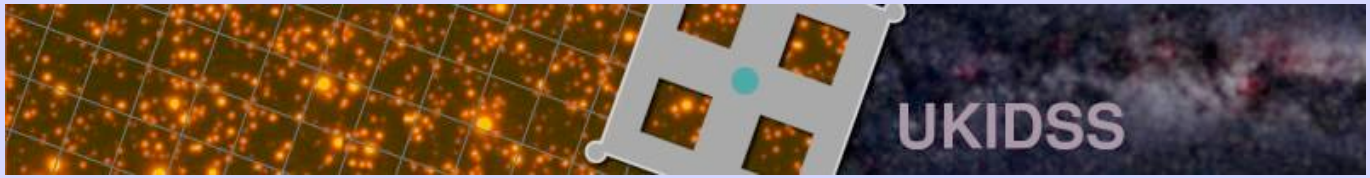
UKIDSS and the VO

- The UKIRT Infrared Deep Sky Survey
- UKIDSS science highlights
- Future : all sky NIR ?
- UKIDSS data access and the VO

(live demo...)



Astro Grid

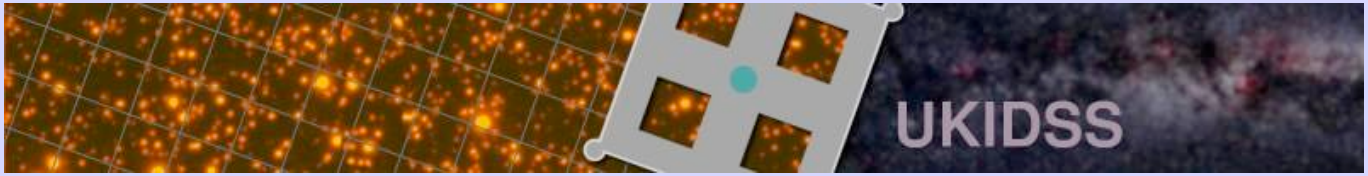
UKIDSS

The UKIRT Infrared Deep Sky Survey

CPI A.Lawrence
CSS Steve Warren
plus 130 others

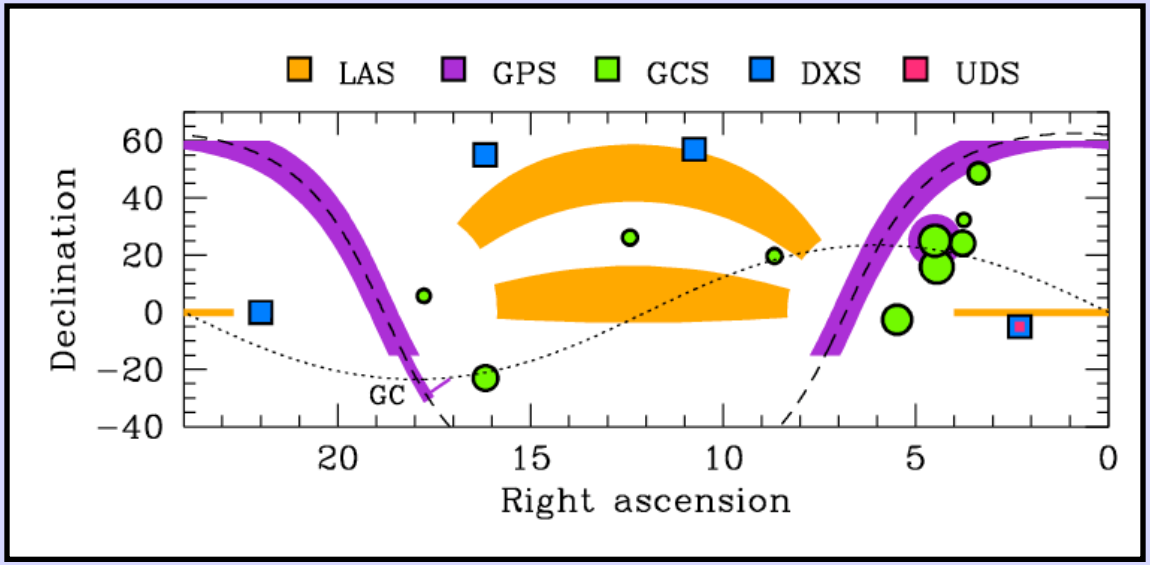
Core Reference
Lawrence et al 2007

- ESO public survey
- 1000 nights UKIRT over 7yrs
- UKIDSS = 50 X 2MASS
- near-ir SDSS
- began 2005 May 13
- data available at http://surveys.roe.ac.uk/wsa

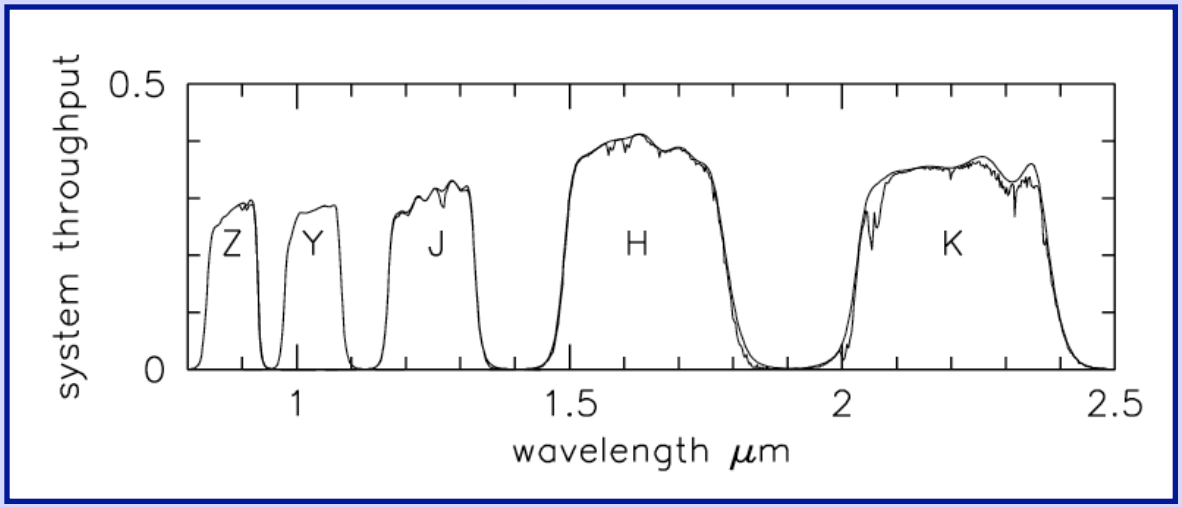


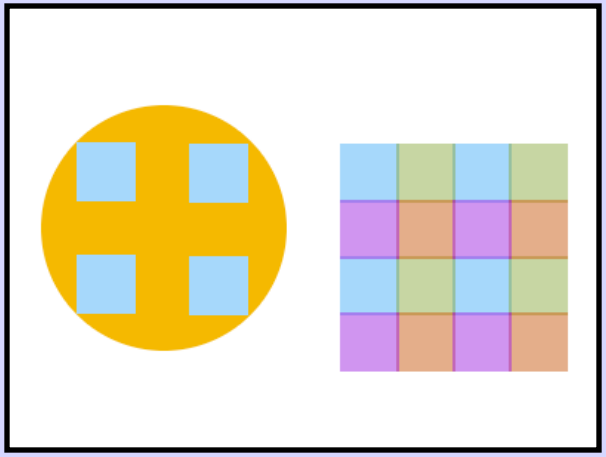
UKIDSS design

Large Area Survey	LAS	YJHK	18.4K	4000 s.d.	262n	ExGal
Deep Extragalactic Survey	DXS	JK	21.0	35	118	ExGal
Ultra Deep Survey	UDS	JHK	23.0	0.77	296	ExGal
Galactic Plane Survey	GPS	JHK	19.0	1800	186	Gal
Galactic Clusters Survey	GCS	ZYJHK	18.7	1600	84	Gal



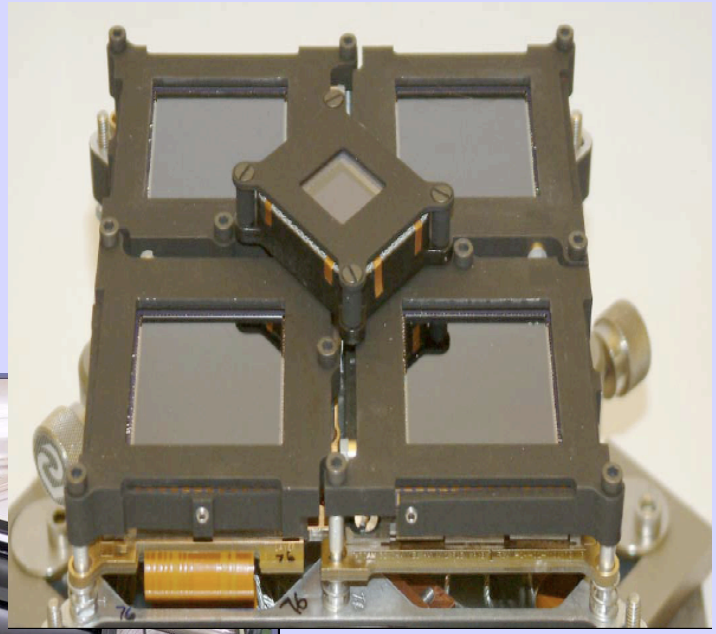
WFCAM

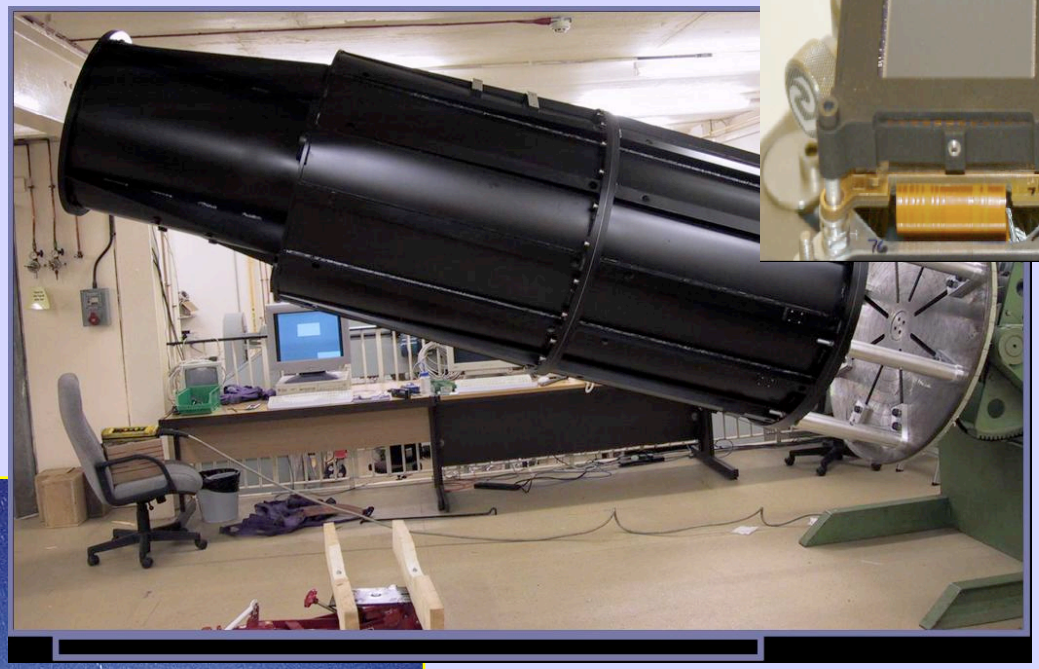


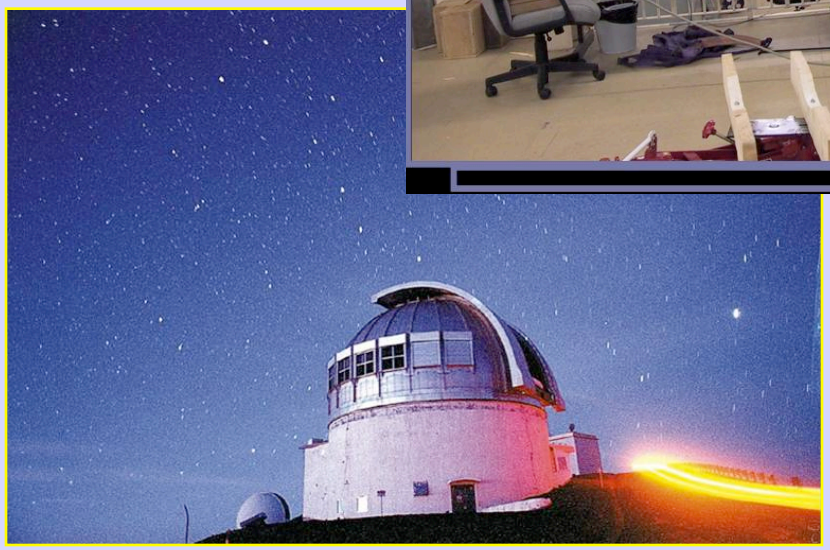


- 4x2048x2048 Hawaii II arrays
- 0.4 arcsec pixels
- 0.21 sq.degs / exposure
- 2x2 microstep to sample
- 2x2 macrostep to tile
- Filters: Z,Y,J,H,K,H_2-S(1),Br-g

WFCAM pix

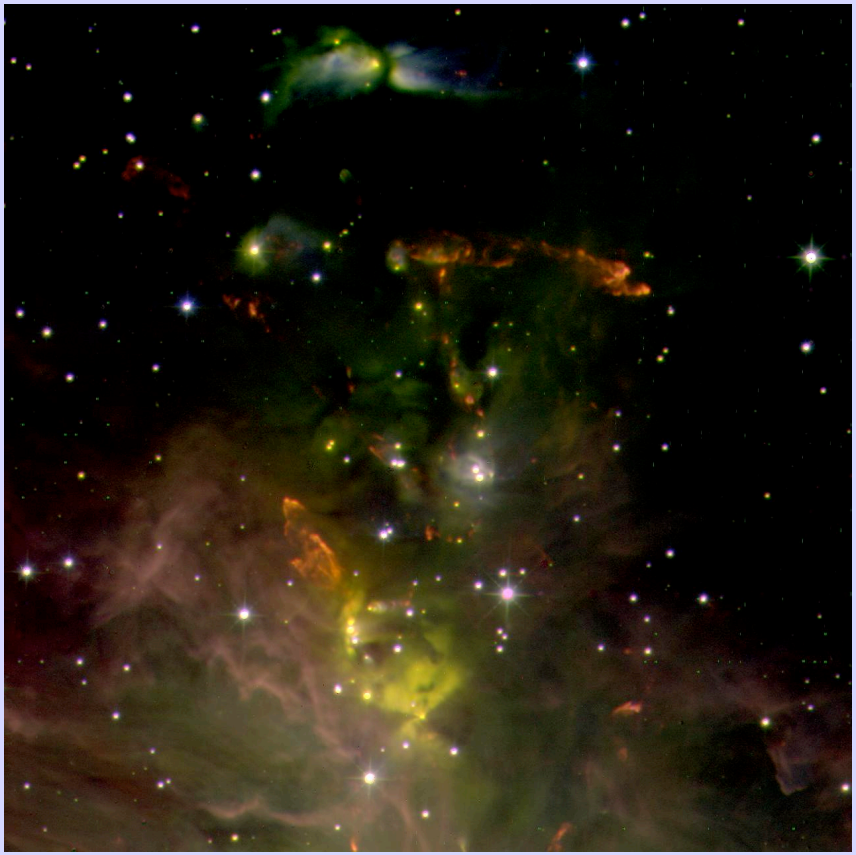




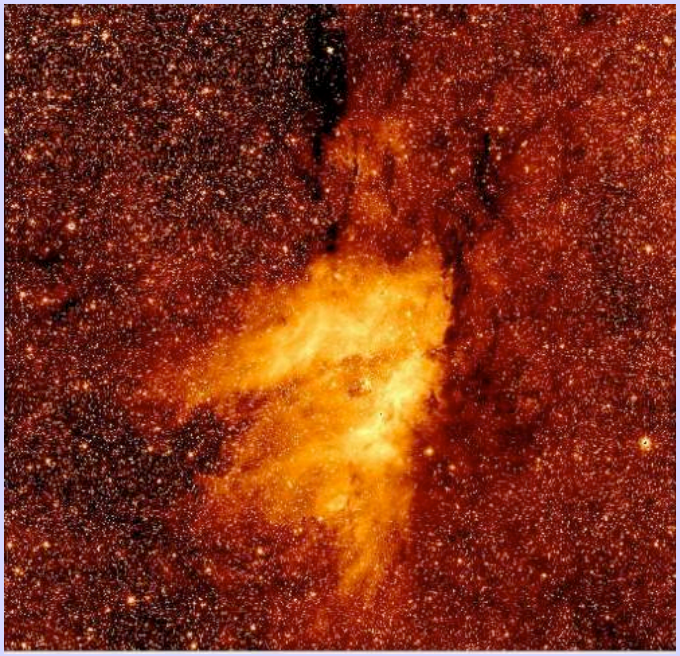


WFCAM pix

NGC 891



ORION

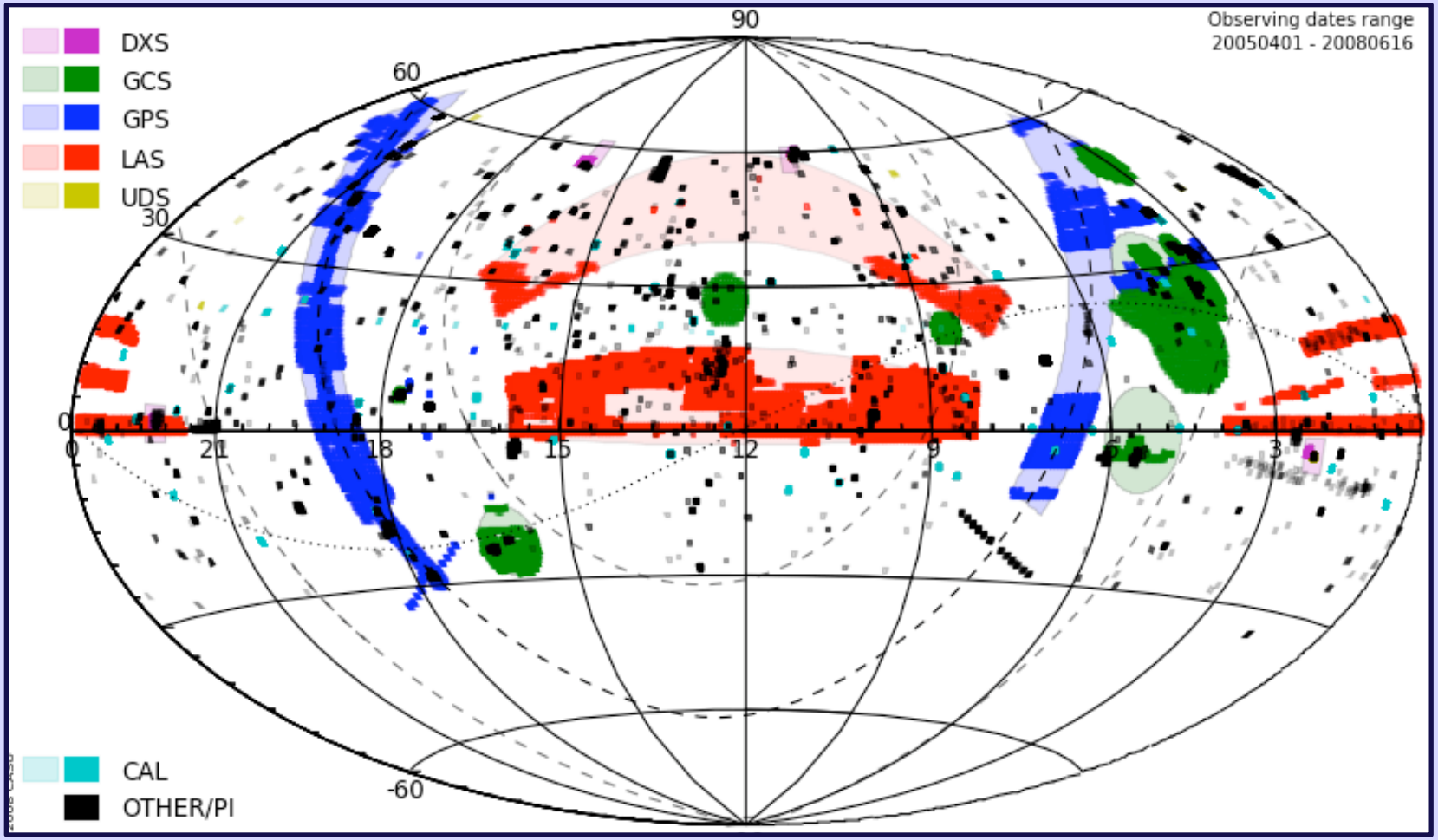


M17

M104

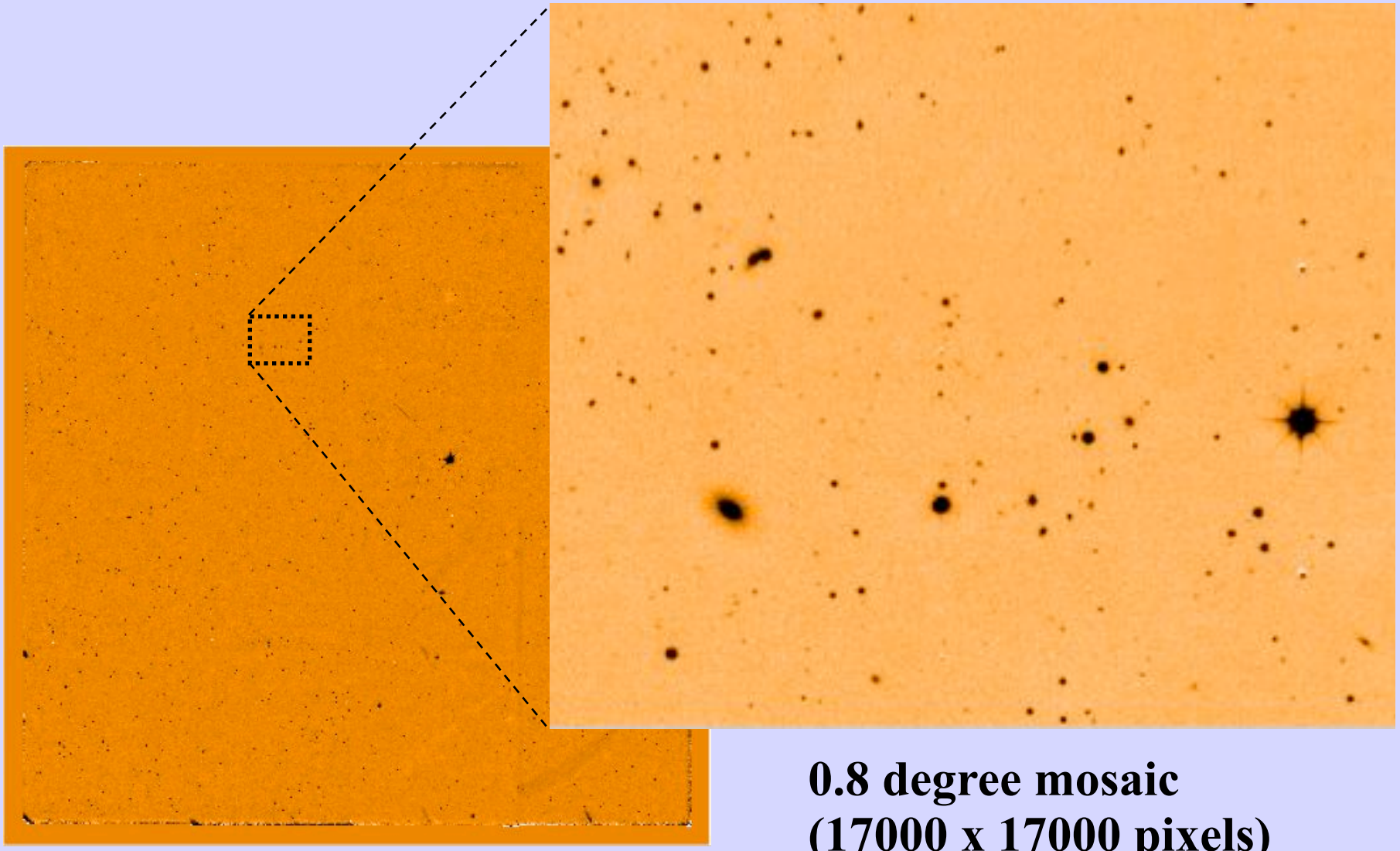
UKIDSS Coverage

about 40% done



as of Sep 2008

scary amounts of data



0.8 degree mosaic
(17000 x 17000 pixels)

data rates

- data rate at telescope — 12 MB/s
- saved data — peak 400 GB/nt; avge 150 GB/nt
- full archive growth — 20 TB/yr
- ten year archive — Raw data 200 TB; Survey maps 50 TB; Catalogs 5 TB

Releases

	Europe	World	area any filter	UDS depth
DR1	Jul 2006	Jan 2008	1238 sq.deg.	K=21.5
DR2	Mar 2007	Sep 2008	1857 sq.deg.	K=21.5
DR3	Dec 2007	*Jun 2009*	3326 sq.deg.	K=21.8
DR4	Jul 2008	*Jan 2010*	3832 sq.deg.	K=22.0

- ... about every nine months thereafter

Roaming the UKIDSS sky

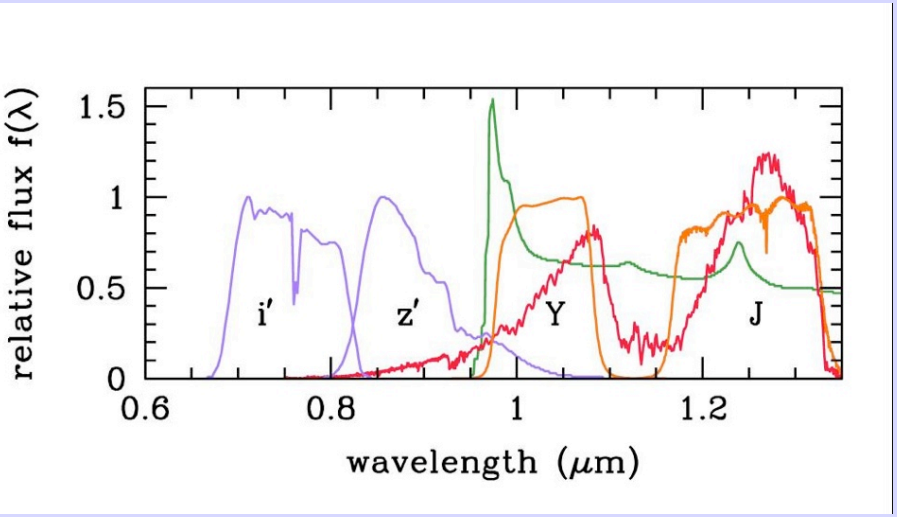
- Gallery of GPS images
- GPS zoomable mosaic
- UDS zoomable mosaic
- UDS-south BiK image

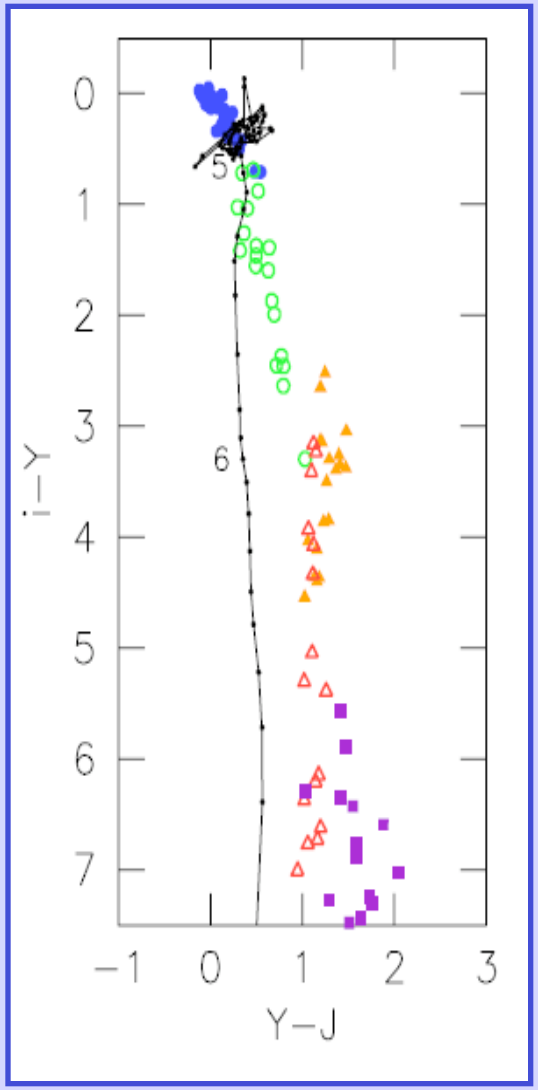
Multi-wavelength data

- GPS : many other Milky Way Surveys
- GCS : 10 well known large open clusters
- LAS : large overlap with SDSS
  - well matched in depth
- DXS : four legacy fields
  - XMM-Subaru
  - Lockman Hole
  - ELAIS N1
  - SA22
- UDS : centre of XMM-Subaru

UKIDSS Highlights

opposite ends of the Universe





black	quasars
blue	O-K
green	M
orange	L
red	T
purple	Y

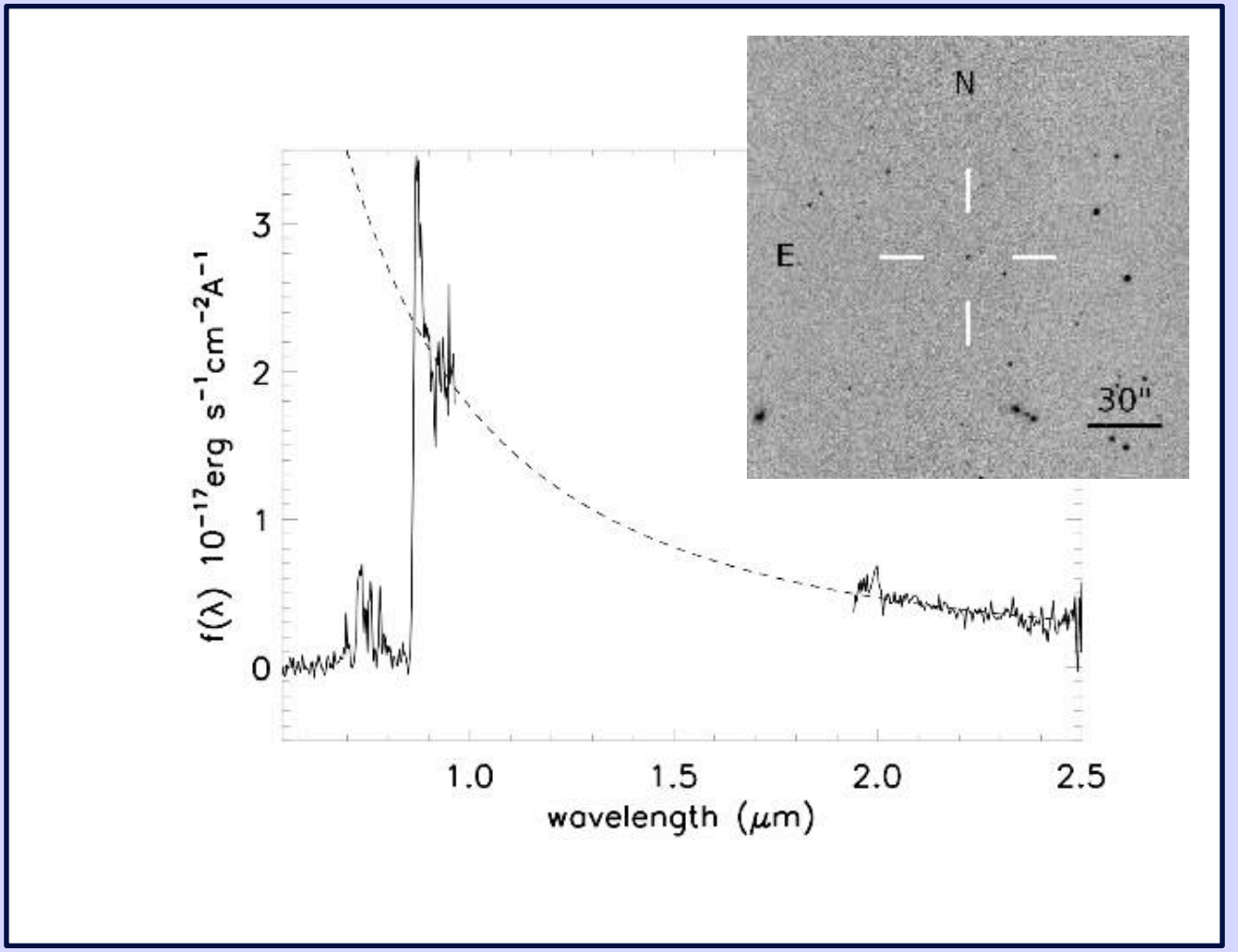
high-z and low-temp :
i and Y drop out

Y-J separates
T-dwarfs and quasars

z=6 quasars

J1319+0950 z=6.12

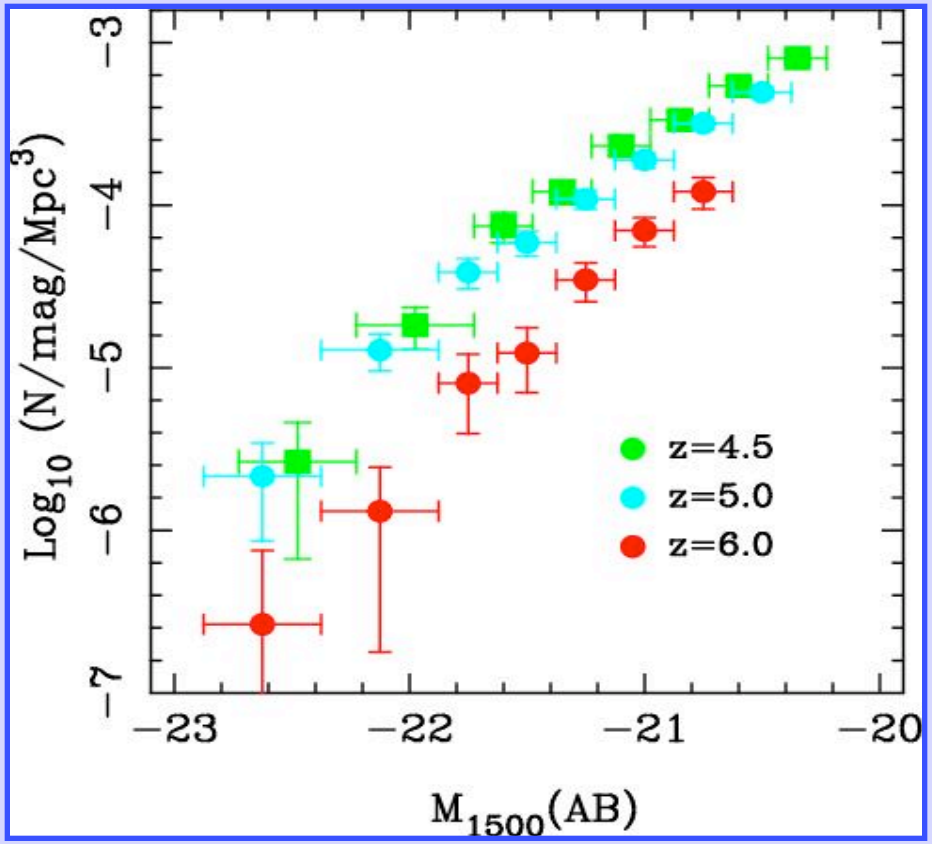
Four z~6 quasars
in 900 sq.deg.
SDSS : two quasars
in same area



**Warren, Mortlock, Patel,
Venemans et al in prep**

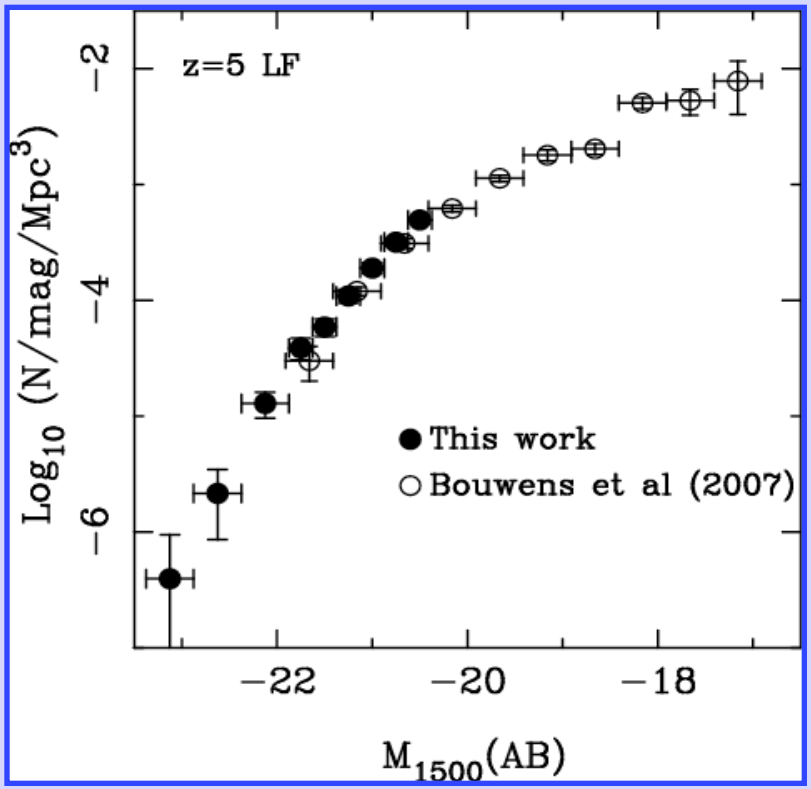
z=4-6 massive gals

select LBGs by
i or z dropout



clear evolution z=5-6

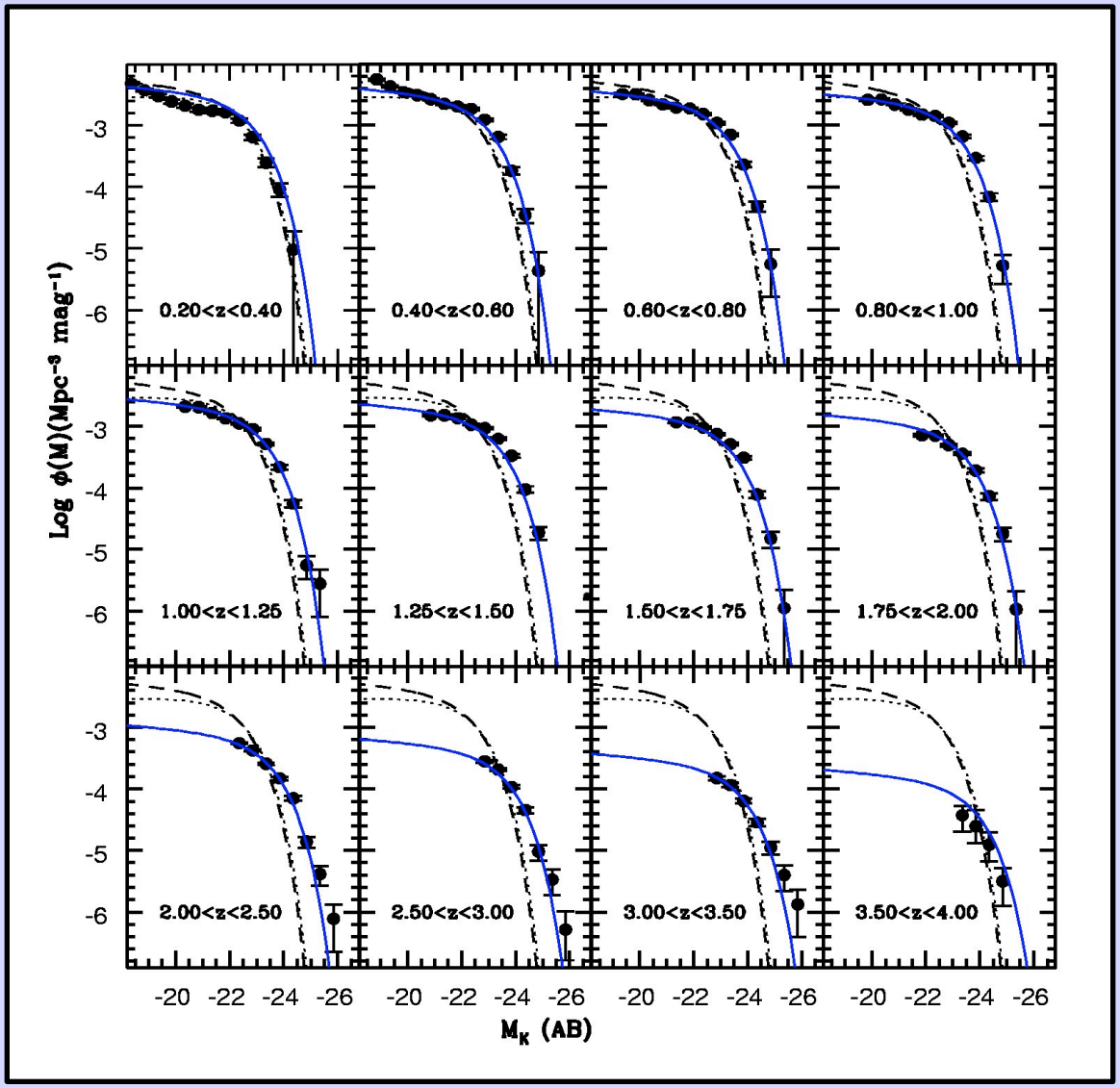
larger area than
HST study ==>
higher luminosities



McLure et al 2008

z=0-4 lum fn evolution

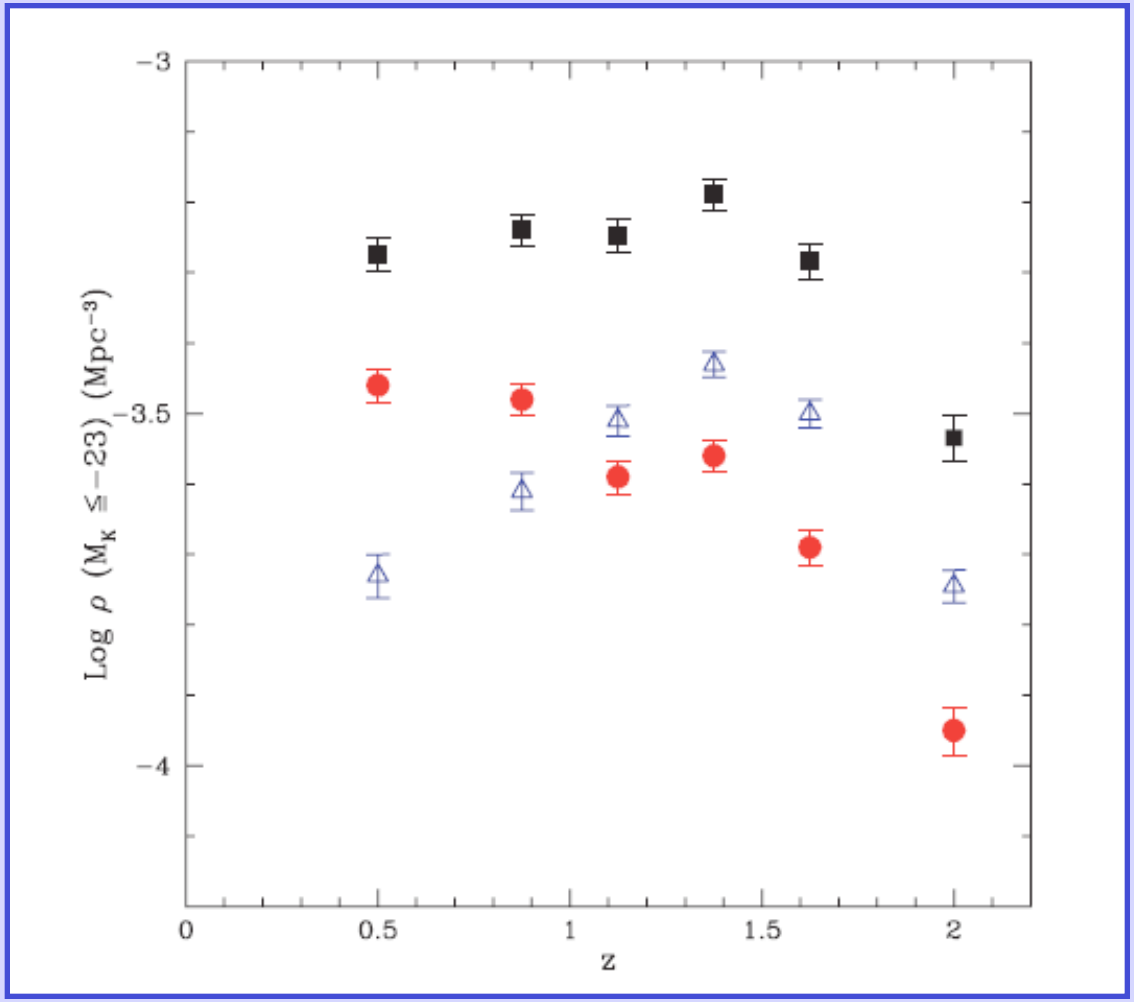
- 50,000 galaxies with K(AB)<23
- photo-z from UDS + Subaru
- Needs both density and lum evoln



Cirasuolo et al 2008

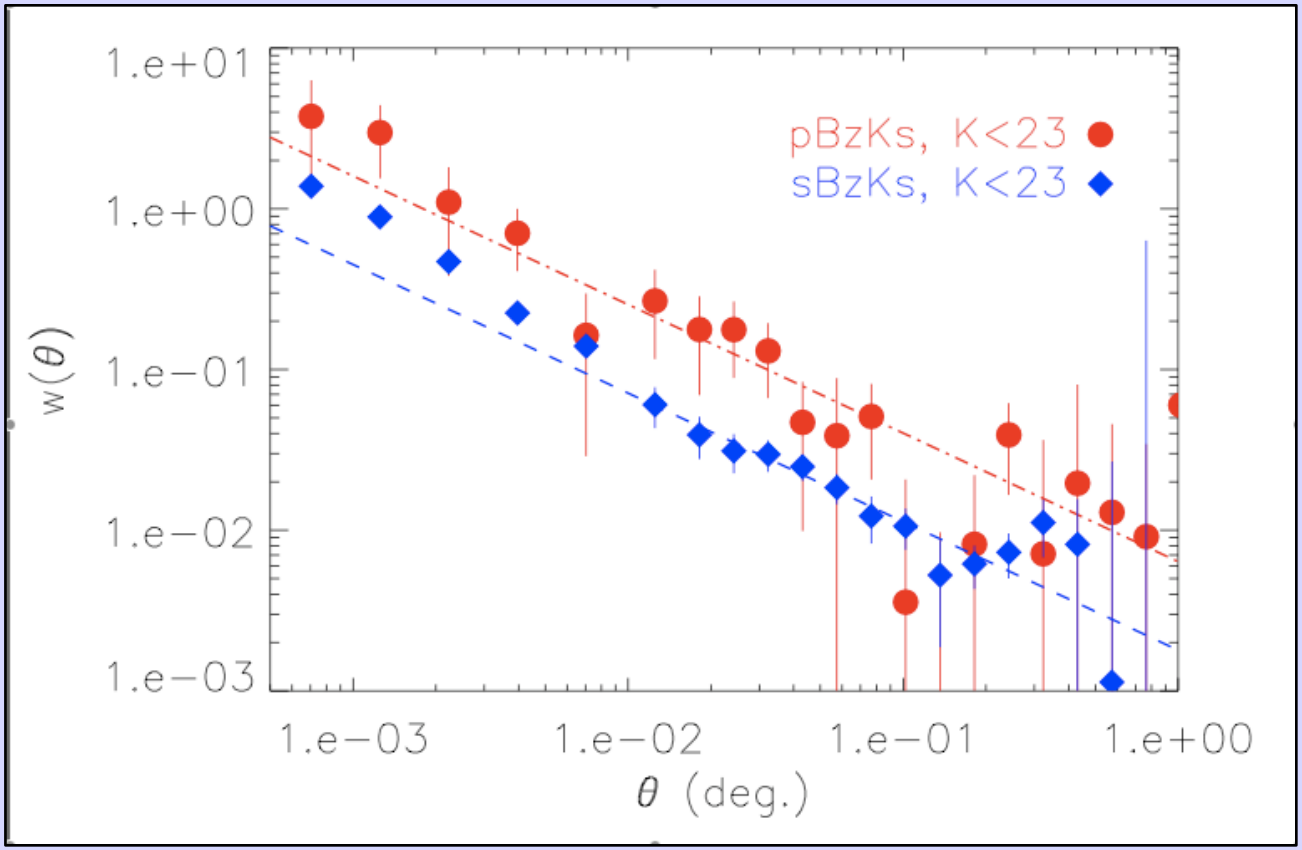
z=2 evolution

- Blue *vs* red luminous gals evolve differently



Cirasuolo et al 2007

z=2 clustering

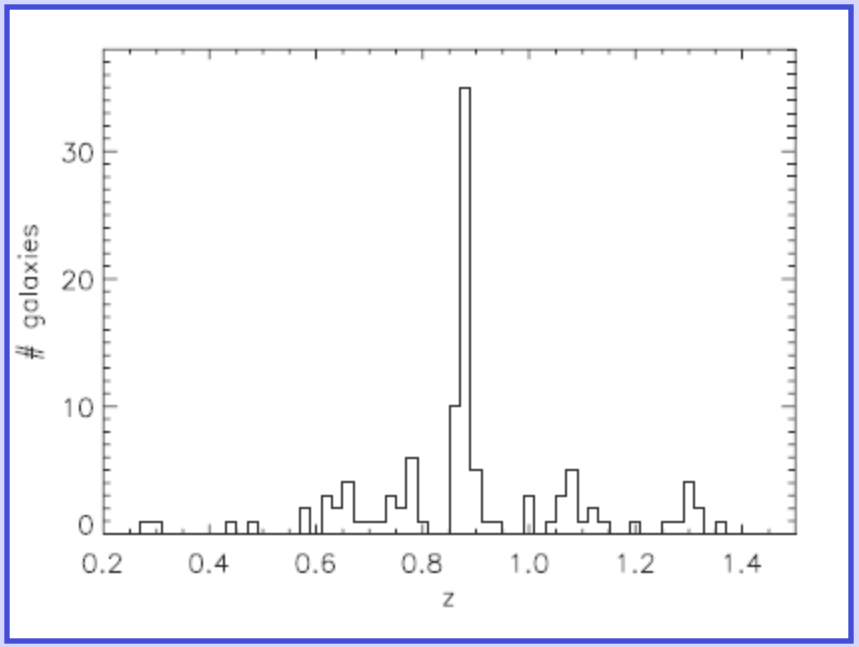


Hartley et al 2008

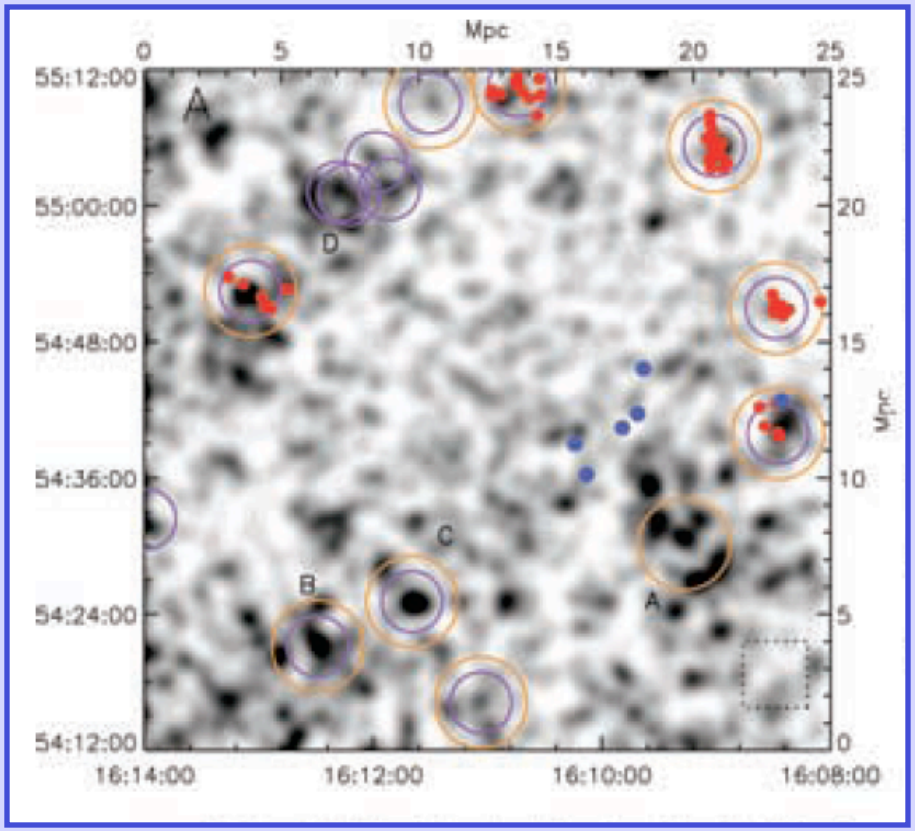
star-forming galaxies cluster
much less strongly than passive galaxies

z=1 supercluster

Swinbank et al 2007



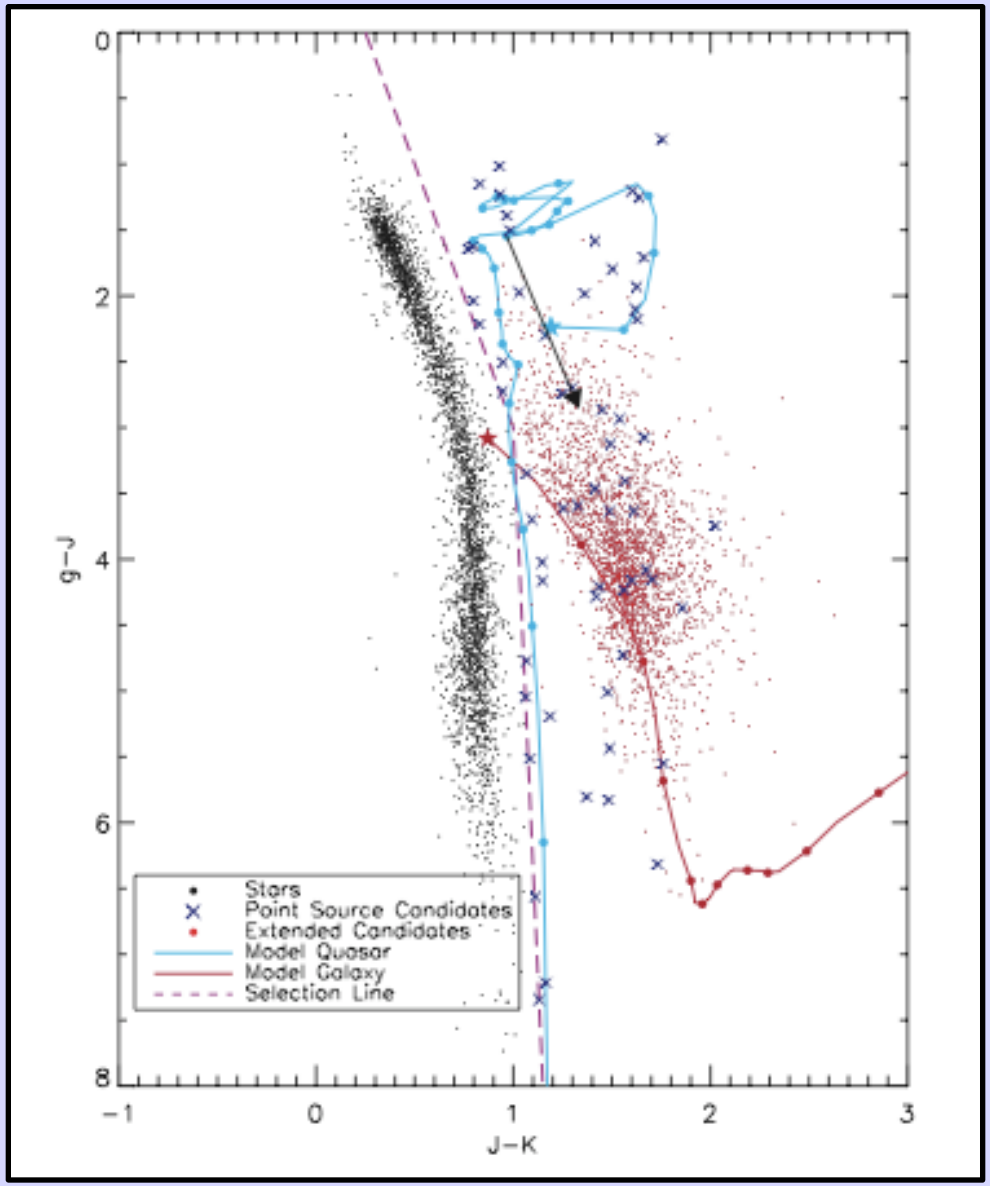
redshift distbn of candidate clusters



colour selected surface density map

structure 30 Mpc across

z=0-2 KX quasars

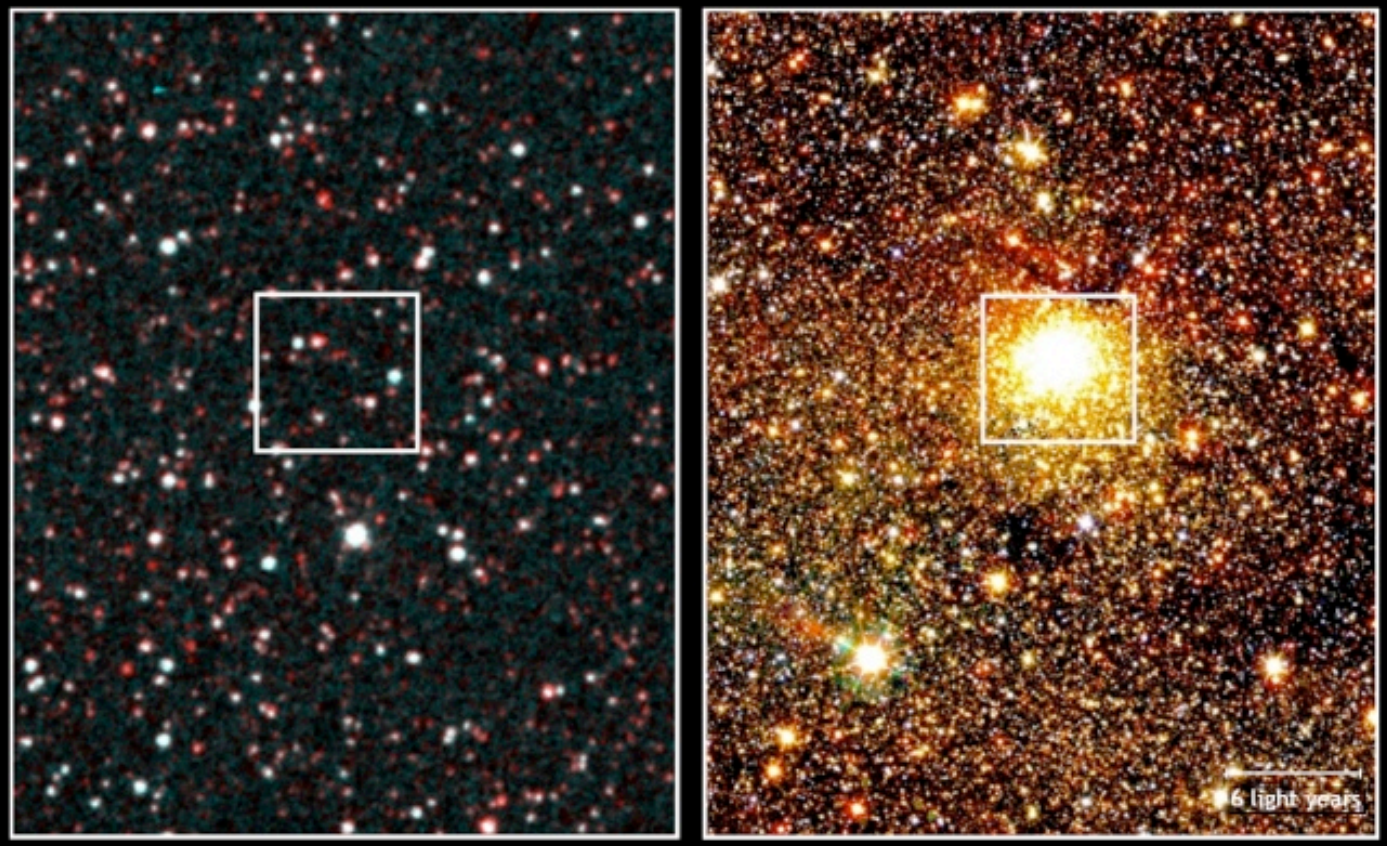


Blue=quasar model track
black = stars
red = galaxies
crosses = quasars

gJK selects quasars cleanly even for reddened objects

Maddox et al 2008

3 kpc new cluster



Heat from the Heavens - Opening up the Infrared Sky

The image on the left shows a region about 9,000 light years from Earth in the Constellation of Aquila. This image in the visual wavelengths was taken by the Palomar Sky Survey in the 1950s. In comparison, the image on the right shows the same area in the infrared, taken as part of the UKIDSS DR1 release. The infrared image reveals the presence of the globular cluster of stars, first seen by the Spitzer Space Telescope, which is about 6 light years across with a mass of 300,000 suns. The brightness of the stars varies dramatically between the visible and infrared wavelengths due to interstellar extinction. (JAC-PR-08-01)

1.5 kpc star forming regions

Heat from the Heavens - Opening up the Infrared Sky

The image on the left shows a region called IRAS 20376 about 5,500 light years from Earth in the Constellation of Cygnus. This image in the visual wavelengths was taken by the Second Digital Sky Survey in the 1980s. In comparison, the image on the right shows the same area in the infrared, taken as part of a future UKIDSS public release. The infrared image reveals the presence and structure of an HII starforming region. (JAC-PR-08-01)

Molecular outflows in N1333

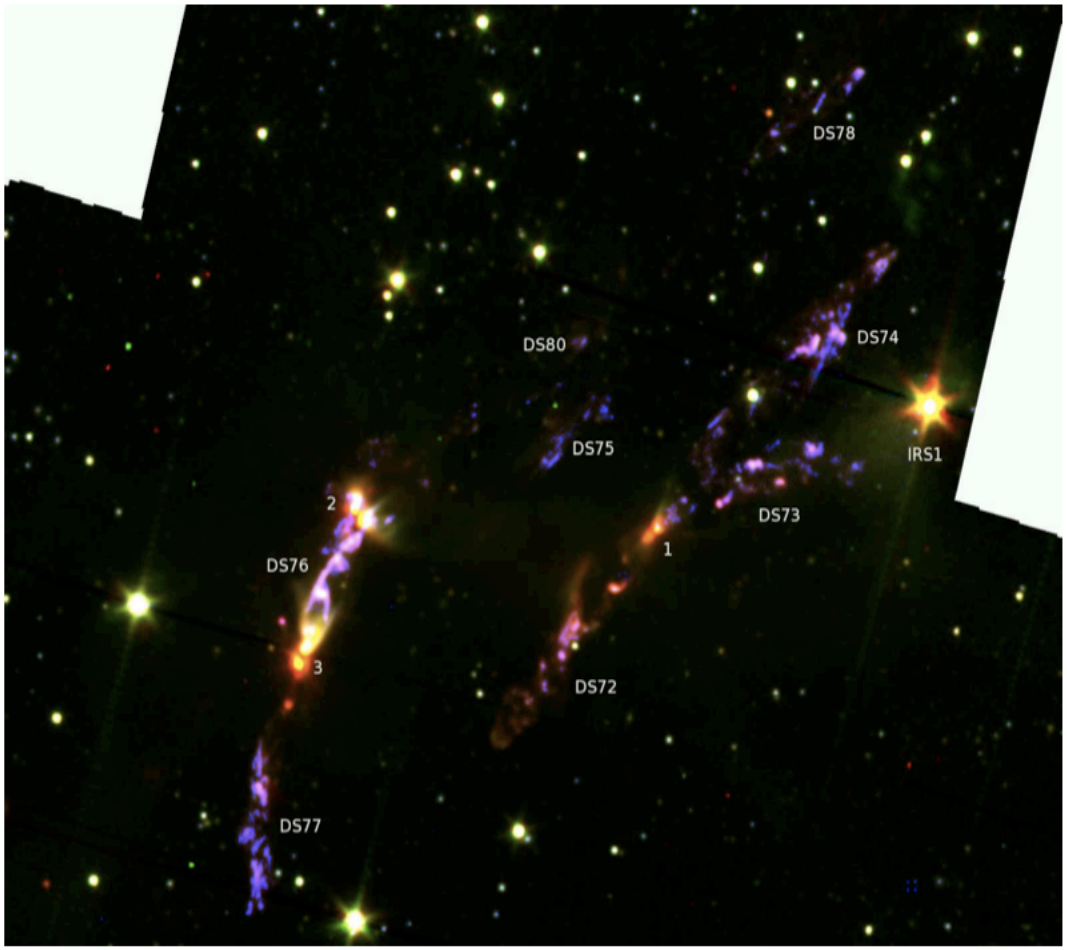
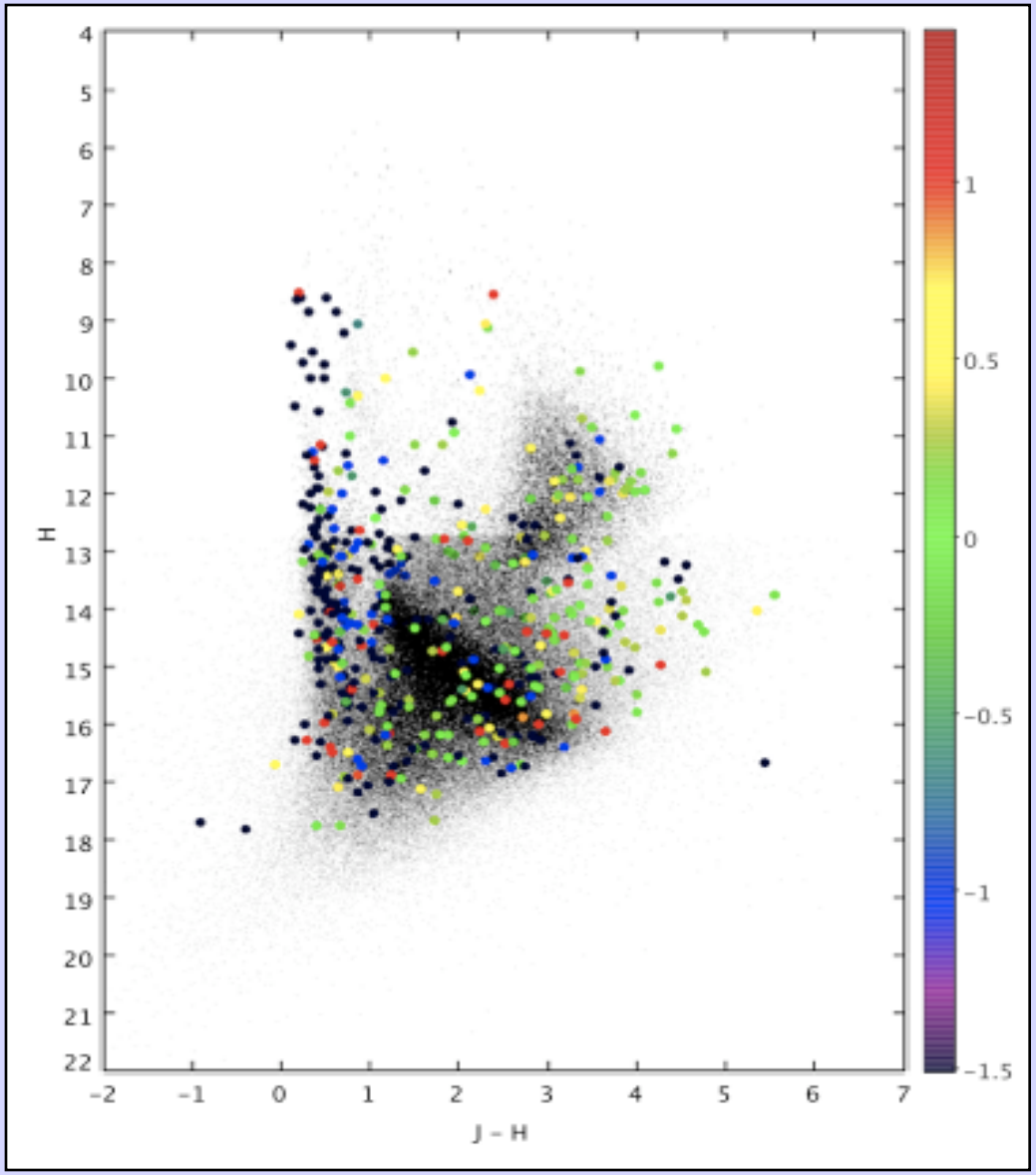


Figure 11. WFCAM H_2 2.122 μm (blue) - Spitzer 3.6 μm (green) - Spitzer 4.5 μm (red) colour composite image of L1448. Jørgensen YSOs are numbered.

Lucas et al 2008

X-ray sources in the bulge

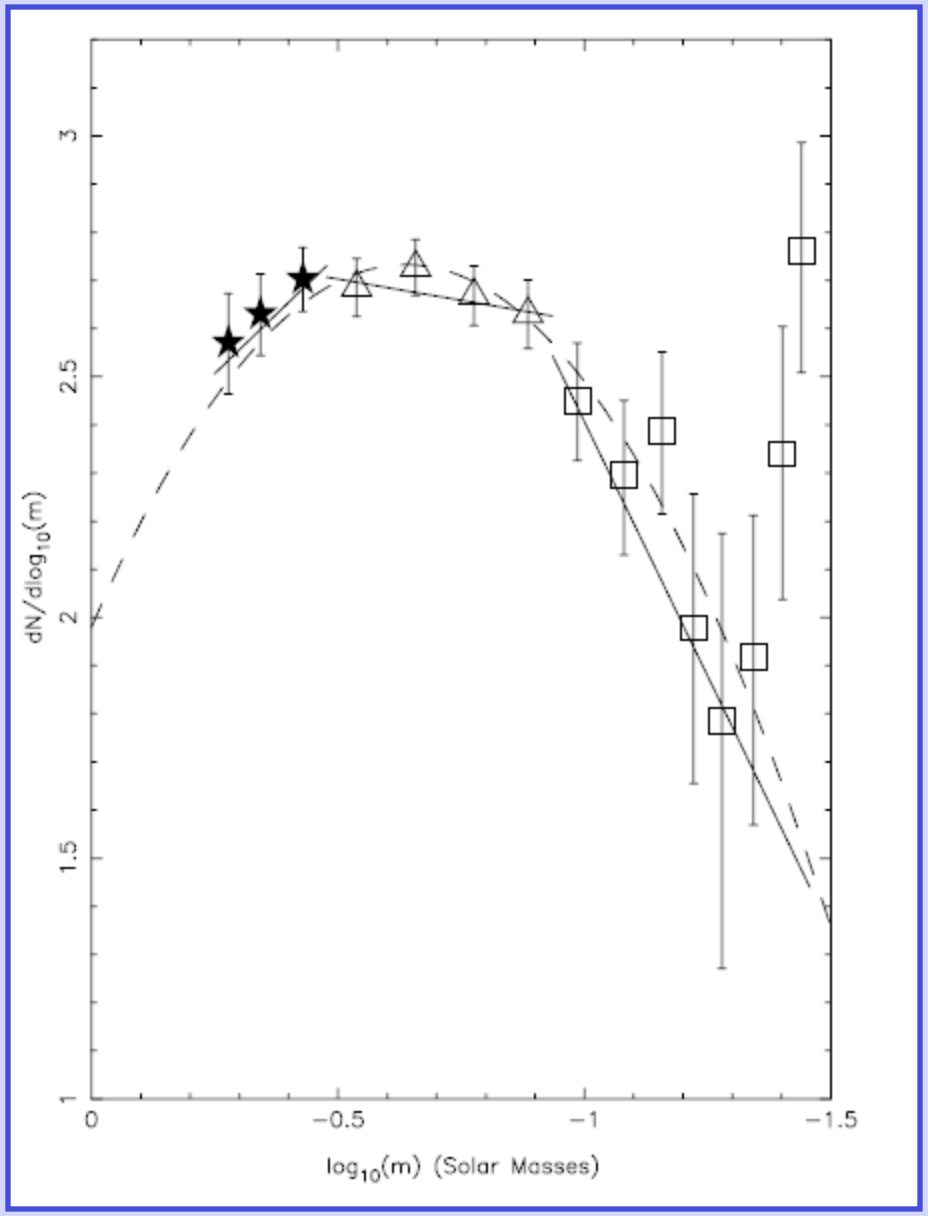


dots = UKIDSS sources
coloured spots = Chandra
colour = X-ray hardness

Lucas et al 2008

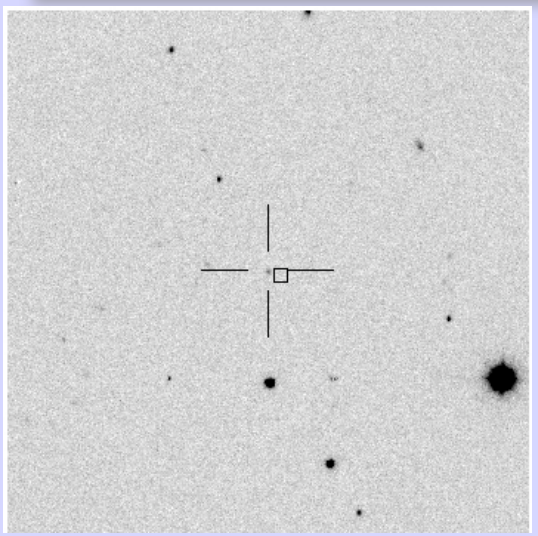
134pc substellar MF

- Pleiades GCS-DR1
- 5 band selection
- 73 new BDs
- MF Gaussian



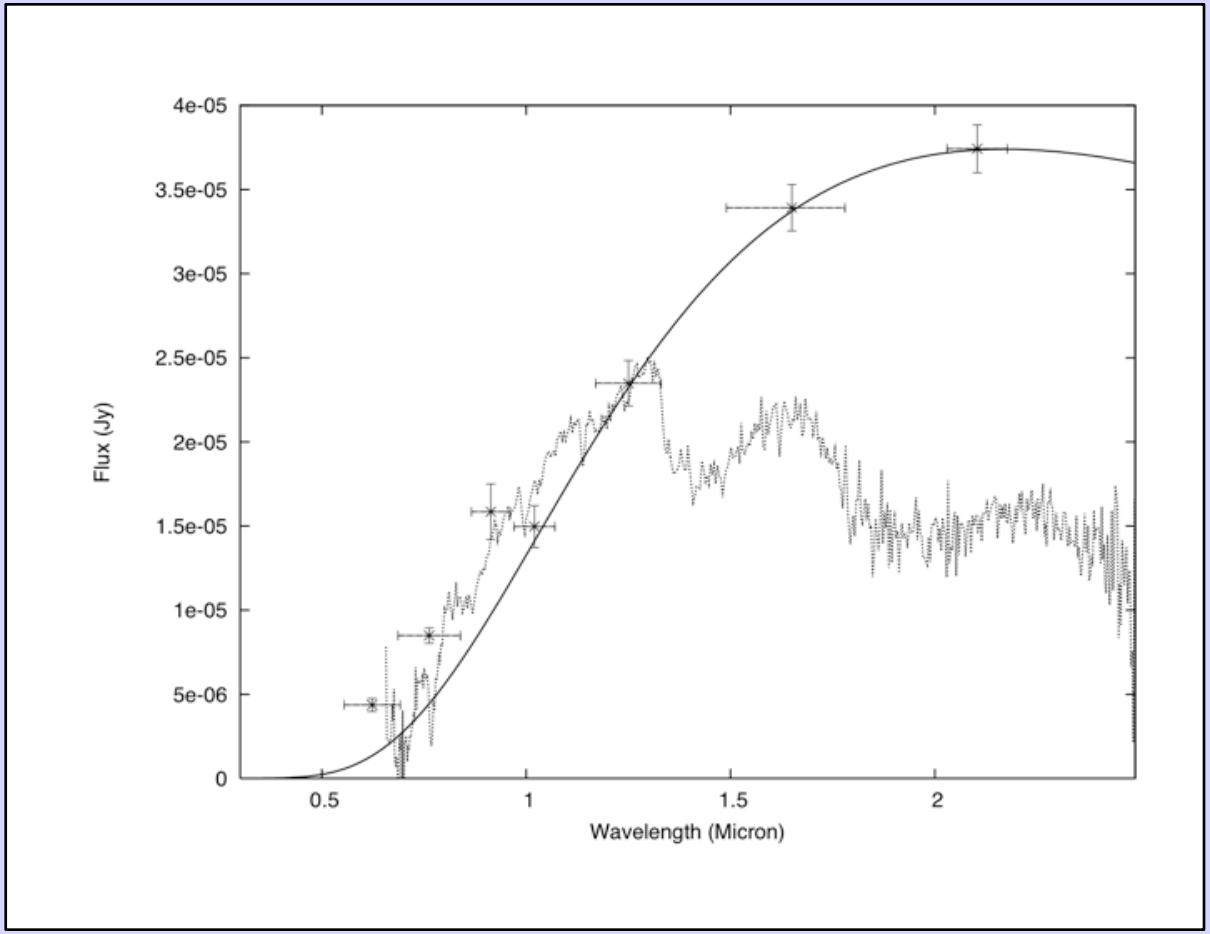
Lodieu et al 2007

60 pc Black Dwarf



41 mas/yr

ULAS J0922+1037
compared to M8.5

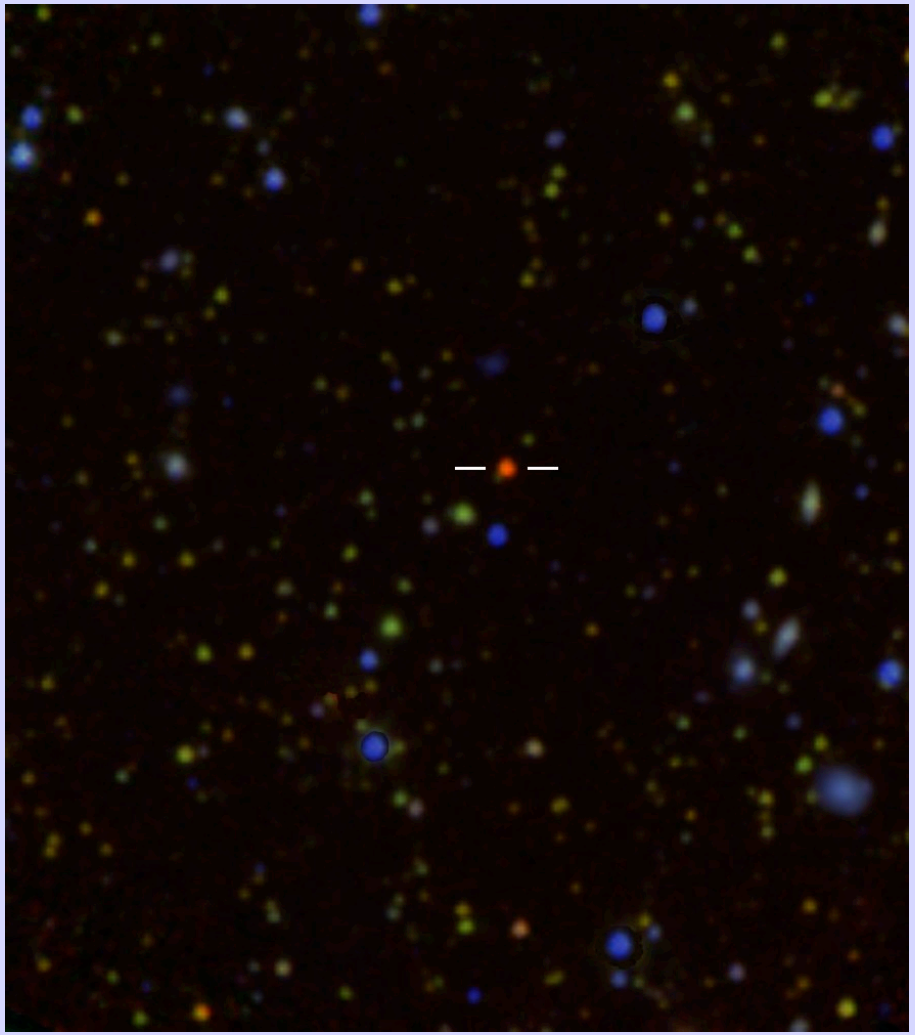


T=2350 Black Body
=> pure He atm. WD

Casewell et al 2008 in prep

20 pc Brown Dwarf

- ULAS J0034-00
- Coolest known dwarf (T8.5)
- T~600K
- M~15-36 M-Jup

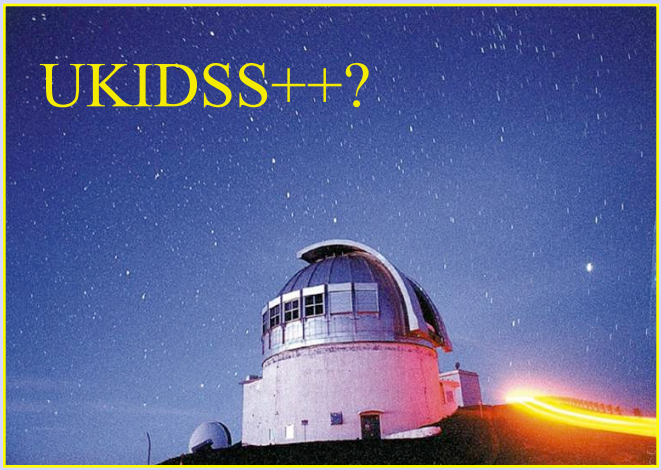


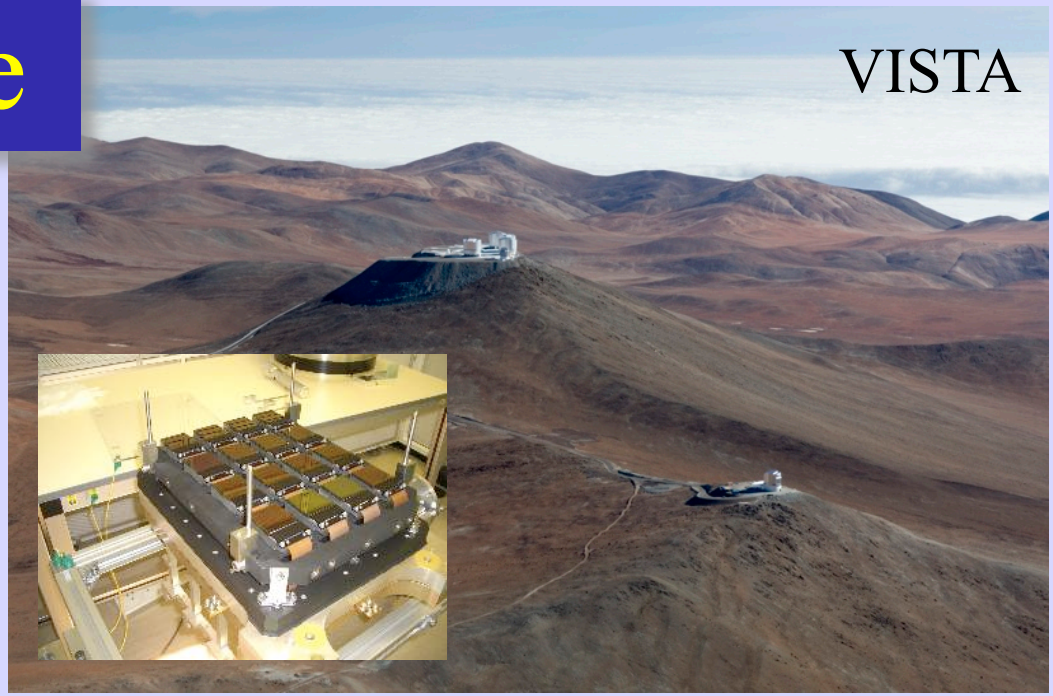
blue = Z
green = Spitzer 3.6um
red = Spitzer 4.5 um

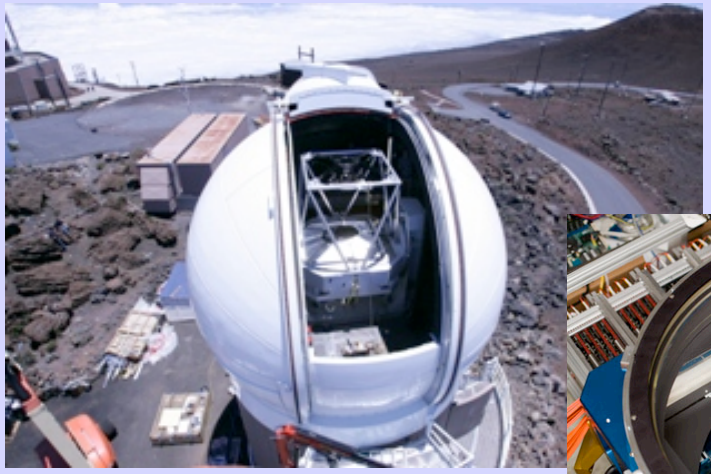
Warren et al 2007

Future

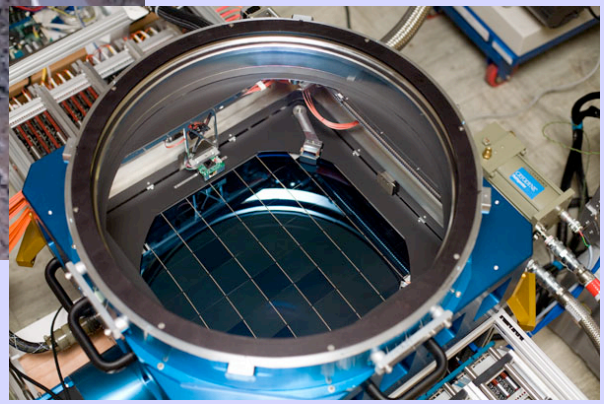
IR survey future







PanSTARRS



Science from *combination* of all these

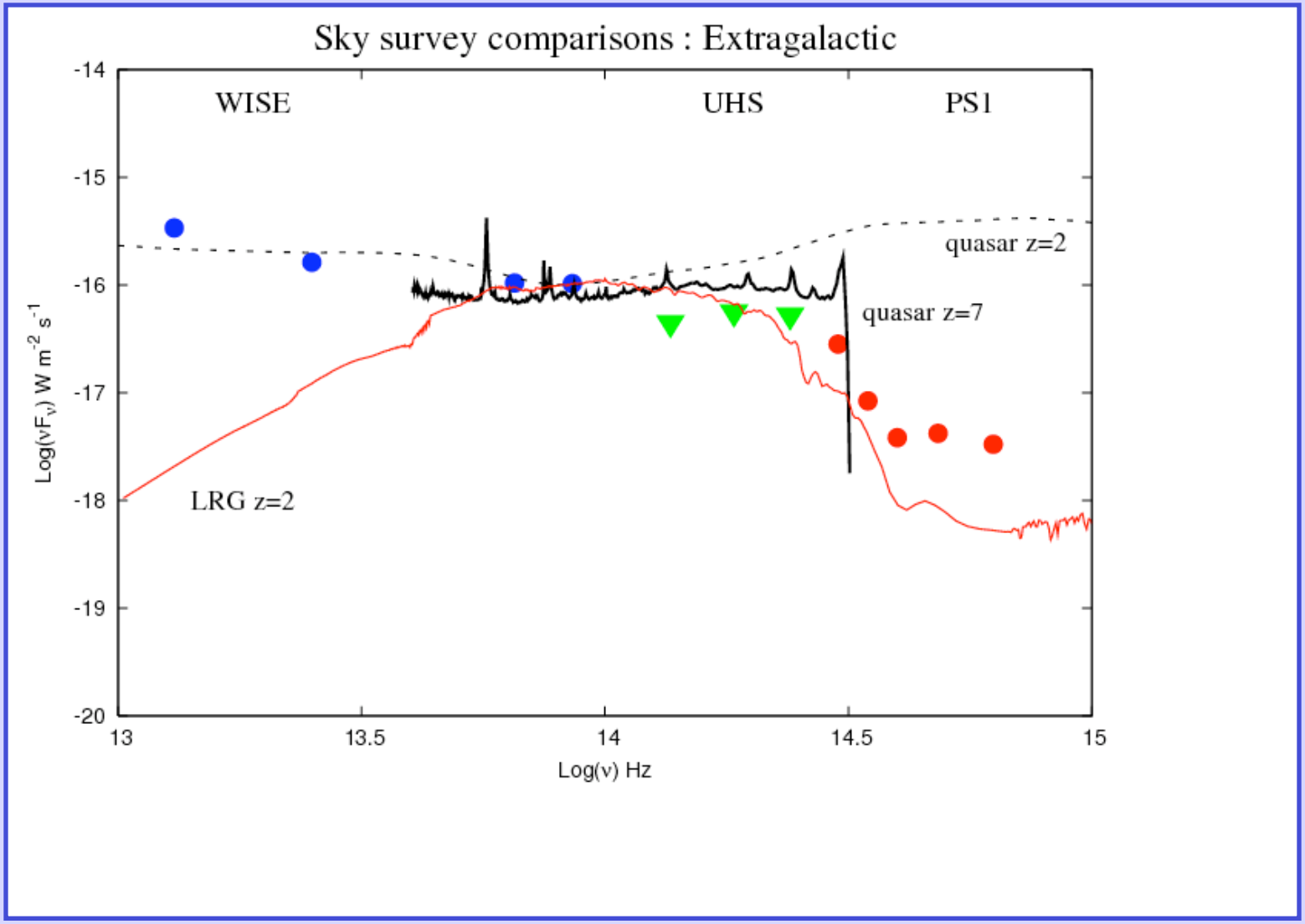
NIR all sky ?

- UKIDSSS LAS+GPS+GCS
  - underway : complete by 2010ish
  - 7000 sq.deg. ZYJHK
- VISTA Hemisphere Survey (VHS)
  - 20,000 sq.deg. YJHK
  - approved : starts 2009 : PI McMahon
- UKIRT Hemisphere Survey (UHS)
  - everything at Dec<60
  - 12,500 sq.deg JHKK : 800 nights needed
  - proposed Nov 2006 : deferred

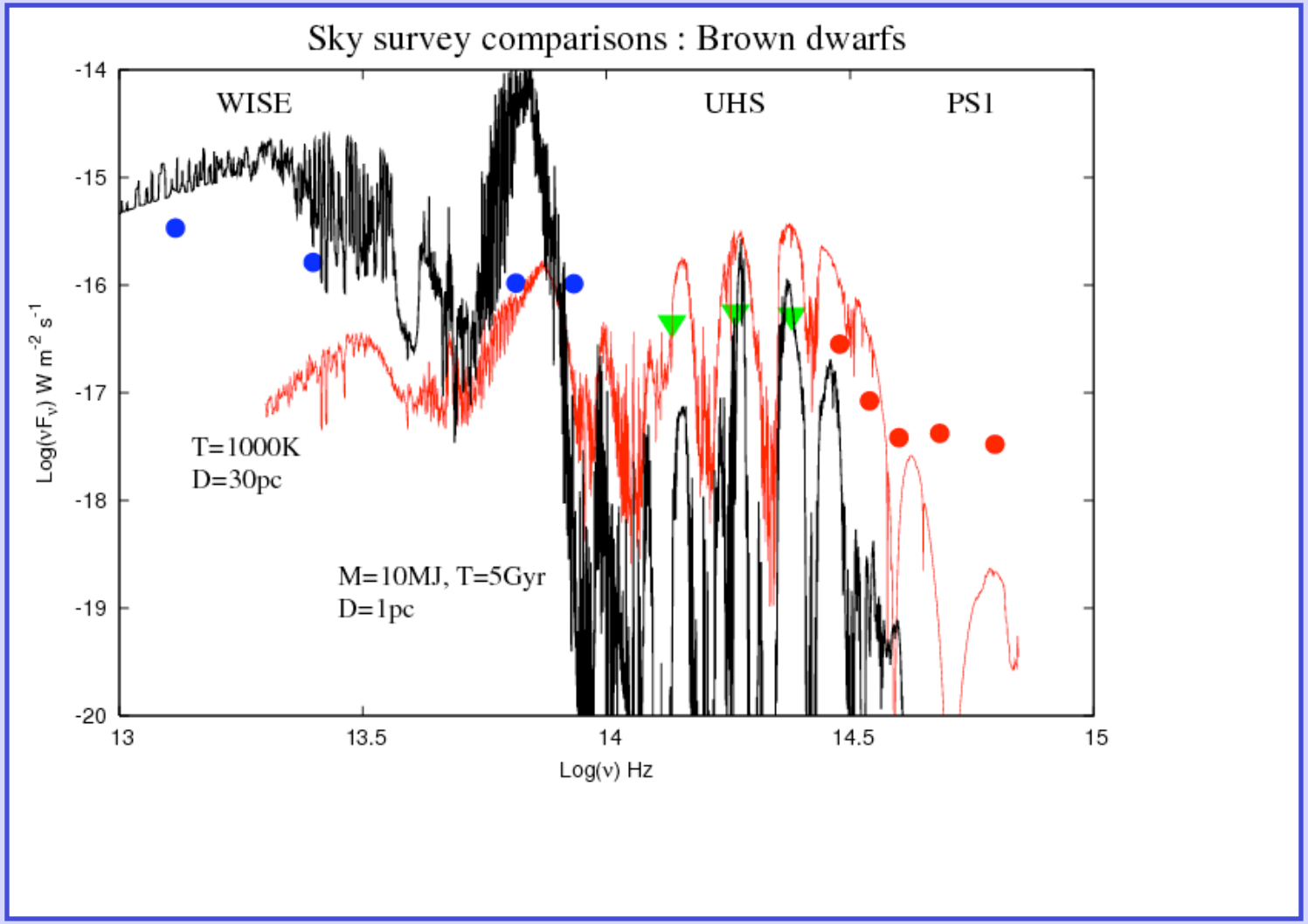
selected goals

- Ionisation history and spatial structure
  - 50 quasars at z>6.4, 10 quasars at z>7.2
- Galactic Archaeology
  - M-dwarfs to 1kpc; M giants throughout the Galaxy
- Extreme brown dwarfs & free floating planets
  - first sight of T<400K and maybe T<200K objects
- Phase space picture of solar neighbourhood
  - proper motions of 10^5 L-dwarfs
- Dark energy : Large scale / high-z clustering
  - 10^5 LRGs at =2-4 : Gpc clustering
  - thousands of rich clusters z<1.5

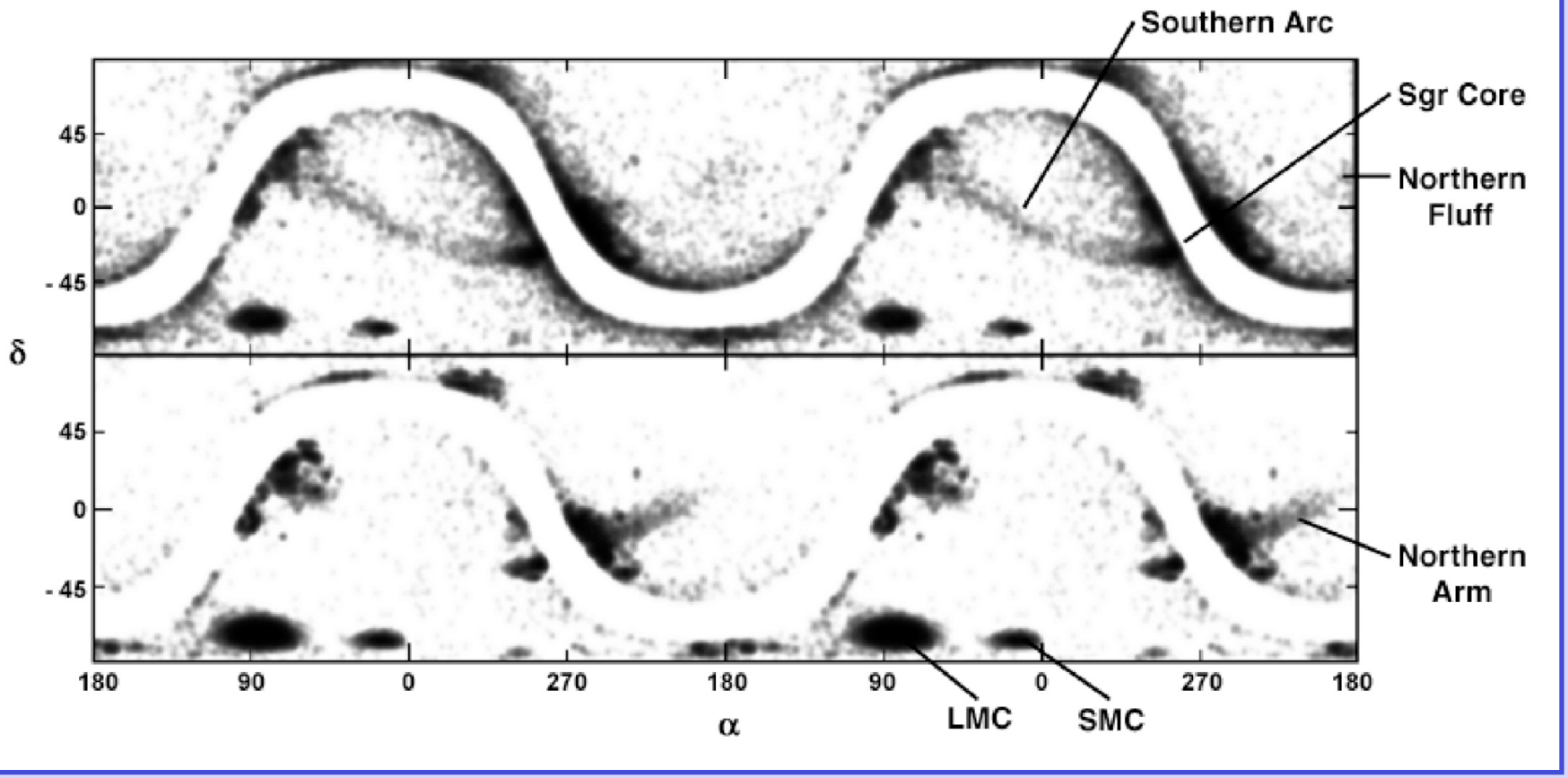
UHS+PS1+WISE : extragalactic



UHS+PS1+WISE : brown dwarfs



Galactic Archaeology



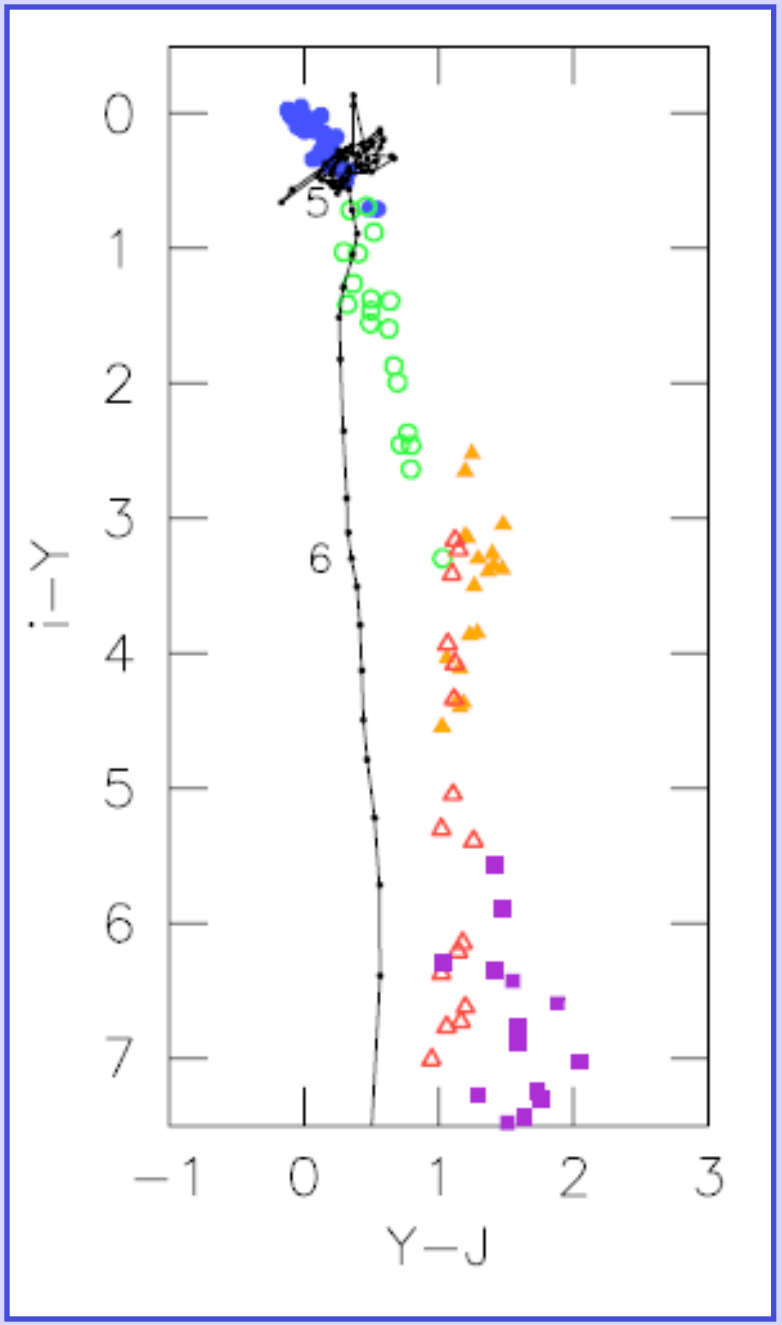
Majewski et al 2003
2MASS filtered in narrow lum/colour range showing Sagitarrius stream

z>6

black	**quasar track**
blue	**O-K**
green	**M**
orange	**L**
red	**T**
purple	**Y**

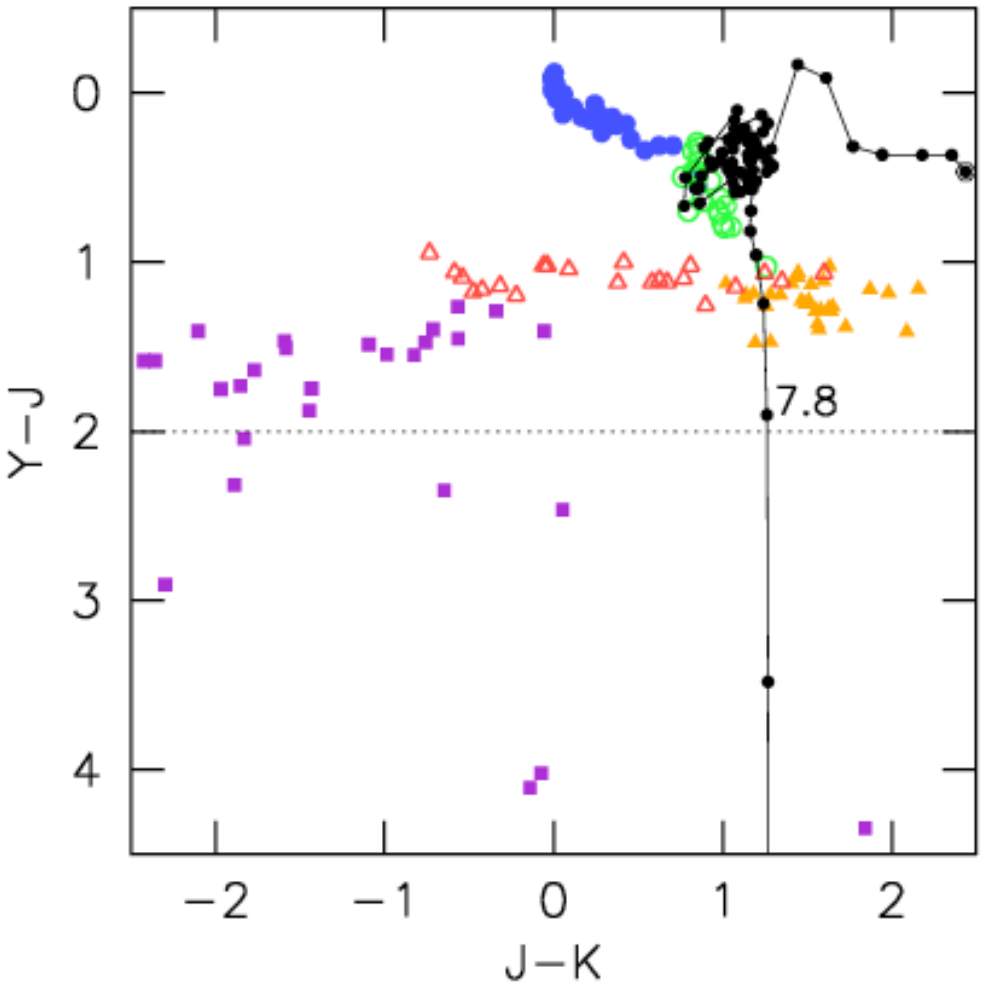
i and Y drop out
Y-J separates
T-dwarfs and quasars

predict 45 quasars
z=6.4-7.2



Hewett et al 2006

z>7

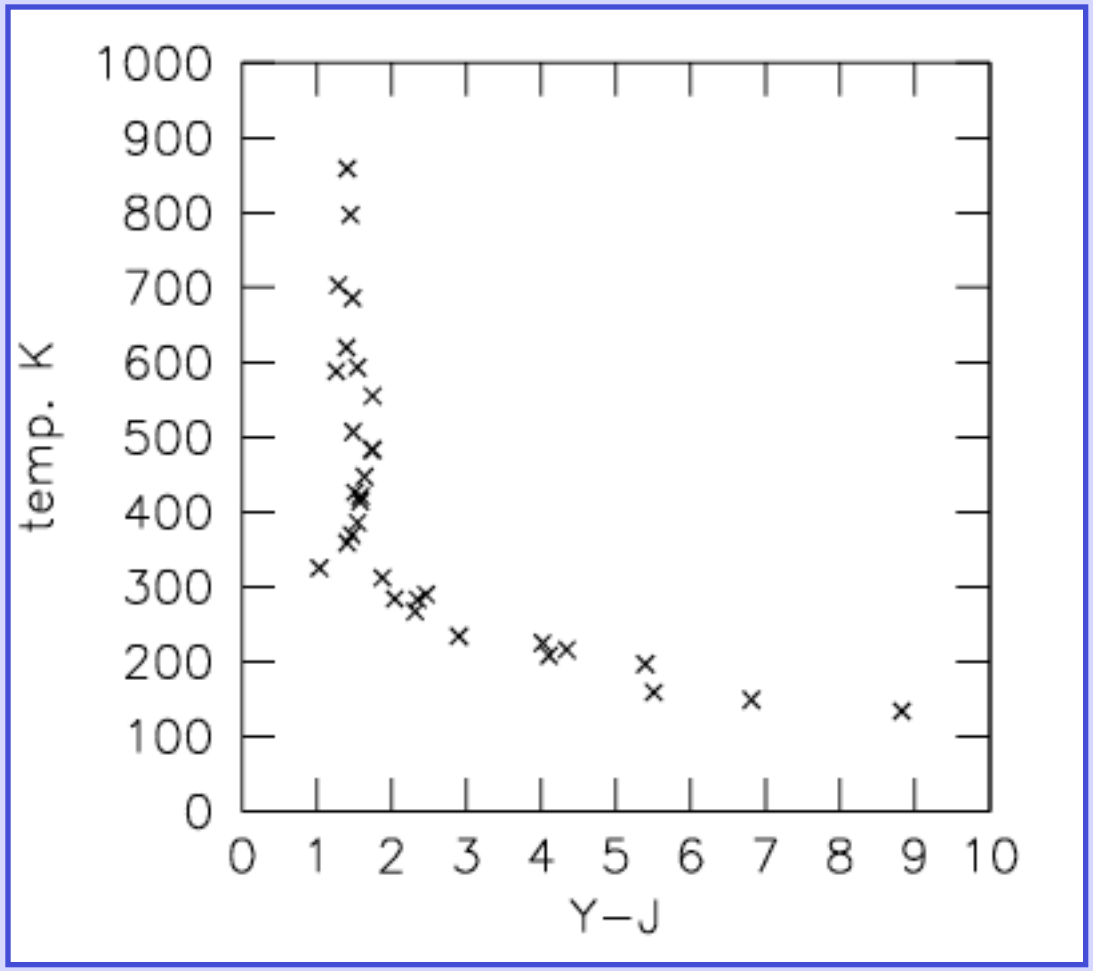


quasars become redder in Y-J confused with T-dwarfs .... need J-K

predict 11 quasars z=7.2-8.0

note also some Y dwarfs with extreme Y-J...

brown dwarf colour *vs* temp



Oldest/smallest stars will have very distinctive Y-J colours

2MASS : T>700
LAS : T=400-700K
UHS+PS : T<400

- PSy deeper than LAS
- 5 x area
- proper motions

predictions from Burrows et al

Demo