

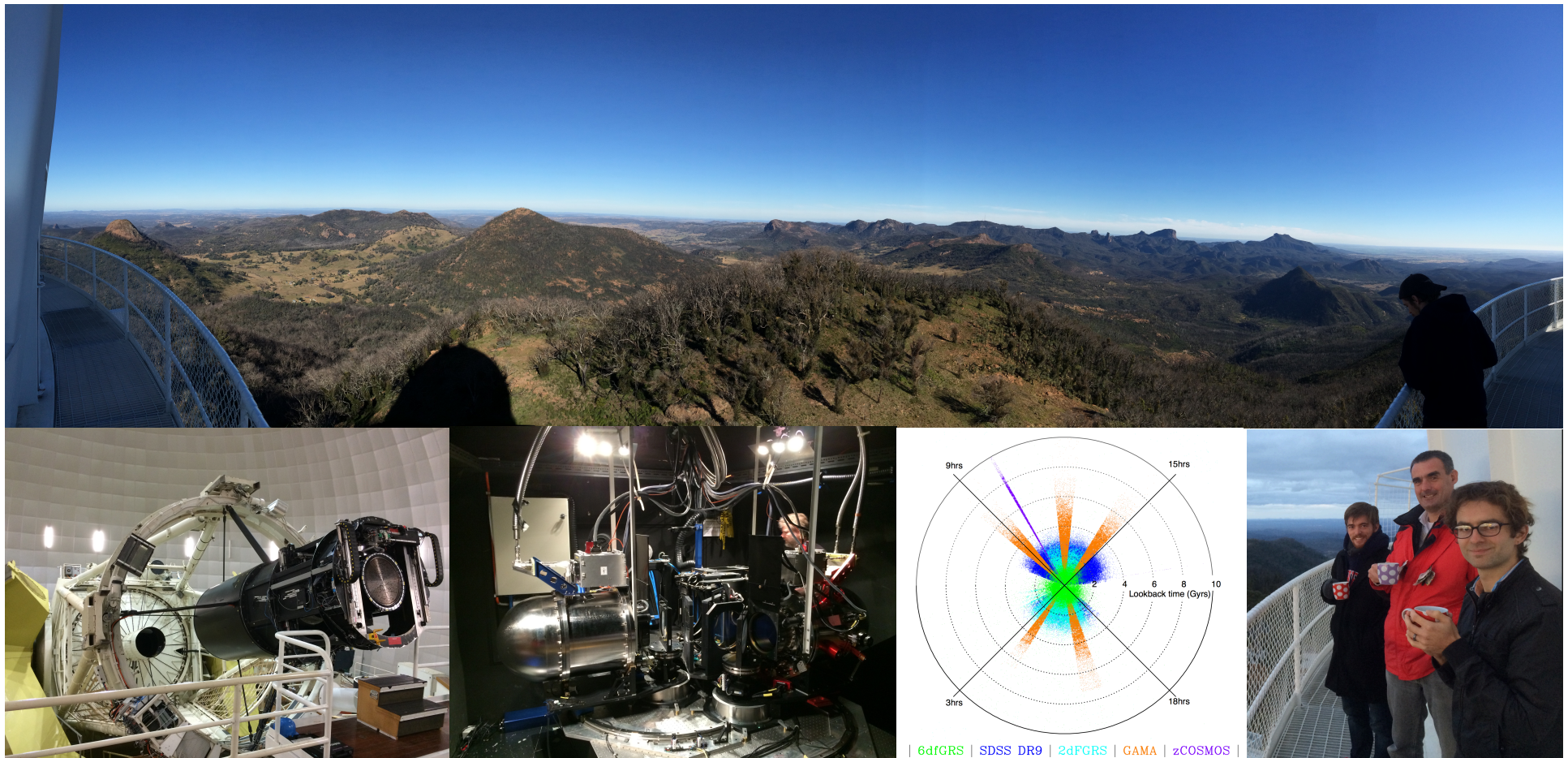


Galaxy And Mass Assembly (GAMA)

Simon Driver, ICRAR
University of Western Australia
& University of St Andrews



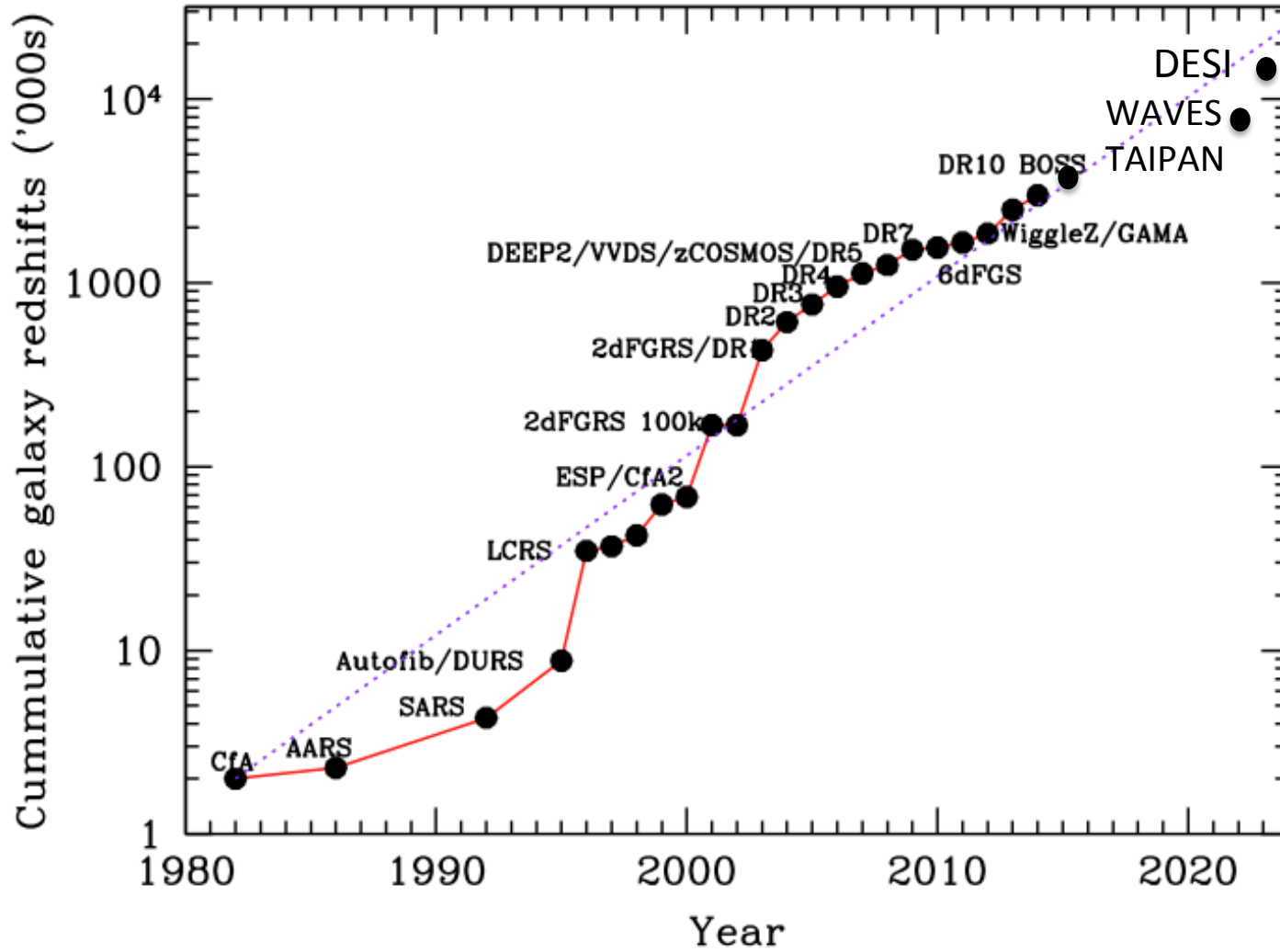
Redshift surveys in perspective
GAMA
zCOSMOS/G10
4MOST/WAVES



The rise of redshifts



MSE
EUCLID



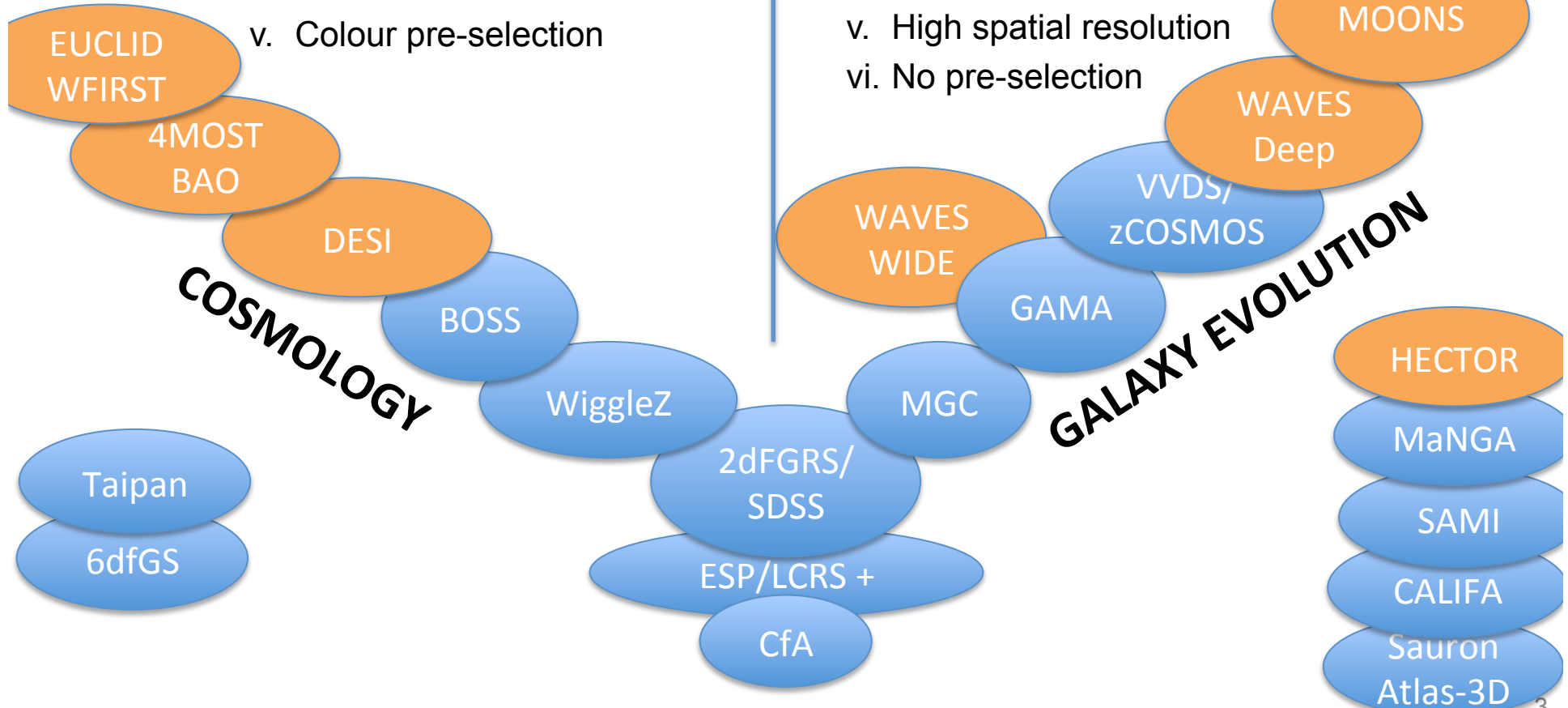
Cosmology v Galaxy Surveys

1. Optimal cosmology survey

- i. Low fidelity
- ii. All sky
- iii. Sparse sampled
- iv. Stand alone
- v. Colour pre-selection

1. Optimal galaxy survey

- i. High fidelity (low mass)
- ii. ~100-500 sq deg
- iii. Fully sampled (groups)
- iv. Multi-wavelength overlap
- v. High spatial resolution
- vi. No pre-selection





Galaxy, LRG and QSO surveys

4000000 Wide Area Vista Extra-galactic Survey (WAVES, 2021+)

1515000 Baryonic Acoustic Oscillations Survey

860421 SDSS Main Galaxy Survey

395831 SDSS QSO Survey

310736 AAO Galaxy And Mass Assembly

226906 AAO two-degree field galaxy redshift survey

214854 AAO WiggleZ

114894 AAO six-degree field galaxy redshift survey

58683 ESO Vipers

43533 US 2 Micron All-sky Redshift Survey

40428 ESO VLT Very Deep Survey

37802 Keck Deep Extra-galactic Evolutionary Probe 2

28364 AAO two-degree field Quasar Survey

25344 Las Campanas Redshift Survey

16917 ESO zCOSMOS

15784 AAO Luminous Red Galaxy Survey

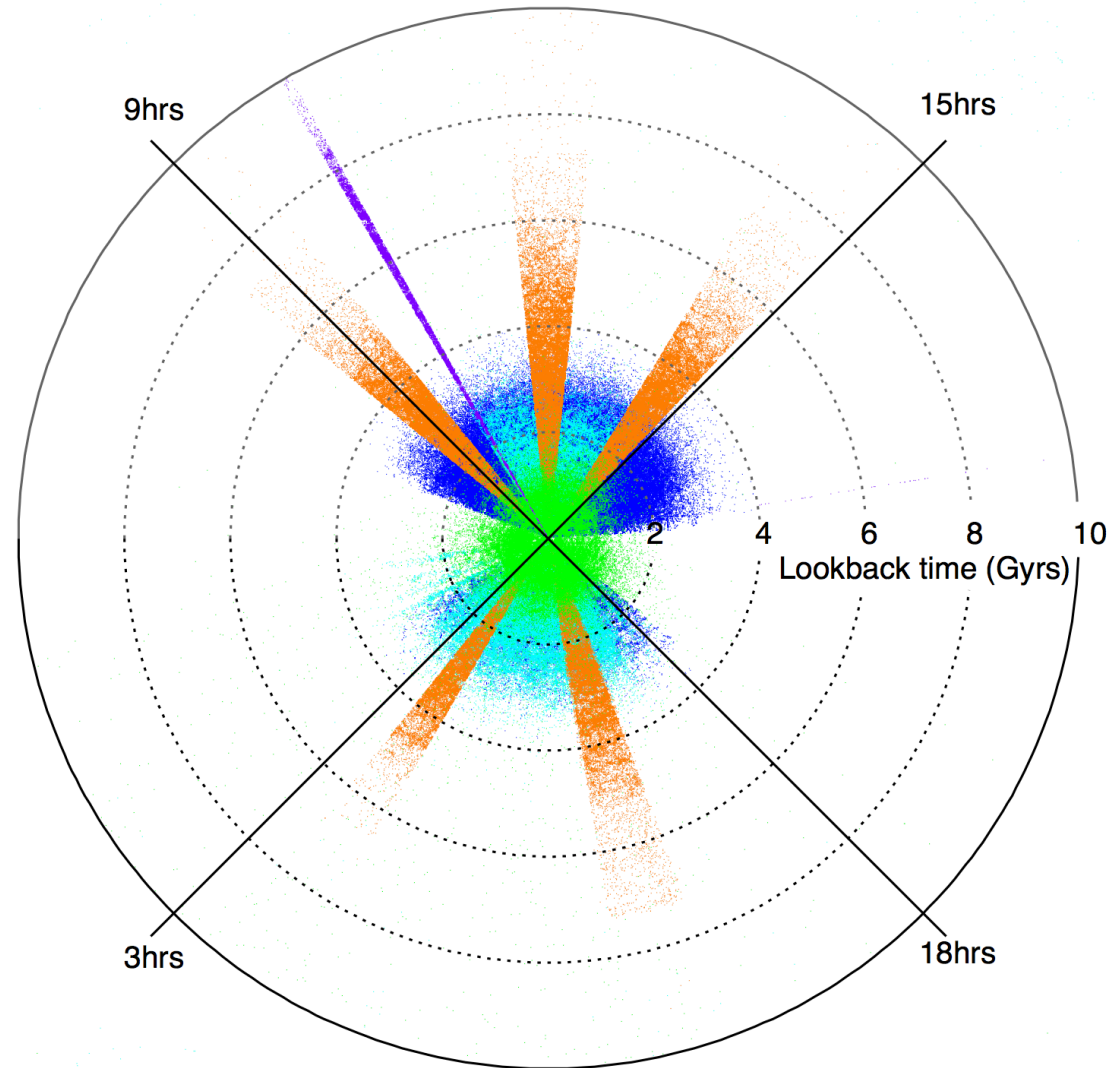
7861 AAO Millennium Galaxy Catalogue

2042 AAO two-degree LRG and QSO Survey

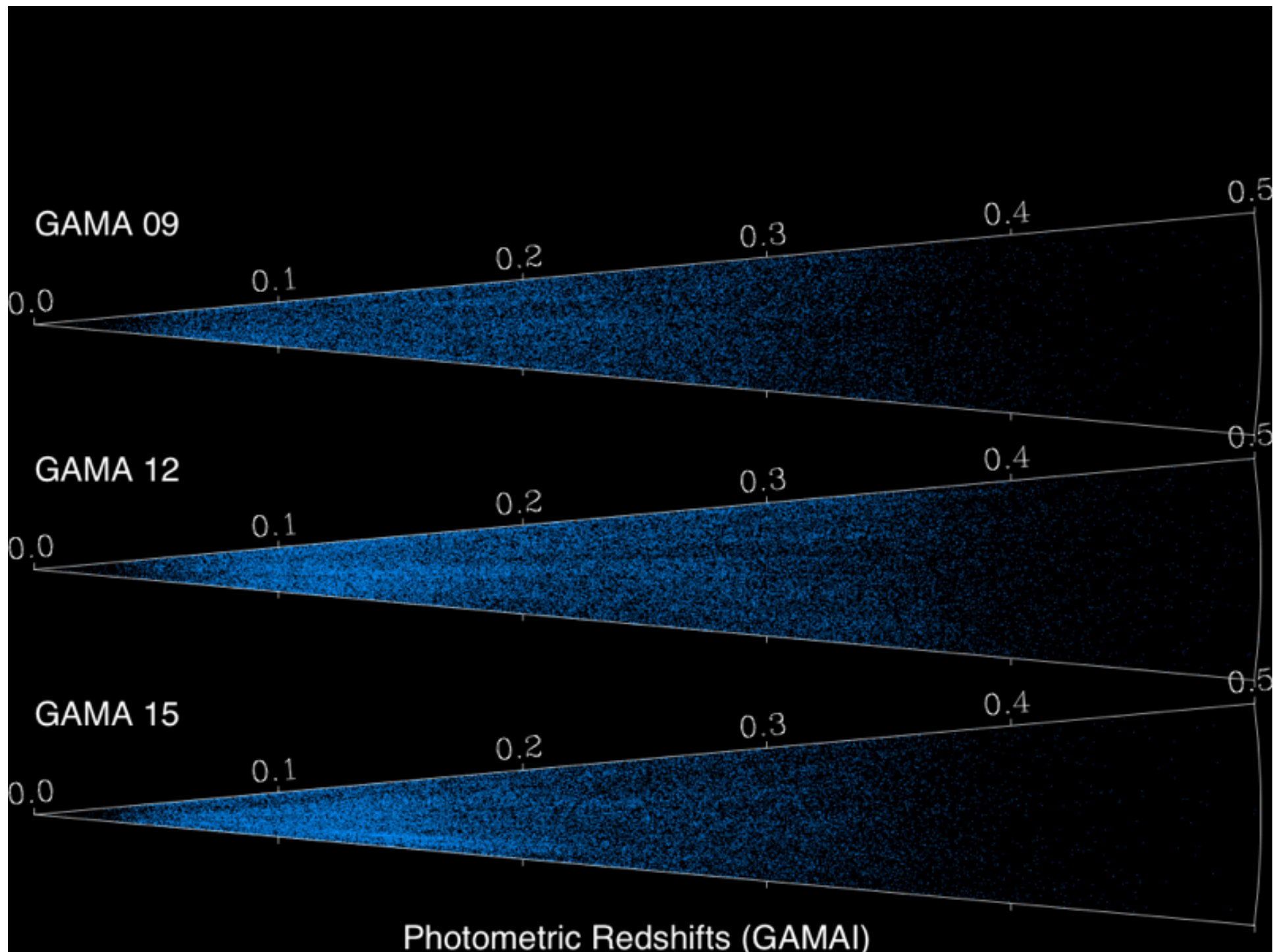
1.52 million well selected galaxy samples (0.66 Australian, 43%)

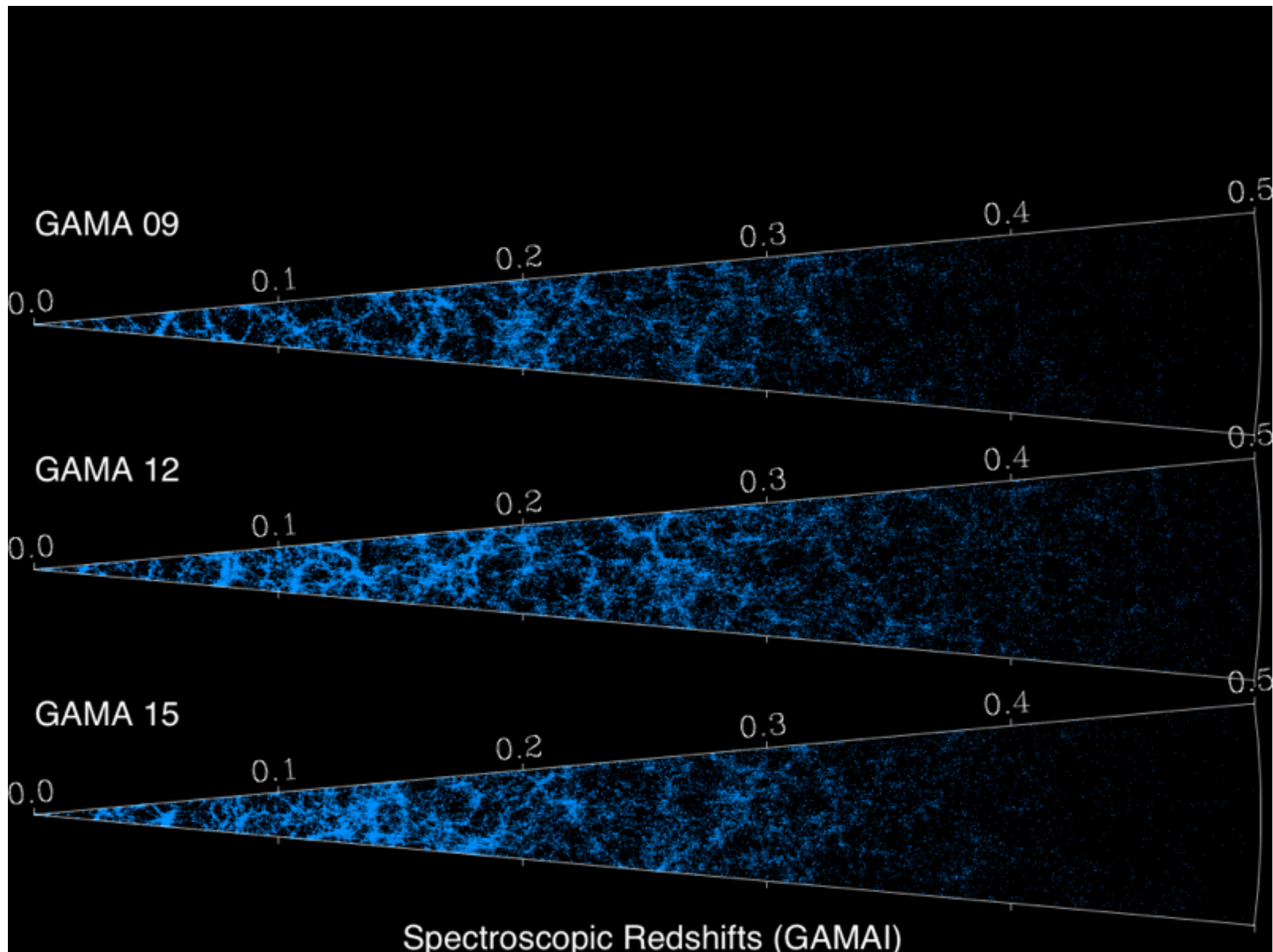
3.91 million ad hoc (0.99 Australian, 25%)

Complete galaxy redshift surveys



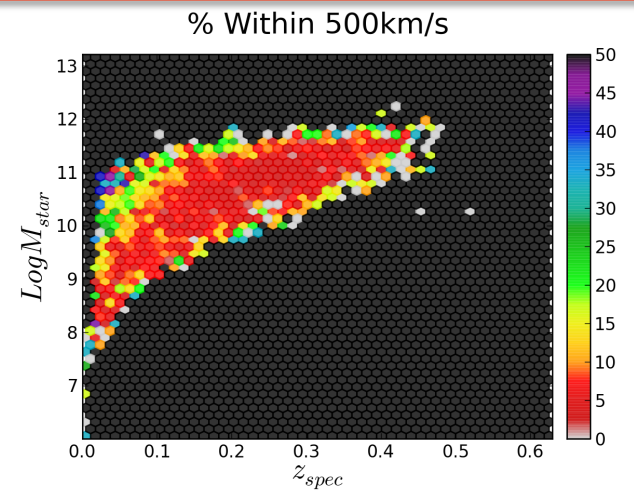
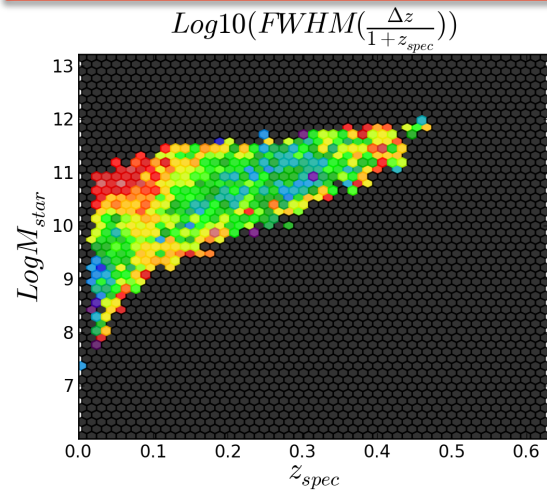
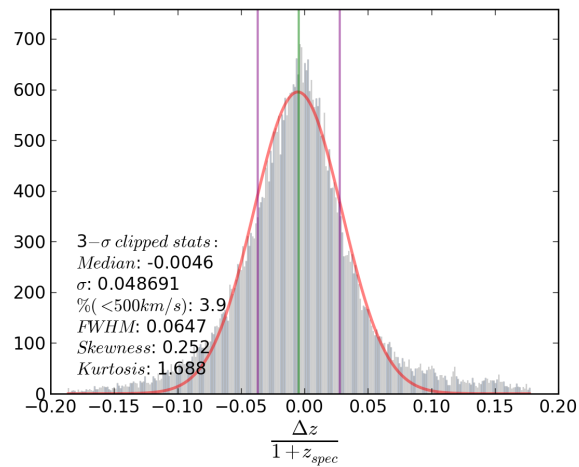
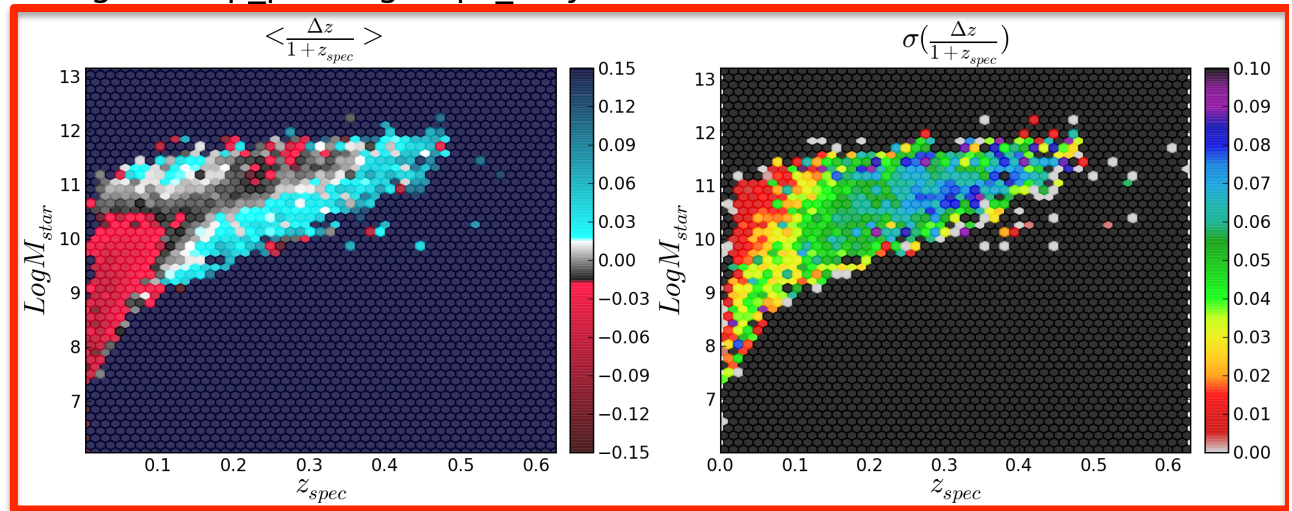
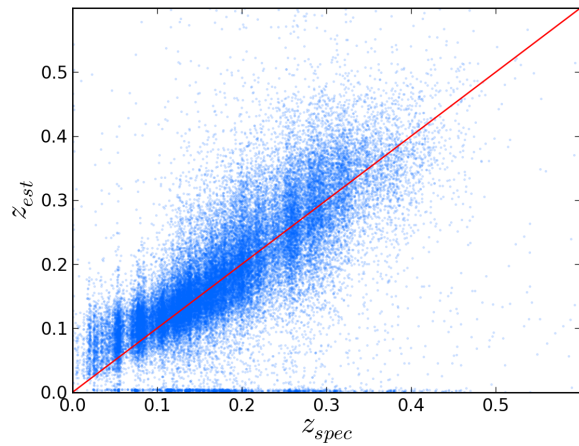
| 6dfGRS | SDSS DR9 | 2dFGRS | GAMA | zCOSMOS |





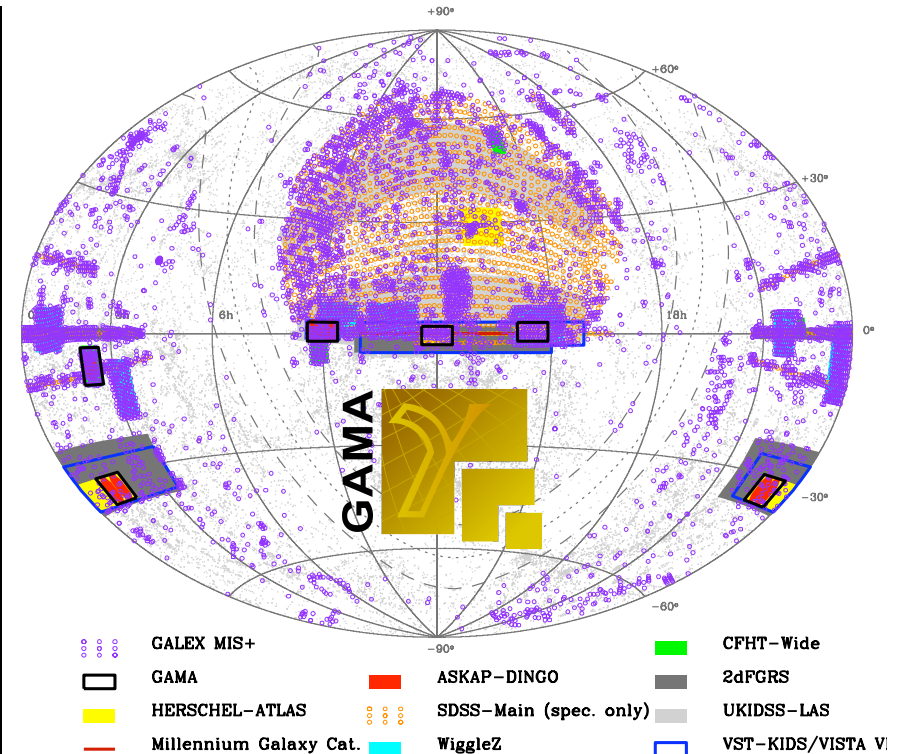
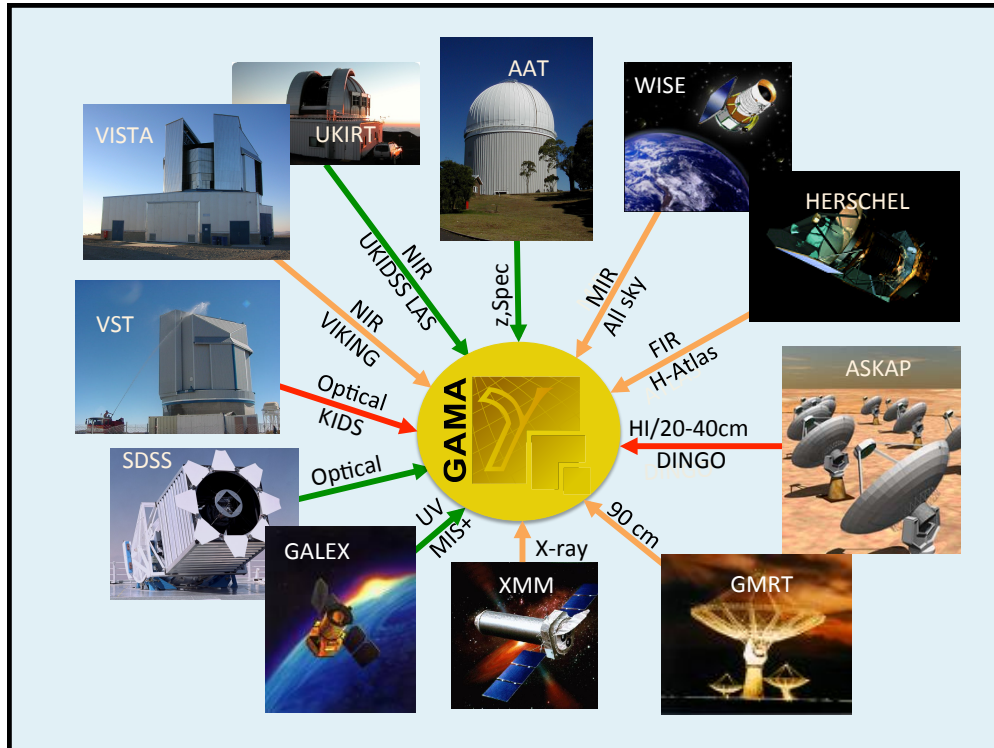
Standard Photo-z

ugriZ-emp_priors-groups_only





Galaxy And Mass Assembly (GAMA)

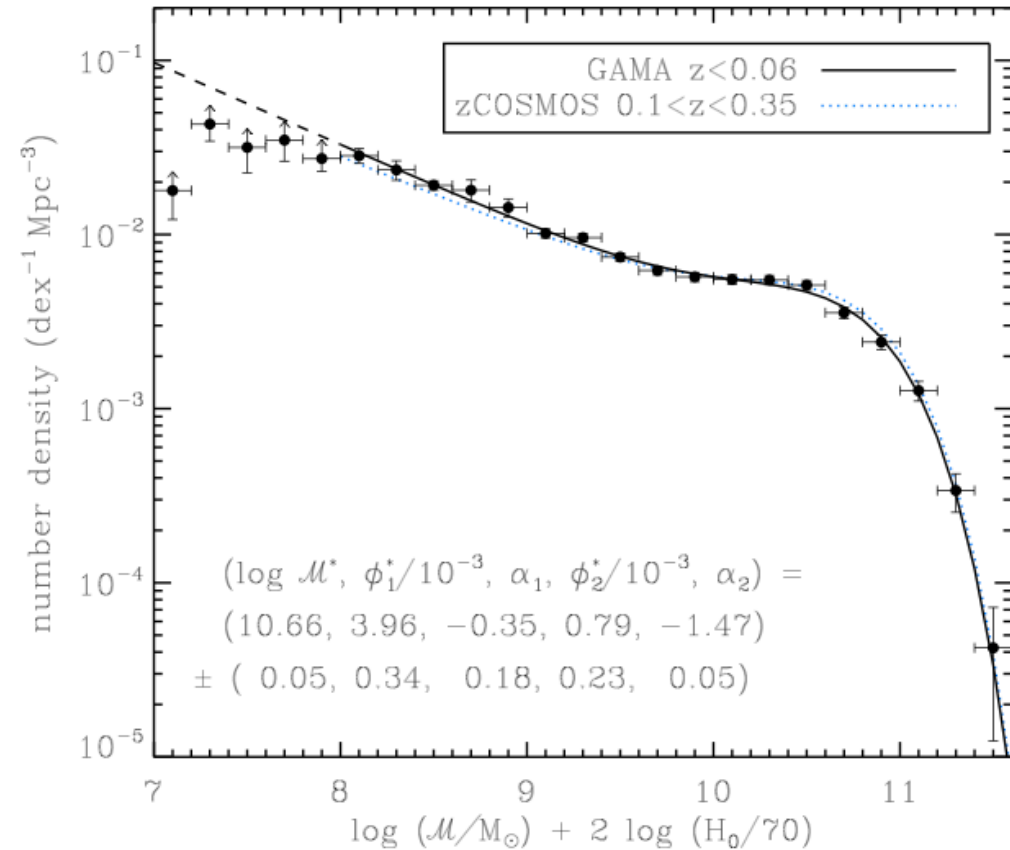


250,000 galaxies to $r < 19.8$ mag over five 60 sq deg ($\sim 98\%$ complete, selected from SDSS)

- catalogue of 25,000 groups (halos) to $10^{12} M_{\odot}$
- 21 band photometry + gas (ASKAP) [GALEX+VST+VIKING+WISE+Herschel]
- mass, energy and structure on 1kpc to 100Mpc scales to $z \sim 0.2$
- Website <http://www.gama-survey.org/> Community Data Releases (DR1,DR2,PDR)

Science ($z < 0.06$)

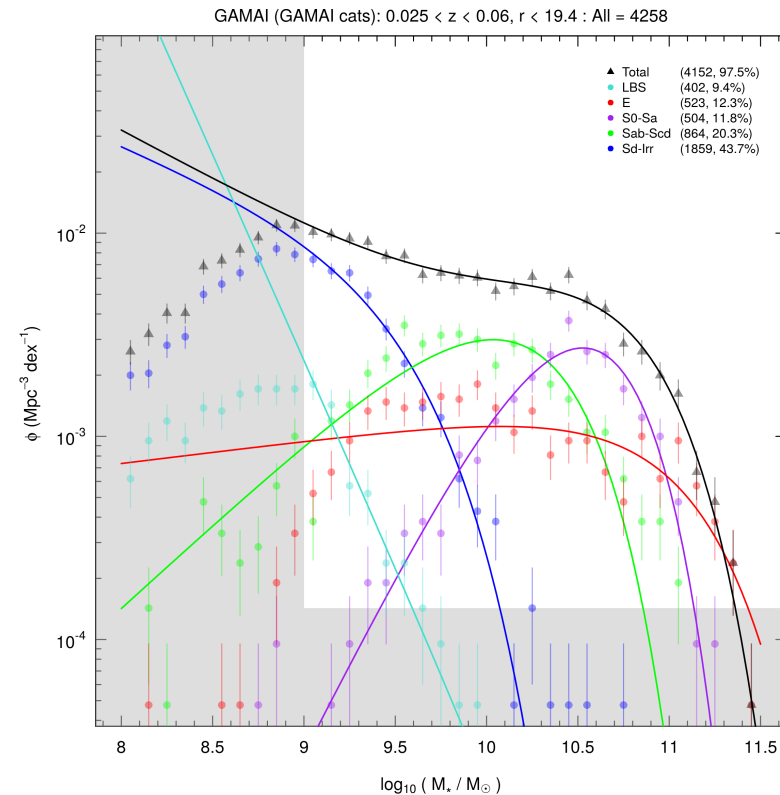
- Mass:
 - GSMF (Baldry et al)
 - GSMF by type (Kelvin et al)
 - SMBH MF (Andrews et al)
 - DUST MF (Dunne et al)
 - HI MF (Wright et al)
 - DM HMF (Robotham et al)
- Energy:
 - CSED (Driver et al)
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- Structure:
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 - Groups (Robotham et al)
 - Filaments (Alpaslan et al)
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 - Bulge-disc decomposition (Lange et al, Haussler et al)



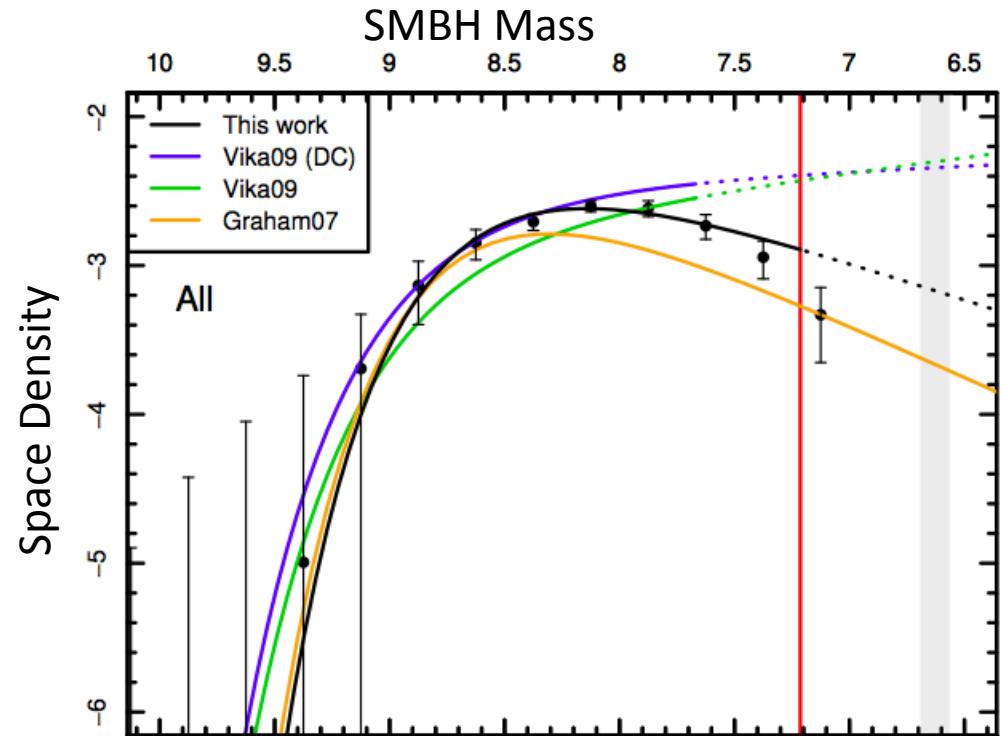


Science ($z < 0.1$)

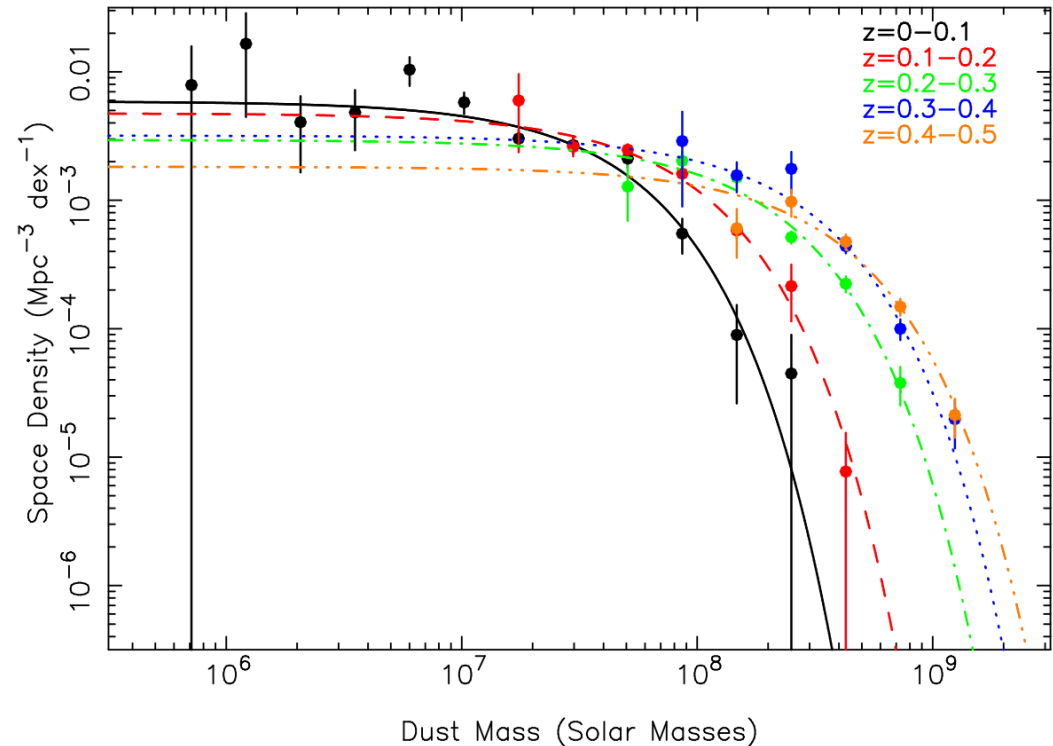
- Mass:
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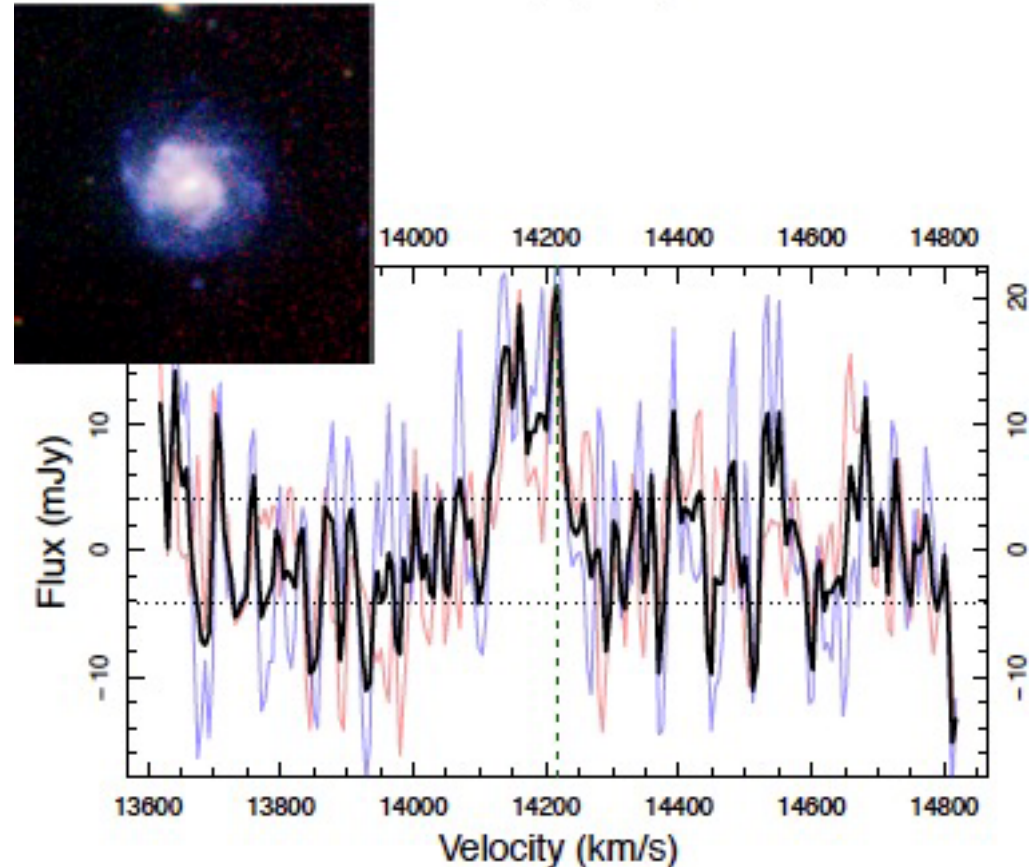


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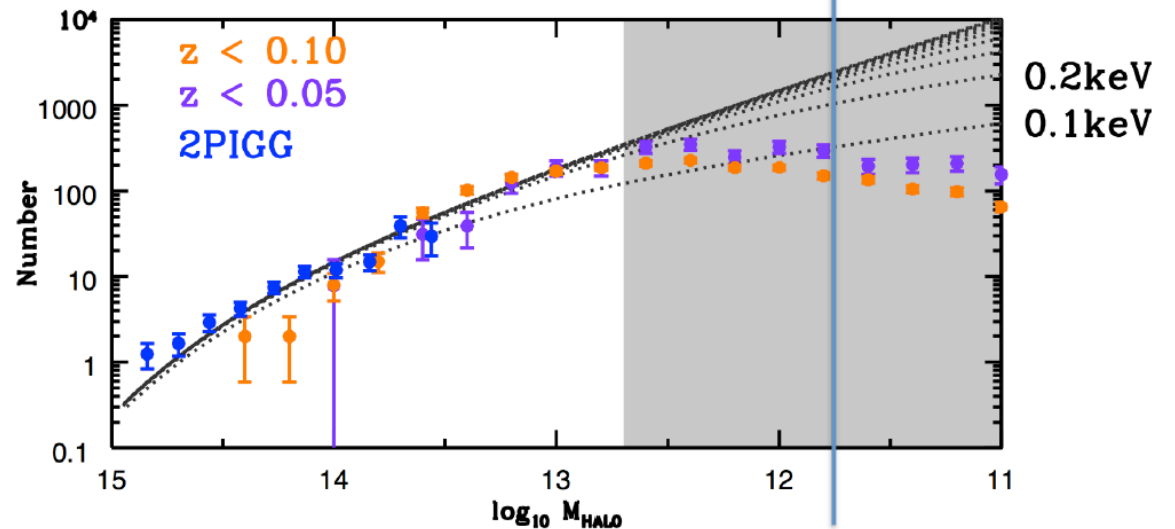
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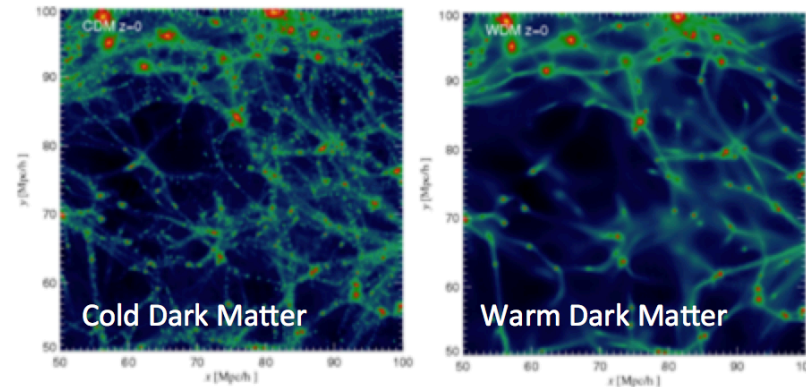


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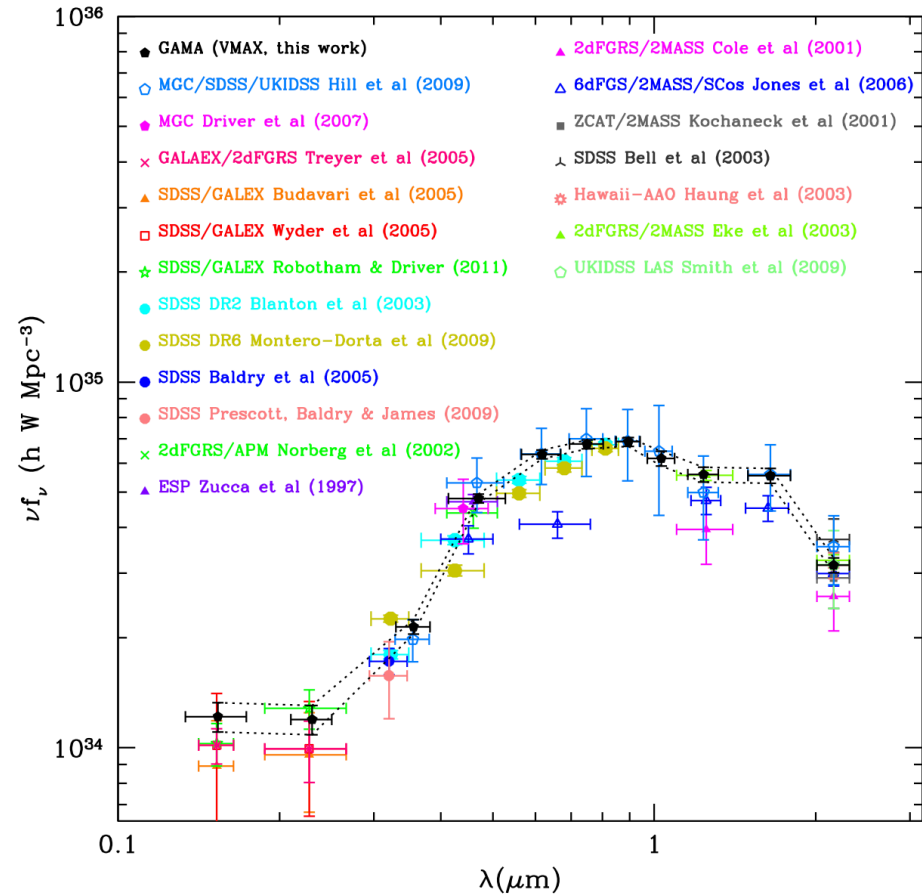


Final limit around here.



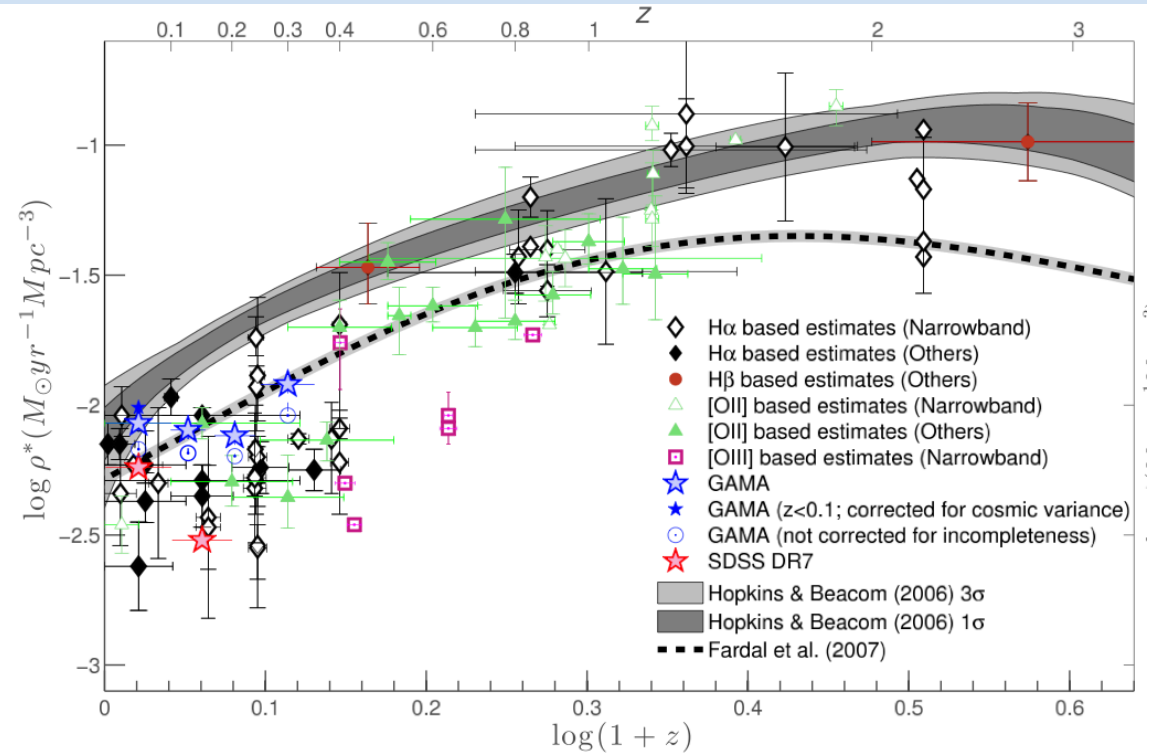
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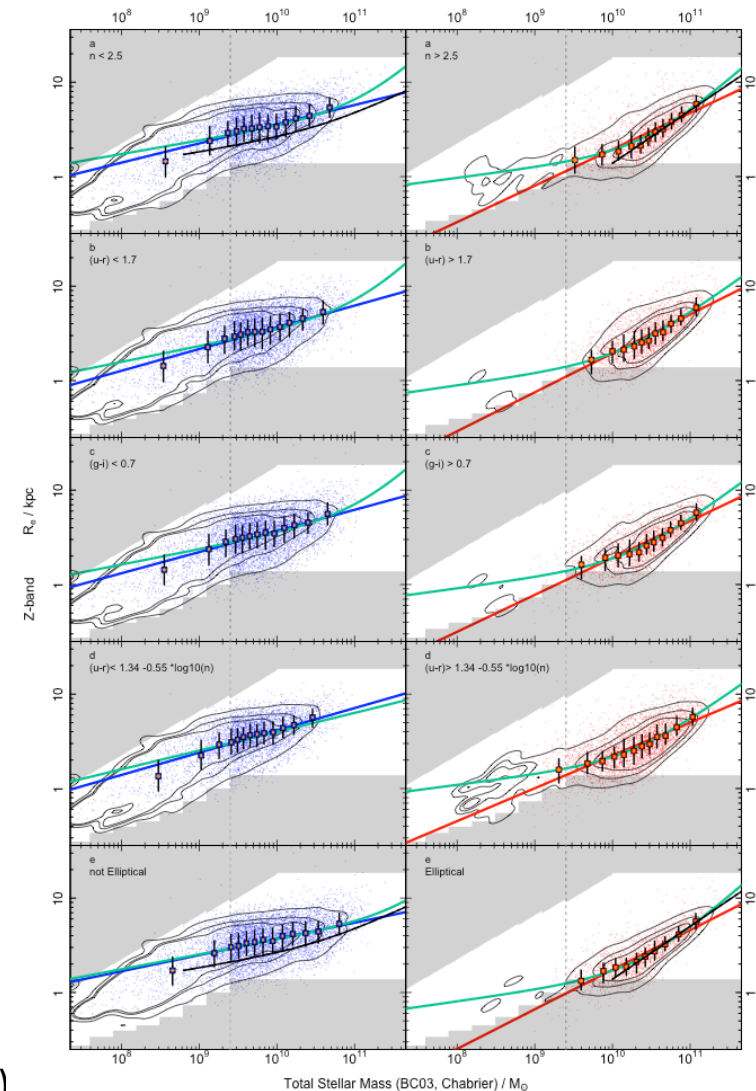


Science ($z < 0.3$)

- Mass:
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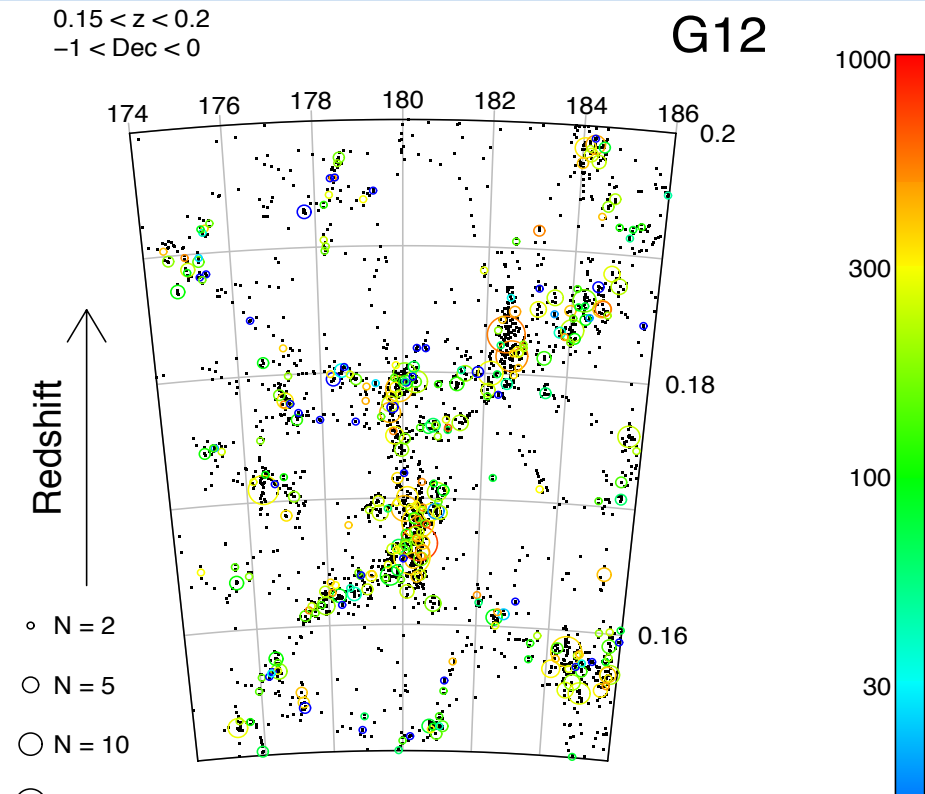


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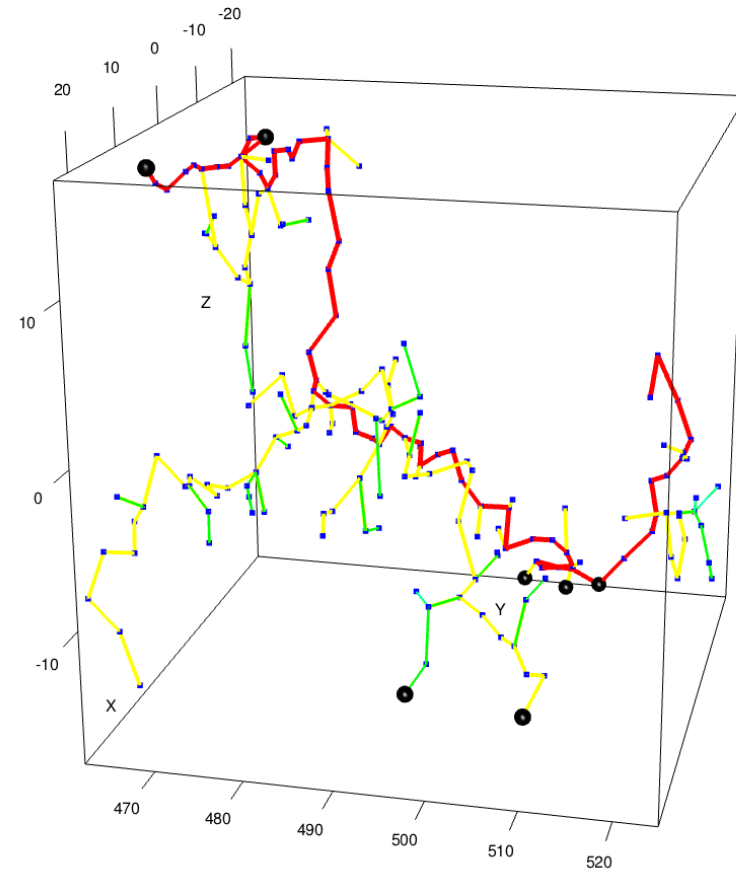


Science ($z < 0.1$)

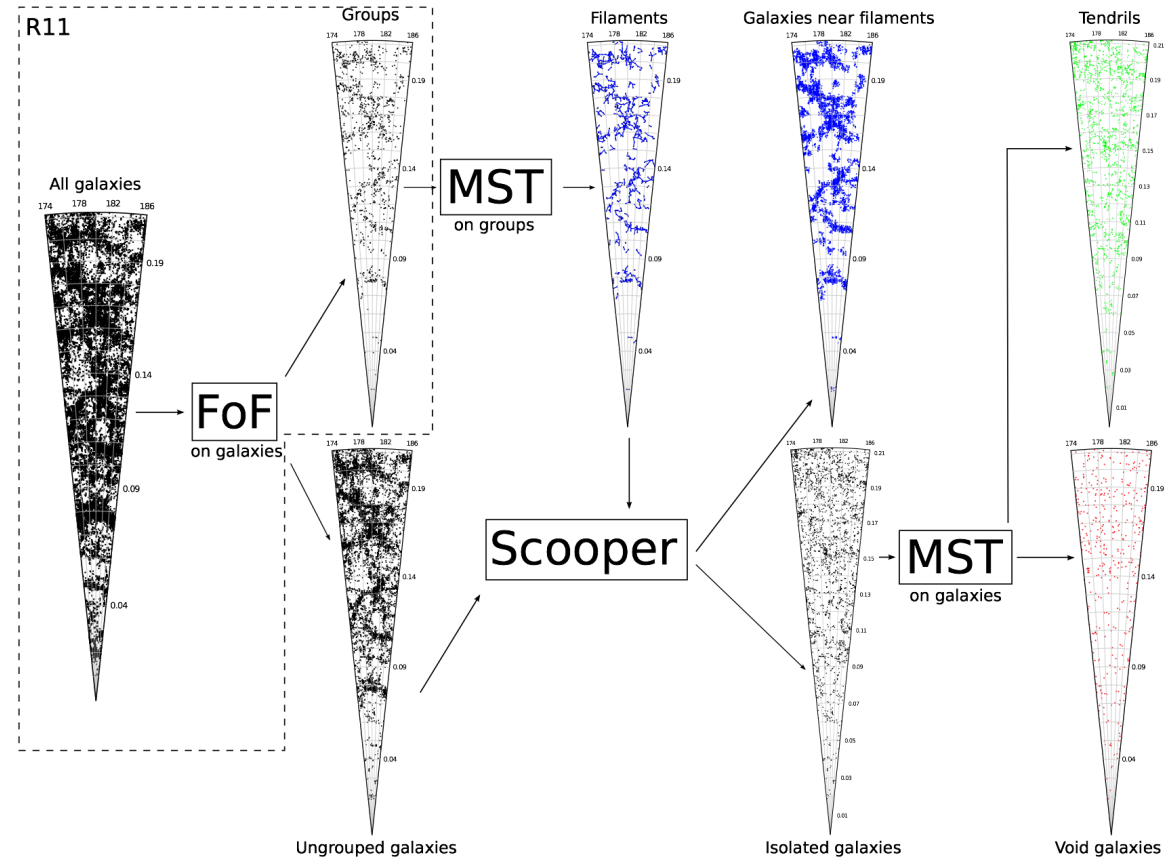
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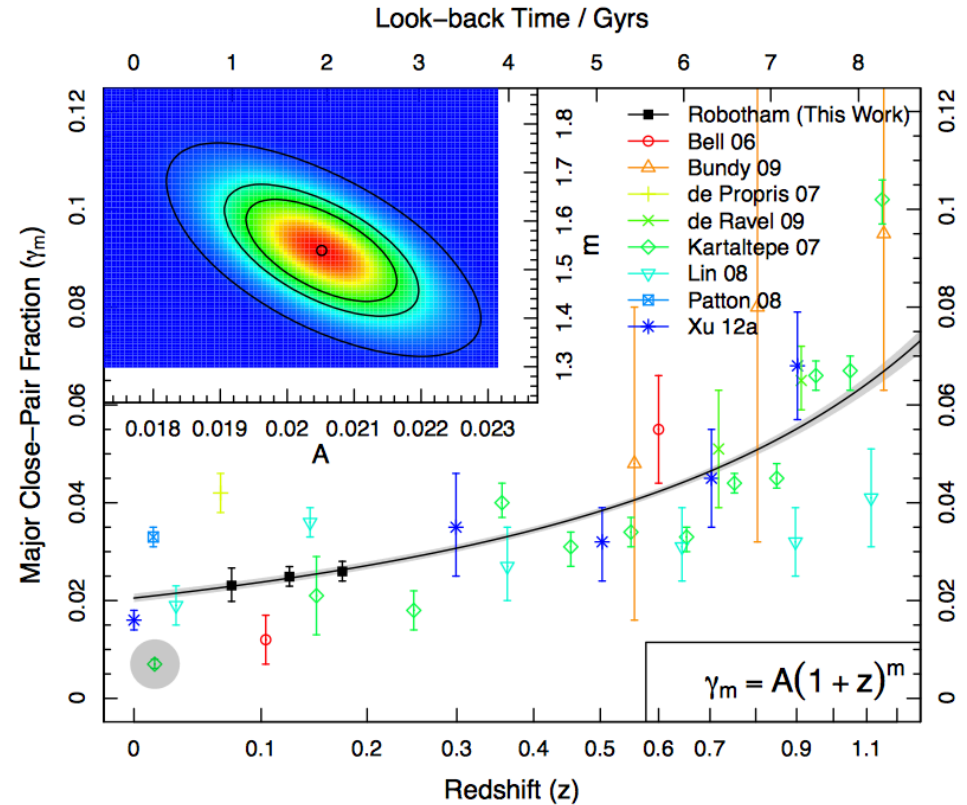


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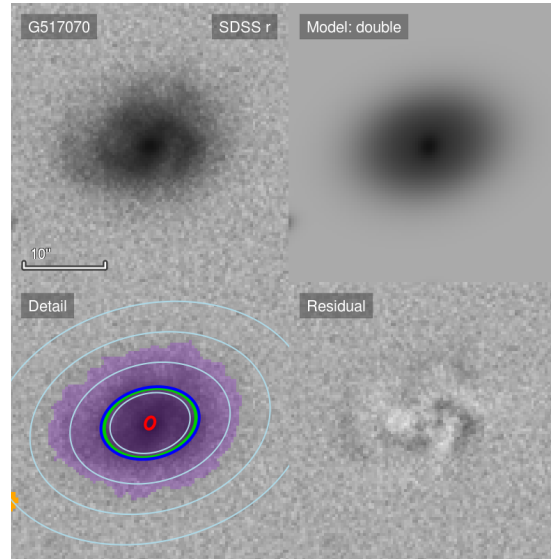
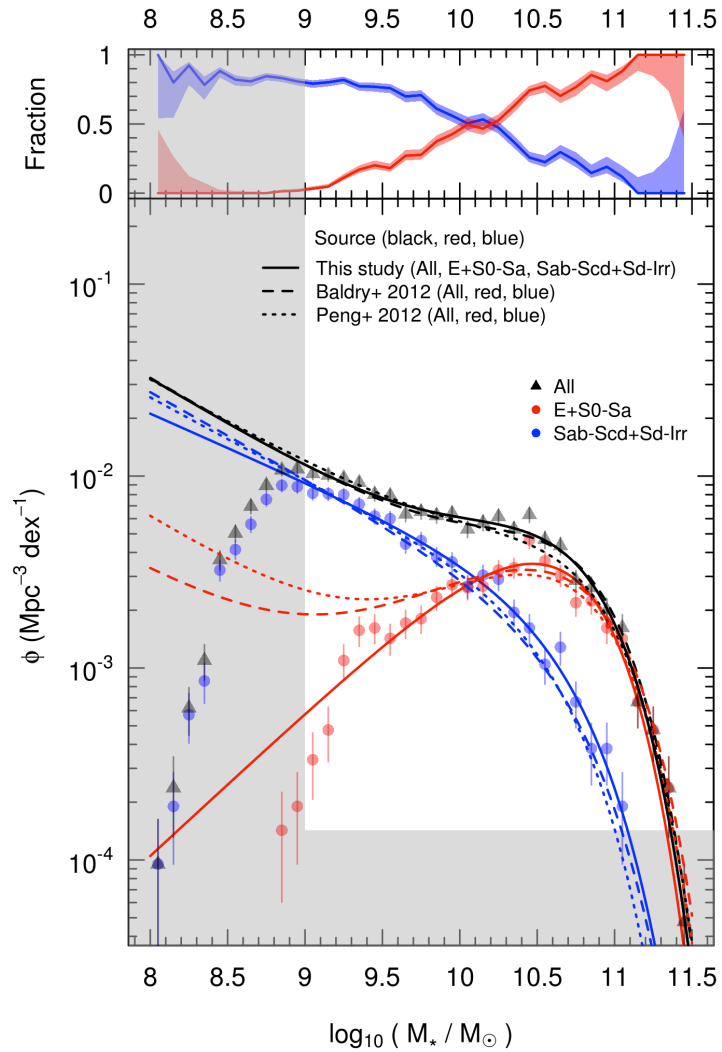


Science ($z < 0.1$)

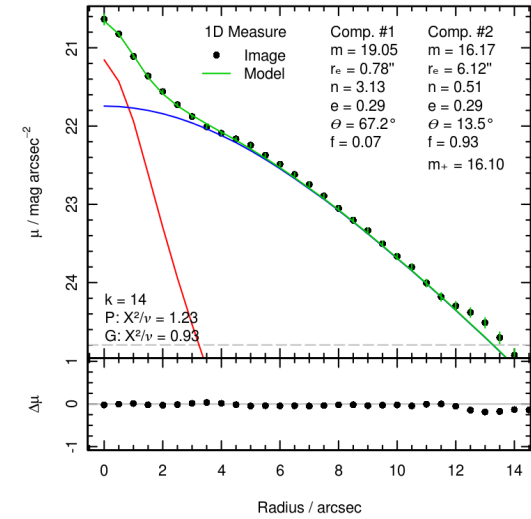
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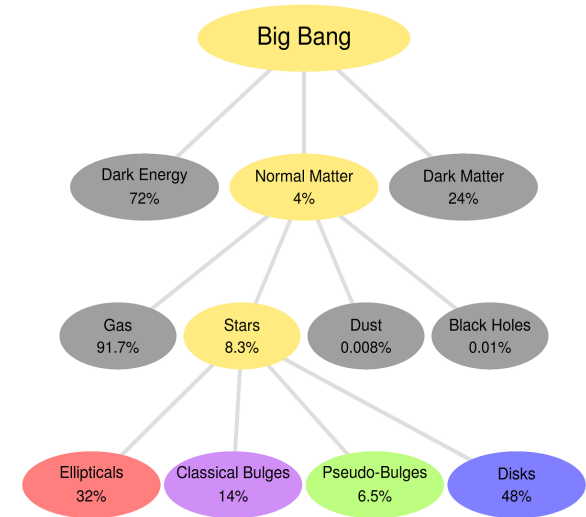
Science ($z < 0.1$)



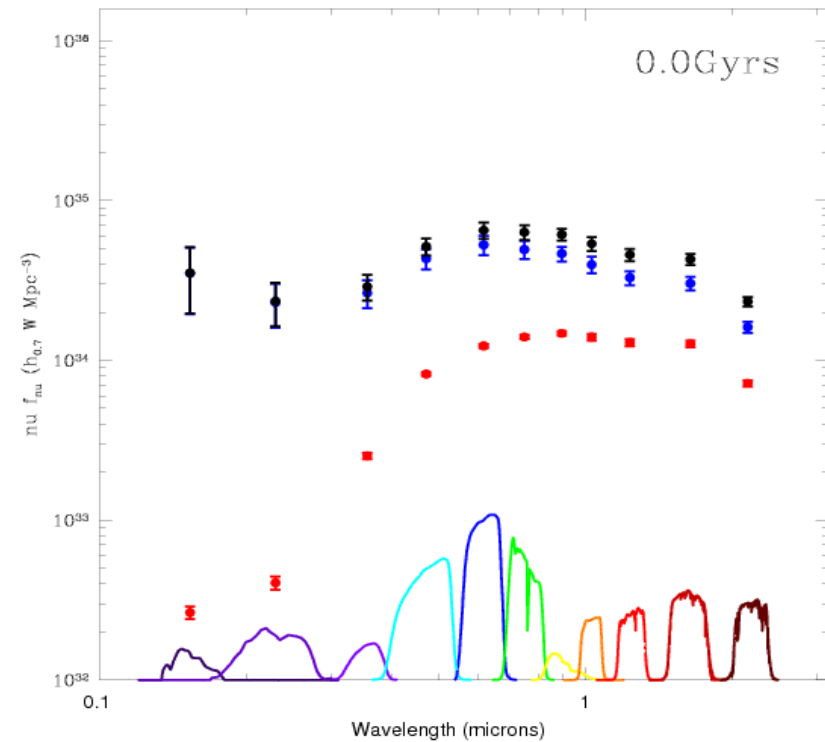
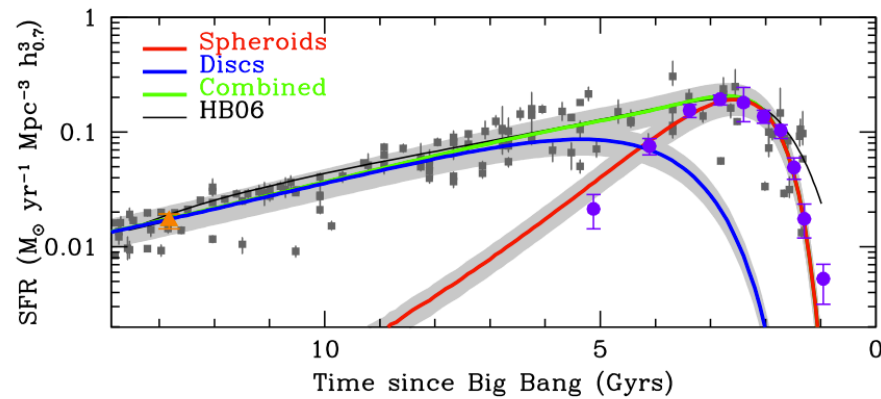
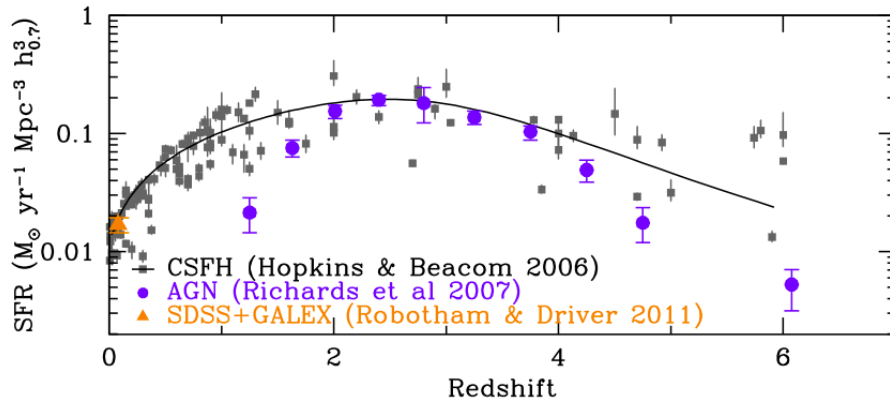
45% Spheroid & 55% Disc



– Bulge-disc decomposition (Lange et al, Haussler et al)

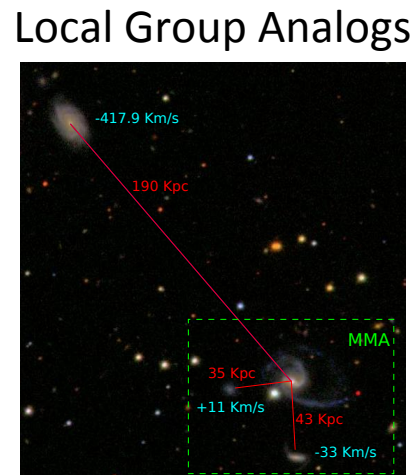
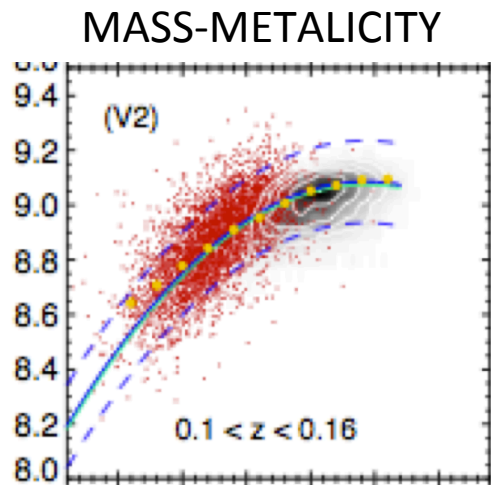
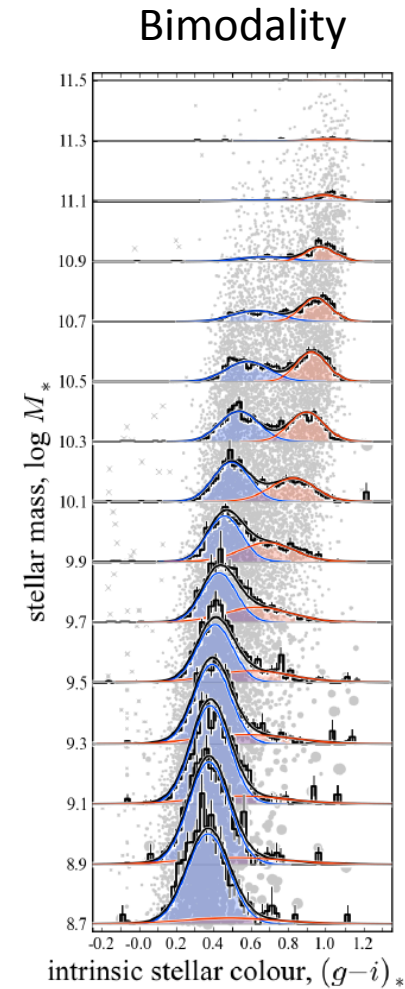
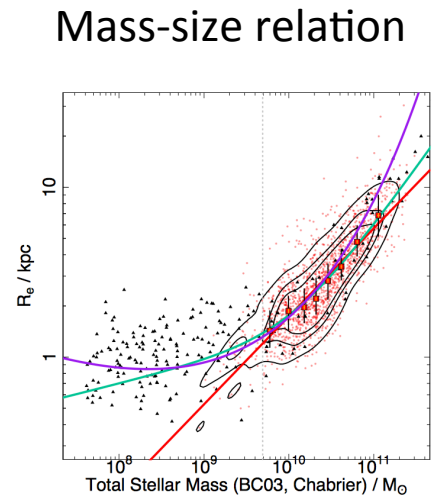
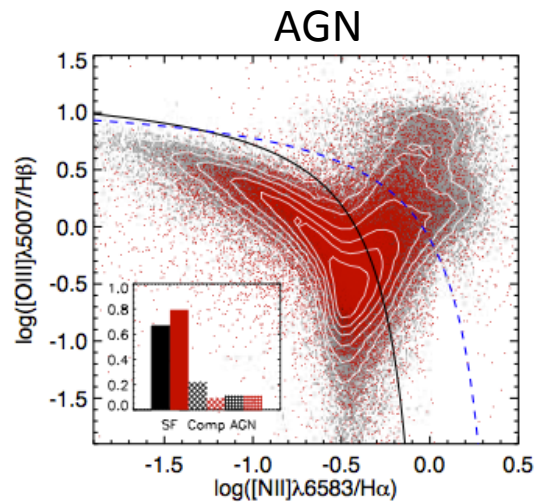


Two phase evolution?

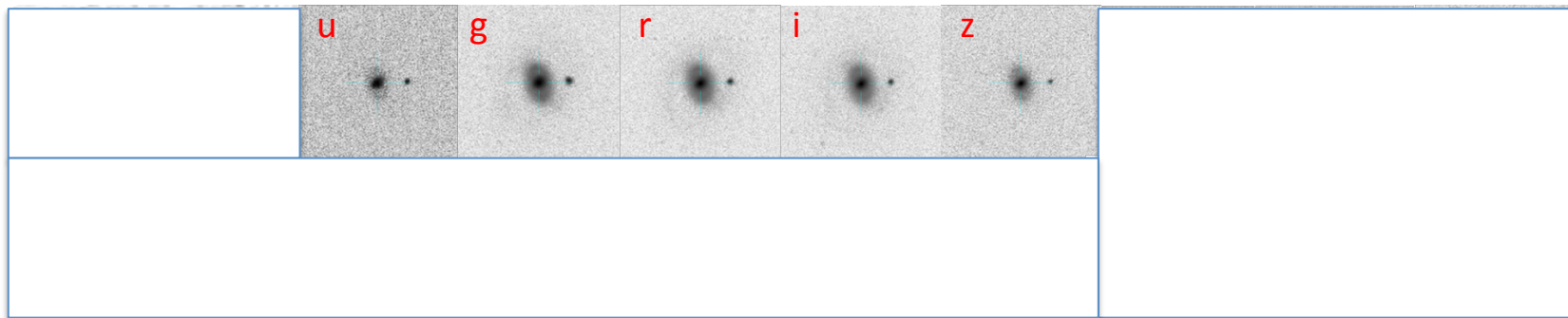
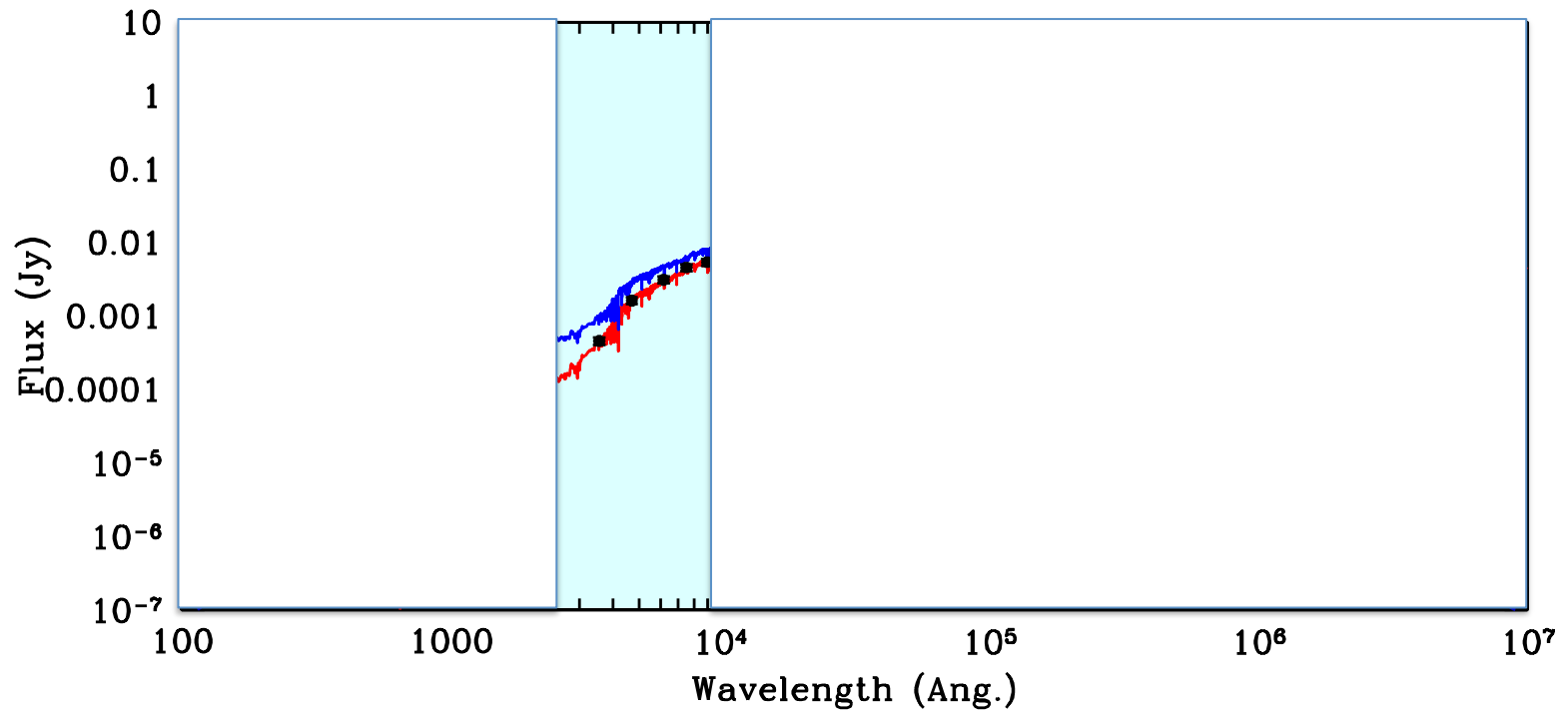


and so much more...

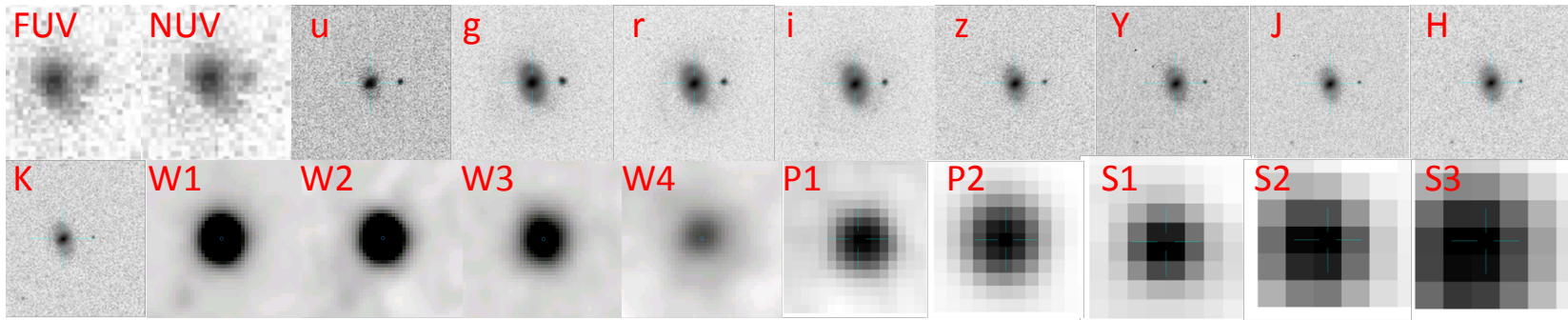
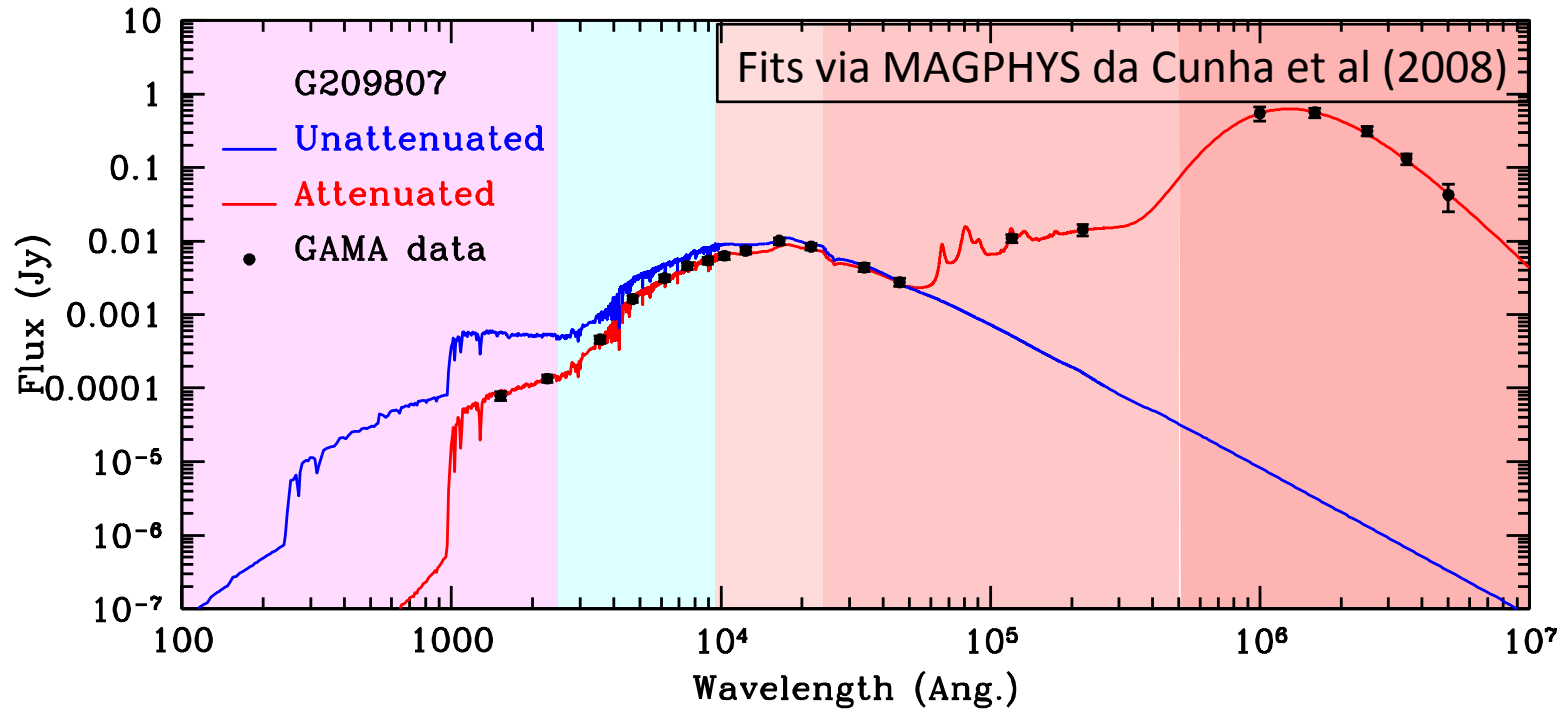
71 papers accepted +180 in progress, but **SAMI**, **VST**, **ASKAP**, **Panchromatic** and **WAVES** to come...



Panchromatic photometry

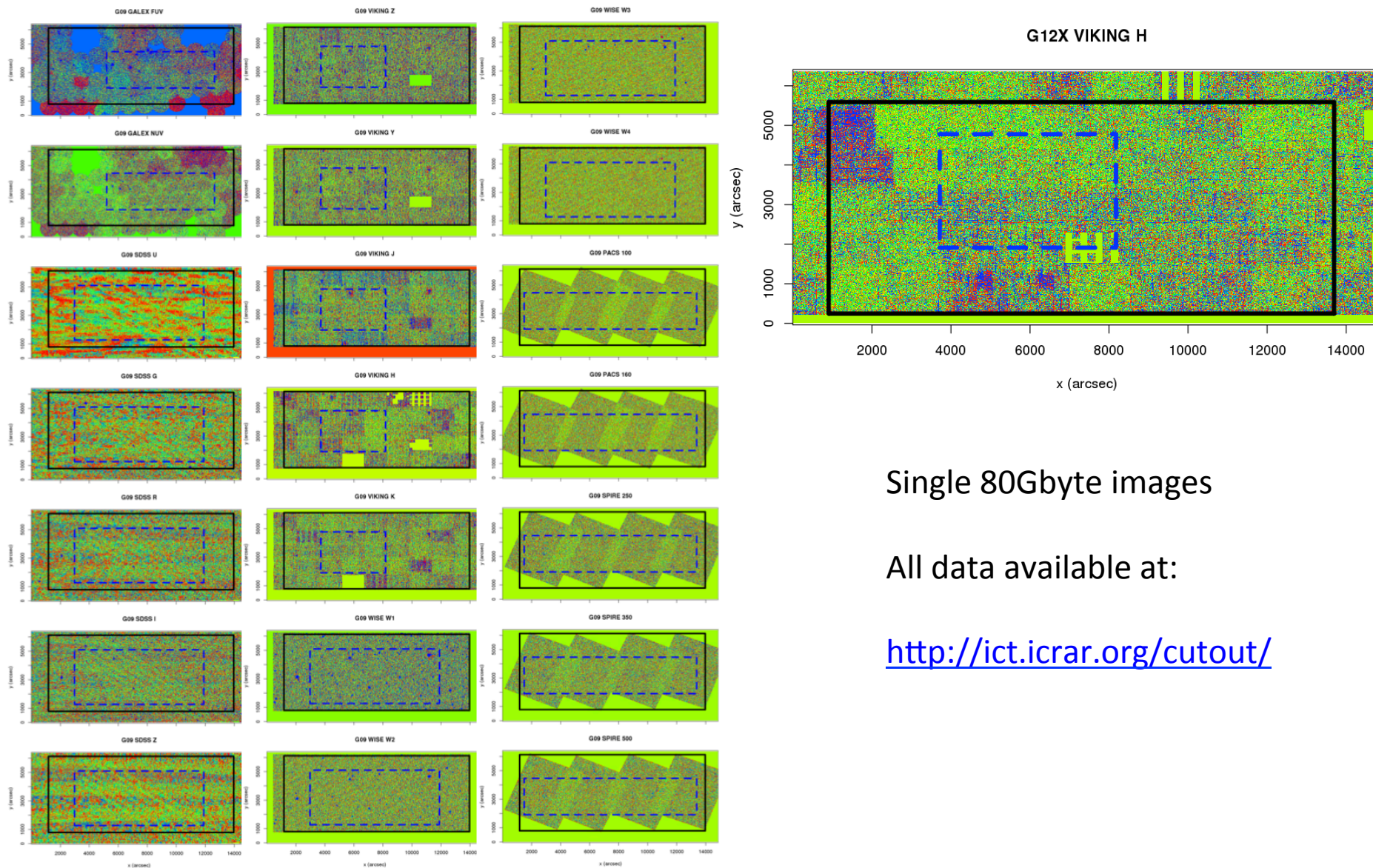


Panchromatic photometry





GAMA SWARPs

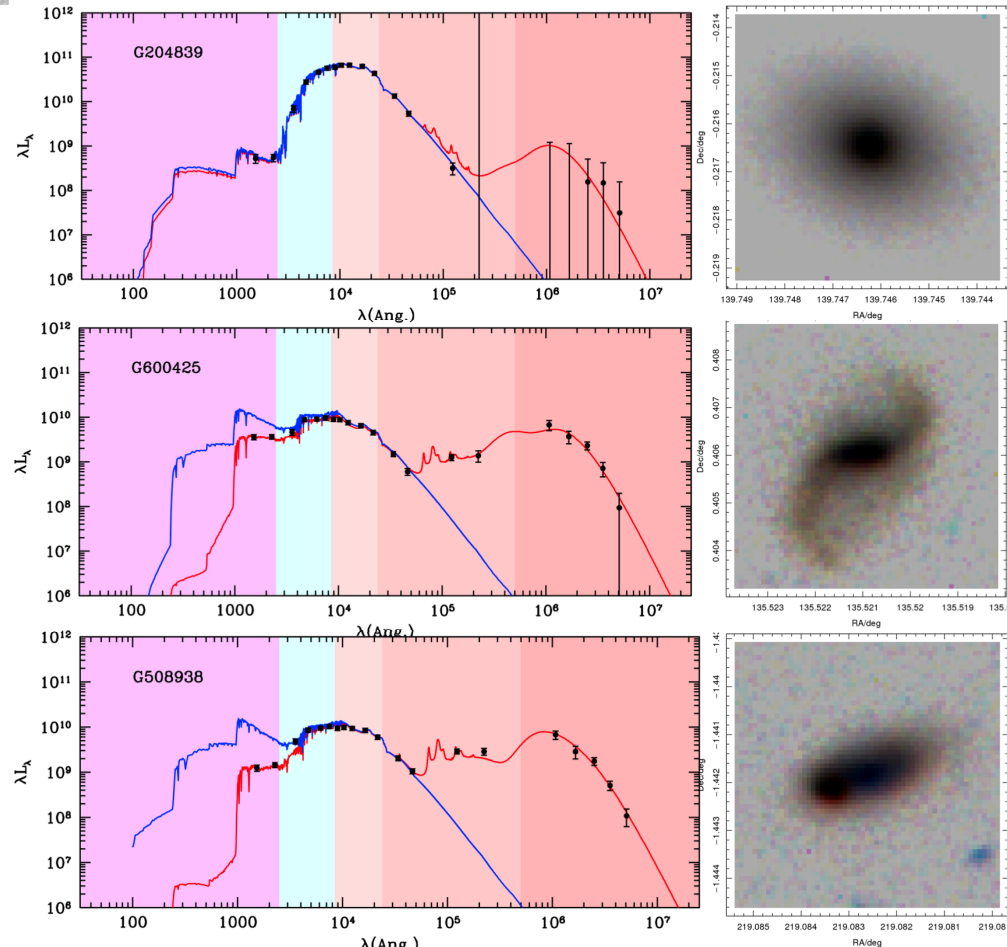
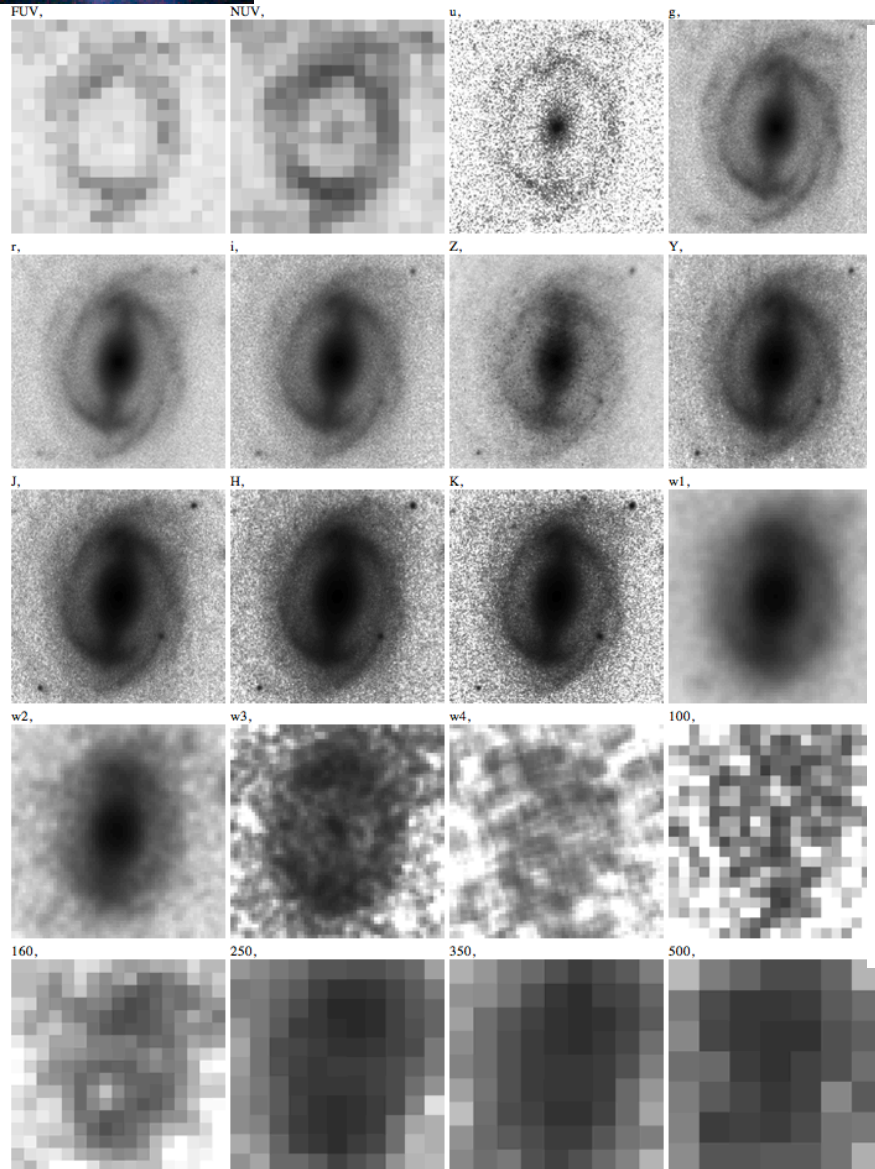
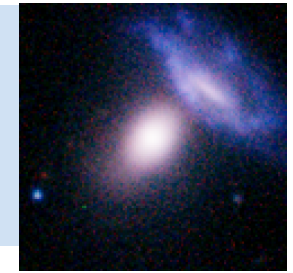
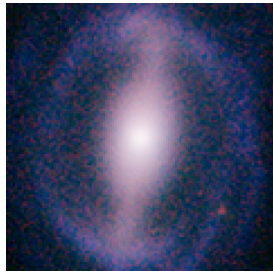


Single 80Gbyte images

All data available at:

<http://ict.icrar.org/cutout/>

Panchromatic photometry



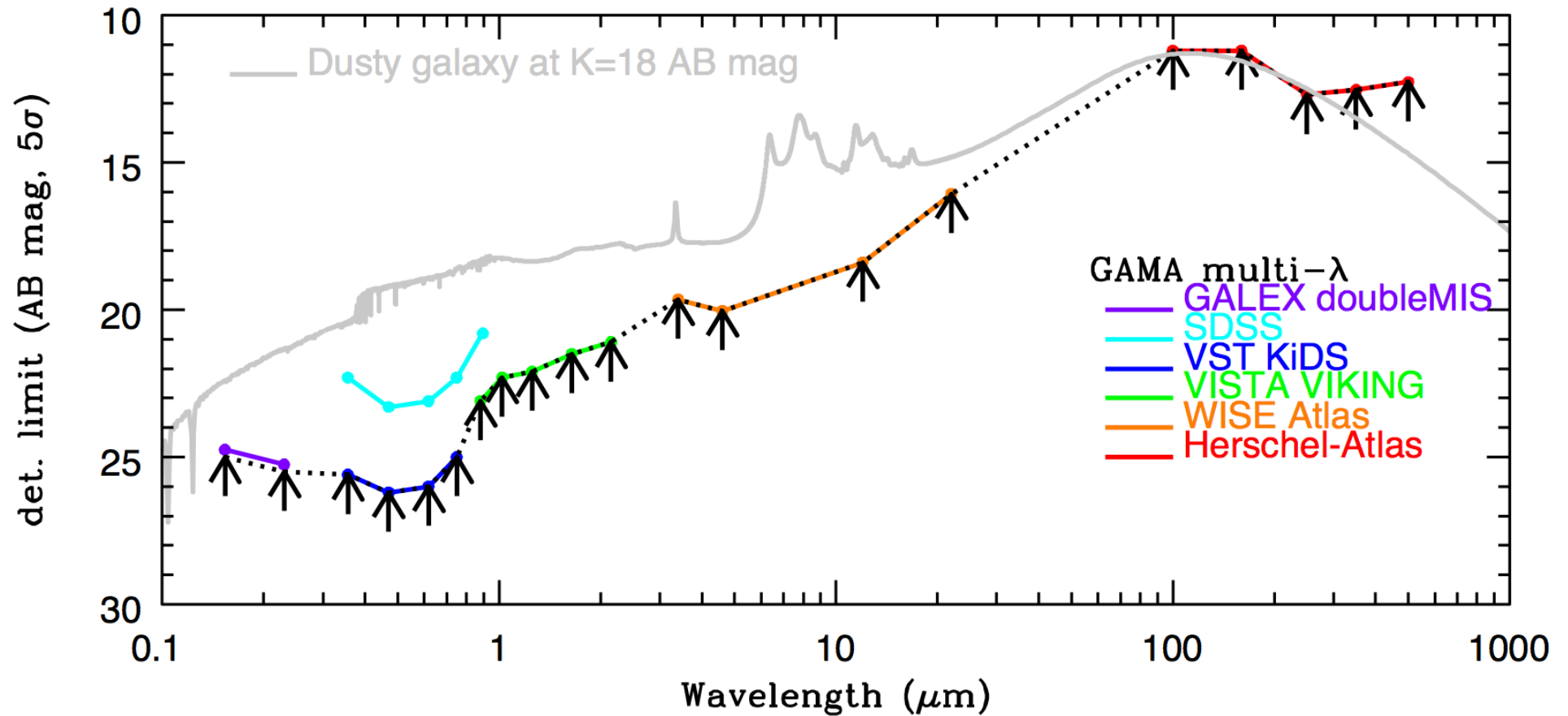
250,000 galaxies with MAGPHYS output.

Complete and unbiased, coming soon

<http://ict.icrar.org/cutout/>

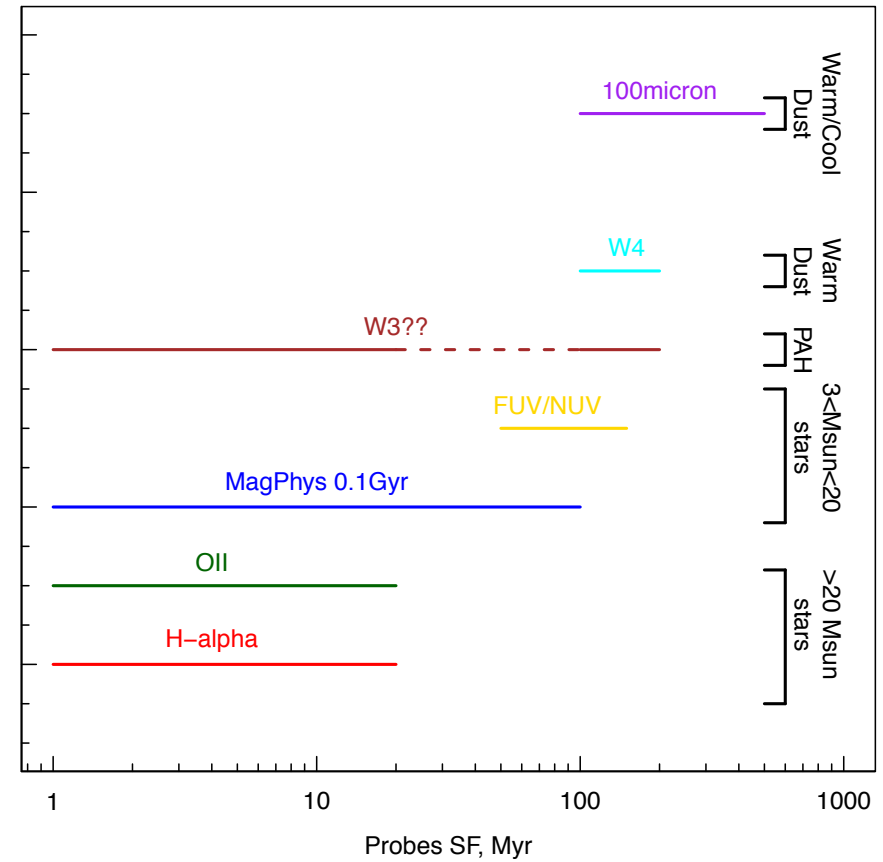
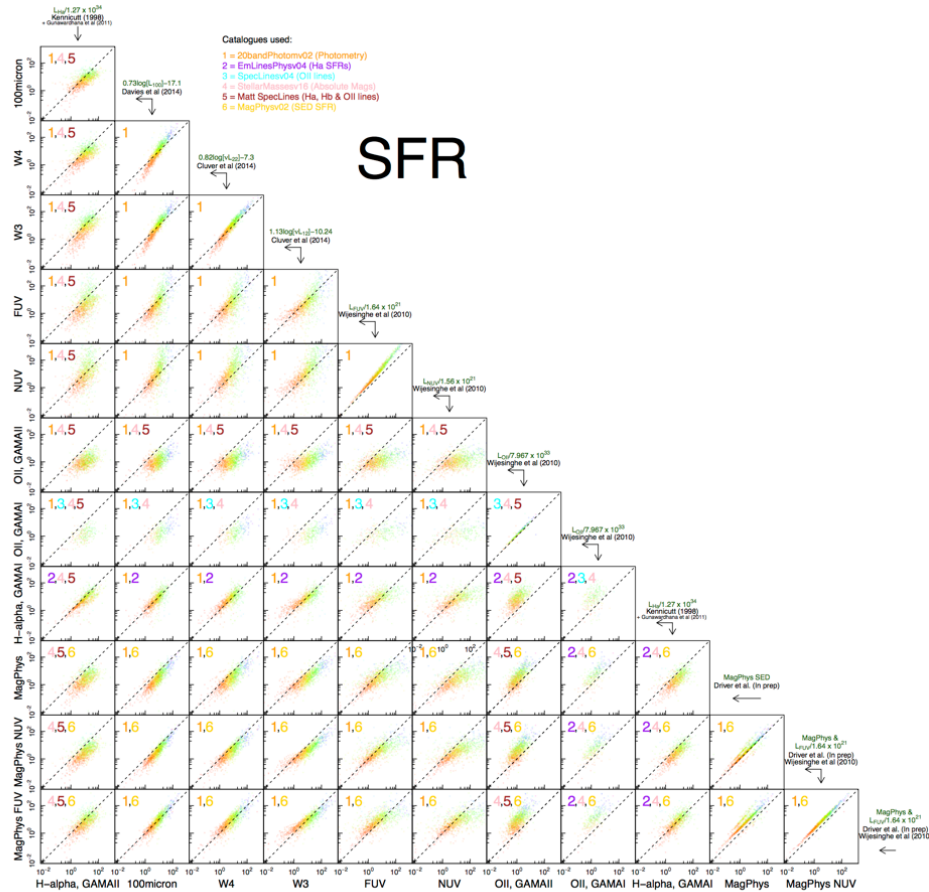
Panchromatic sensitivity

Achieving sensitivity limits close to those stated on facility/team websites.





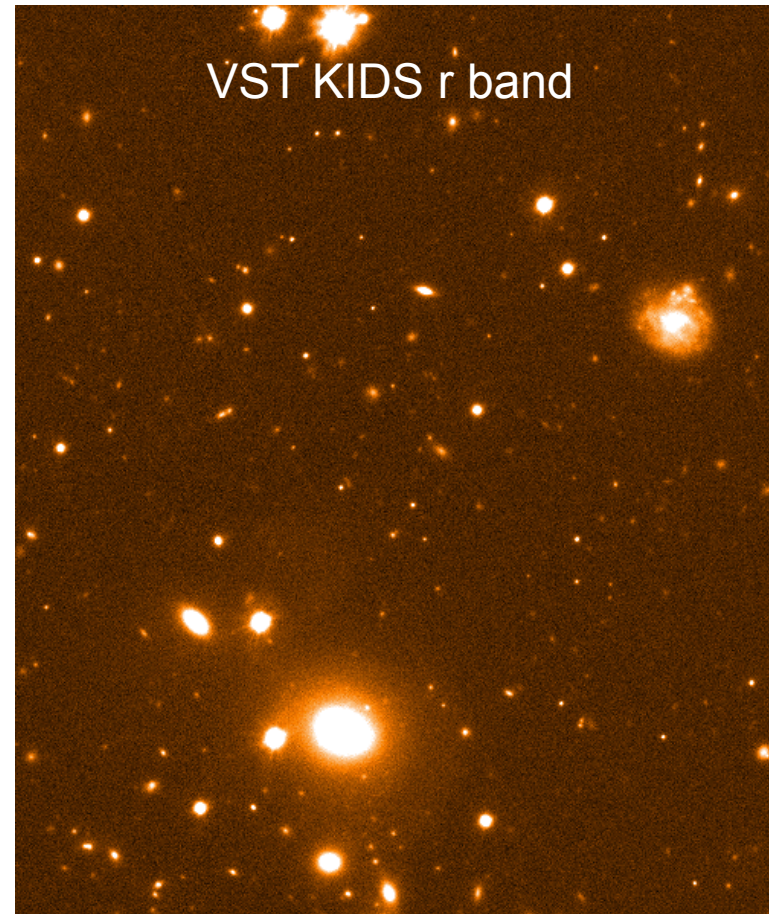
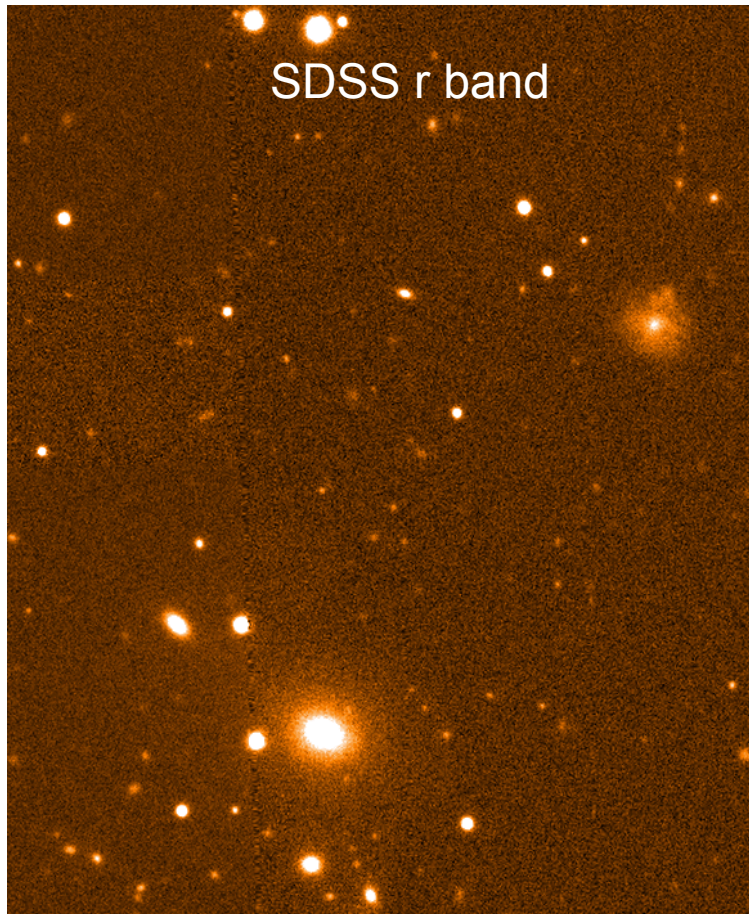
e.g., multiple SFR tracers



Luke Davies, UWA, using multiple SFR tracers to monitor SFR during merger

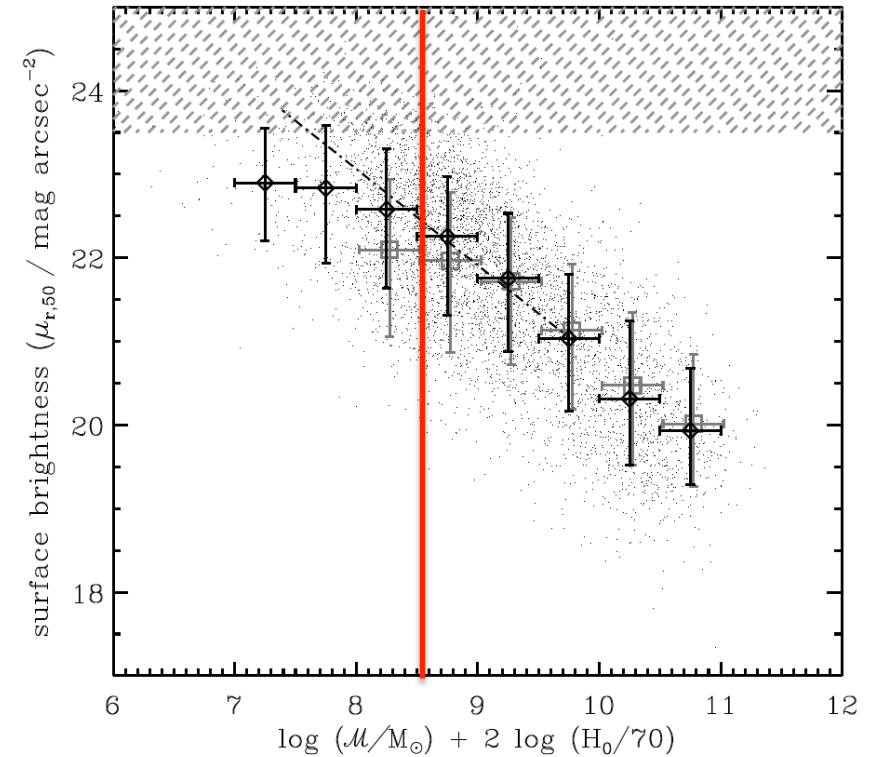
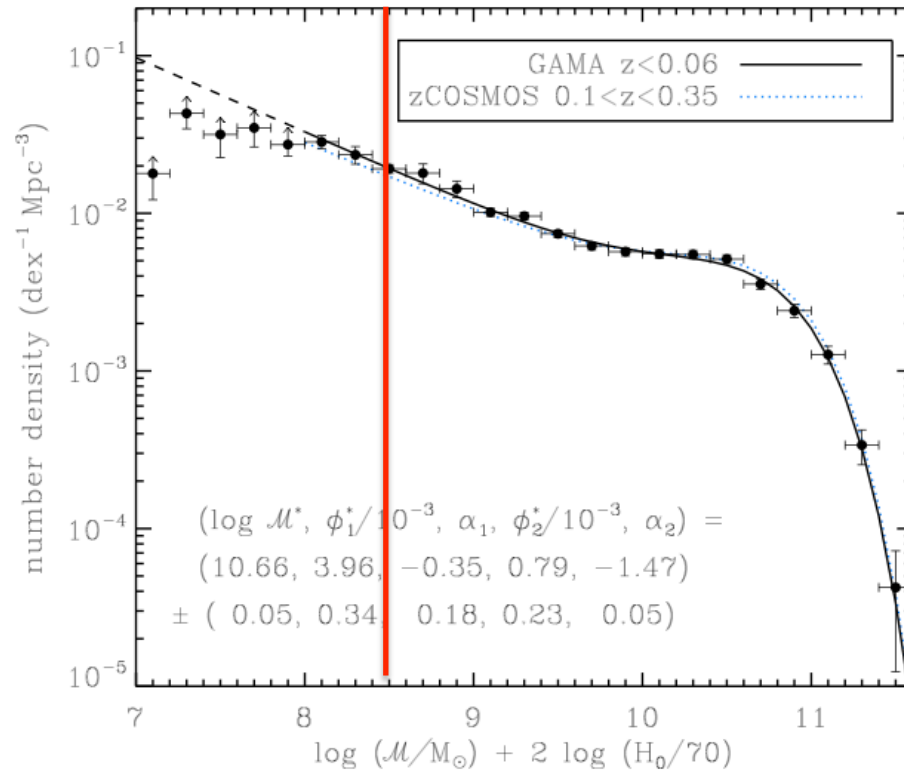
VST observations now underway

Imaging resolution & depth
 $1.5'' \rightarrow 0.7''$, $r \sim 22 \rightarrow r \sim 24$



Galaxy Stellar Mass Function

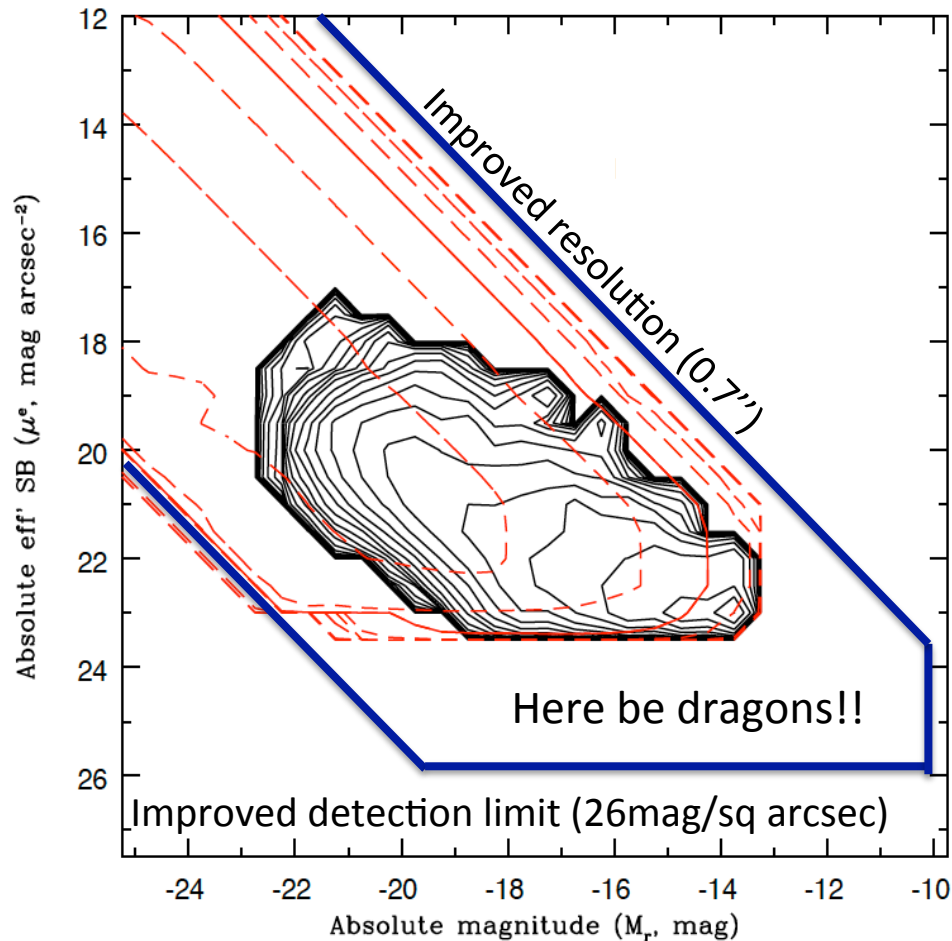
GALAXY STELLAR MASS FUNCTION ONLY KNOWN TO $10^{8.5} M_{\odot}$ AT $z=0$



Baldry et al (2013)



VST: Unlocking the low surface brightness low luminosity Universe



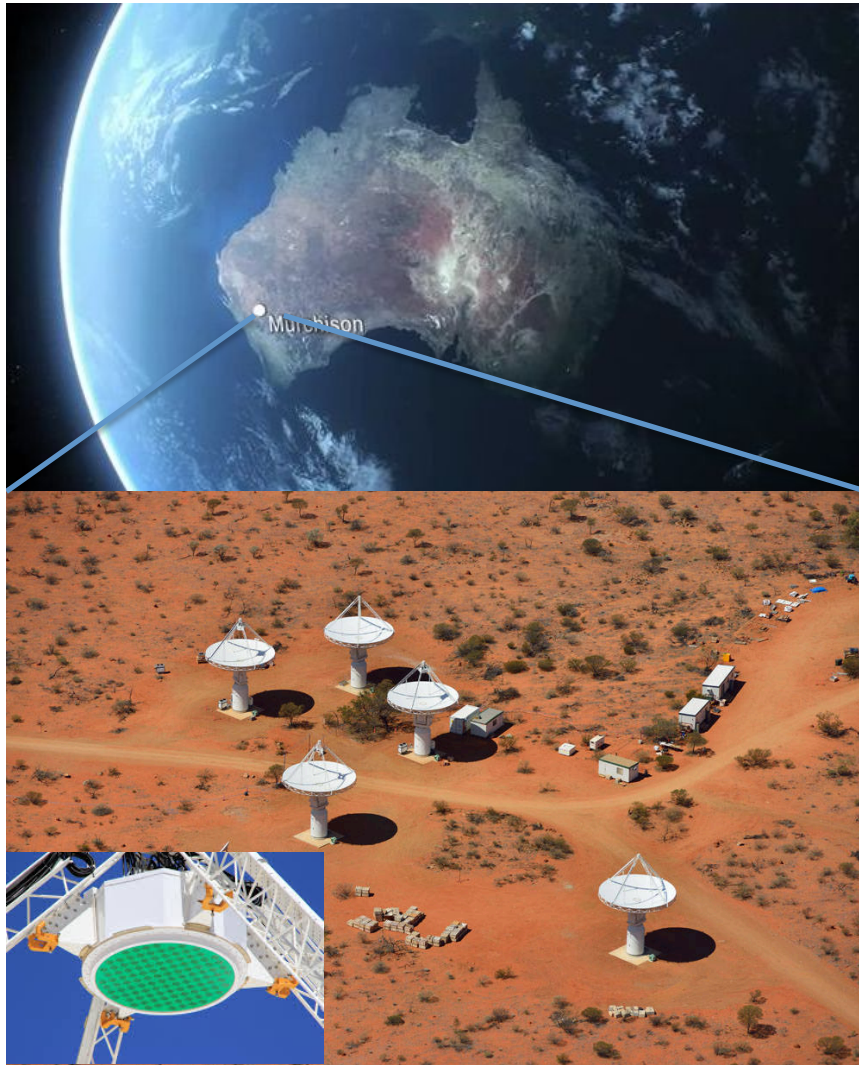
The current constraint on the space density of galaxies is shown as contours with the selection boundaries for various volumes shown in red.

VST-KiDS will allow

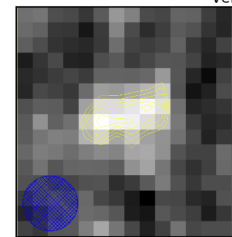
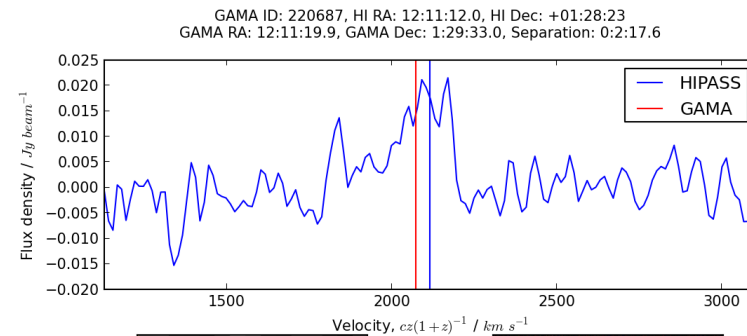
- improved resolution
- improved surface brightness
- group refined photo-z's



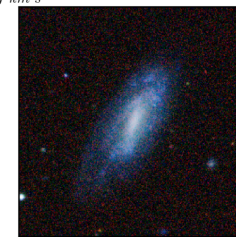
HI gas and dynamics via ASKAP



Australian-SKA Pathfinder
Thirty-six 12m antennas with phase array feeds
30 sq deg field of view
GAMA23 region primary deep target
Operations with 12 antennas commence Dec-2014
HI to $z=0.45$



HIPASS zero-moment map



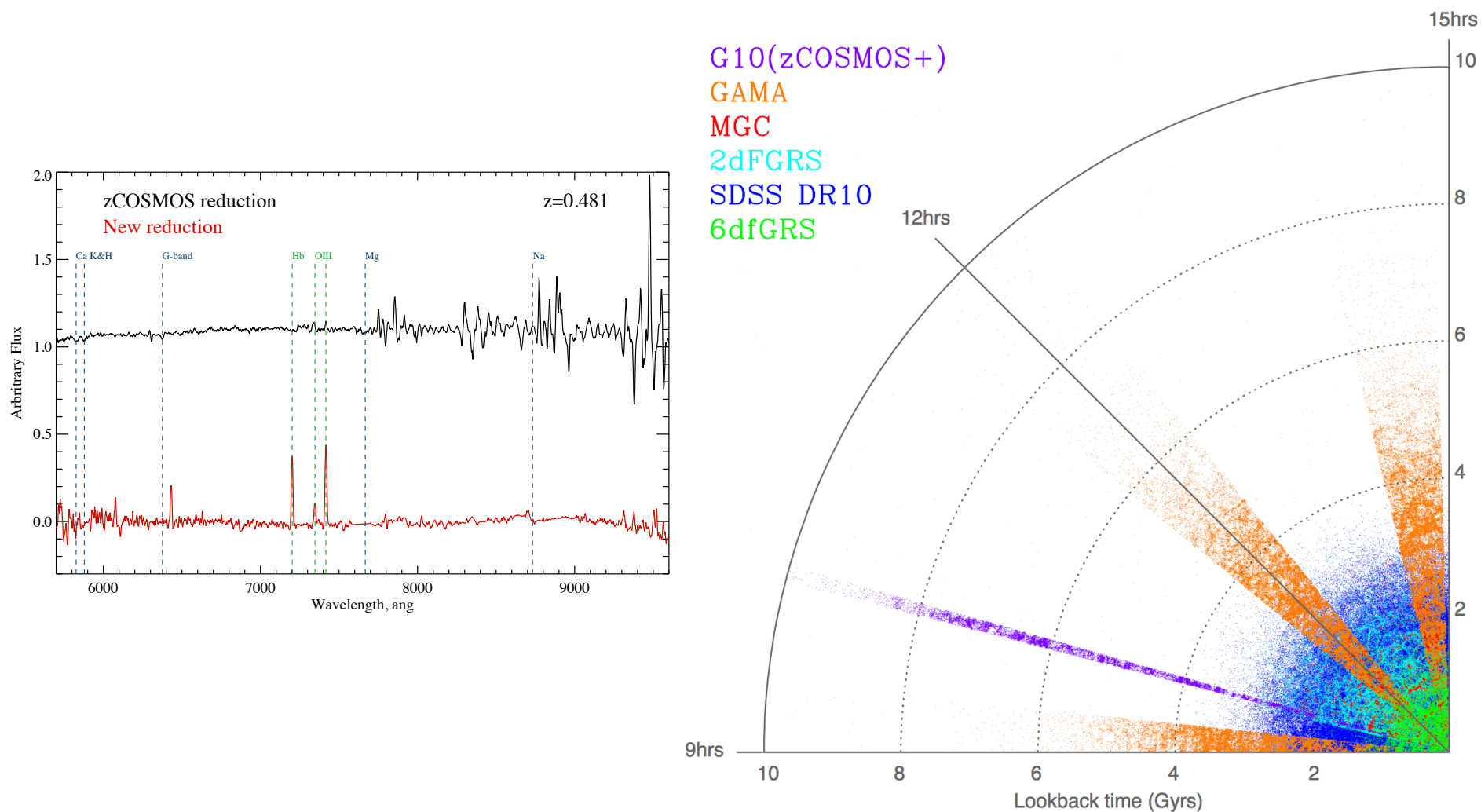
GAMA image

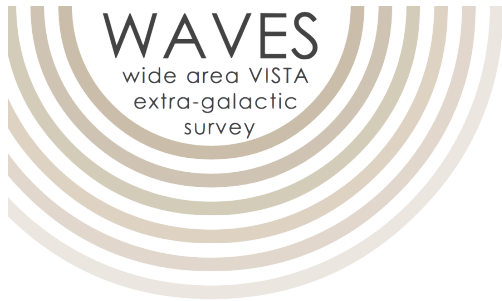


Introducing G10 aka zCOSMOS

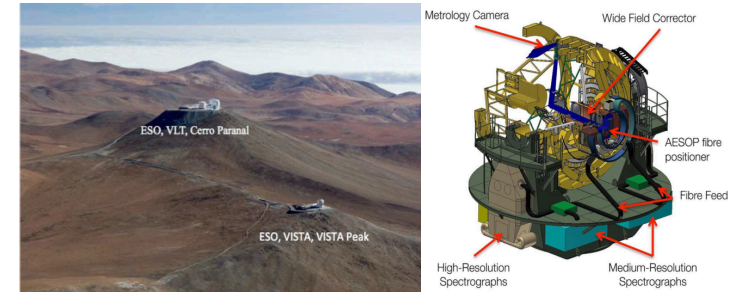
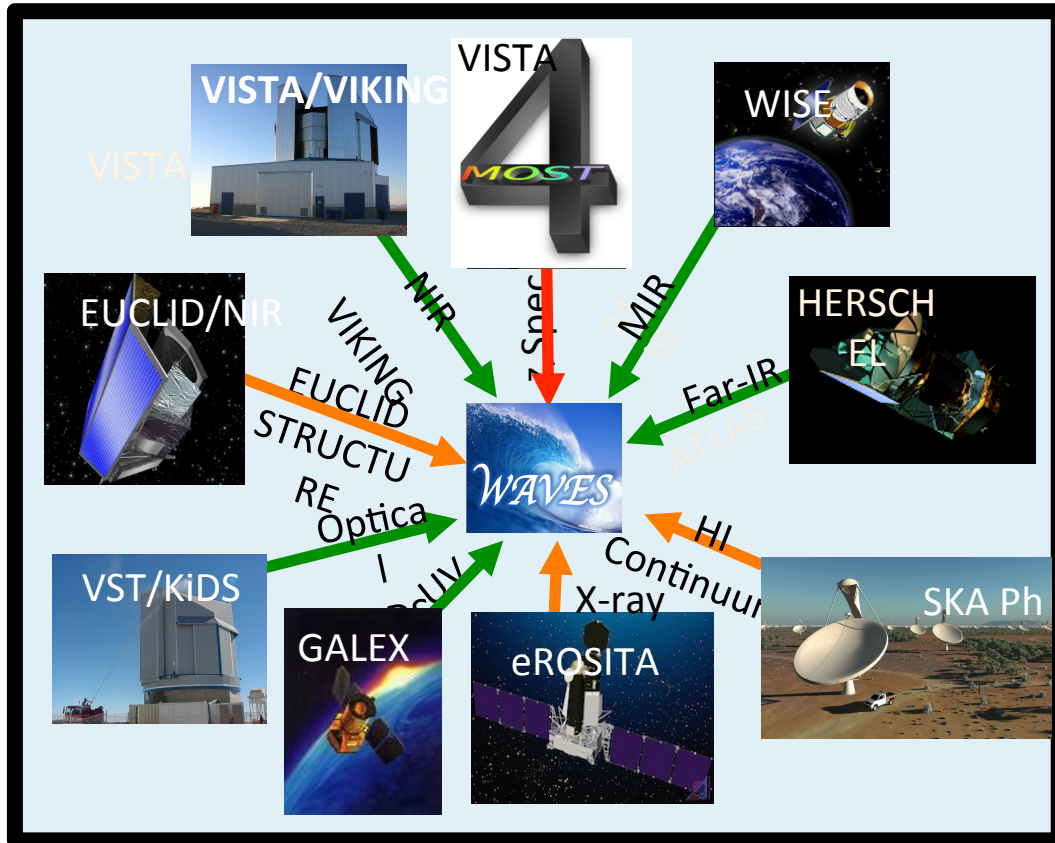
Complete analysis from ESO archive of the zCOSMOS 20k sample

Available at: <http://ict.icrar.org/cutout/G10/> see Davies et al (2014, astro-ph:1409.3574)





Wide Area VISTA Extra-galactic Survey



4MOST Design Reference Survey

2-4 million galaxies

WIDE (700 sq deg):

$r < 22$ (photo- $z < 0.2$)

VST KiDS South

DEEP (100 sq def):

$r < 22$

GAMA23 (VST KiDS)

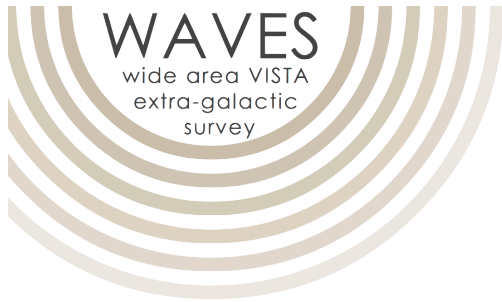
CDM v WDM

85,000 groups (Wide)

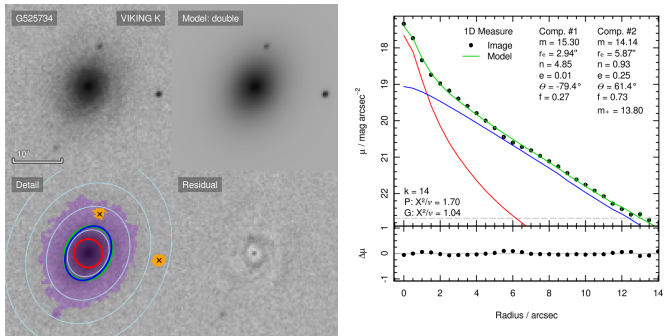
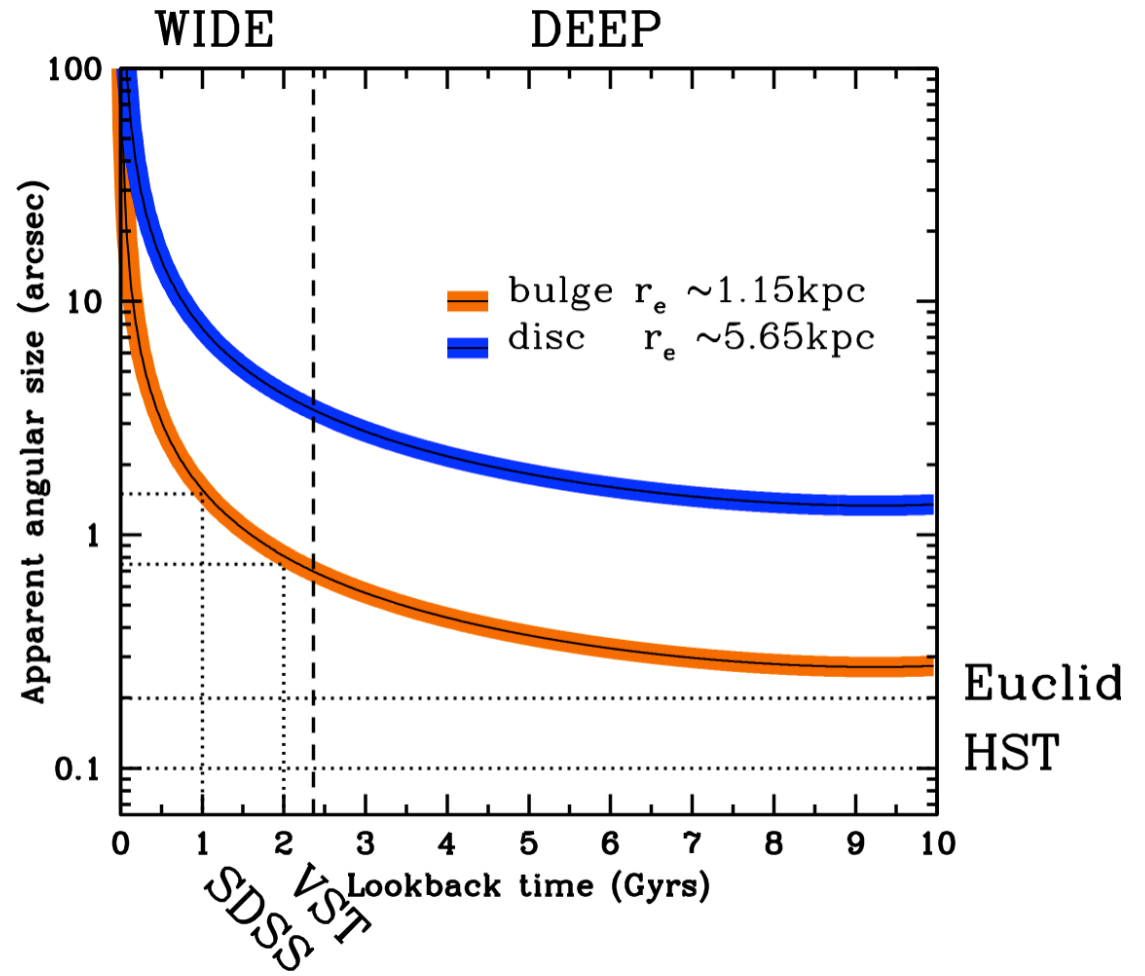
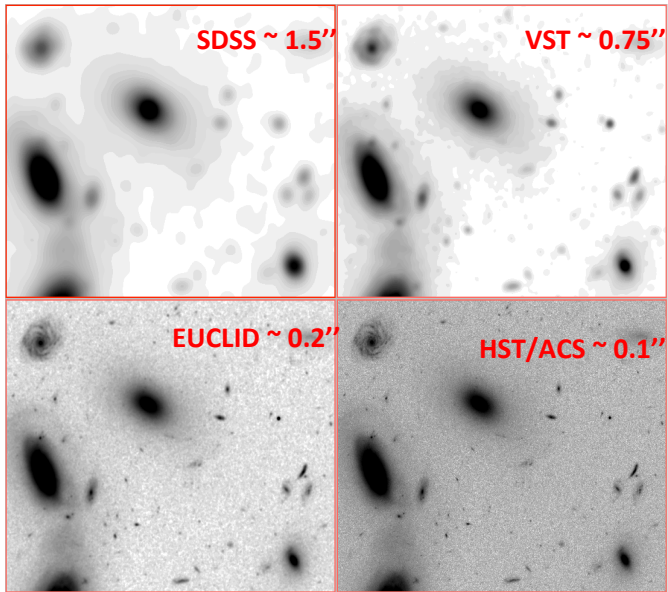
50,000 groups (Deep)

Mass, Energy, Structure to $z=1$

Deep = 75x zCOSMOS



Bulge-disc decomposition of 2million galaxies to $z=1$ with EUCLID

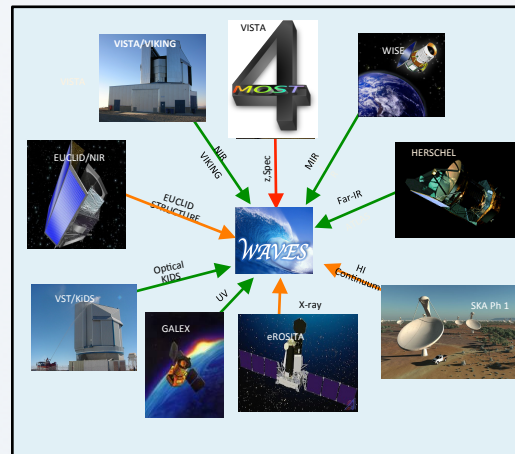
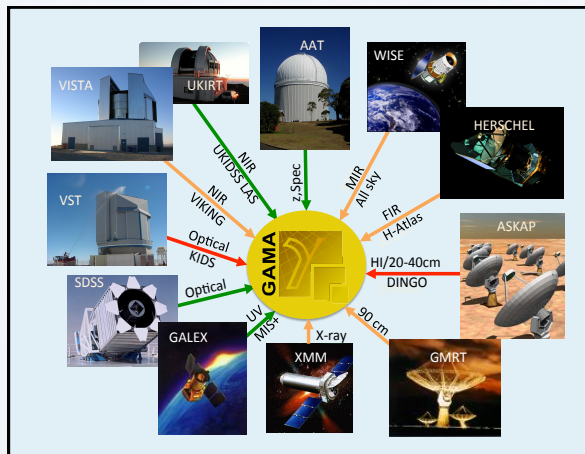


MULTI-WAVELENGTH AND SPECTROSCOPIC SURVEY GROUP @ ICRAR

Evolution of mass, energy & structure

GAMA: 2014-2019

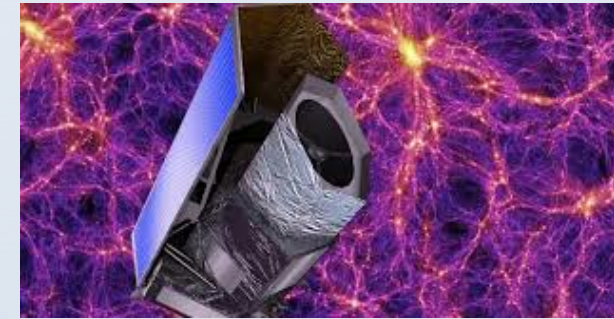
WAVES: 2015-2029



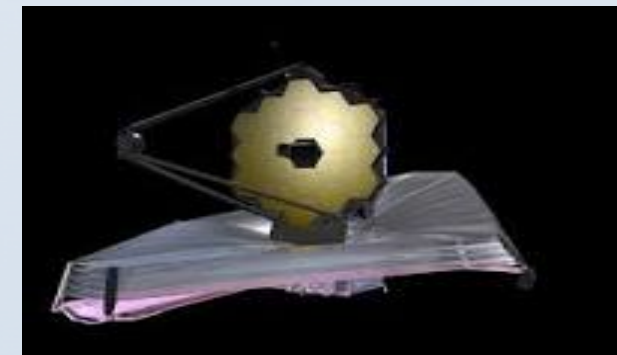
Wide-area galaxy spectroscopic surveys



High-resolution imaging



First galaxies

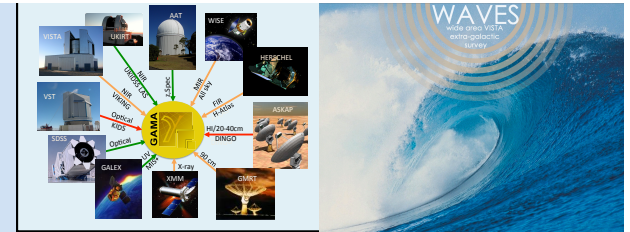


The HI Universe

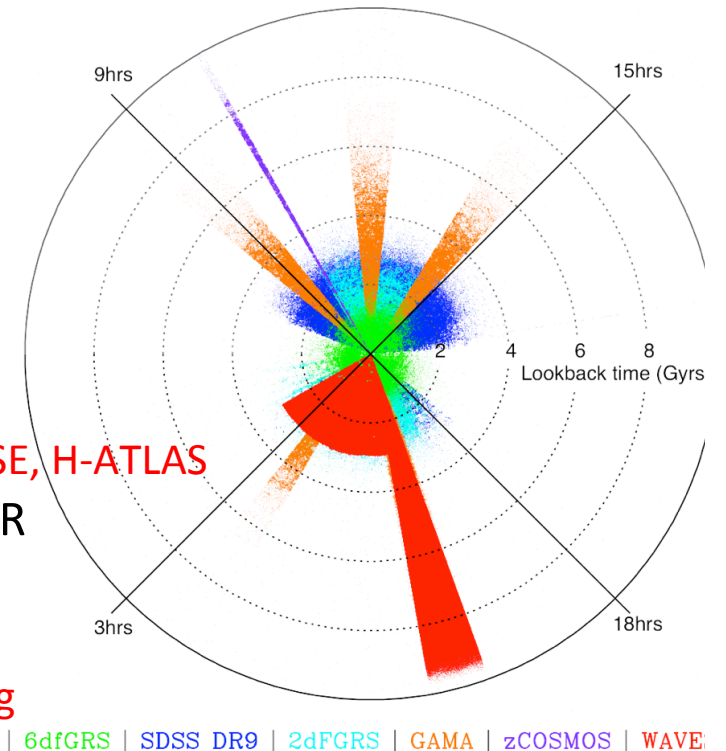




Thank-you:



- AAT/AAO, SDSS, UKIRT
- ESO (VST, VLT, VISTA)
- ESA (HERSCHEL)
- NASA (GALEX, WISE)
- UK Wide-Field Centres: CASU, WFSU
- Teams:
 - 2dFGRS, SDSS, MGC, 6df GS, zCOSMOS
 - GALEX, SDSS, VST KiDS, UKIDSS LAS, VISTA VIKING, WISE, H-ATLAS
- Software: SExtractor, SWARP, PSFex, Aladin, Topcat, R
- Funding: SUPA, STFC, ARC, ERC, RS, SIEF, ICRAR
- GAMA Team: 80 Scientists but in particular:
 - Joe Liske, Ivan Baldry, Aaron Robotham, Peder Norberg



- GAMA DR2: <http://www.gama-survey.org/DR2>
- GAMA PDR: <http://ict.icrar.org/cutout>
- zCOSMOS/G10: <http://ict.icrar.org/cutout/G10/>
- WAVES: <http://www.wave-survey.org/>
- CompareYourFacility: <https://asgr.shinyapps.io/ganttshiny/>
- Cosmic variance calc: <http://star-www.st-and.ac.uk/~asgr/cosvar/>