Galaxy and Mass Assembly

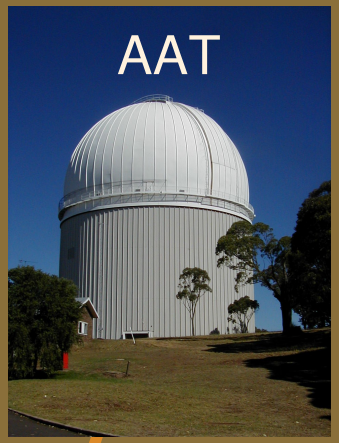
(GAMA)

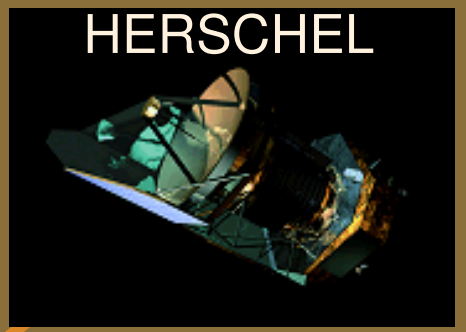
Jochen Liske

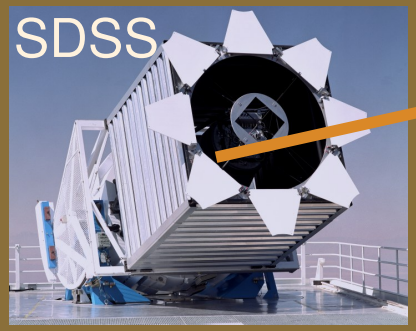
GAMA

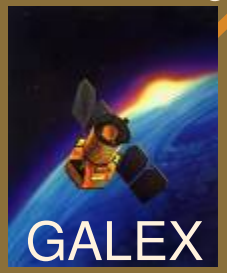
A comprehensive, multi-wavelength, state-of-the art survey of the low-redshift Universe, exploiting the latest generation of ground and space-based wide-field survey facilities to study galaxy formation and evolution.

Facilities contributing to GAMA









NIR VIKING

NIR LAS

Spec

FIR ATLAS

Optical KIDS

HI

Optical

UV

90 cm

Science

GMRT

GAMA team and structure

WORKING GROUPS AND HEADS

Science	Cats	Database	Observing	Mocks	Multi-λ	Spec. pipel.	Image pipel.
Peacock (ROE)	**Baldry** (LJMU)	**Liske** (ESO)	**Driver** (PI, St And)	**Norberg** (ROE)	**Hopkins** (AAO)	**Loveday** (Sussex)	**Bamford** (Portsmouth)

TEAM MEMBERS

Bland-Hawthorn (USyd)	Cameron (St Andrews)	Conselice (Nottingham)
Couch (Swinburne)	Croom (USyd)	Cross (ROE)
De Propris (CTIO)	Dunne (Nottingham)	Doyle (Portsmouth)
Eales (Cardiff)	Edmondson (Portsmouth)	Ellis (USyd)
Frenk (Durham)	Graham (Swinburne)	Hill (St Andrews)
Jones (AAO)	Kelvin (St Andrews)	Kuijken (Leiden)
Lahav (UCL)	Nichol (Portsmouth)	Oliver (Sussex)
Parkinson (ROE)	Phillipps (Bristol)	Popescu (UCLan)
Prescott (LJMU)	Proctor (Swinburne)	Robotham (St Andrews)
Roseboom (Sussex)	Sharp (AAO)	Staveley-Smith (UWA)
Sutherland (Camb.)	Thomas (Portsmouth)	Tuffs (MPIA)
van Kampen (ESO)	Warren (Imperial)	postdocs+students pending

AFFILIATED CONSORTIA

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

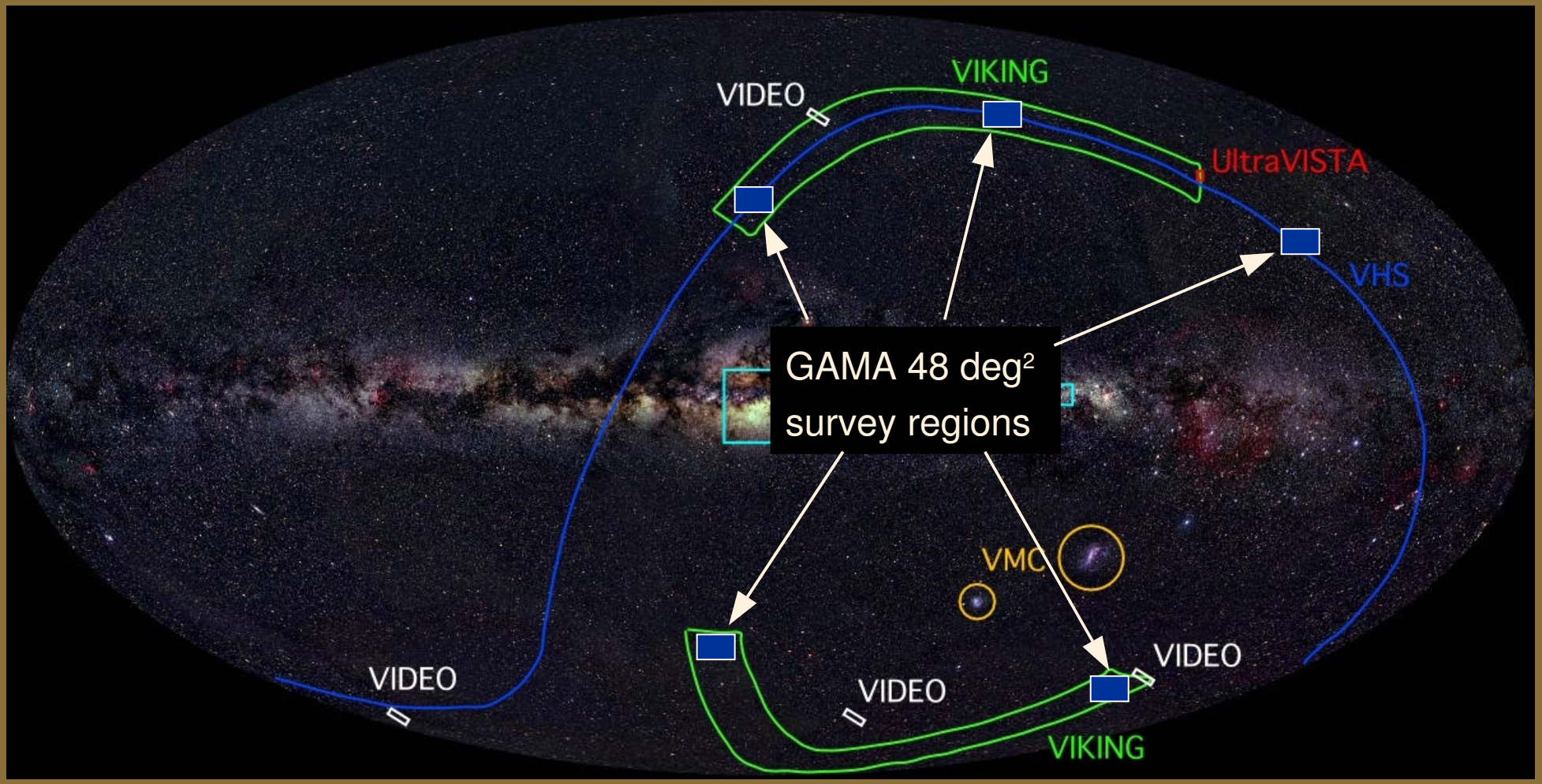
Status of GAMA imaging

- GALEX: observations ongoing, completed by 2010 (?)
- VST: KIDS (see K. Kuijken's talk)
- VISTA: VIKING (see K. Kuijken's talk)
- UKIRT: UKIDSS-LAS ongoing
- HERSCHEL: ATLAS to commence this year
- ASKAP: EoI submitted in Dec 2008
  invitation for full proposal received in Jan 2009
- GMRT: 1st round of observations completed, further obs required for full coverage

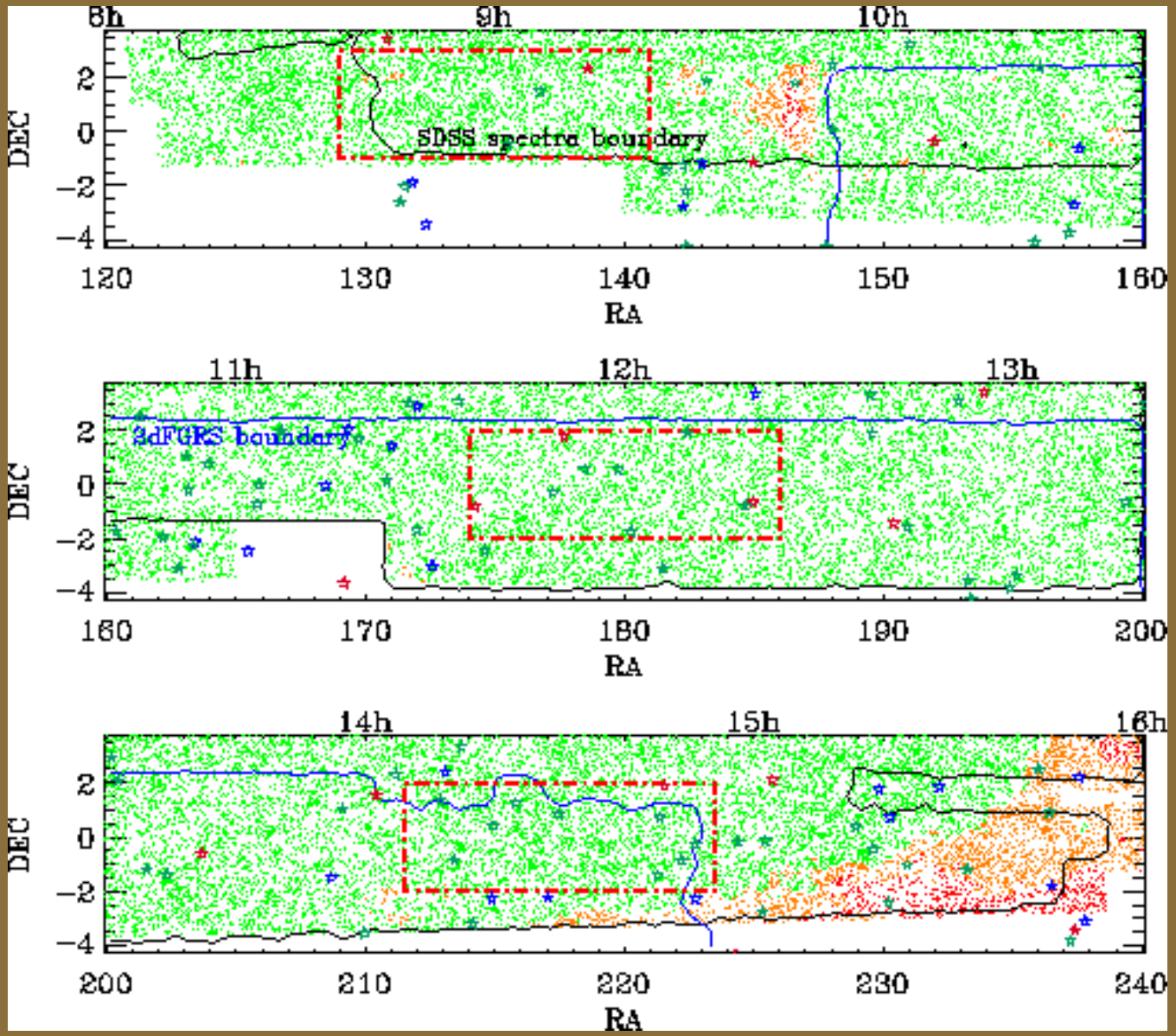
GAMA spectroscopy

- Fibre spectroscopy using AAT/AAOmega (2dF successor)
- Area: 240 deg^2 split over 5 regions
- Main sample: ~250K galaxies to r < 19.8 mag and K_{AB} < 17.5 mag (selected from SDSS and UKIDSS-LAS)
- <z> ~ 0.25
- R = 1300, 370 < λ < 880 nm
- Science goal of GAMAz: study of structure on 1 kpc – 1 Mpc scales
  - CDM halo mass function of groups and clusters from group velocity dispersion
  - Galaxy stellar mass function to Magellanic Cloud masses by type and environment
  - Merger rate as a function of mass, mass ratio, type and environment
  - Properties of galaxy components (bulge-disk decomposition)

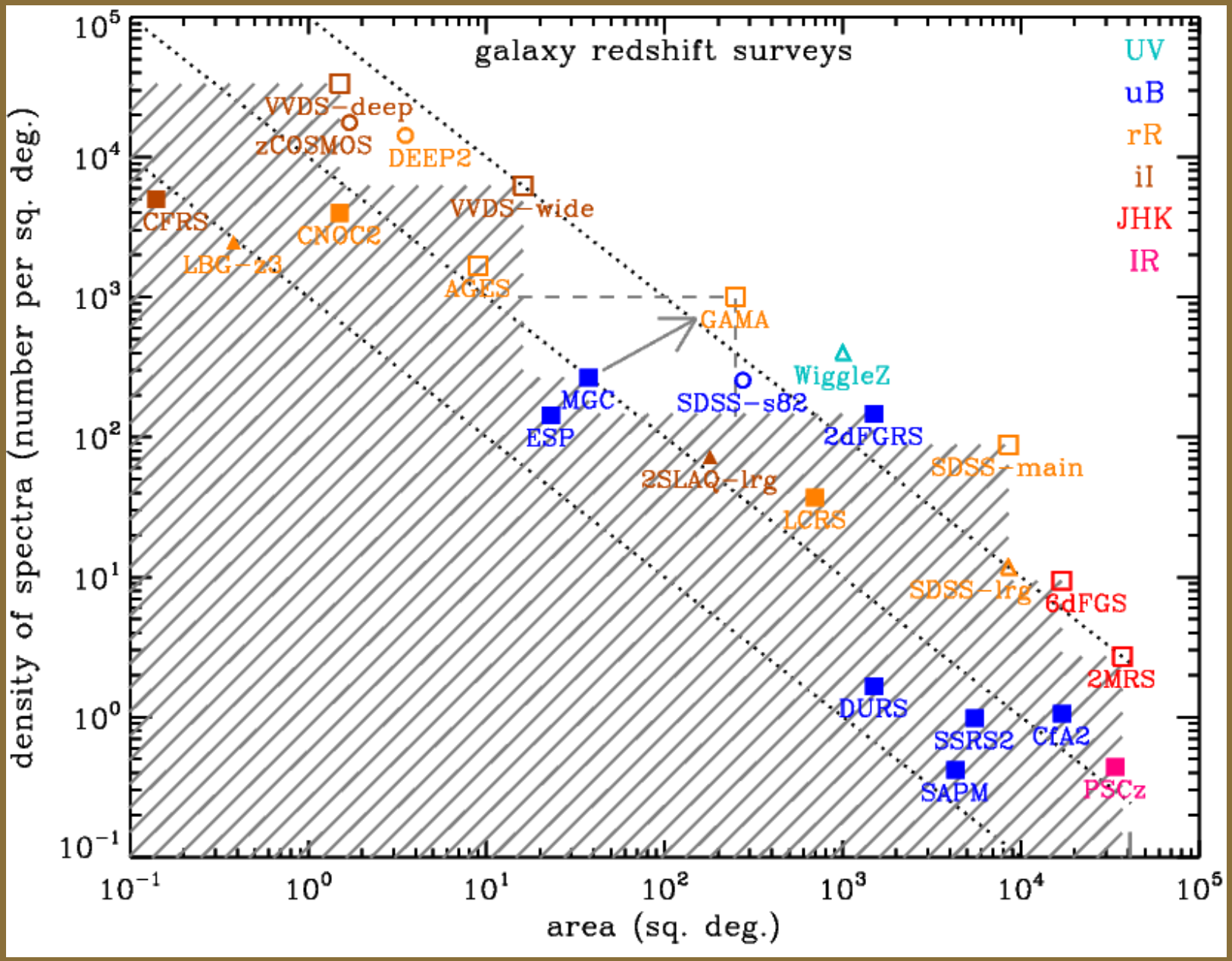
GAMA survey regions



GAMA-N survey regions



GAMA in comparison



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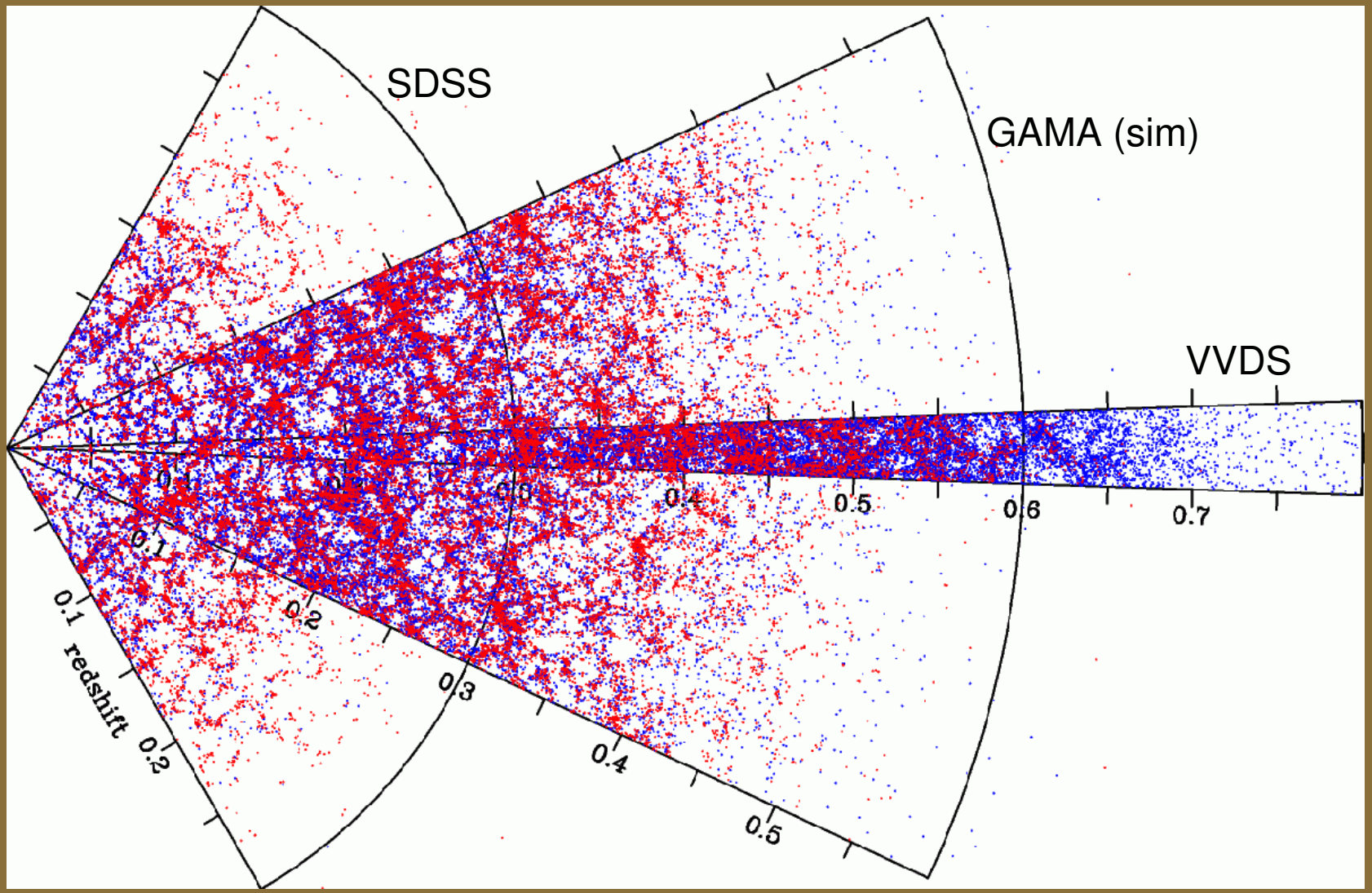

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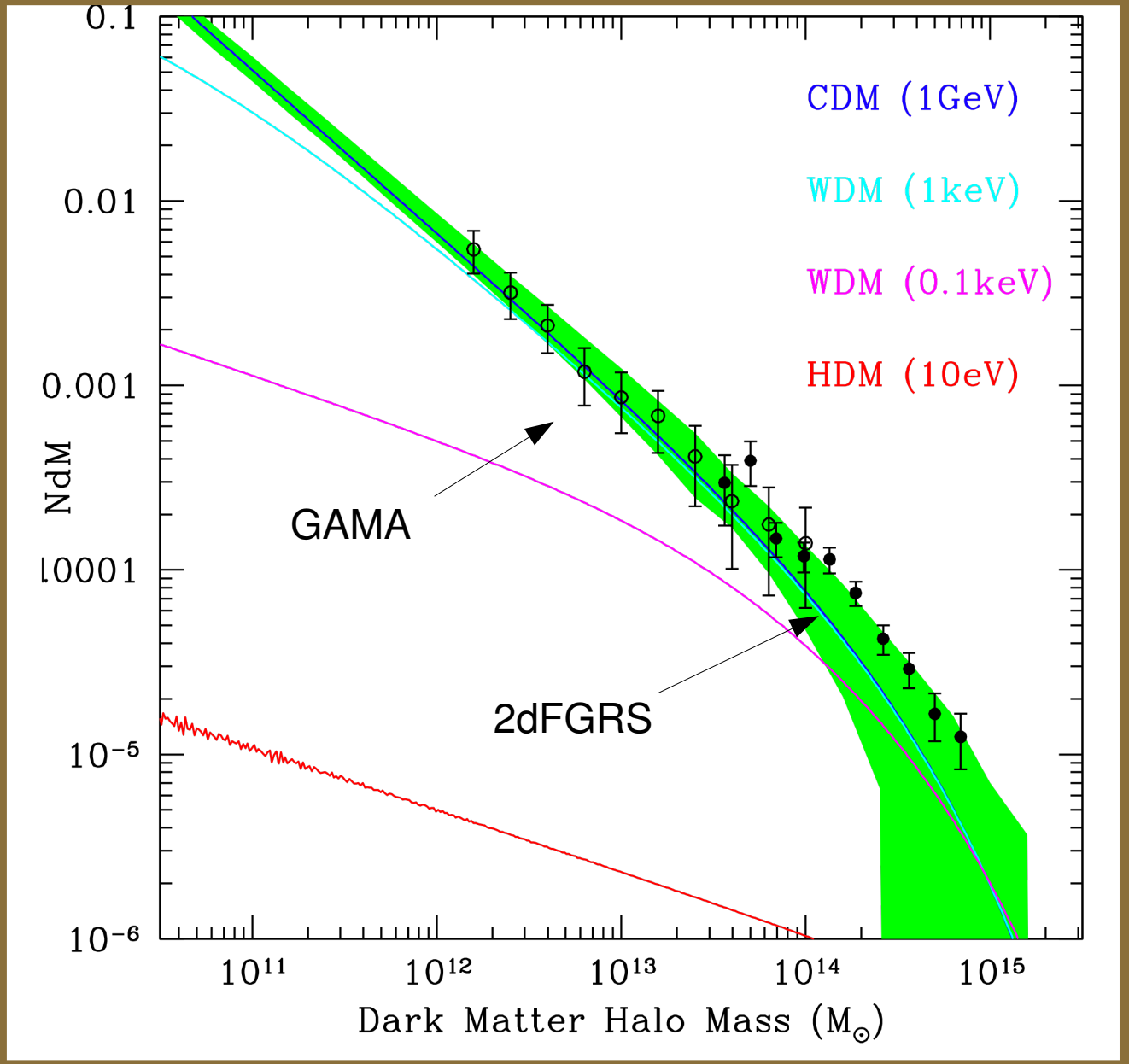
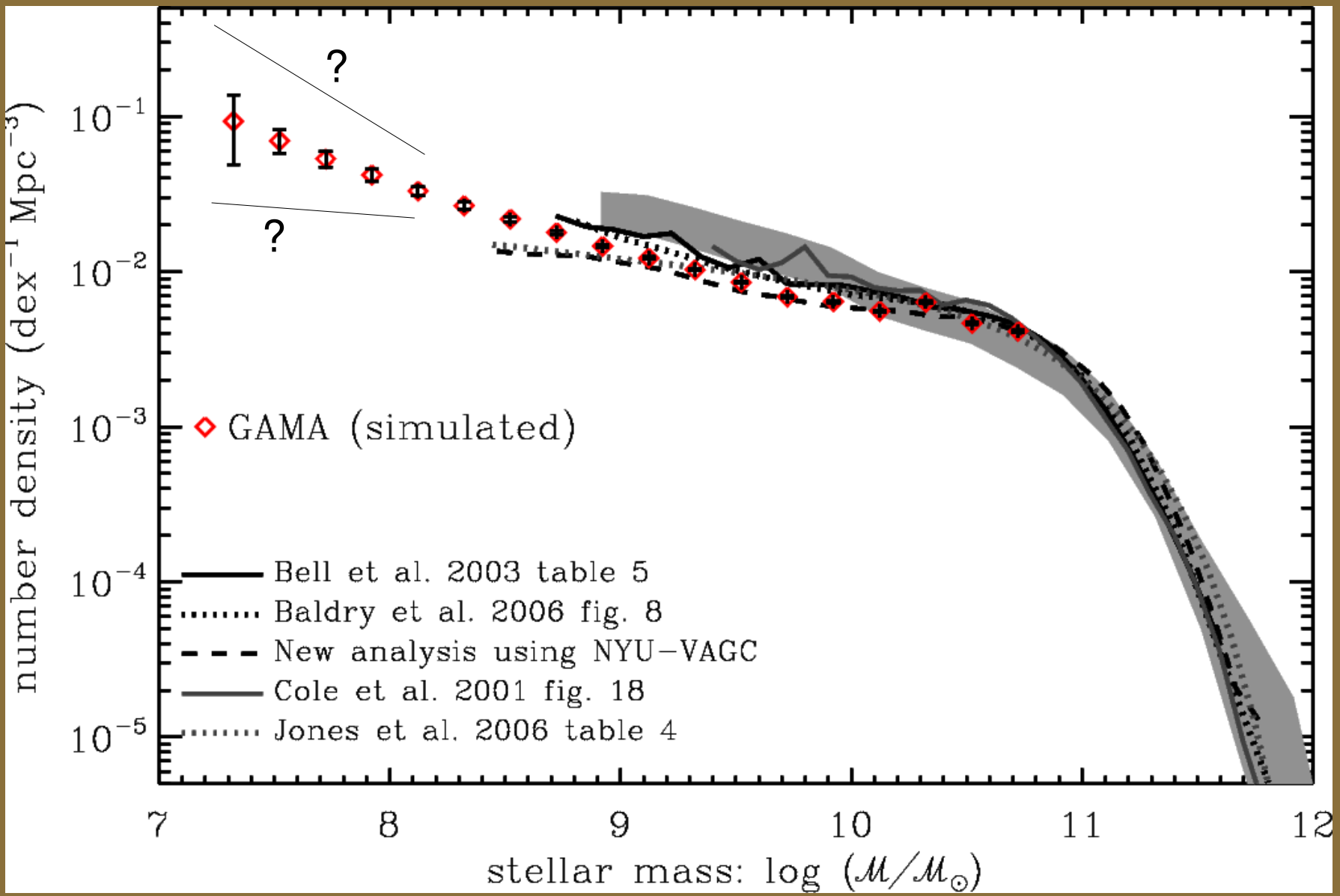
The halo mass function

- Robust prediction of structure formation models.
- Measurement requires depth + resolution + high completeness in dense areas.



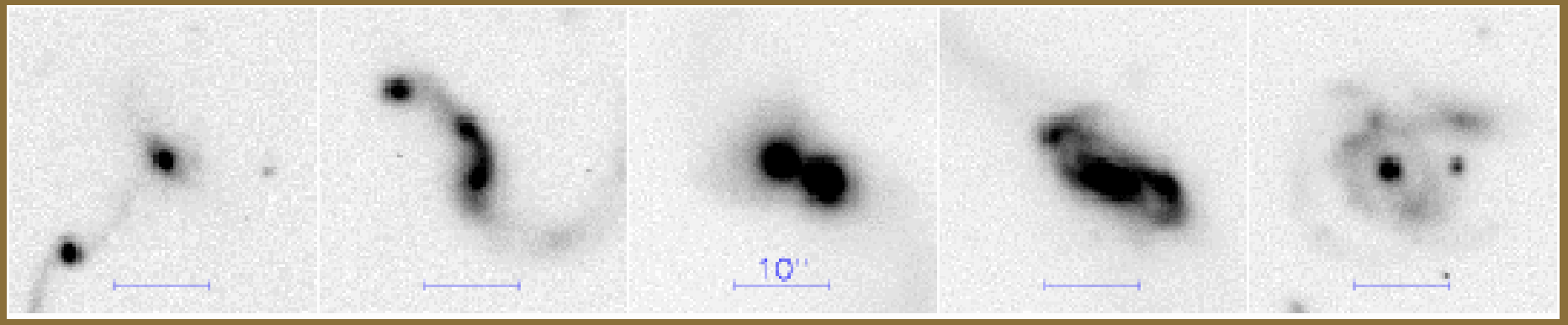
The stellar mass function

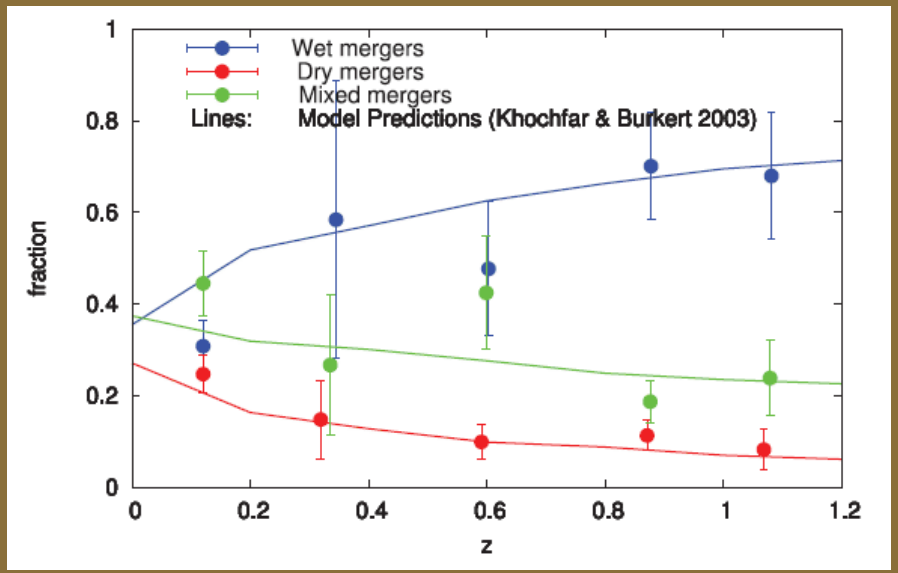
- Provides mass-dependent star-formation efficiency and constrains feedback.



The galaxy merger rate

- Mergers are a principal mode of galaxy assembly in CDM models of galaxy formation.





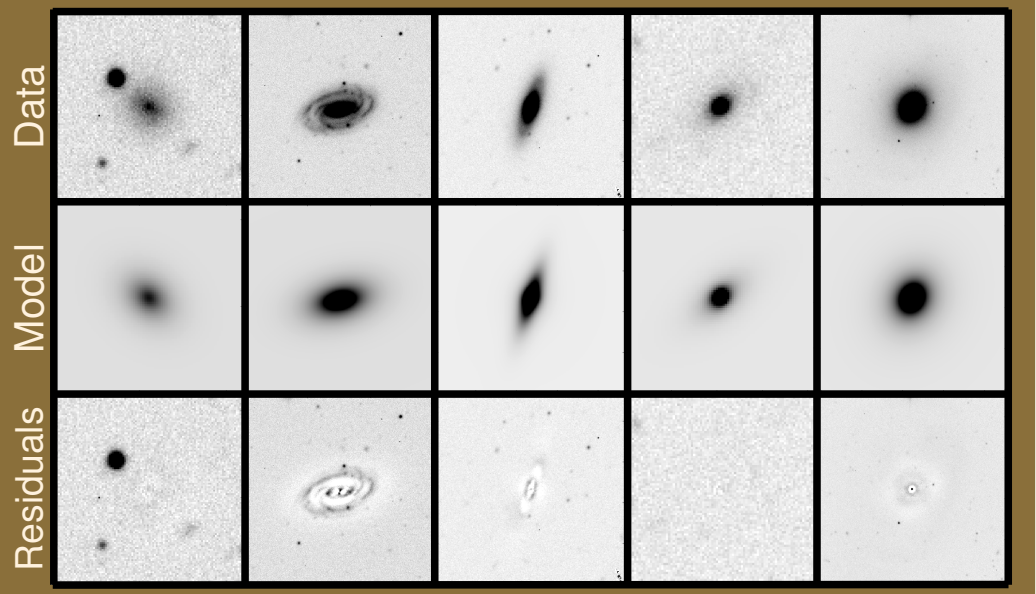
Lin et al. (2008)

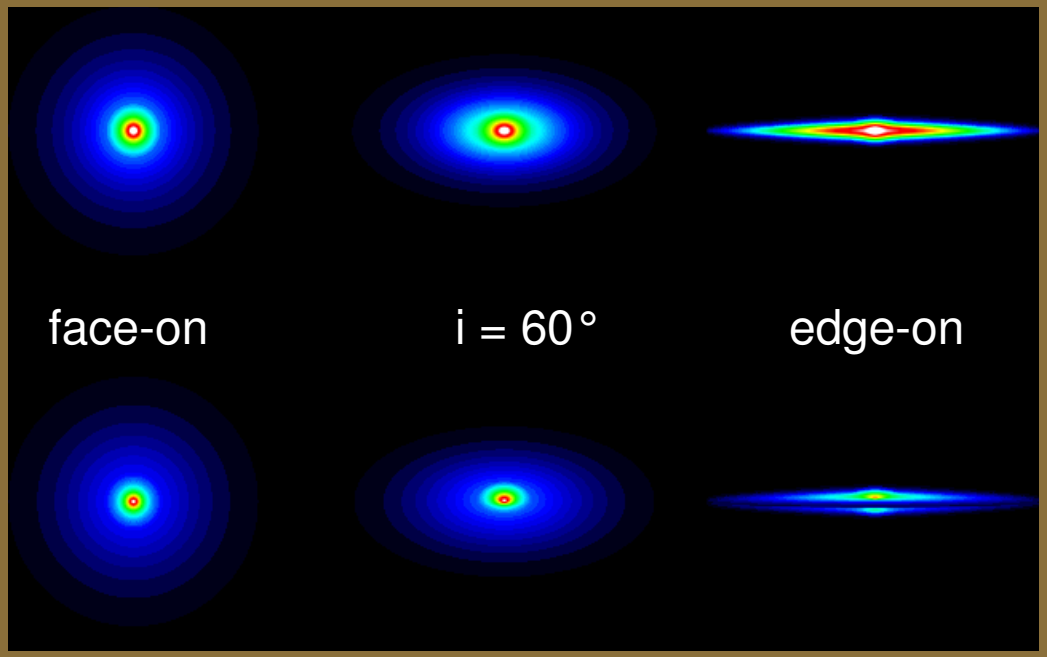
- Identify all stages of mergers by using dynamical pairs *and* morphological indicators.
- Explore merger rate as a function of mass ratio and merger type.
- Crucial: high completeness for close pairs, high-resolution imaging, depth.

Properties of bulges and disks

Multi-λ bulge-disk decomposition:

- Stellar mass functions to assess relative importance of different formation processes.
- Luminosity-size relations.



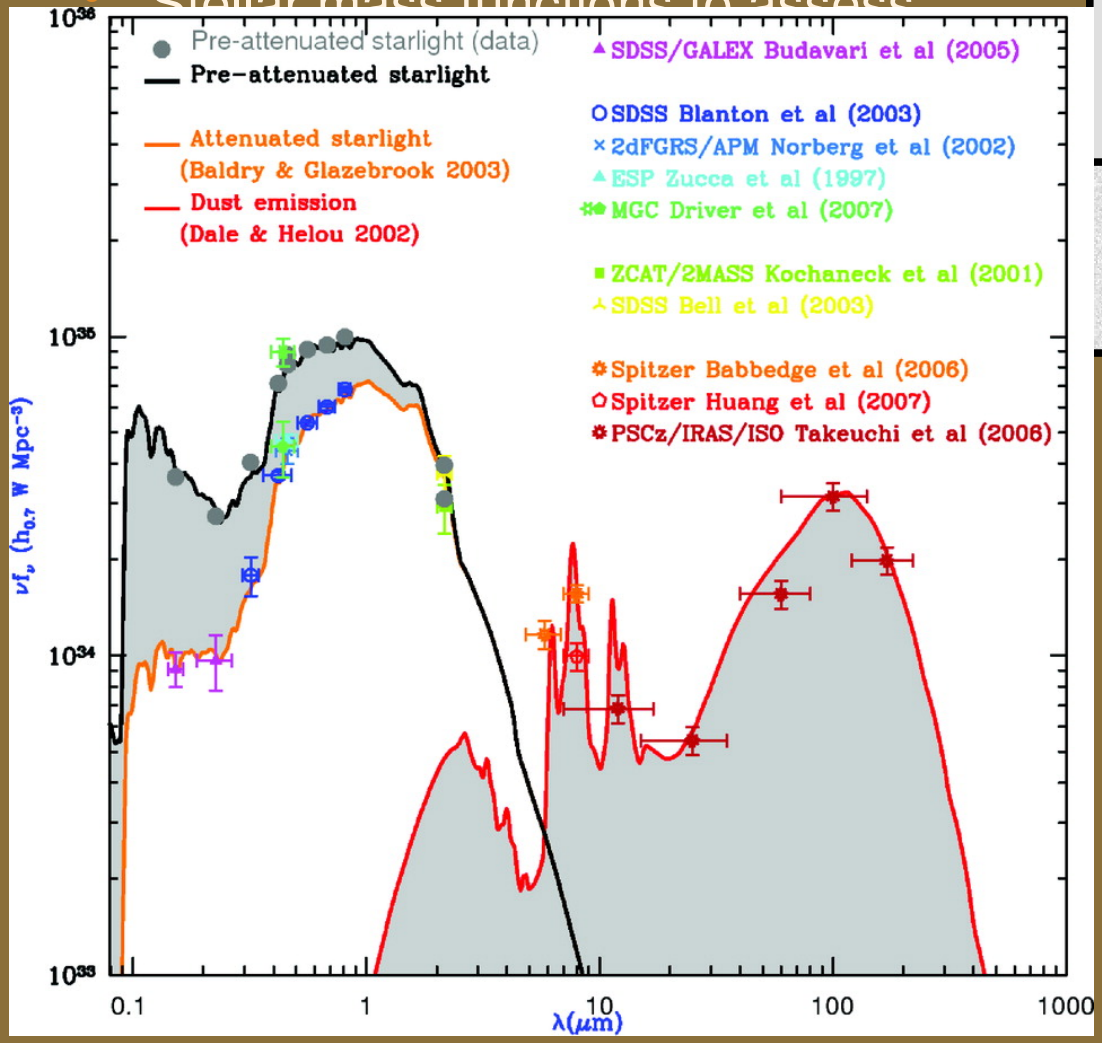


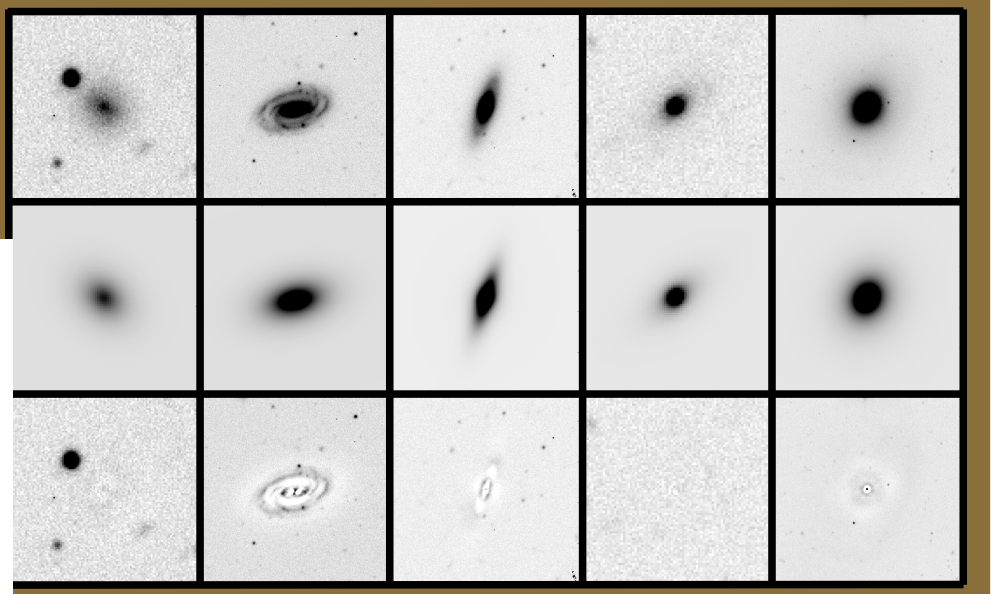
- Colour profiles.
- Dust in disks.
- Classical vs pseudo-bulges.
- ...

Properties of bulges and disks

Multi-λ bulge-disk decomposition:

- Stellar mass functions to assess



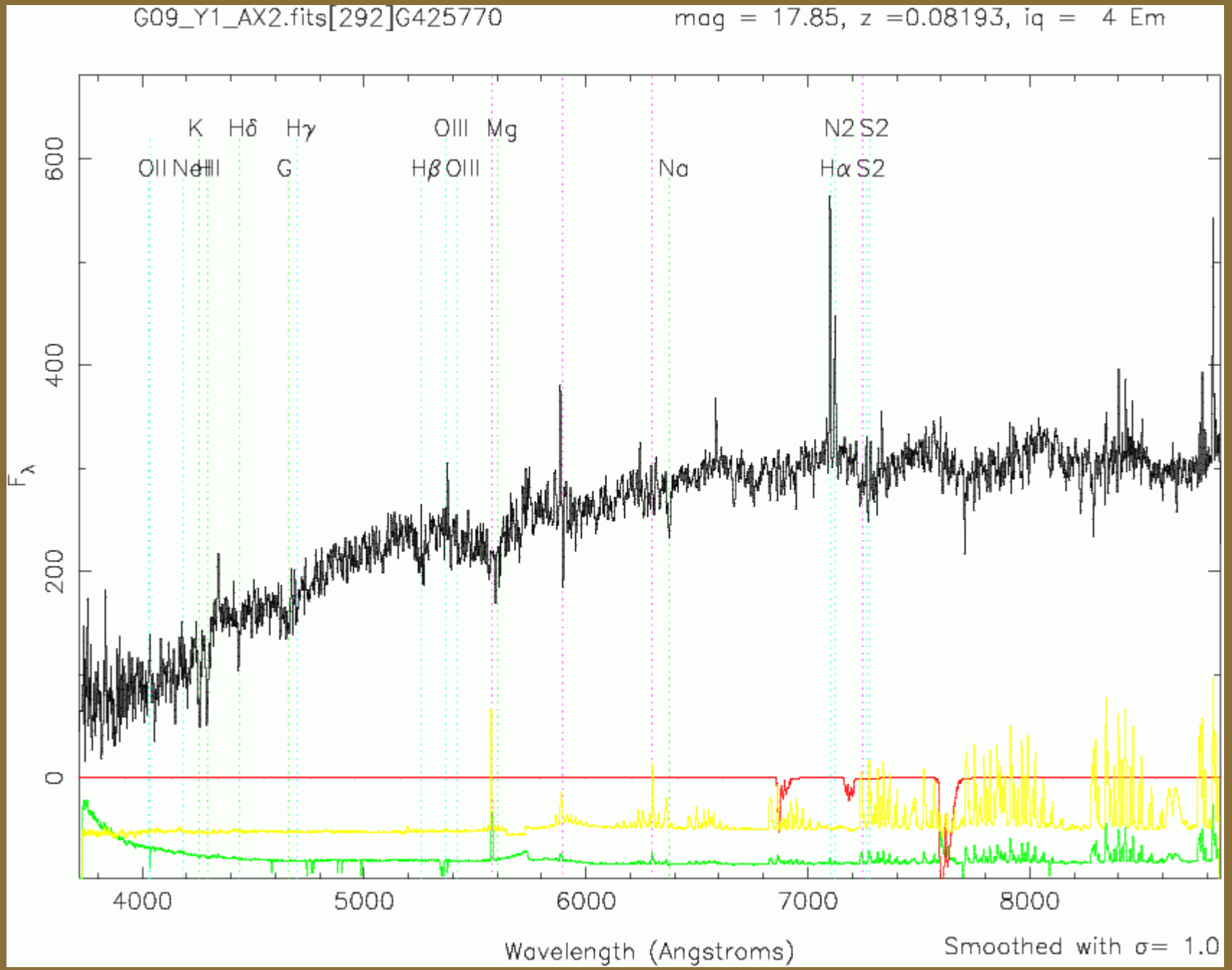


- Colour profiles.
- Dust in disks.
- Classical vs pseudo-bulges.
- ...

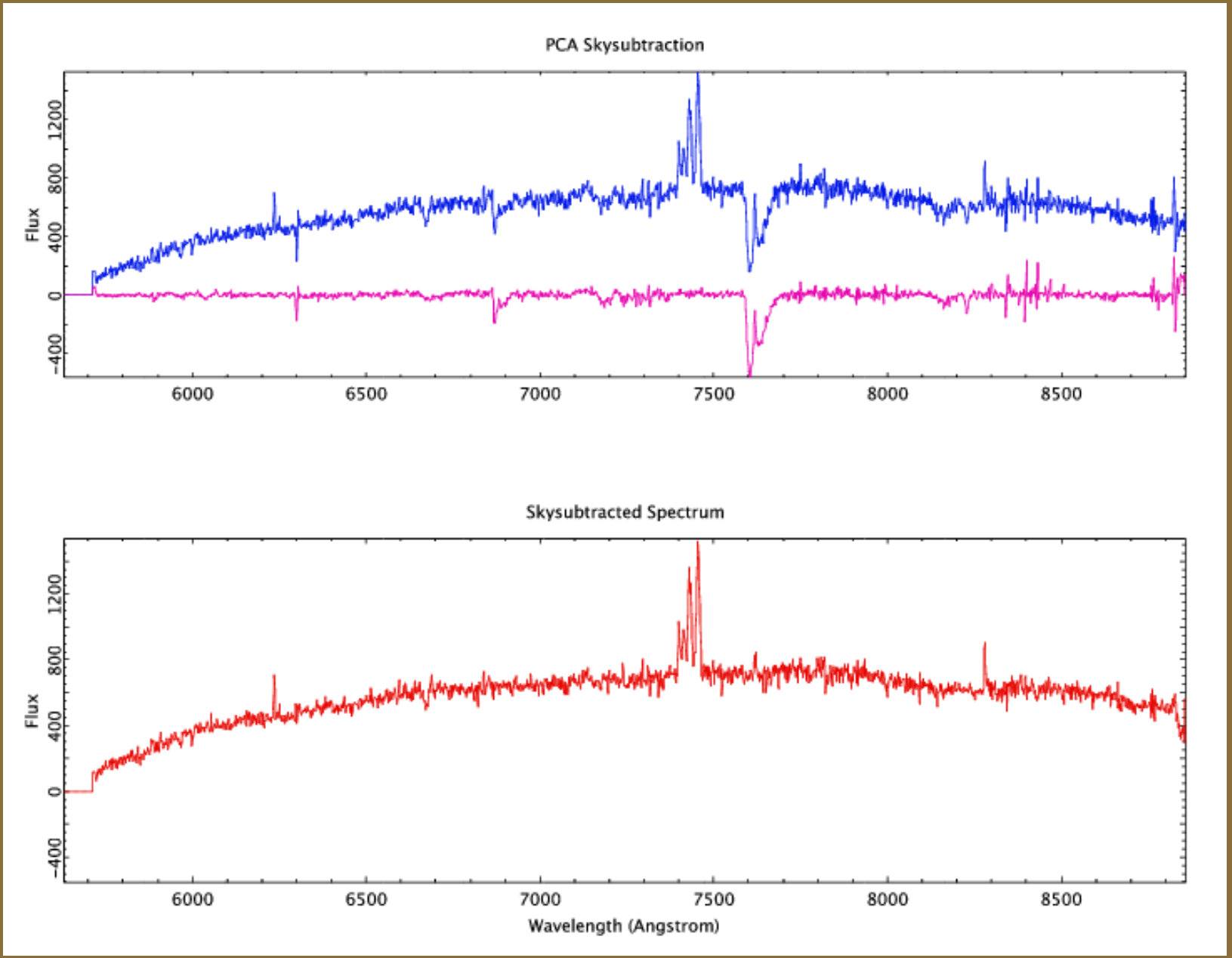
Status of GAMA spectroscopy

- 66 nights allocated (2008-2010)
- 21/22 clear nights in March-April 2008
  - 159 fields observed → all 3 GAMA-N regions covered almost entirely at least once to variable depths (including a deep strip to r < 19.8 mag)
  - 50,746 good quality redshifts at 96.6% (!) completeness
- 2009 campaign ongoing
- An additional ~90 nights are required to complete the survey:
  to be requested by an ASKAP/GAMA consortium in 2009/2010

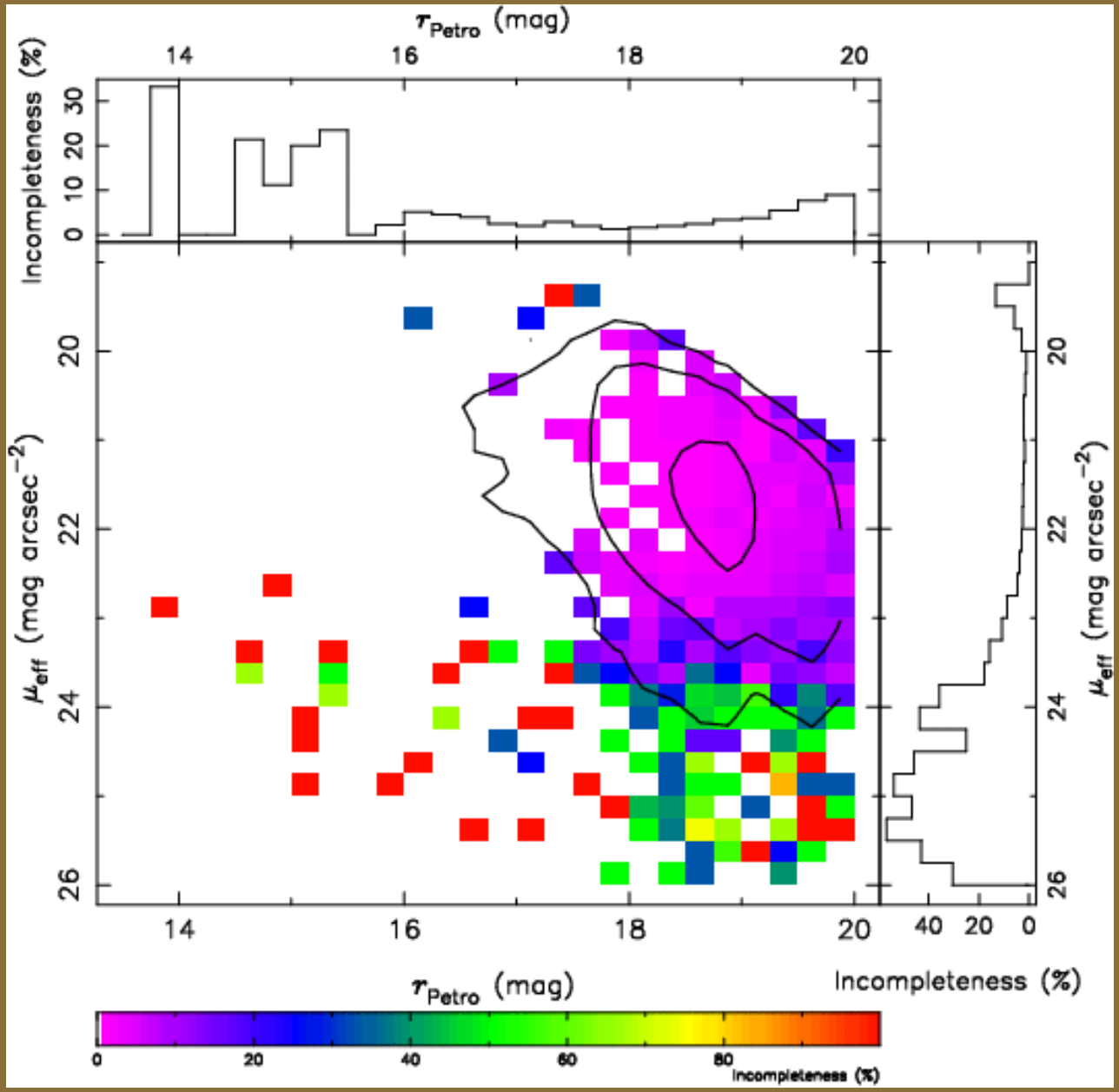
GAMA example spectrum



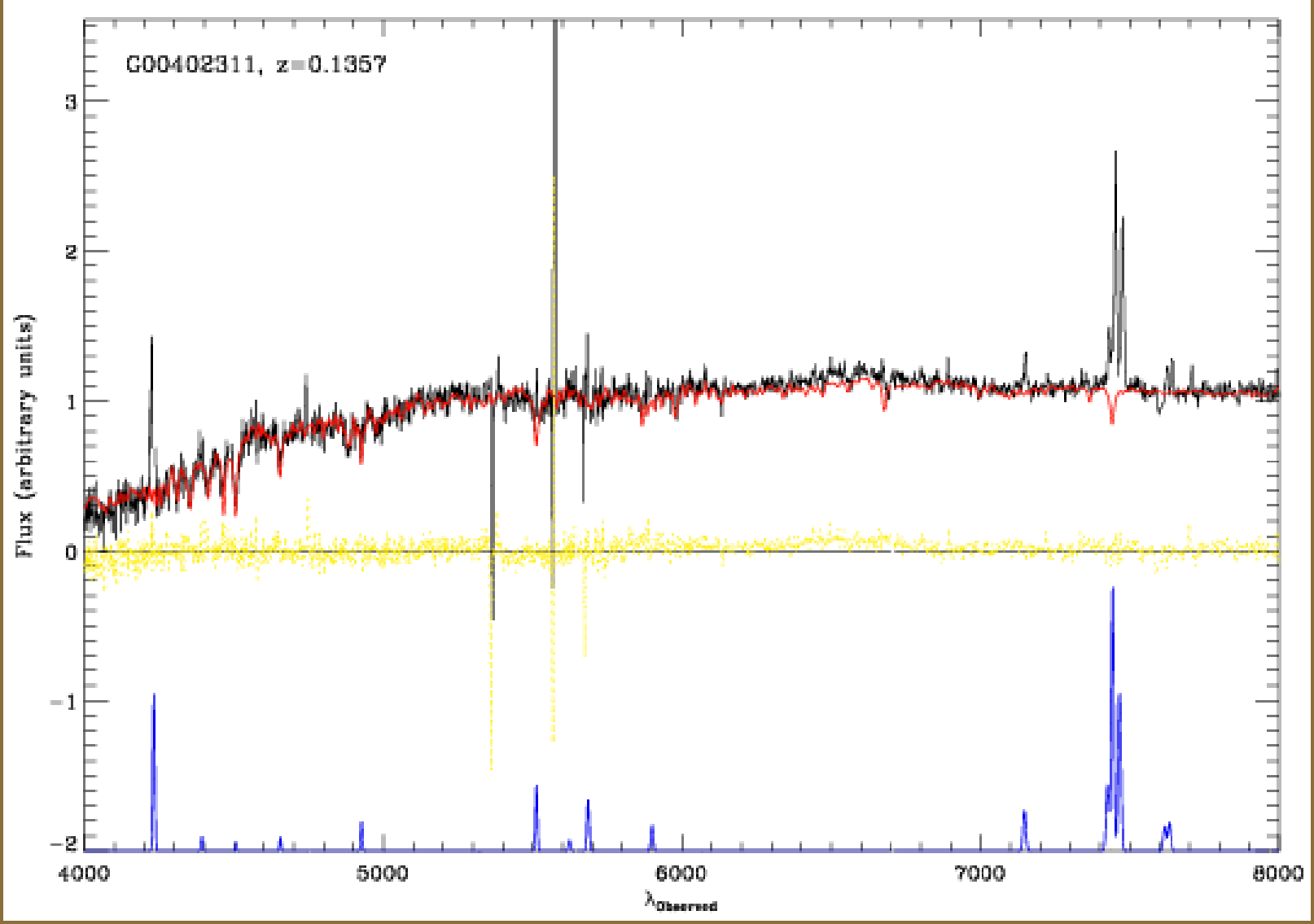
PCA sky subtraction



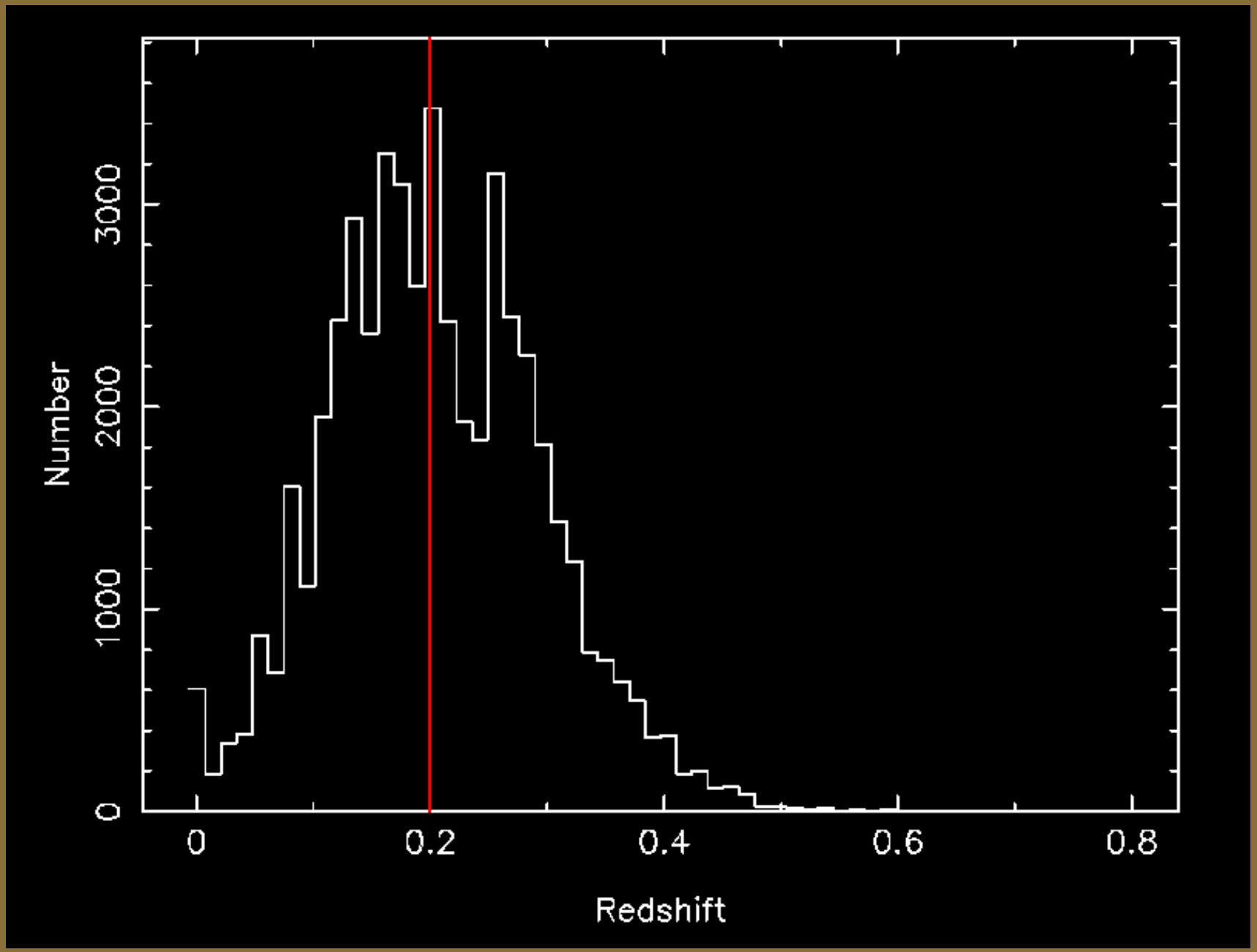
GAMA year 1 redshift completeness



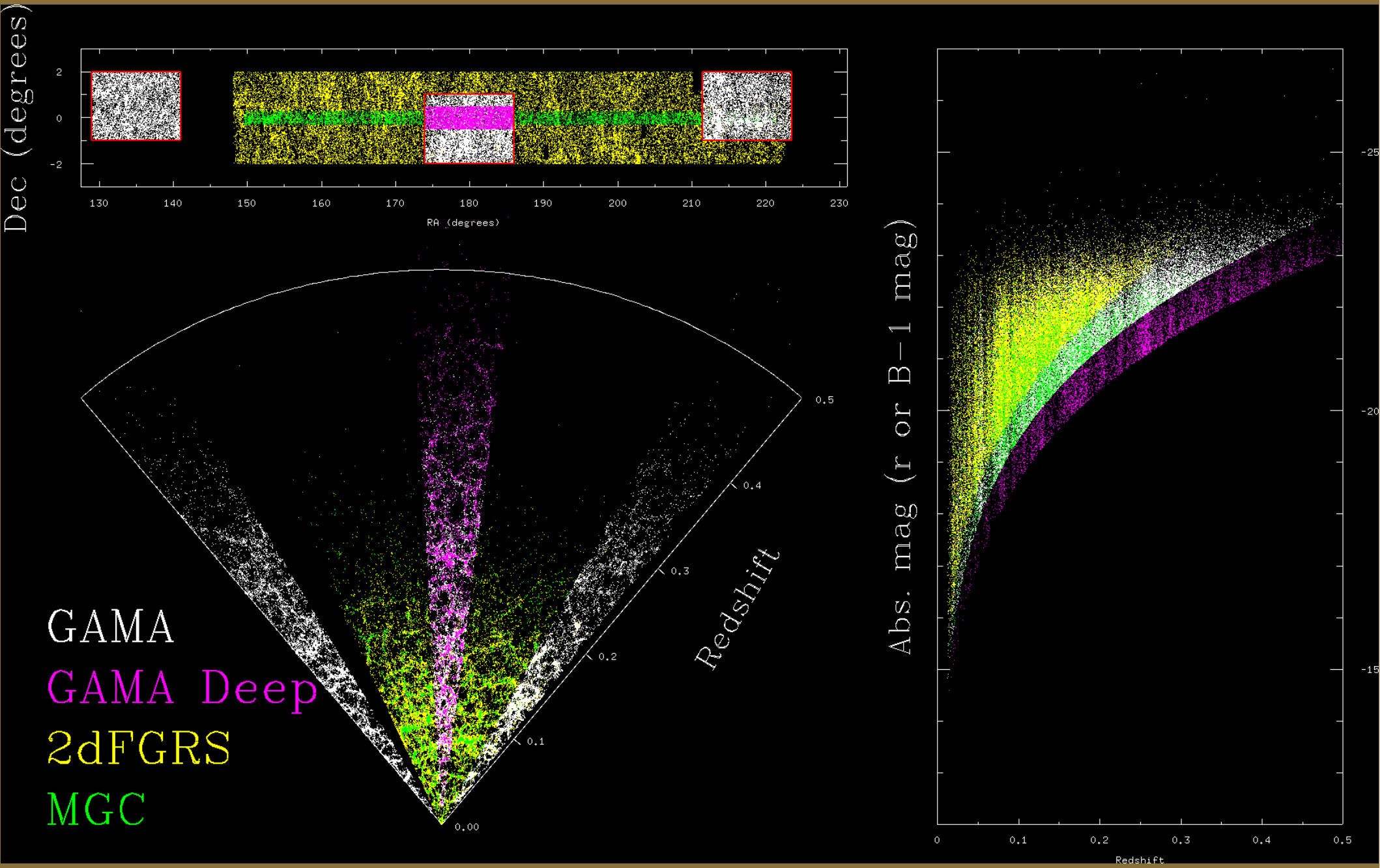
Spectral decomposition with GANDALF



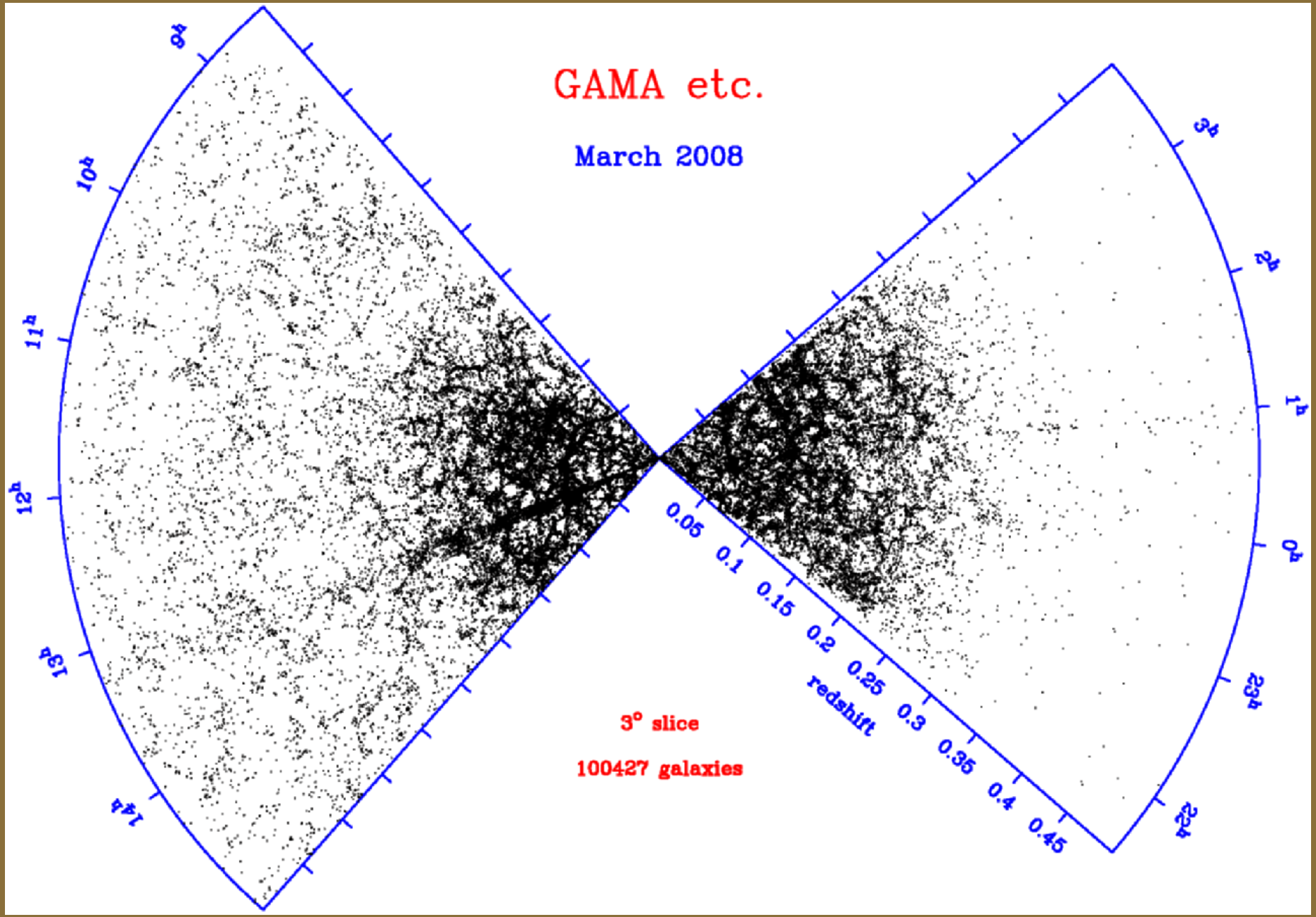
GAMA year 1 redshift distribution



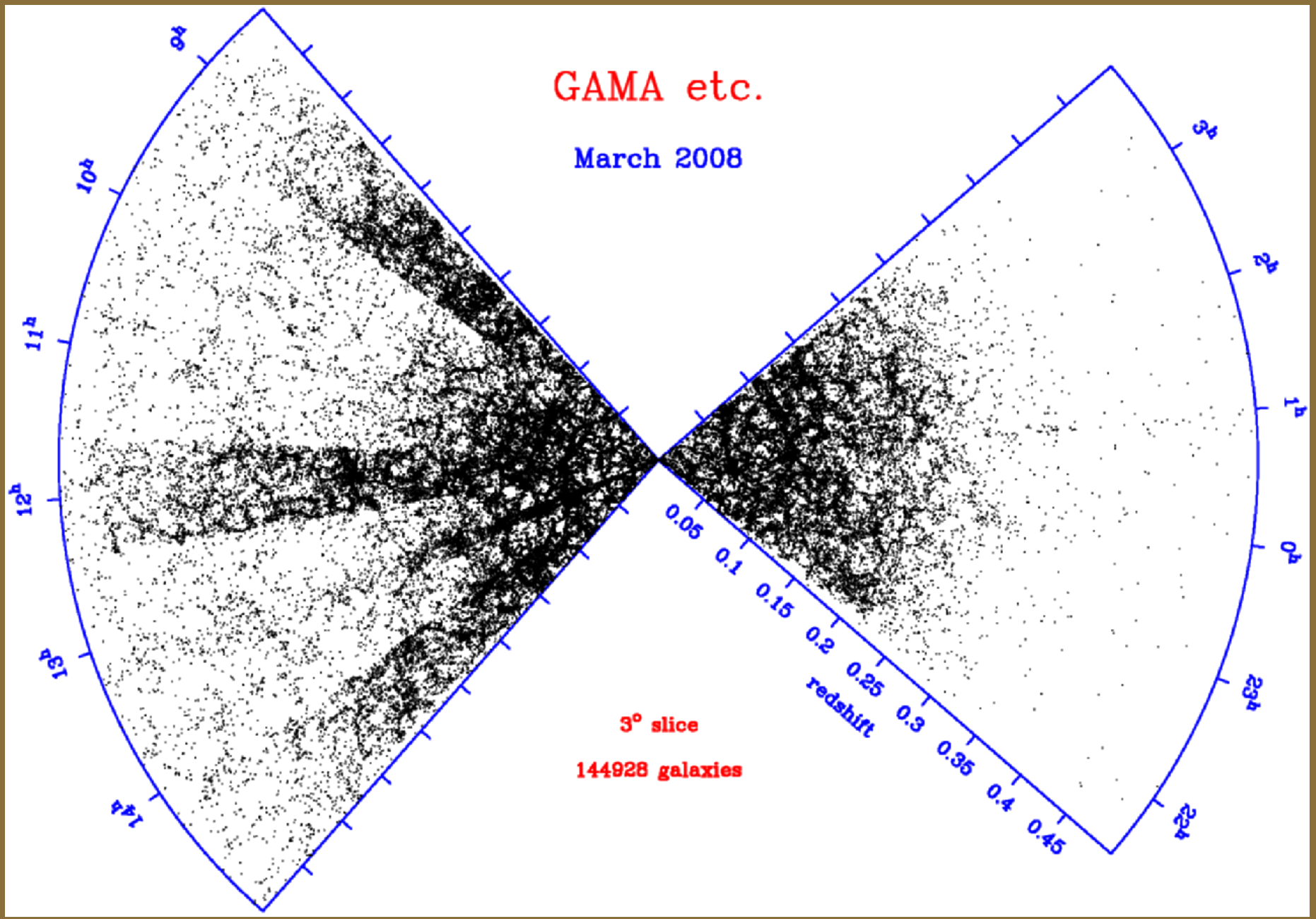
GAMA year 1 redshift cone



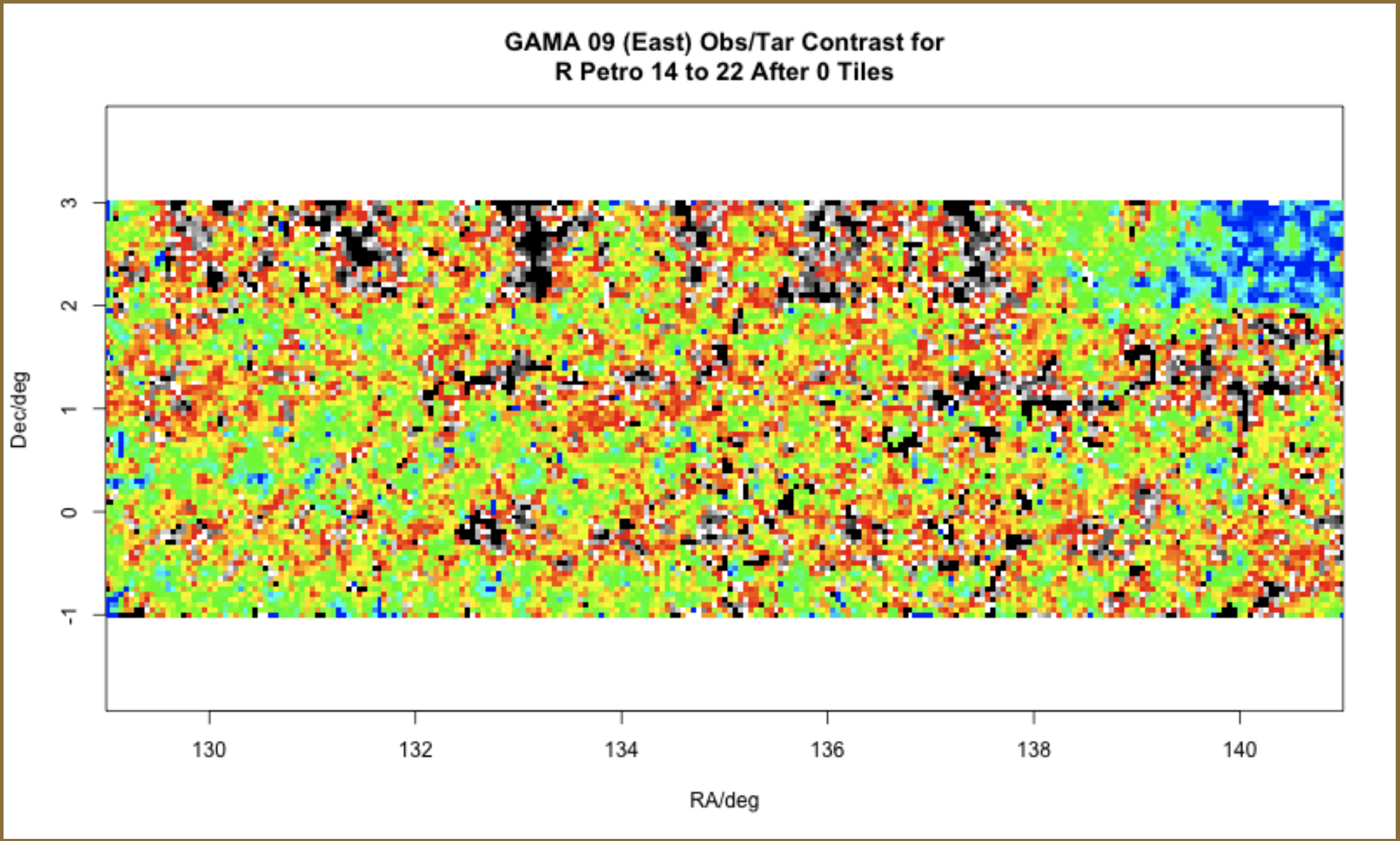
Redshift cone before GAMA Y1



Redshift cone after GAMA Y1



GAMA year 2 progress



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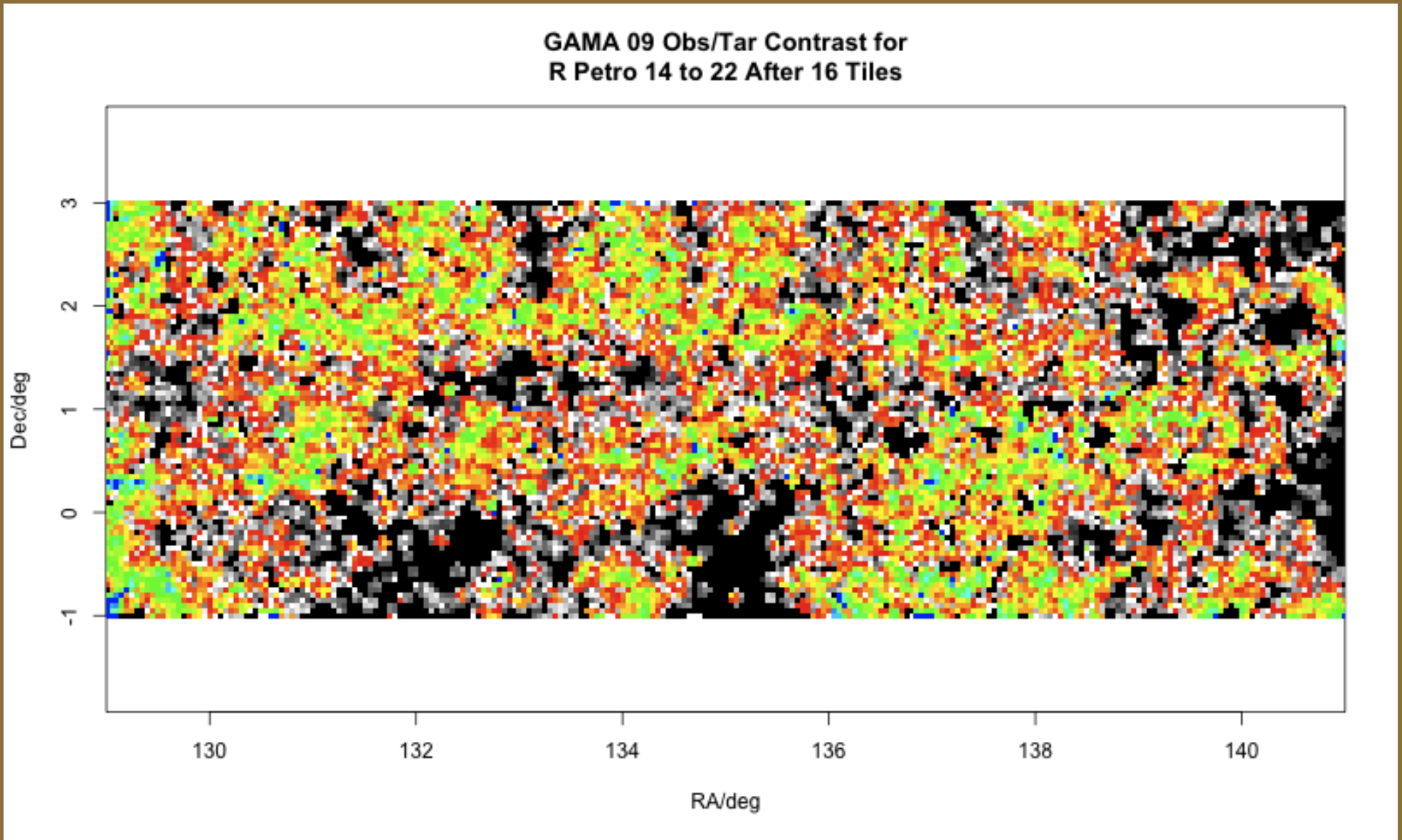
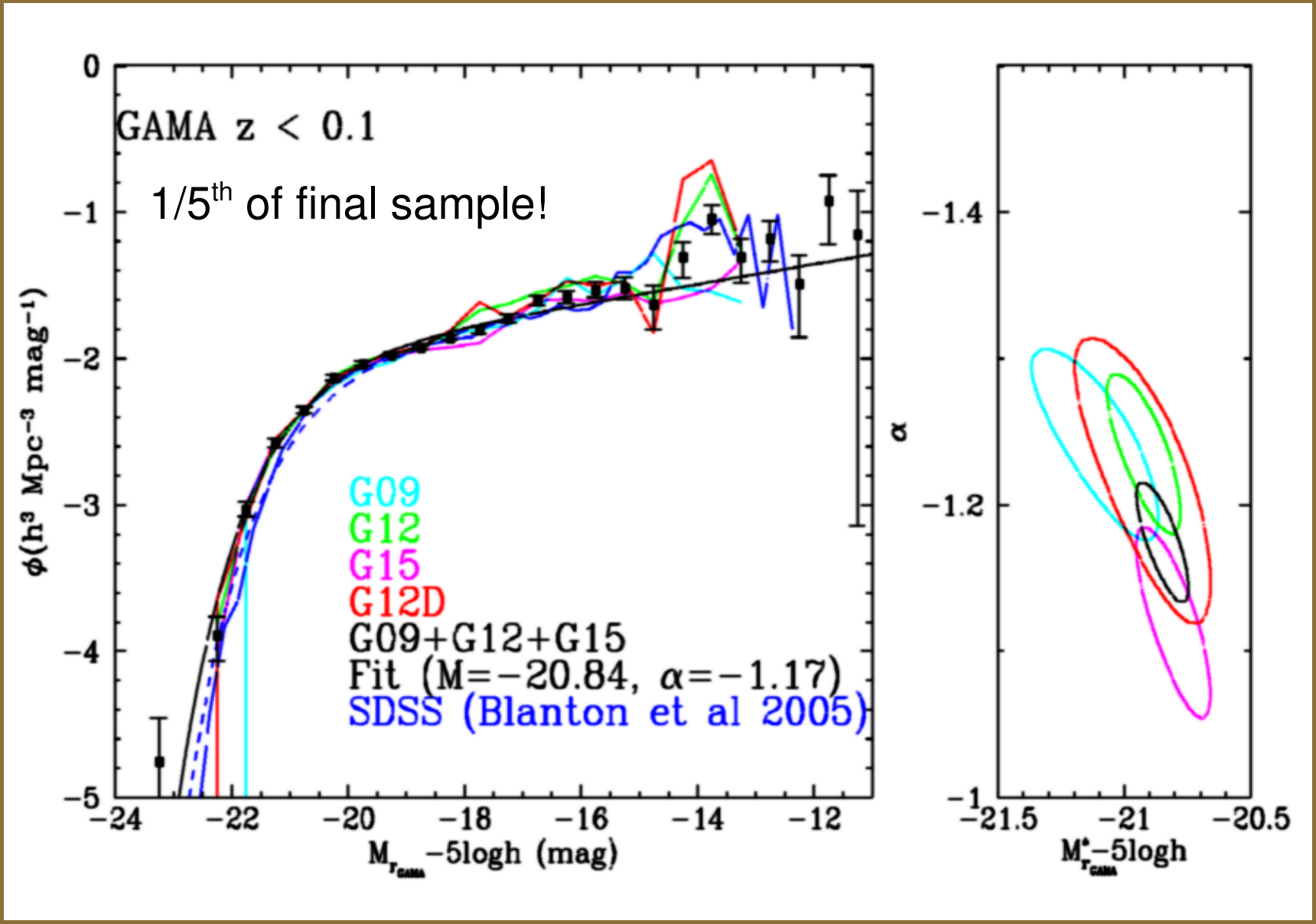
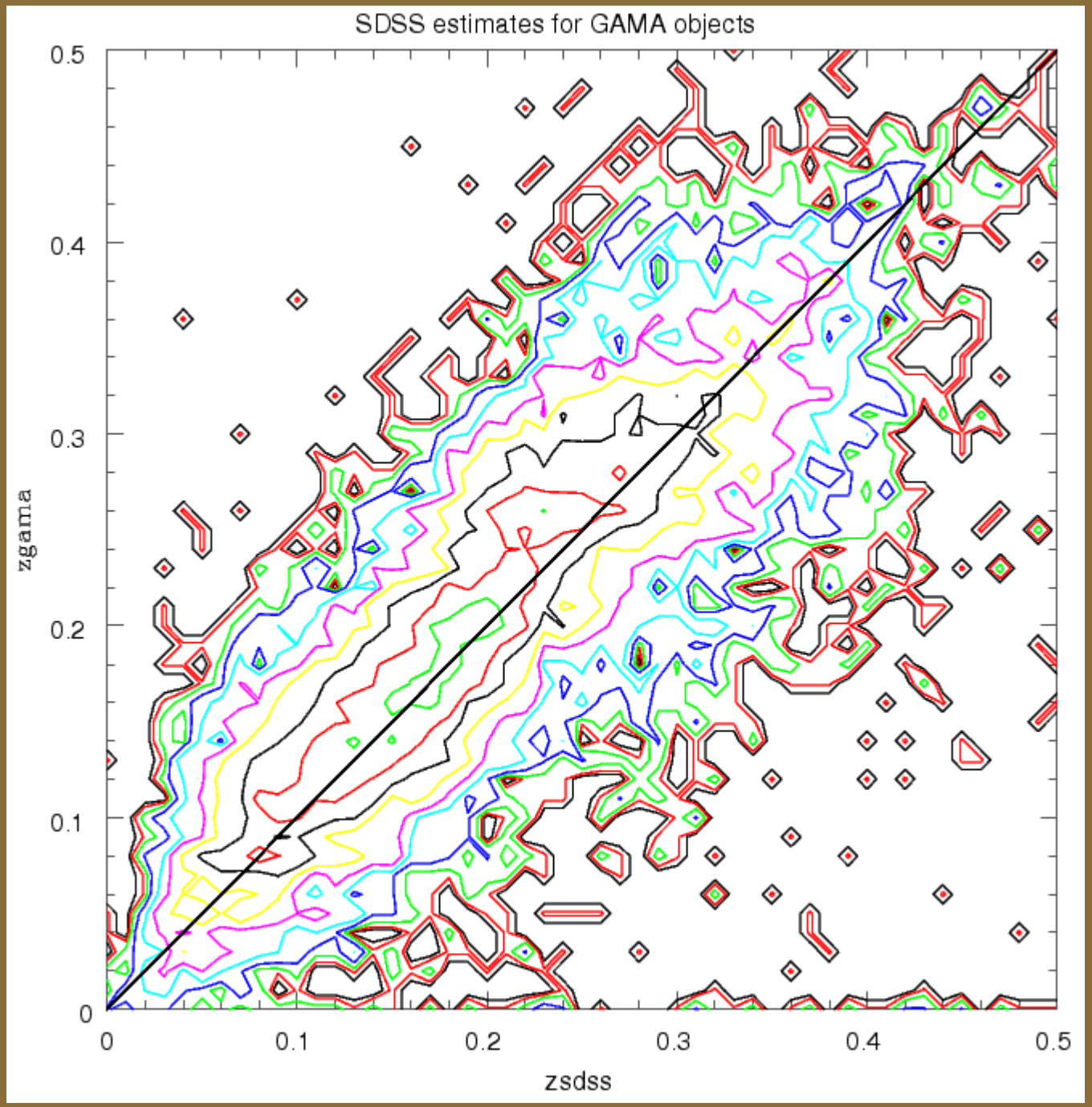


GAMA year 1 r-band LF



GAMA photo-z improvement



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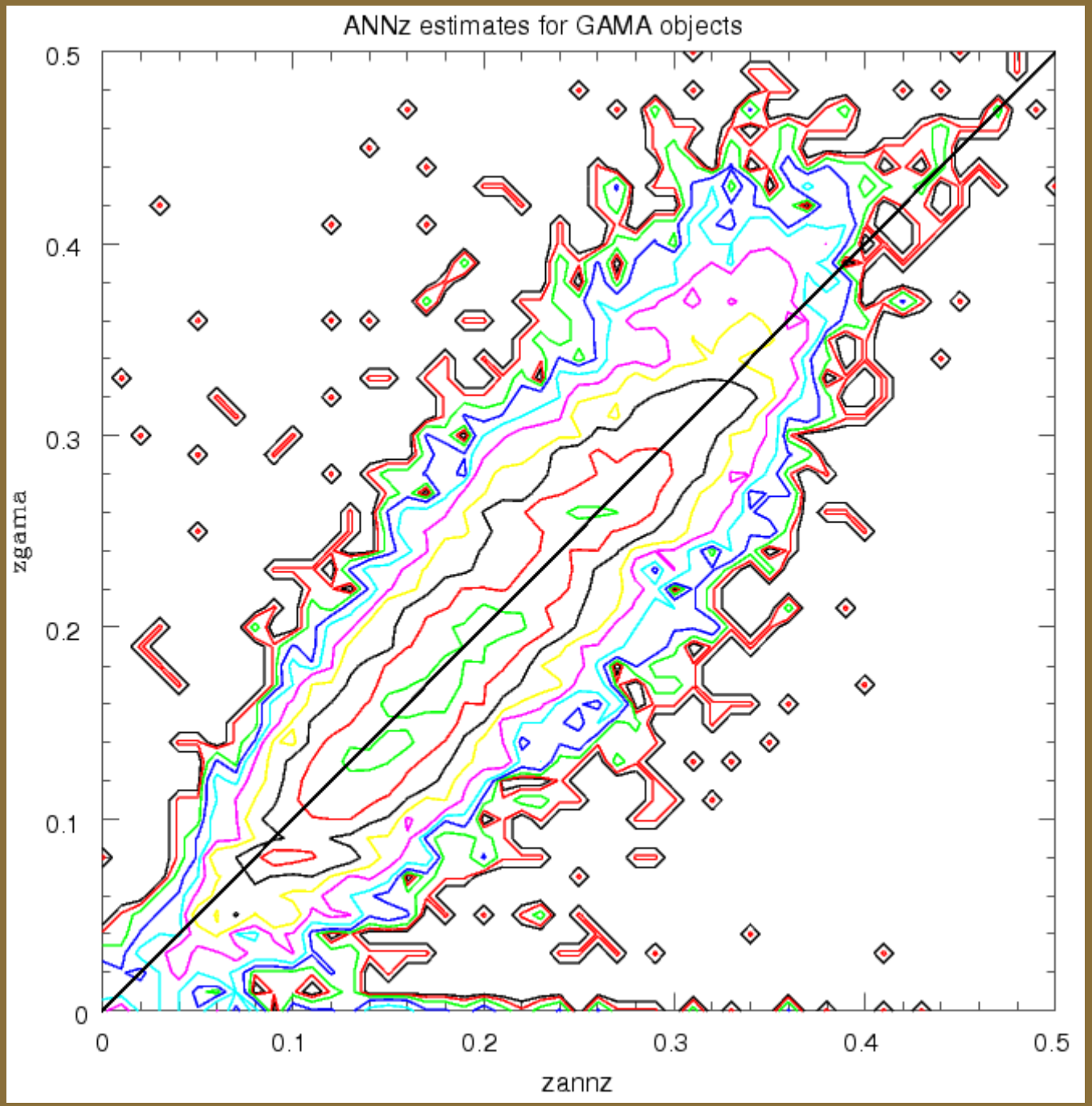
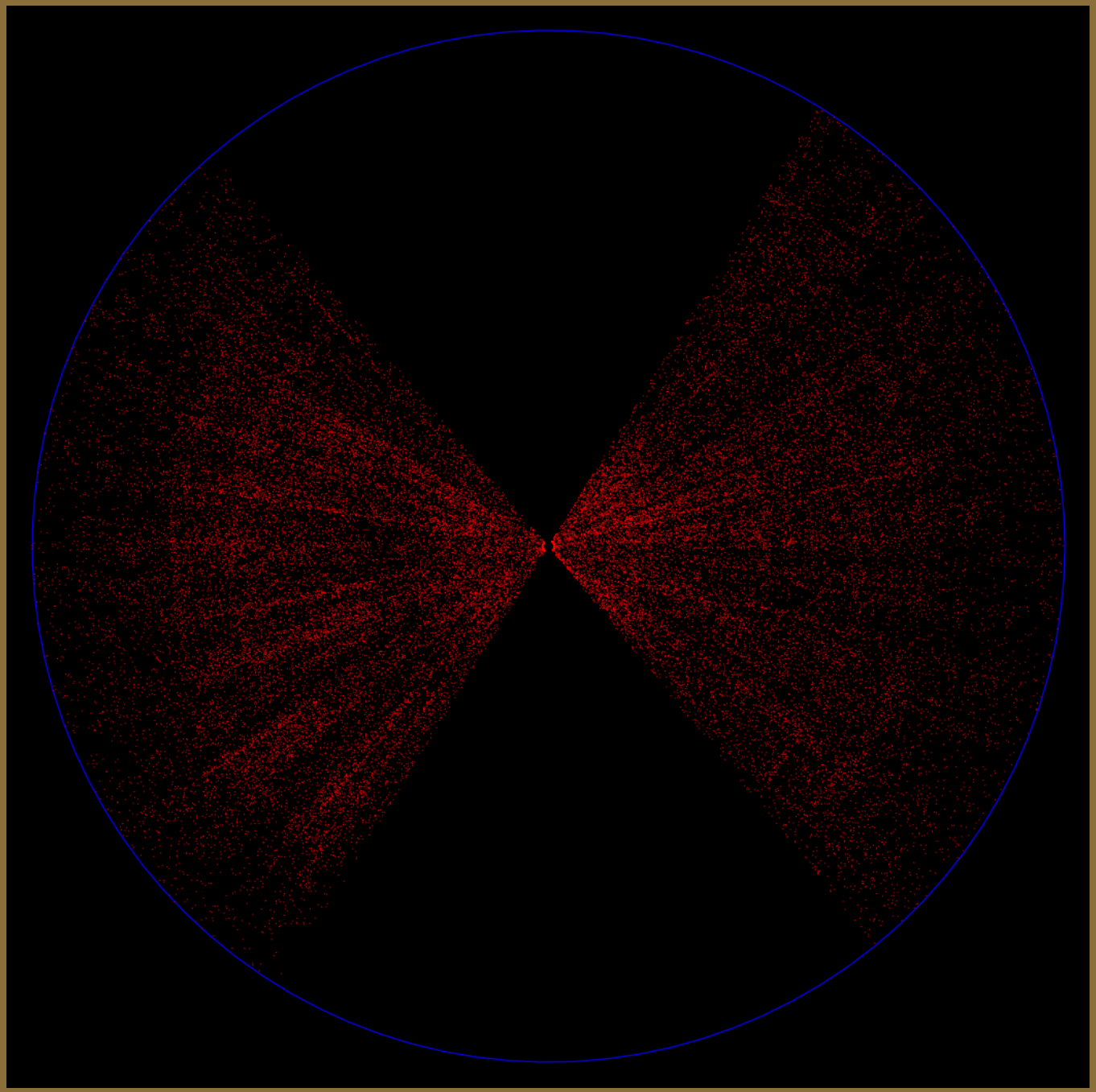


See J. Loveday's talk later today.

Spec-z vs photo-z

SDSS main sample
to z < 0.2: photo-z



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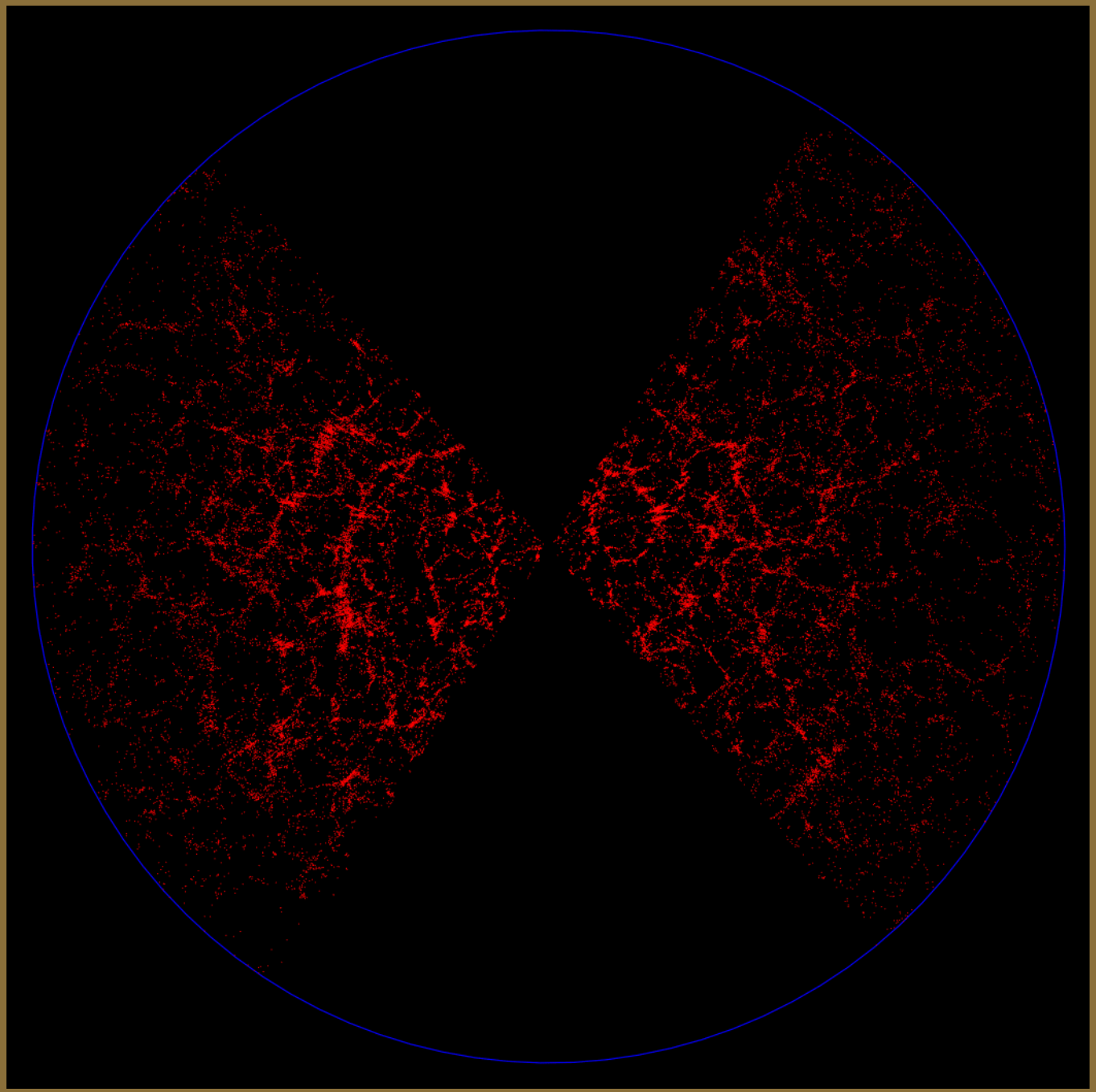
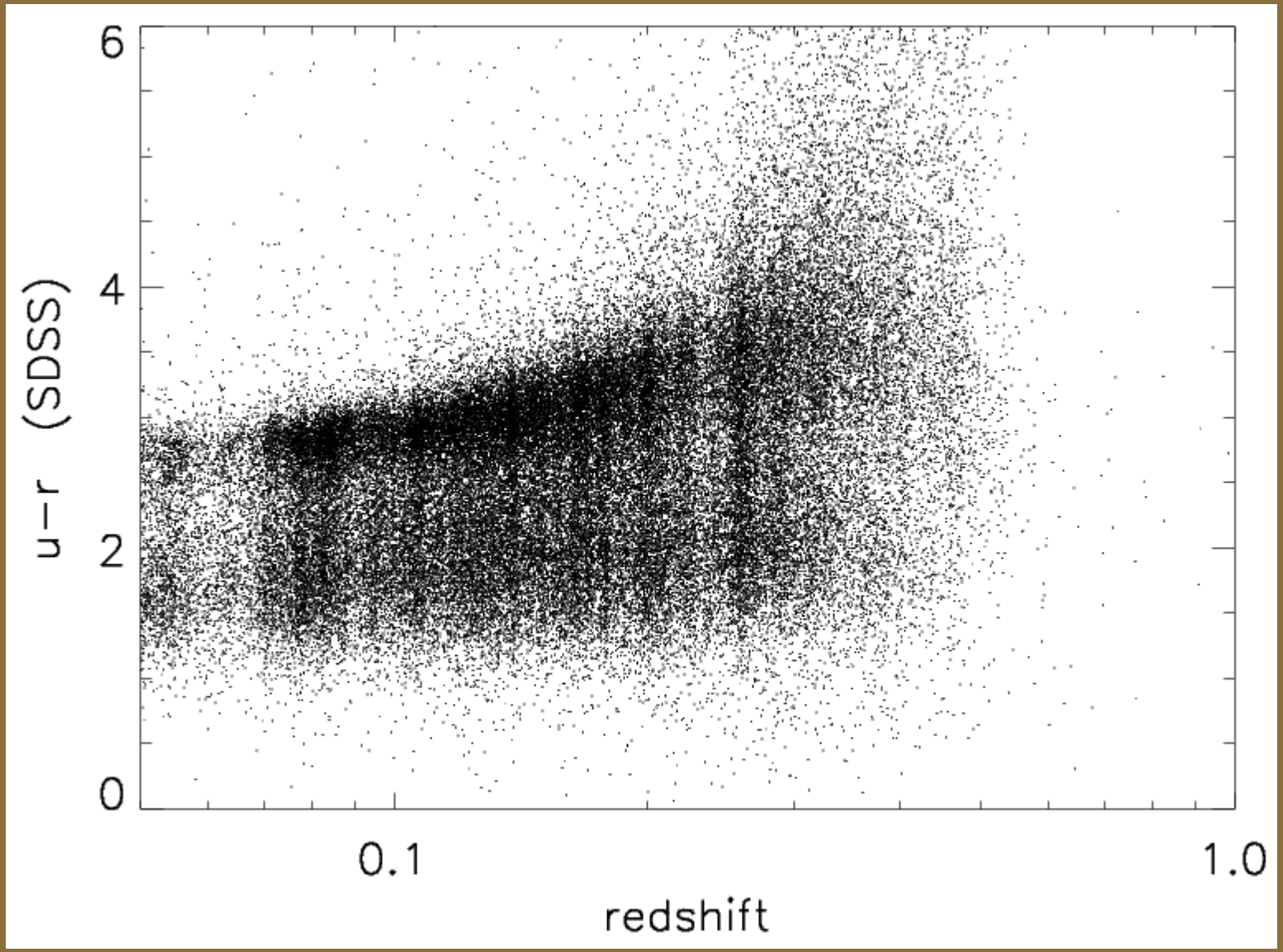
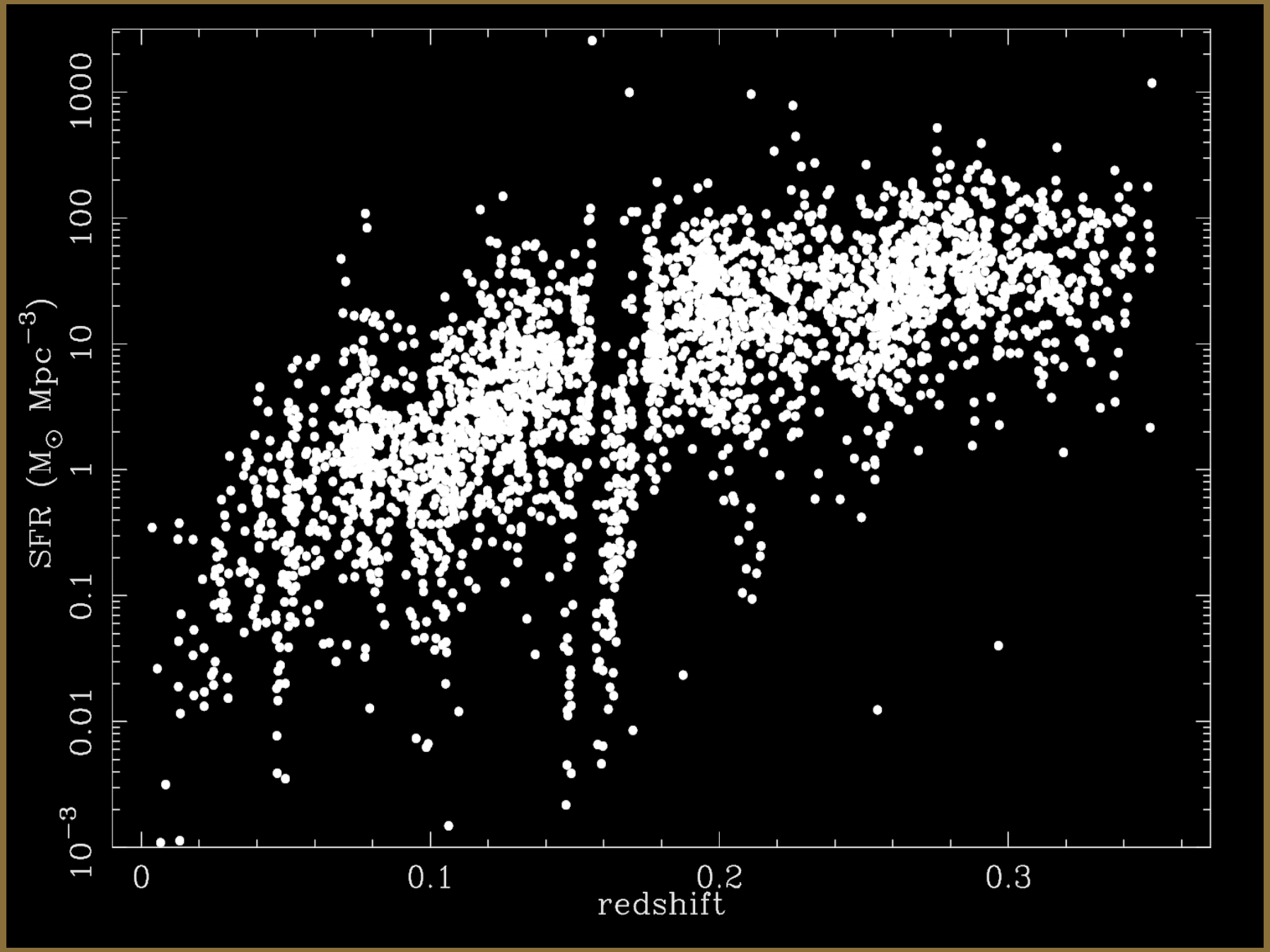


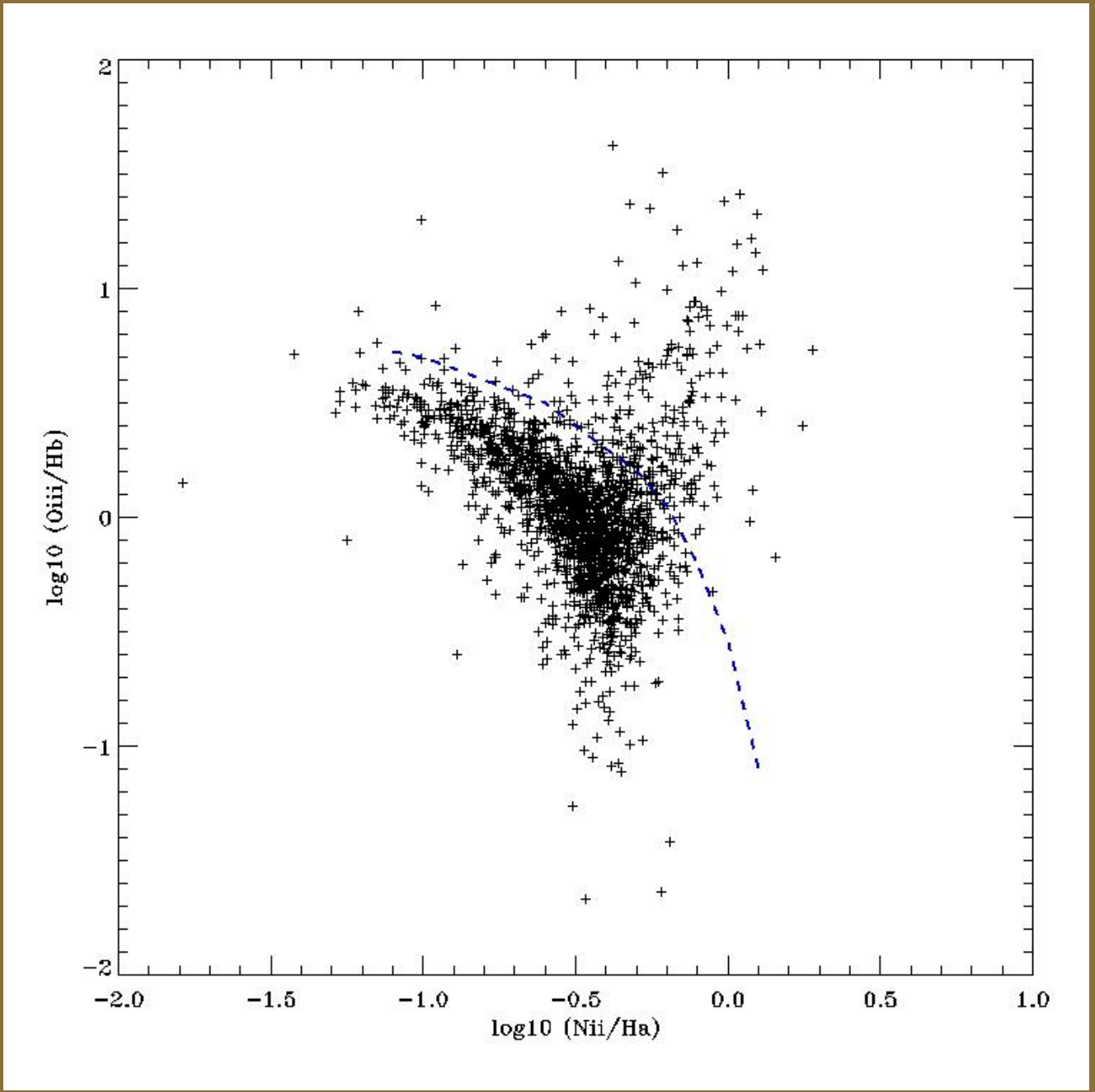
Colour bimodality vs redshift



SFR vs redshift



BPT diagram



What's next?

Does the VLT have a role to play in studies of the low-redshift Universe?

What's missing?

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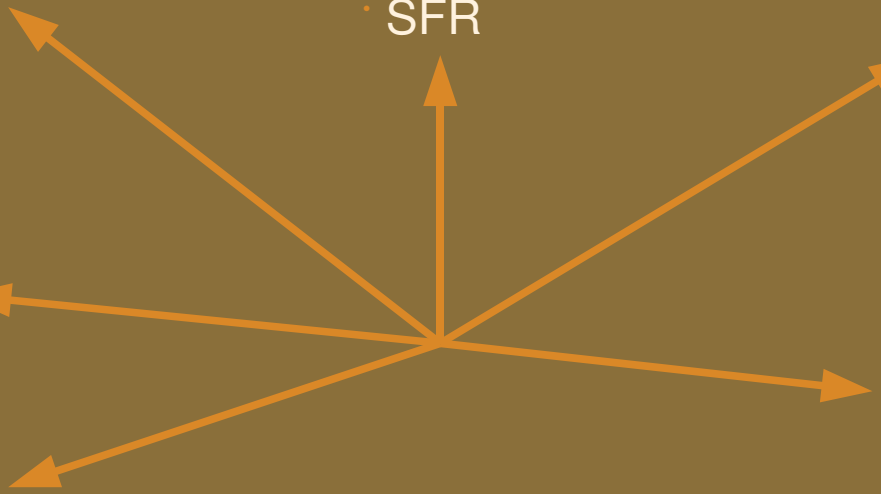


Gas
- mass
- metallicity

Stars
- mass
- stellar populations
- SFH
- SFR

Morphology/structure
- size
- concentration
- asymmetry
- B/D separation

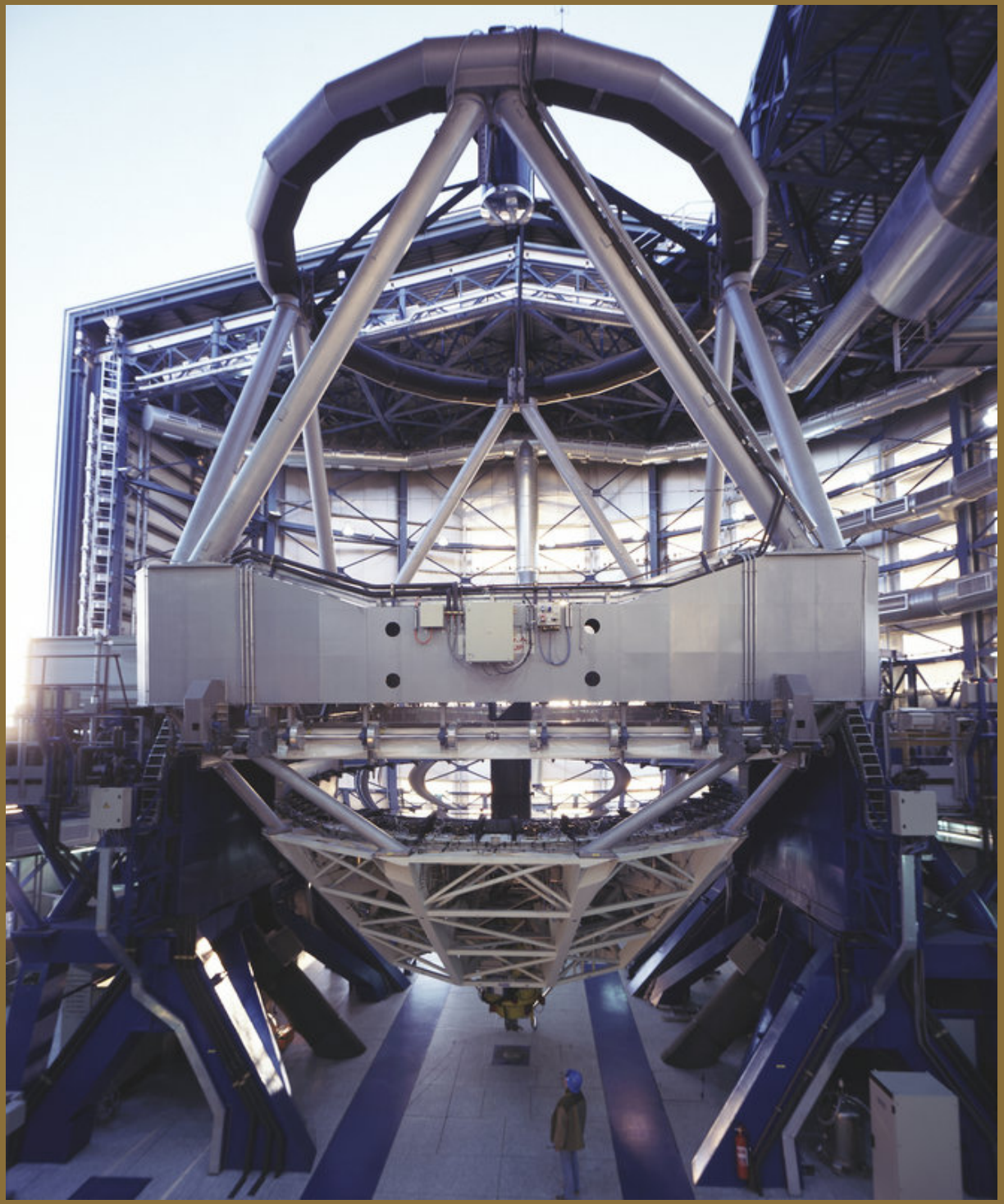
Dust
- mass
- type
- distribution

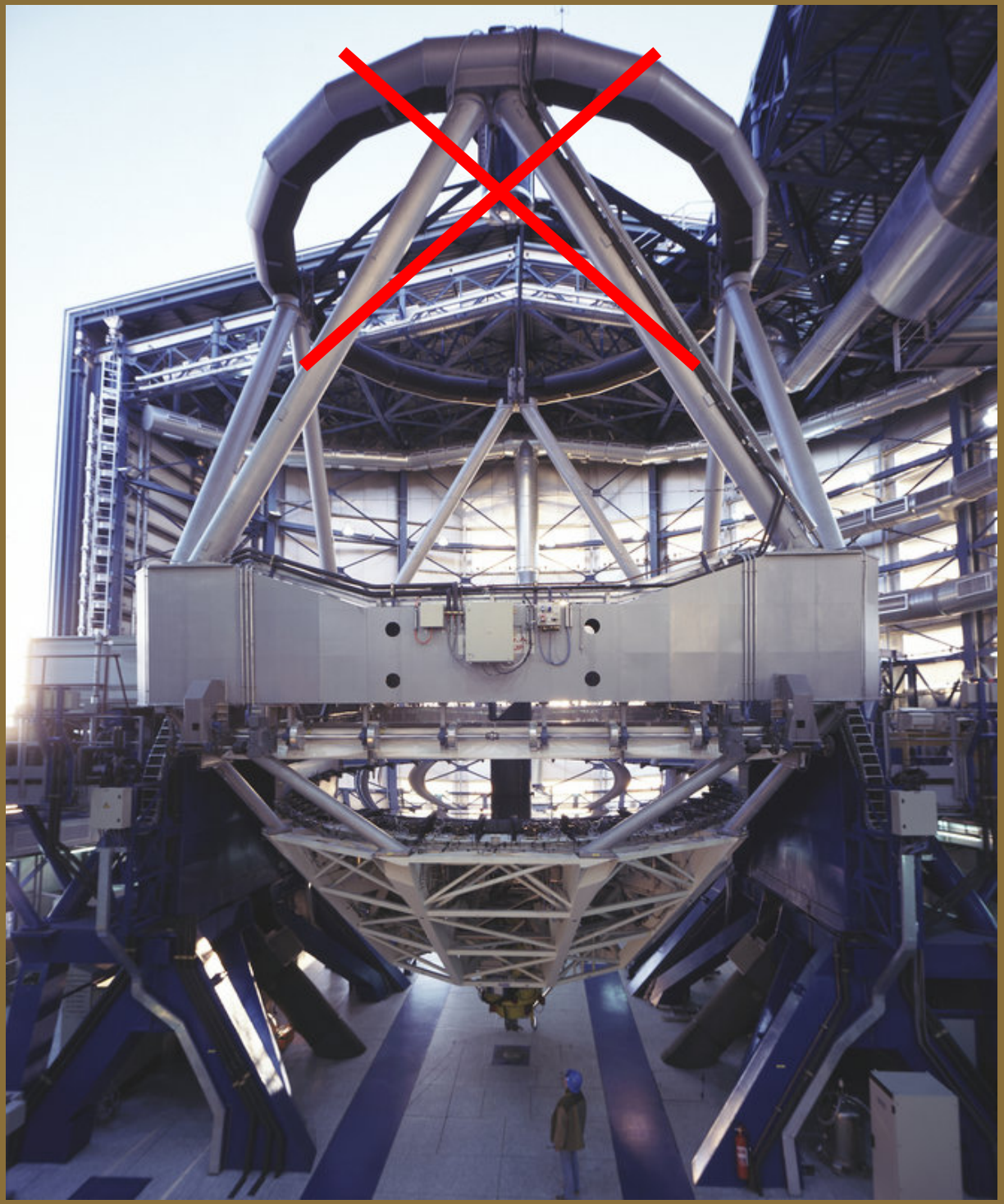
AGN activity / SMBHs

Environment
- field
- groups
- clusters
- mergers

Go deeper?

- Push the VLT to its limit, pre-selecting low-z gals
- Hard to get enough volume with VIMOS





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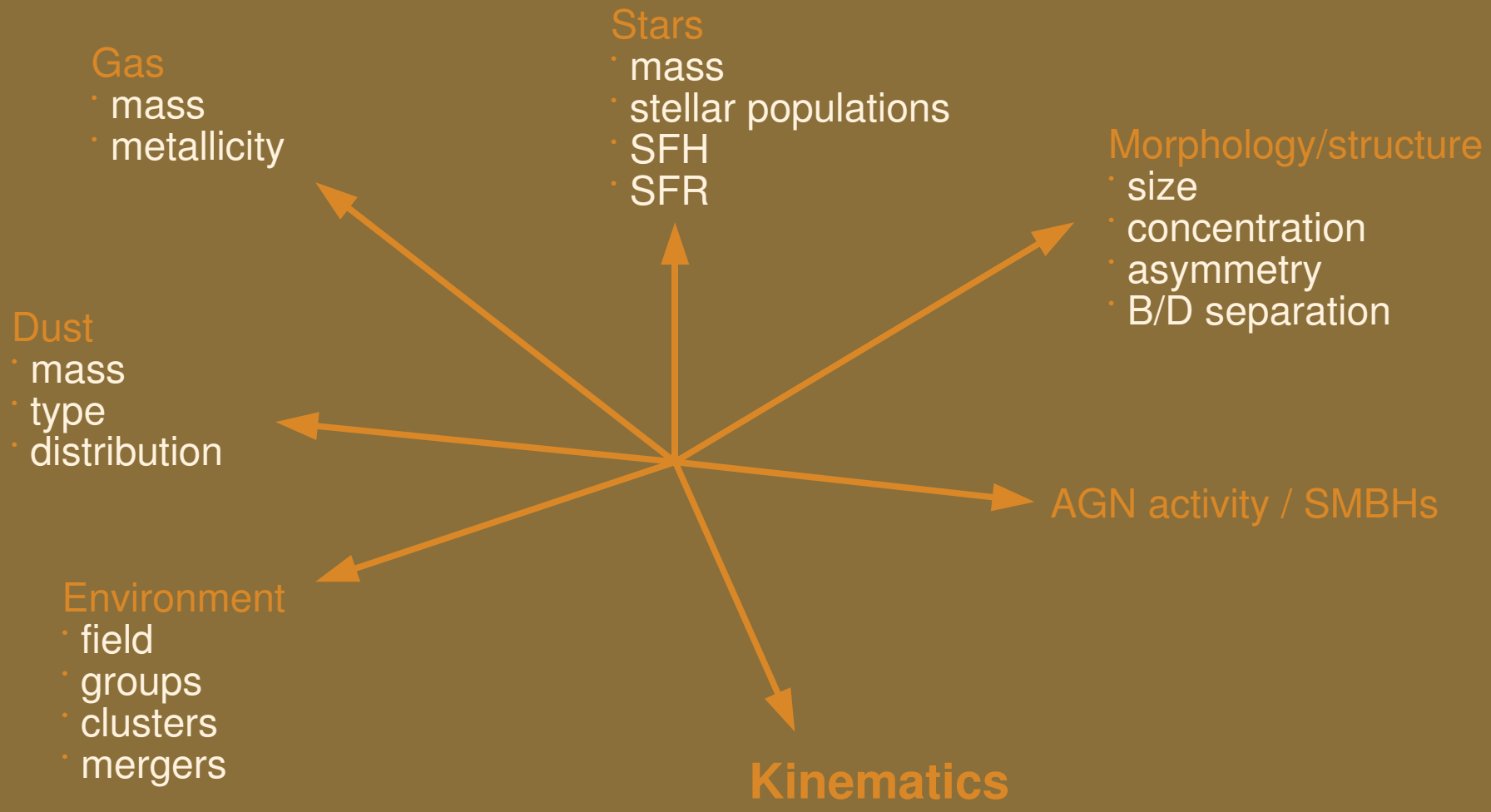

GAMA+

Some science drivers for a spatially resolved (1D), 'high' resolution spectroscopic VIMOS survey of low-redshift GAMA-selected galaxies:

- Dynamical mass function
- Fundamental Plane at L << L*
- Tully-Fisher at L << L*

} Downsizing in scaling relations?

- Gradients: abundances, extinction, SFR
- Stellar populations of (pseudo-)bulges and disks
- Joint photometric and kinematic bulge-disk decomposition
- ...
- See also L. Tresse's talk later today.

GAMA+

- VIMOS slits can be up to 30” long.
- VIMOS slits can be tilted.
- Highest resolution: 2000-2500.
- Number density of $r < 19.8$ galaxies is well matched to VIMOS.
- GAMA is an excellent starting point for selecting this sample (for many reasons)!
- 3h exposure time $\rightarrow$ S/N ~ 22 in the continuum at ~21.5 mag/arcsec^2 (in R).
- ~450 hours (incl overheads) would result in a sample of ~8000 galaxies!

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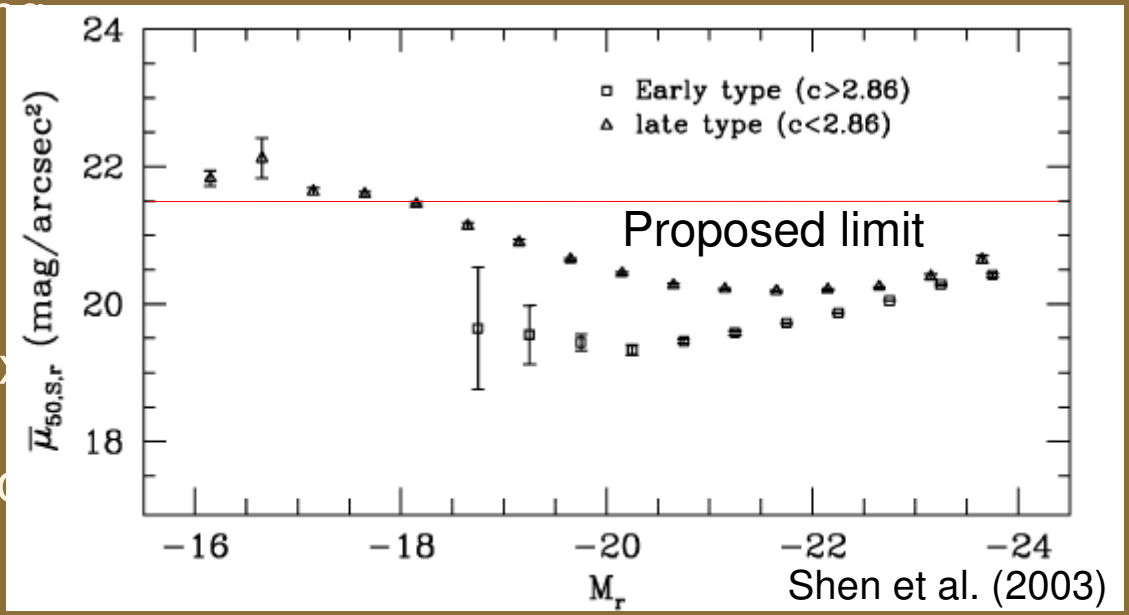

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- Is this only the first step? See JBH's talk on FIREBALL tomorrow.

Conclusions

- In my view, the role of the VLT in the field of low-redshift galaxy surveys lies in opening up the domain of spatially resolved spectroscopy, which has largely been missing from past large (field) surveys.
- This is the last axis of observational parameter space that remains to be added to large low-z surveys.
- It would represent a major milestone in the campaign of obtaining a complete picture of the galaxy population at low redshift for comparison with high-z studies and theory.
- No competitor in sight (for now).
- 'Obvious' future development: full 3D spectroscopy.