



# GAMA\*



**Aaron Robotham**  
University of St Andrews  
&  
The GAMA Team

\* Galaxy And Mass Assembly

## GAMA WORKING GROUPS/HEADS

SCIENCE	CATS	DATABASE	OBS.	MOCKS	RADIO	SPEC. PIPE.	IMAGE. PIPE.
Peacock (Edin.)	Baldry (LJMU)	Liske (ESO)	Driver (PI, St And)	Norberg (Edin.)	Hopkins (USyd)	Loveday (Sussex)	Bamford (Nott.)

### TEAM MEMBERS

Bridges (AAO)	Edmonson (Ports)	Ellis (USyd)
Bland-Haw'n (U.Syd)	Jones (AAO)	Prescott (LJMU)
Cameron (ETH)	Kuijken (Leiden)	Proctor (Swin.)
Conselice (Nott.)	Lahav (UCL)	Sharp (AAO)
Brough (AAO)	Nichol (Ports.)	Staveley-Smith (UWA)
Croom (U.Syd)	Oliver (Sussex)	Sutherland (Camb.)
Cross (Edin.)	Parkinson (Edin.)	Tuffs (MPIK)
Frenk (Durham)	Phillipps (Bristol)	van Kampen (Innsbruck)
Graham (Swin.)	Popescu (UCLan)	Warren (Imperial)
Hill (StA)	Eales (Cardiff)	Dunne (Nottingham)
Robotham (StA)	Kelvin (StA)	Vikka (StA)

### TEAM AFFILITATIONS:

UKIRT/LAS, VST/KIDS, VISTA/VIKING, HERSCHEL-ATLAS, DURHAM ICC

### WEBSITE:

<http://www.eso.org/~jliske/gama/>

# What GAMA is:



VISTA



UKIRT



AAT



WISE

- Science focus on:

- Structure on 1kpc to 1Mpc Scales (Galaxy Assembly)

- Environment (LSS-Cluster-Group-Halo)

- Components (Nucleus-Bulge-Bar-Disc-Truncation)

- Constituents (Stars-Plasma-Cold Gas-Dust-DM)

- Mass (DM-Baryonic-HI-Stellar)

- Energy (Total SEDs)

- Entropy (SMBHs)

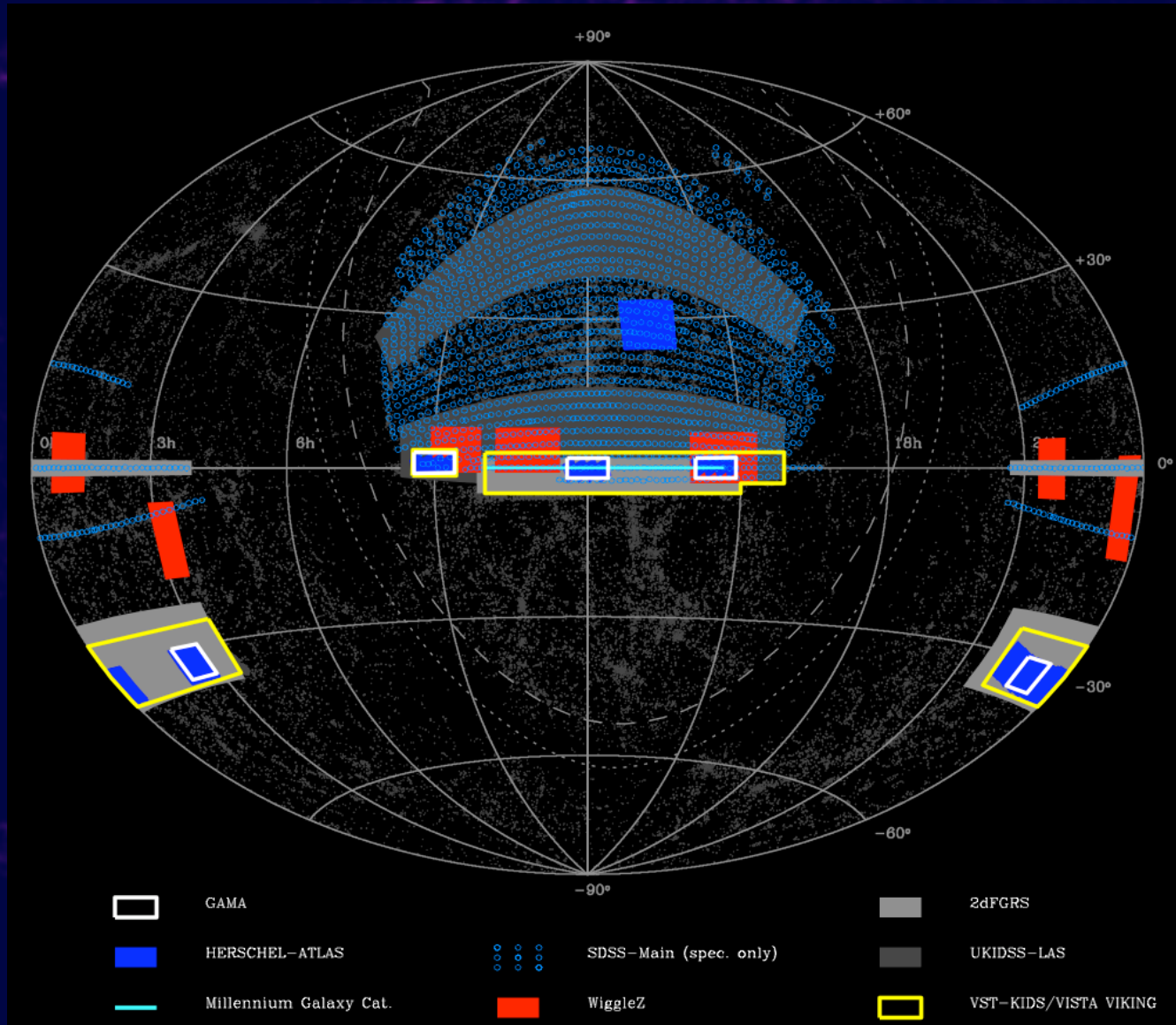
- Fully multi-wavelength ([X-Ray]-UV-OPT-IR-Radio)



SCIENCE

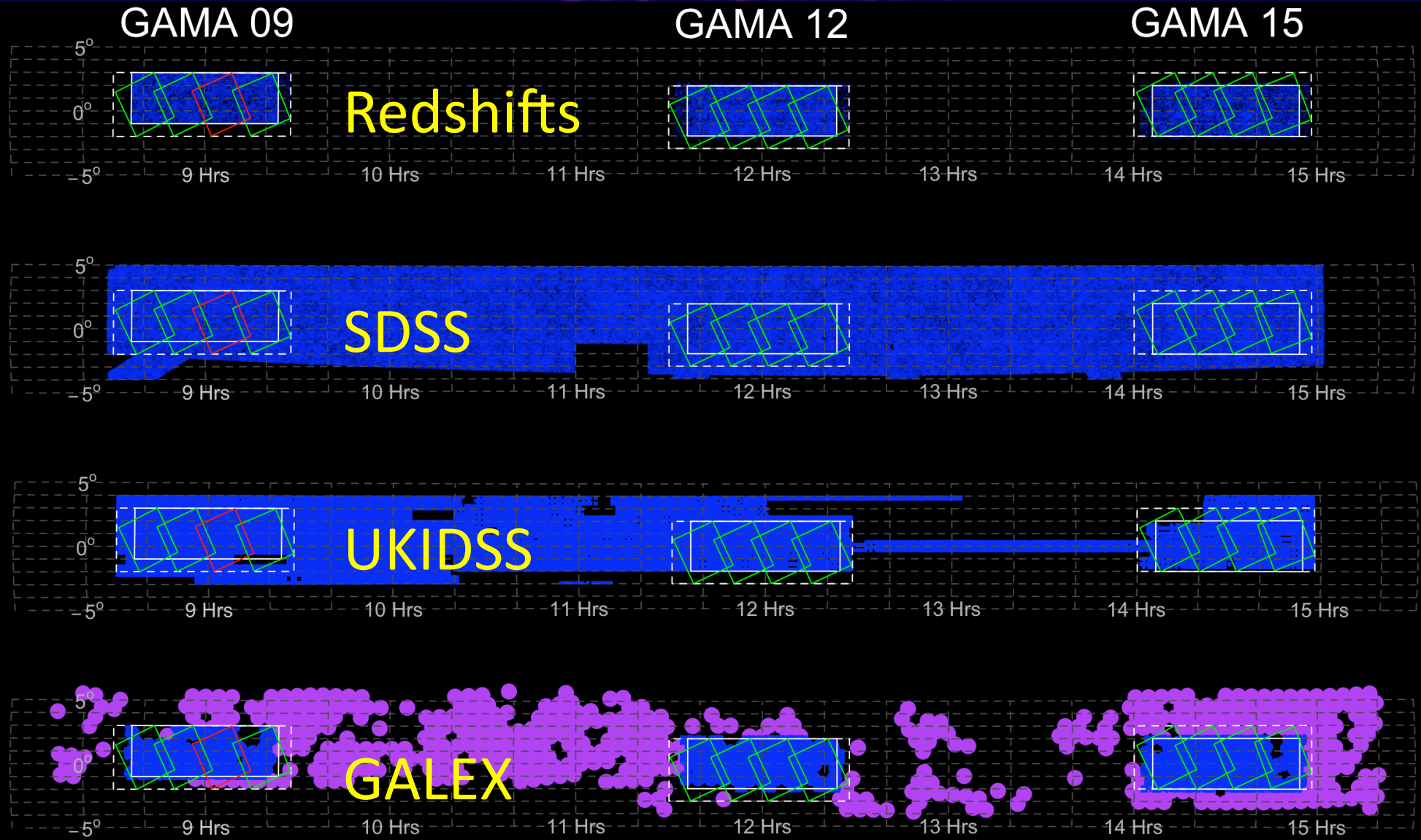


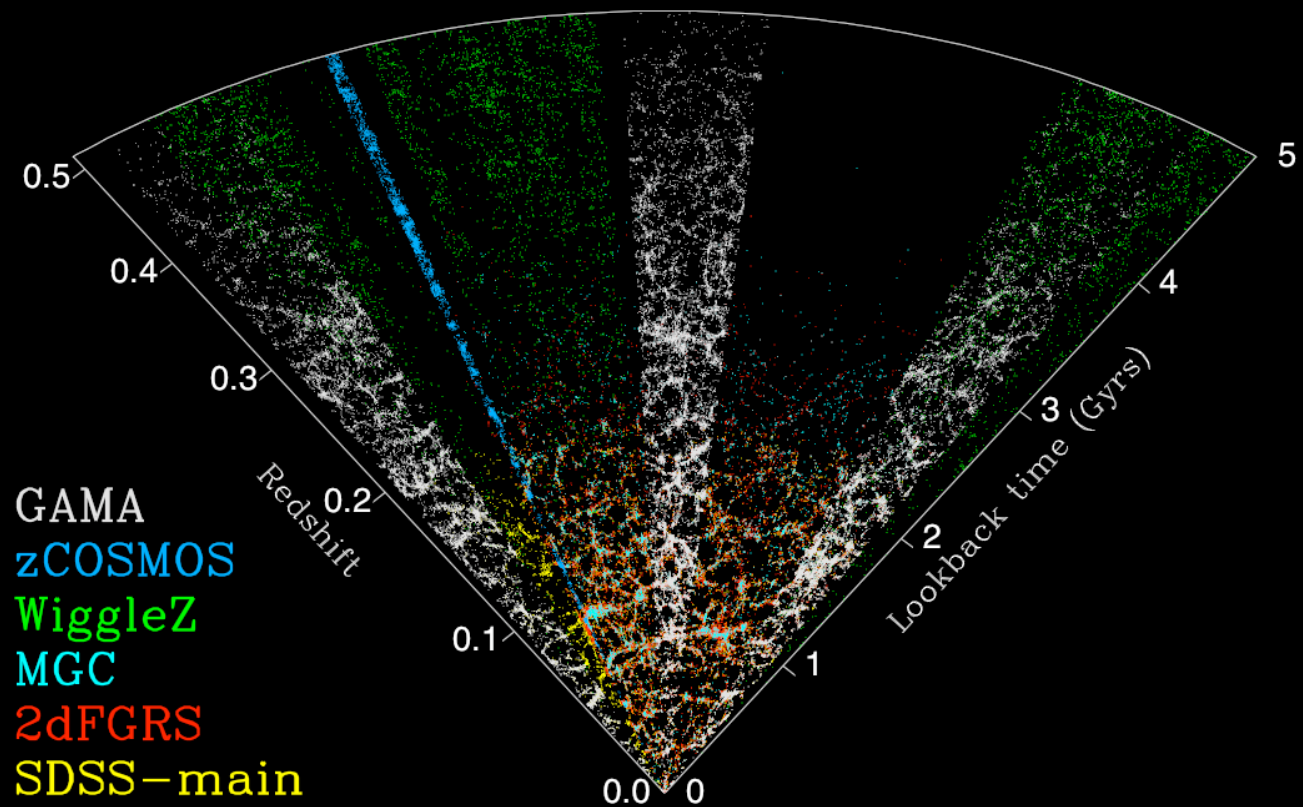
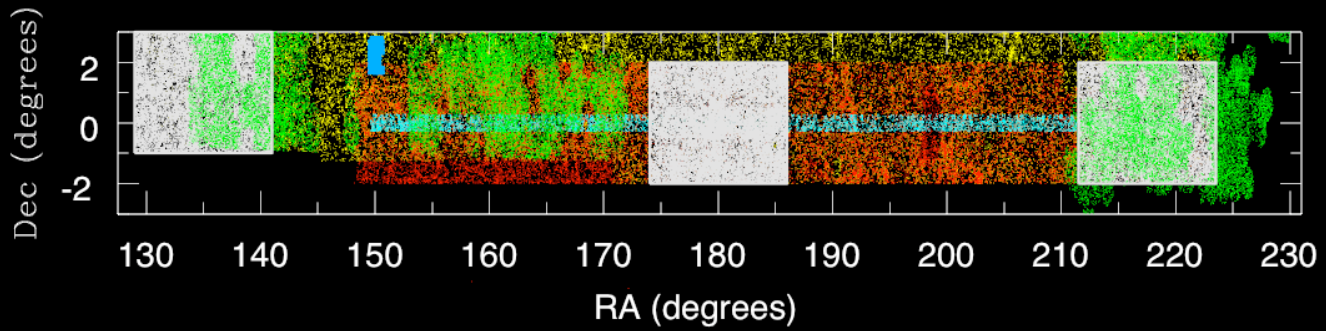
# Survey Region

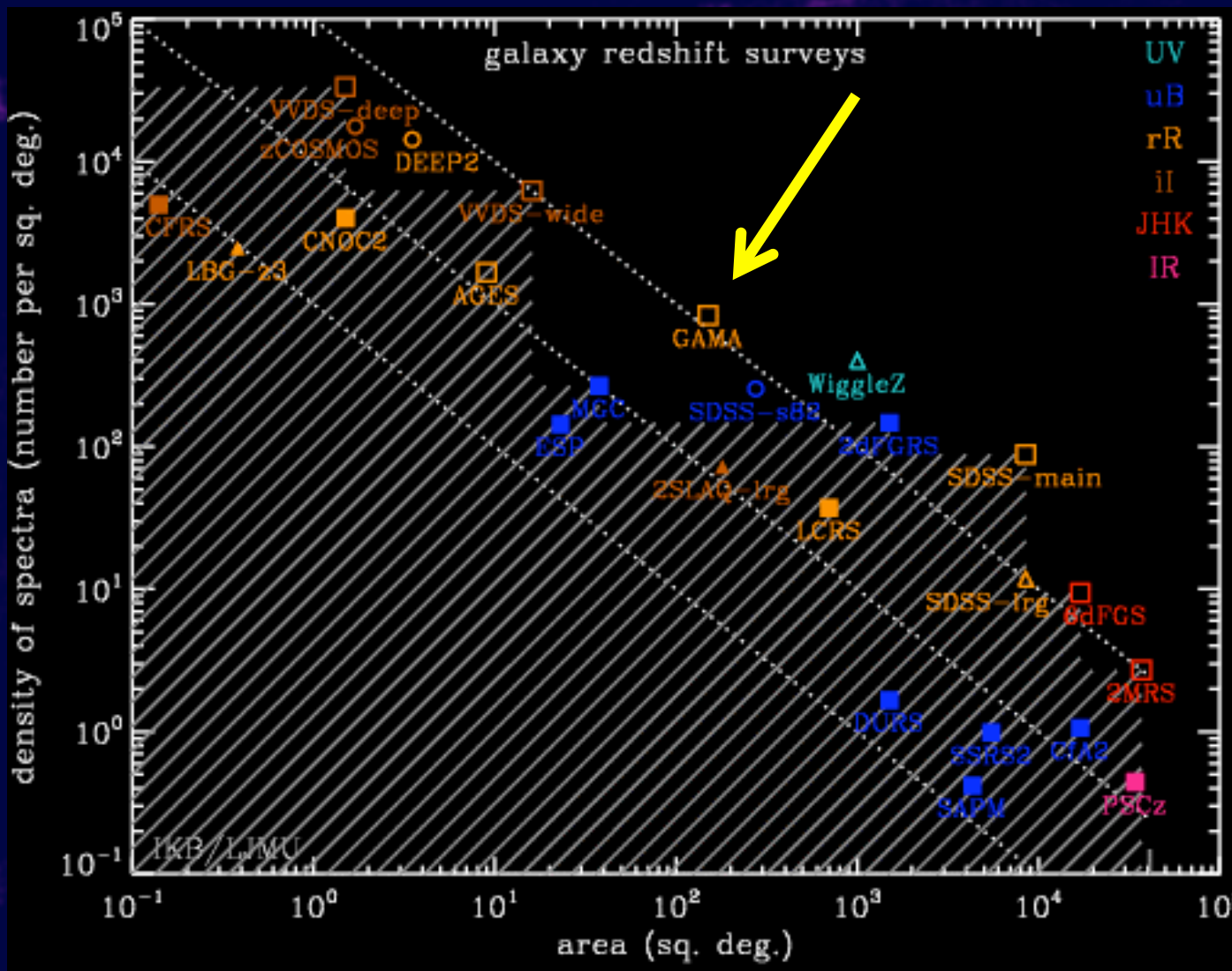




# GAMA Coverage



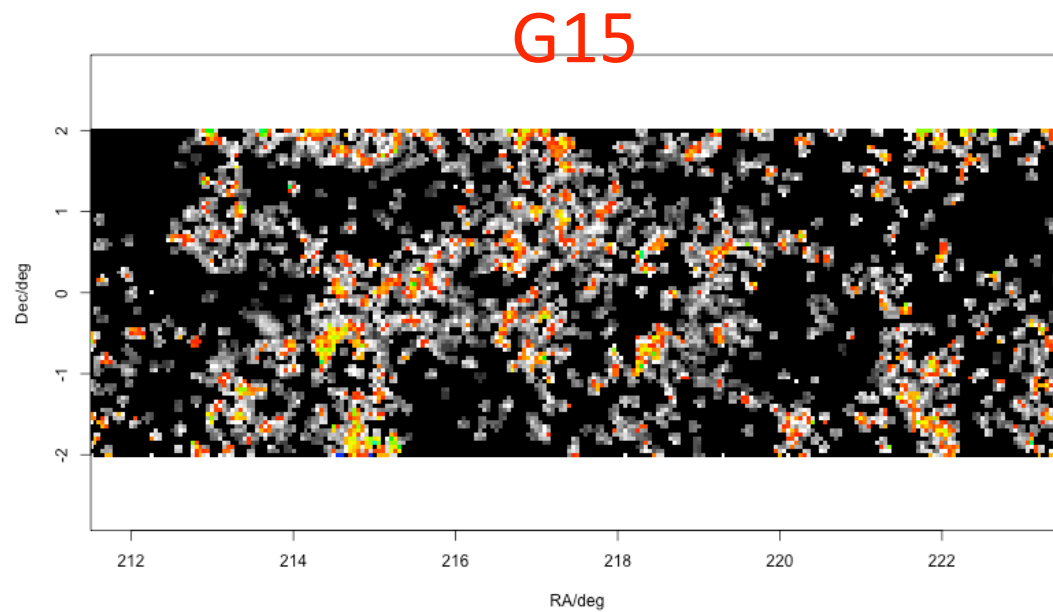
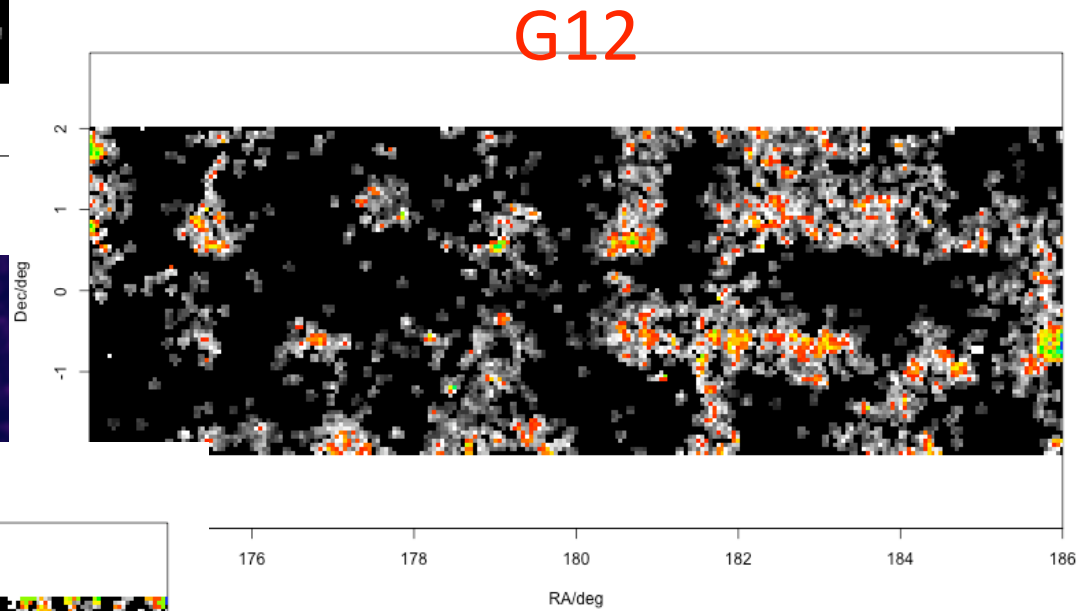
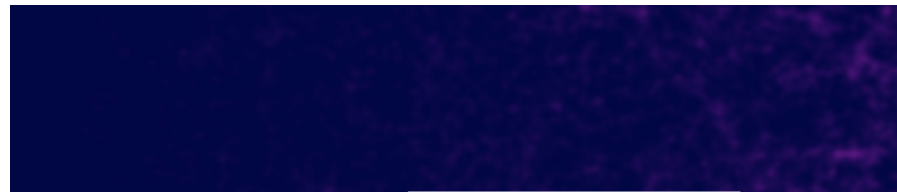
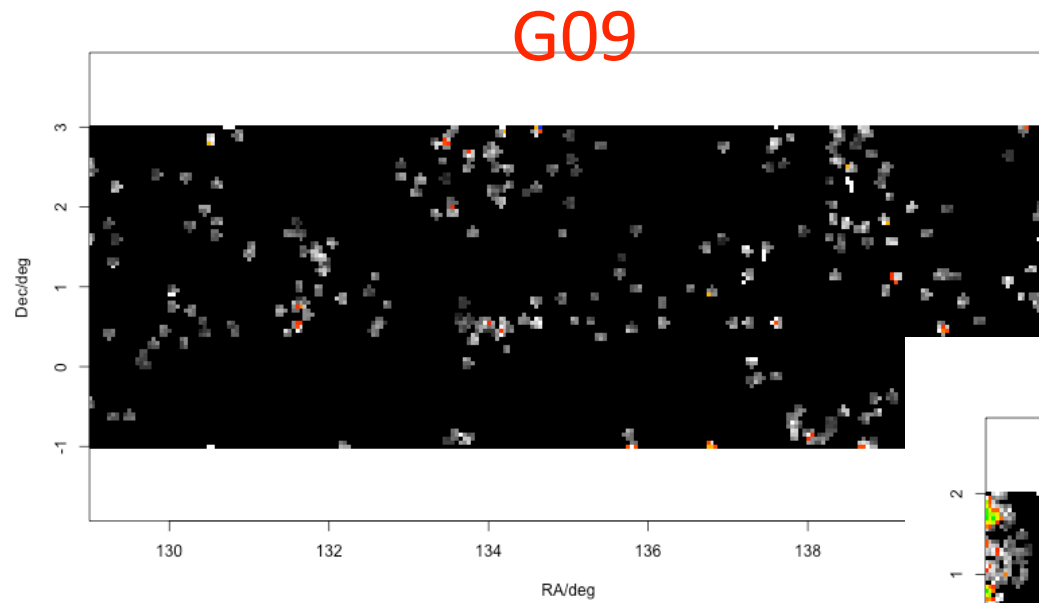




# GAMA Redshift Survey

- Aims to be 99% complete down to:
  - $r < 19.4$  (G09 / G15) 19.8 (G12)
  - $K < 17.6$  (All)
  - $z < 18.2$  (All)
- 90k high fidelity redshifts will be our first data product (+10k, 120-130k final).
- Group catalogues and environmental measures to follow (after year 3 AAT).

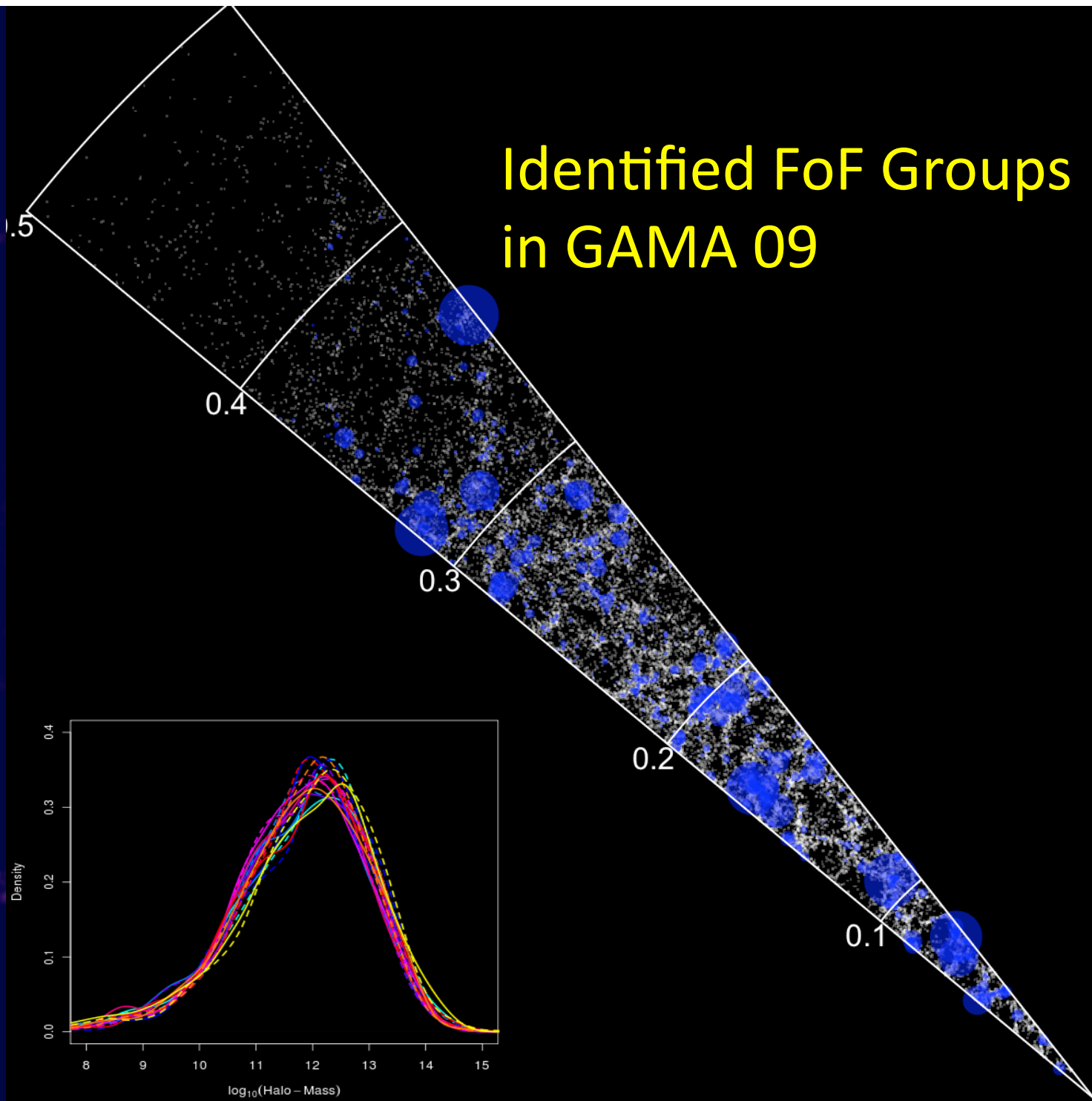




# Current Completeness

G09:	99.21%
G12:	95.12%
G15:	93.49%

# Identified FoF Groups in GAMA 09



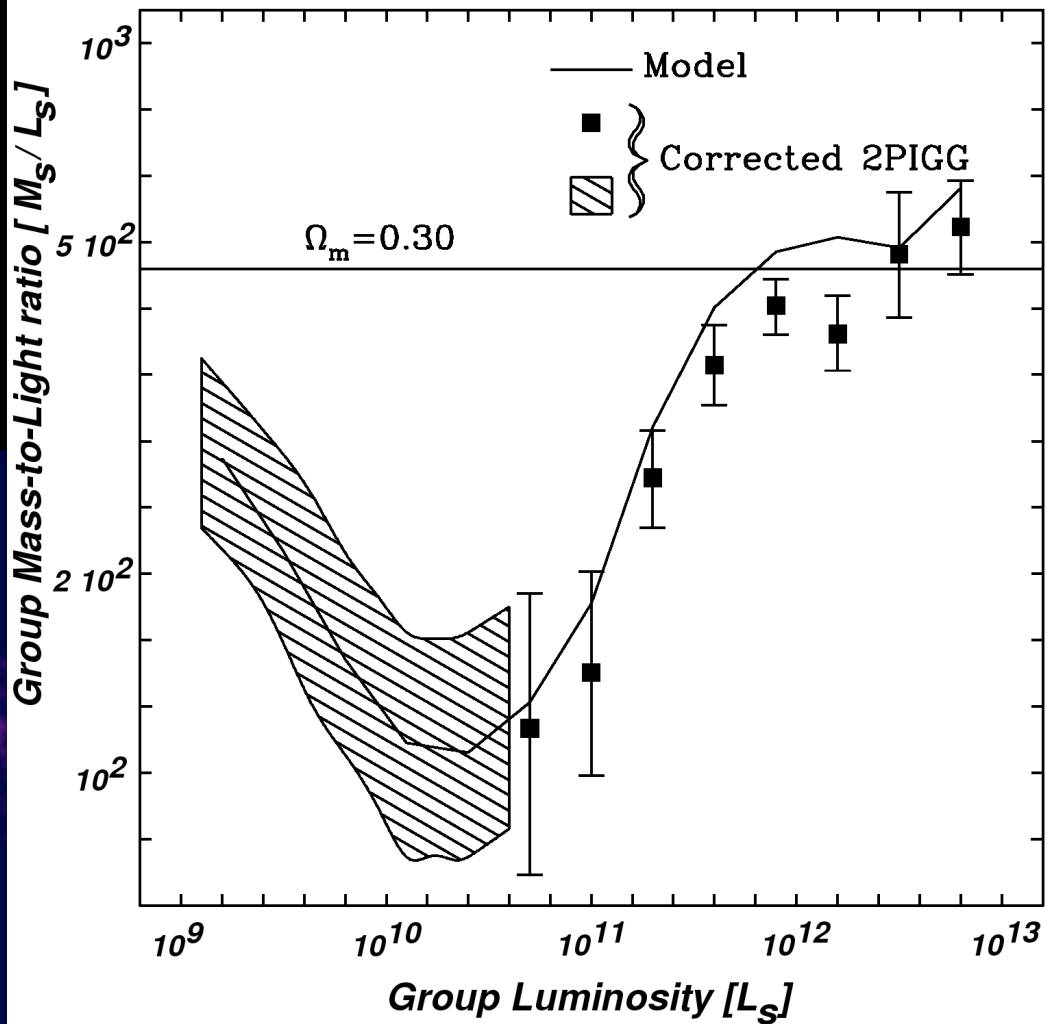
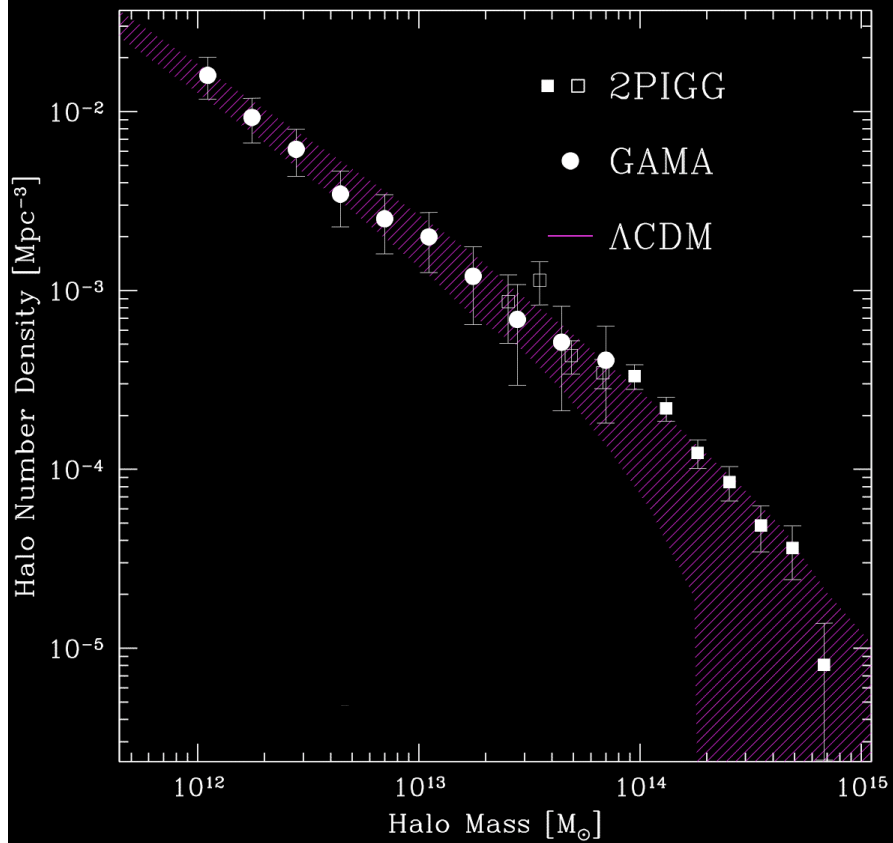


Figure: P. Norberg

# Redshift Space Correlation Functions

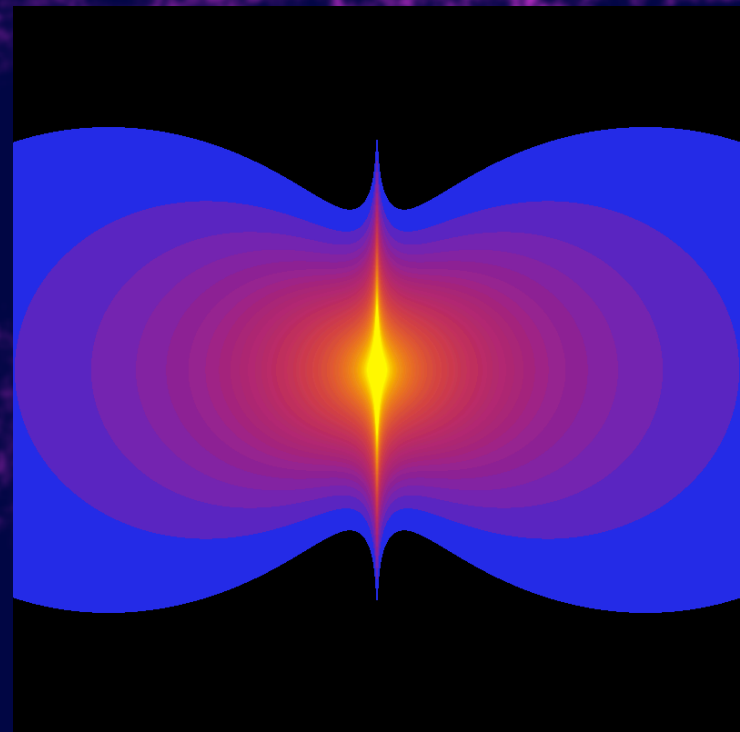
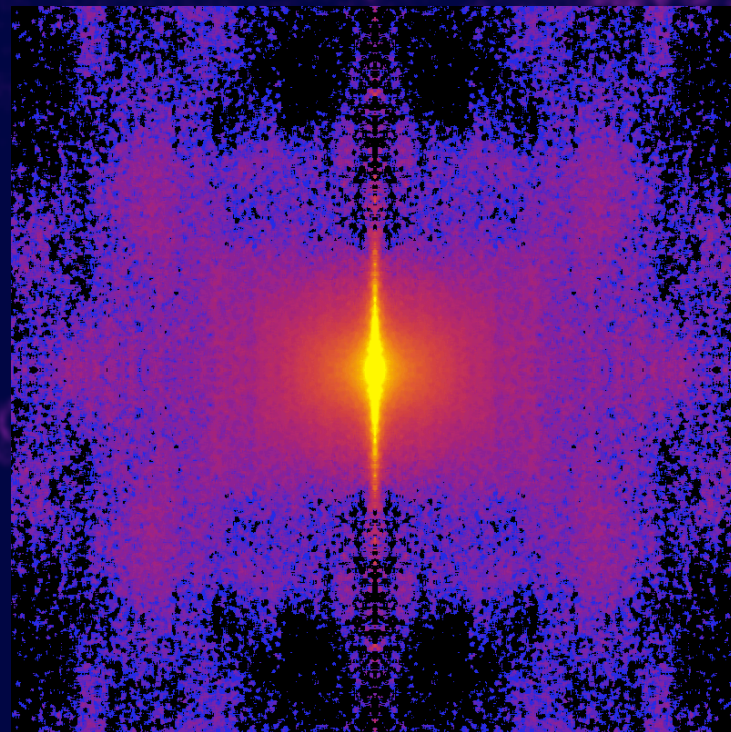
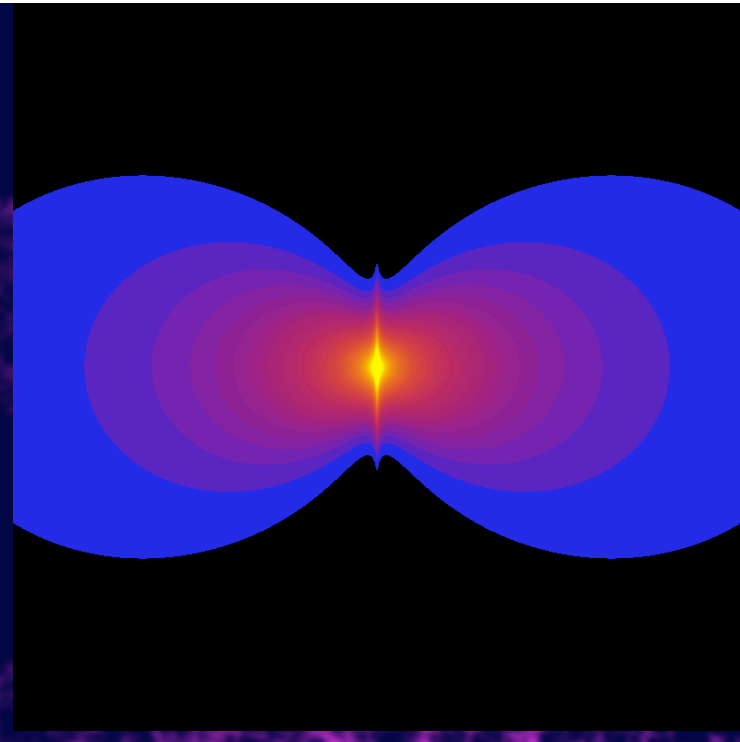
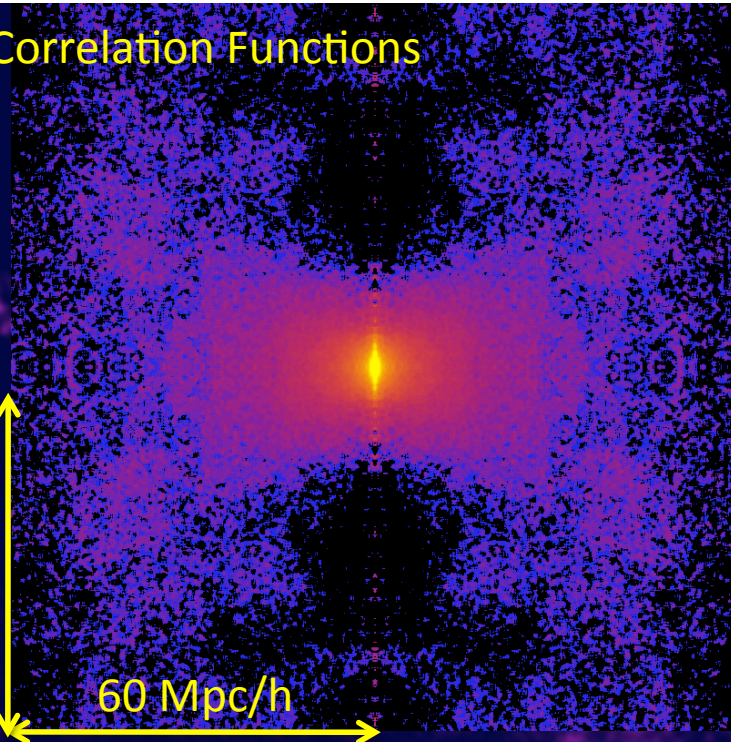
BLUE

Velocity

60 Mpc/h

RED

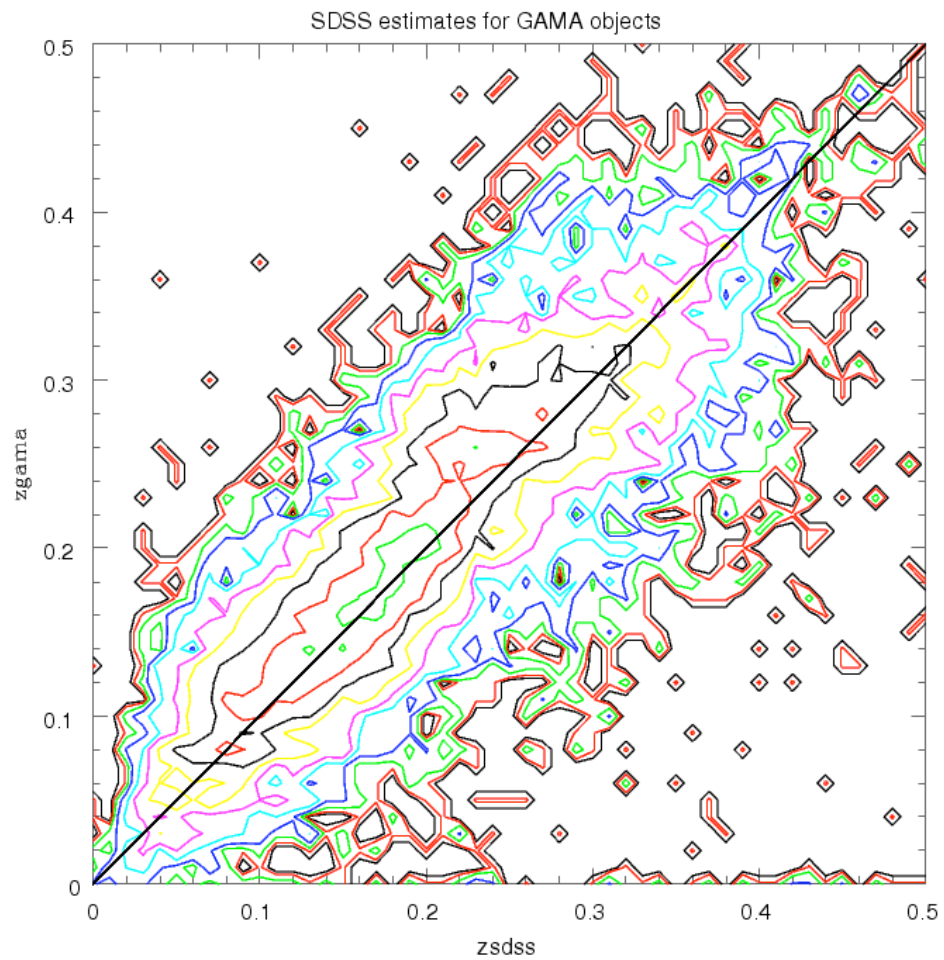
John Peacock



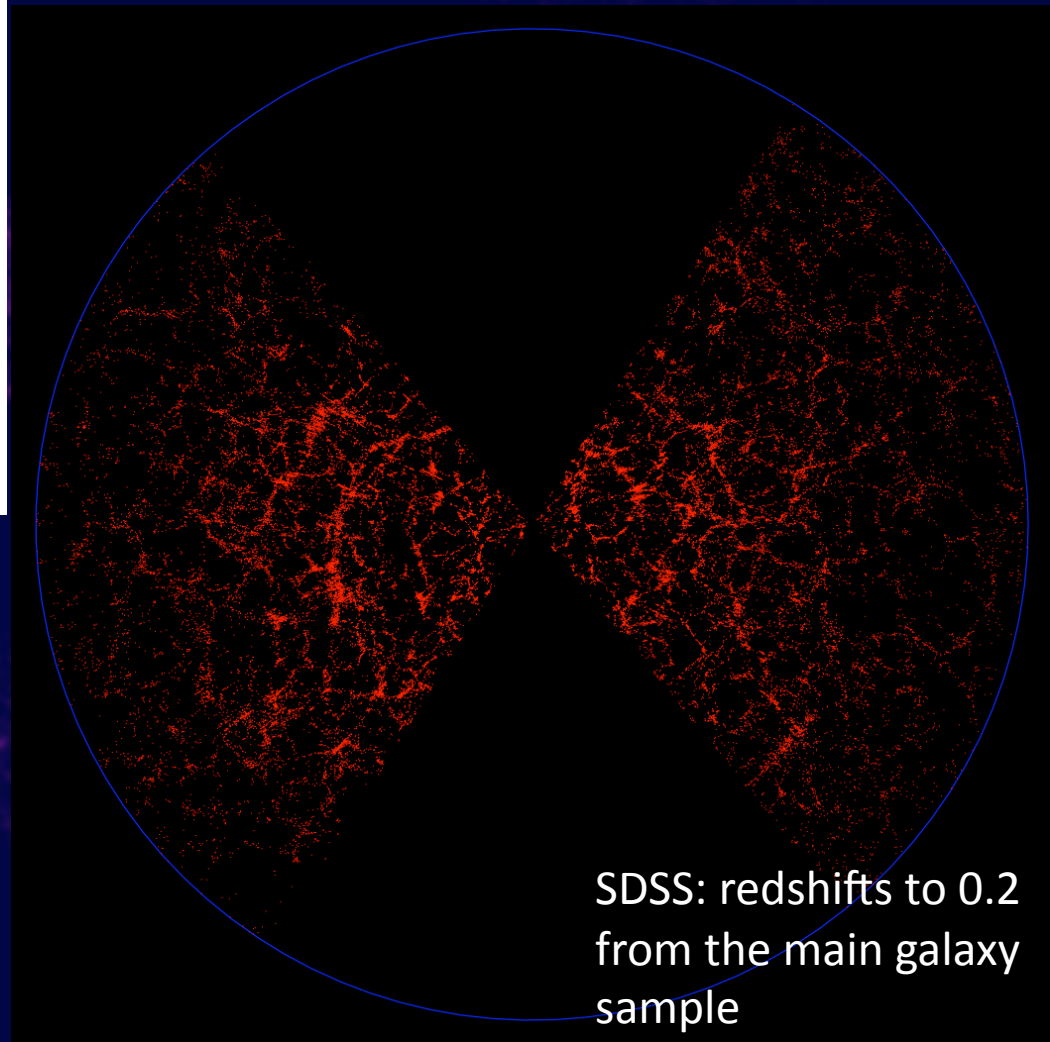


# GAMA Photometric Survey

- Fully mosaiced (SWarp) photometry in ugrizYJHK (20GB per image). + GALEX
  - Common: gain/ zero point/ res (0.4'' per pix).
  - Co-addition weight-maps also produced.
- Magnitudes defined in various ways:
  - SExtracted standalone.
  - SExtracted r/K defined apertures.
  - Sersic magnitudes (GALFIT).
- Currently have a common region of 116.5 sq-deg
- 61,274 galaxies have full 11 band photometry.



## GAMA Photo-z (Credit Hannah Parkinson)

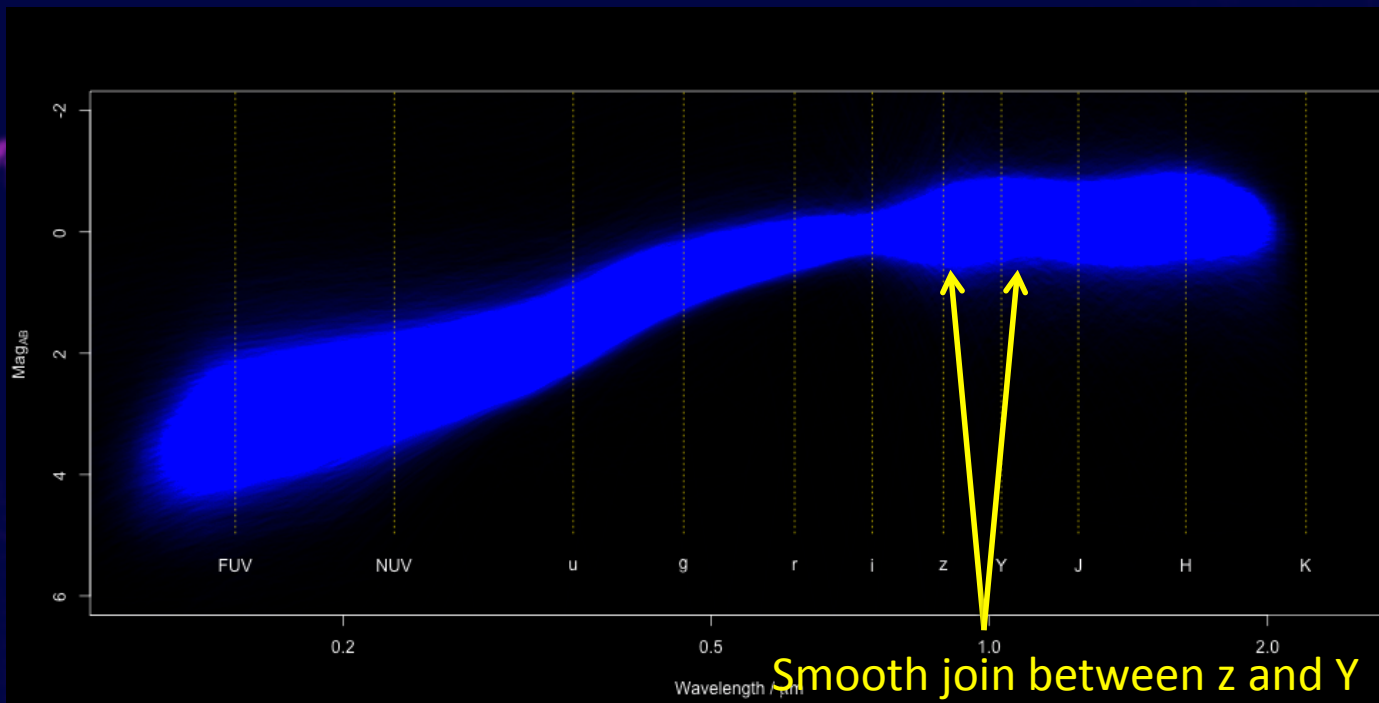


Do we even need spectra? Photo-z is pretty good, right?

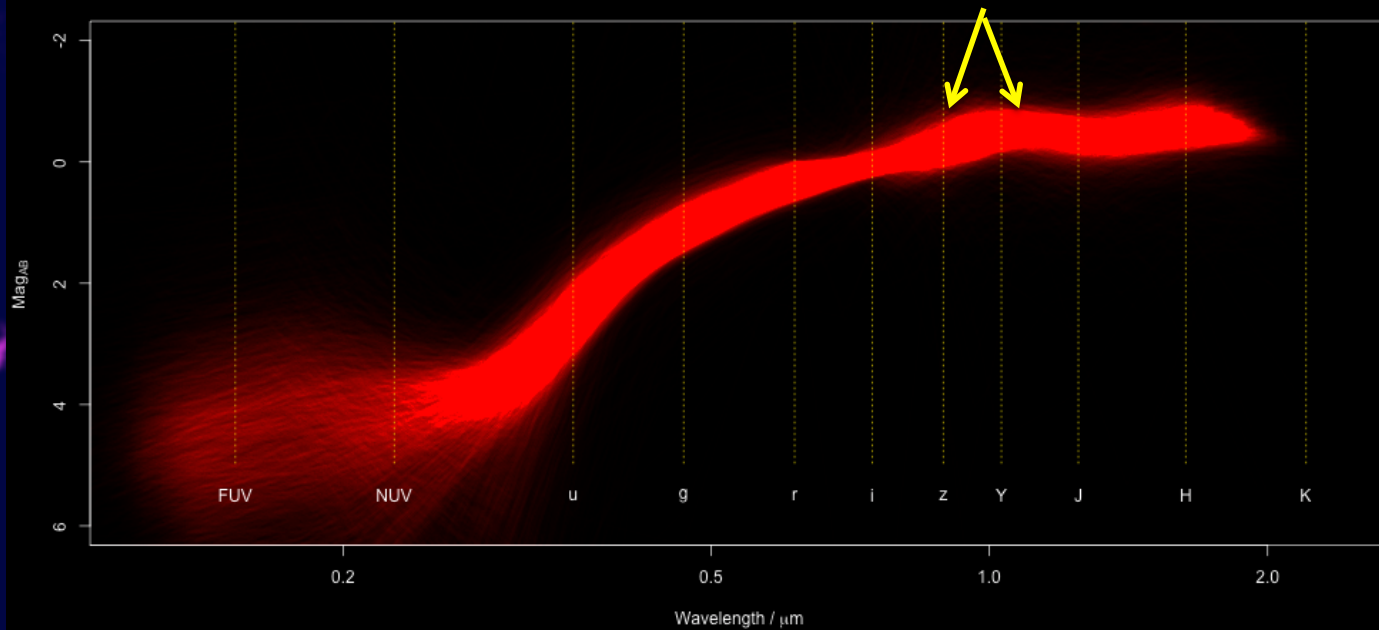
(Credit Ivan Baldry)

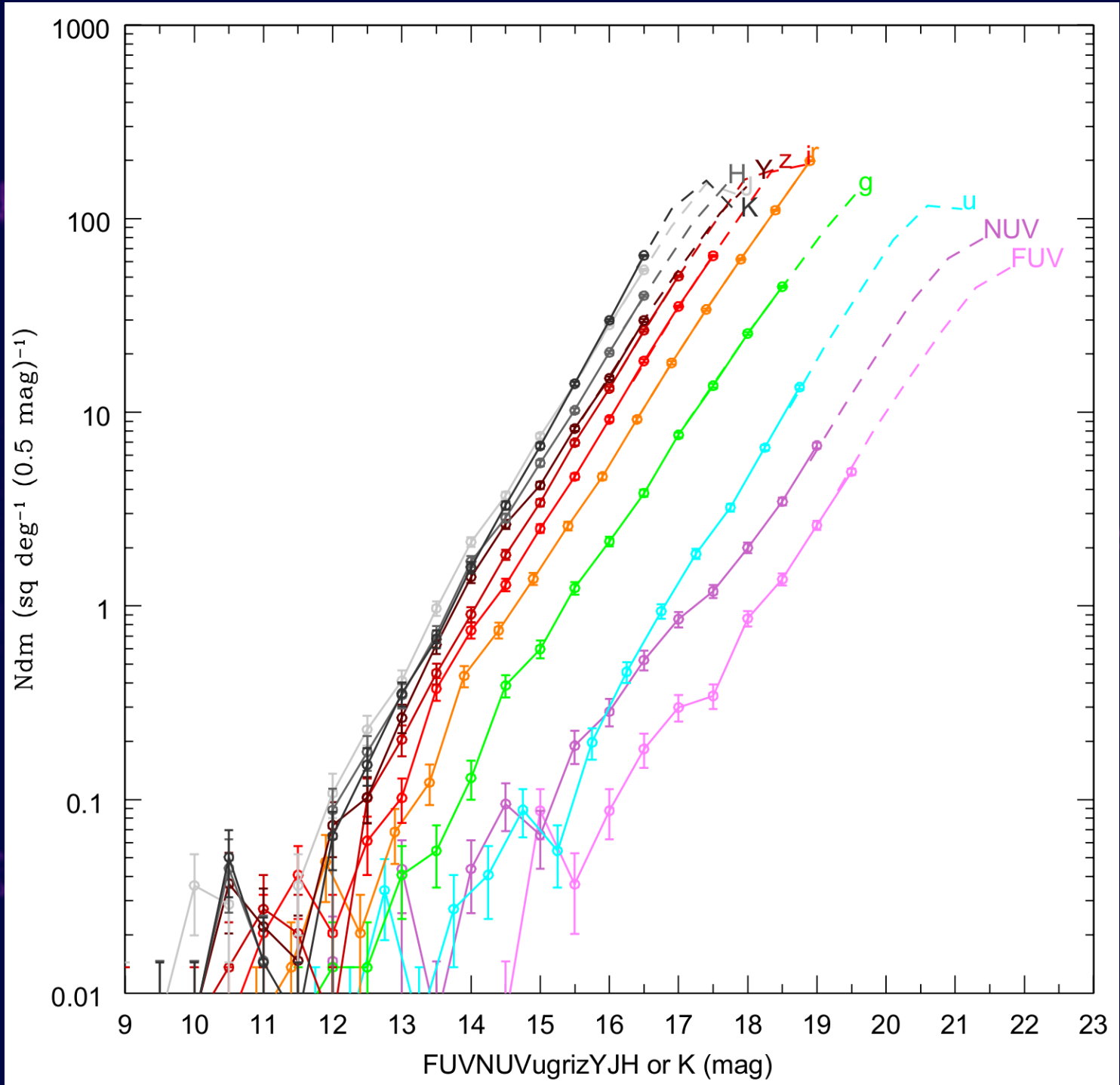
SDSS: redshifts to 0.2 from the main galaxy sample

Full SEDs for 24,706 blue ( $u-r < 2$ ) and 8,327 red ( $u-r > 2.5$ ) galaxies.



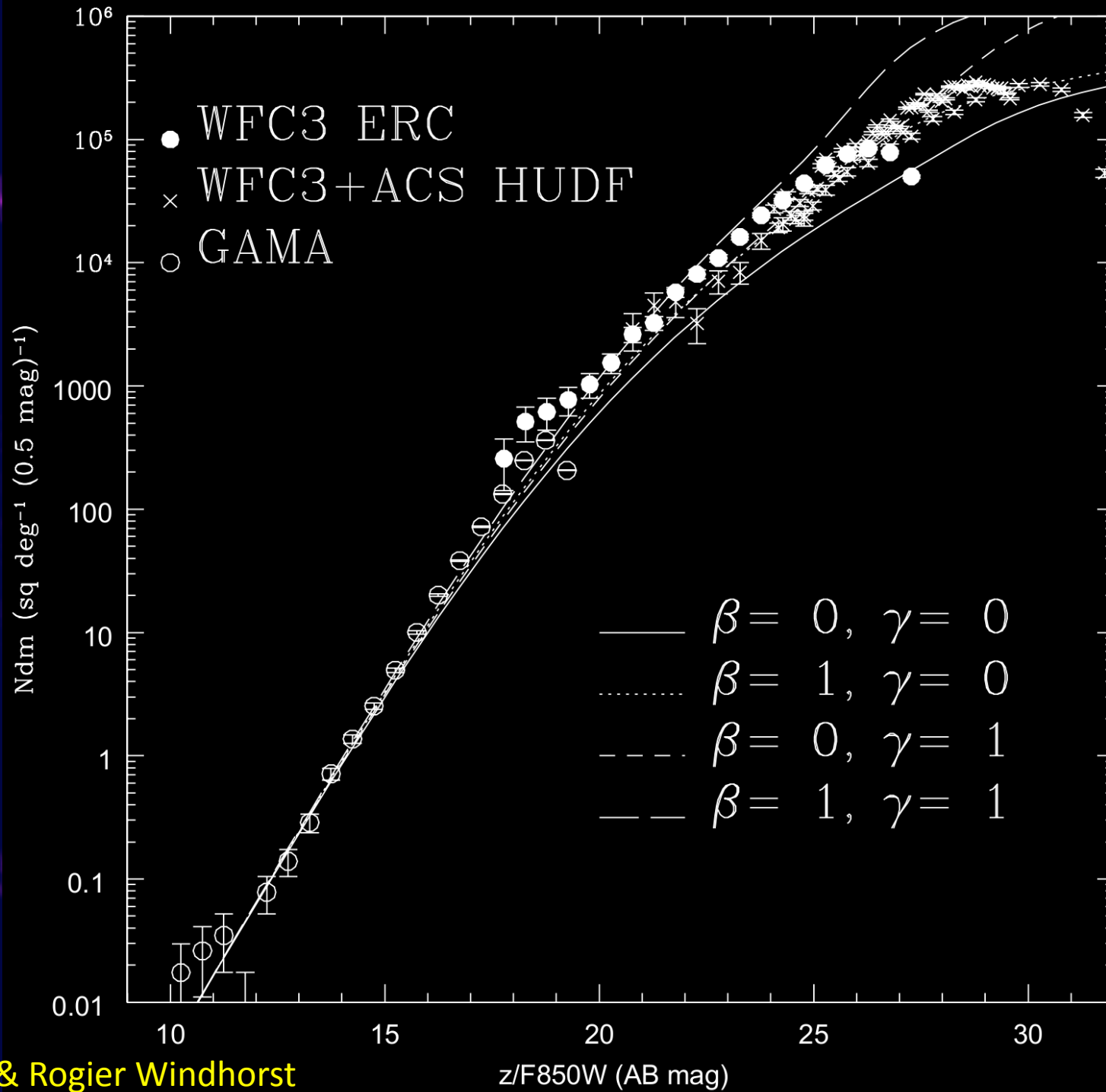
Smooth join between z and Y





Simon Driver

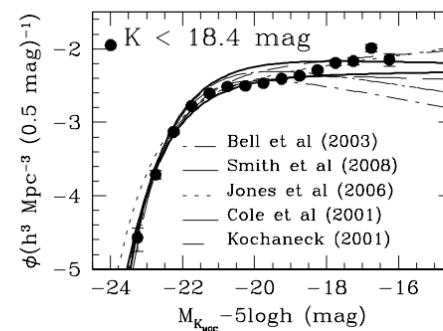
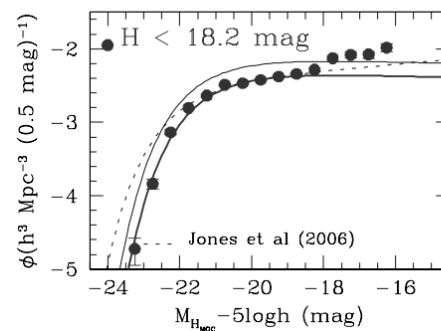
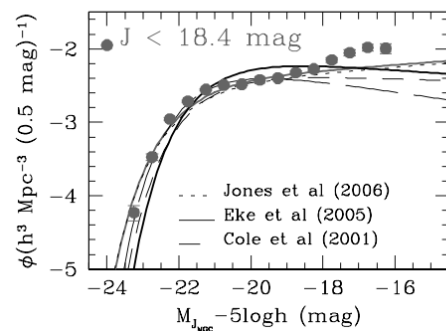
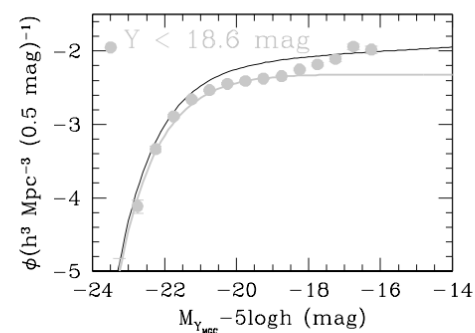
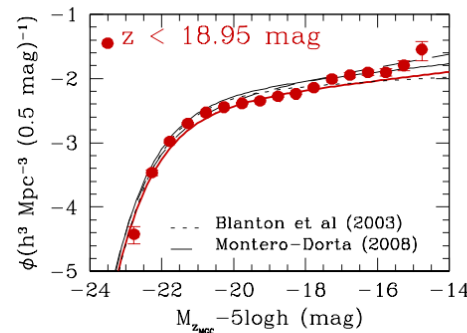
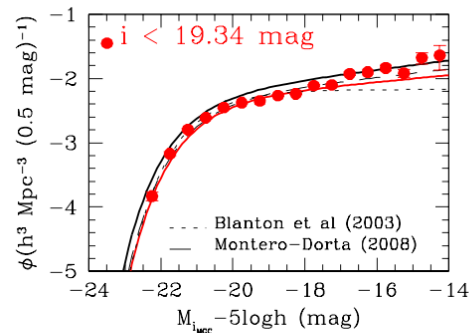
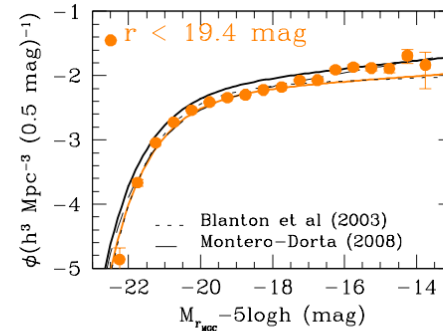
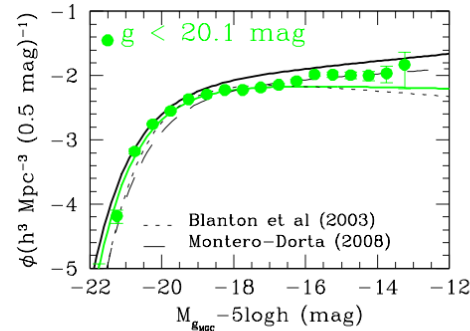
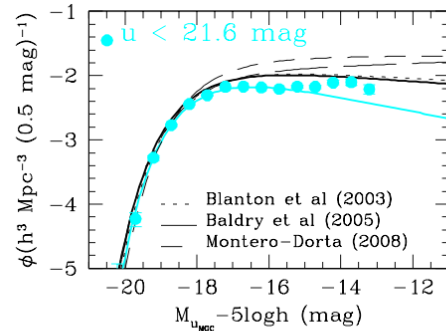
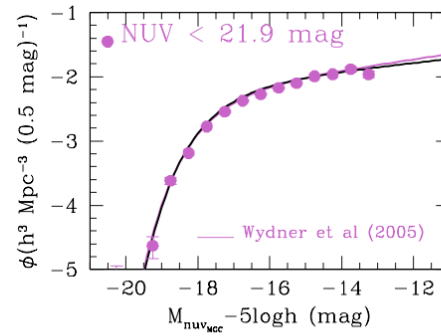
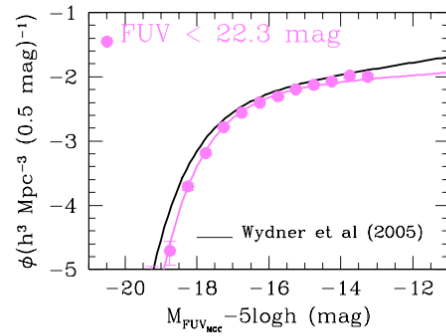


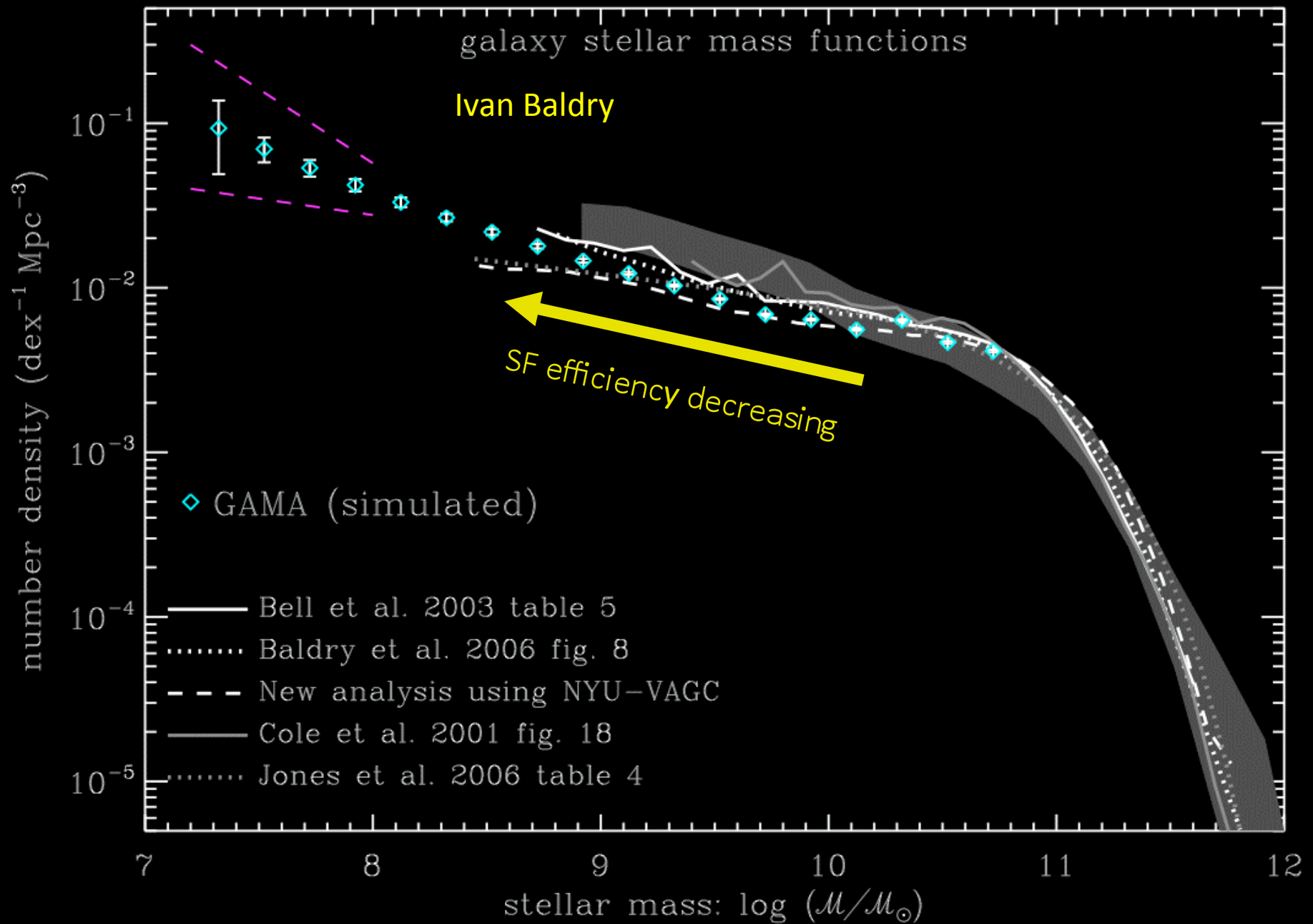


Simon Driver & Rogier Windhorst

11 band LFs using the common region of 116.5 sq-deg and  $z < 0.1$

Simon Driver



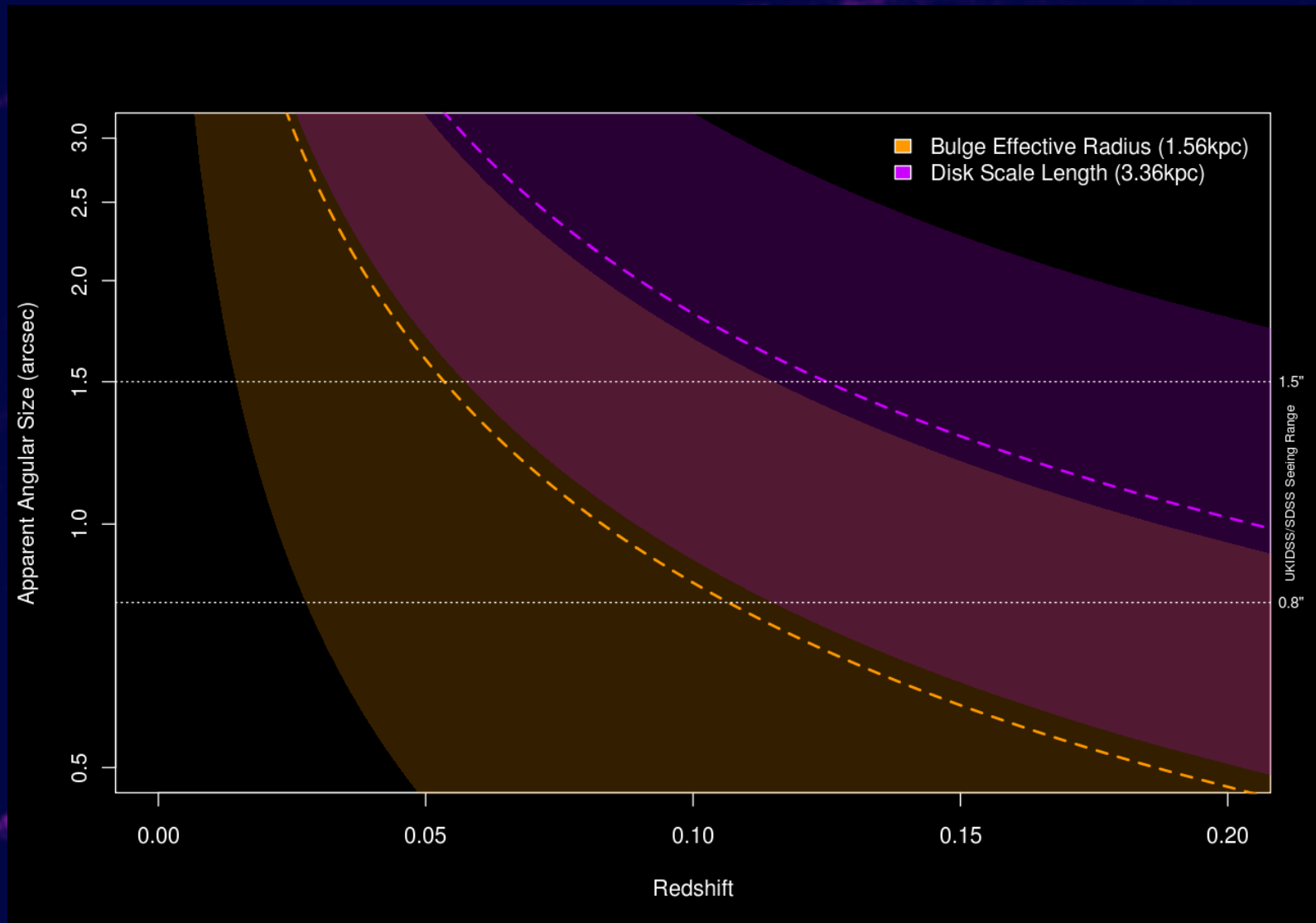


# The Problem of Dust

- Driver et al. 2007 show that observational geometry has a large effect on optical and Near-IR attenuation.
- To truly recover galaxy SED and CSED structural and dust modeling is vital (Tuffs et al. 2004).
- MGC work used GIM2D (Allen 2006). In St. Andrews we are developing a multi-component GALFIT-3 pipeline (Lee Kelvin).

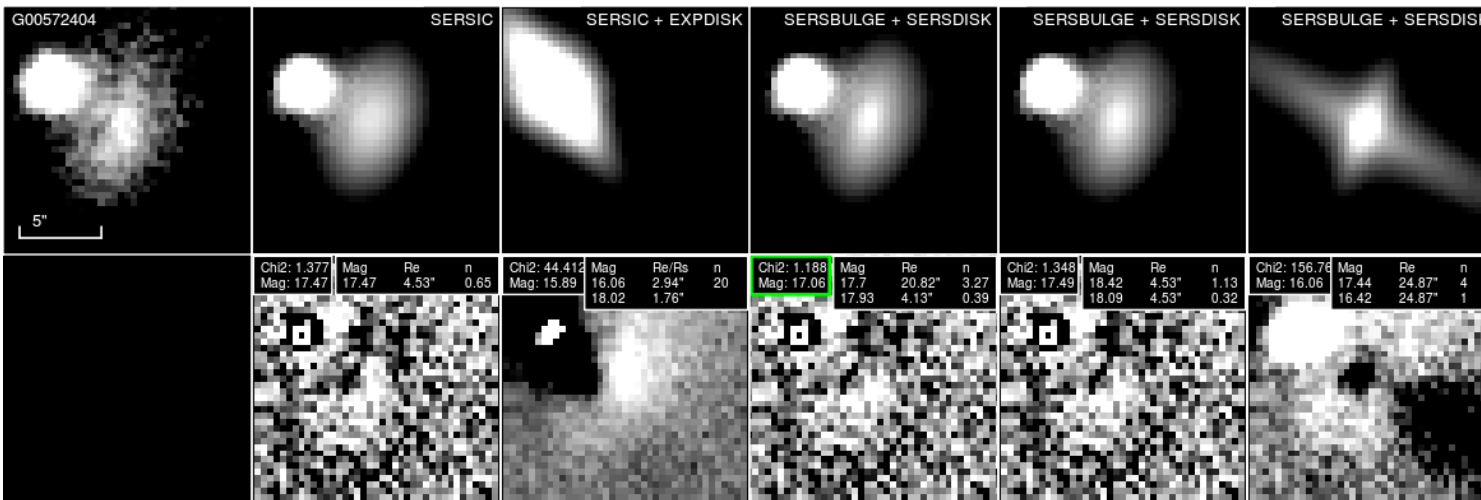


# Limit of BDD



Lee Kelvin

Structural Scale Data from Allen 2006



Bright star next to fainter galaxy.

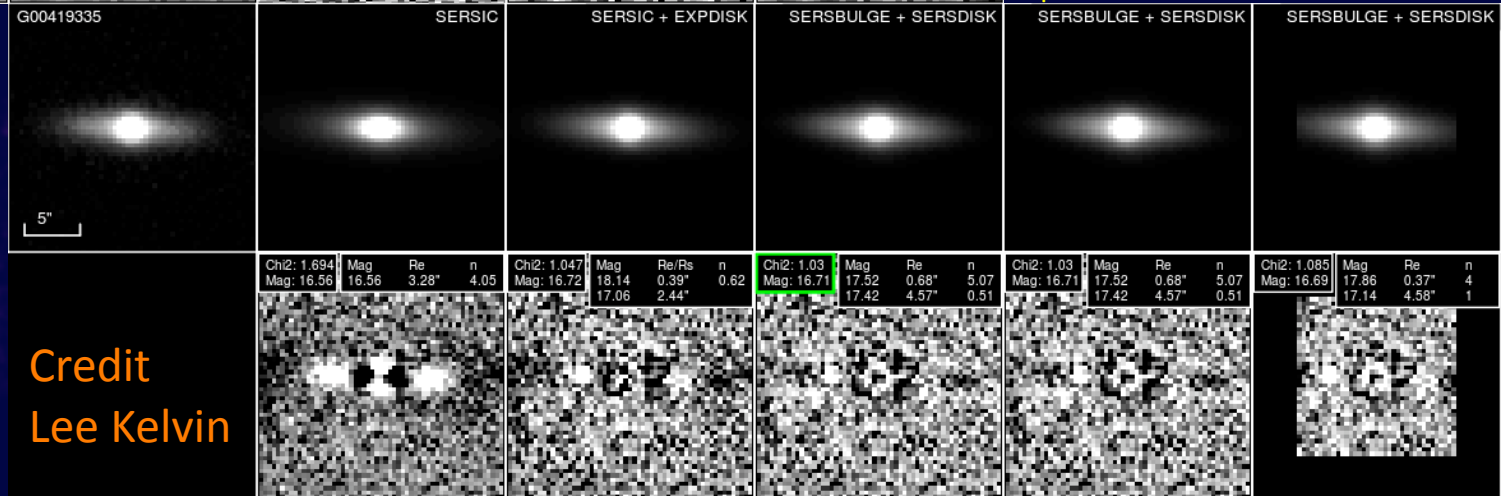
Tough to fit without great care- process must be automated!

$$r_{\text{petro}} = 17.49$$

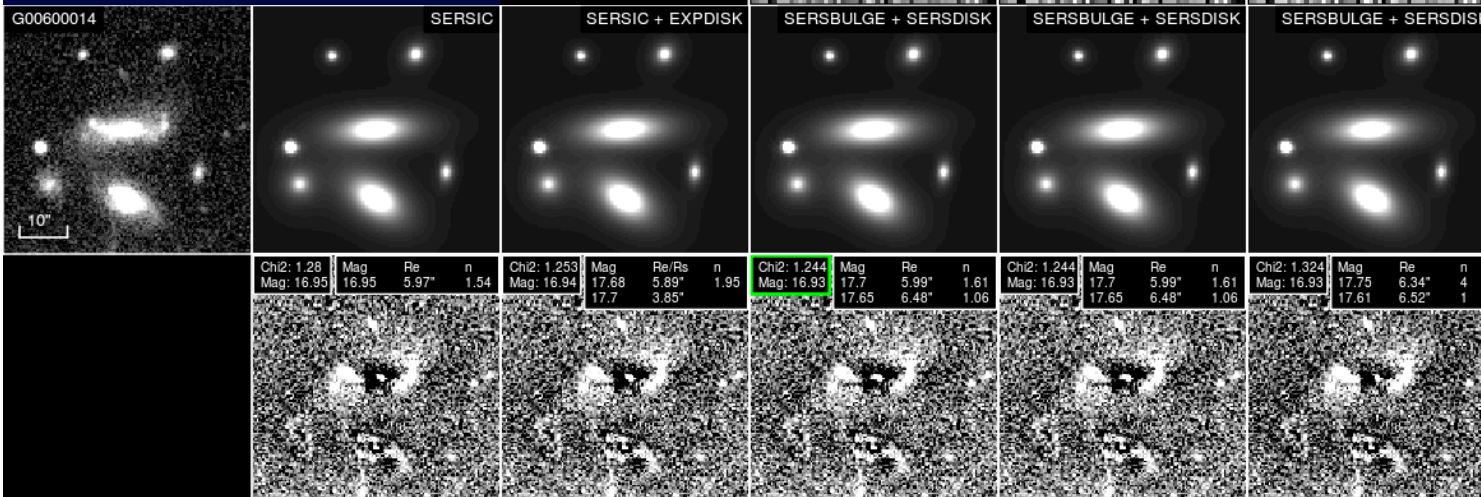
Classic inclined bulge disk system.

Multiple "good" choices.

$$r_{\text{petro}} = 16.74$$



Credit Lee Kelvin

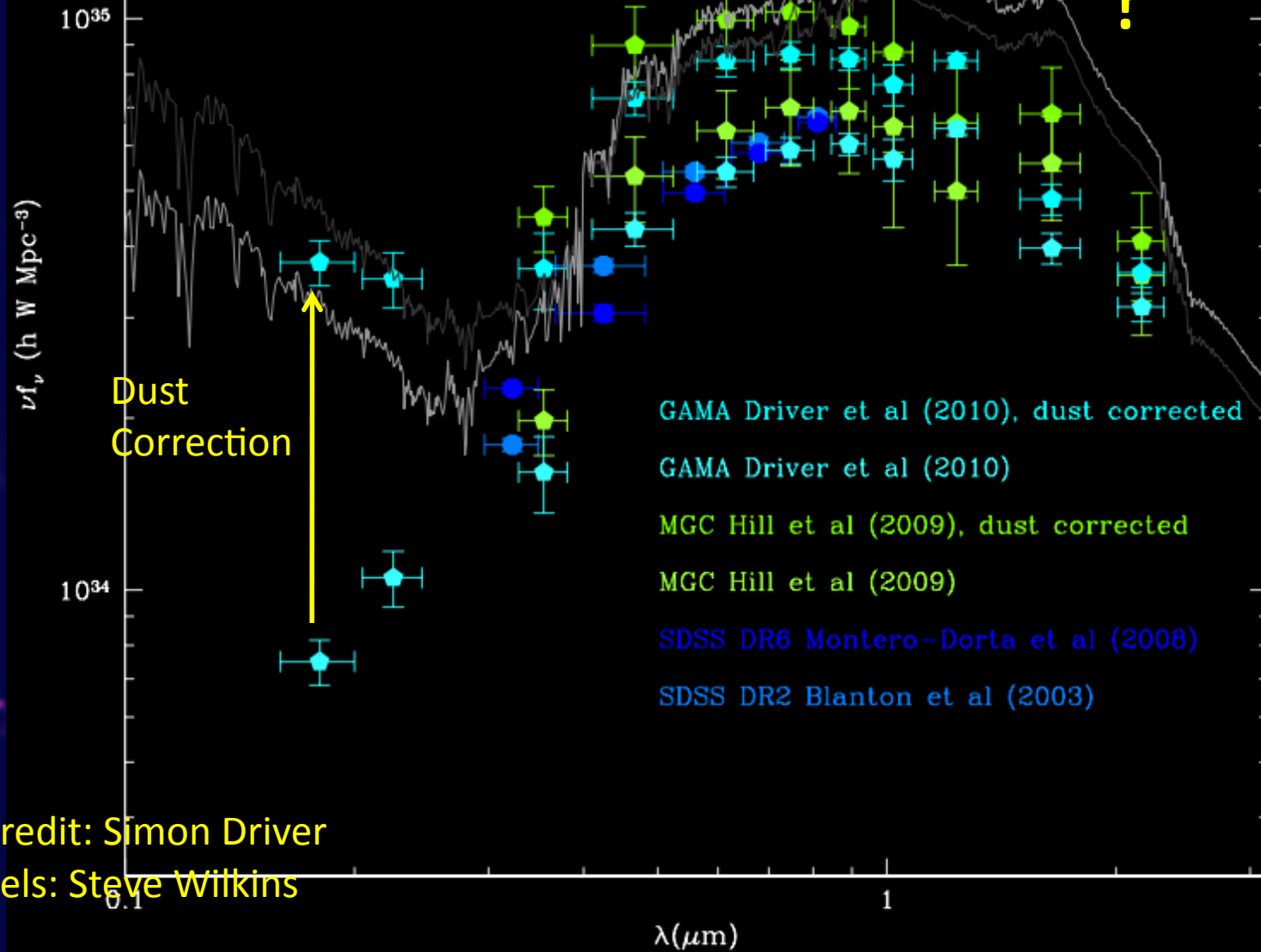


Complicated group plus a star.

Must pick up multiple systems and fit appropriate model.

$$r_{\text{petro}} = 16.95$$

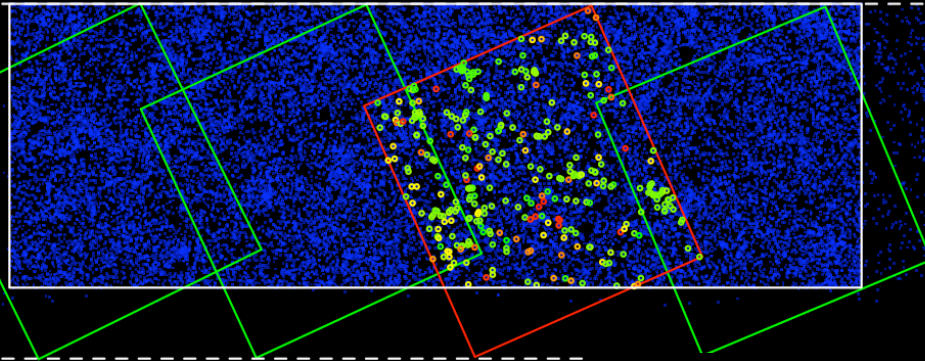
Model = HB06, SP-IMF, PEGASE stellar synthesis model



Picture Credit: Simon Driver  
SFH models: Steve Wilkins

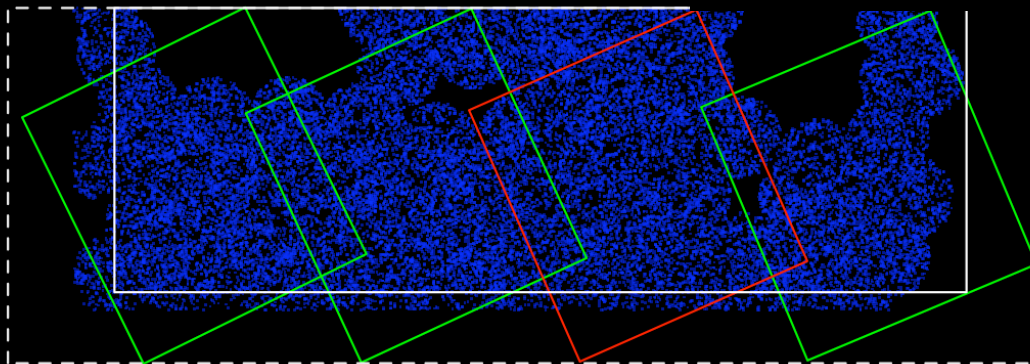
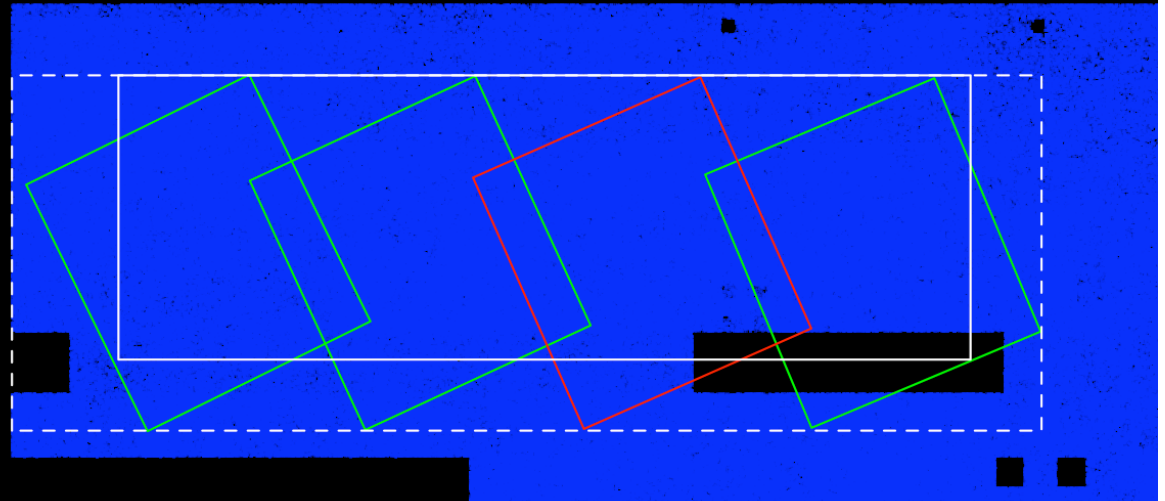
# Herschel ATLAS SV

- 0.015
- 0.025
- 0.035
- 0.045
- 0.055
- 0.065



Redshifts  
(low z highlighted)

SV UKIDSS



SV GALEX

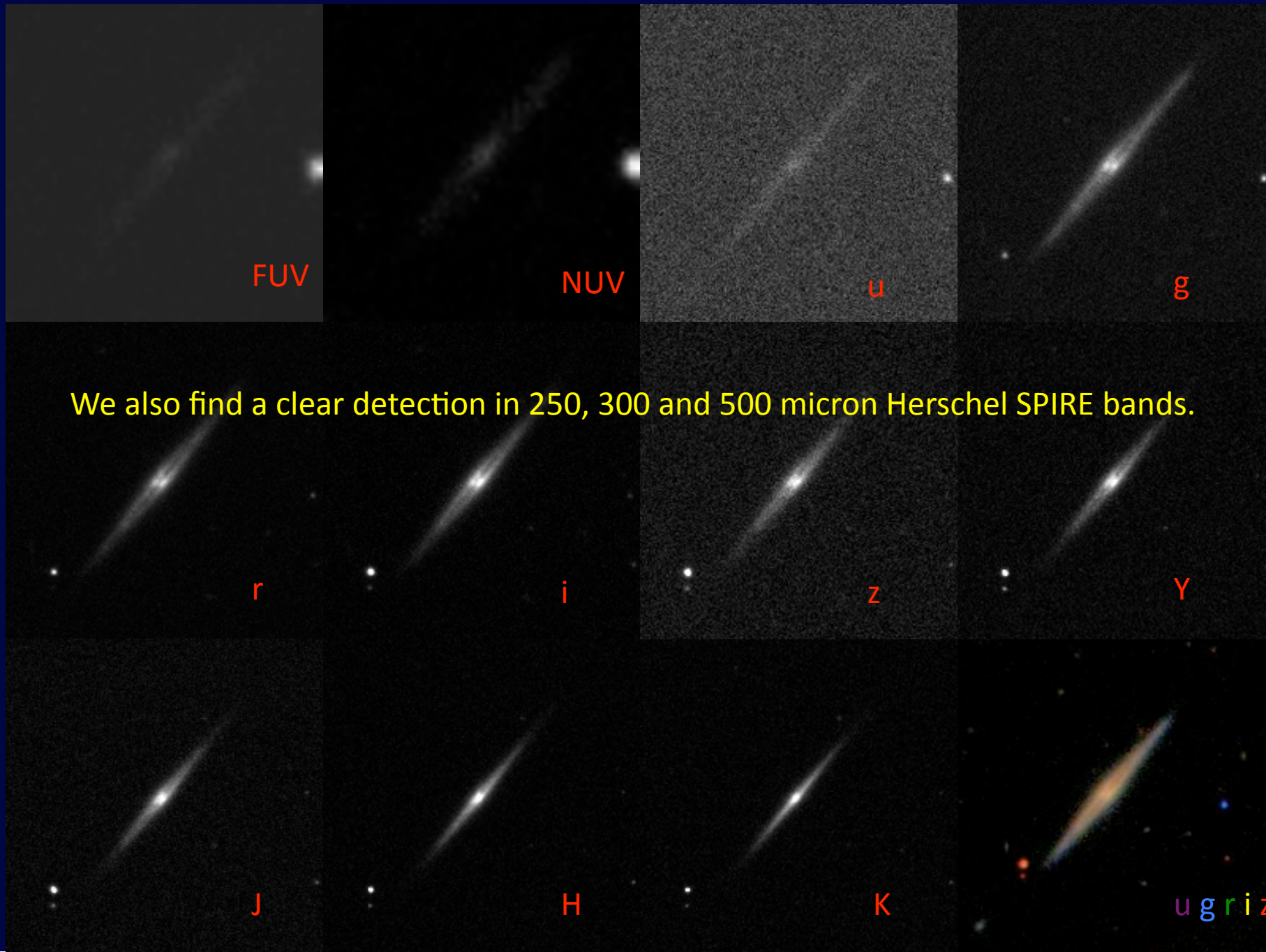




# Case Study- G550582

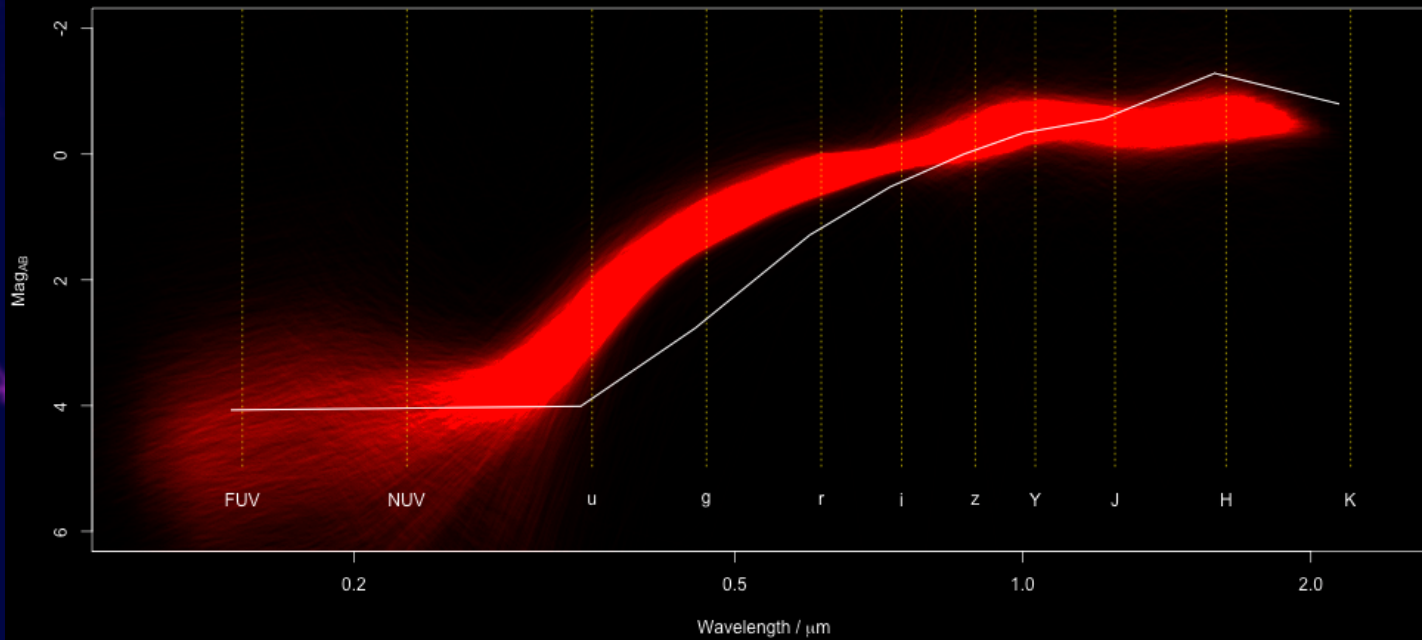
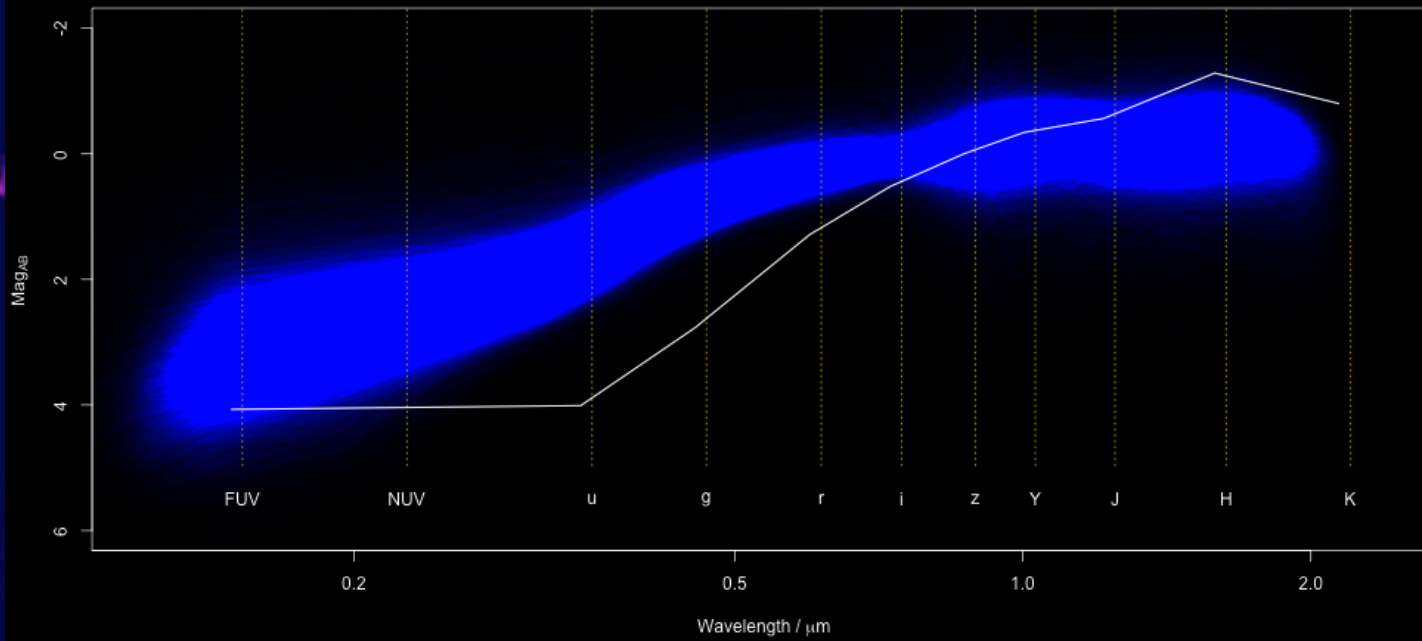


## Available Photometry



We also find a clear detection in 250, 300 and 500 micron Herschel SPIRE bands.

# SED for G550582



# Galfit Analysis

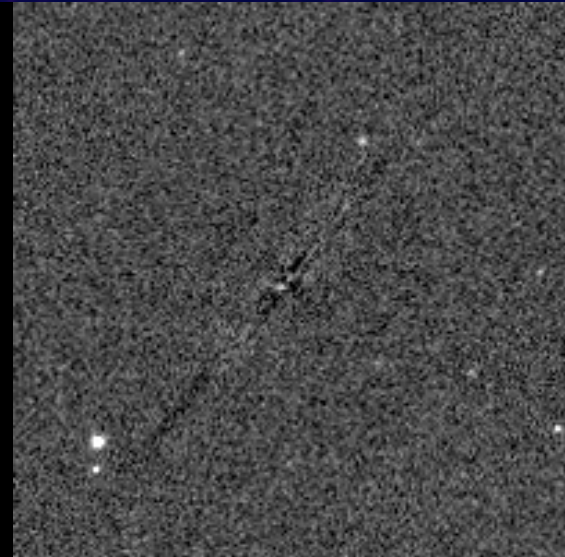
Original



Model

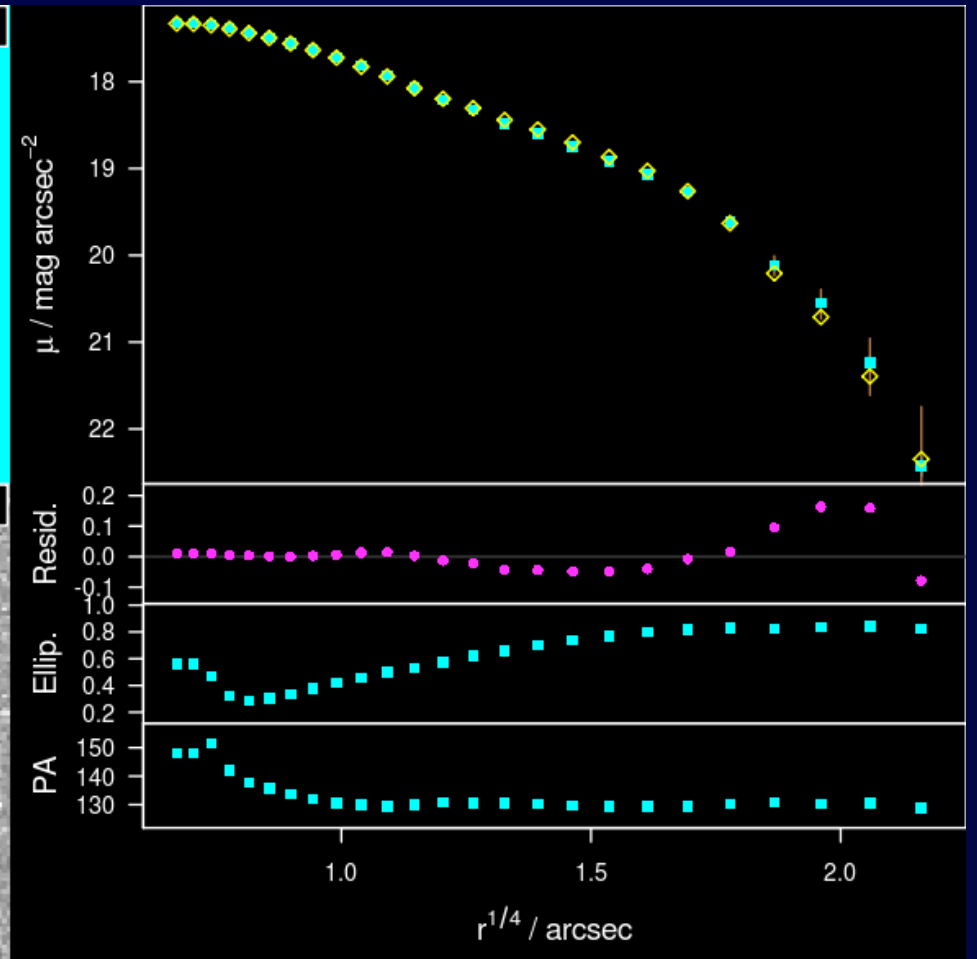
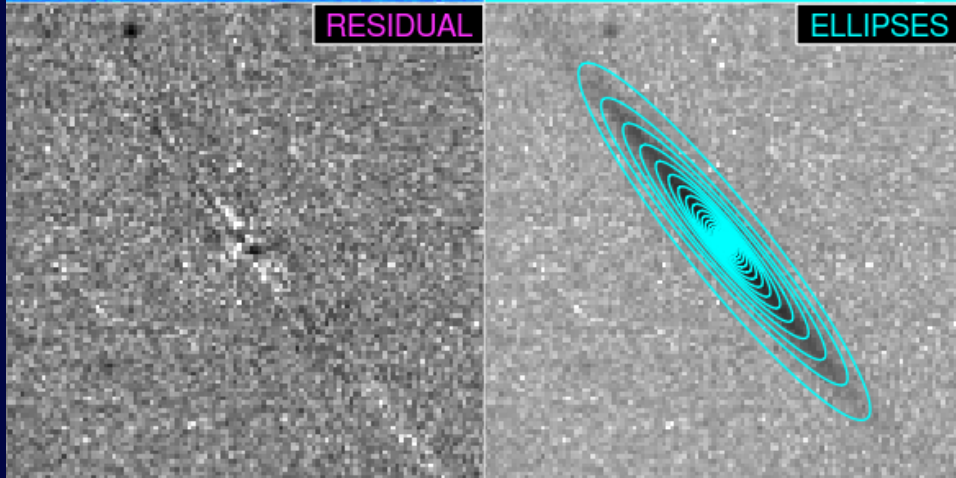
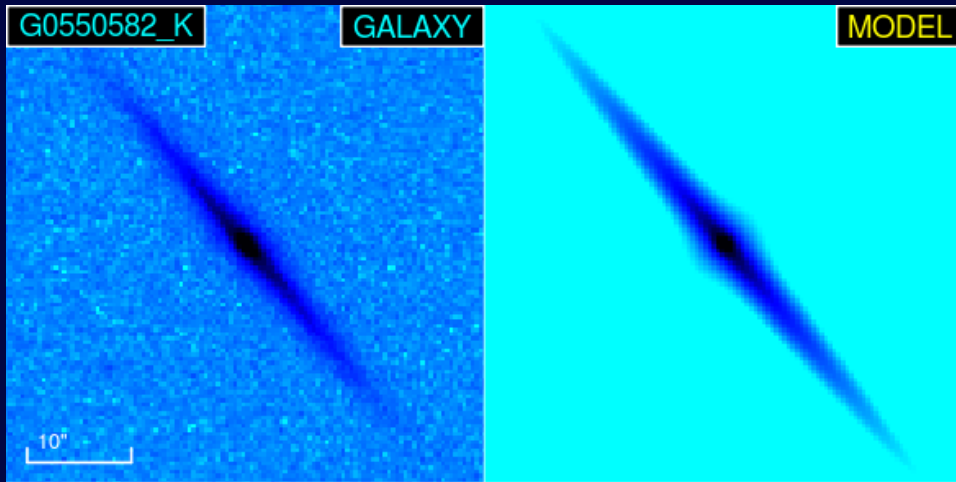


Residual



Bulge: Sersic (de Vaucouleurs)  
 $n=4$   $r_e=1.56$  Kpc

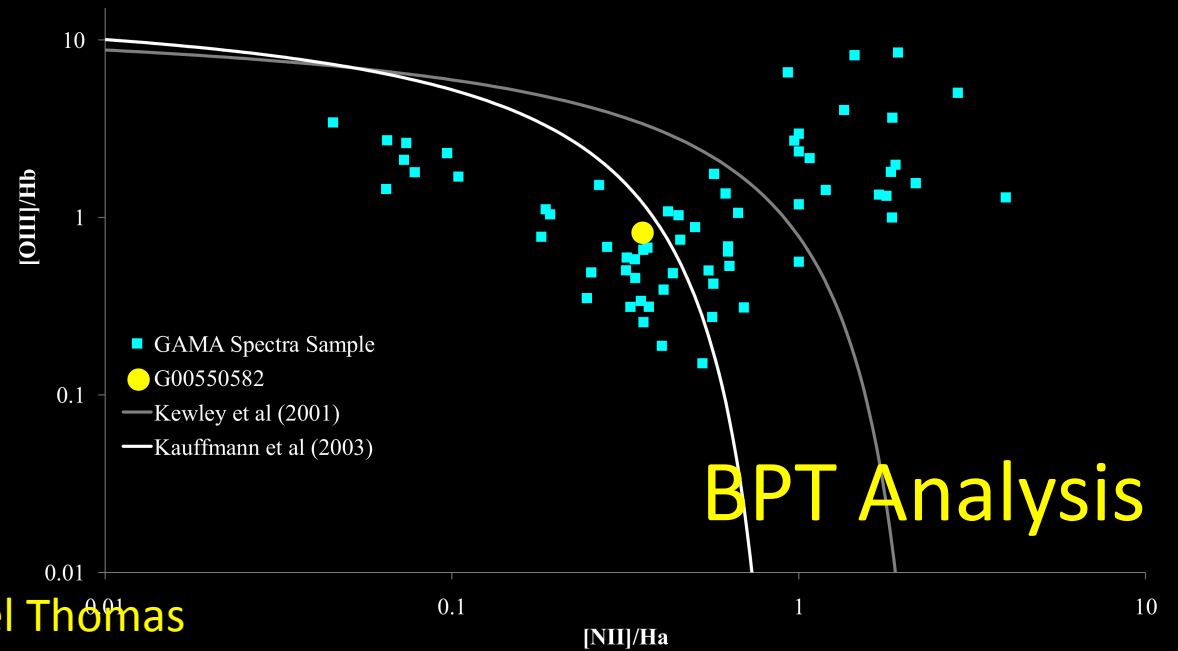
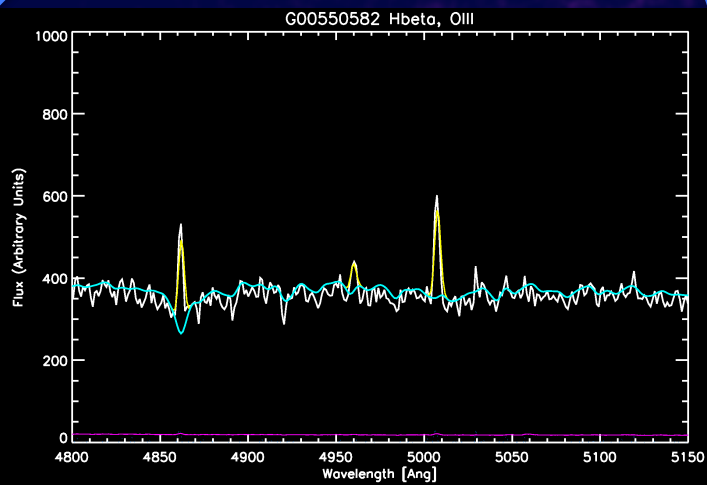
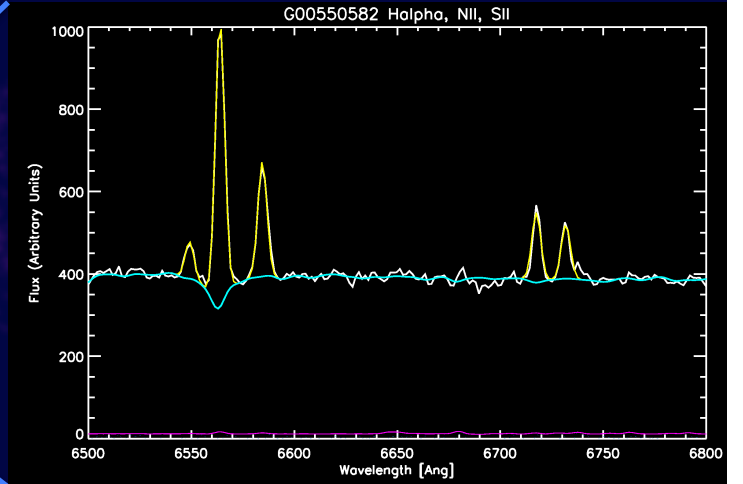
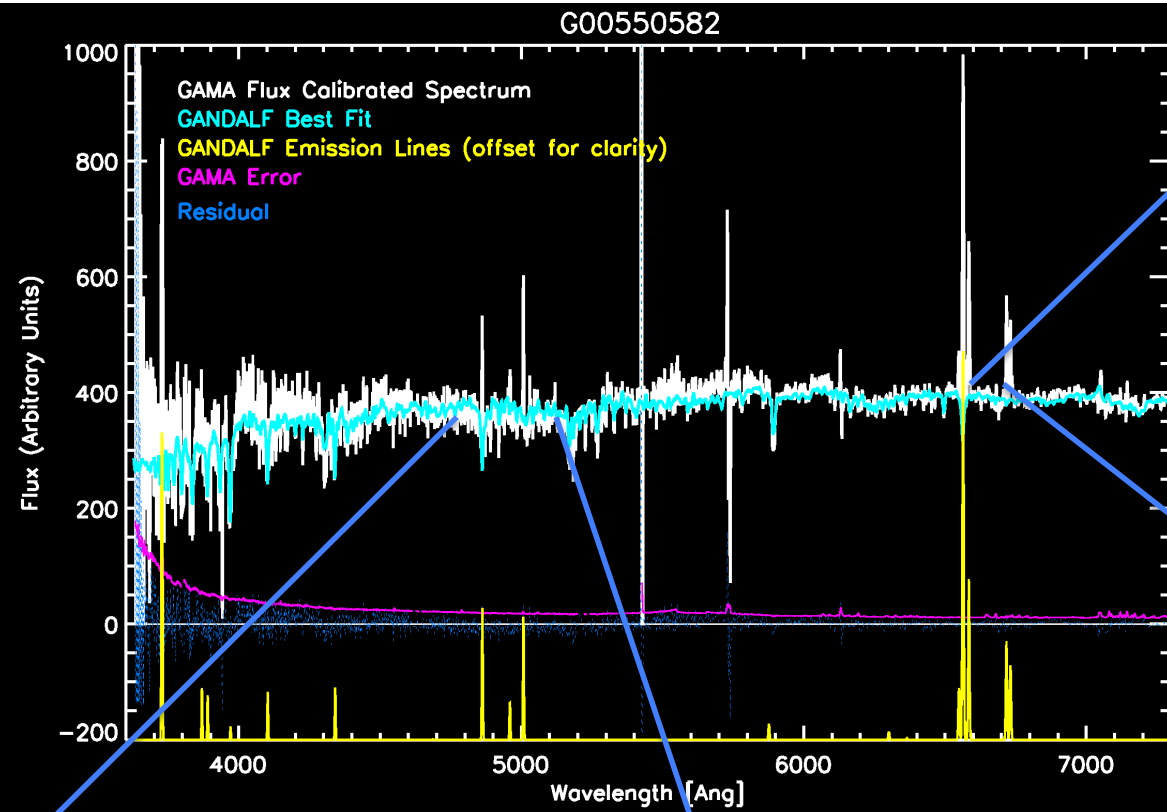
Disk: Edge on Exponential  
 $r_h=0.47$  Kpc  $r_s=6.85$  Kpc



Lee Kelvin



# Gandalf Analysis



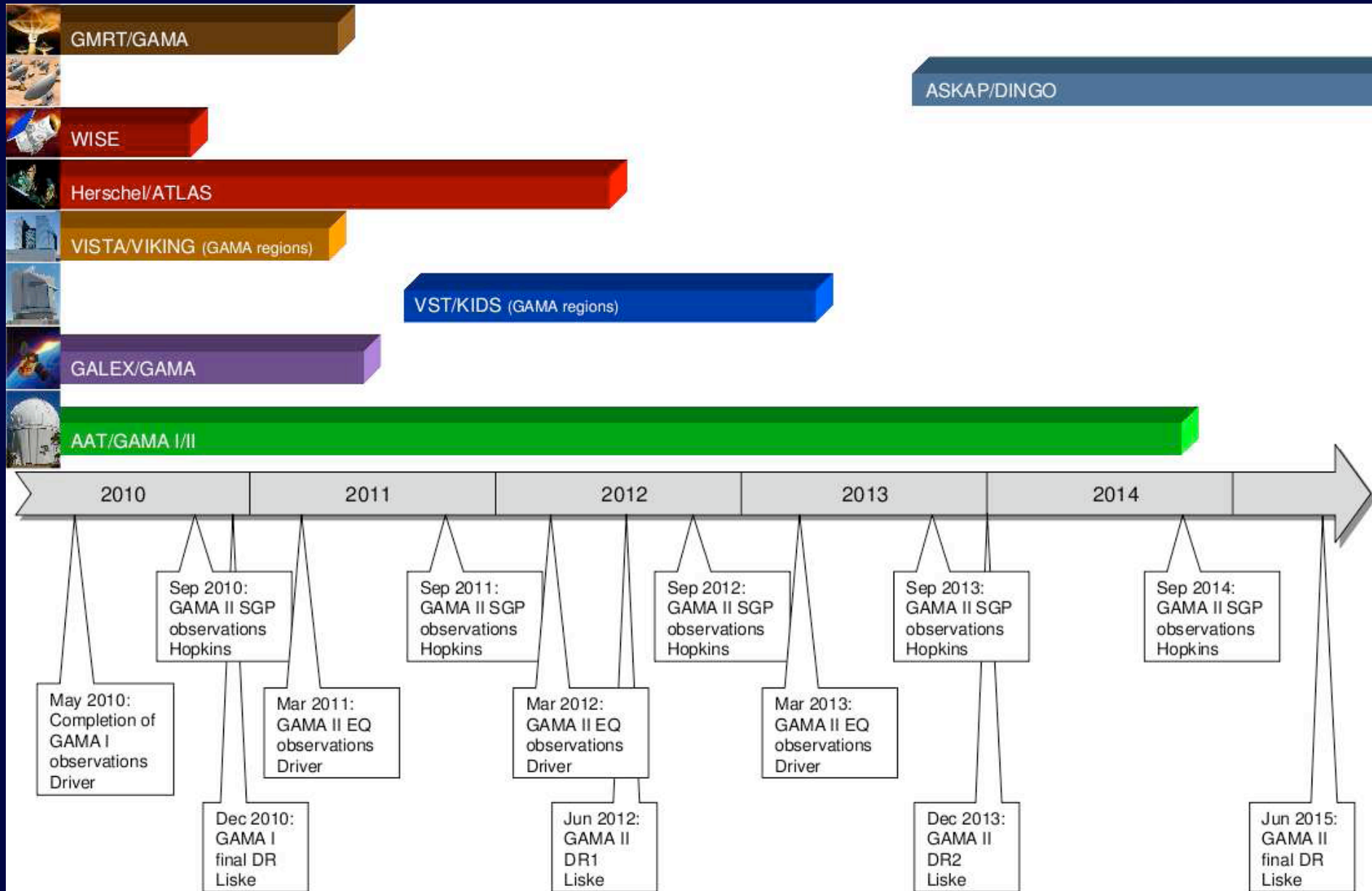
Gandalf Credit: Issi Doyle & Daniel Thomas





GAMA

The Future







# Australian Square Kilometer Array Boolardy Station, Western Australia

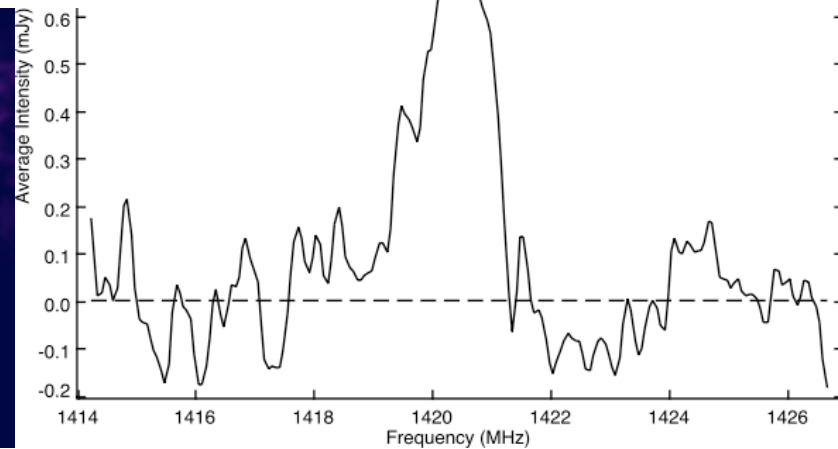
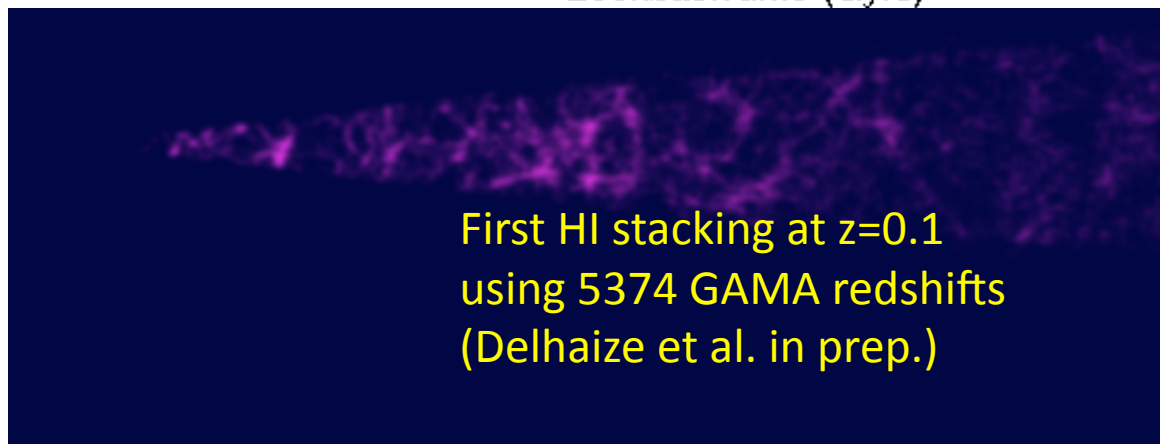
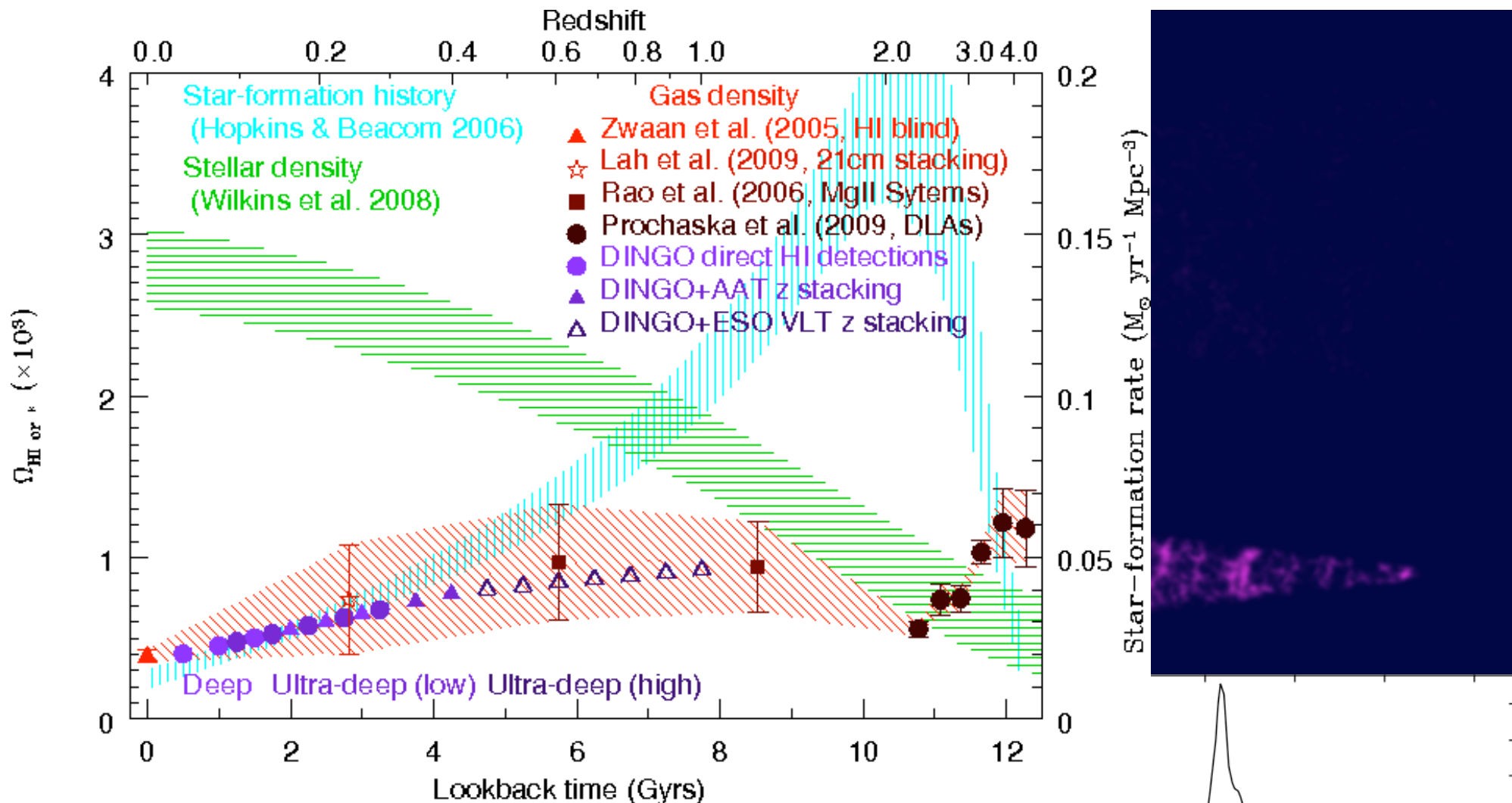


Bit like GMRT dishes, except smaller and cheaper.

x30

A black arrow originates from the bottom right corner of the 12m antenna image and points towards a large, semi-transparent grey oval on the desert floor, which represents the scale of the entire station.

- SKA demonstrator (could form core of final SKA)
- Approved budget: A\$100M
- 30-36 12m Antenaes
- Will measure HI and Dyn masses out to  $z=0.6$  !!!
- Main motivation as a technology demonstrator for SKA
- GAMA has had the DINGO (Deep Investigation of Neutral Gas Origins!) project accepted for further study.





# Conclusions

- GAMA is offering the astronomical community the definitive low-z galaxy database.
- Principle work encompasses:
  - Group/ cluster catalogues- HMF.
  - Galaxy BBDD, dust modeling and SEDs.
  - The CSED.
- Future work:
  - DINGO project on ASKAP- HI mass.
- Email: [spd3@st-and.ac.uk](mailto:spd3@st-and.ac.uk) / [asgr@st-and.ac.uk](mailto:asgr@st-and.ac.uk)



A microscopic image of a fish fin, showing a dense network of fine, branching structures. The word "Fin" is overlaid in the center in a bold, yellow, sans-serif font. The background is a dark, almost black, color, which makes the lighter, fibrous structures of the fin stand out. The fin appears to be a cross-section or a close-up of the fin's internal structure, showing a complex, interconnected pattern of fibers and cells.

Fin

## All (~250k):

**General:** GAMA ID : SDSS ID : z (heliocentric) : z quality

**Flux:** UV : optical : near-IR : mid-IR : far-IR : radio (20,rest-21,30,40,90cm)

**Shape:** CAS : Sersic index: half-light radii : b/a : PA in *ugrizYJHK*

**Opacity:**  $\tau_{UV,ugriz,YJHK}$

**Spectral features:** Emission:  $H\alpha, H\beta, H\gamma, H\delta, OII, OIII, NII$

Abs.:  $Dn4000, Ca4227, H\alpha, H\beta, H\gamma, H\delta, Mgb, Fe$

**SFR:** UV :  $H\alpha$  : far-IR : radio continuum

**Fossil record:** Age : SFH : element abundance

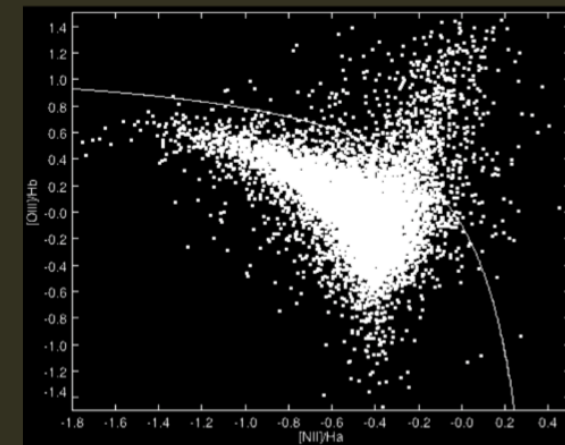
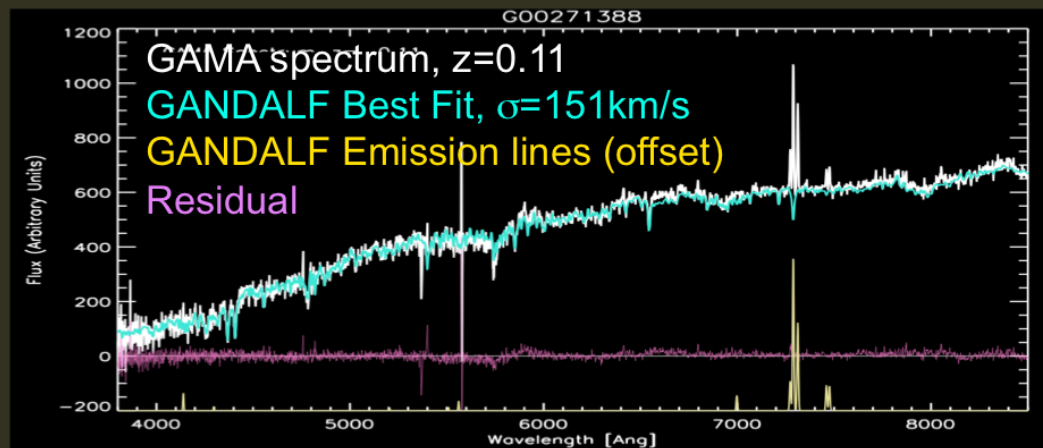
**AGN:** BPT diagnostics : type : strength : ionisation state

**Dynamics:**  $\sigma_{spec}$  (GANDALF) :  $W_{21}$ : HI line profile

**Distances:** Tully-Fisher : Faber-Jackson

**Masses:** Stellar : SMBH : HI : dust : baryon : dynamical

**Environment/Halo:** Local density : group membership : group halo mass



# Colour Images

u

r

K



u

g

r

i

z

