

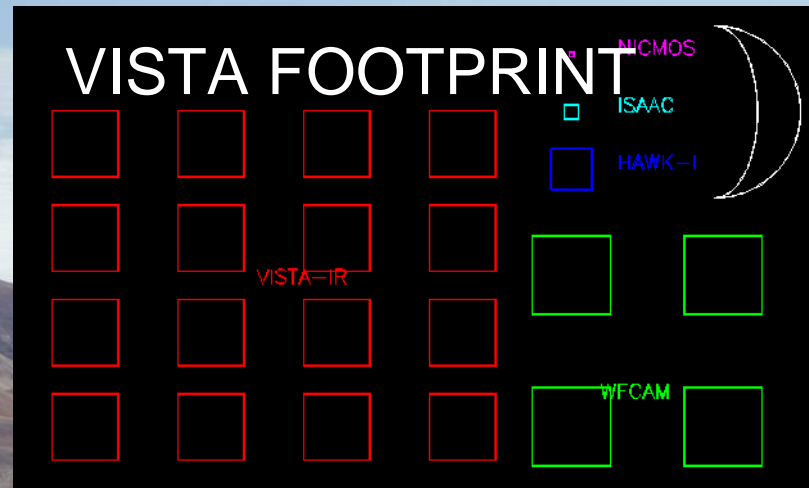
VIKING: the VISTA Kilo-degree  
INfrared Galaxy survey

Will Sutherland  
(VISTA Project Scientist)

Galaxy And Mass Assembly (GAMA)

Simon Driver  
(GAMA PI)

ESO/VLTs



ESO/VISTA

## Six Public Surveys:

### 1 Hemisphere, 2 Galactic, 3 Extragalactic

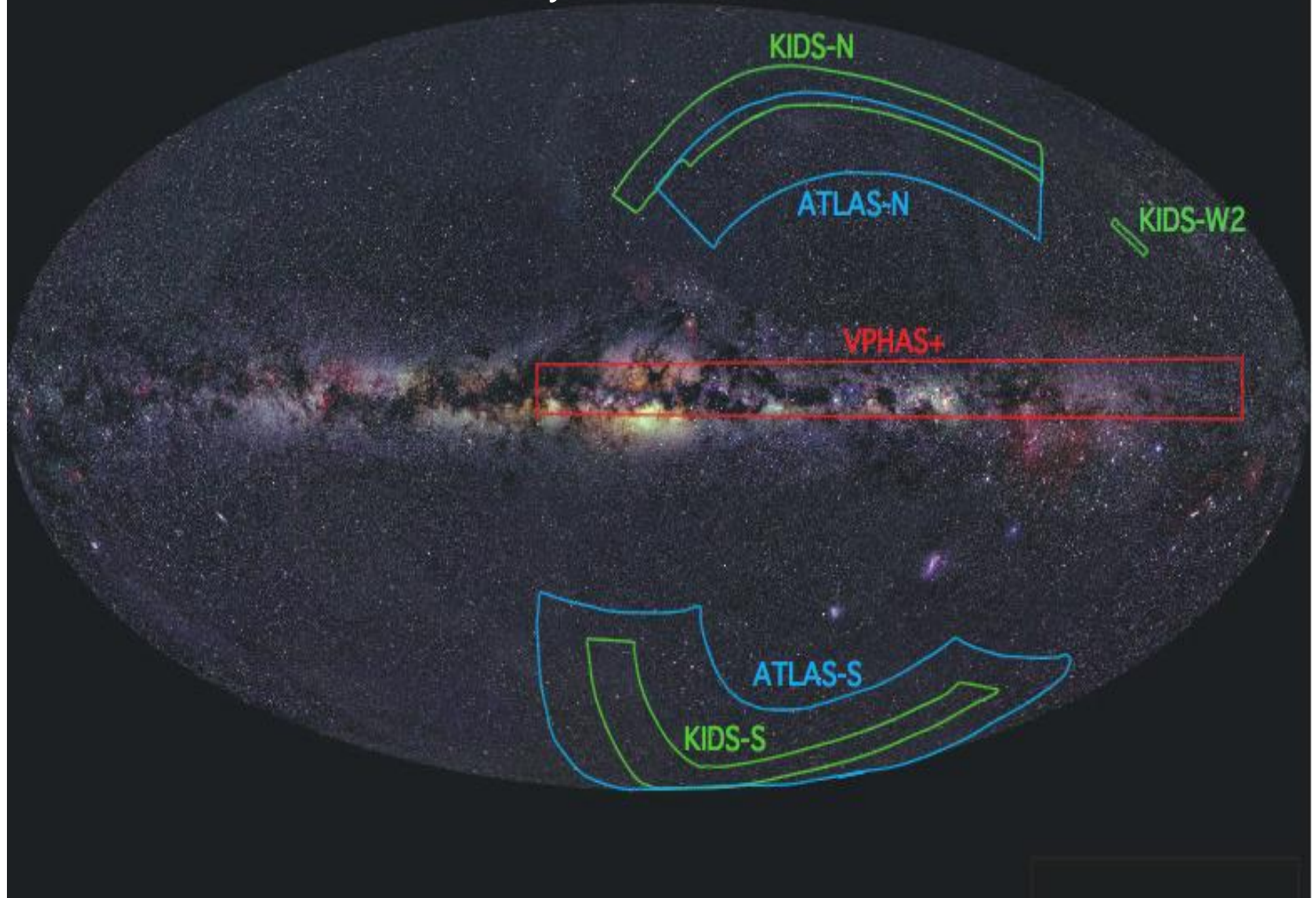
- VVV : VISTA Variables in Via Lactea.
  - Bulge, multi-epoch for variables, + galactic plane.
- VMC: Magellanic Clouds + bridge
- VHS: VISTA Hemisphere Survey
  - J, Ks, ~ 60sec, + more bands in DES area.
  - ~ 3.5 mag gain over 2MASS. Complements WISE.
- VIKING: VISTA Kilo-degree Infrared Galaxy survey
  - 1500 deg<sup>2</sup>, ~ 2dFGRS stripes.
  - ZYJHKs, ~ 400 sec, complement VST-KIDS.
- VIDEO: VISTA Deep Extragalactic Observations
  - ~ 13 deg<sup>2</sup>, mainly 3 SWIRE fields. “SDSS at z ~ 1 - 2”.
  - Lots of Spitzer / Herschel / SCUBA2 / ALMA synergy.
- Ultra-VISTA: Ultra-deep survey
  - 1 field = COSMOS. Y,J,H,Ks + narrowband 1.18  $\mu$  m.
  - 0.75 deg<sup>2</sup> gets  $\frac{3}{4}$  of time ( ~ 1000 hrs).

# VIKING basics:

- 1500 deg<sup>2</sup>, high |b|, in two stripes, NGP + SGP.
- Area matches 2dFGRS and VST-KIDS.
  - Optimal for Southern followup, VLT, ALMA, etc.
  - NGP stripe on equator, also overlaps UKIDSS, Sloan.
- 9-band combined survey: ugri (VST), ZYJHK<sub>s</sub> (VISTA)
  - Depth: ~ UKIDSS + 1.5 mag, Sloan + 2 mag.
  - ~ 220 nights of VISTA time over 5 years.
- PI: WJS. Co-PI: Konrad Kuijken.
  - 30 co-I's, 14 UK + 16 other ESO.

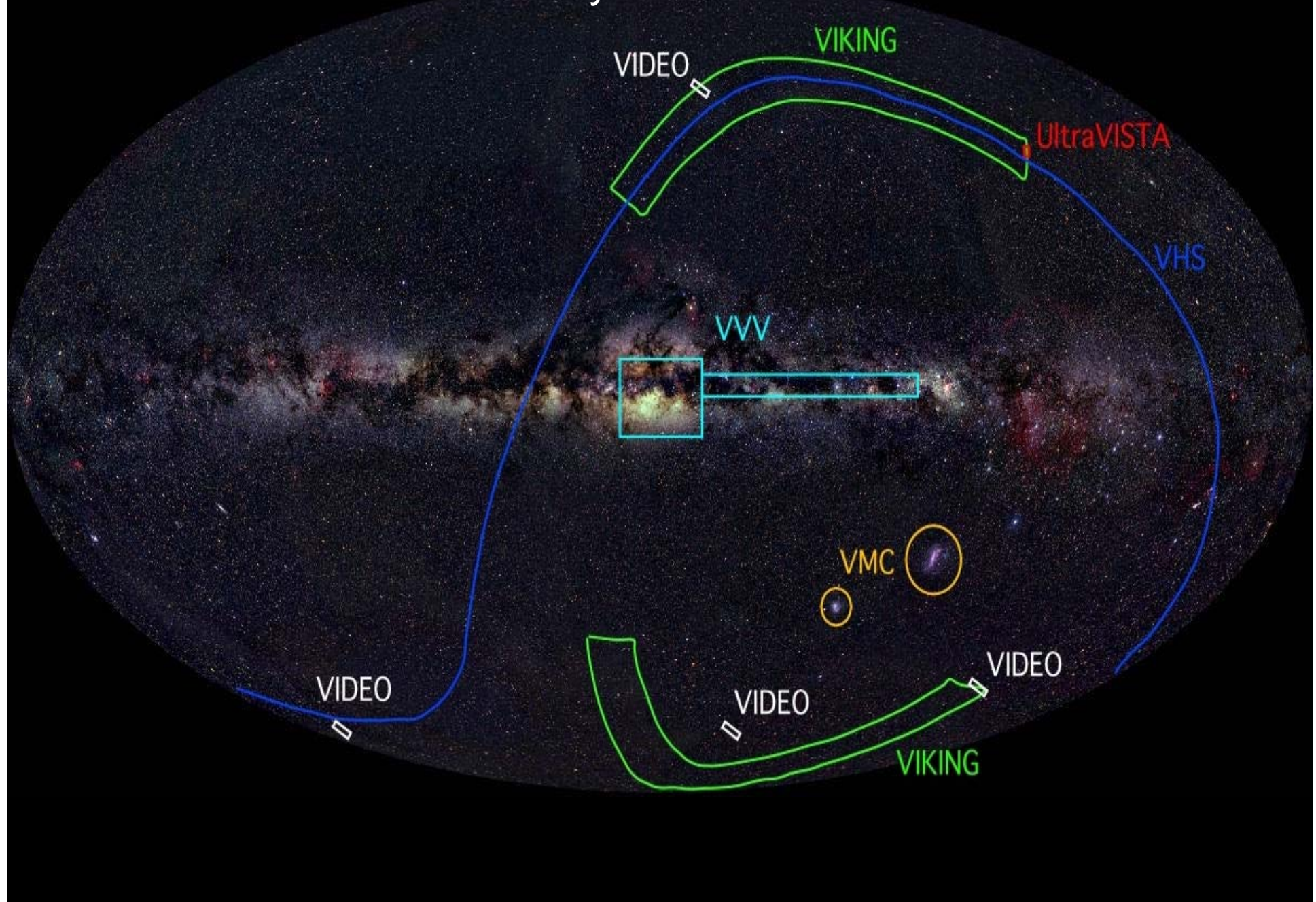


# Planned VST surveys to commence March 2009

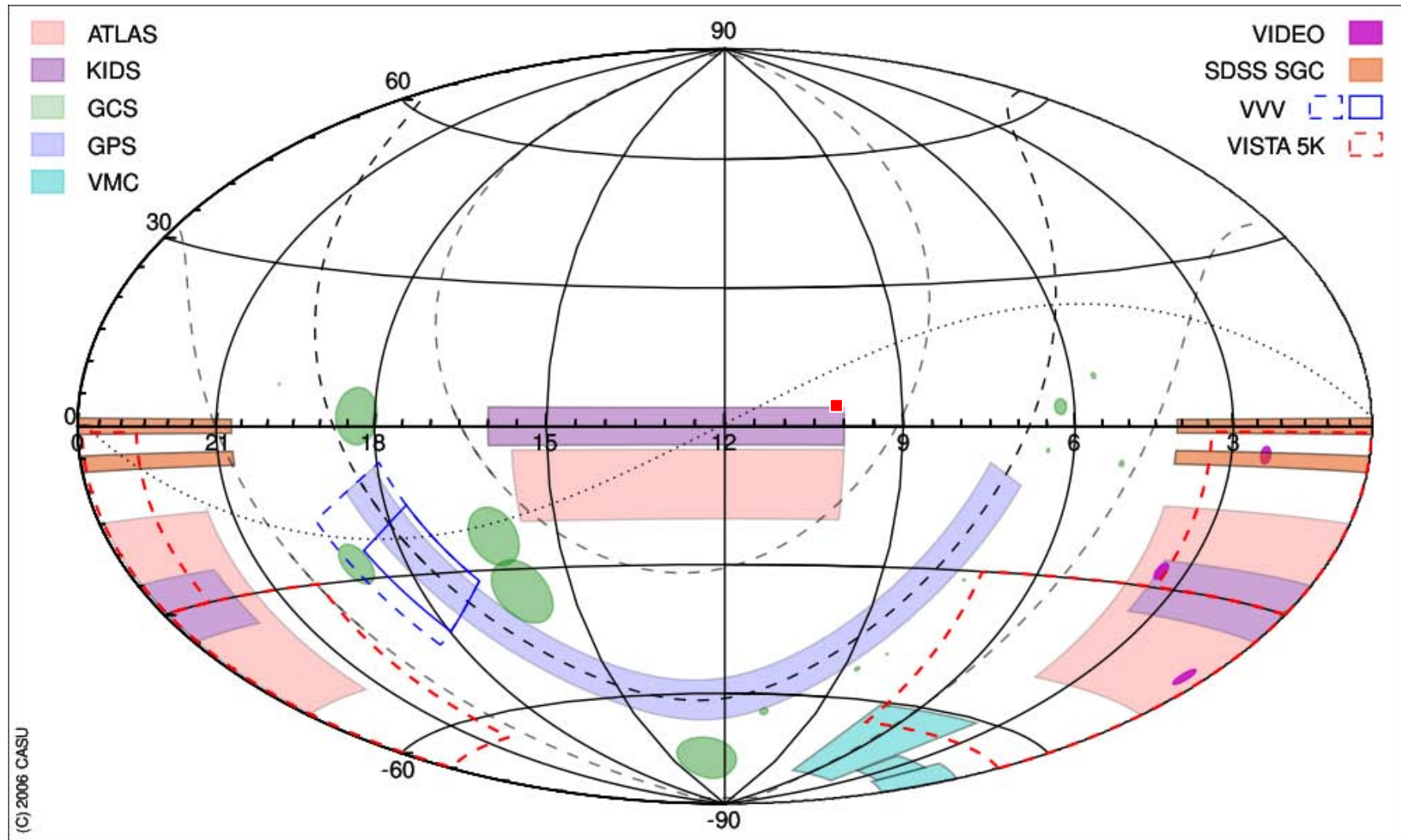




# Planned VISTA surveys to commence March 2009

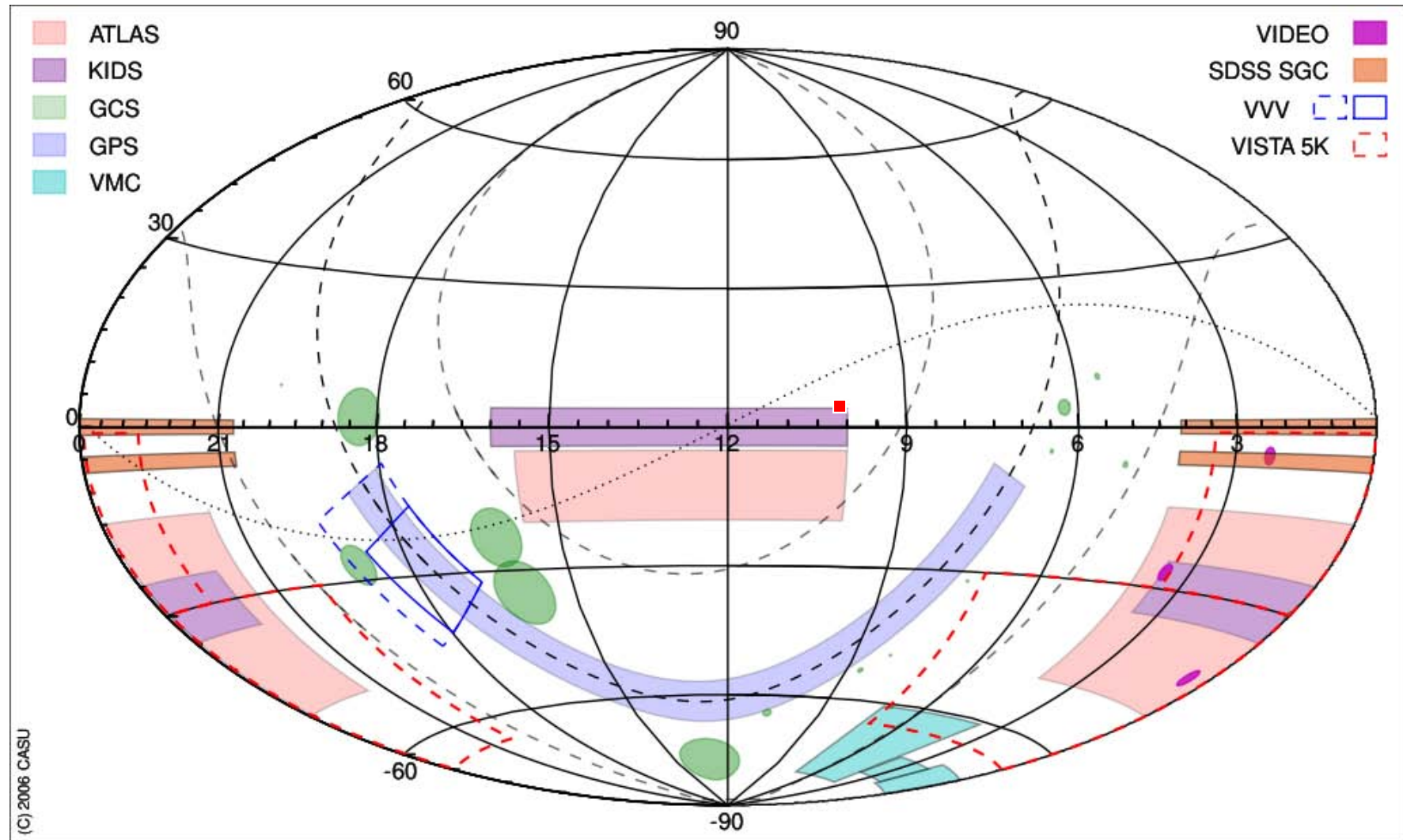


# But which area to survey with XMM ?



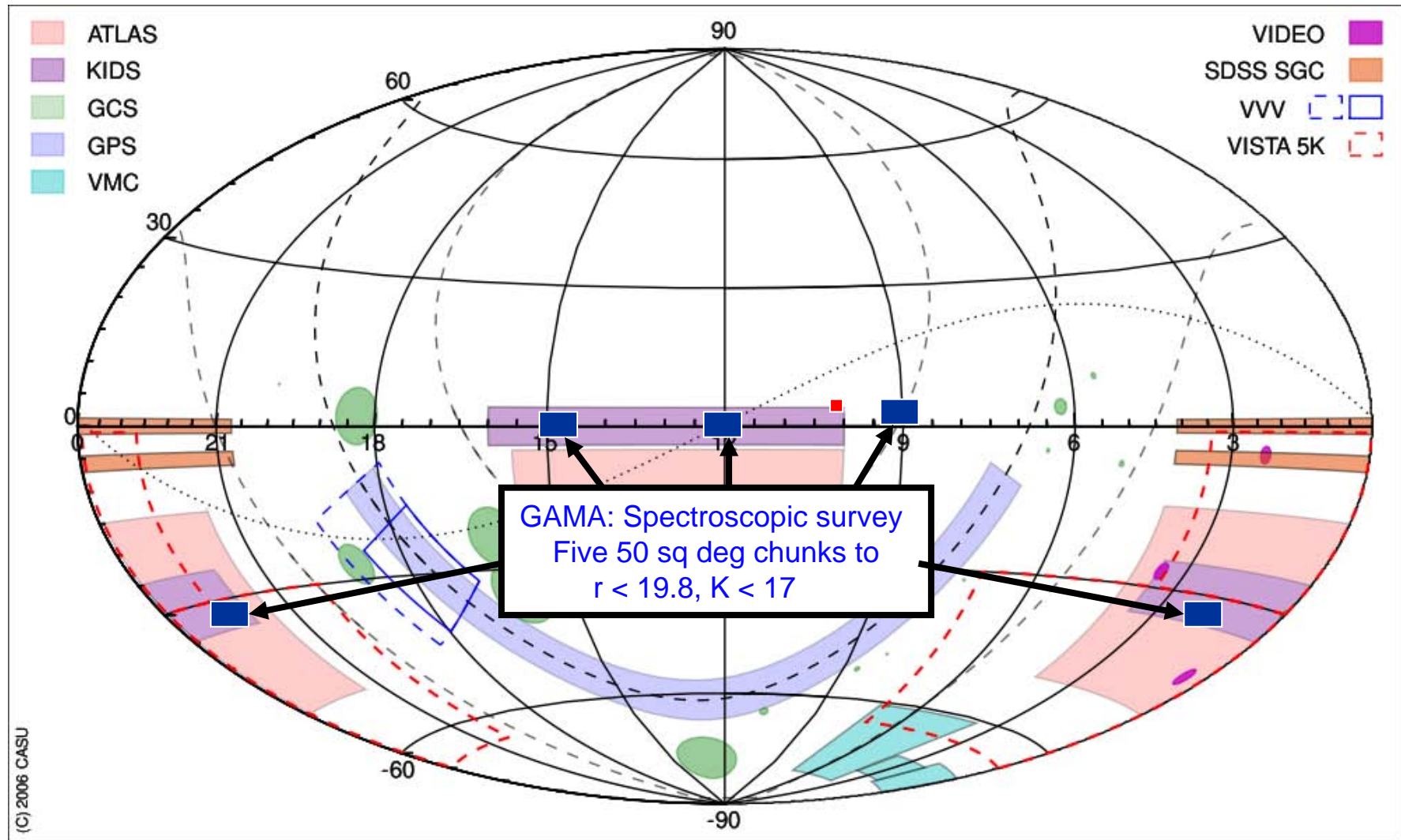


But which area to survey with XMM : GAMA regions ?

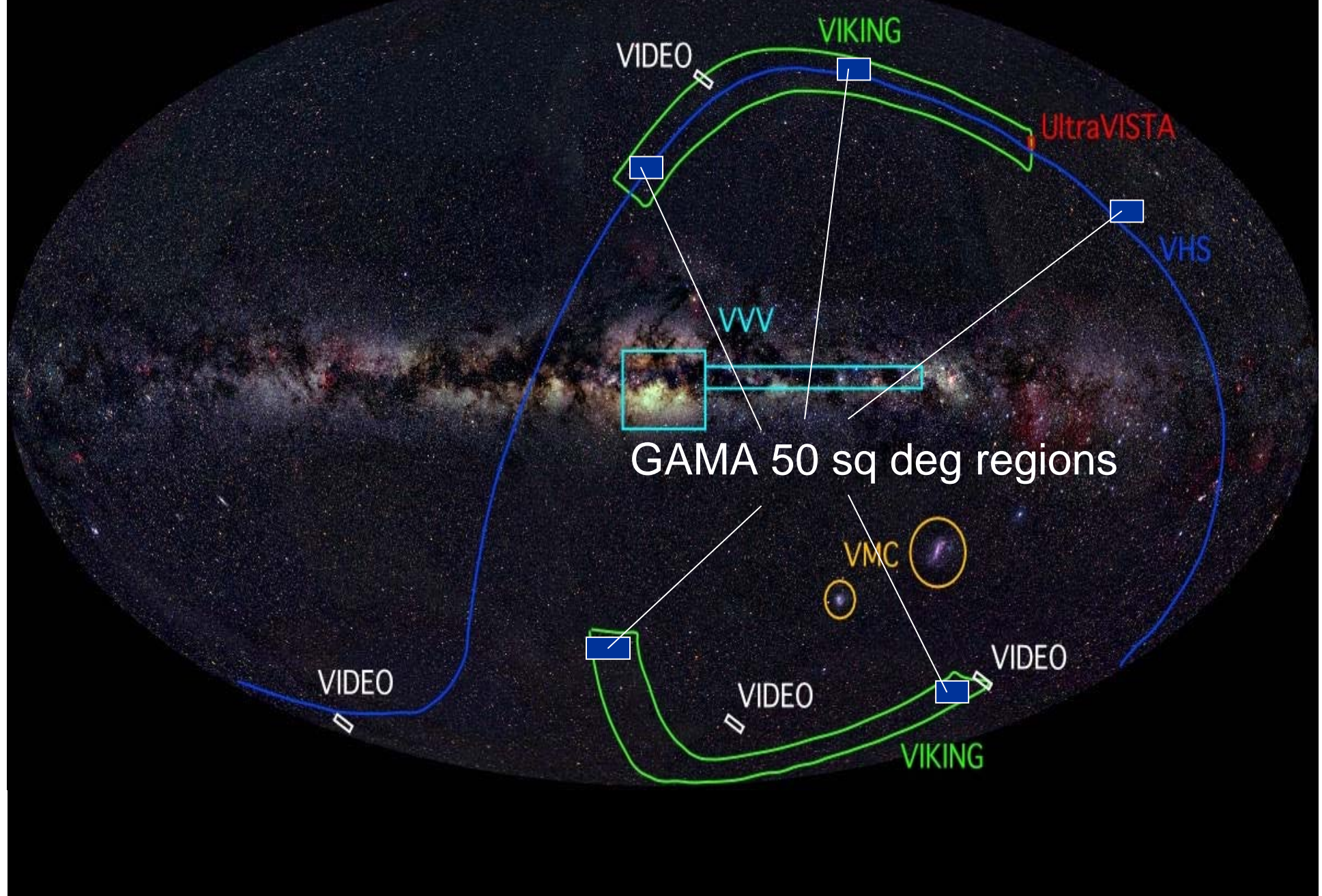




# But which area to survey with XMM : GAMA regions ?



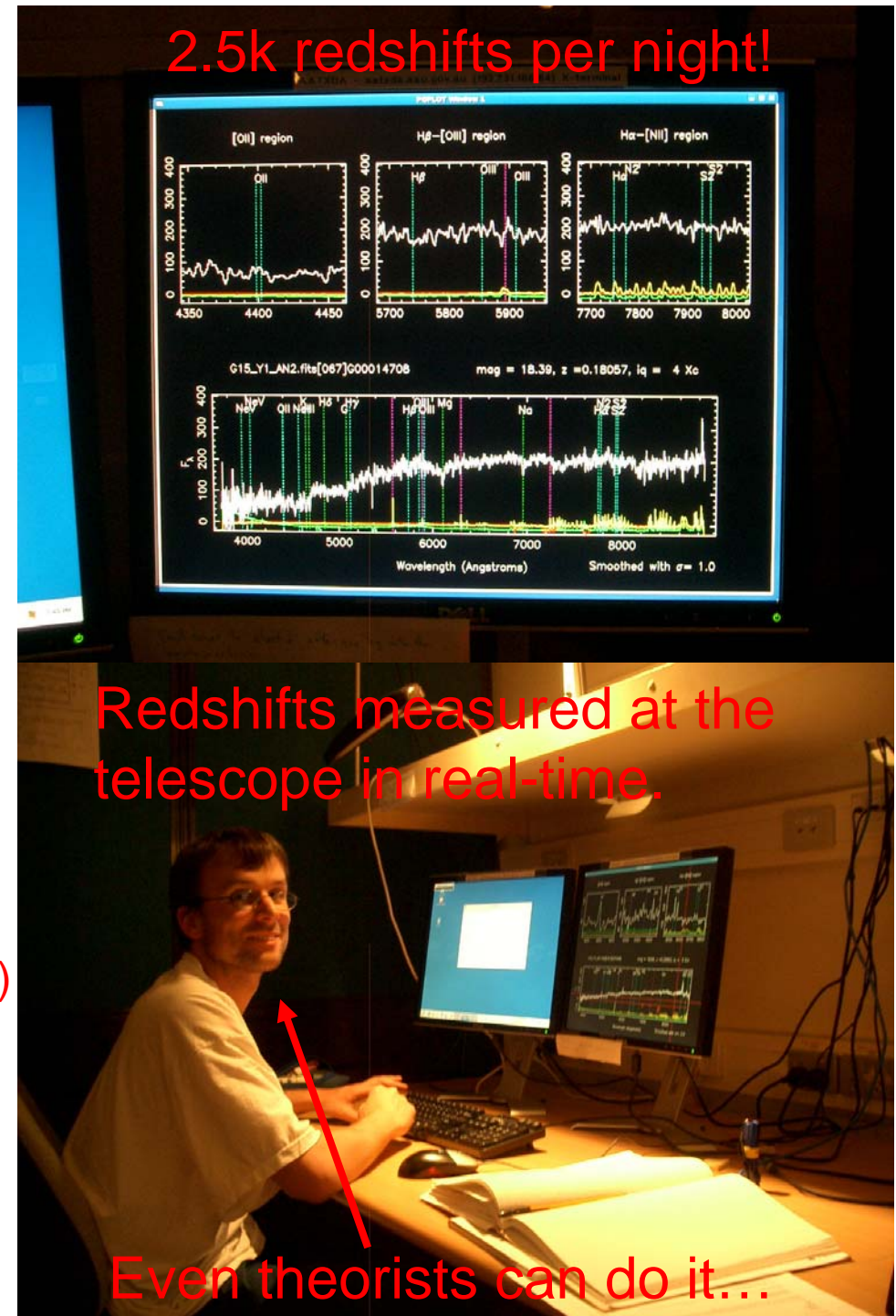
# Planned VISTA surveys to commence March 2009





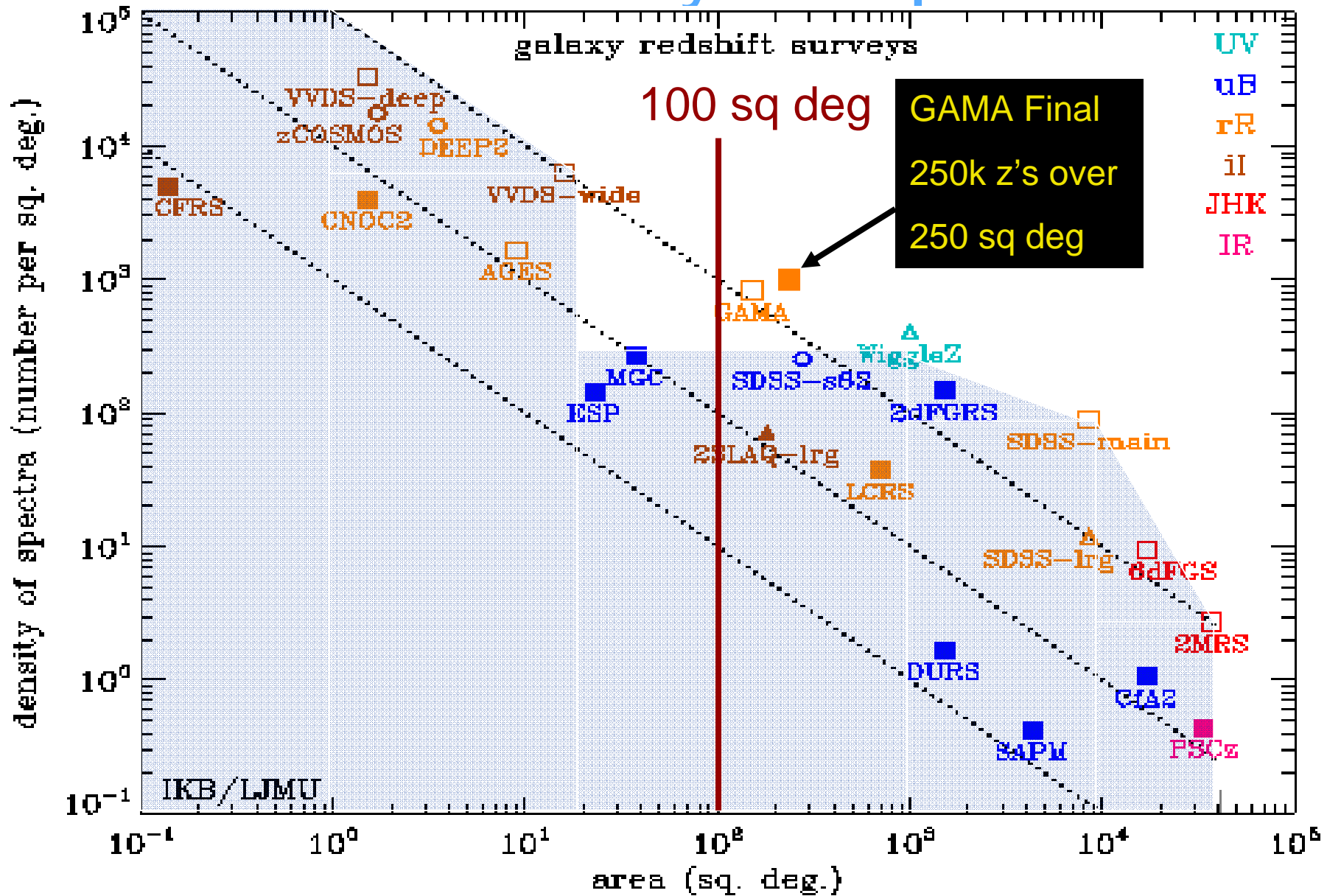
# GAMA

- Spectroscopic survey overlapping with:
  - VST KIDS
  - VISTA/VIKING
  - HERSCHEL-ATLAS
- Input cat based on:
  - SDSS (North), VST (South)
  - UKIDSS (North), VISTA (South)
- 156 nights at AAT with AA-Ω
- Five 50 sq deg regions (250 sq deg)
  - $r < 19.8$ ,  $K < 17.0$  (AB mags)
  - $0.0 < z < 0.4$  ( $< 1$  for AGN)
- Started March 2008
  - 50,271 redshifts obtained (21 nights)
  - 96.6% completeness
- Redshift density:
  - 12x SDSS
  - 8x 2dFGRS
  - 5x SDSS stripe 82





# GAMA: Survey comparison



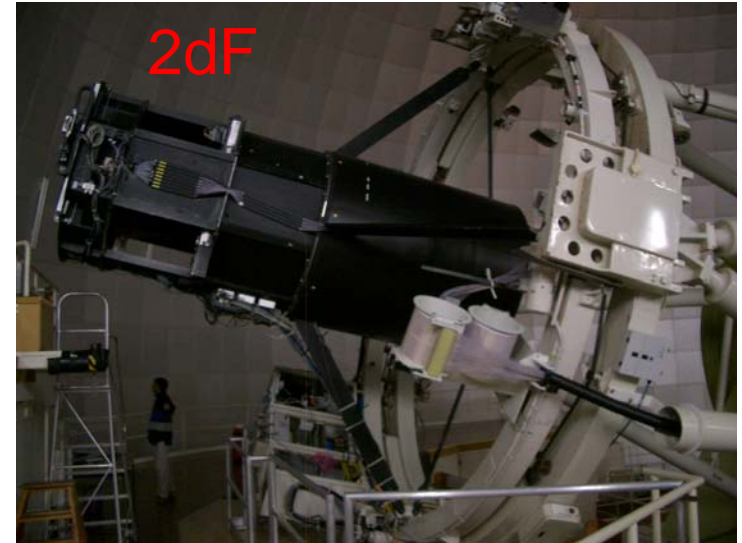
# The Anglo-Australian Telescope

(3.9m)



AAT

2dF Tumbling

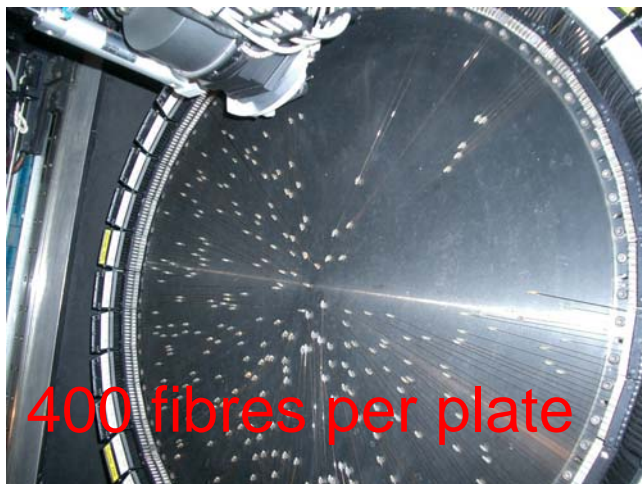


2dF

Robotic positioner

QuickTime™ and a Motion JPEG OpenDML decompressor are needed to see this picture.

Double-beam spectrograph



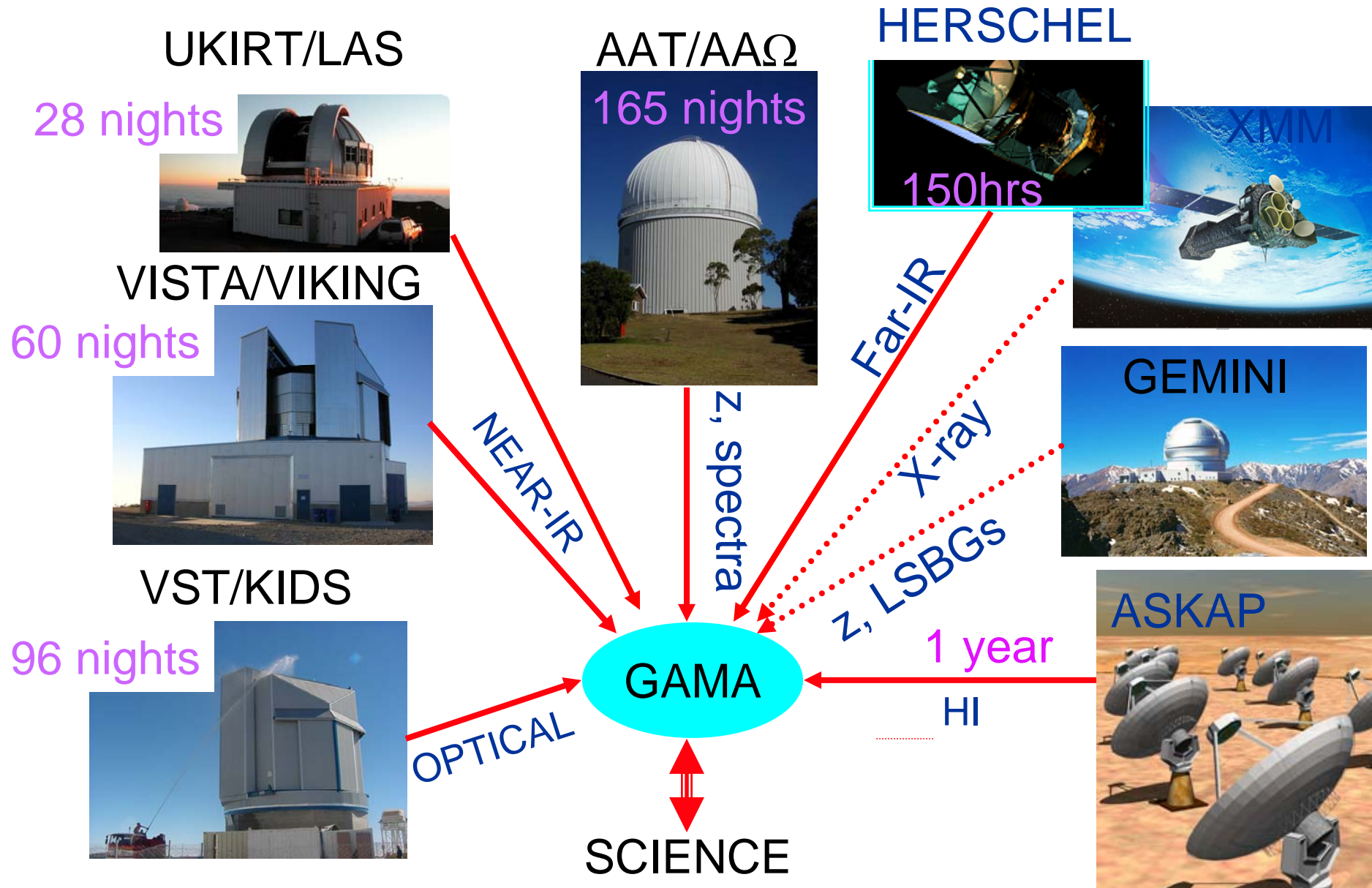
400 fibres per plate

2.5k redshifts per night via two 400 fibre plates ....!



AAO Spectrograph

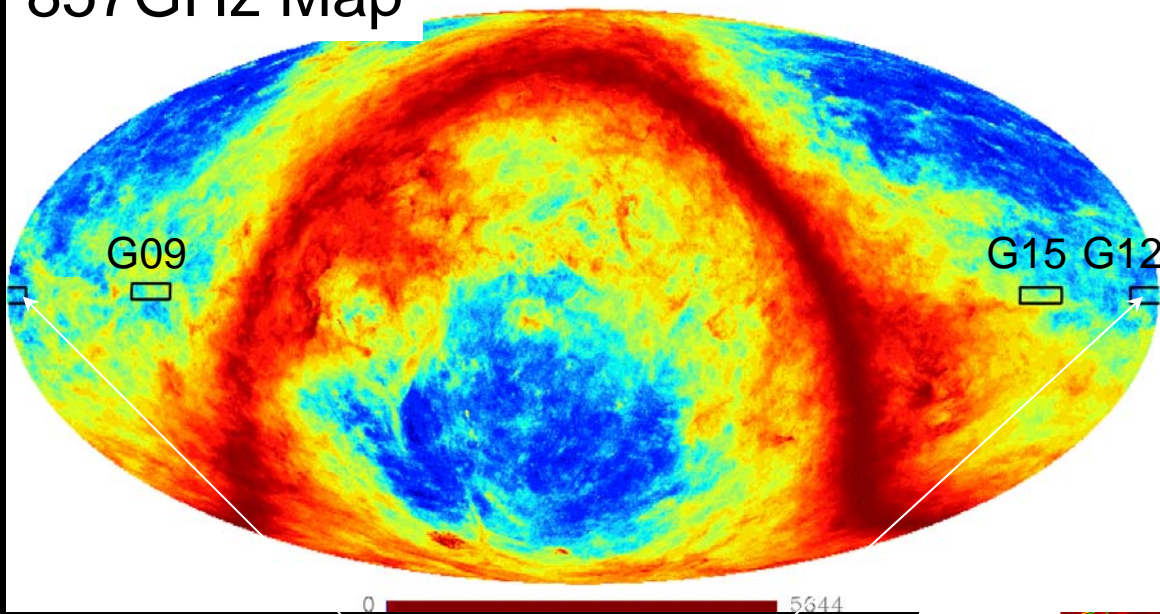
# GAMA: Contributing Facilities





/map\_tot\_857GHz\_eq.fits: UNKNOWN1

# 857GHz Map

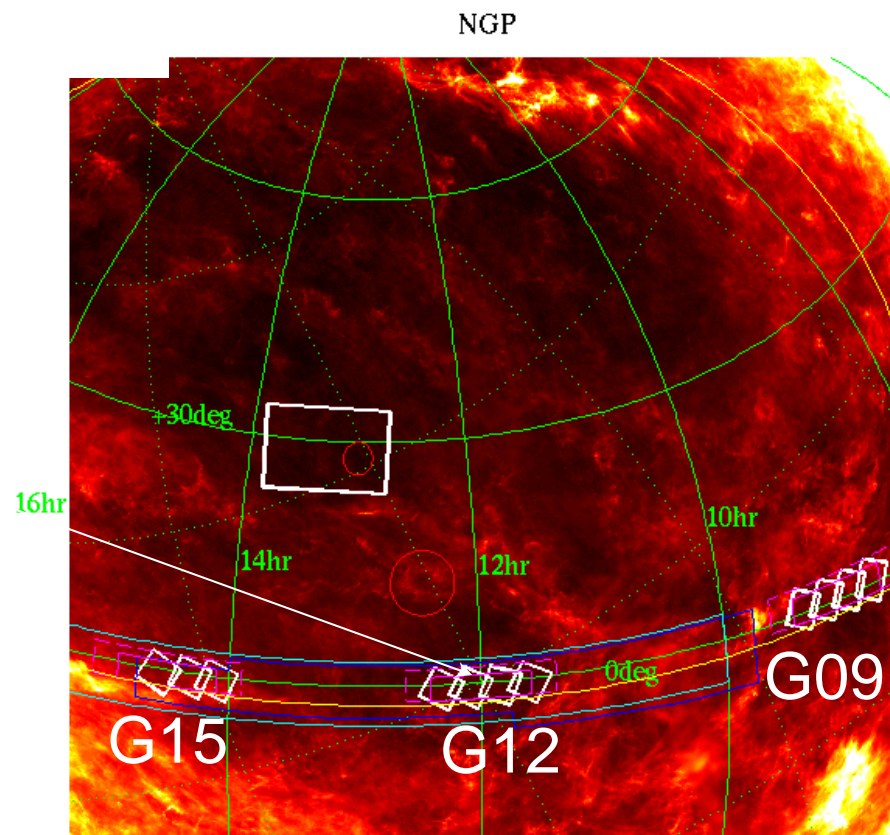


## HERSCHEL-ATLAS SURVEY

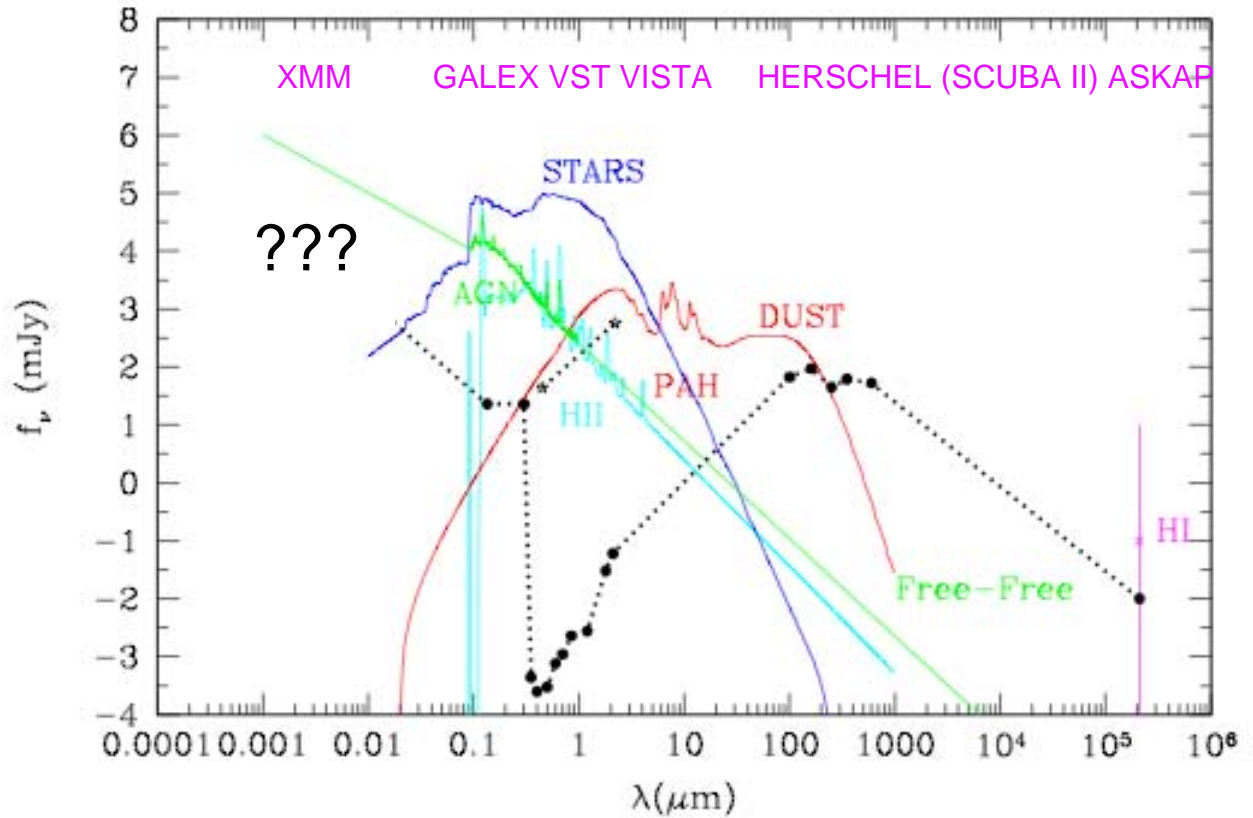
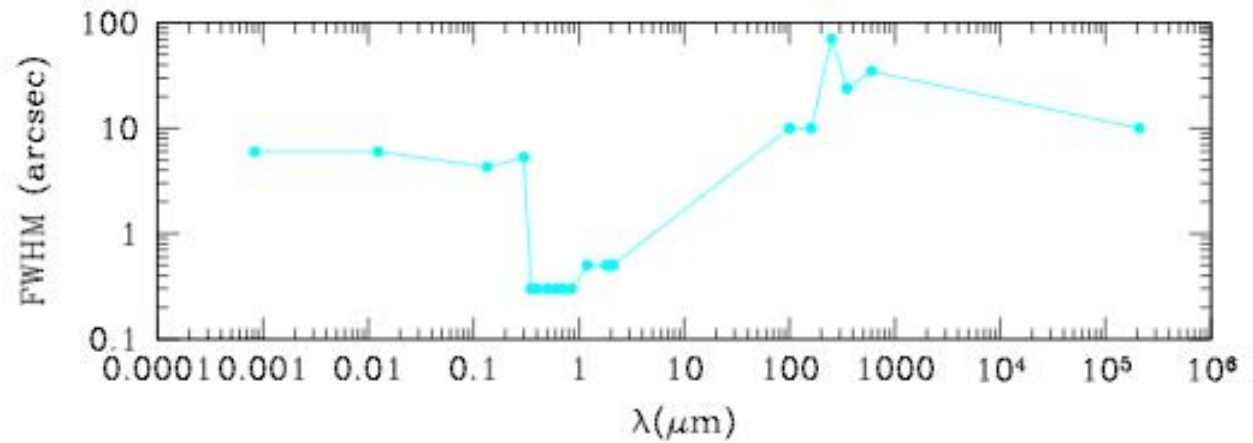
Launch:  
Oct-Dec 2008  
(next talk)

### GAMA 12hr REGION

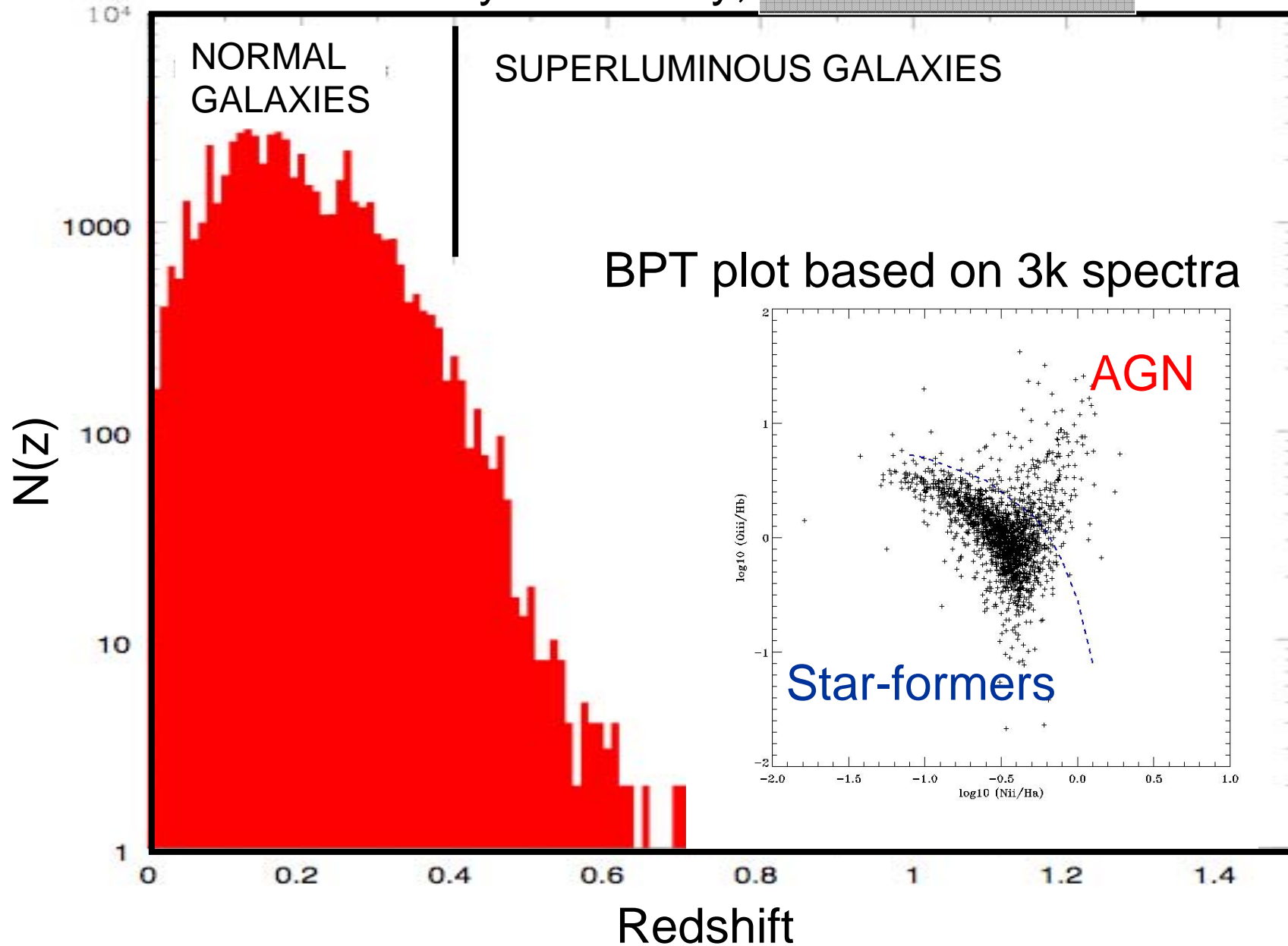
GAMA12 region avoids Galactic Cirrus



Aim to model total energy output of galaxies for >5k systems



Resolved systems only, no UVX selection





# GAMA: Facility Wavelength Time Depth Status

(on GAMA) (5 $\sigma$ , AB)



AAT/AAO  
GAMA

Spectra

165nights

$r < 19.8$ ,  $K=17.0$  mag

in progress



UKIRT  
LAS

Near-IR (YJHK)

35nights

$Y=22.0$ ,  $J=20.9$ ,  $H=20.2$ ,  $K=20.4$  in prog.



VISTA  
VIKING

Near-IR (YJHK)

75nights

$Z=23.8$ ,  $Y=23.0$ ,  $J=22.8$ ,  $K=21.9$  Mar 09

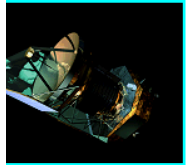


VST  
VST

Optical (ugriz)

120nights

$u=24.8$ ,  $g=25.4$ ,  $r=25.2$ ,  $i=24.2$  Mar 09



HERSCHEL  
ATLAS

Far-IR

200hours

100,160,250,350,500 microns  
67, 94, 45, 62, 53 mJy Mar 09



ASKAP  
DEEP

Radio (21cm)  
700MHz-1.8GHz

1yr

1.4GHz  
0.03mJy

2010+



XMM

X-Ray Meeting in Paris April 08 to discuss 100 sq deg survey

?

# GAMA regions

Five equal sized chunks of 4 by 12 degrees surveyed to the same depth

	RA(deg)	Dec(deg)	
G09	129.0-141.0	-1 to +3	FIXED
G12	174.0-186.0	-2 to +2	FIXED
G15	211.5-223.5	-2 to +2	FIXED
G03	~30.0-45.0	-35 to -31	NOT
G22	~315.0-330.0	-35 to -31	FINALISED (but inside Her'l-ATLAS)

# GAMA regions



AAT SDSS UKIRT VISTA VST HERSCHEL ASKAP

G09	20%	100%	100%	Yes	Yes	Yes	No
G12	30%	100%	100%	Yes	Yes	Yes	Yes
G15	20%	100%	100%	Yes	Yes	Yes	No
G03	0%	No	No	Yes	Yes	Yes	No
G22	0%	No	No	Yes	Yes	Yes	No



XMM?

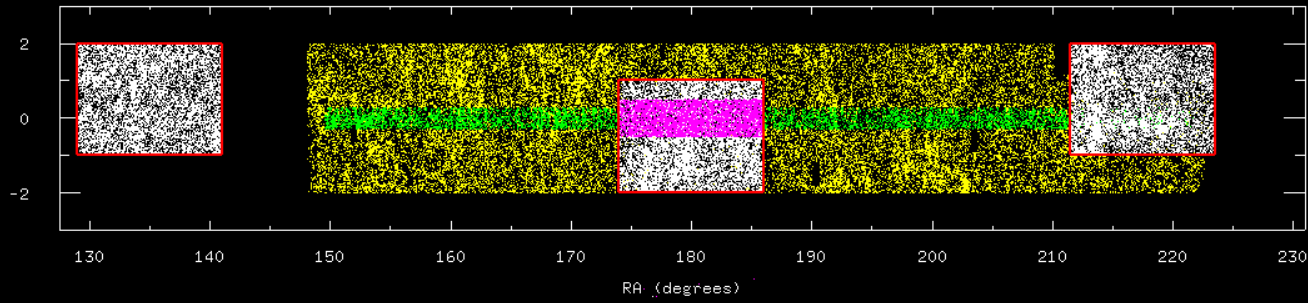
SPT?



Move ASKAP/DEEP to G03 or G22?

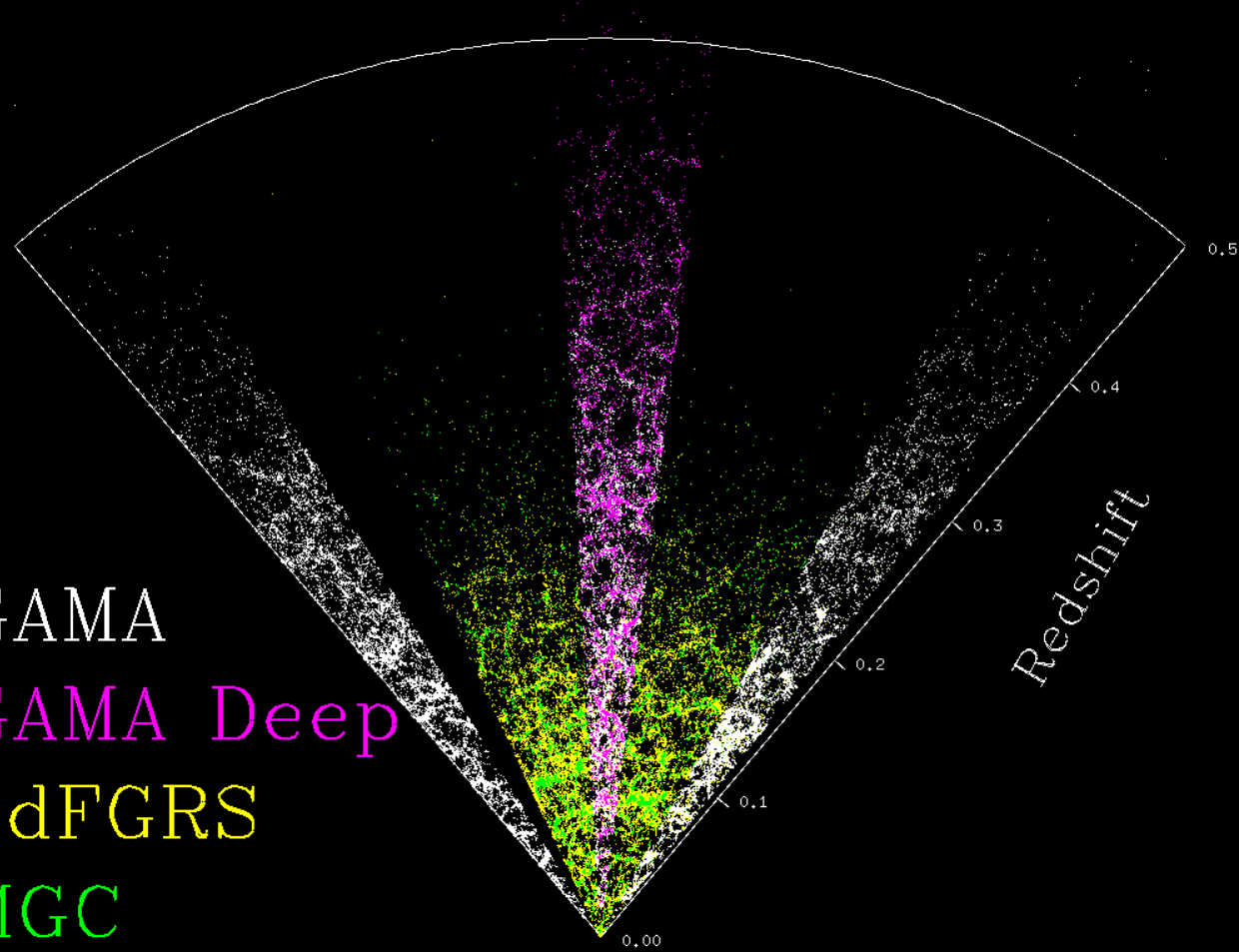


Dec (degrees)



GAMA  
CONE  
PLOT  
08/04/08

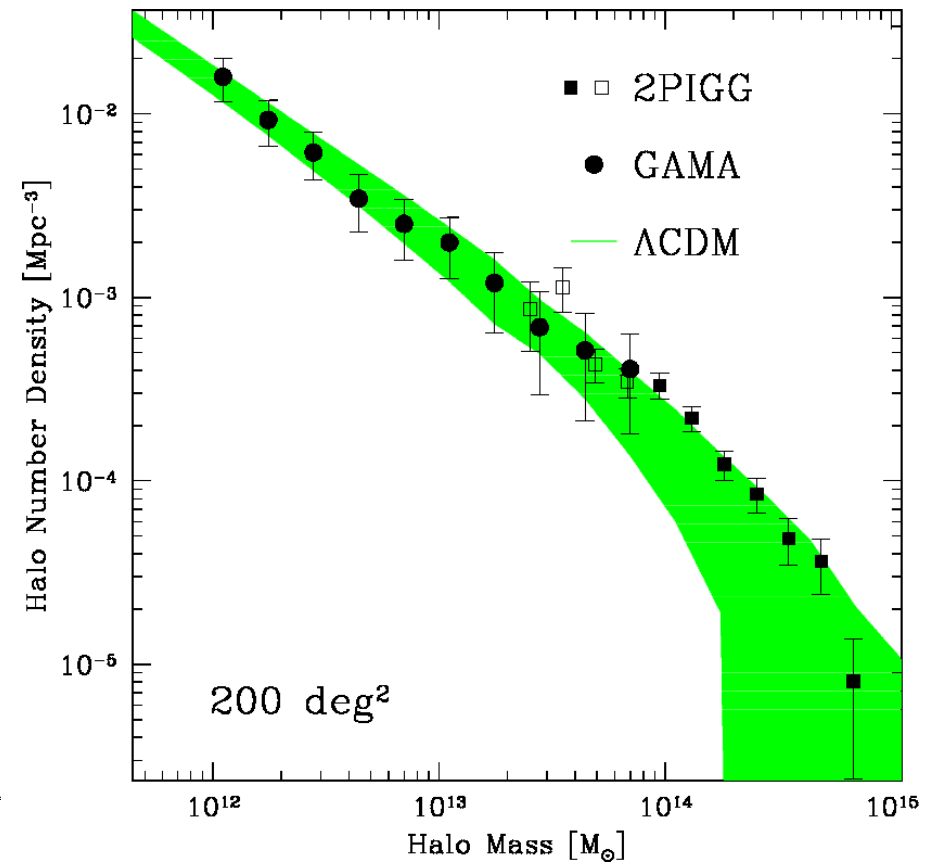
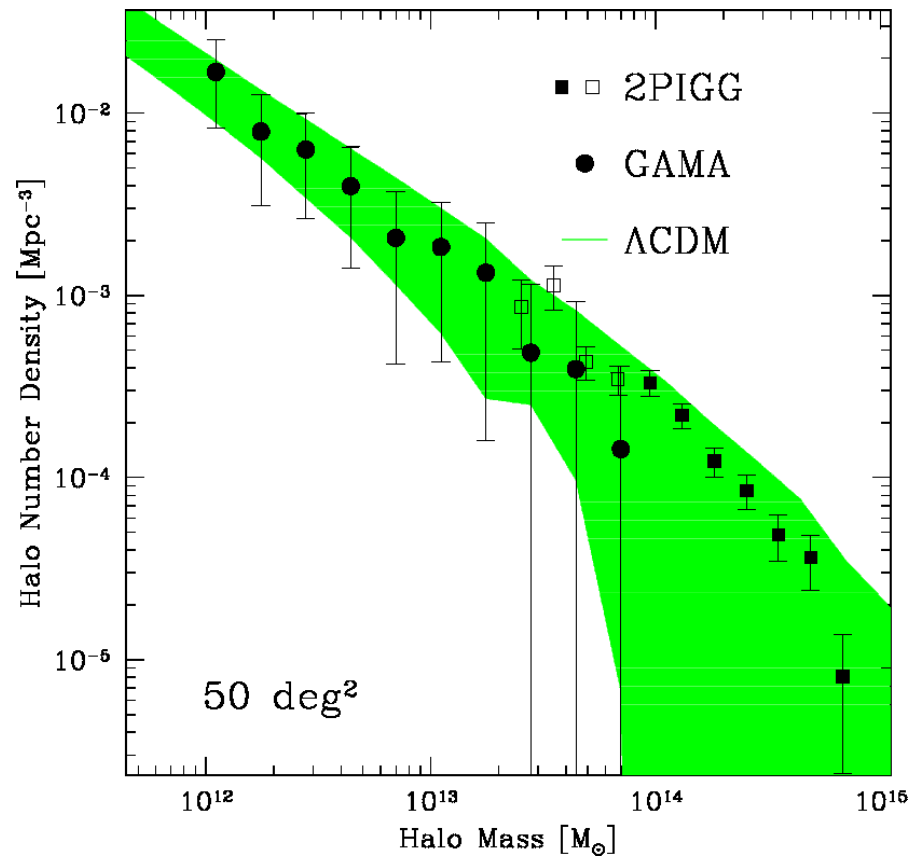
GAMA  
GAMA Deep  
2dFGRS  
MGC



# GAMA: Science

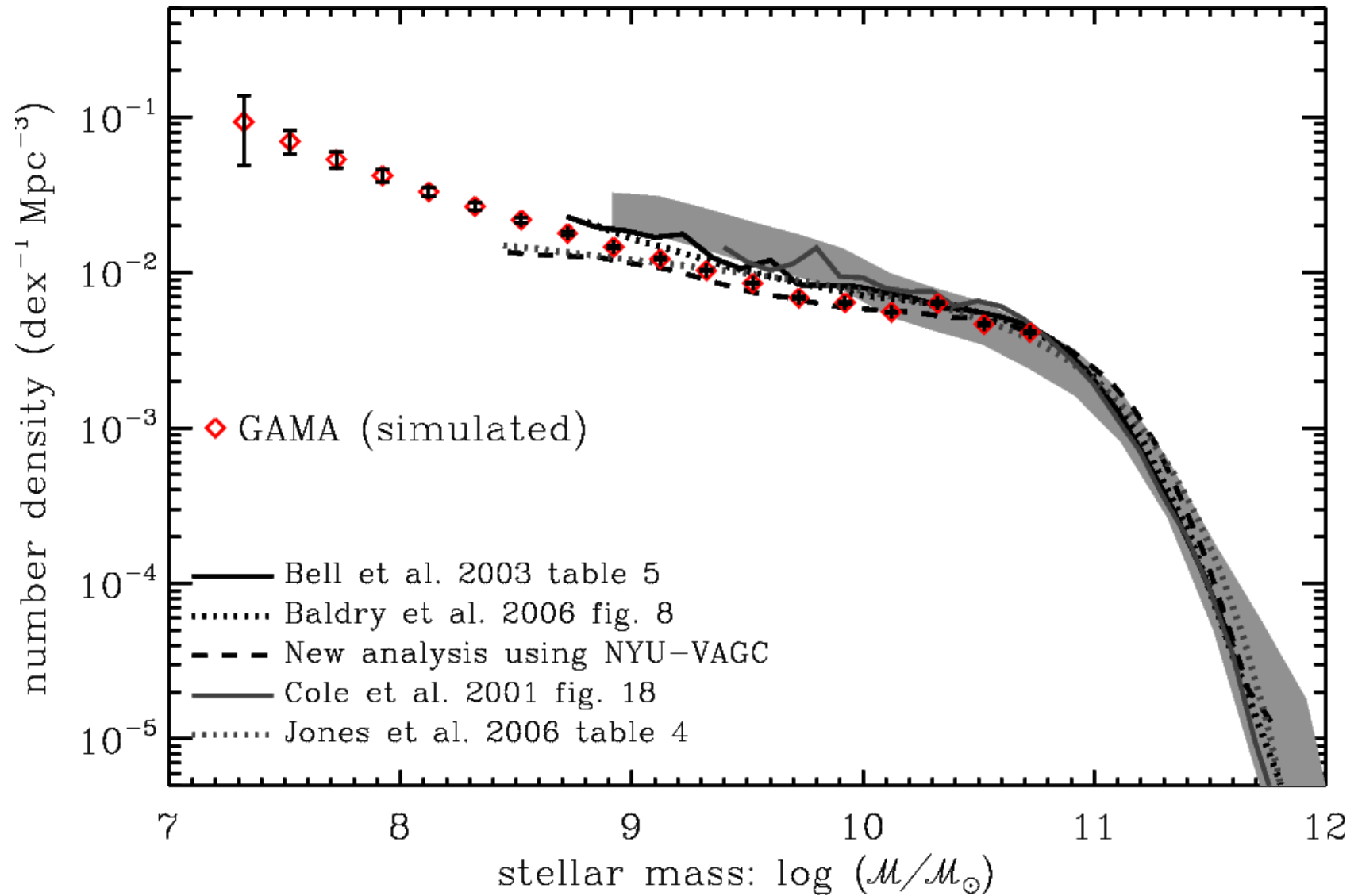
- 250 sq deg. (5x50 sq deg. chunks each 4x12.5deg), 250k galaxies  $z < 0.4$
- General:
  - **A study of structure on 1kpc-1Mpc scales**, where baryon physics is critical
  - Tracing how mass (stars, dust, gas) follows light
  - Provide a definitive low redshift benchmark for the JWST and the SKA
- Specific goals:
  - **the CDM Halo mass function** from group velocity dispersions
  - the stellar mass function into the dwarf regime
  - the HI mass function and associate gas/stellar mass ratios
  - the baryonic mass function and baryon to dark matter ratios
  - determine the galaxy merger rates as a function of mass ratio
  - individual baryon budget and energy output of 250k galaxies
- Provision of a SDSS/2MASS like public database incorporating:
  - Optical: ugri (VST), spectra (AAT)
  - Near-IR: ZYJHK (VISTA)
  - Far-IR: 100-500 microns (HERSCHEL)
  - **Radio: 21cm (ASKAP/DEEP)**

# The CDM halo mass fn





# The GAMA Stellar Mass fn

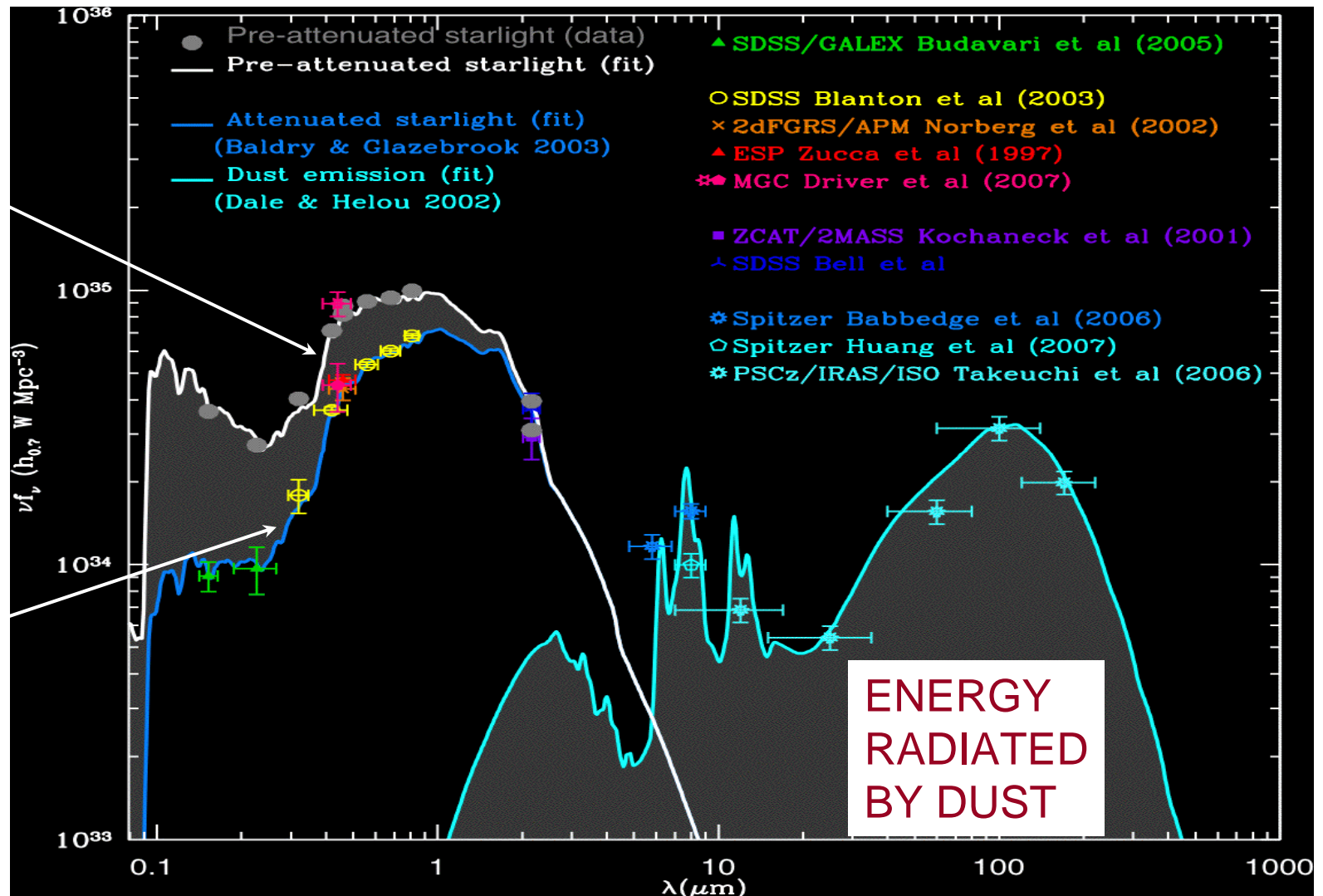


# Energy Output

GAMA will measure the individual energy output from 0.3 to 500micron for ~250k galaxies (c.f. Driver et al. 2008)

ENERGY  
PRODUCED  
BY STARS

ENERGY  
WHICH  
ESCAPES  
INTO IGM



# Galaxy And Mass Assembly

Simon Driver (Univ. St Andrews) and the GAMA team (incl. VIKING)

## 1. What is GAMA?

- New generation SDSS scale survey: 250 sq deg, 2mag deeper than SDSS
- Fully multi-wavelength: AAT, VST, VISTA, HERSCHEL, ASKAP (GALEX, SCUBAII)
- A comprehensive study of matter and energy on 1Mpc to 1kpc scales  $z < 0.4$

## 2. Overlap with XMM

- Superb overlap with proposed XXL survey field (100 sq deg = 2 GAMA chunks)
- Comparable  $n(z)$  distributions for normal galaxies
- GAMA could be expanded to include UVX selection
- Will provide: optical, near-IR, far-IR, spectra and radio measurements/

## 3. GAMA update:

- GAMA commenced March 1st 2008
- >50,000 redshifts measured in three weeks with AAT/AA $\Omega$  (>96% Completeness)
- Proposal to commence GAMA south due March 2009 for obs starting Oct 2009
- Quick look science: Local LF, bimodality, BPT, SFH, Photo-z calibration....

## 4. How you can get involved:

- Annual data release (December 2008)
- Website: <http://www.st-and.ac.uk/~jliske/gama/>
- Contact: [spd3@st-and.ac.uk](mailto:spd3@st-and.ac.uk) or [gama\\_panel@eso.org](mailto:gama_panel@eso.org)



# GAMA: Team Affiliations and Structure

## WORKING GROUPS/HEADS

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

## TEAM MEMBERS

**Bland-Haw'n (U.Syd)**  
Cameron (St And)  
Conselice (Nott.)  
**Couch (Swin.)**  
**Croom (U.Syd)**  
Cross (Edin.)  
Frenk (Durham)  
Hill (St And)

**Jones (AAO)**  
**Kuijken (Leiden)**  
Lahav (UCL)  
Nichol (Ports.)  
Oliver (Sussex)  
Parkinson (Edin.)  
Phillipps (Bristol)  
Popescu (UCLan)

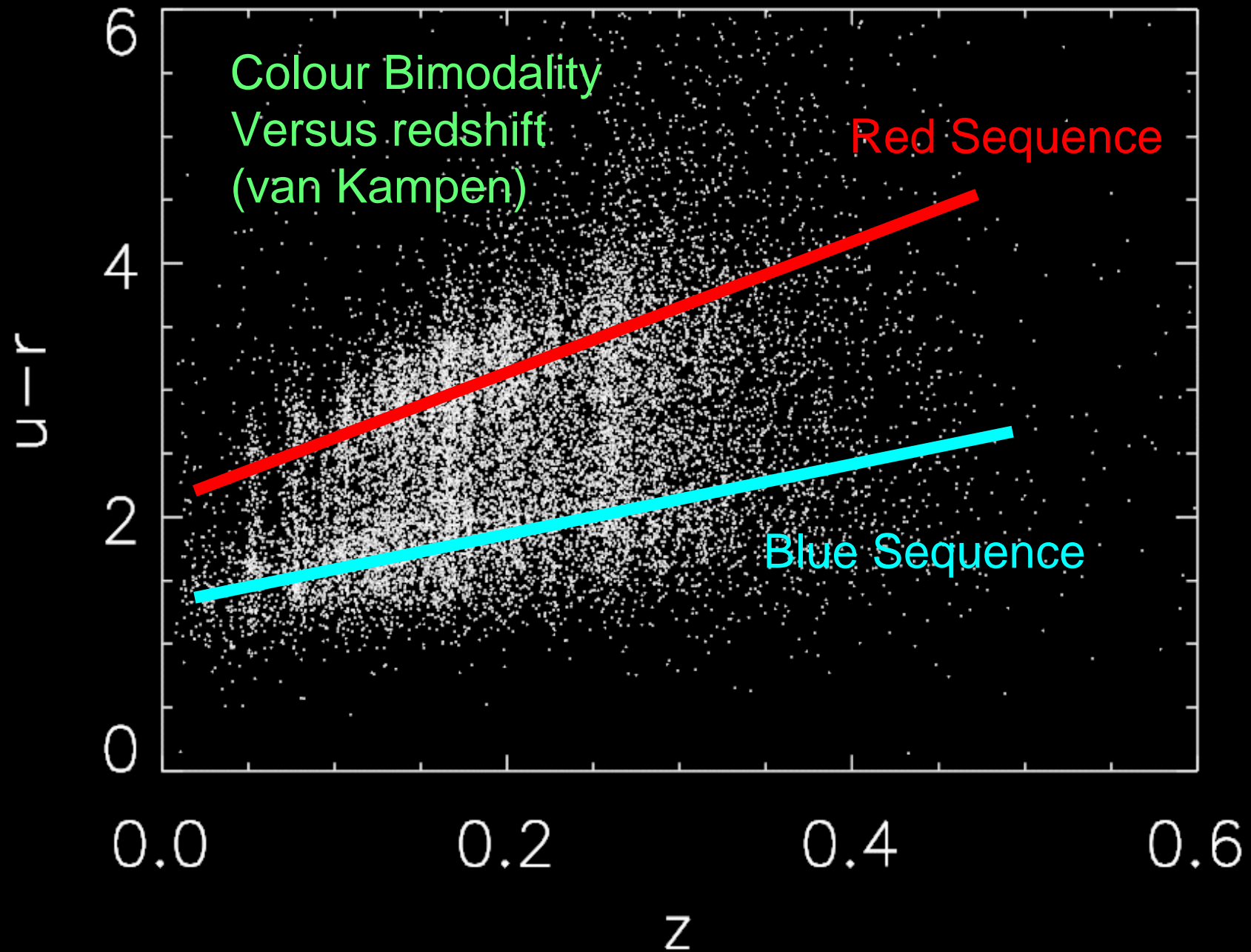
Prescott (LJMU)  
Proctor (Swin.)  
**Sharp (AAO)**  
**Staveley-Smith (UWA)**  
**Sutherland (Camb.)**  
**Tuffs (MPIK)**  
**van Kampen (Innsbruck)**  
Warren (Imperial)

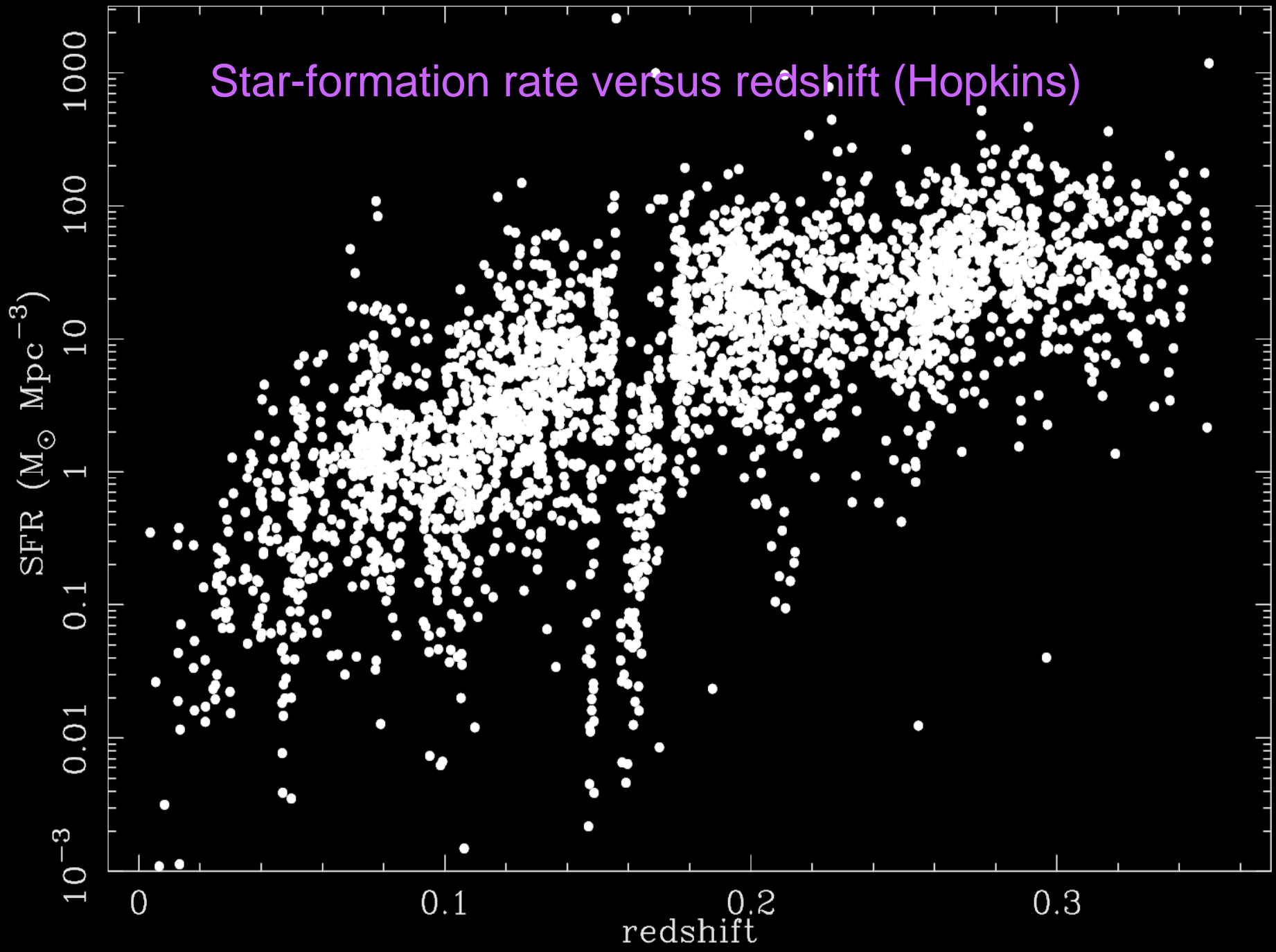
## TEAM AFFILIATIONS:

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

## WEBSITE:

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



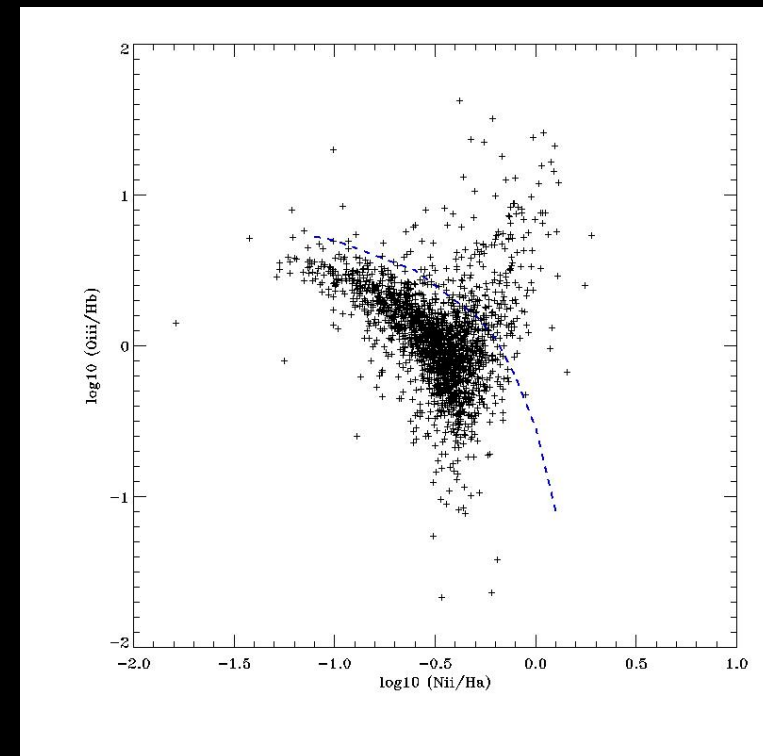
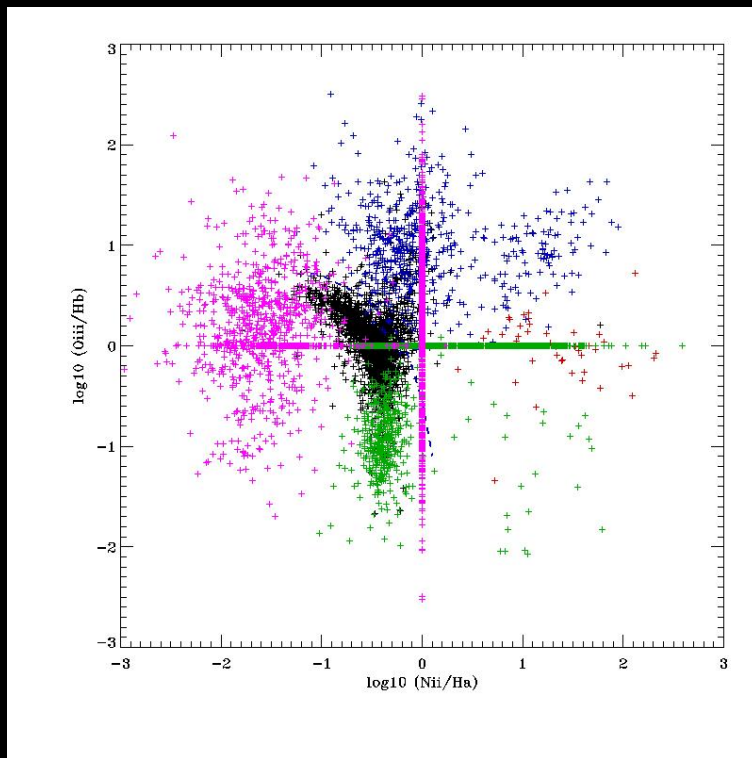


Star-formation rate versus redshift (Hopkins)



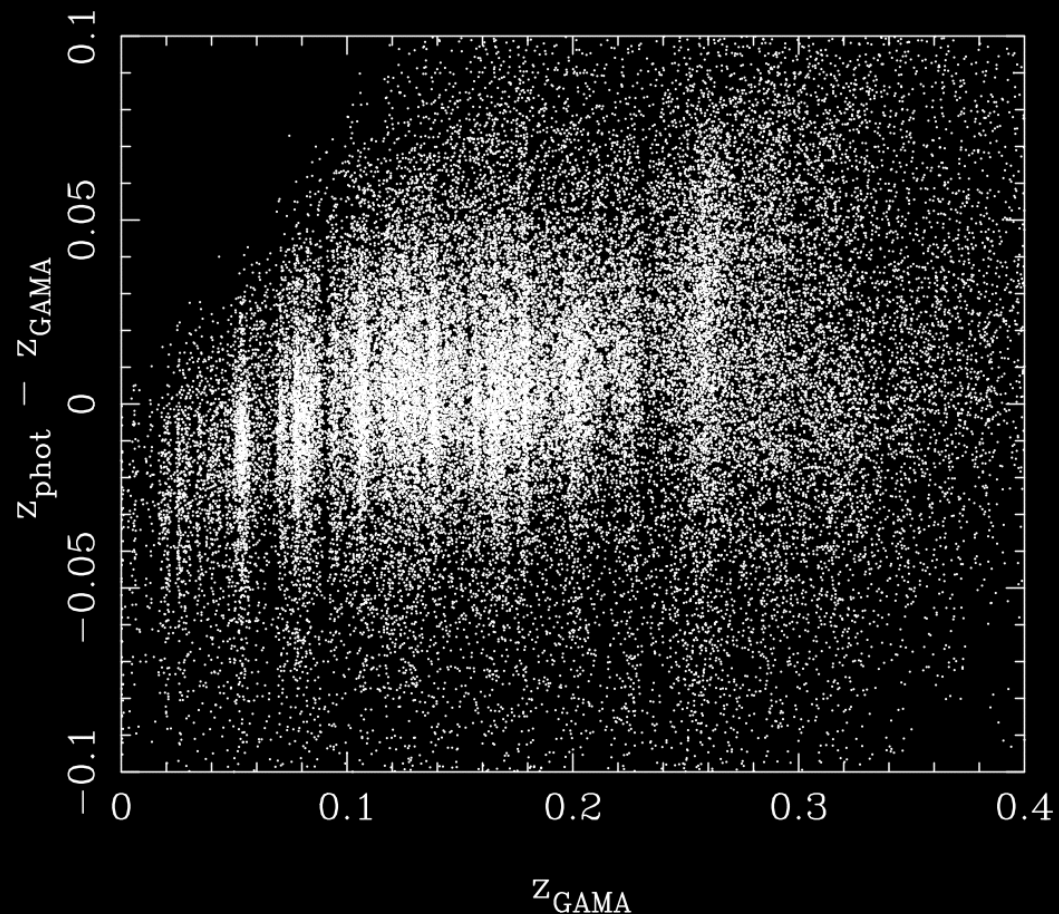
# GAMA Y1 Science: AGN

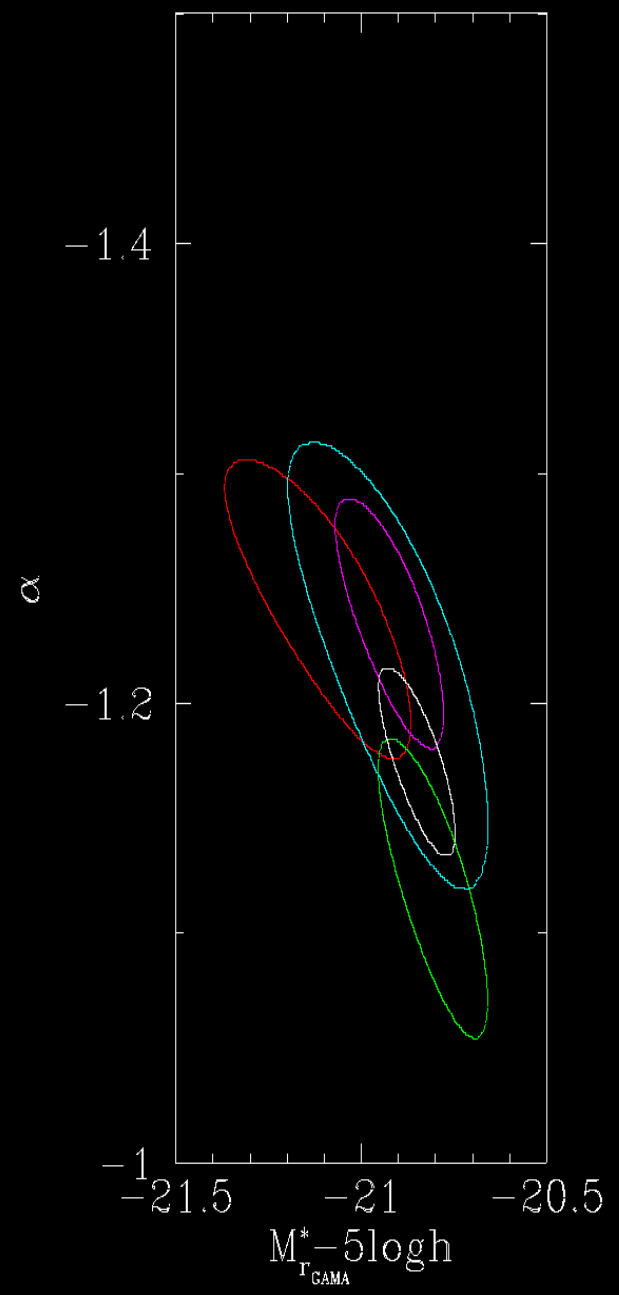
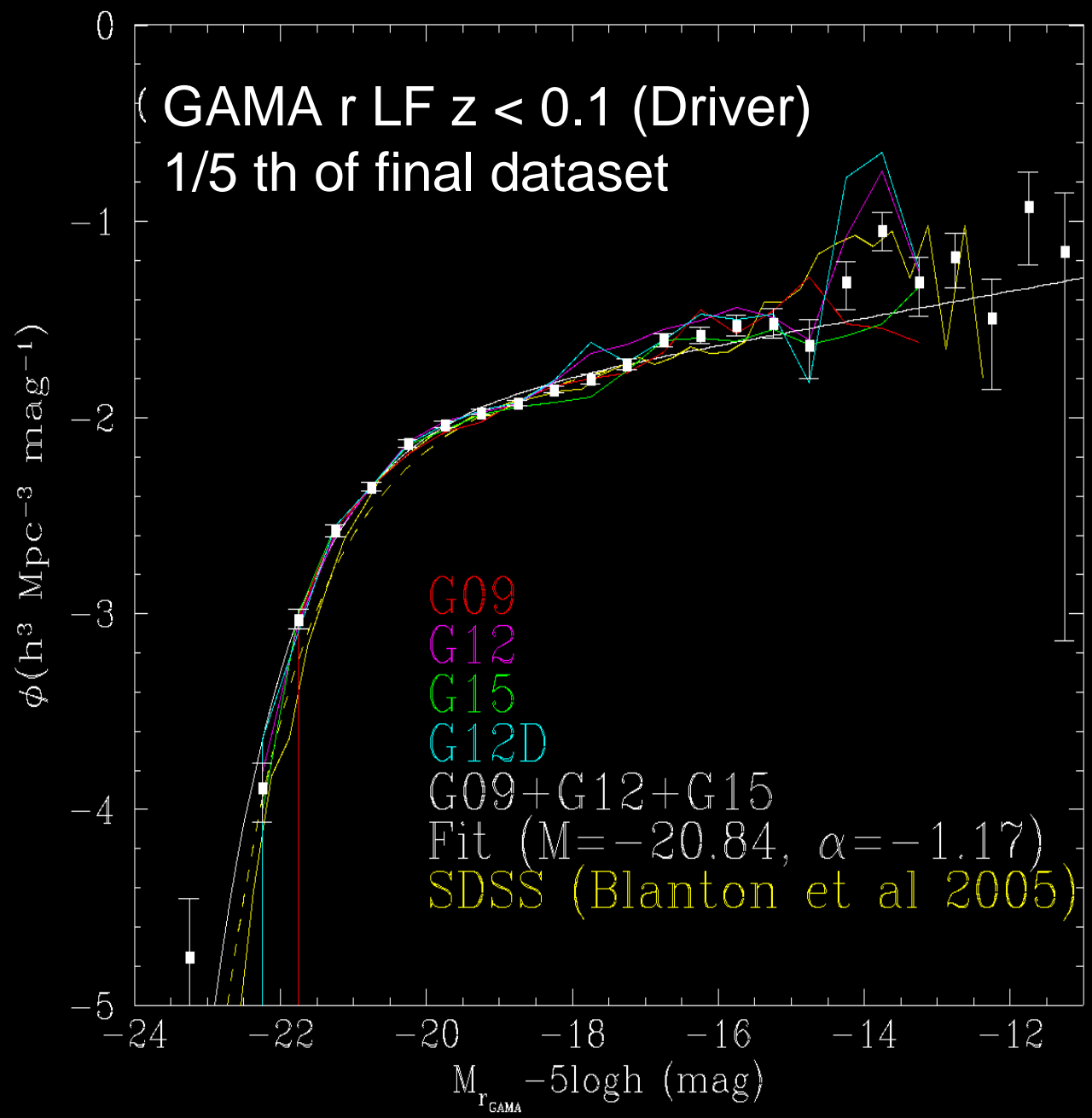
- BPT diagram (Sharp)

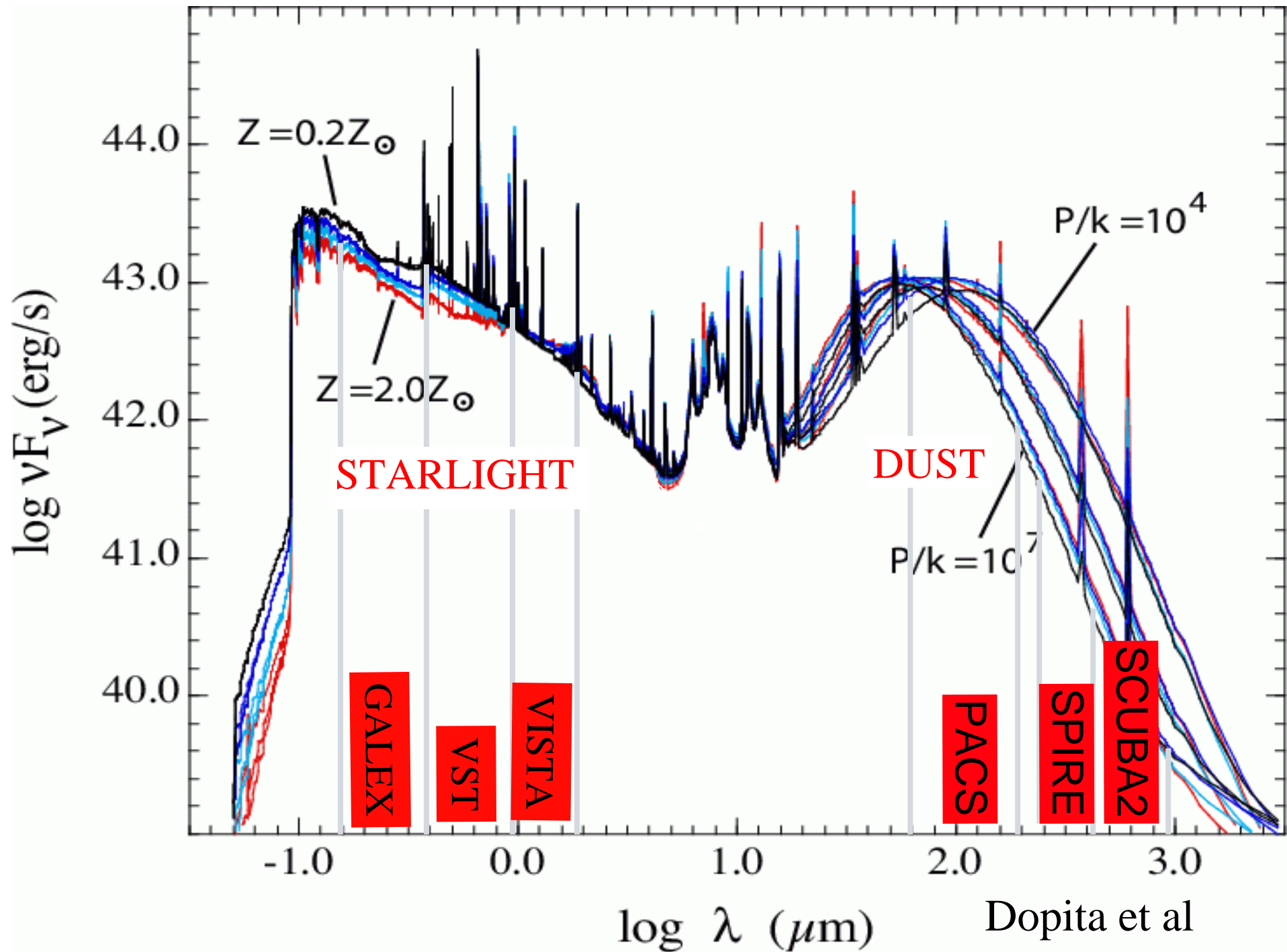


# GAMA Yr1 Science: Calibration of photo-z codes

SDSS photo-z's versus GAMA (Peacock)



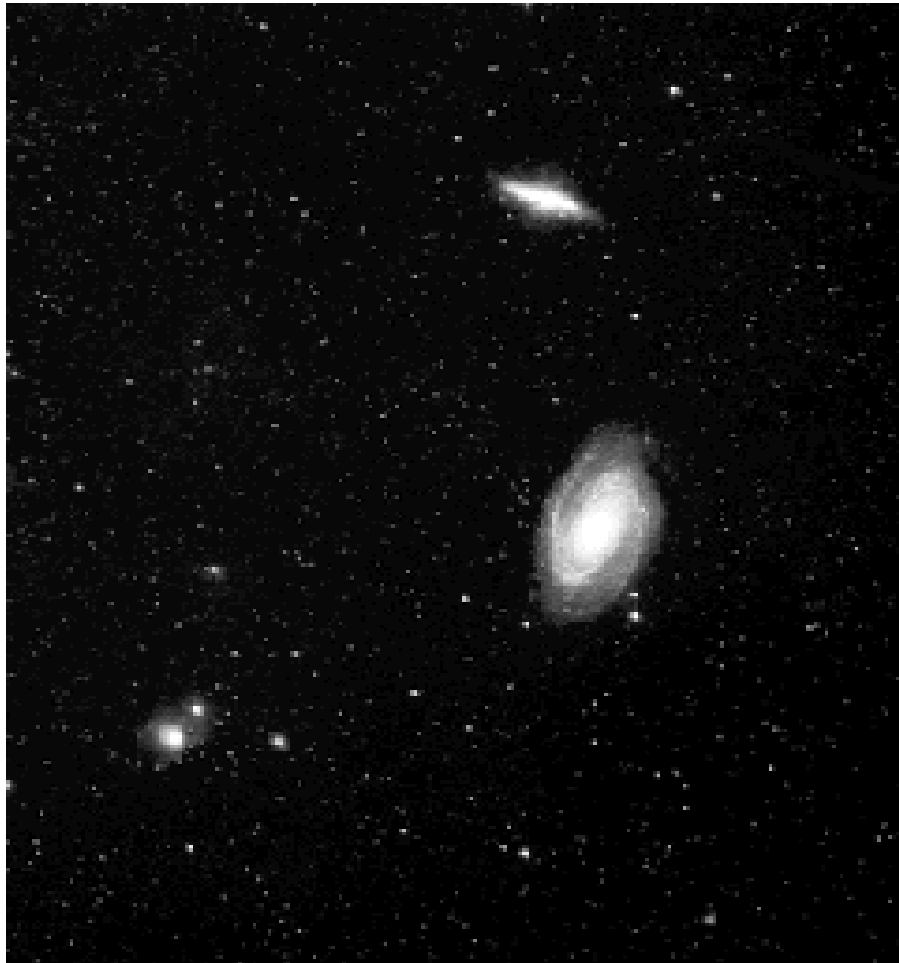




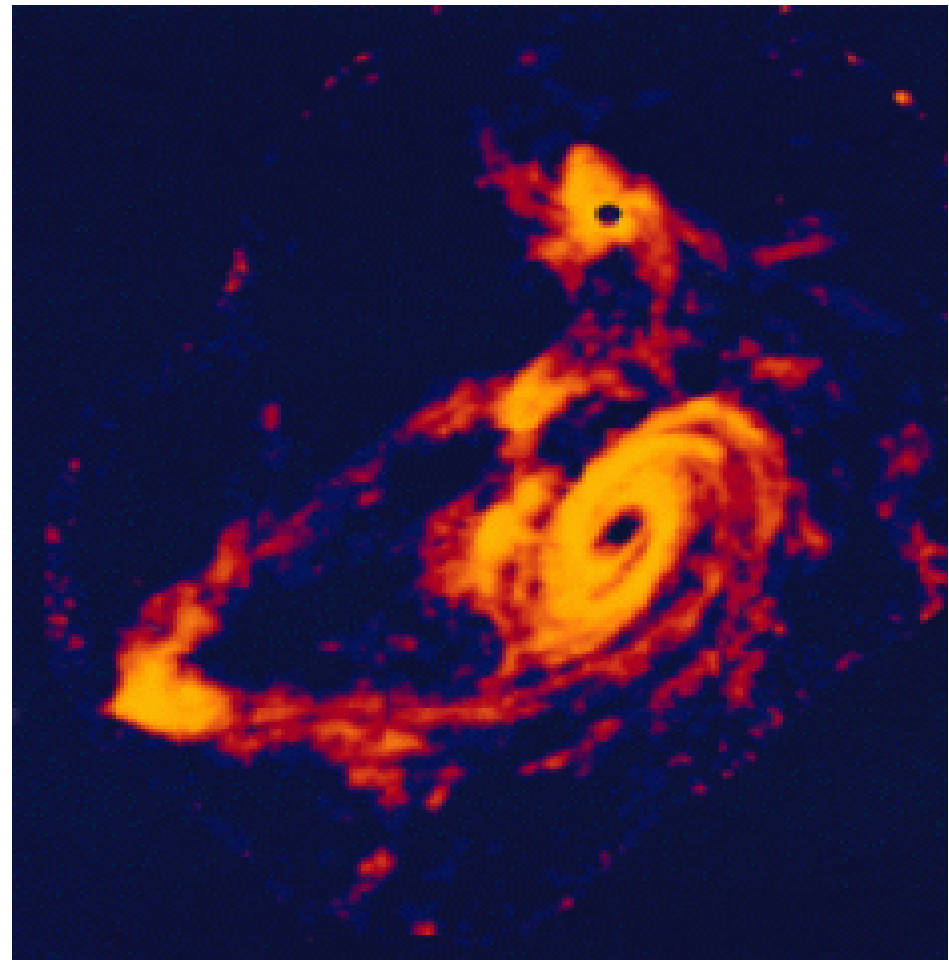


To fully understand galaxy form./evol we need to understand stars, dust AND gas: ==> GAMA+ASKAP/DEEP

Optical image  
(Stars)



21cm image  
(Gas)



ASKAP/DEEP with a 10" beam  
will be unable to resolve all HI  
complexes, spectroscopic  
confirmation will be important  
and optical-far-IR data useful

$z=0.20213$

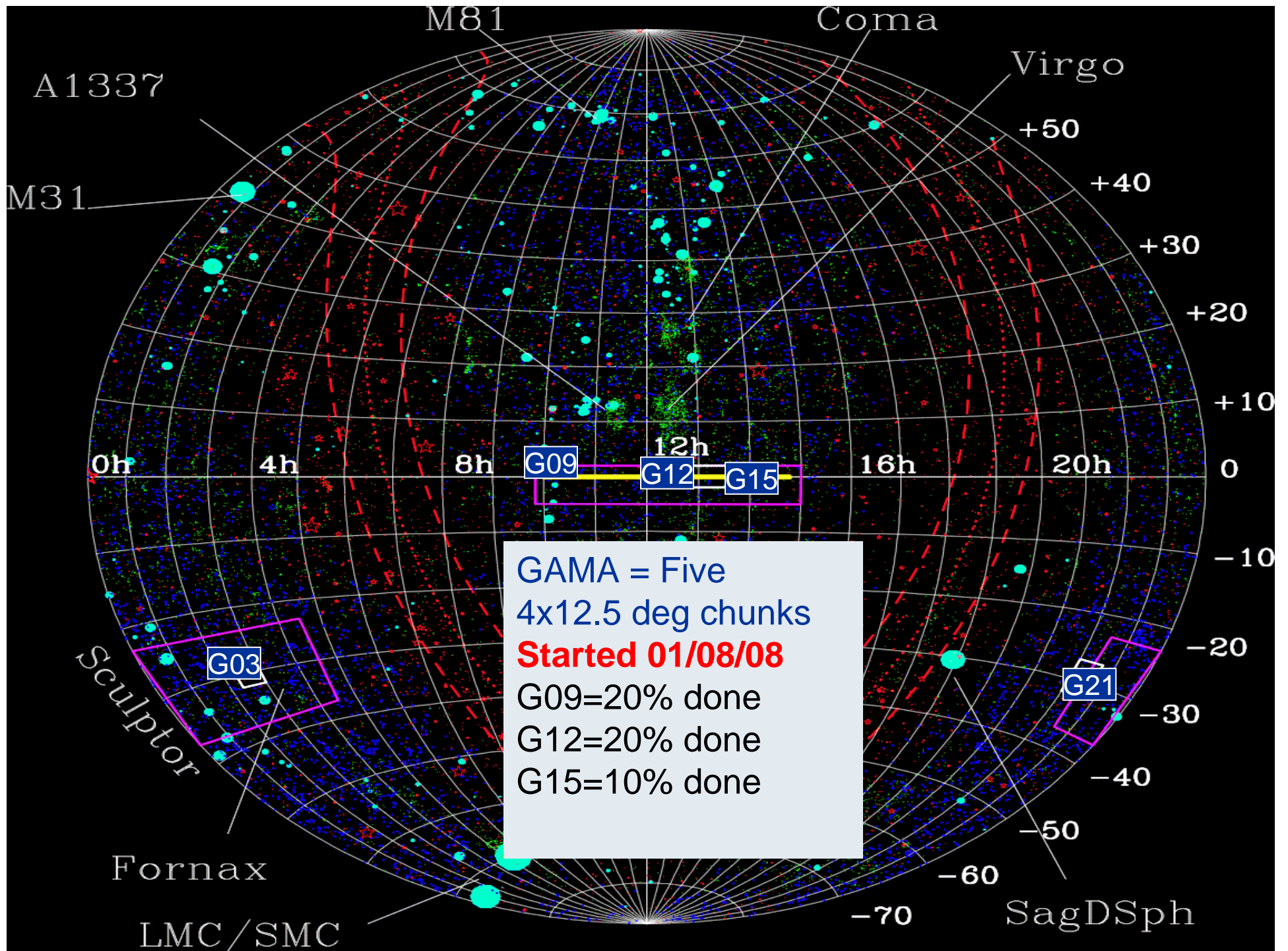
$z=0.16586$

$z=0.20311$

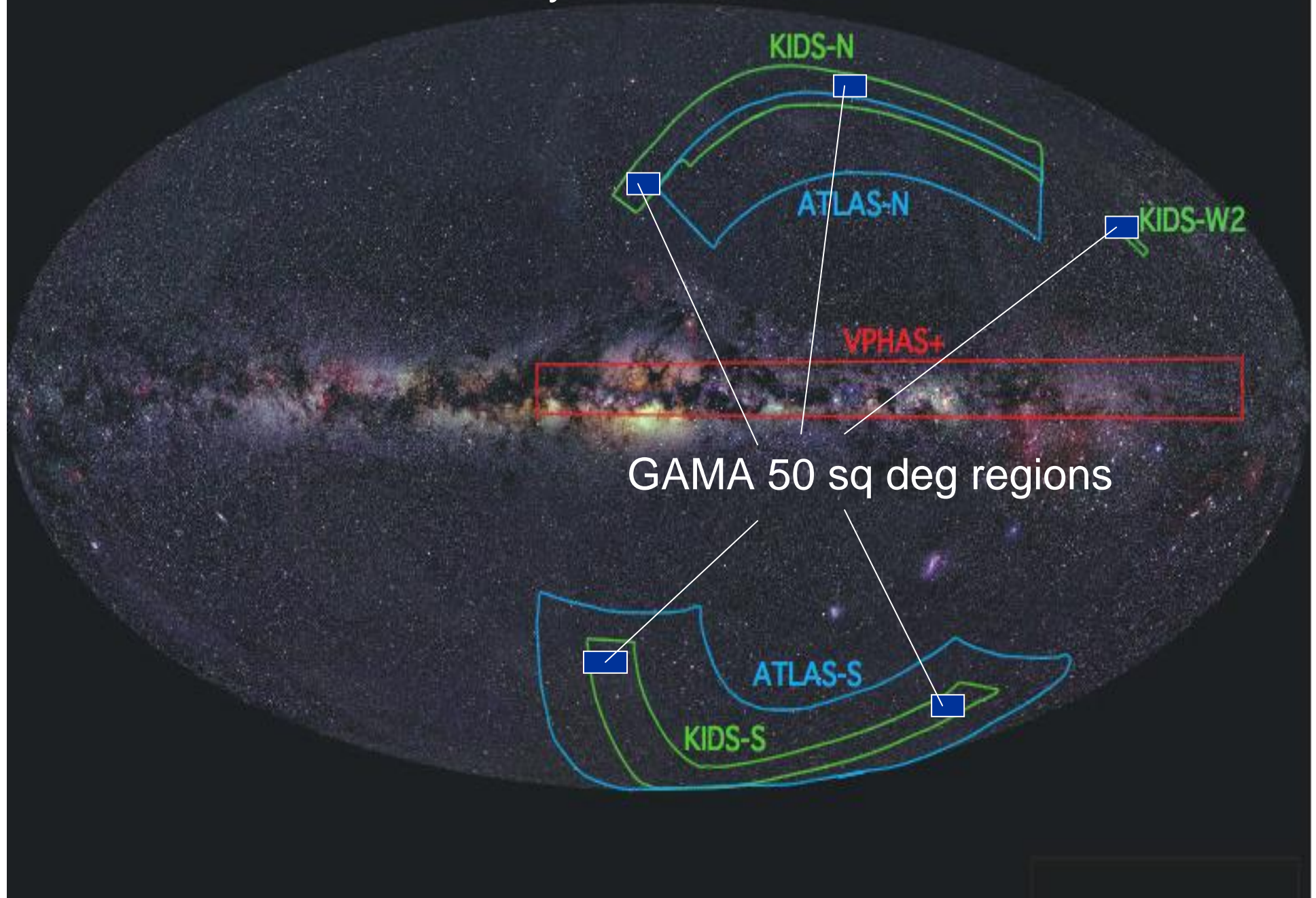
MGC FIELD  
062\_2  
 $b_{\text{lim}} \sim 24 \text{ mag}$

10 arcmin





# Planned VST surveys to commence March 2009





# GAMA12h proposed for ASKAP Deep Observation

- GAMA depth and area well matched to the proposed ASKAP deep field.
- XMM?

