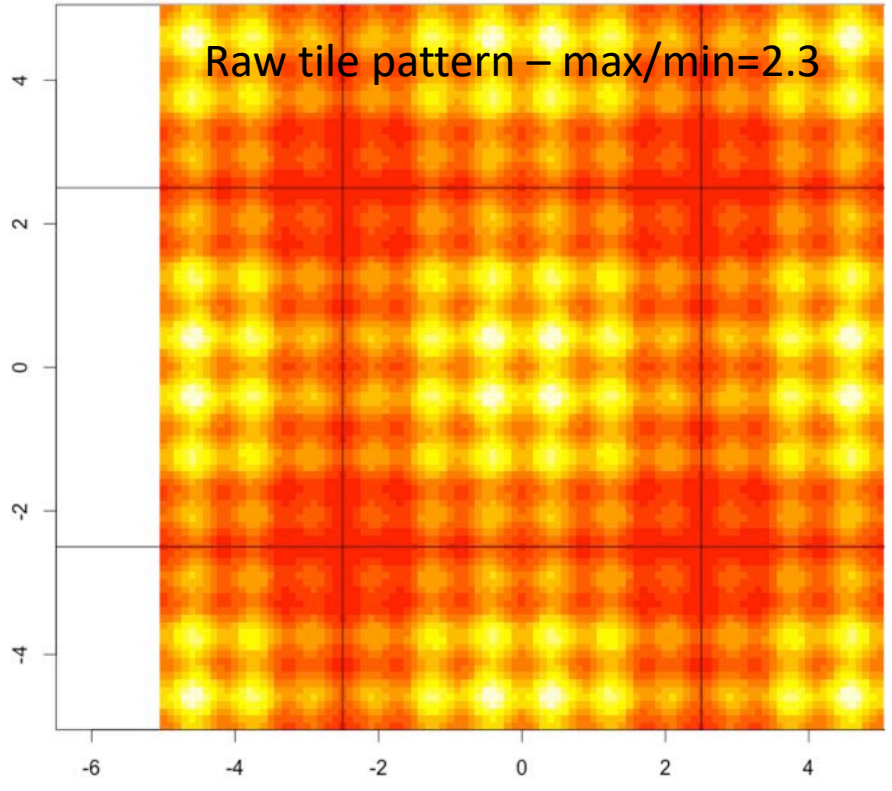


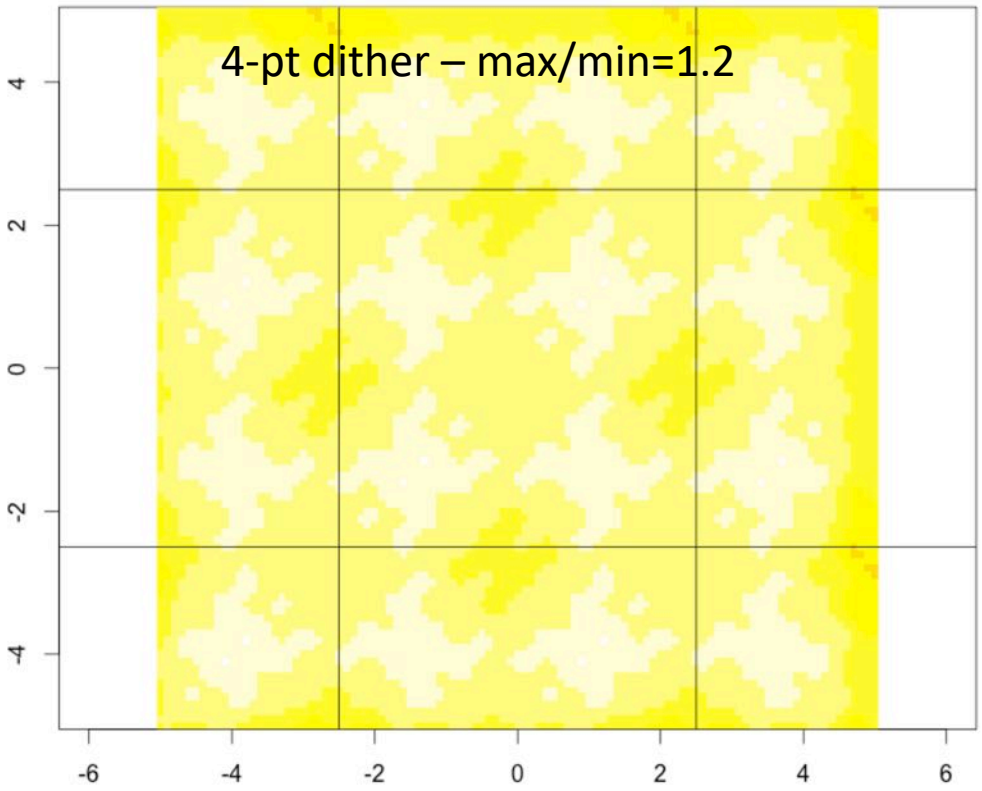
Meyer

Spherical cap tiling (Robotham)



Sensitivity images (Robotham)



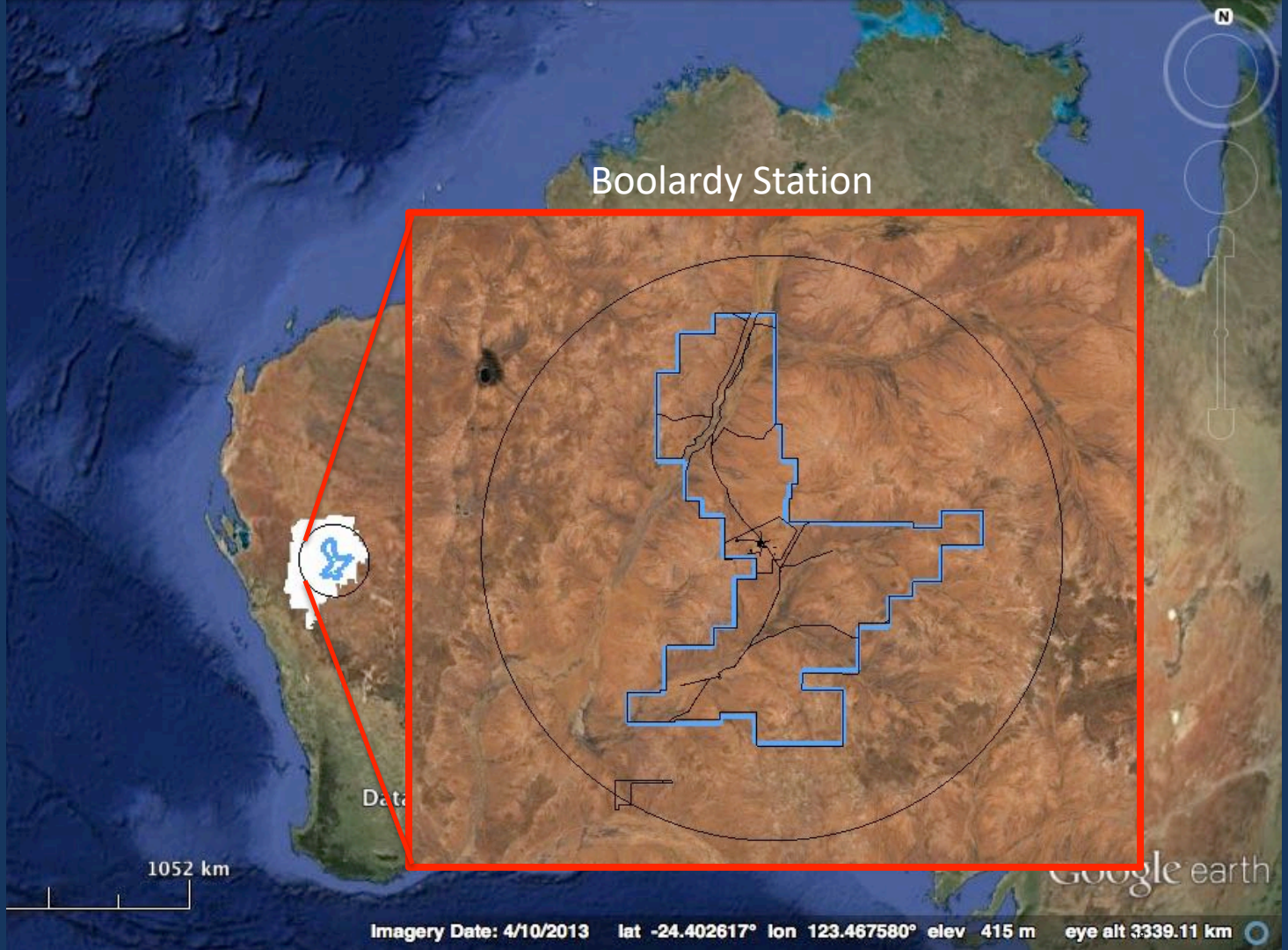


Australian SKA Pathfinder (ASKAP)

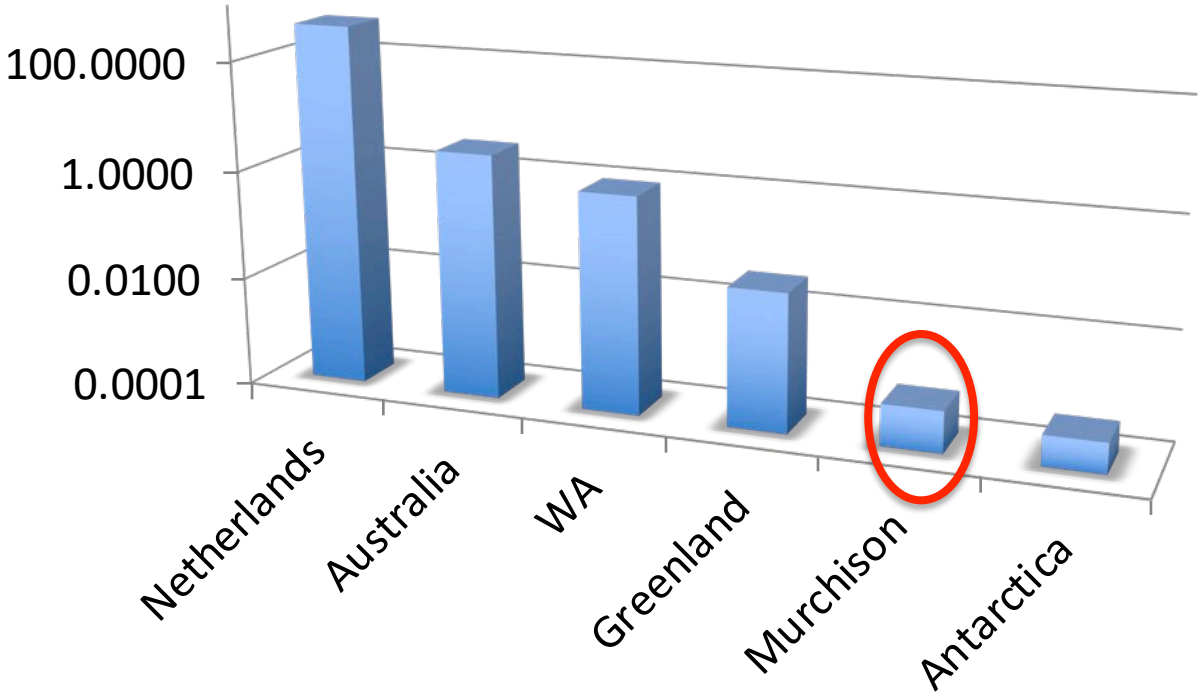
- Radio interferometer – 36 ×12-m dishes
- CSIRO Phased Array Feed (PAF) technology: 36 beams
- Frequency range 700 to 1800 MHz
- Instantaneous bandwidth 300 MHz
- Maximum baseline 6 km
- SKA precursor on a radio-quiet site
- Wallaby (HI) and EMU (continuum) are the two key survey science projects


N
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
1052 km
Google earth
Imagery Date: 4/10/2013 lat -24.402617° lon 123.467580° elev 415 m eye alt 3339.11 km


Murchison Shire
Netherlands
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
1052 km
Google earth
Imagery Date: 4/10/2013 lat -24.402617° lon 123.467580° elev 415 m eye alt 3339.11 km


Boolardy Station
1052 km
Imagery Date: 4/10/2013 lat -24.402617° lon 123.467580° elev 415 m eye alt 3339.11 km

Population density (people/km^2)

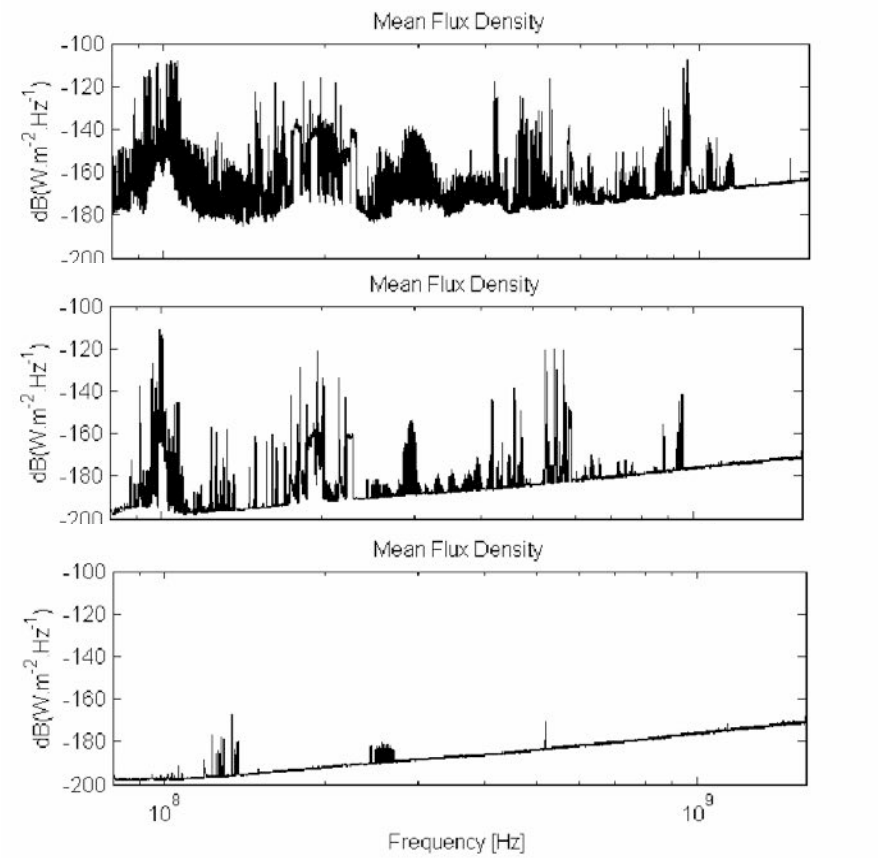


A radio-quiet site

Sydney:
Population 5M

Narrabri (ATCA):
Population 6,000

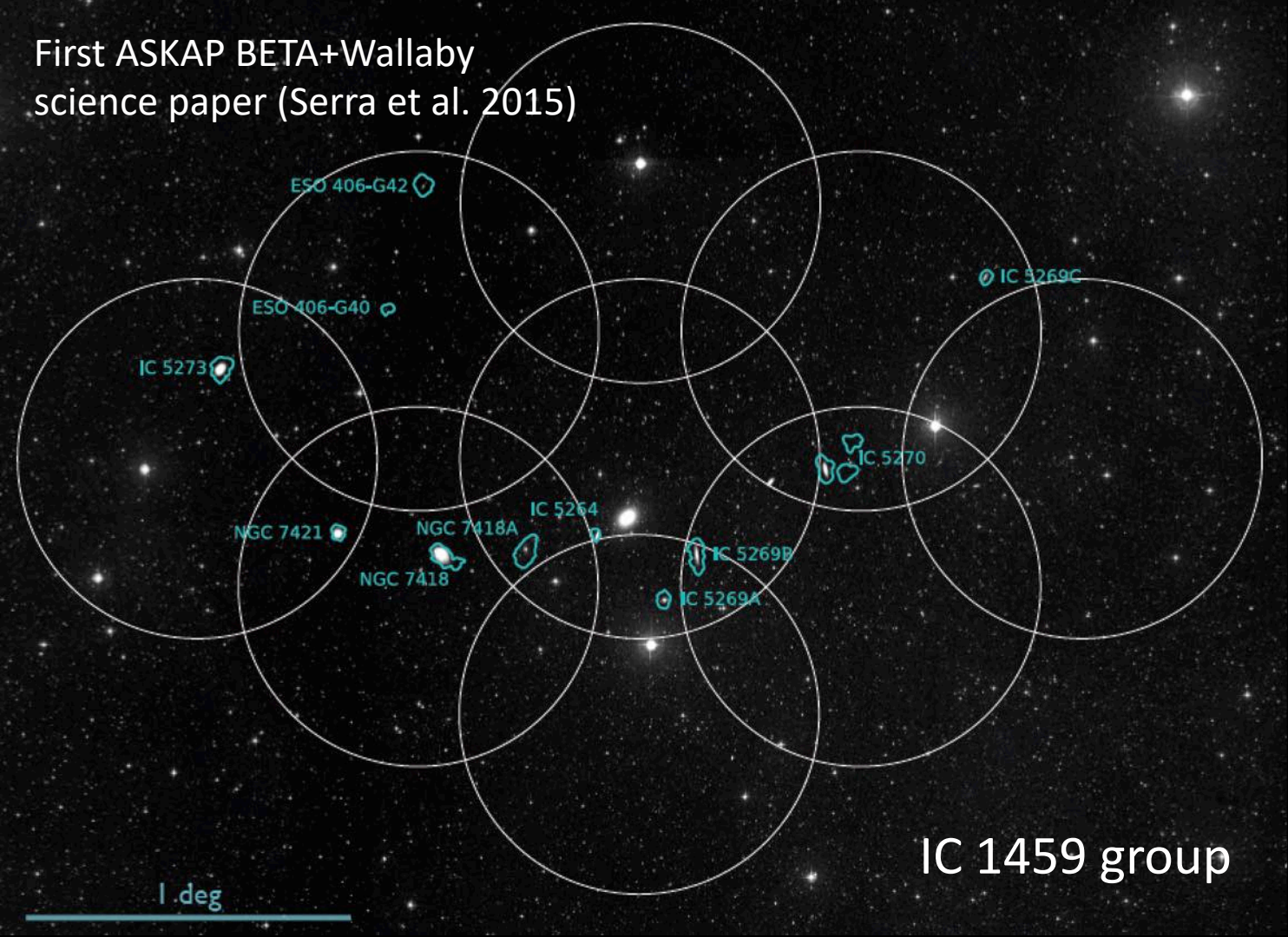
Murchison, WA
Population 160

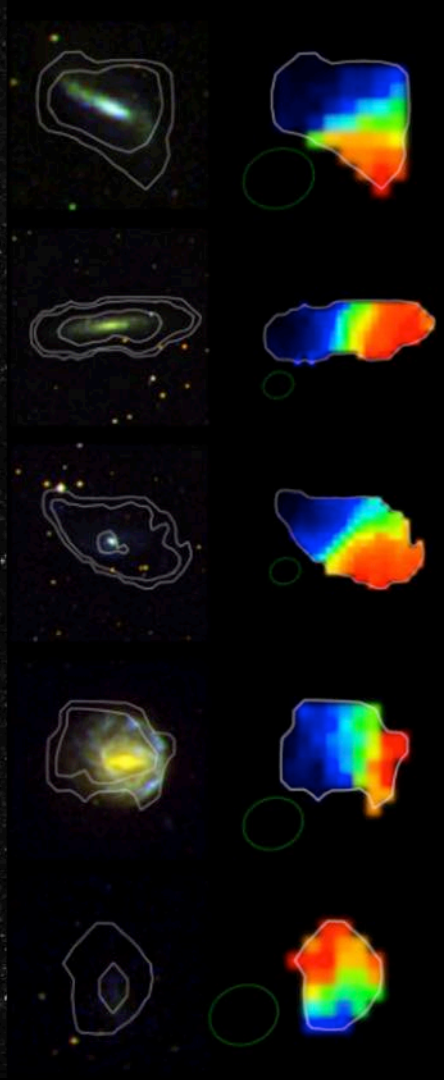


Wallaby timeline

- Sept 2014: commissioning science with BETA (6 antennas)
- Oct 2016: early science commences (12 antennas, 48 MHz)
- Oct 2017: early science concludes (16 antennas, 240 MHz, 650 hrs)
- Dec 2018: Full ASKAP functionality (36 antennas)
- Mar 2019: pilot survey commences (400 hrs)
- Late 2020: Pawsey supercomputer upgrade

First ASKAP BETA+Wallaby science paper (Serra et al. 2015)





IC 1459 group

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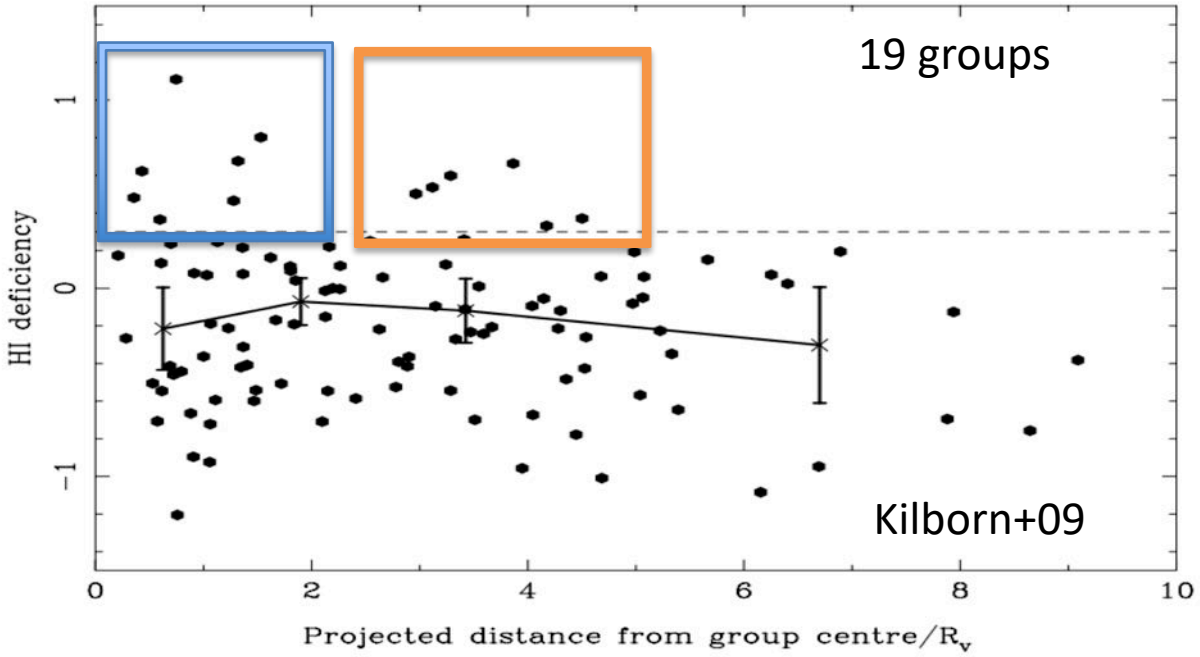
Early Science (ES) focus: environment

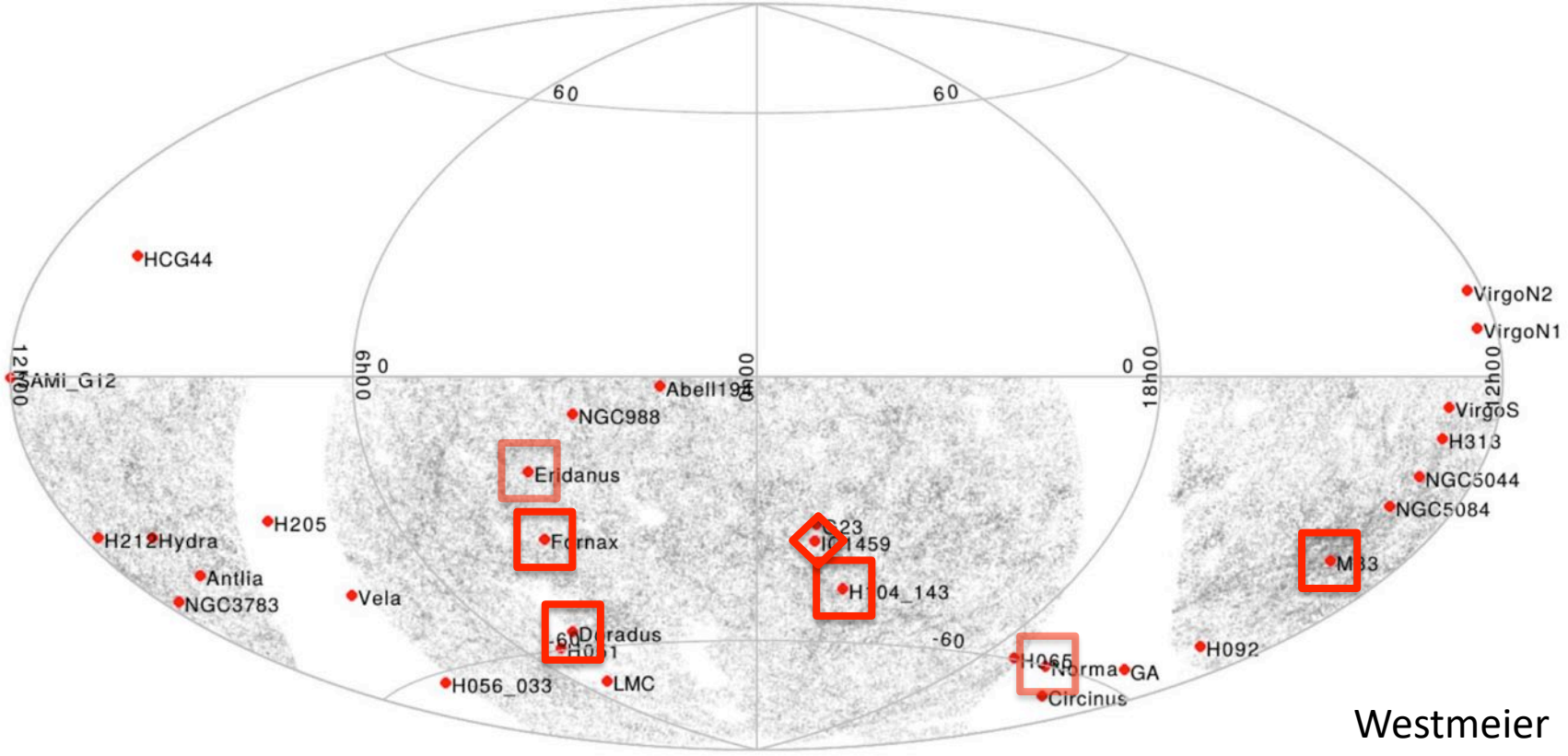
When did galaxies lose their gas?



Preprocessing in and outside groups

Wallaby SWG3 pre-processing workshop – Swinburne March 8-10 (Kilborn and Wong)

WALLABY ES fields



Westmeier

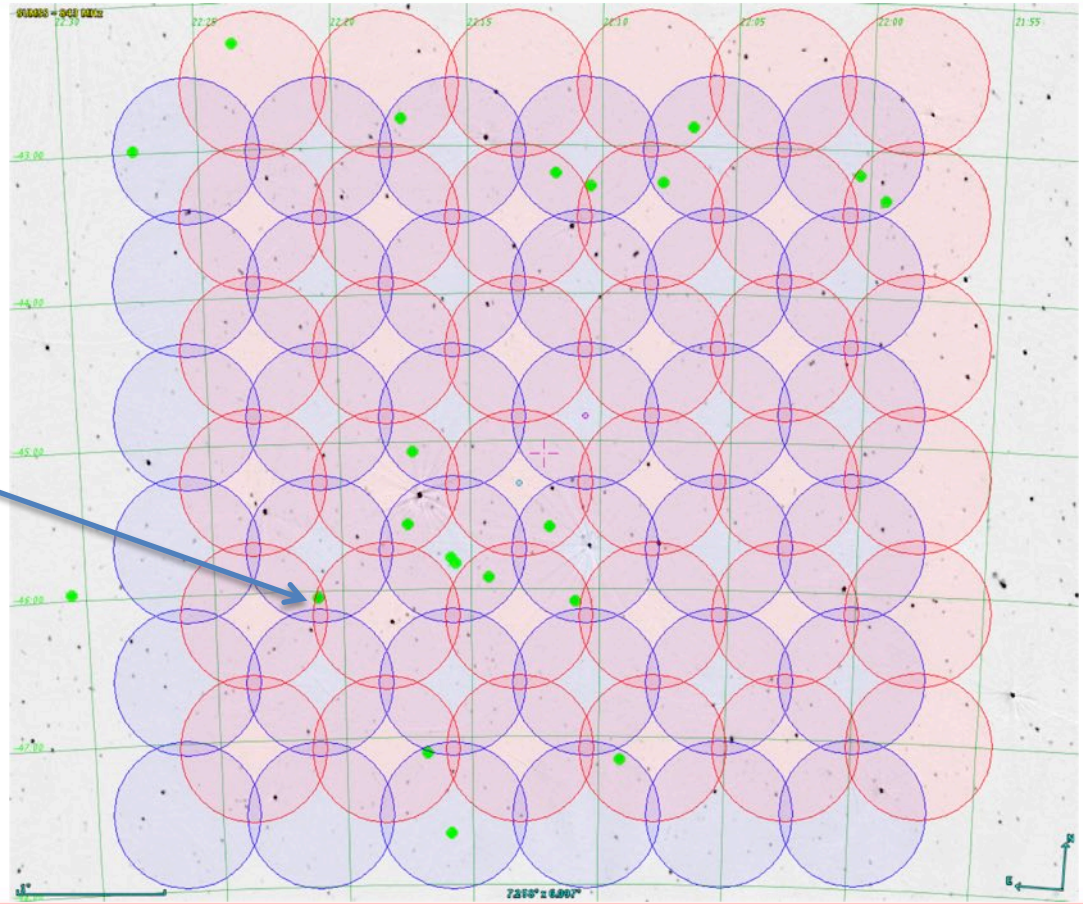
Early Science progress

WALLABY Early Science * Observations with ASKAP-12

No	Field name	Date	Bandwidth [MHz]	Antennas	Flagged [%]	Total time [hours]
Field 1	NGC 7232 Group	Aug to Sep-16	48	10 - 12	16 - 43	43.6
"	"	Oct-16	48	10 - 12	11 - 28	136.8
Field 2	Fornax Cluster	Oct to Dec-16	48/144/168	10 - 12	20 - 34	59.3
"	"	Dec-16	192	10 - 12	11 - 30	163.9
Field 3	Dorado Group	Dec-16/Jan-17	192	9 - 10	tbd	72.9
"	"	Sep-17	192/240	12	tbd	64
Field 4	M 83 Group	Dec-16/Jan-17	192	9 - 10	tbd	80.8
"	"	Sep-17	192/240	12	tbd	31.5

ES data is virtually identical to the Wallaby main survey data in resolution and sensitivity

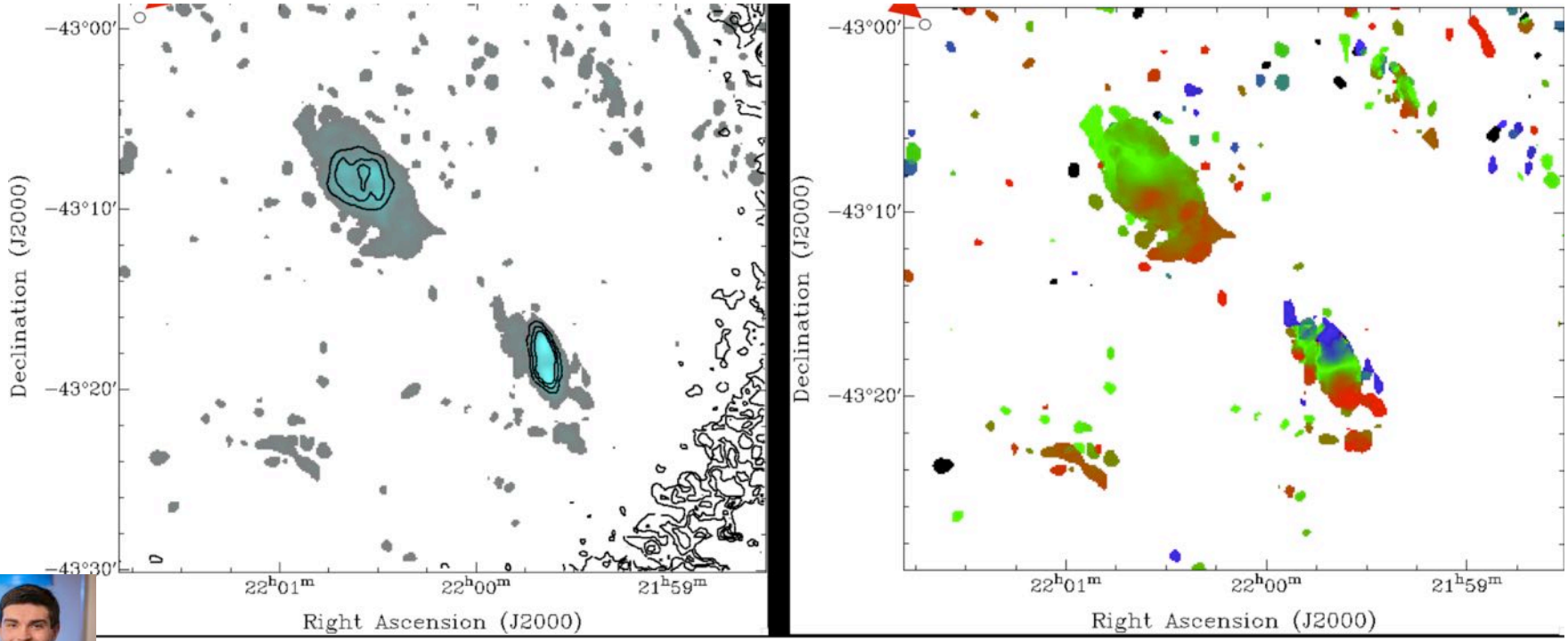
ES1 coverage

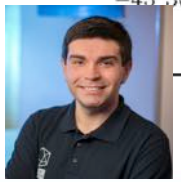


ES1

NGC 7232 field and beam pattern on coloured DSS

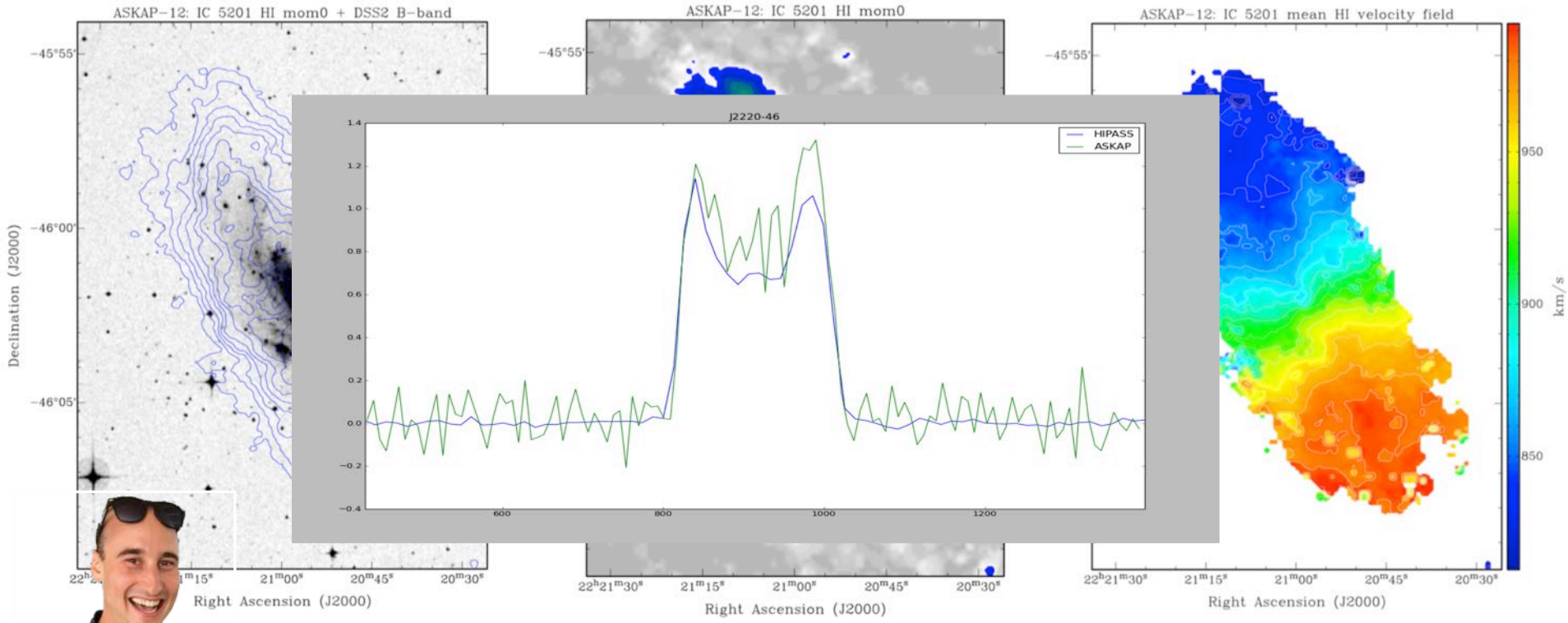
NGC 7162/A in the NGC 7232 group





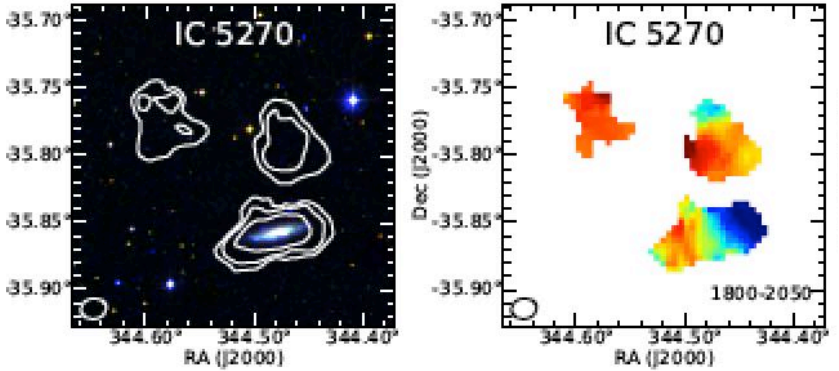
Reynolds et al. (submitted)

IC 5201 in the NGC 7232 group



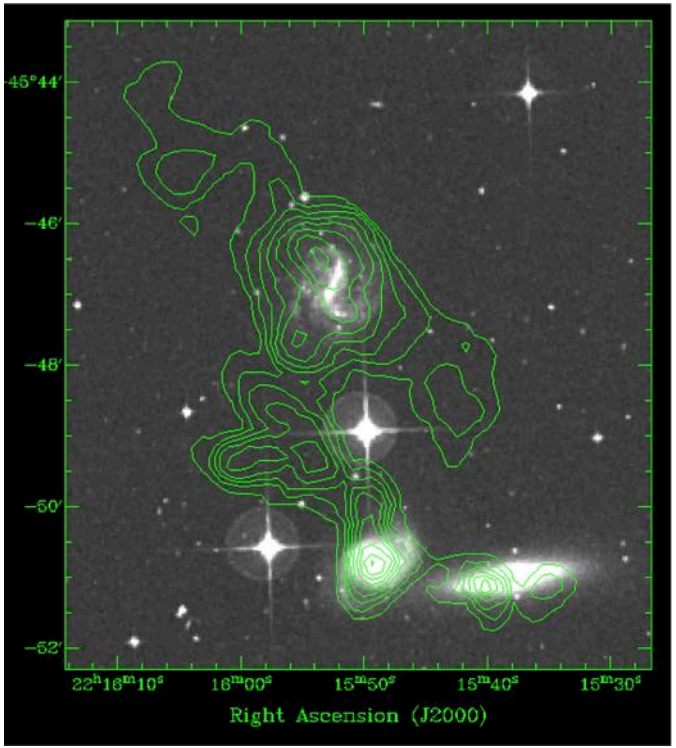
Kleiner et al. (to be submitted)

Tidal dwarf galaxies



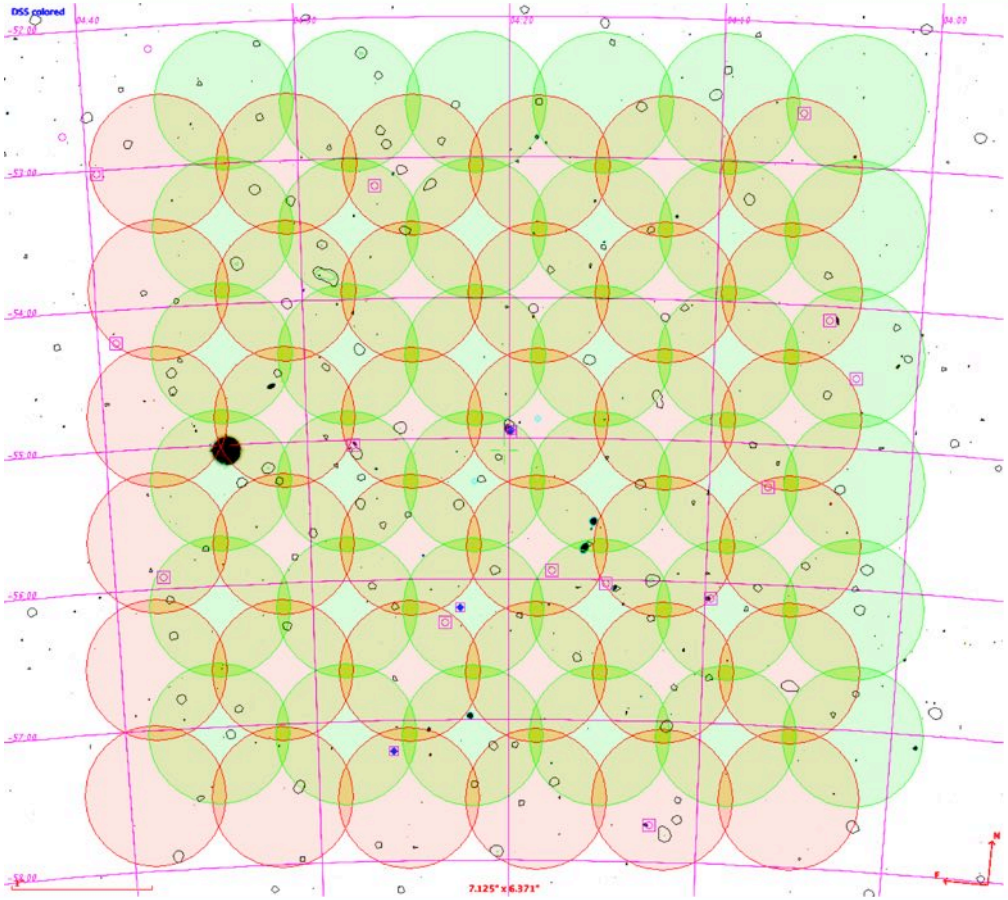
BETA
HI clouds

ASKAP-12 HI
clouds



Lee-Waddell et al. (submitted)

ES3 coverage

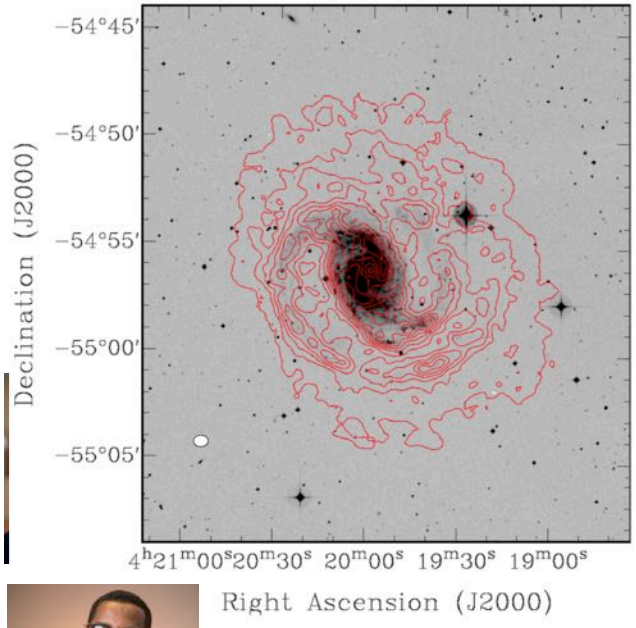


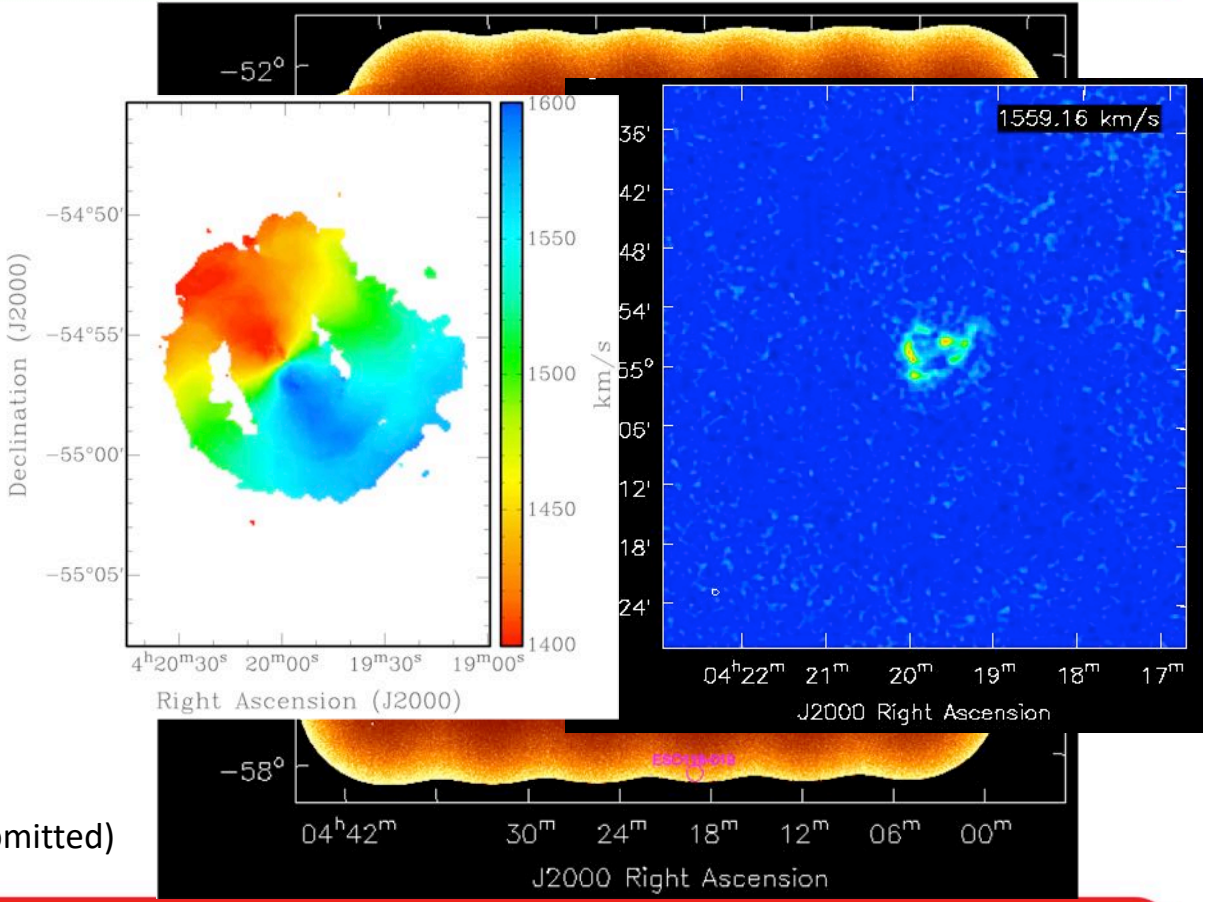
6 deg

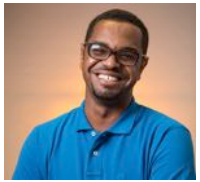
ES3

Dorado field
and beam pattern
on coloured DSS

Dorado



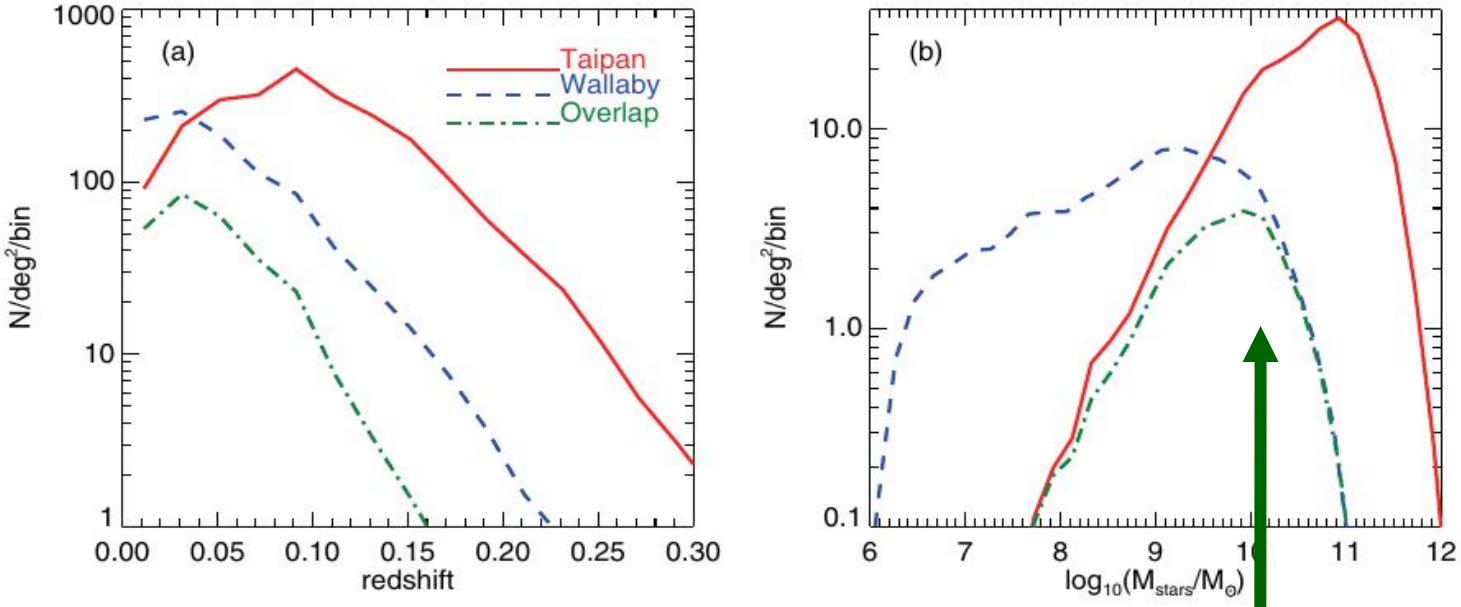




Agali, Rhee et al (to be submitted)

Taipan/WALLABY synergies

Da Cunha et al. (2017): Taipan white paper – Predictions based on GALFORM model of Lagos et al. (2012) using Mill I and II



Overlap dynamic range at intermediate stellar masses:
→ high mass galaxies are gas poor
→ low mass galaxies too faint for optical survey

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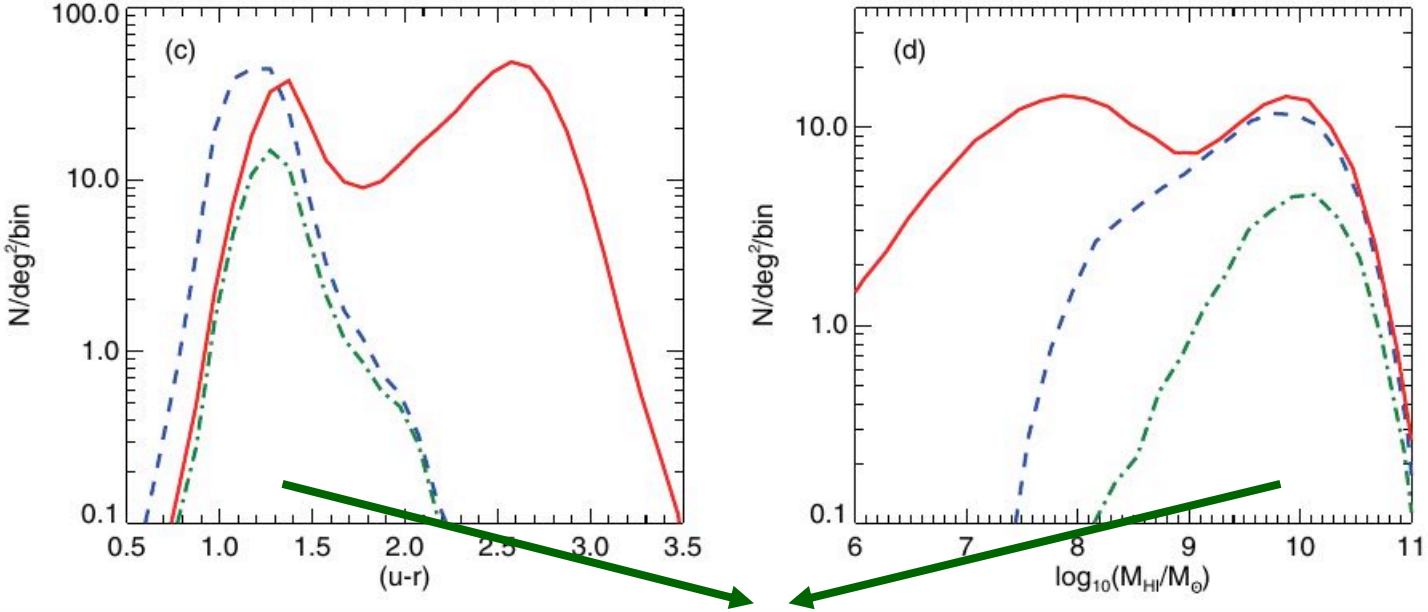

Overlap region:
→ blue cloud and green valley
→ high HI masses

Summary

- Wallaby science has started (4+2 ES fields - same area, resolution and sensitivity as ASKAP-36)
- Initial science focus: pre-processing in group environment
- Wallaby is zero-redshift, all-sky ‘anchor’ for high-z studies – most O/IR synergy with TAIPAN, SkyMapper, VISTA, VST, LSST
- Expected completion 2020/21