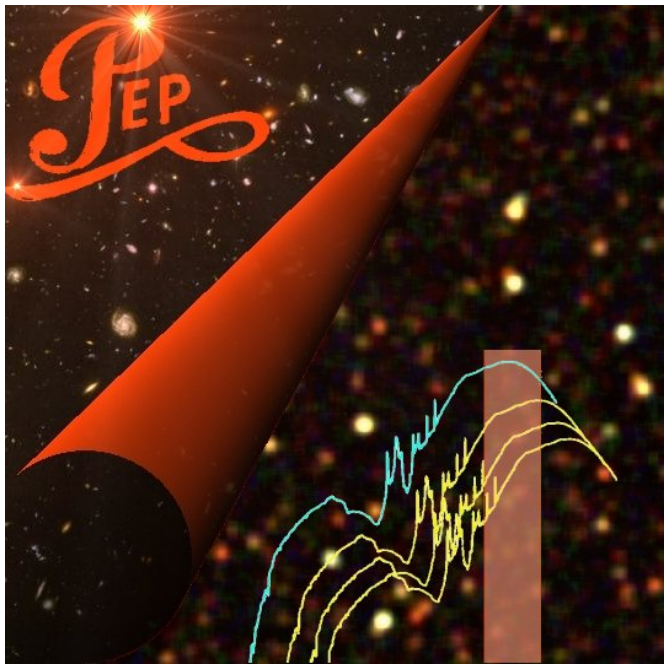
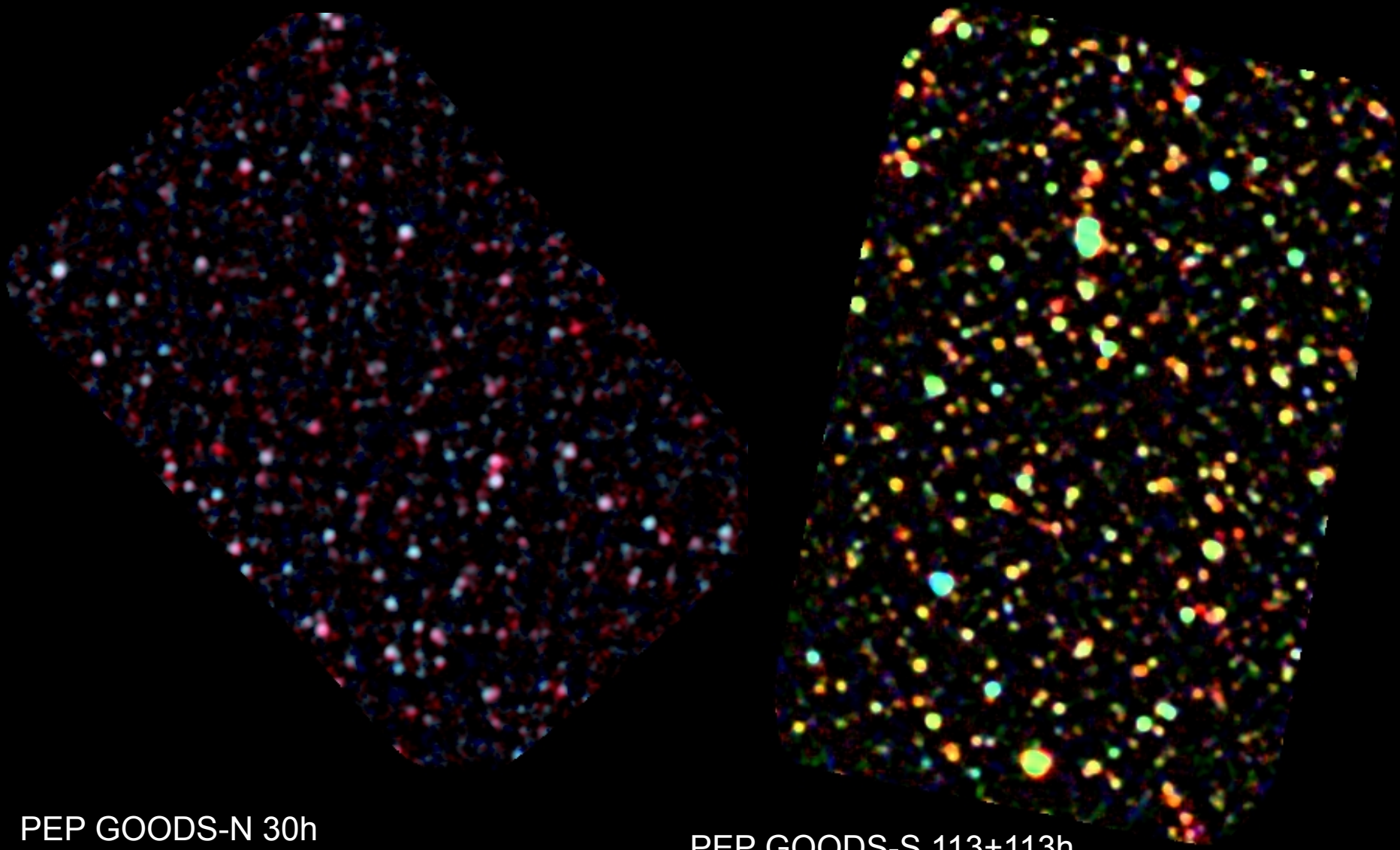
First results from PACS deep surveys

Dieter Lutz, for the PACS Evolutionary Probe (PEP) team

Herschel First Results Symposium - ESLAB 2010
May 4, 2010



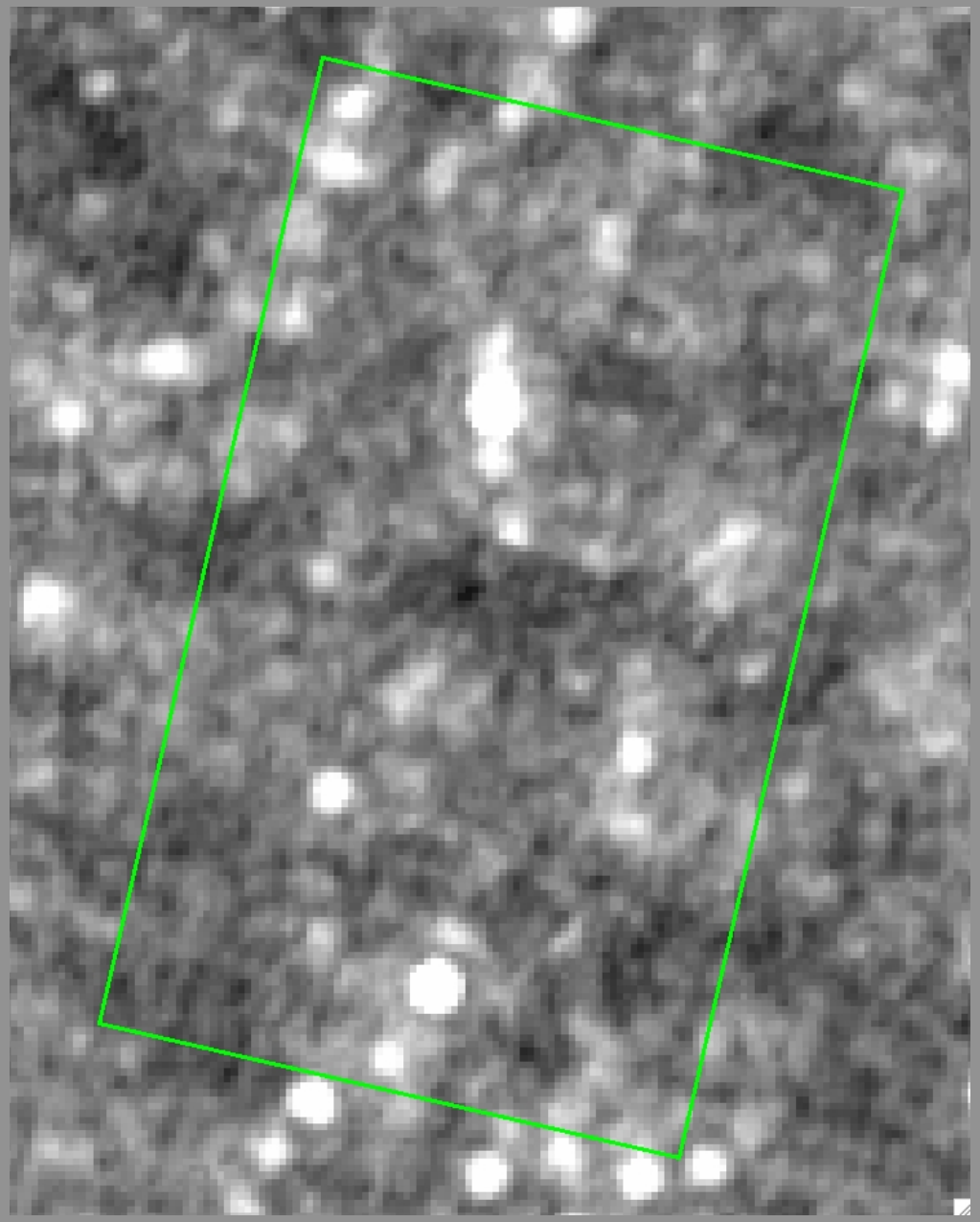
The deepest Herschel-PACS blank fields taken to date



PEP GOODS-N 30h
100+160μm during
Science demonstration phase
~300 sources

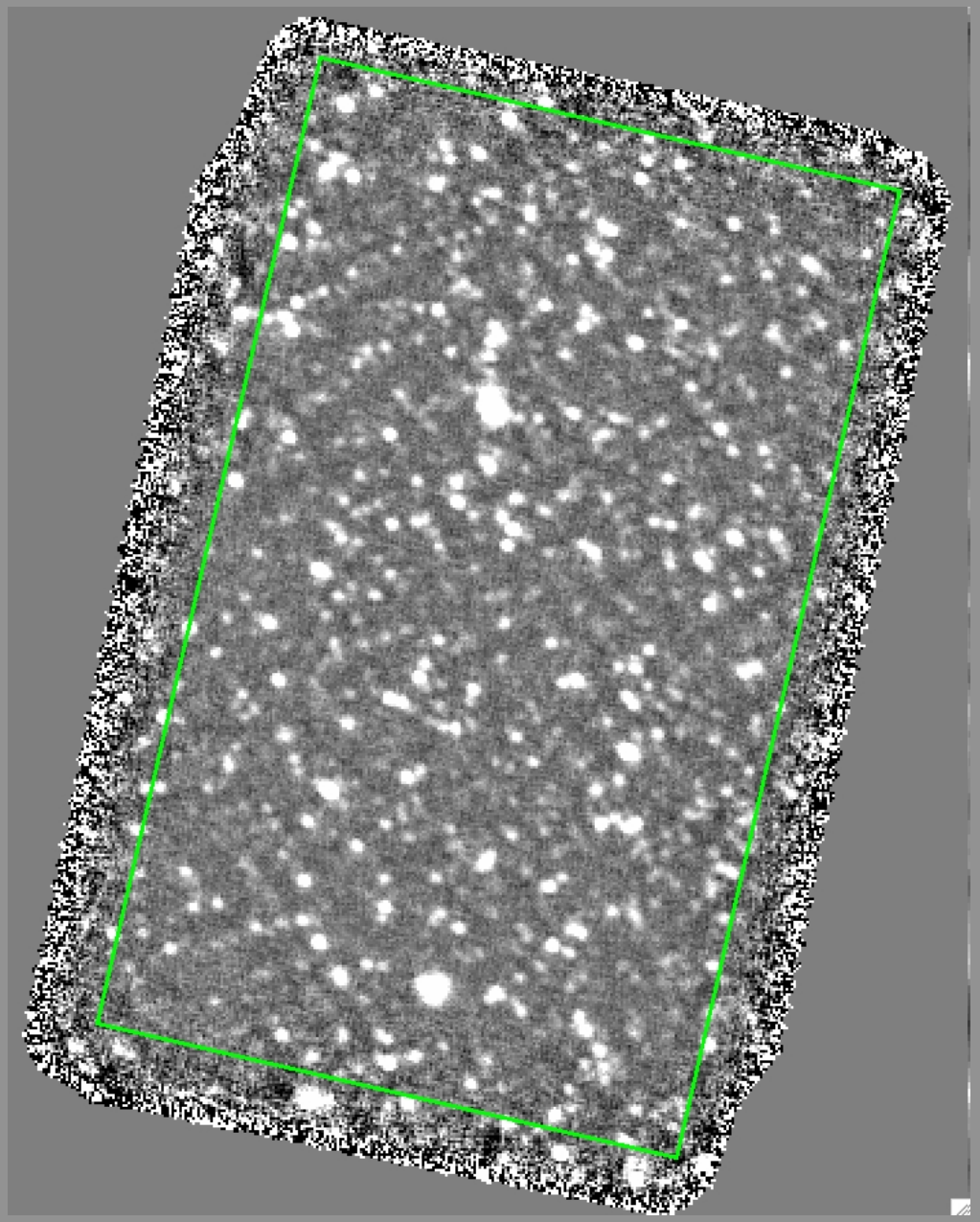
PEP GOODS-S 113+113h
70+100+160μm
~800 sources

From MIPS to PACS



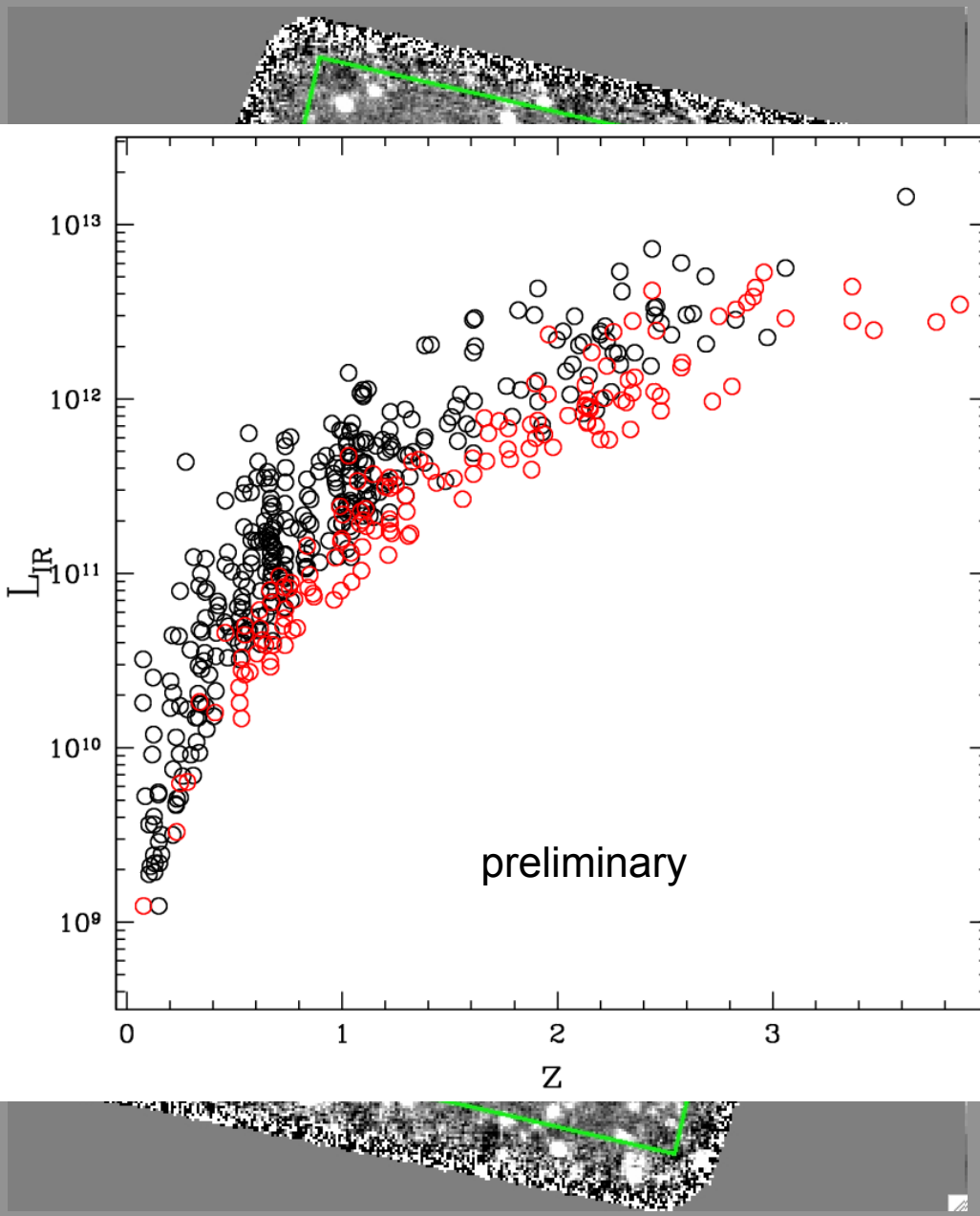
GOODS-S MIPS 160μm
FIDEL team

From MIPS to PACS

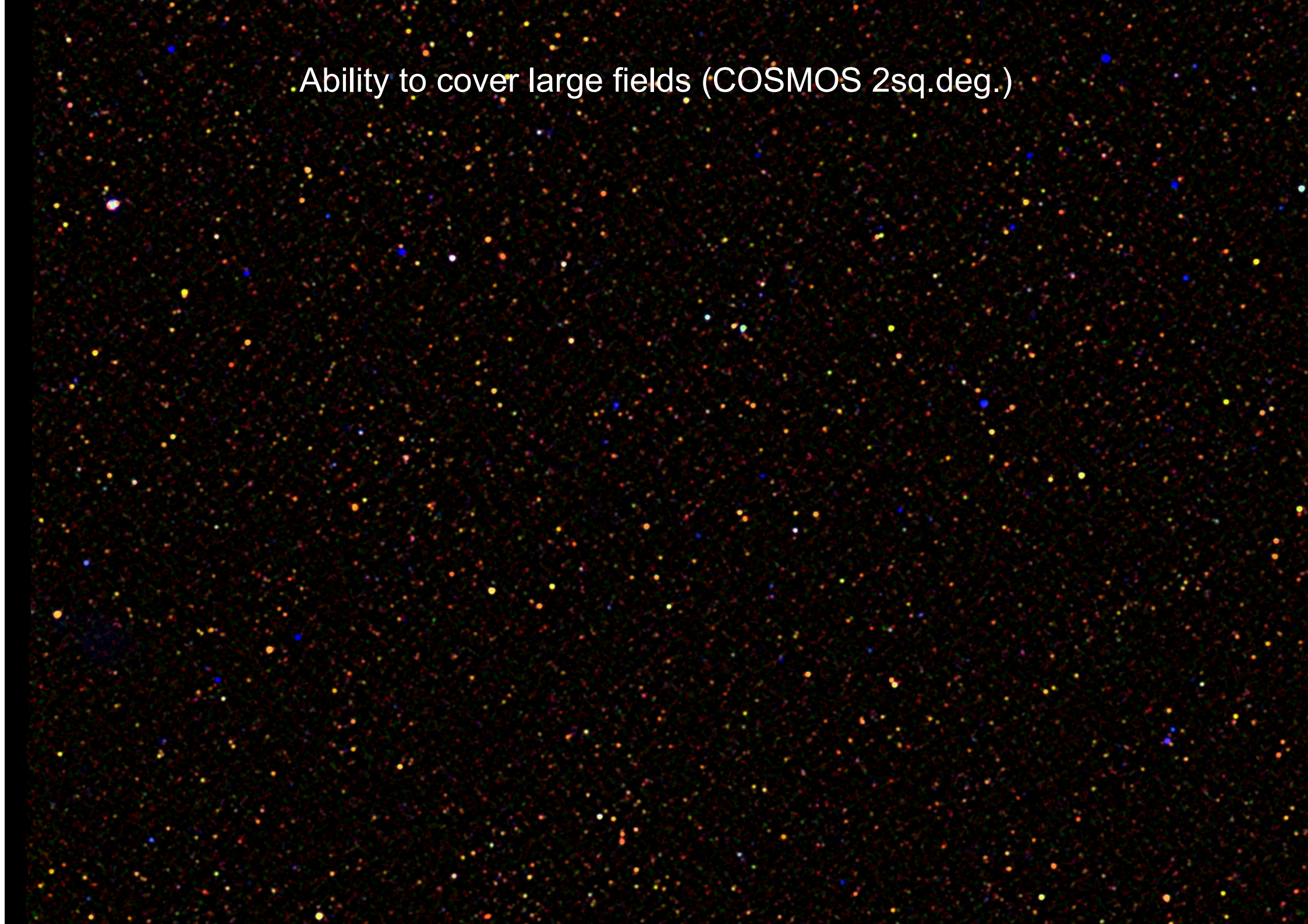


GOODS-S PACS 160μm
PEP team

From MIPS to PACS



GOODS-S PACS 160μm
PEP team


Ability to cover large fields (COSMOS 2sq.deg.)

PEP fields

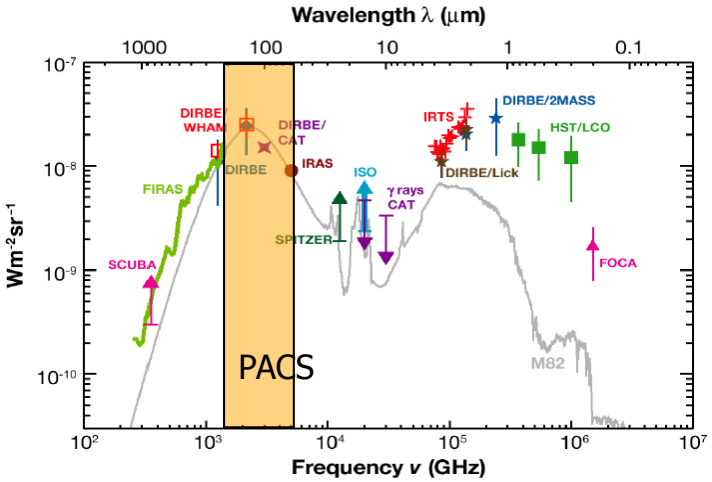
- PEP is the major Herschel 100/160μm extragalactic survey of key multiwavelength fields

Field	Area	Total Exp. [hours]
COSMOS	85'x85'	213
Lockman Hole	24'x24'	35
E-CDFS	30'x30'	35
Groth Strip	67'x10'	35
GOODS-S	10'x15'	113 113
GOODS-N	10'x15'	30

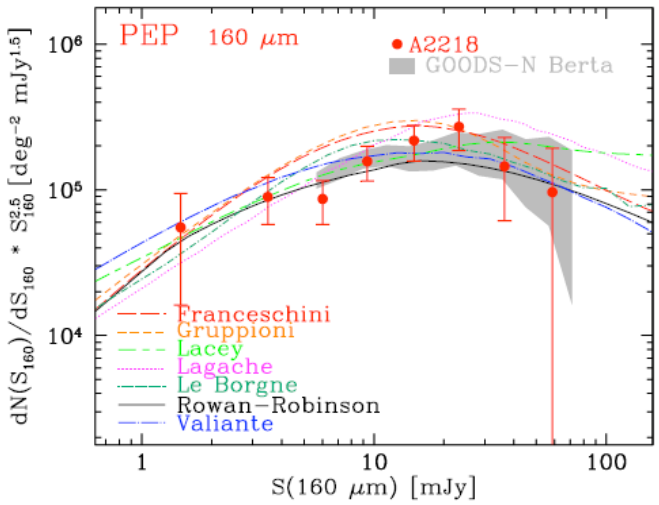
- +10 lensing galaxy clusters

- Coordinated with Hermes for SPIRE coverage
- Hermes and Atlas extend to wider+shallower PACS coverage
- GOODS-Herschel will go deeper on (parts of) GOODS fields
- Herschel lensing survey substantially extends the number of lensing clusters

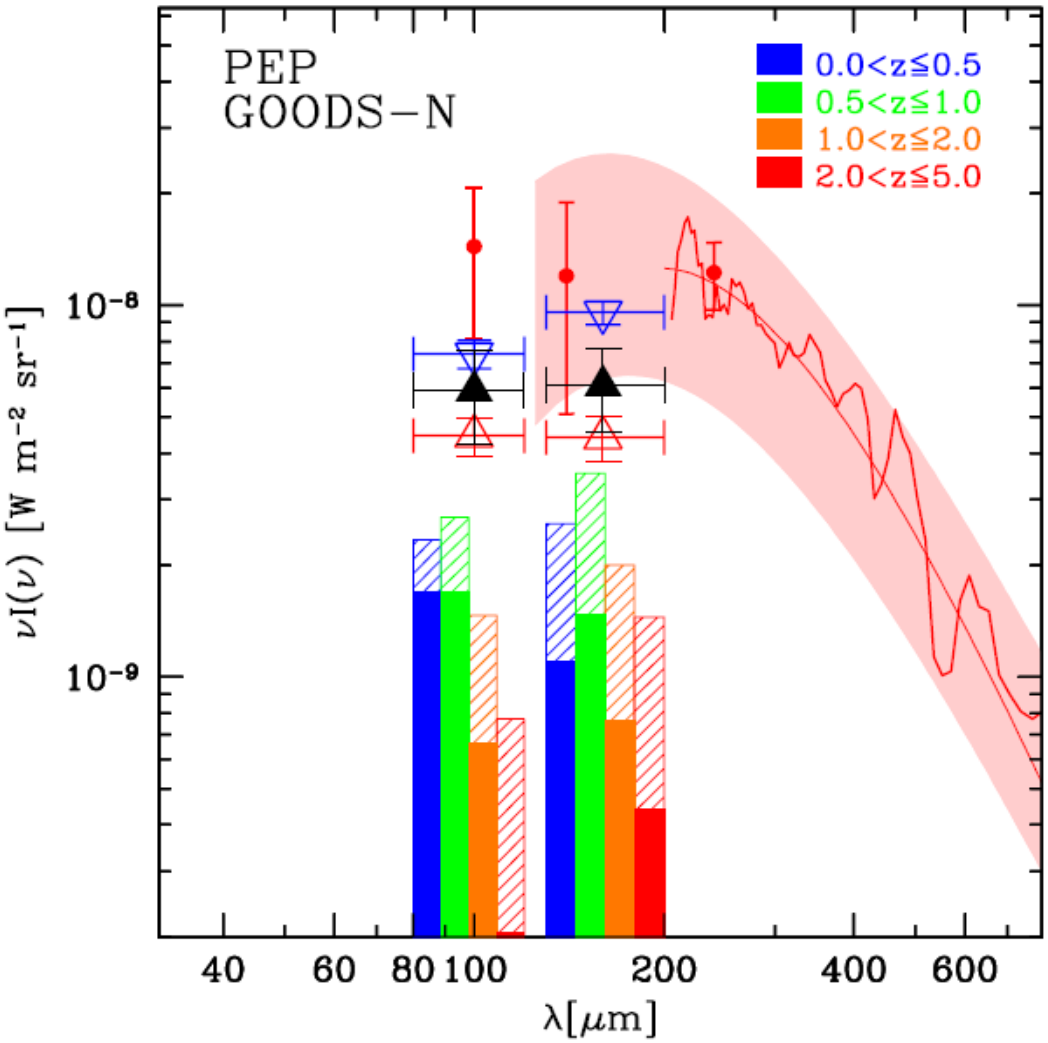
Resolving the Cosmic Infrared Background with PACS



Lagache et al. 2005 ARAA



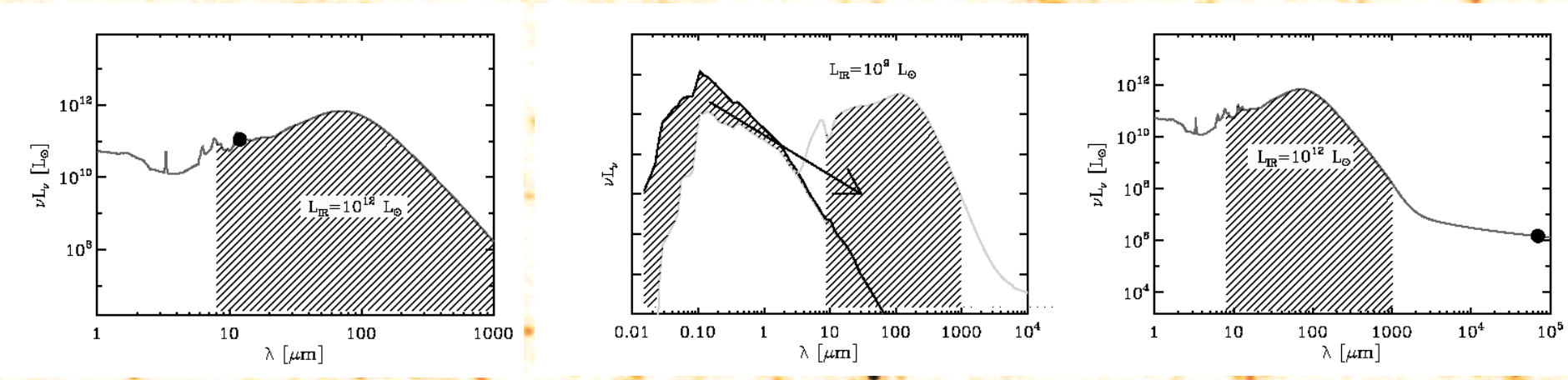
Altieri et al. 2010 Abell 2218 lensed counts



Berta et al. 2010 (talk on Thursday)

The need for far-IR calorimetric star formation rates

- Our community has been relying almost exclusively on extrapolation from the optical and mid-infrared as the avenue towards studying galaxy evolution.and star formation rates
- We know this extrapolation is pretty good
- **But how good?**

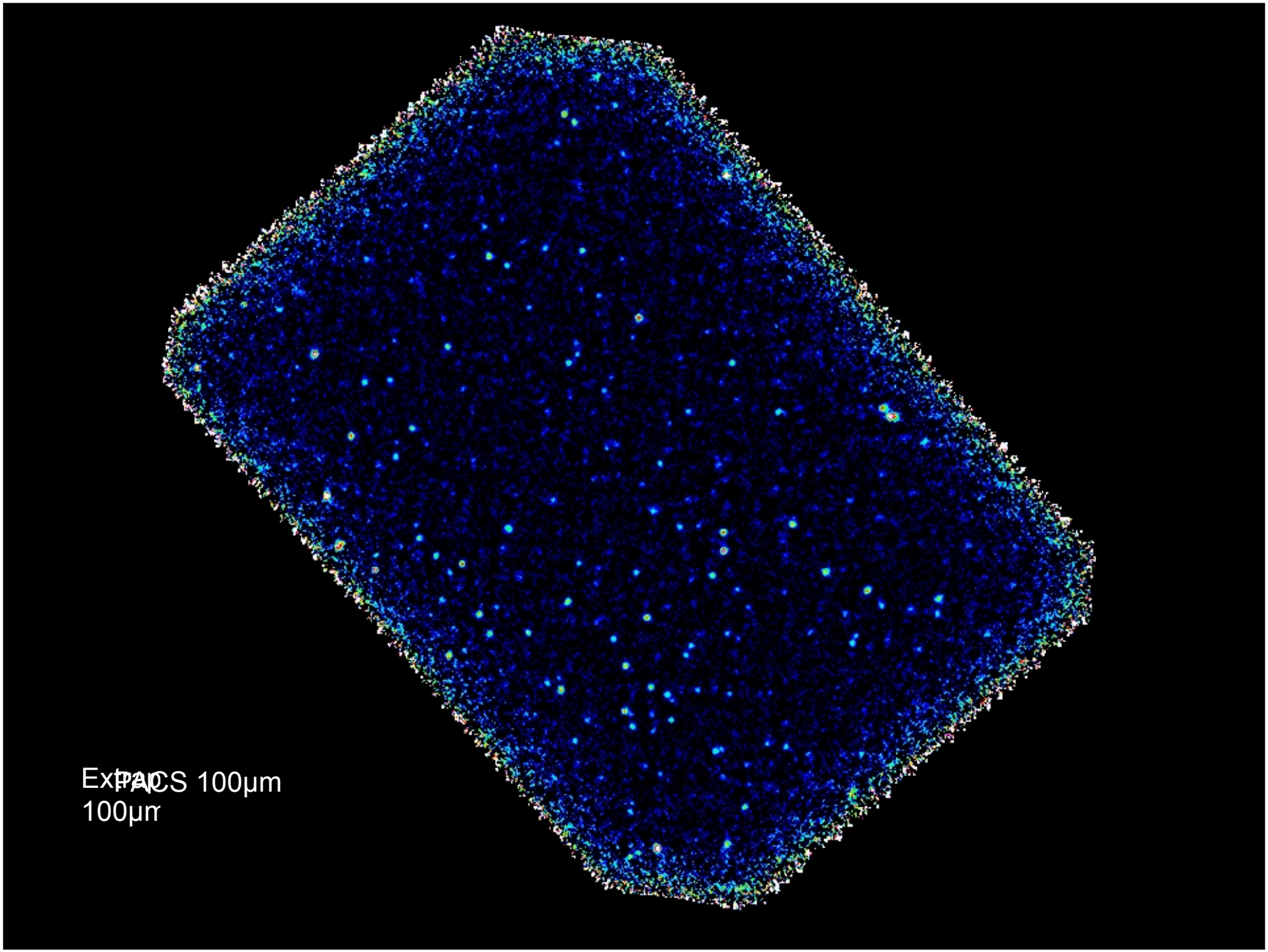


From 24μm

From rest frame UV

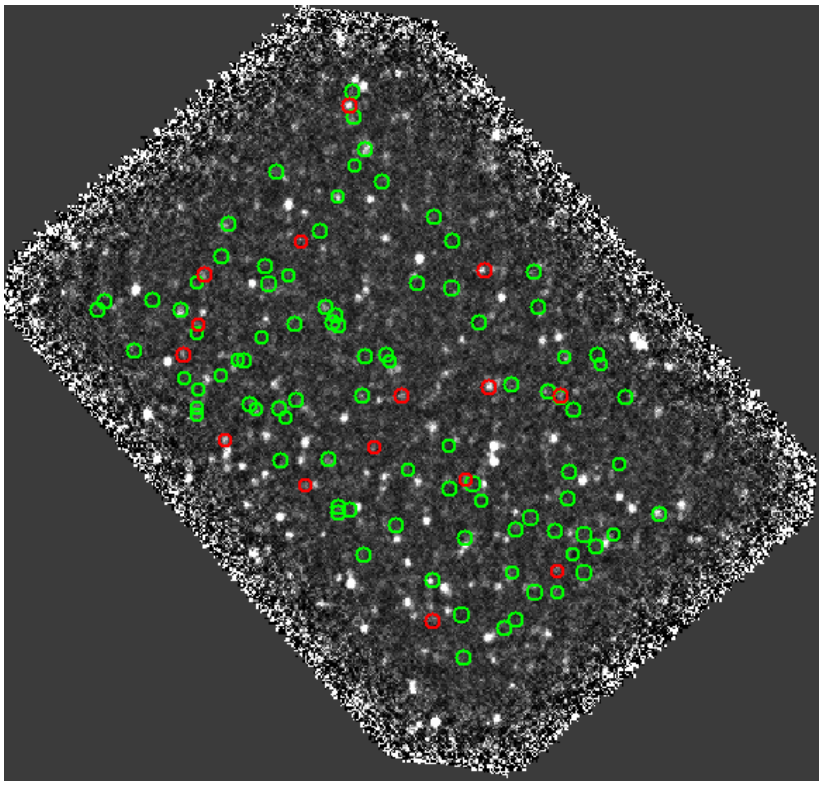
From submm/radio

COSMOS 24μm image

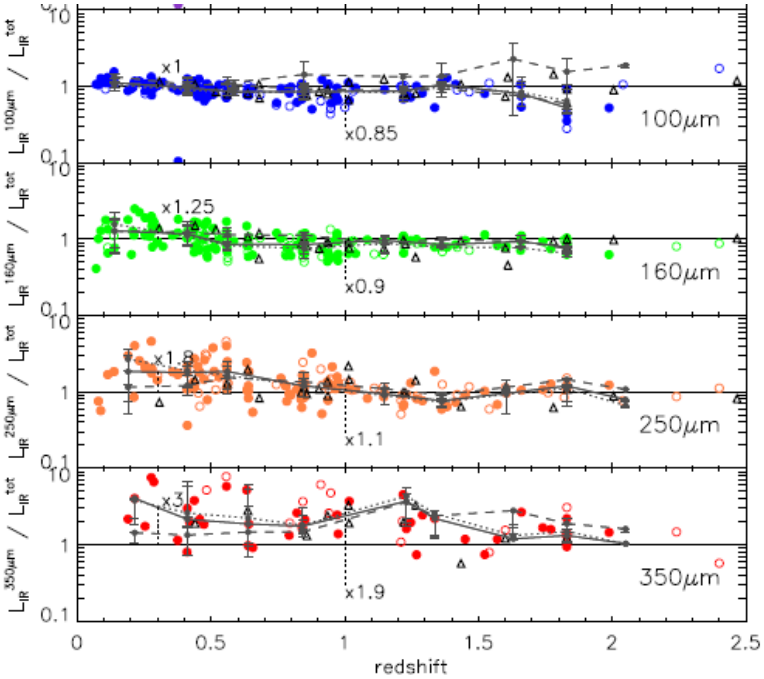

Extra
100µm
PACS 100µm

The star formation rates of typical z~2 star forming galaxies

- BzK star-forming galaxies in GOODS-N, K_{AB}<22, z=1.5-2.5
- Far-infrared luminosity from 160μm flux, redshift, Chary & Elbaz 2001 SED

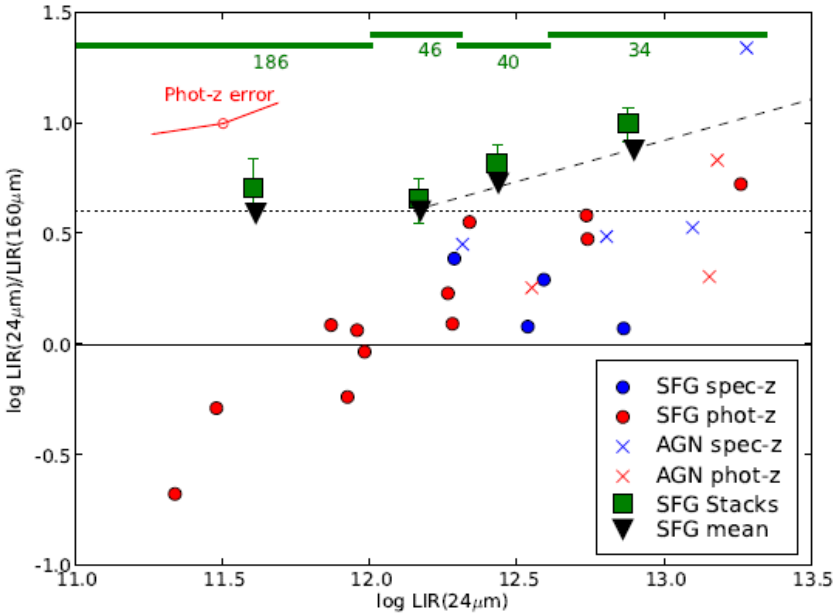


Nordon et al. 2010



Elbaz et al. 2010 (next talk)

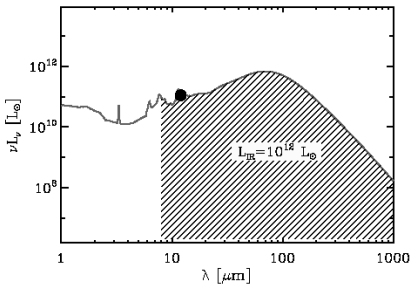
Z~2: Extrapolation from 24μm overpredicts FIR



• Star formation rates based on 24um, z, and Chary/Elbaz SED family **overpredict the calorimetric FIR by factors 4-7.5 *at this redshift***

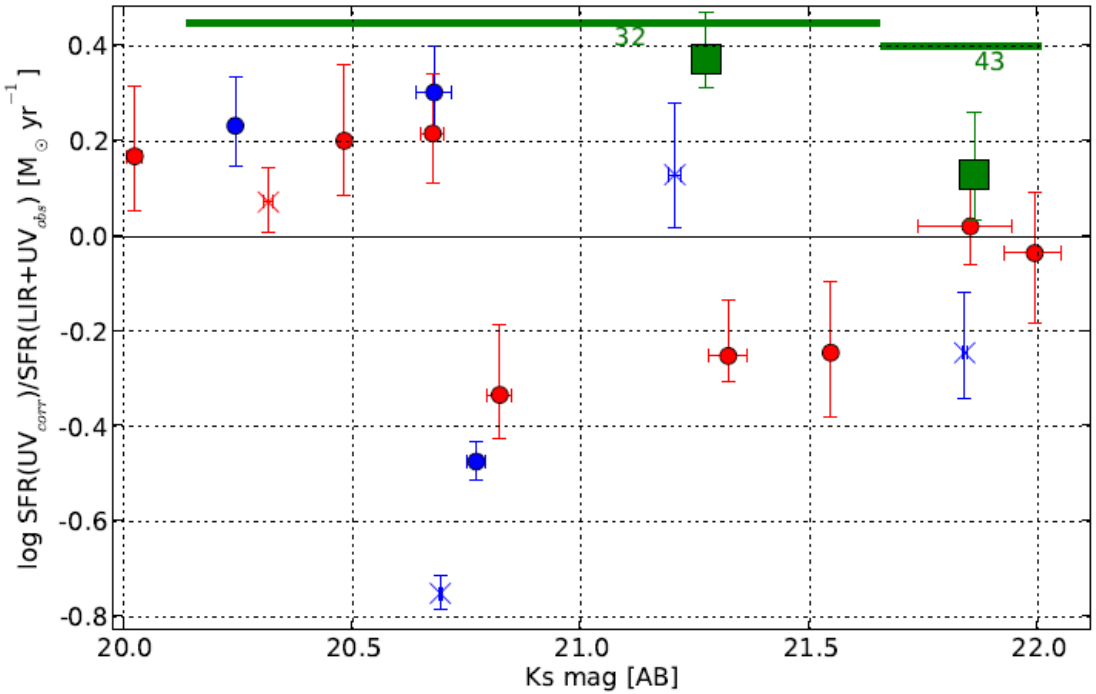
• Similar behaviour of X-ray AGN and other galaxies

• **Obscured AGN and/or changing SED shape/PAH strength**? Setting in of the effect at z=1.5 favours the latter, to be continued…



Nordon et al. 2010 (poster)

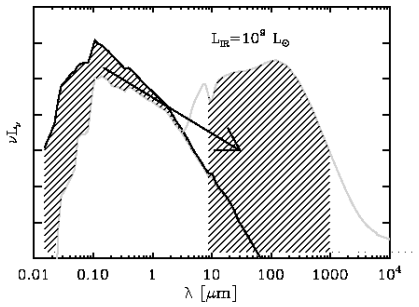
Z~2: Extrapolation from rest frame UV slightly overpredicts FIR



Extrapolation from rest frame UV (used here: Daddi (2004) BzK recipe and Calzetti (2000) extinction law

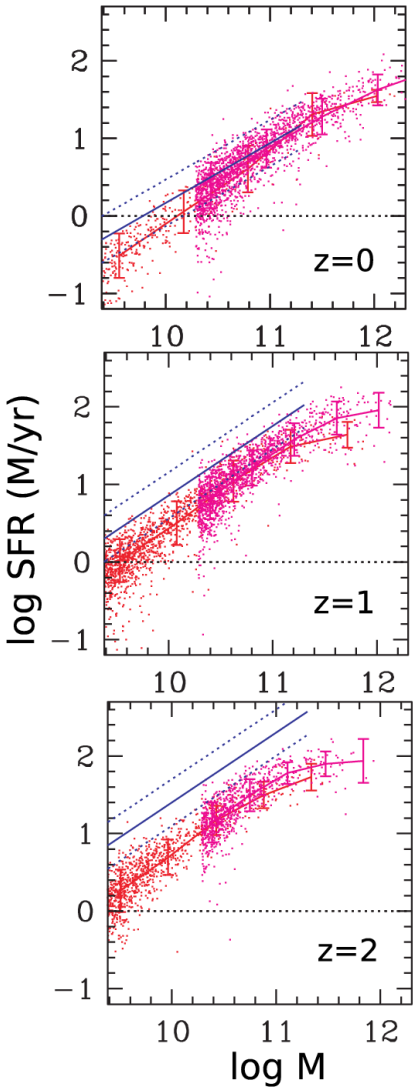
Overprediction by factor ~2

Modest modification to extinction law needed?

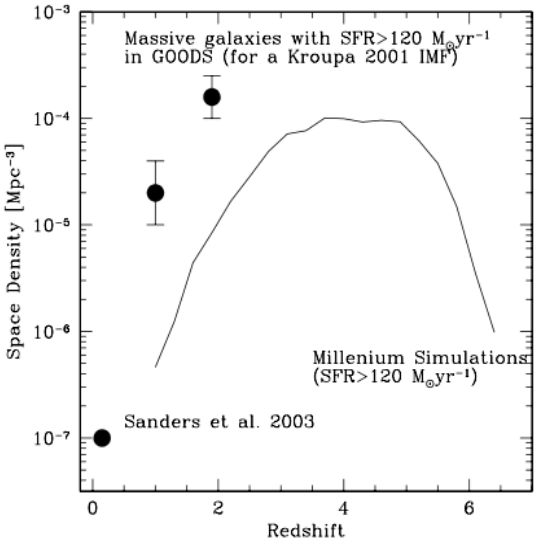


Nordon et al. 2010 (poster)

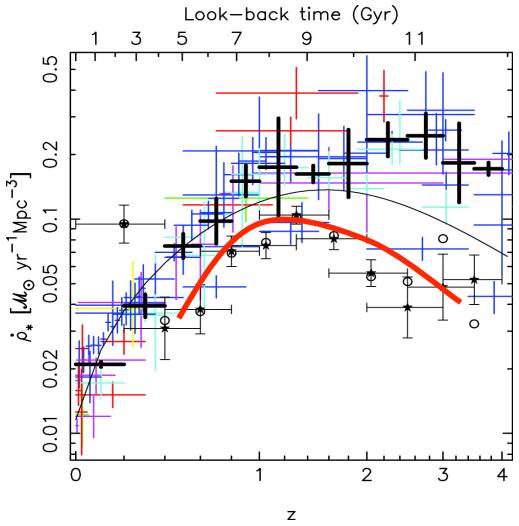
Towards reconciling observed and theoretical star formation rates



Dave 08



Daddi+ 07

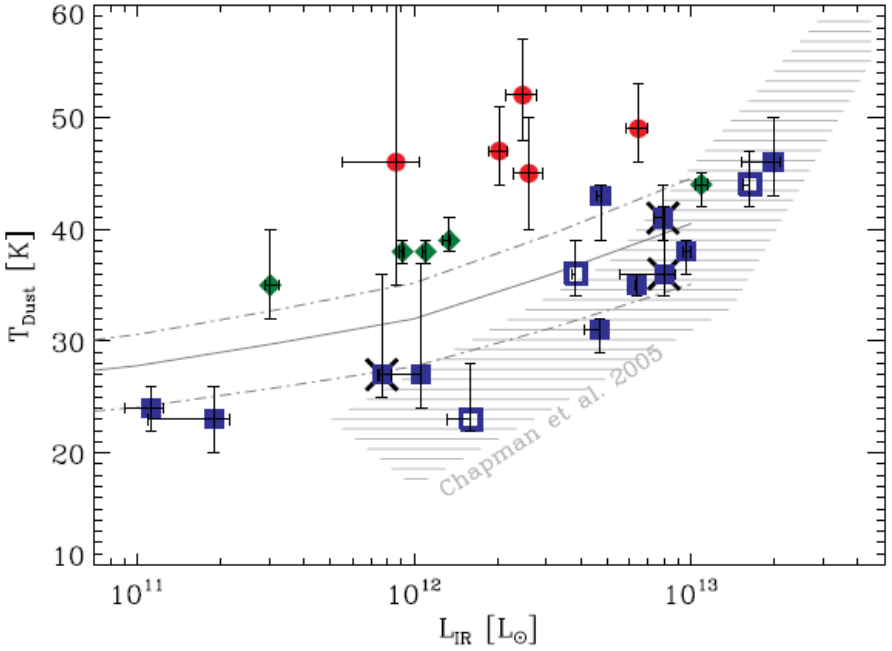


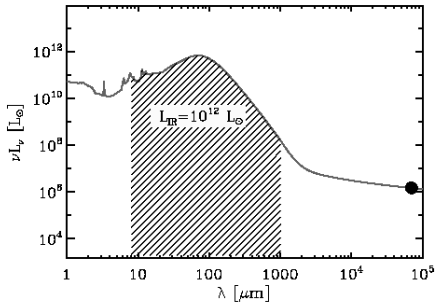
Perez-Gonzalez+08

Extrapolation from submm/radio assuming radio/FIR correlation

Very high IR luminosities of SMGs as estimated from submm/radio via local radio-FIR relation are substantiated by Herschel data

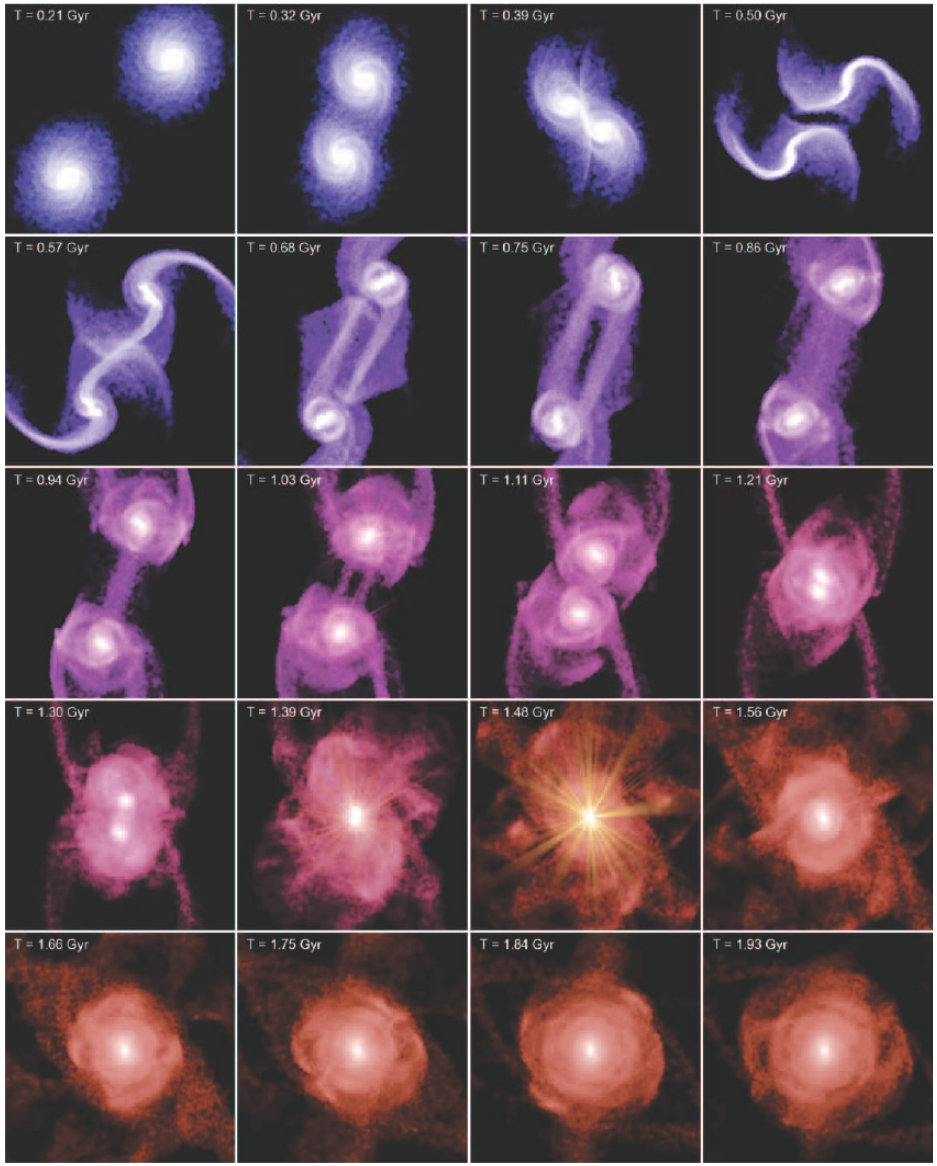
.. Previous selection effects on dust temperature can now be largely avoided



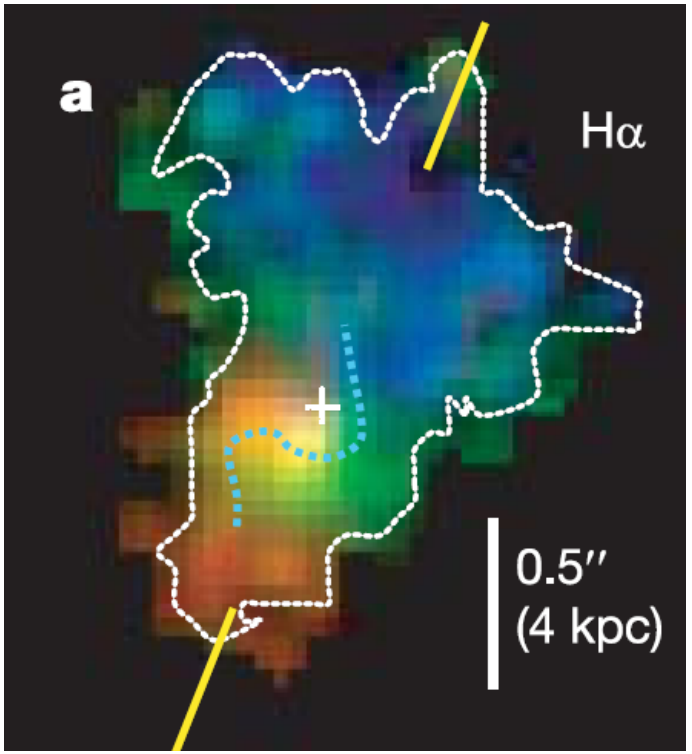


Magnelli et al. 2010 (talk on Thursday)

The co-evolution of AGN and star formation

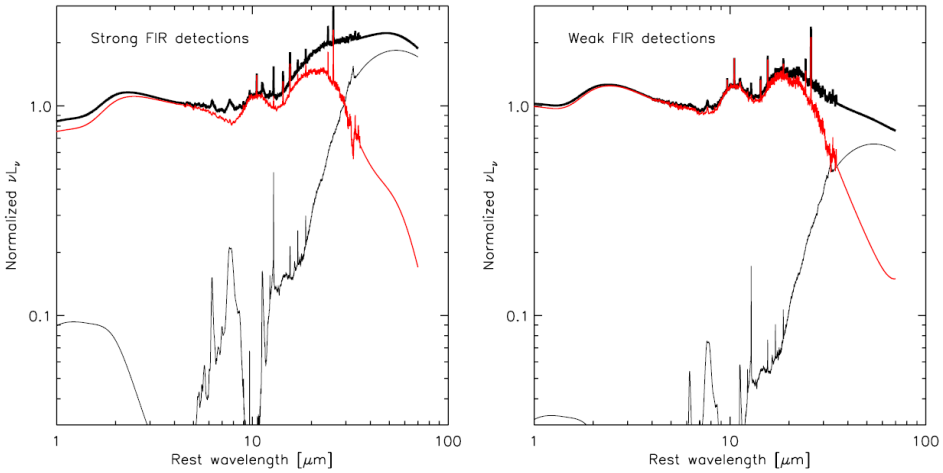


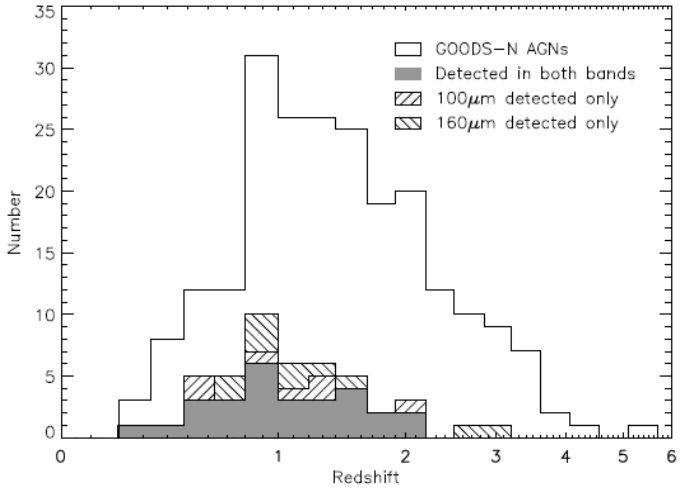
Models of merging galaxies (Hopkins+06)



BzK-15504 z~2.38 rotating disk with central AGN (Genzel+08)

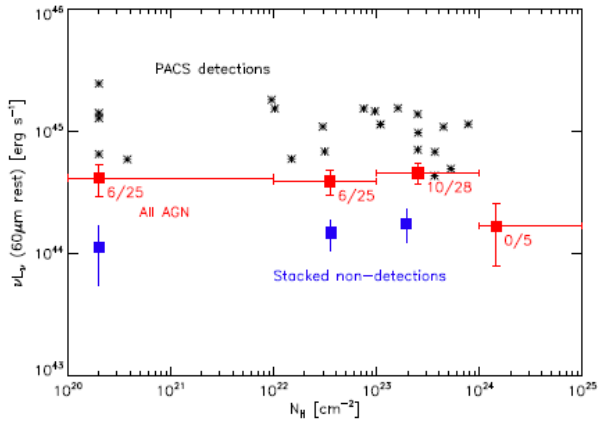
X-ray selected AGN in GOODS-N: Using FIR to measure star formation





FIR has best contrast between host star formation and intrinsic AGN SED
(QSO SEDs from Netzer+07)

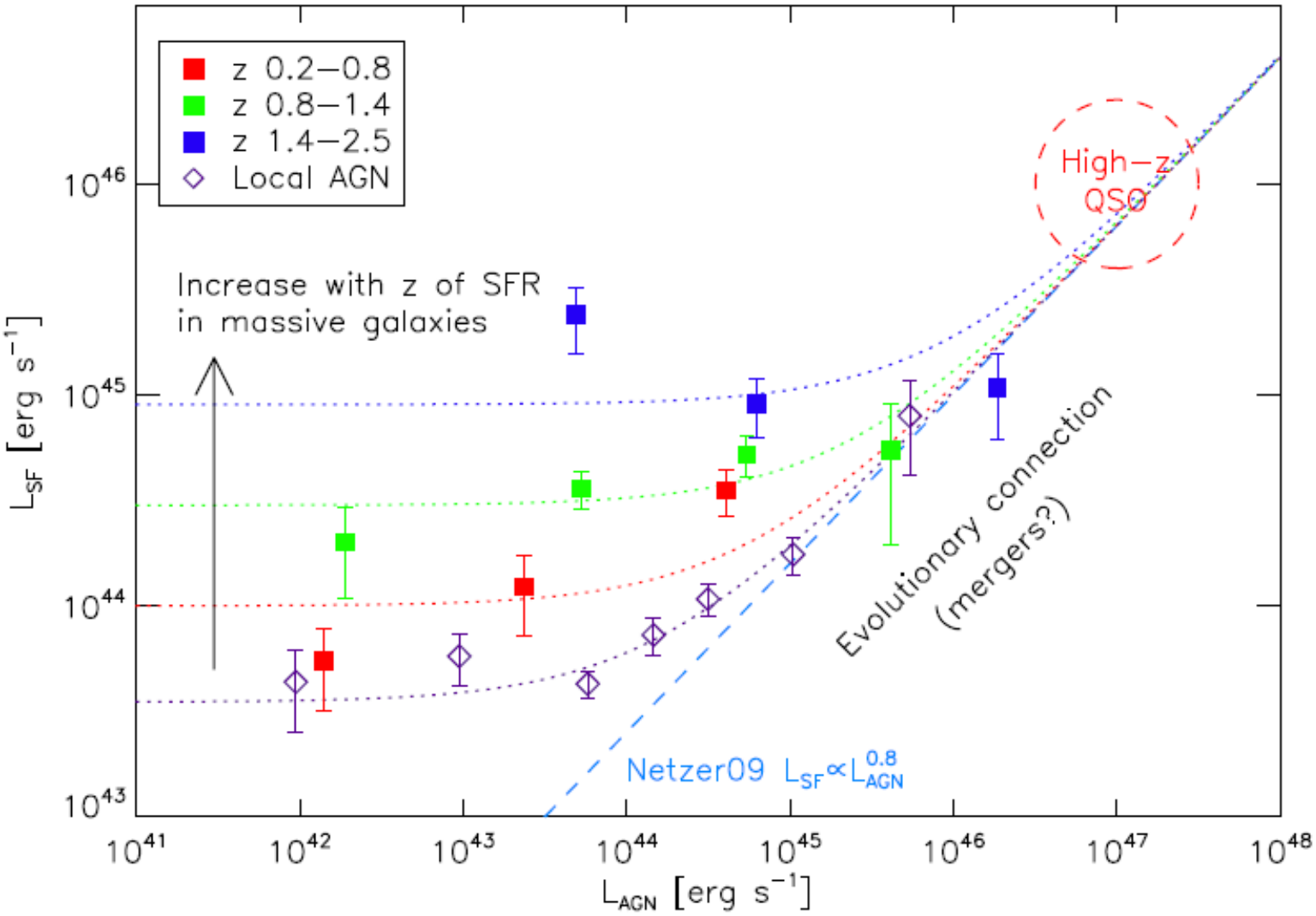
FIR detection rate 21% for X-ray AGN



No trend with obscuration
(but only few L_X>10^{44} in sample)

Shao et al. 2010 (poster)

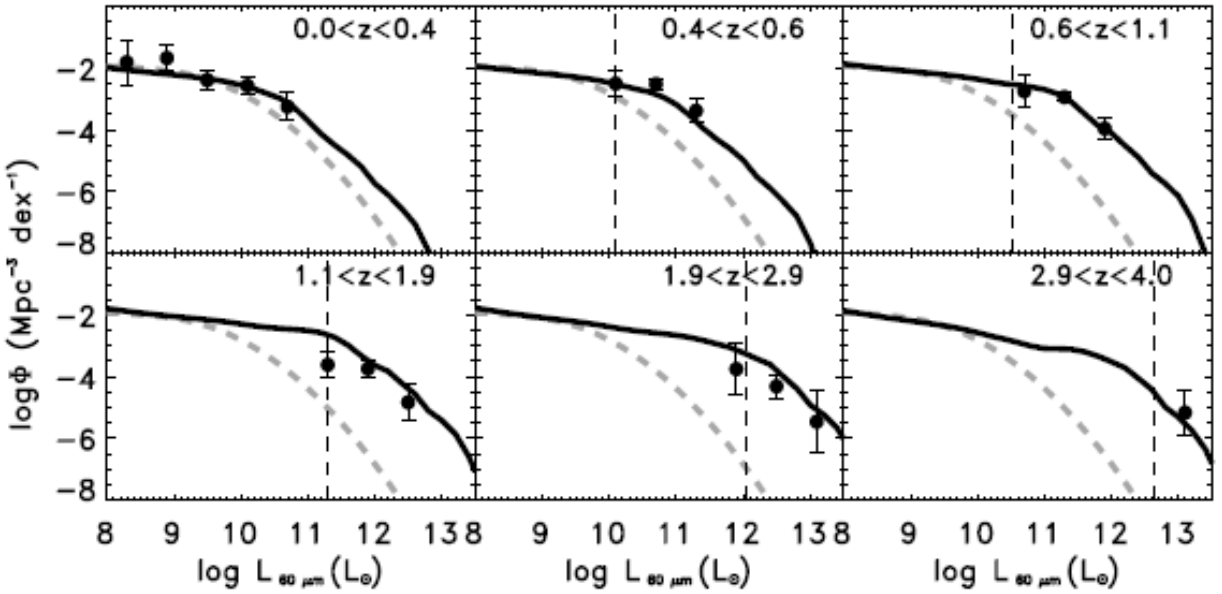
Two modes of AGN / host coevolution: Merger vs. secular



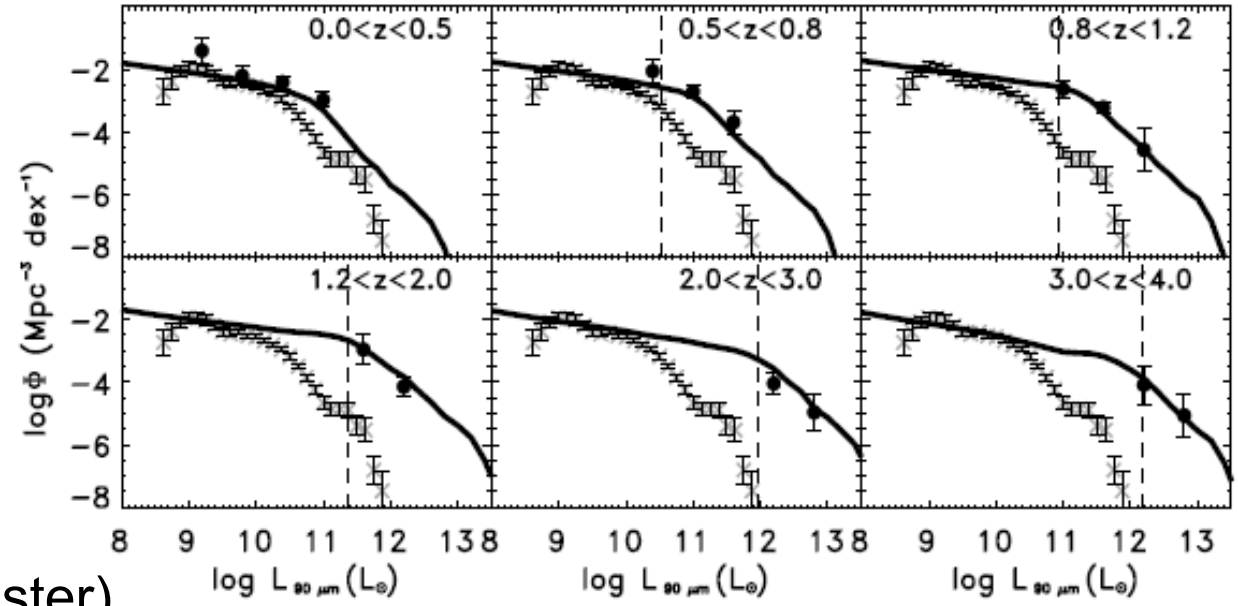
Shao et al. 2010 (poster)

Direct far-infrared luminosity functions

Rest frame
60μm

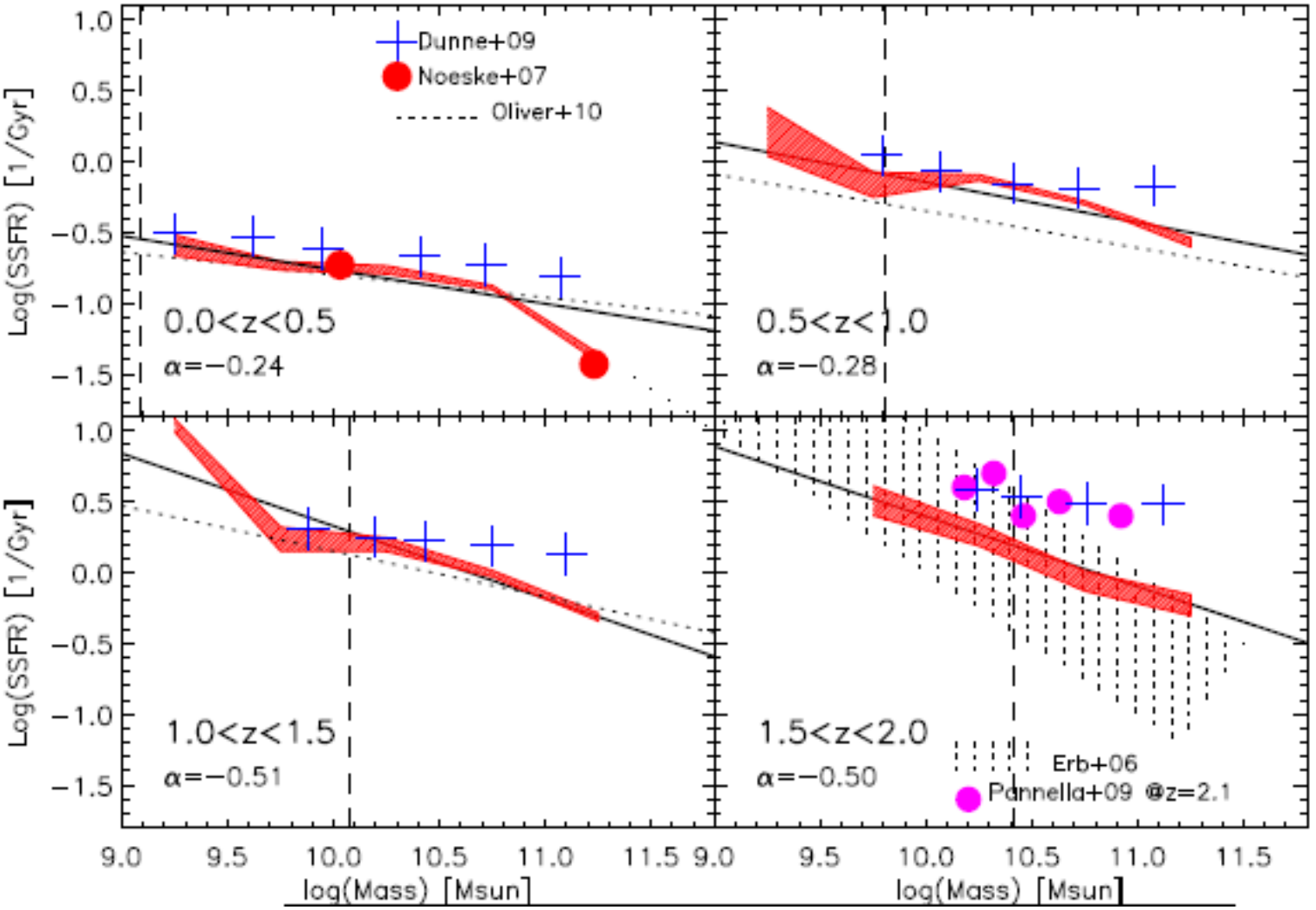


Rest frame
90μm



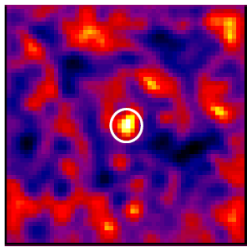
Gruppioni et al. 2010 (poster)

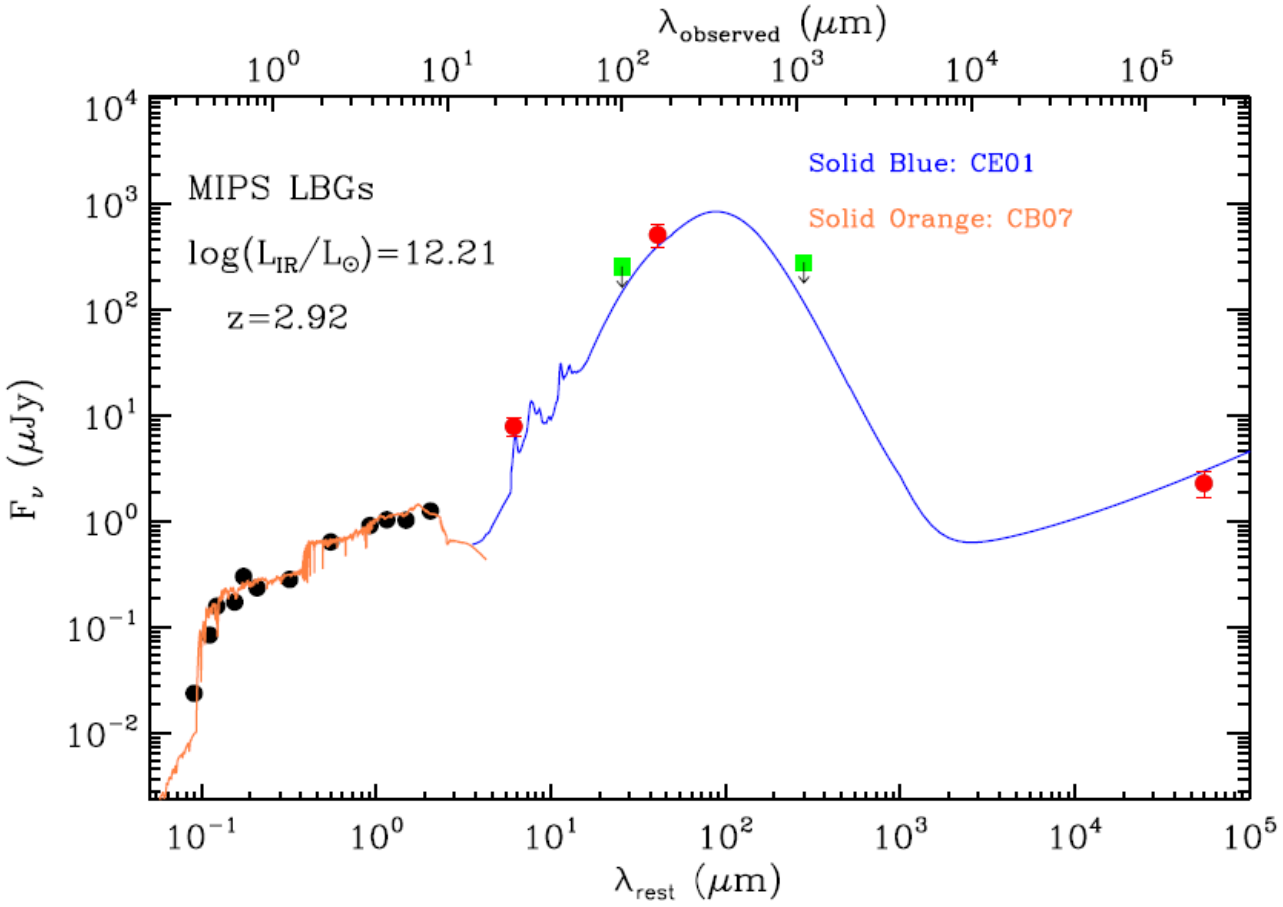
FIR-based determinations of the specific star formation rate



Rodighiero et al. 2010 (talk on Thursday)

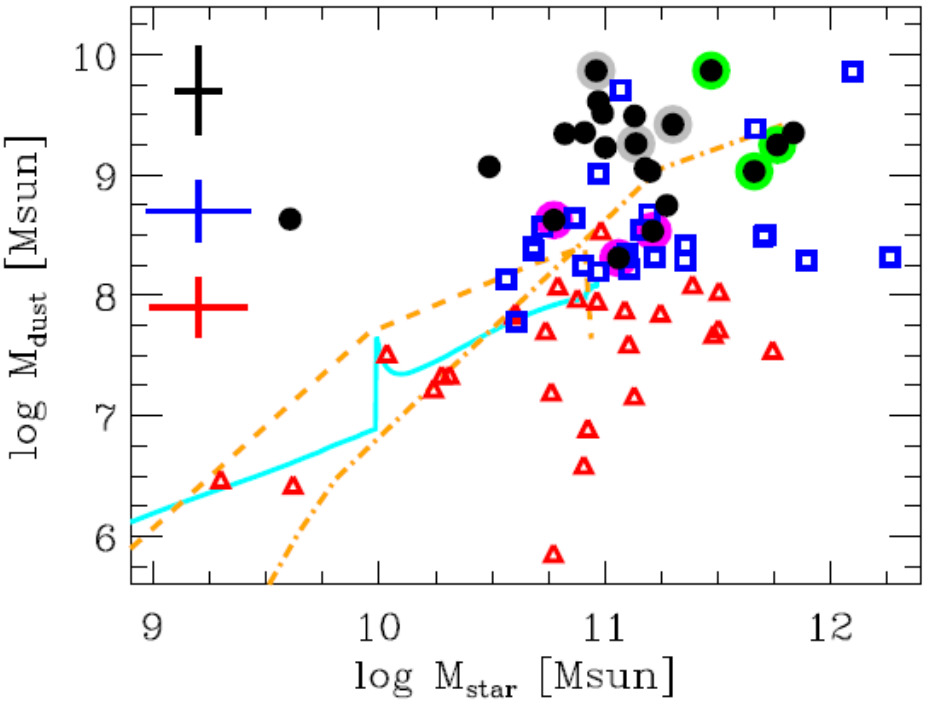
Stacked far-infrared detection / SED constraints for Lyman Break Galaxies

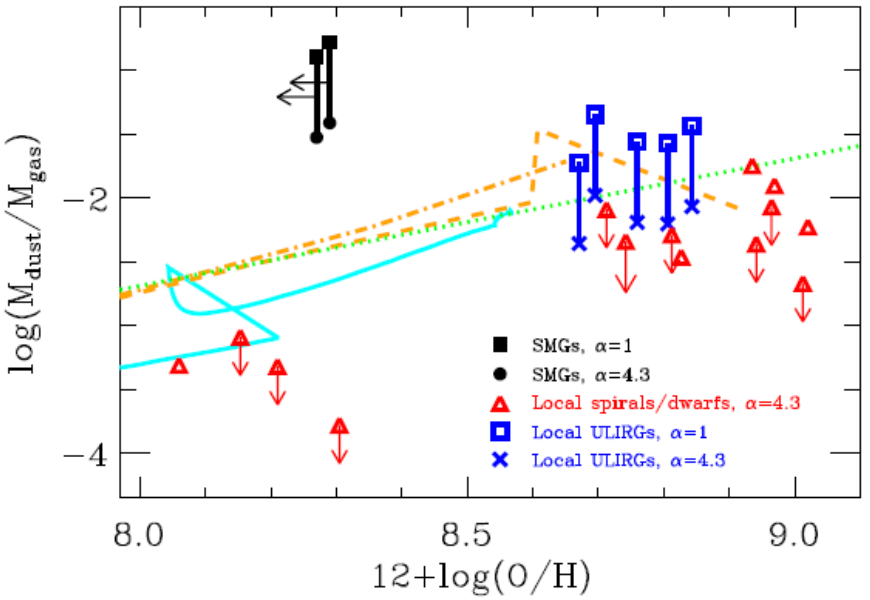




Magdis et al. 2010 (Poster)

Surprisingly large dust masses of submillimeter galaxies





Santini et al. 2010

… more dust than expected for gas phase metallicity

Thank you!

Jose Acosta
Bruno Altieri
Paola Andreani
Herve Aussel
Stefano Berta
Angel Bongiovanni
Damien Le Borgne
Nicolas Bouche
Drew Brisbin
Hector Castaneda
Antonio Cava
Jordi Cepa
Andrea Cimatti
Emanuele Daddi
Helmut Dannerbauer
Helena Dominguez-Sanchez
David Elbaz
Emeric Le Floc'h
Natascha Förster Schreiber
Reinhard Genzel
Ignacio Gonzalez
Gianluigi Granato
Andrea Grazian
Carlotta Gruppioni
Martin Harwit
Ho-Seong Hwang
Georgios Magdis
Benjamin Magnelli
Roberto Maiolino
Leo Metcalfe
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Koryo Okumura
Ana Perez
Ismael Perez Fournon
Albrecht Poglitsch
Paola Popesso
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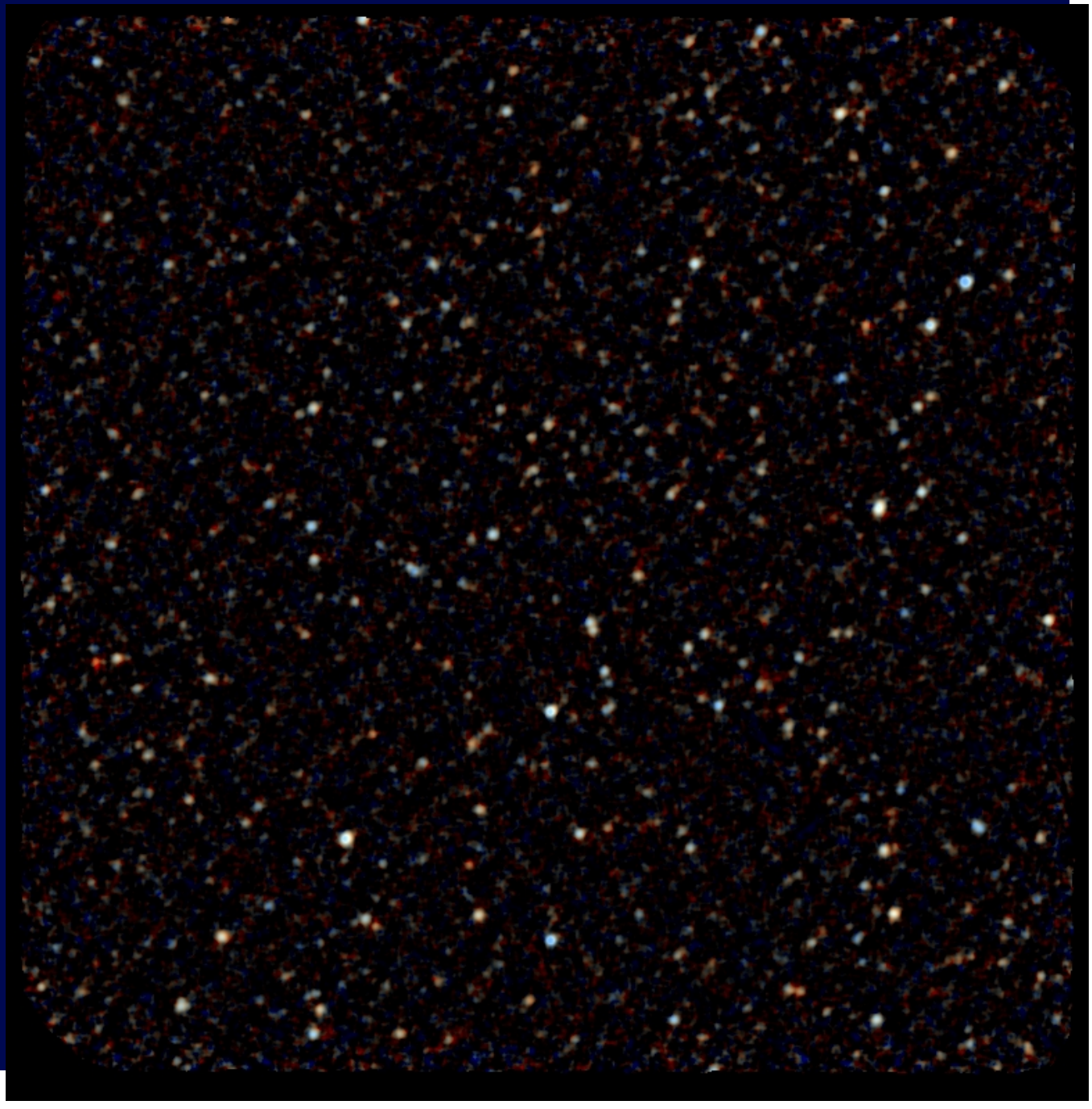

Lockman Hole