

Digging up the Dirt on Galaxies



erschel ATLAS

Loretta Dunne, Steve Eales
and the ATLAS consortium

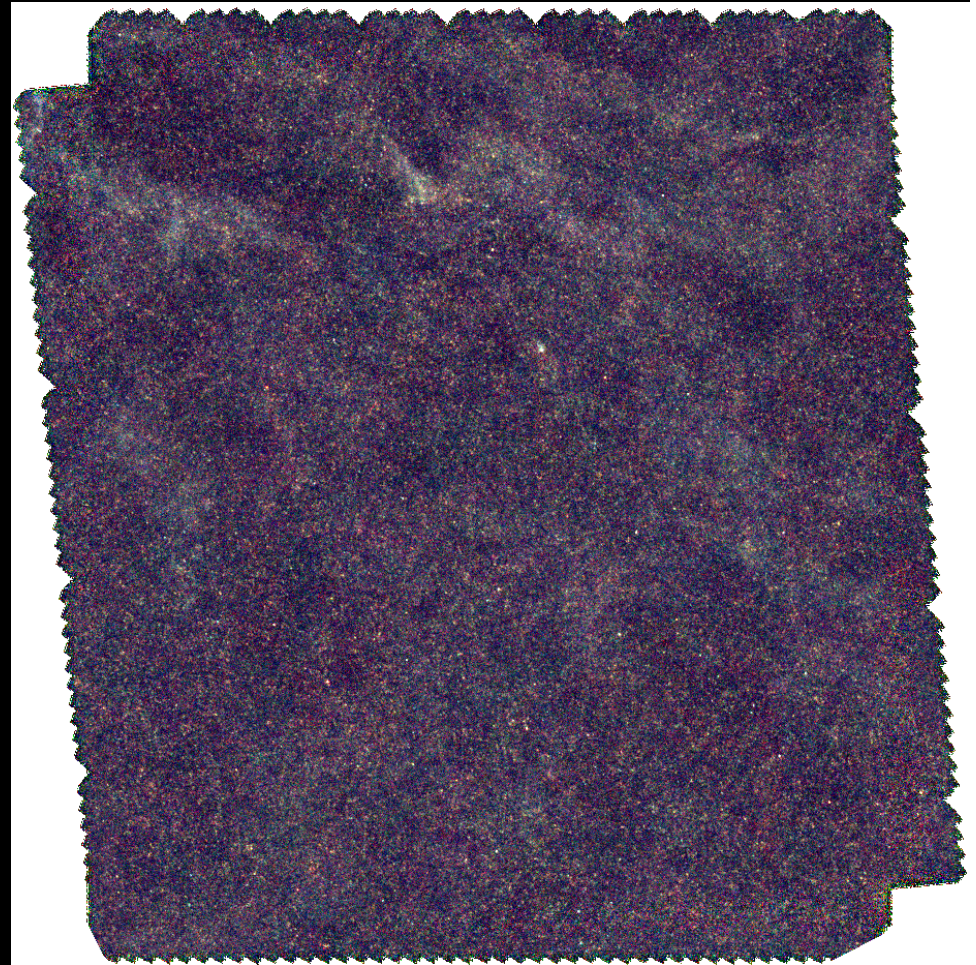


The University of
Nottingham

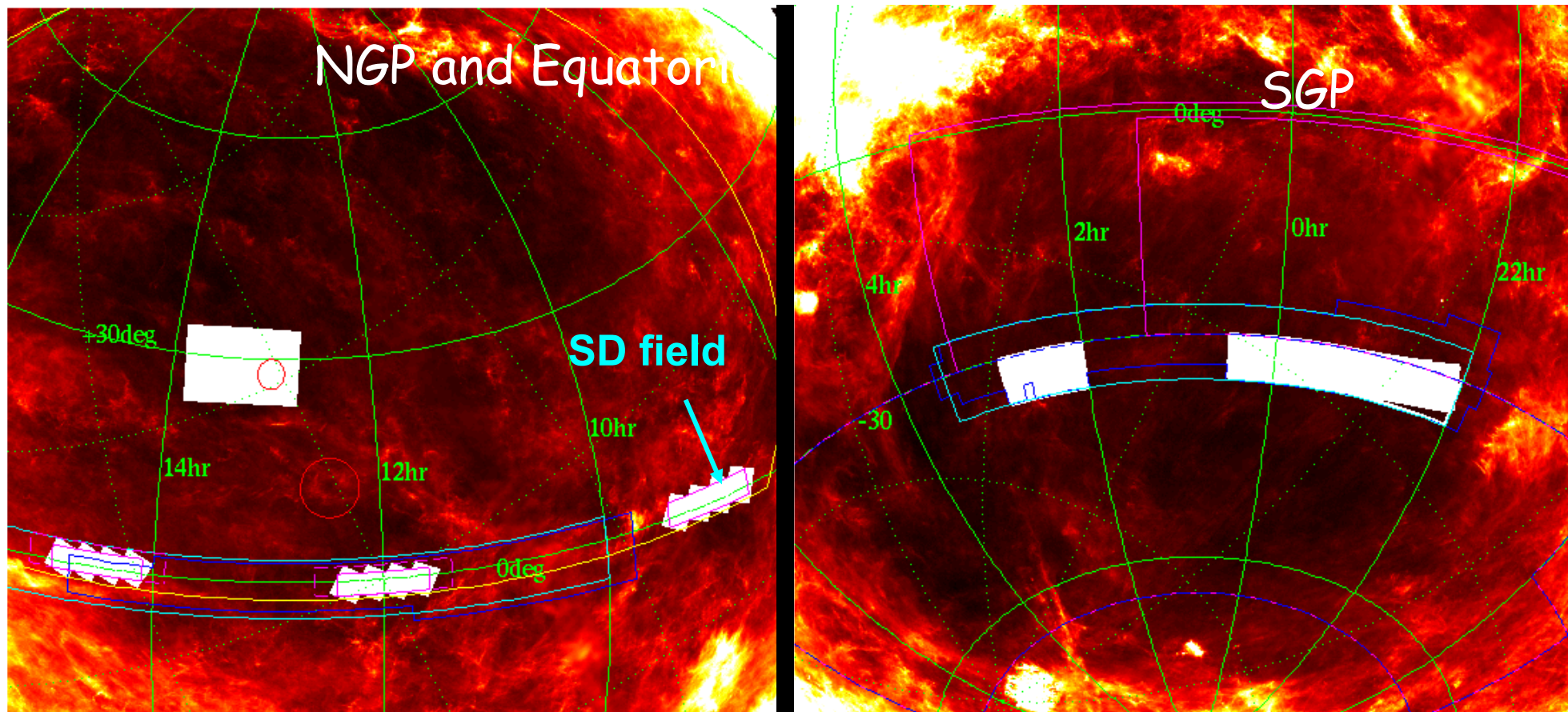
The Herschel ATLAS

Astrophysical Terahertz Large Area Survey

- The widest area survey with Herschel (~ 550 sq deg)
- Consortium of 150+ astronomers worldwide led by Nottingham and Cardiff (Dunne, Eales)
- Covering 5 bands with PACS and SPIRE (110 – 500 microns) in fast parallel mode
- 5 sigma sensitivities of 132, 126, 33, 36 and 45 mJy / beam from 110-500 μ m
- Detect $\sim 10^5$ sources to $z \sim 3$



3-col SPIRE H-ATLAS SD field

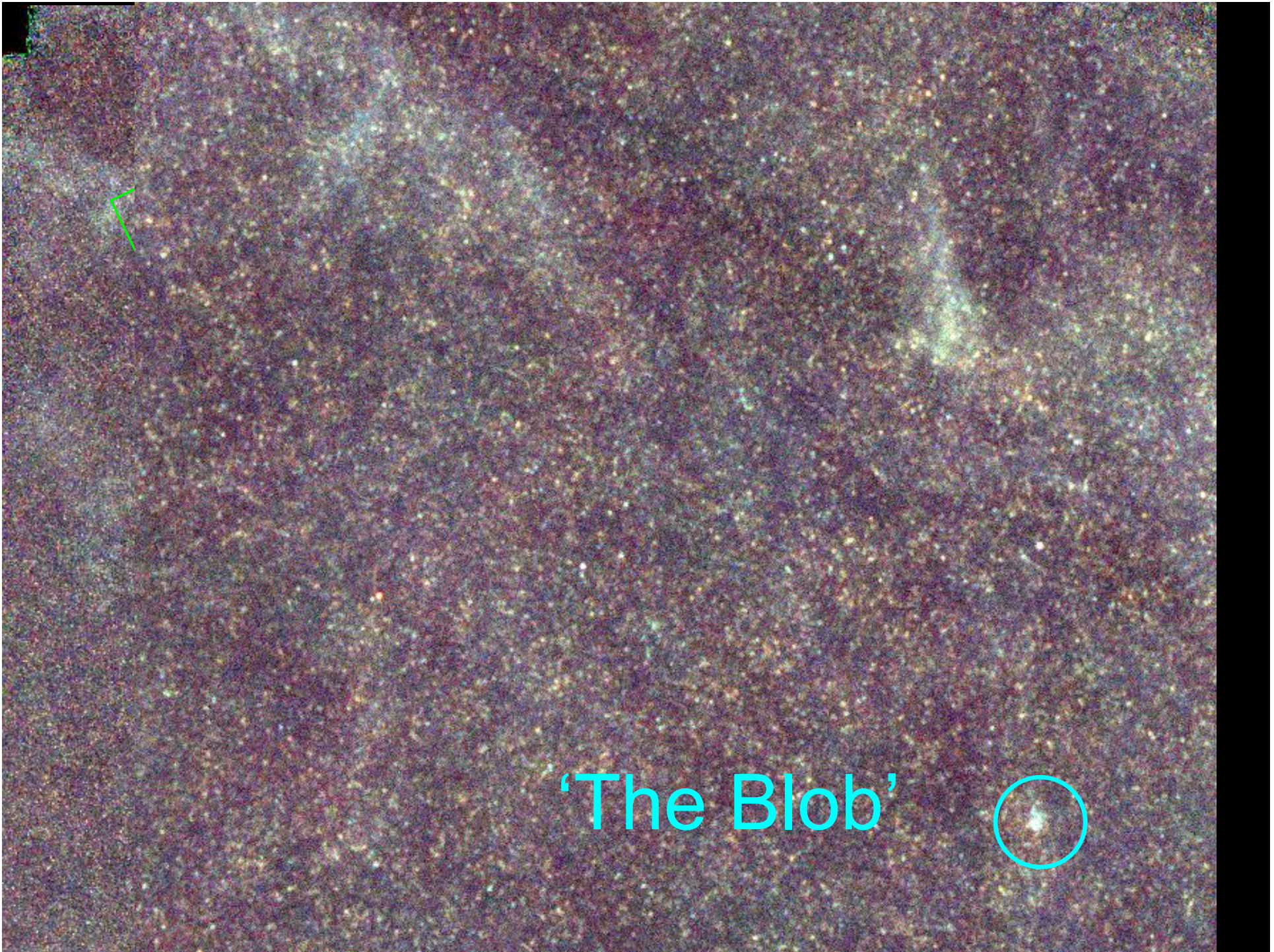


Fields chosen to allow maximum overlap with existing and planned surveys
 GALEX, 2dF, SDSS, GAMA, UKIDSS, KIDS, VIKING, PanSTARRS, DES, SPT, SASSy

and to be accessible to new facilities which will be valuable for follow-up
 ALMA, SKA and prototypes, SCUBA2, LOFAR, e-MERLIN

Key Science Themes in H-ATLAS

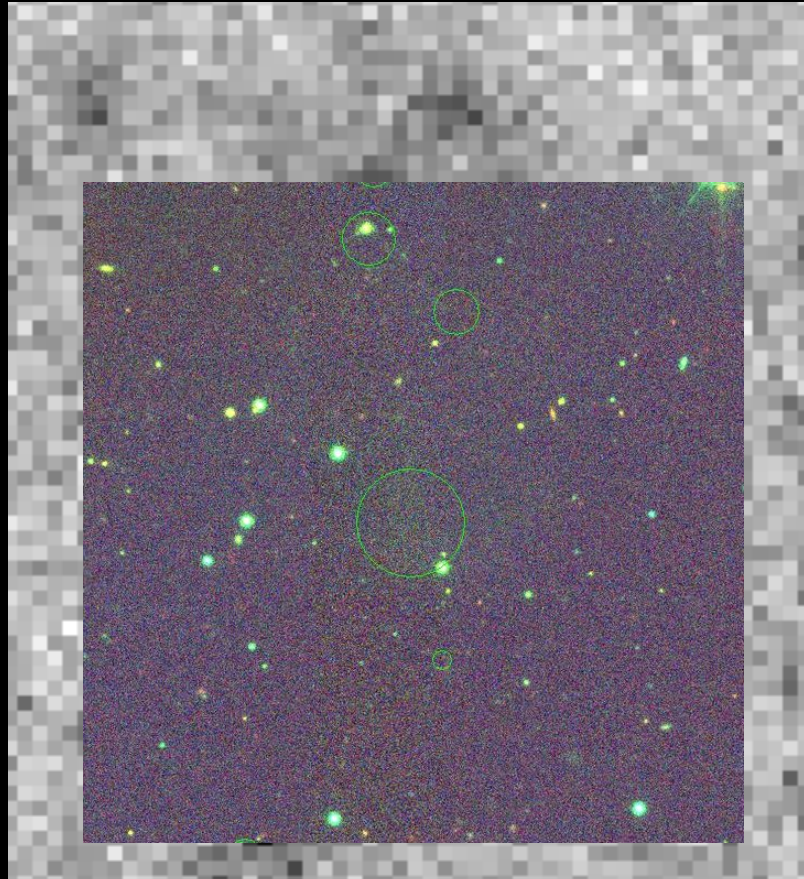
1. Local Universe Survey
2. Synergies with Planck
3. The Herschel Lens Survey
4. AGN and rare objects
5. Large scale structure and High-z galaxies
6. Galactic star and planet formation



'The Blob'



The 'Blob'



Intriguing Galactic
Object

Either very low mass
Bok globule

.. Or normal mass
but very far out of
the plane

See Mark Thompson
poster

H-ATLAS: Local Universe

Census of dust and obscured SF in $\sim 70,000$ galaxies at $z < 0.3$

UNBIASED study of galaxy evolution in submm bands

Overlap with UV / optical / NIR surveys allows holistic study of galaxy populations

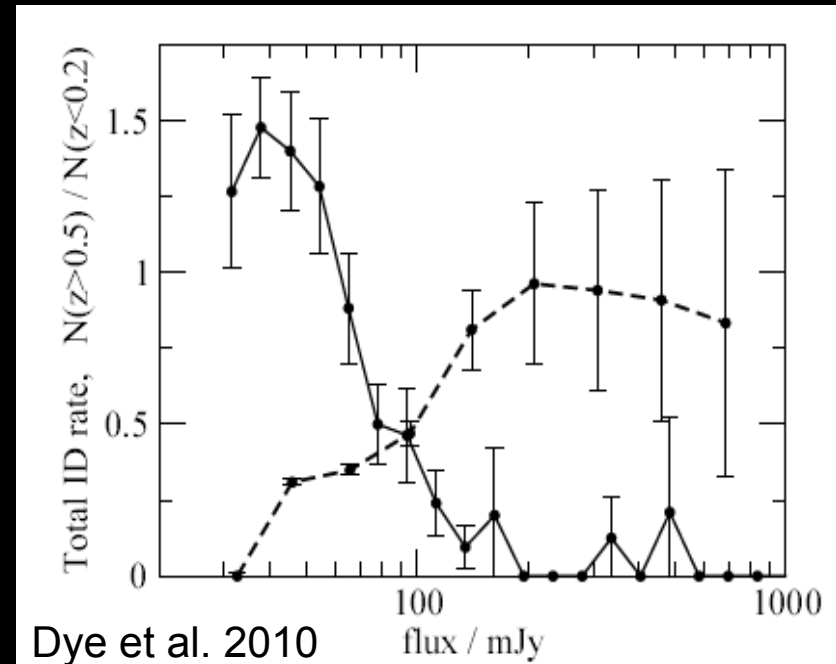
Survey contains a range of environments



First Results: Luminosity and dust mass functions
Modelling galaxy SEDs
Radio/FIR correlation

Local galaxy catalogue

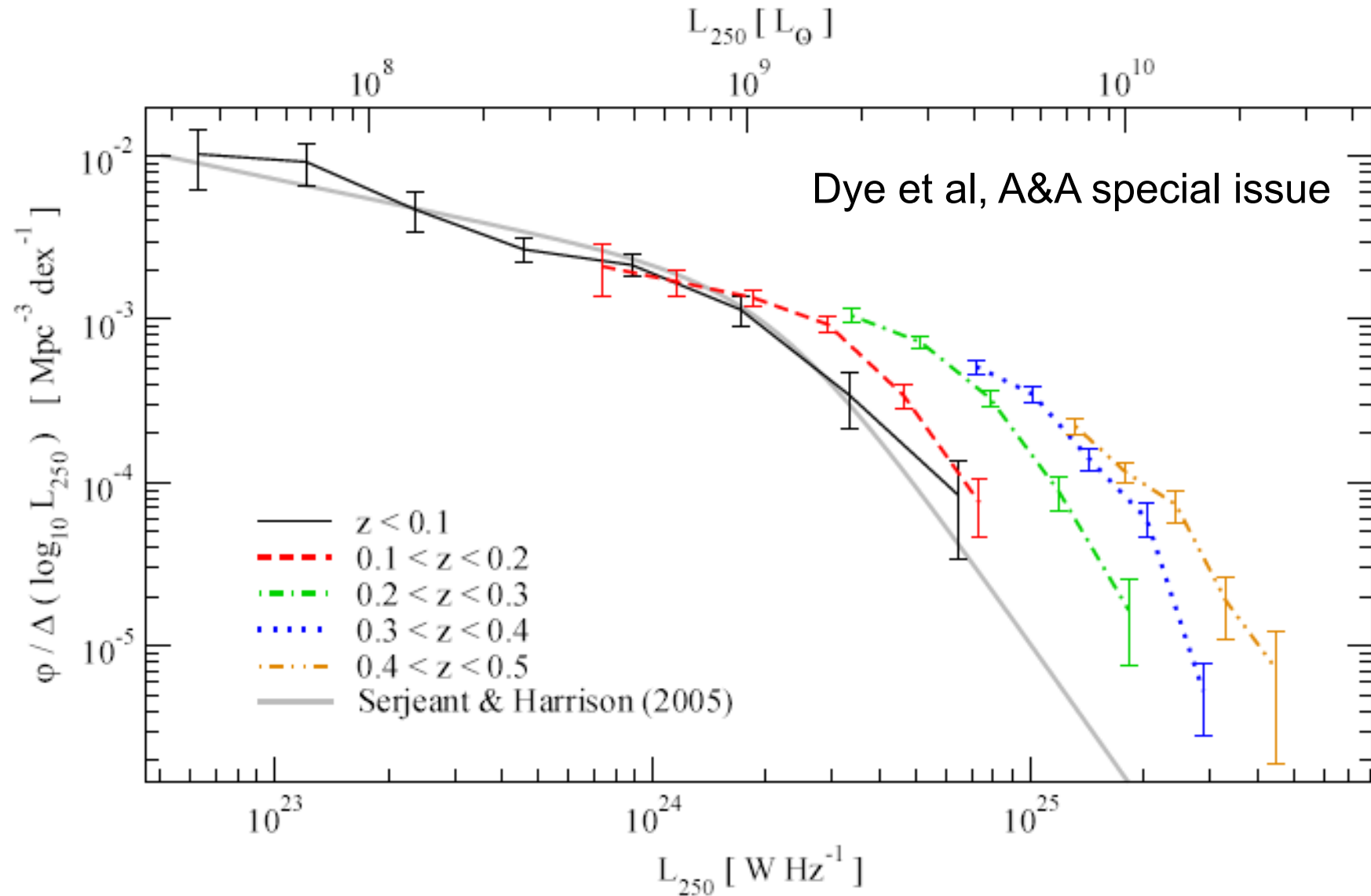
- 5 sigma $250\mu\text{m}$ catalogue of 6600 sources
- XID to optical ($r < 22.4$) using SDSS DR7 and a likelihood ratio method (see poster by Dan Smith)
- 2240 reliable counterparts ($>80\%$ reliability)
- Includes 66 'stars' – either stars or QSO



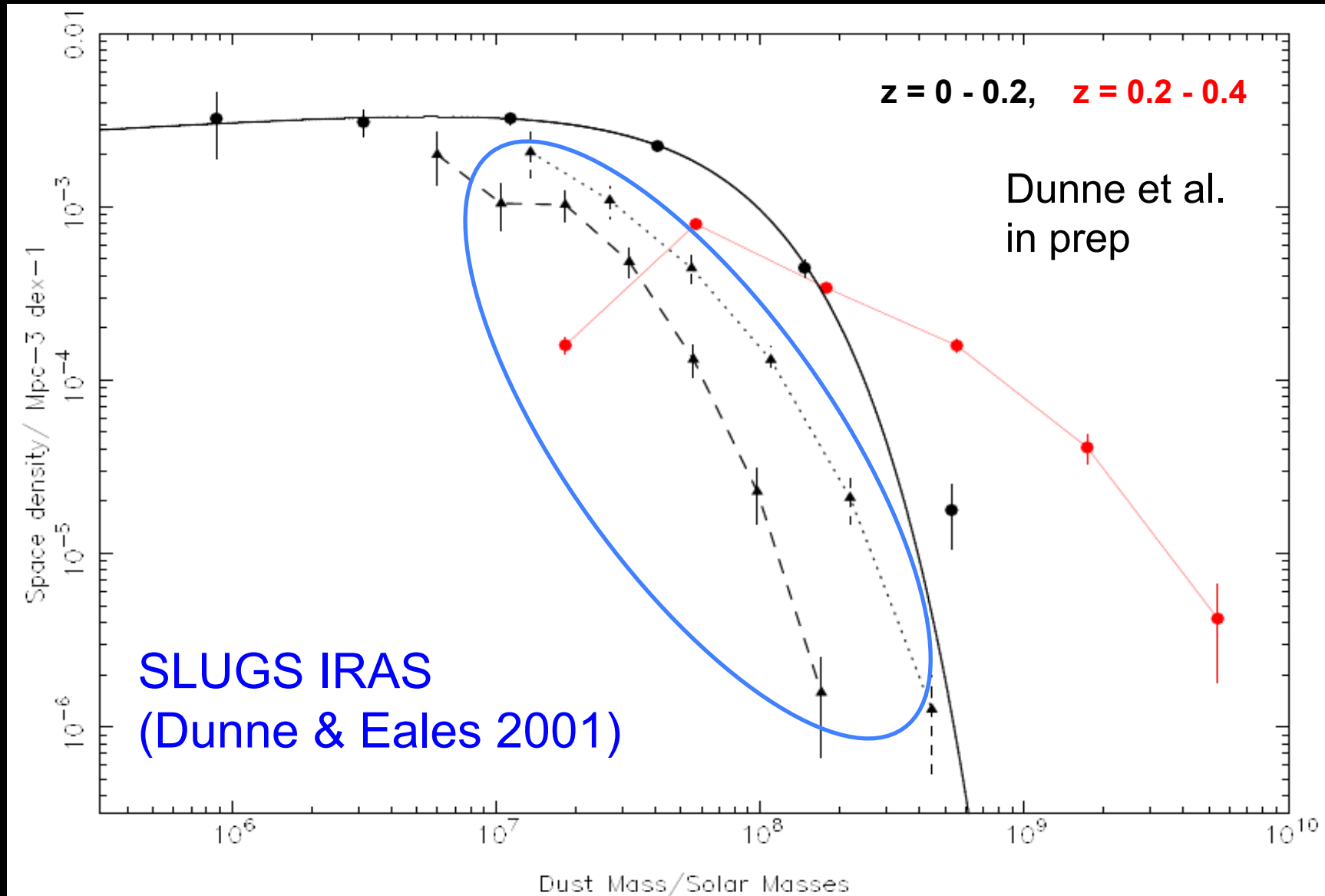
N(z) of identified sources

Remaining sources believed to be at higher z (see Cooray talk on Thursday)

Evolution of the 250 μ m Luminosity Function



Dust mass functions

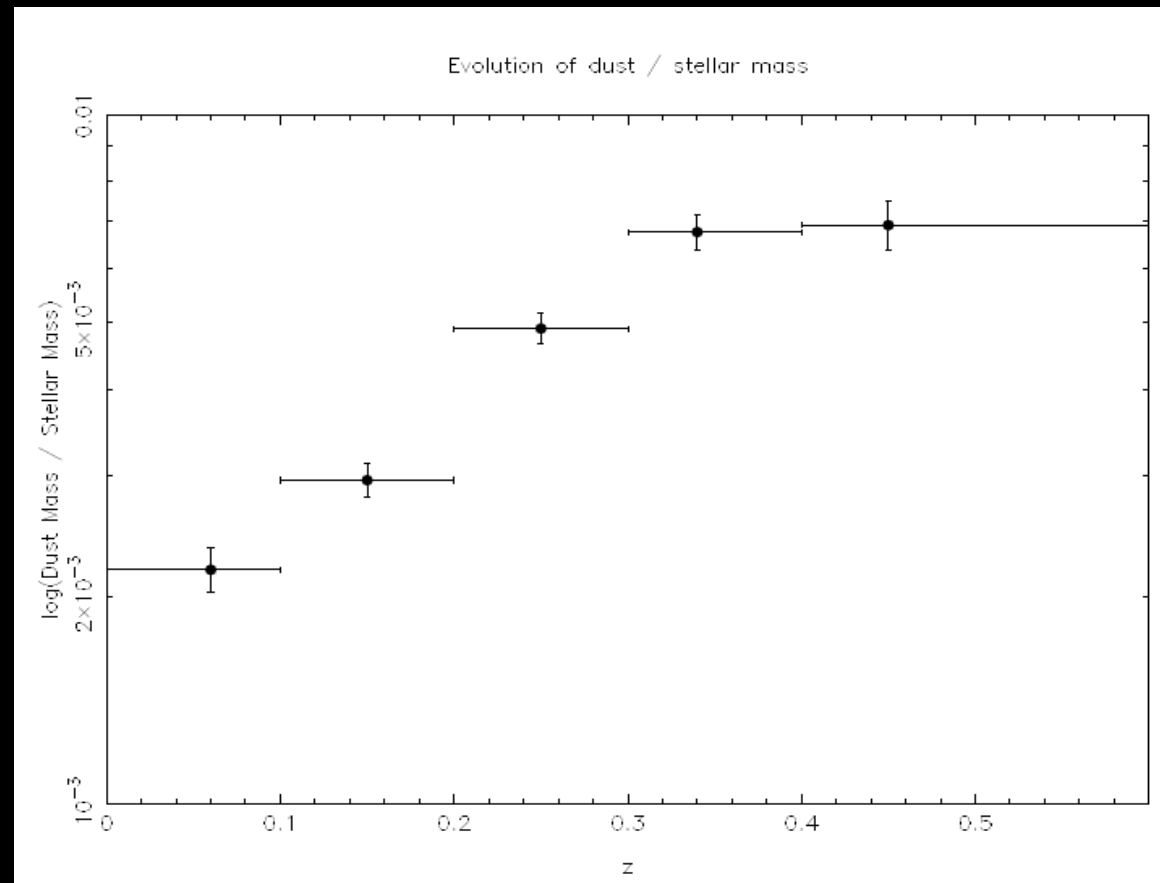


Evolution in the submm bands

LF shows strong evolution
(Dye et al.)

L250 evolves as $(1+z)^{7.1}$
(Dye et al.) – consistent with
that at $60\mu\text{m}$ (Saunders 90)
but steeper than that at
 $24\mu\text{m}$ (Le Fl'och 05)

Dust mass / stellar mass
also appears to evolve over
the past 2-3 billion years
(Dunne et al. in prep).



.... and now for something completely
different

Modelling edge-on galaxies – UGC 4754 (Baes et al. A&A special issue)

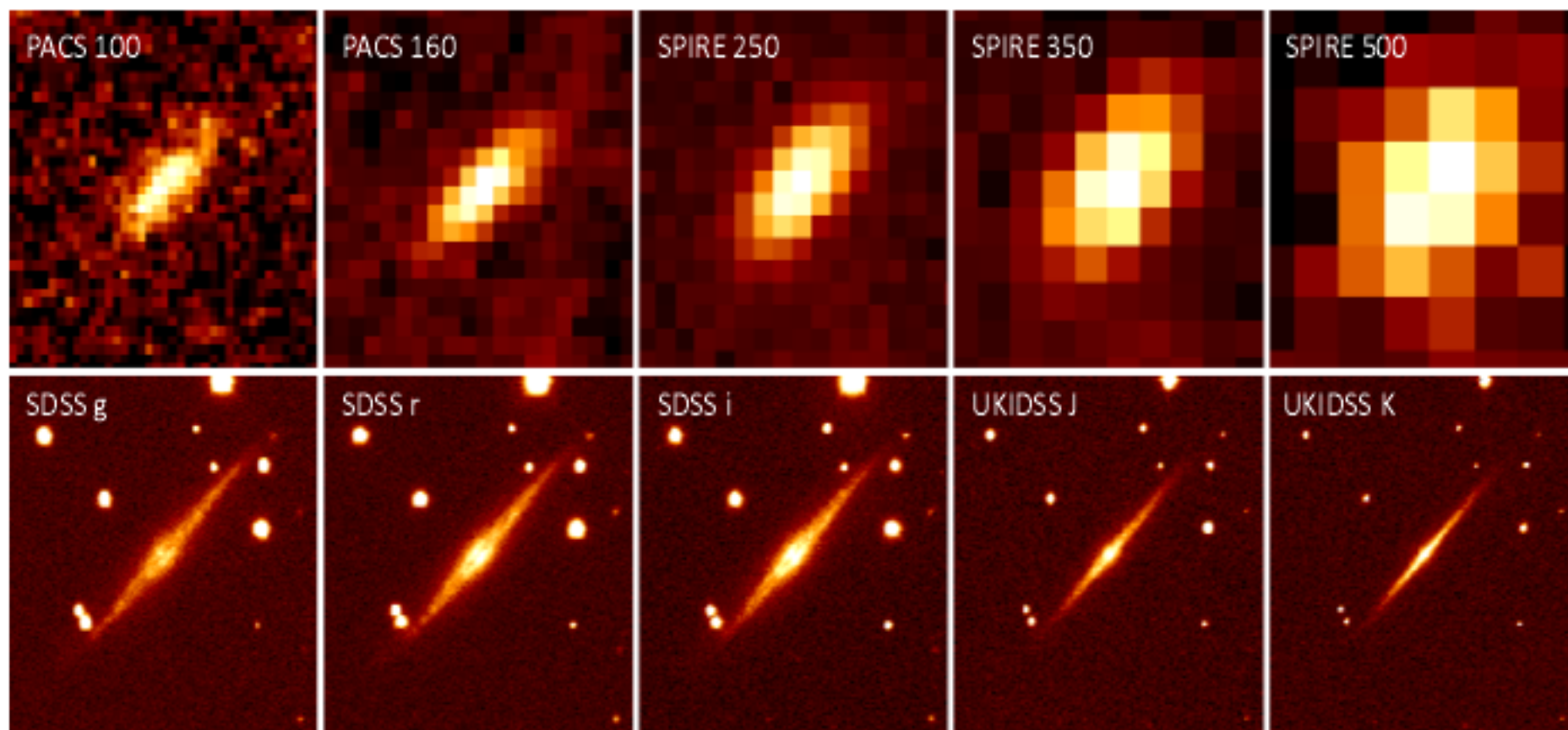
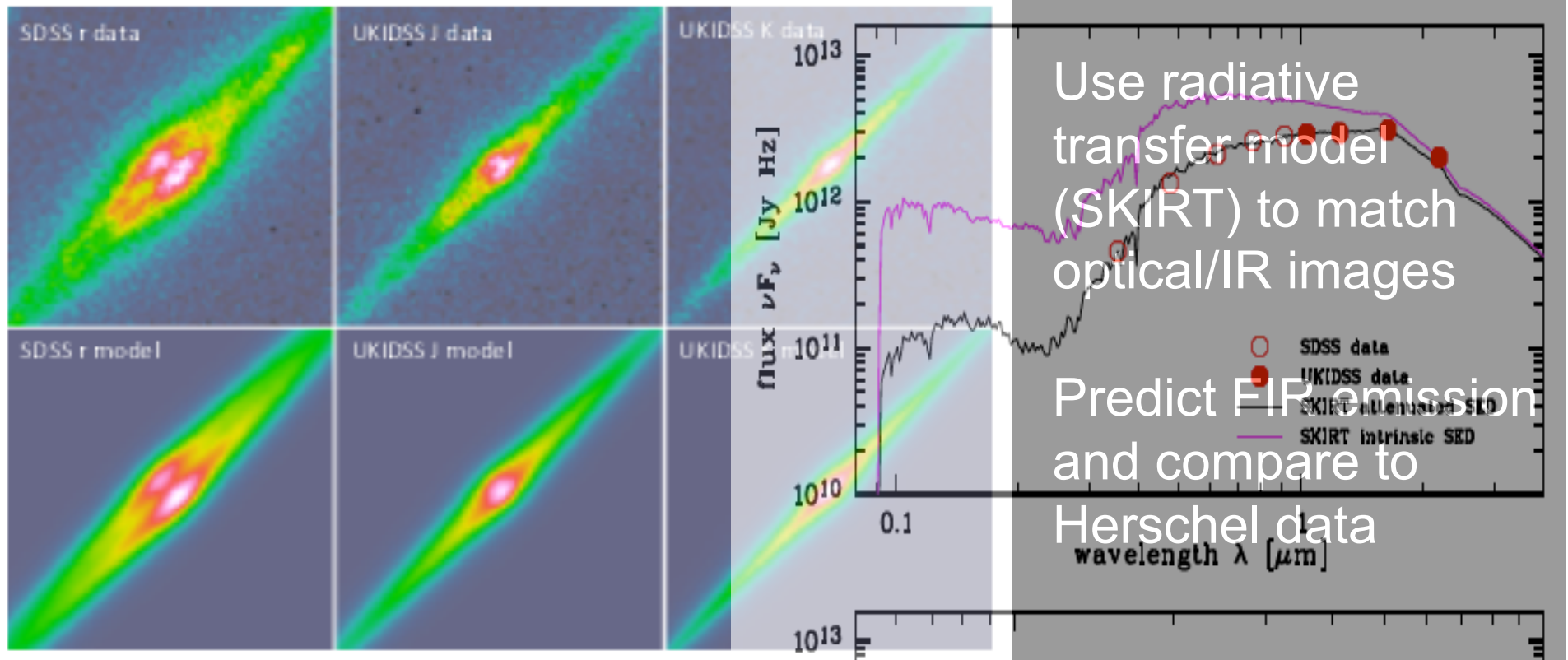


Fig. 1. The multi-wavelength view of UGC 4754. The top row shows the Herschel images, the bottom row a selection of optical and NIR images from SDSS and UKIDSS. The field-of-view of each image is $100'' \times 100''$.



- Predicts less FIR emission by x3
- Not fixed by higher sub-mm emissivity
- Require extra 'hidden' dust, in optically thick clumps (eg star forming regions)

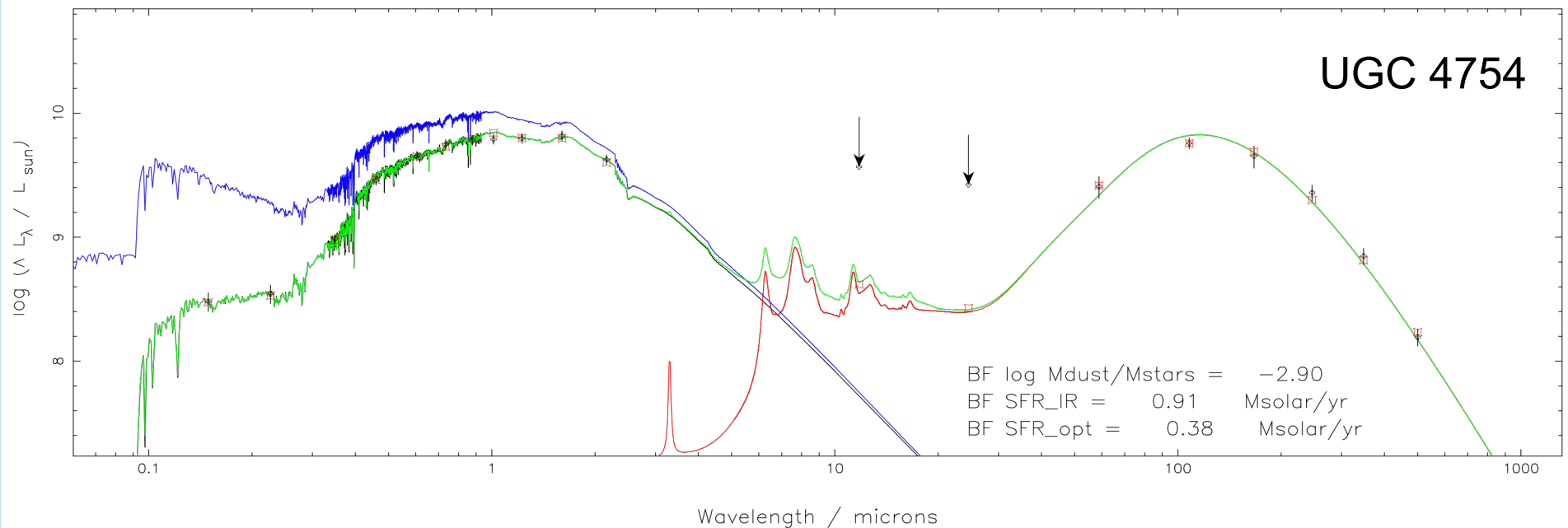
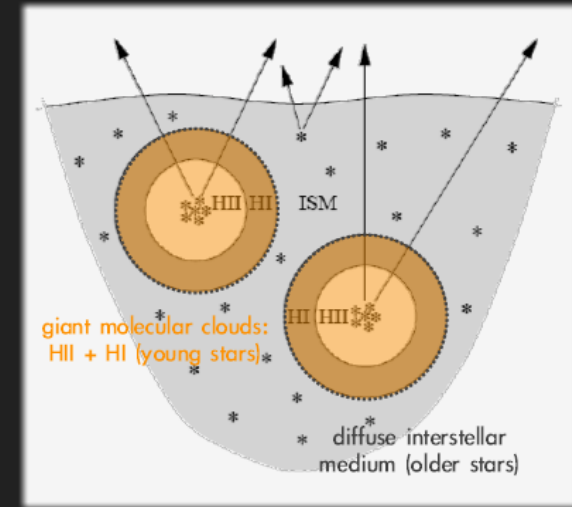
Energy balance SEDs

Smith et al, in prep (see poster)

Da Cunha et al. 08, 10 (see poster)

Burgarella poster

Balance UV/optical energy loss with FIR emission.
Uses 2 dust components – diffuse ISM (cirrus) and
birth clouds.

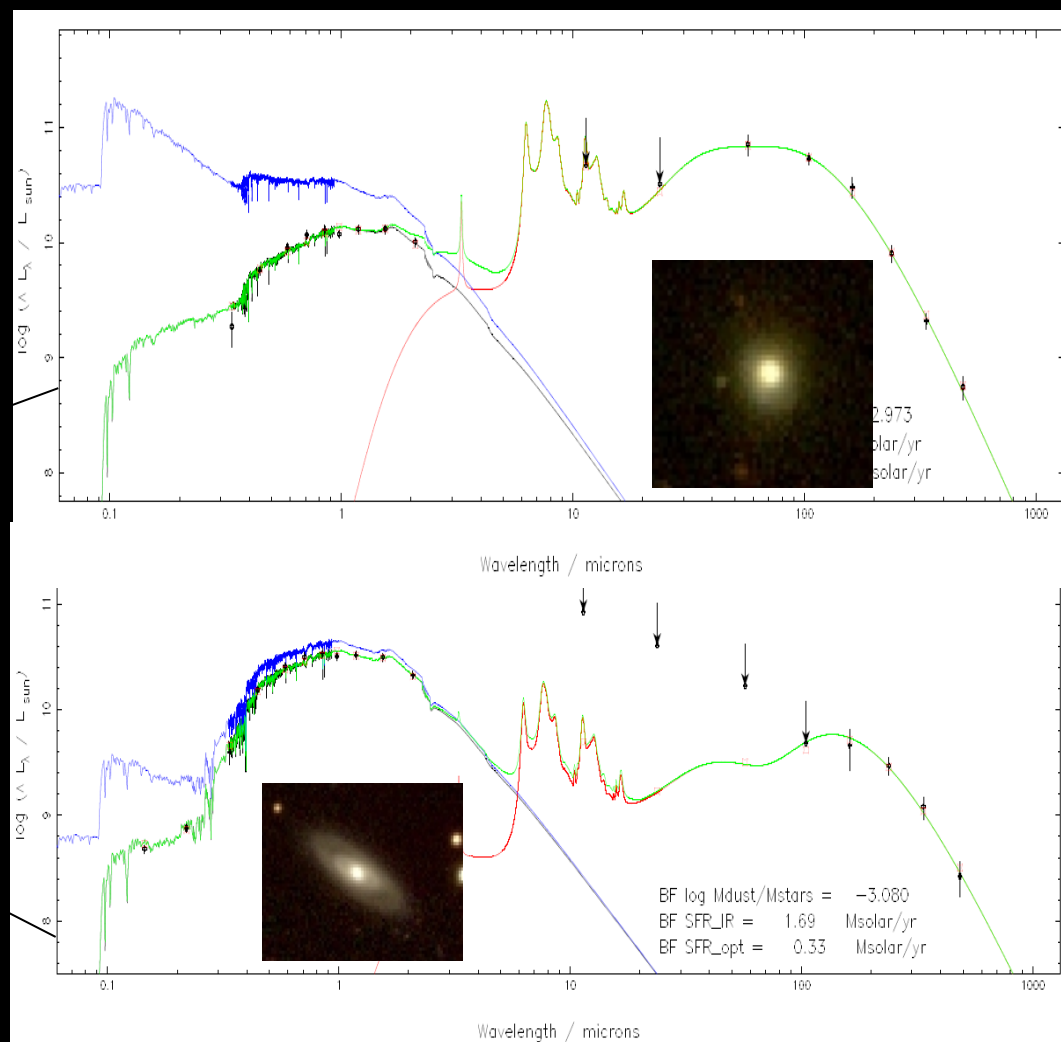
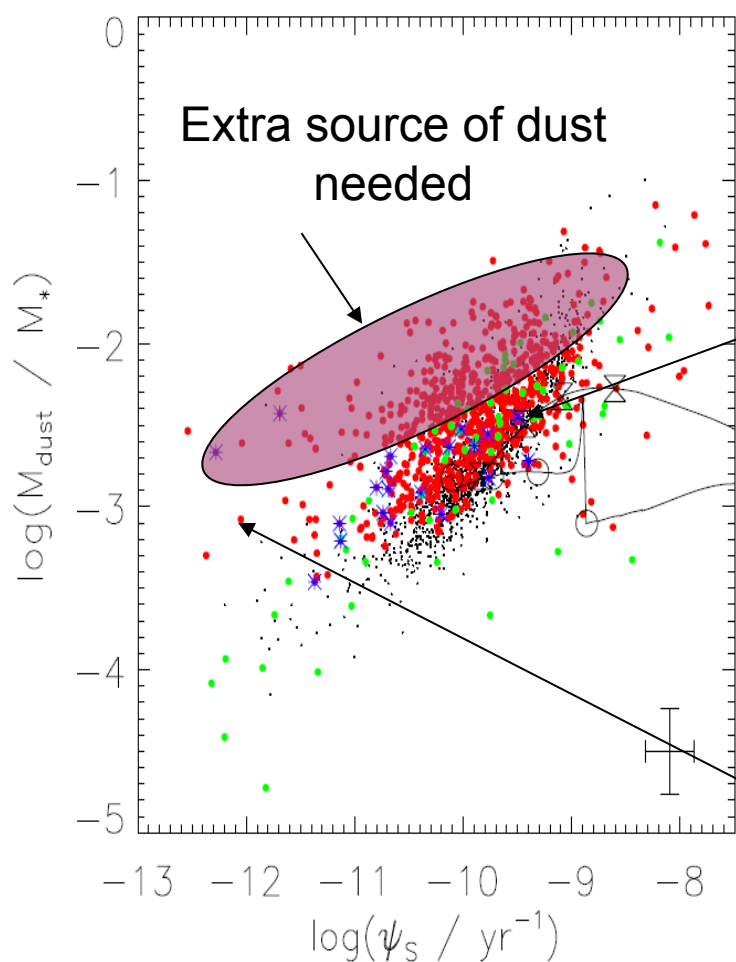


Both obscured and unobscured SF accounted for
Total L_{IR} computed from energy balance
Diffuse dust and star-birth dust accounted for

Fits for ~1000 sources so far

The nature of local sub-mm galaxies

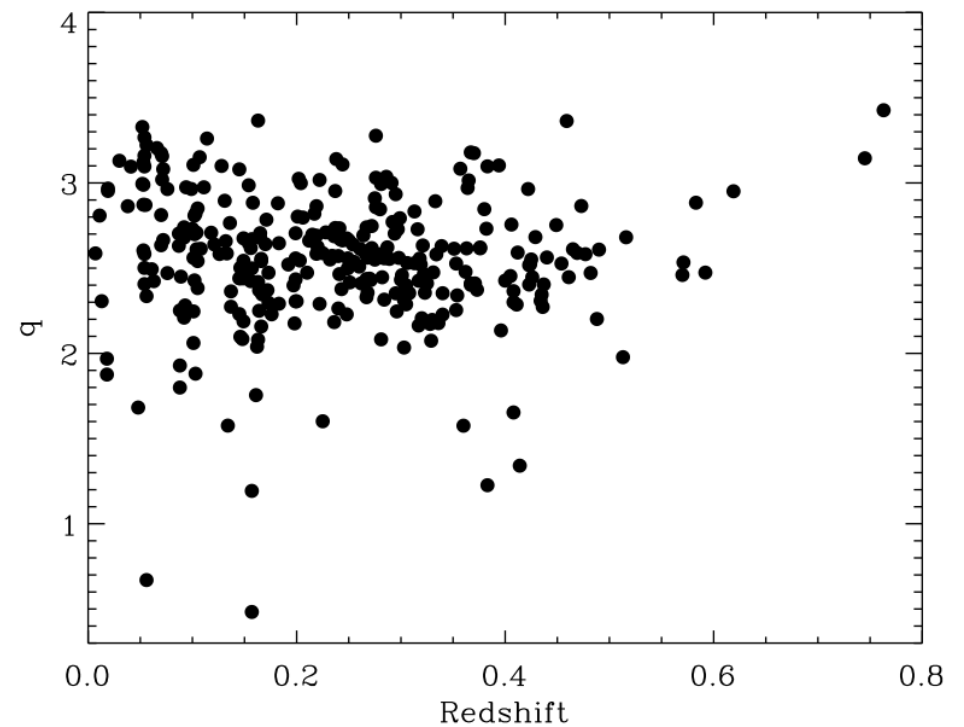
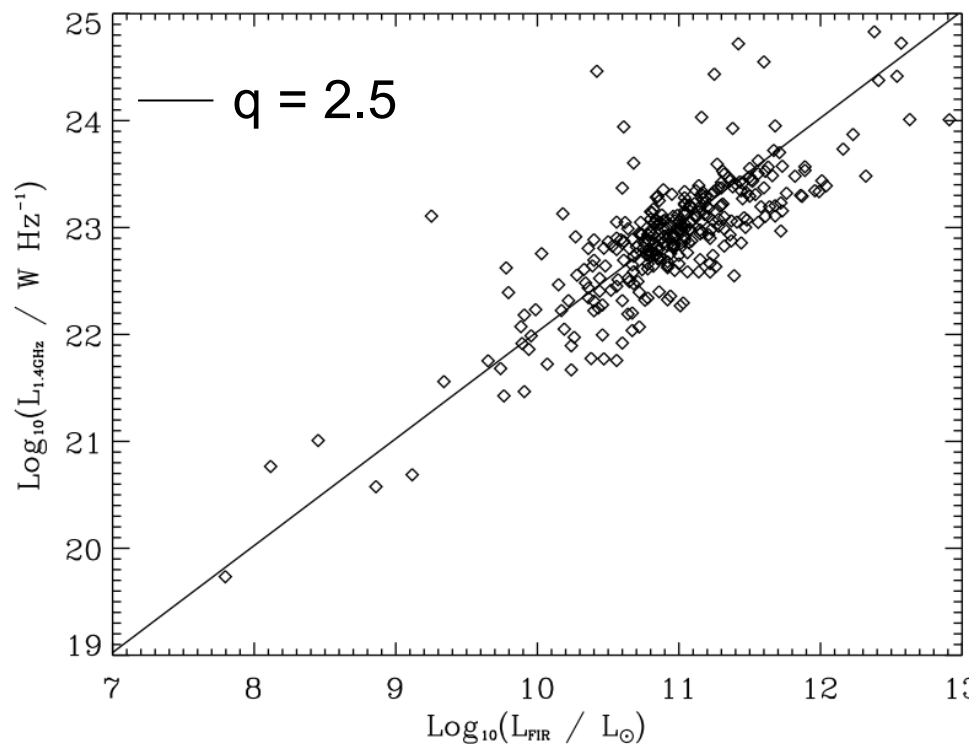
Smith et al. in prep (see poster)



Radio-FIR correlation

Jarvis et al. in prep

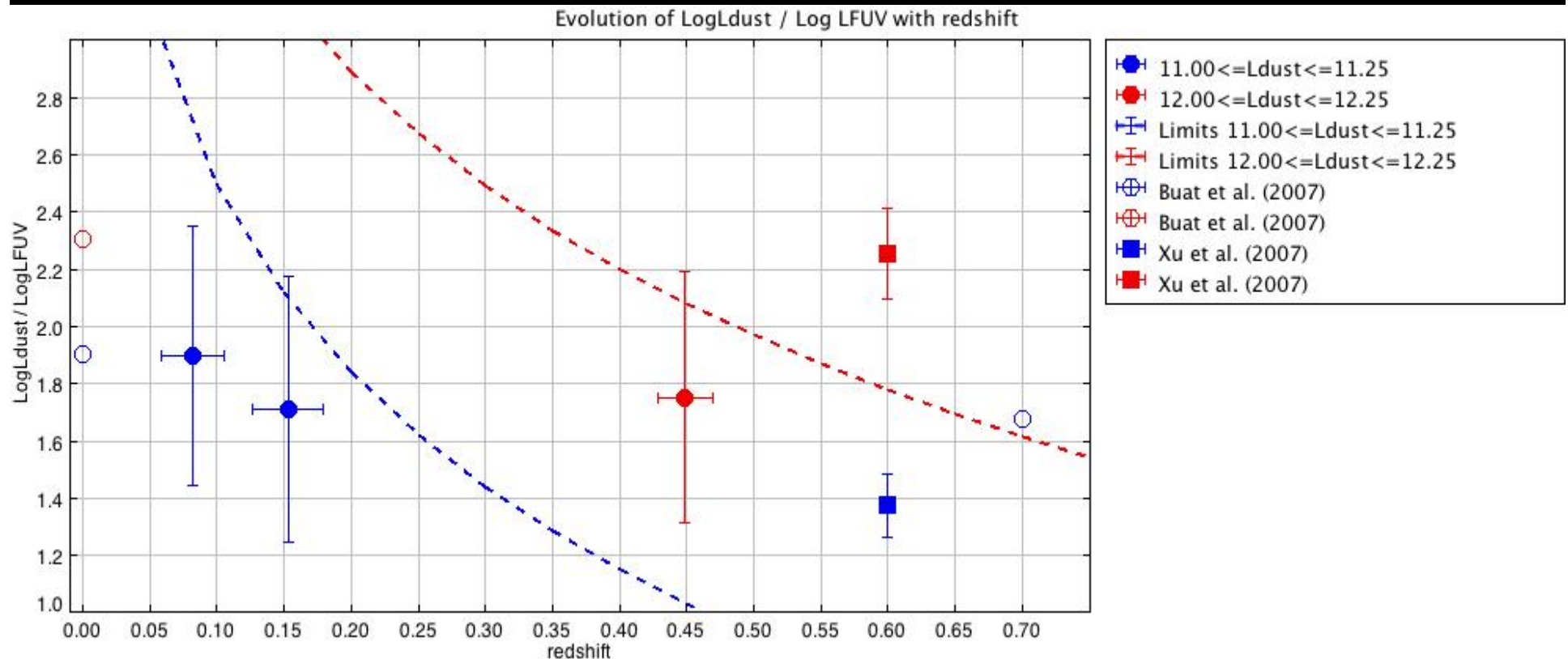
FIR luminosity from Herschel and radio from FIRST / NVSS
Little evolution in $q(\text{IR})$ out to $z \sim 0.8$, agrees with studies at higher- z



Studying dust obscuration

Burgarella (see poster)

- $L_{\text{dust}} / L_{\text{UV}}$ from CIGALE UV-submm SED fitting code (Noll 09)
- H-ATLAS points consistent with earlier work from IRAS and Spitzer
- No strong trend of $L_{\text{dust}}/L_{\text{UV}}$ with z - though hampered by limited numbers with UV detections. Need more data to be conclusive



Next steps ... 45 sq deg in
GAMA 15



Summary

- The Herschel ATLAS is a key legacy survey of 550 sq degrees.
- Covers a range of science from Galactic to high-z
- Strengths are unbiased selection, wide areal coverage and huge statistical power
- 8 papers submitted to A&A and a further ~15 in preparation on the first 3% of survey data.

Further information and data release

- H-ATLAS counts and clustering – S. Maddox (Thurs)
- H-ATLAS AGN and QSO – M. Jarvis (Thurs)
- H-ATLAS lenses – M. Negrello (Thurs)
- H-ATLAS high-z – A. Cooray (Thurs)

+ Numerous H-ATLAS posters

H-ATLAS survey paper (Eales et al. 2010, PASP, 122, 499)

SD data, maps and catalogues will be made public around mid-June 2010 from our website: www.h-atlas.org