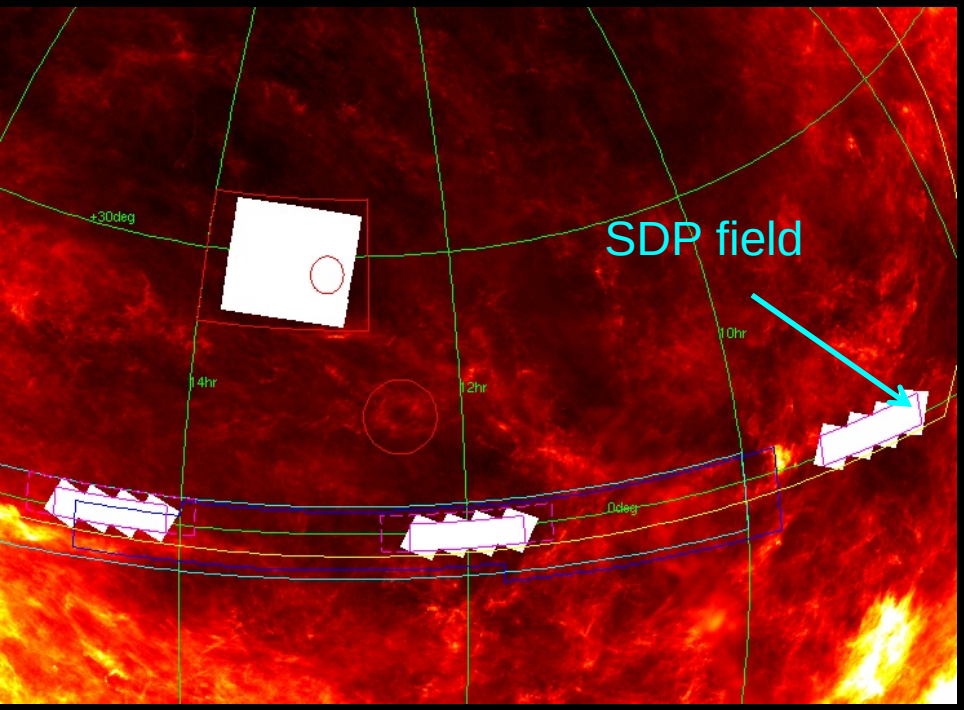
The Herschel ATLAS

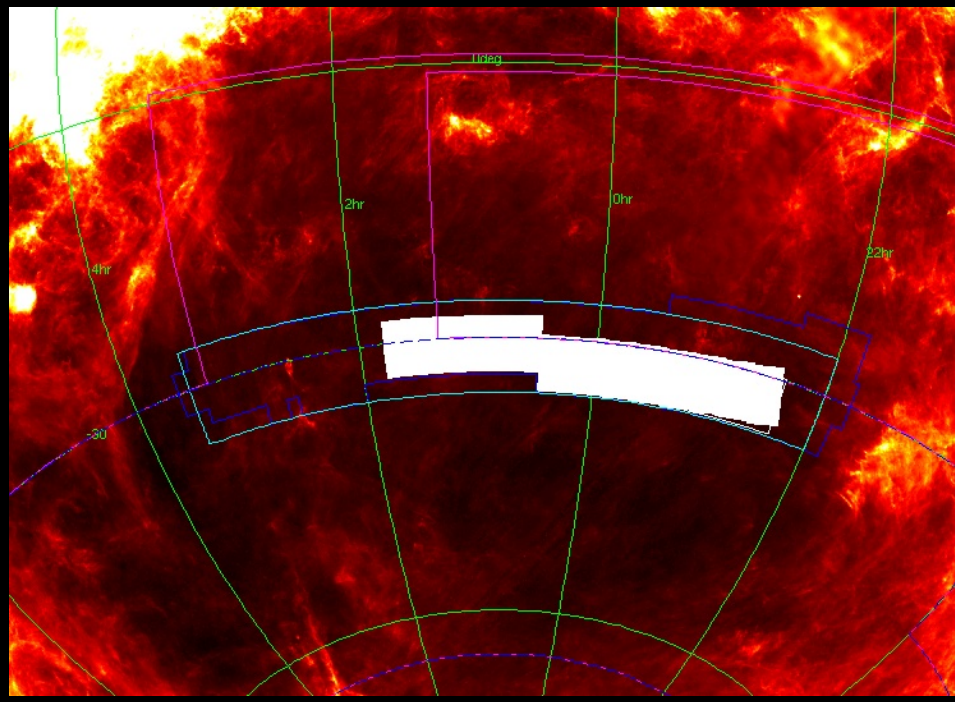
Steve Eales and the H-ATLAS team

- Survey of 550 square degrees in five far-IR and submm bands (two in common with Planck) – the largest Herschel extragalactic survey
- International team of ≈150. PIs: Steve Eales (Cardiff) and Loretta Dunne (Canterbury, New Zealand)
- original aim was to provide a survey of dust and dust-obscured star formation in the local universe to complement the SDSS and 2dF Galaxy Redshift Survey
- has detected ≈5×10^5 sources out to z≈5
- now being used for a large number of projects, including cosmographic surveys using gravitational lensing and galaxy evolution at high redshift

NGP and Equatorial

SGP

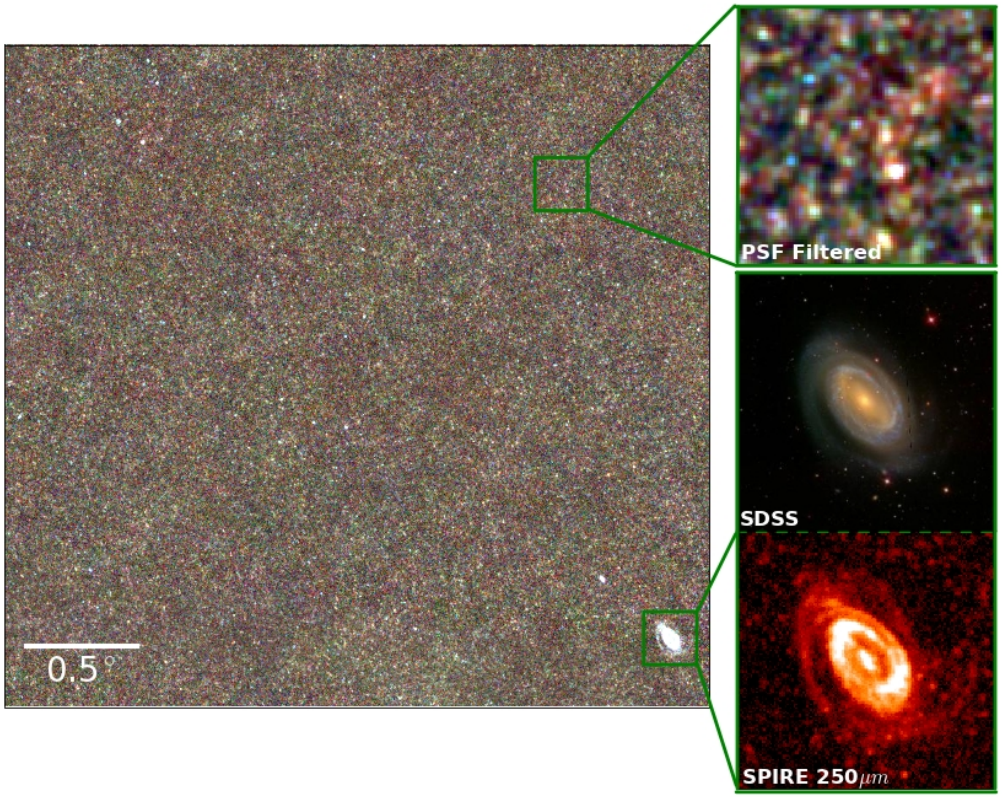




Fields chosen to allow maximum overlap with existing and planned surveys
GALEX, 2dF, SDSS, GAMA, UKIDSS, KIDS, VIKING, PanSTARRS, DES, SPT, SASSy

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

Survey Status



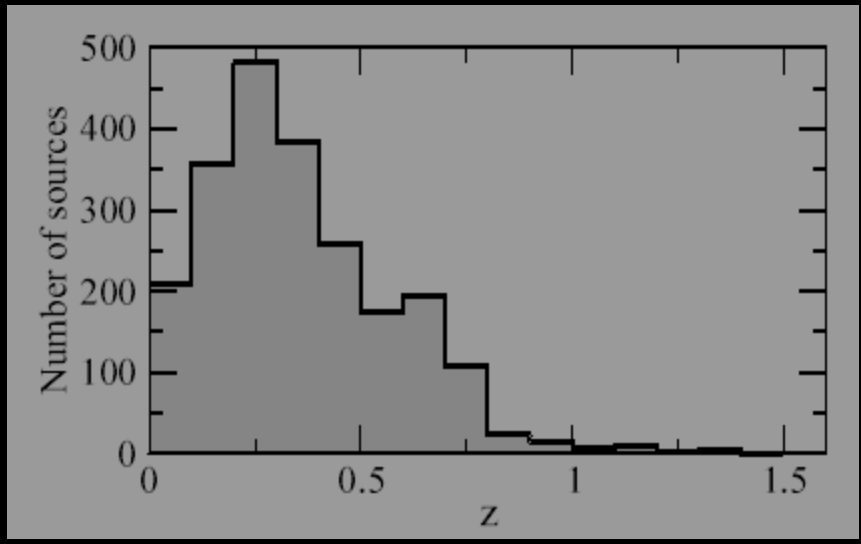
False-colour image made from the three SPIRE images (red-500 μm; green-250 μm; blue – 250 μm) of one sixteenth of the NGP field, which includes the Coma Cluster.

- Data from Science Demonstration Field (7000 sources + optical/IR counterparts) publicly released (h-atlas.org)
- H-ATLAS Phase 1 (equatorial fields) – essentially complete, with data release planned for Autumn 2013
- SGP and NGP – all data taken, final maps made for the NGP, preliminary maps made for the SGP. Final data release planned for 2014

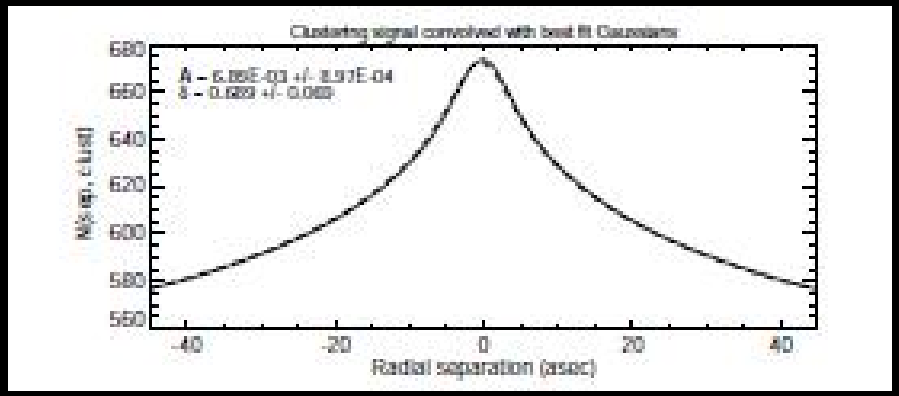

‘The Blob’

Results from Science Demonstration Phase

- 5 sigma 250μm catalogue of 6600 sources
- 2240 reliable counterparts (>80% reliability – Smith et al. 2011, MN 416, 857). A high fraction have redshifts because of the GAMA redshift survey.
- *BUT the surface-density of SDSS galaxies around the Herschel positions shows that 60% of the Herschel galaxies have counterparts brighter than the SDSS limit*



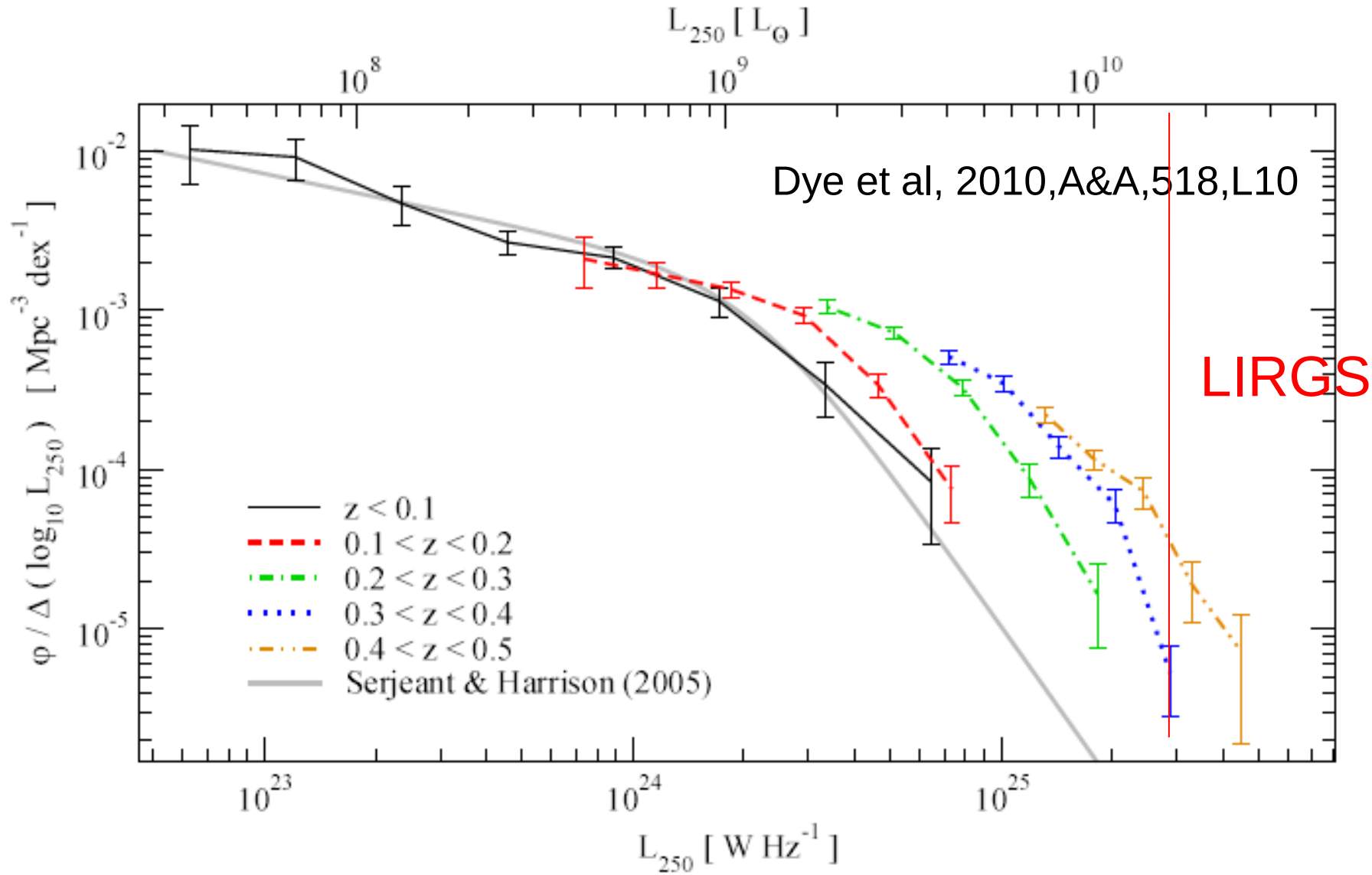
N(z) of identified sources



Surface-density of SDSS galaxies around Herschel positions

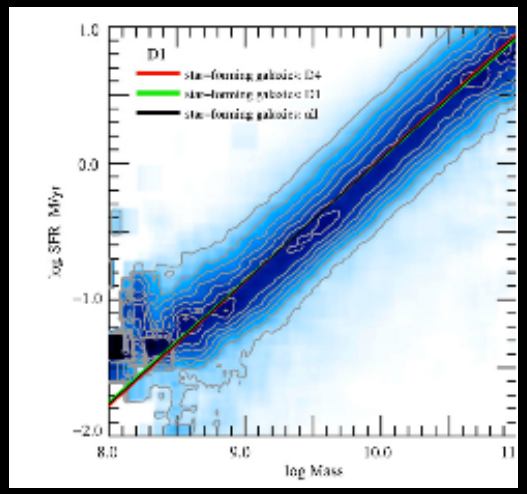
Need LOFAR/E-VLA/ASKAP radio

Evidence for Recent Cosmic Evolution



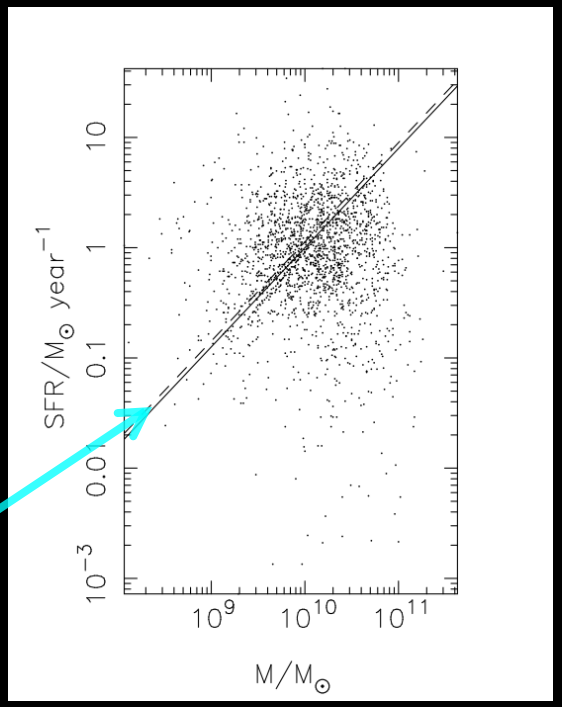
Diagnosing the evolution

MAGPHYS is a simple physical model for a galaxy based on the Bruzual and Charlot stellar evolution models that allows one to derive stellar masses and star-formation rates from multi-band photometry (Da Cunha et al. 2008)

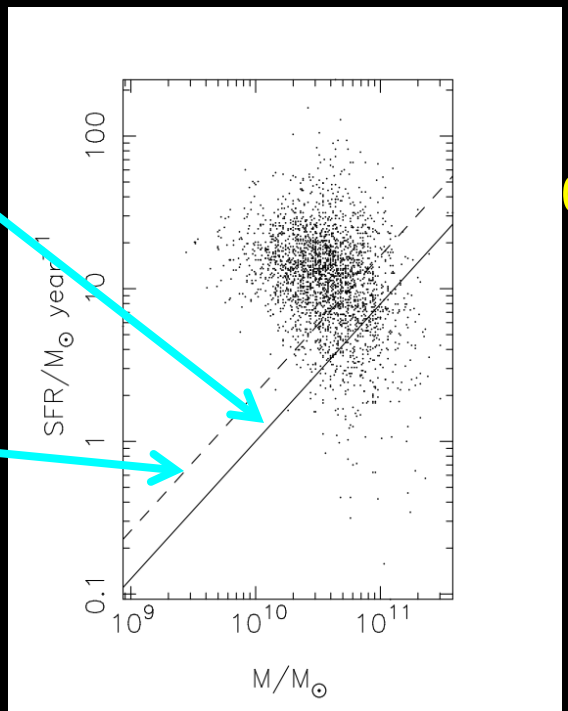


Galaxy Main Sequence

Evolved Galaxy Main Sequence

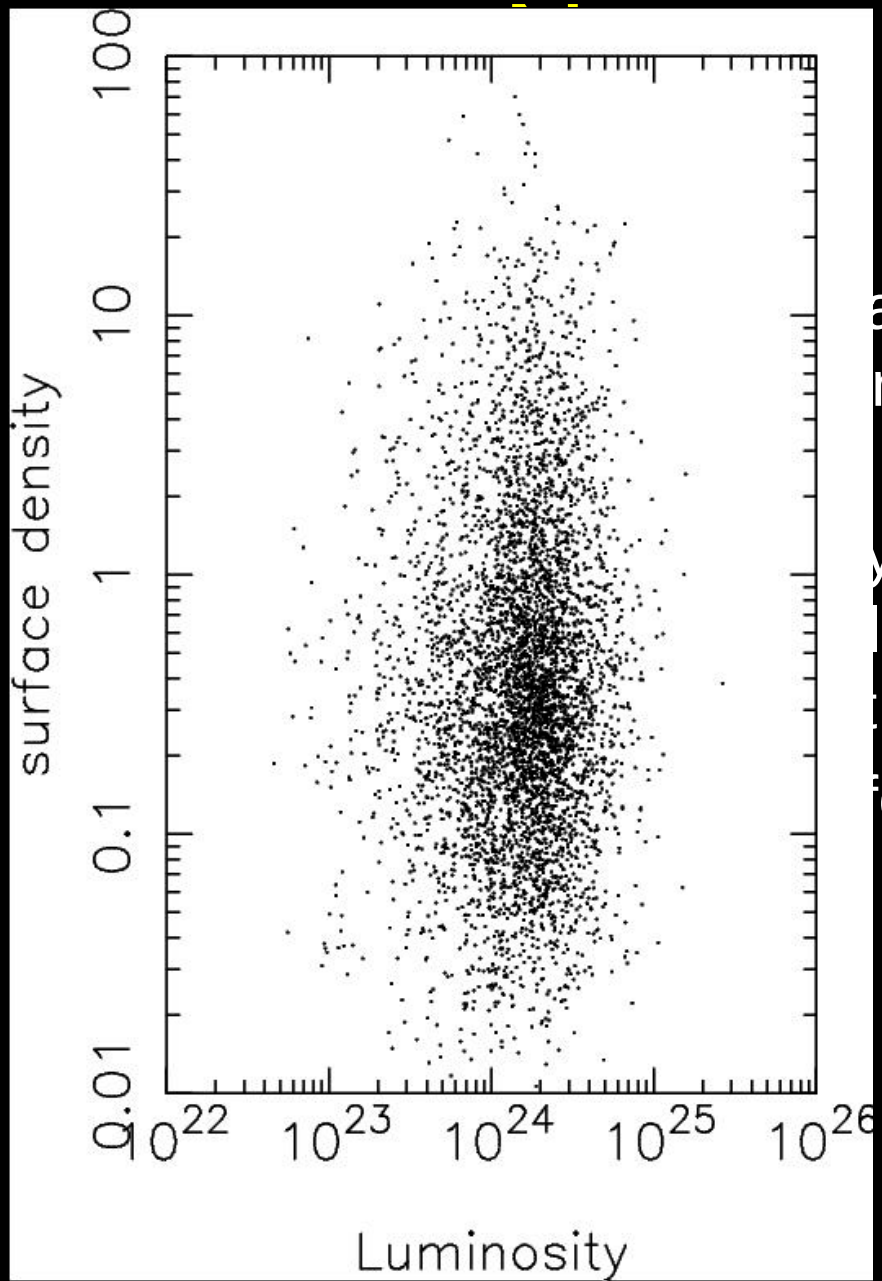


Z < 0.1

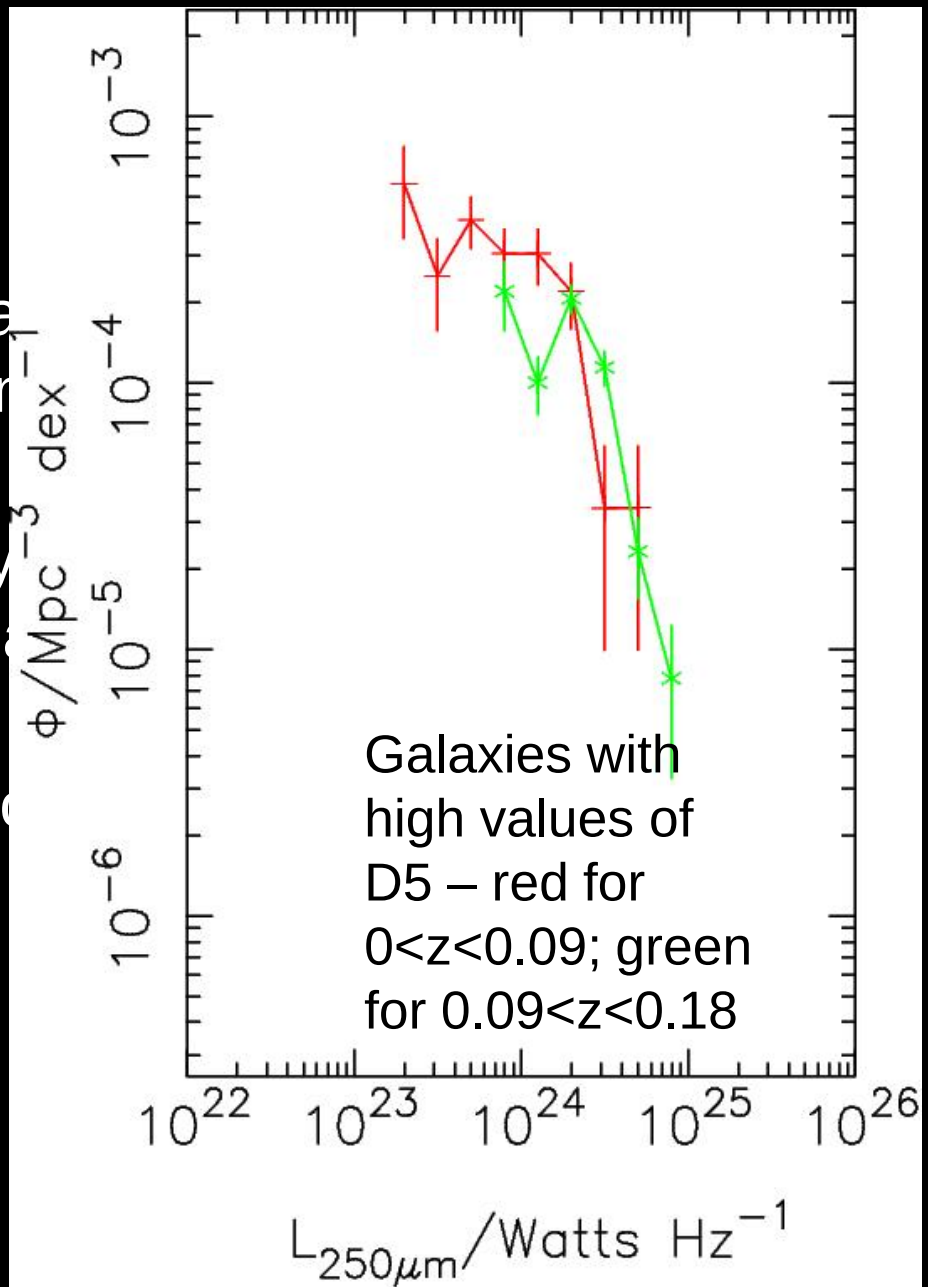


0.3<z<0.4

No correlation of D5 clustering statistic with 250-micron luminosity

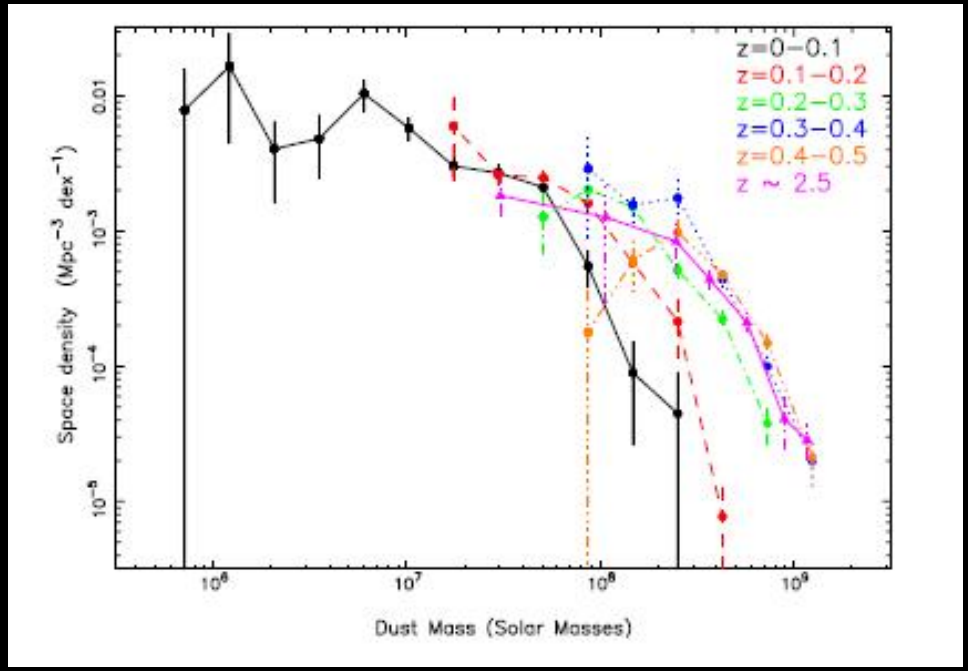


No evidence for stronger evolution for galaxies in denser environments



Evidence for Nature rather than Nurture

- The mass of dust should be a tracer of the mass of the ISM in a galaxy
- Dunne et al. (2011, MN,417,1510) have estimated the ‘dust-mass function’ for H-ATLAS



Purple line shows an estimate from the deep SCUBA surveys – Dunne, Eales and Edmunds 2003

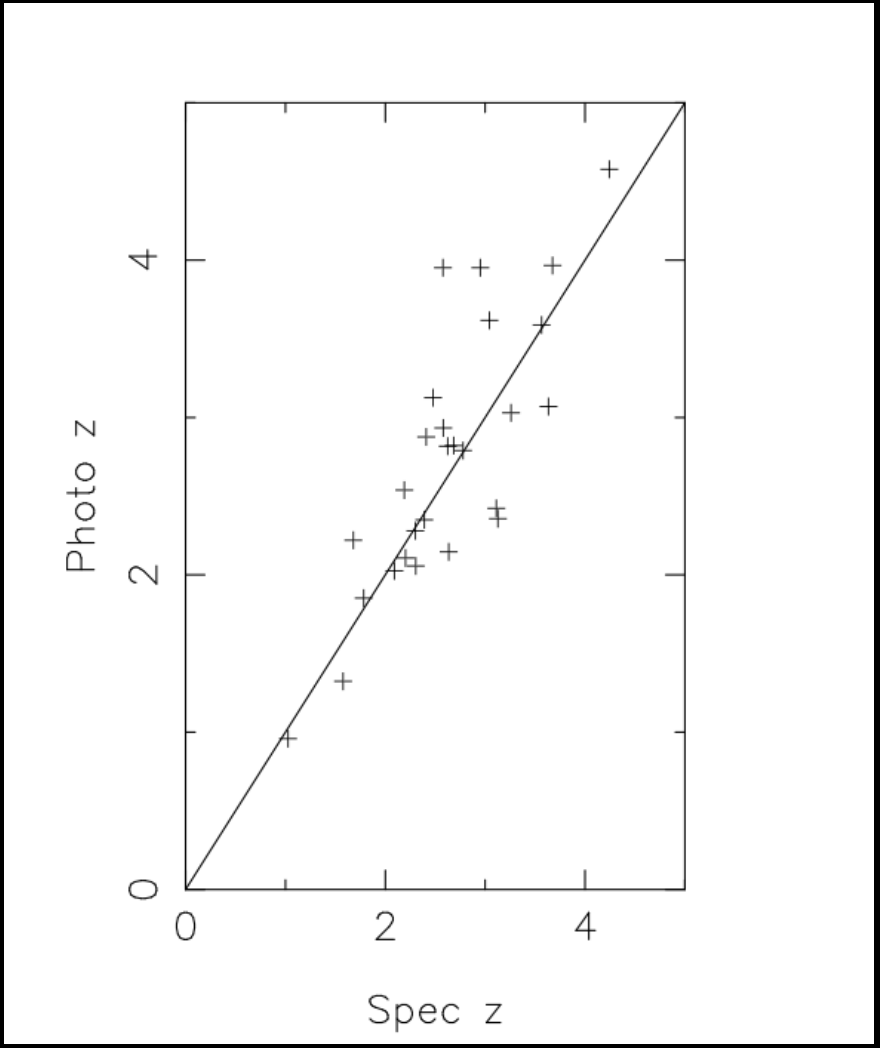
CO redshifts and photometric redshifts

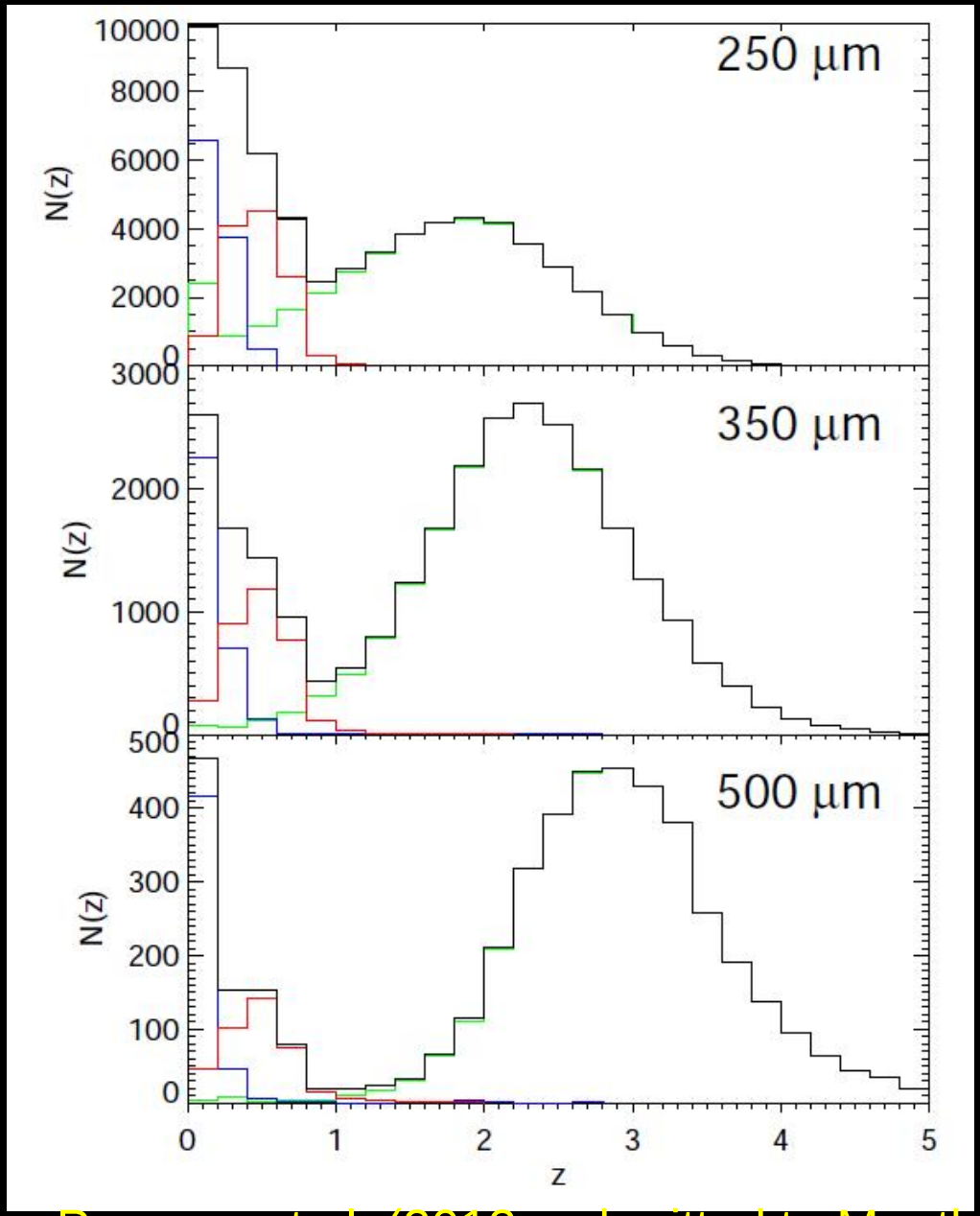
- Observations of CO with APEX, CSO, GBT, PdeB interferometer

- Do not require accurate position of the optical/IR counterpart

- So far, 30 H-ATLAS sources with spectroscopic redshifts at $1<z<4.24$

- Photometric redshifts from the Herschel spectral energy distributions, calibrated using the CO redshifts



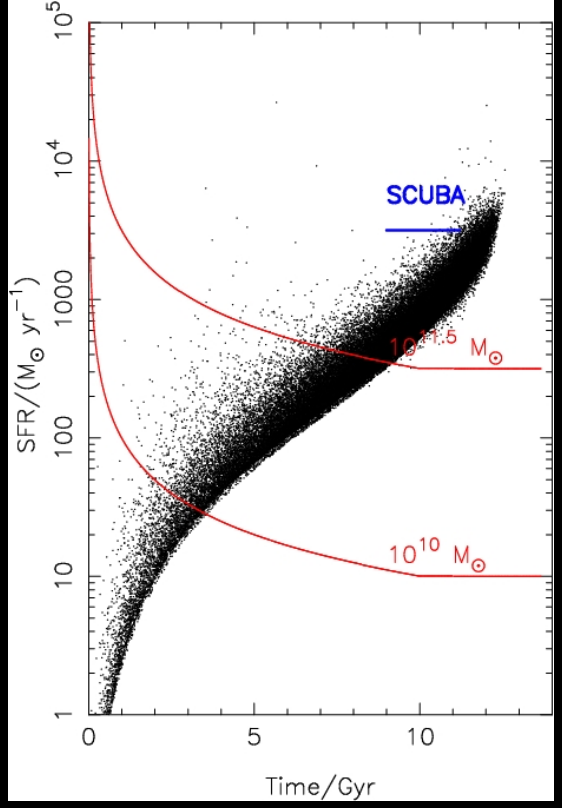


Pearson et al. (2013, submitted to Monthly Notices

Redshift Distributions

- Bimodel redshift distribution at 250μm suggests two population of sources, ***but strong evolution of a single population might produce a similar effect (Blain and Longair 1996).***

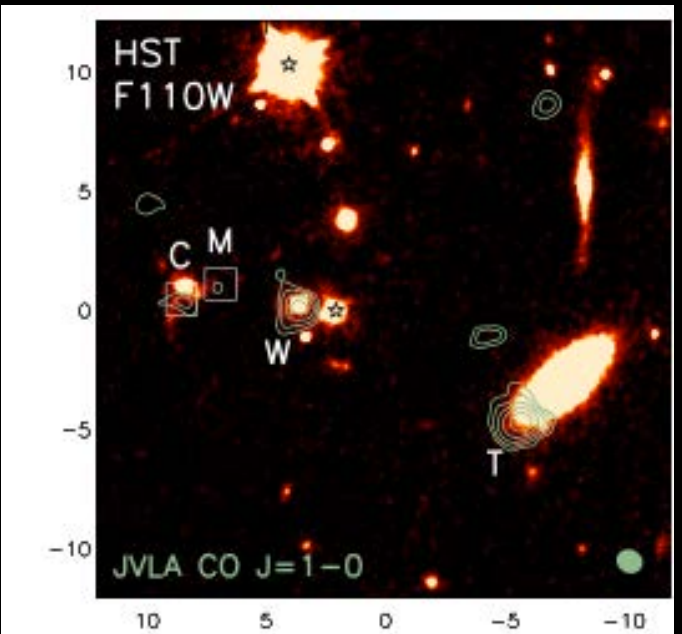
- Lapi et al. (2011, ApJ, 742, 24) show that the high-redshift peak can be fit by a model in which the high-z sources are ellipticals being forced in single bursts of star formation, ***but this model may not be unique***

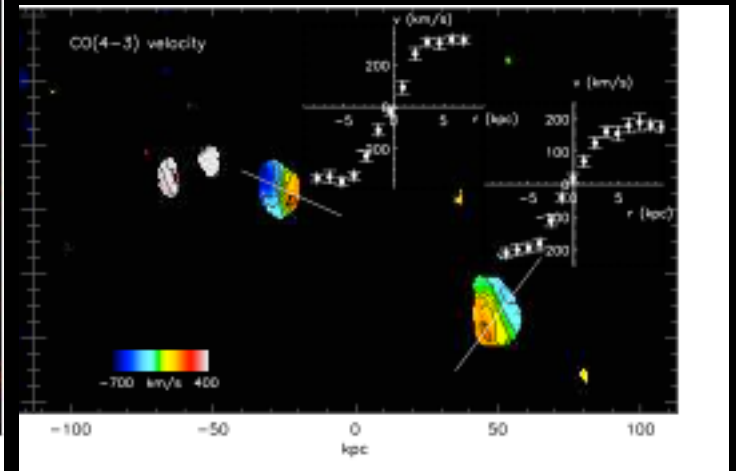


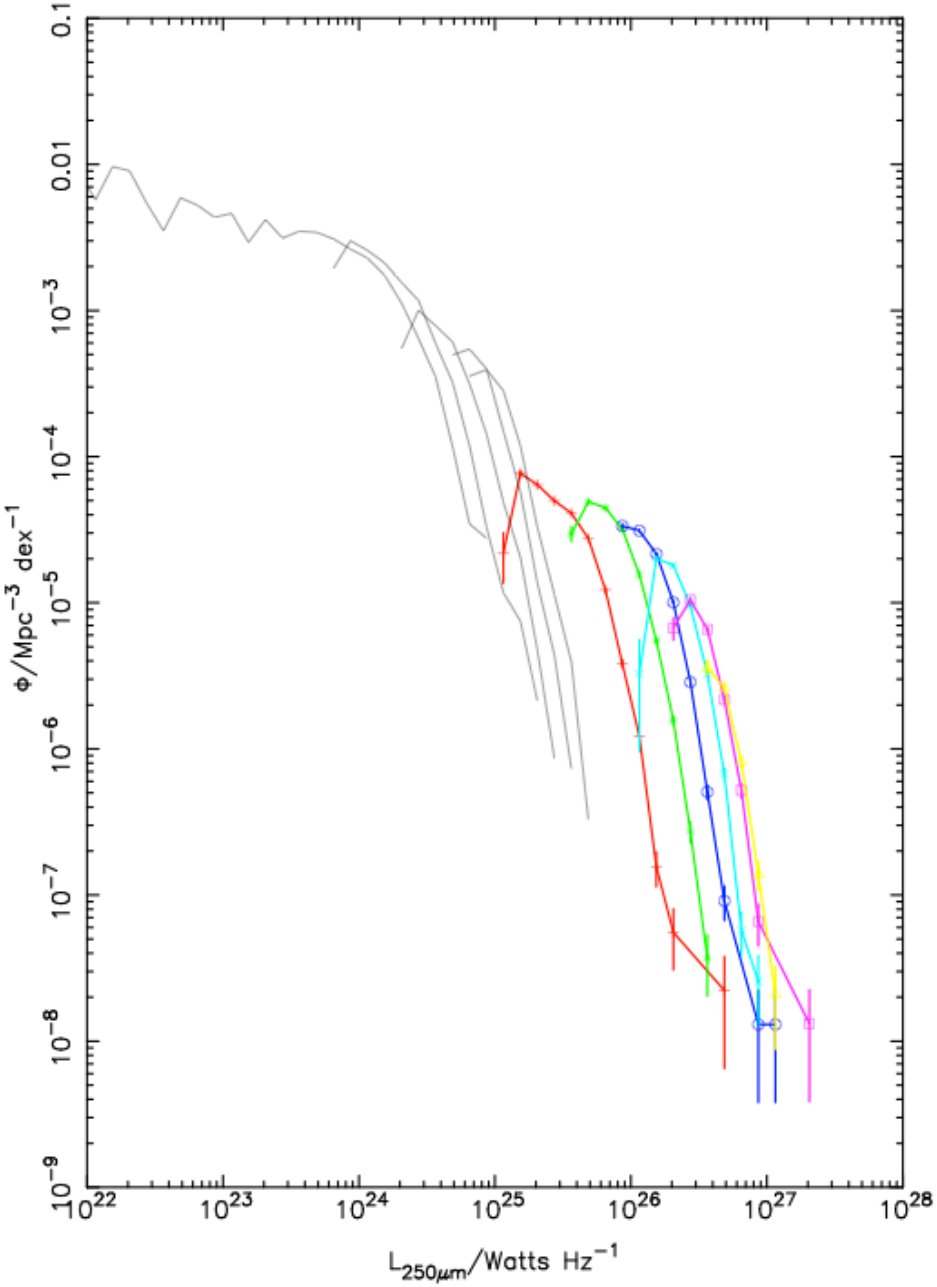
- Star formation rate estimated from the bolometric dust luminosity (Kennicutt 1998)

- Red lines show the star-formation rate necessary to make an elliptical of a given stellar mass in the lesser of 1 Gyr and 10% of the lookback time

But observations of one of the most luminous H-ATLAS sources show that it is made up of two disk systems (Ivison et al. 2013, submitted to Monthly Notices)







Steady evolution out to z ≈ 4

Final comments

• Our Phase 1 Data (maps, catalogues of 150,000 sources + optical counterparts) will be released to the general community later this year.

• See h-atlas.org for more information

• But if you have ideas for projects that we are not already doing with the data contact us (stephen.eales@astro.cf.ac.uk, loretta.dunne@canterbury.ac.nz