

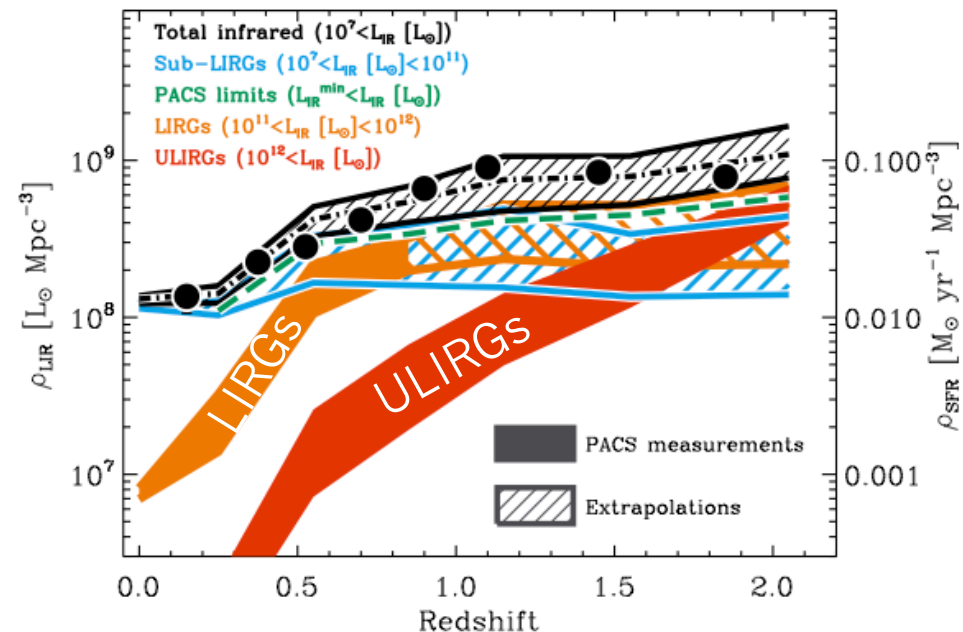
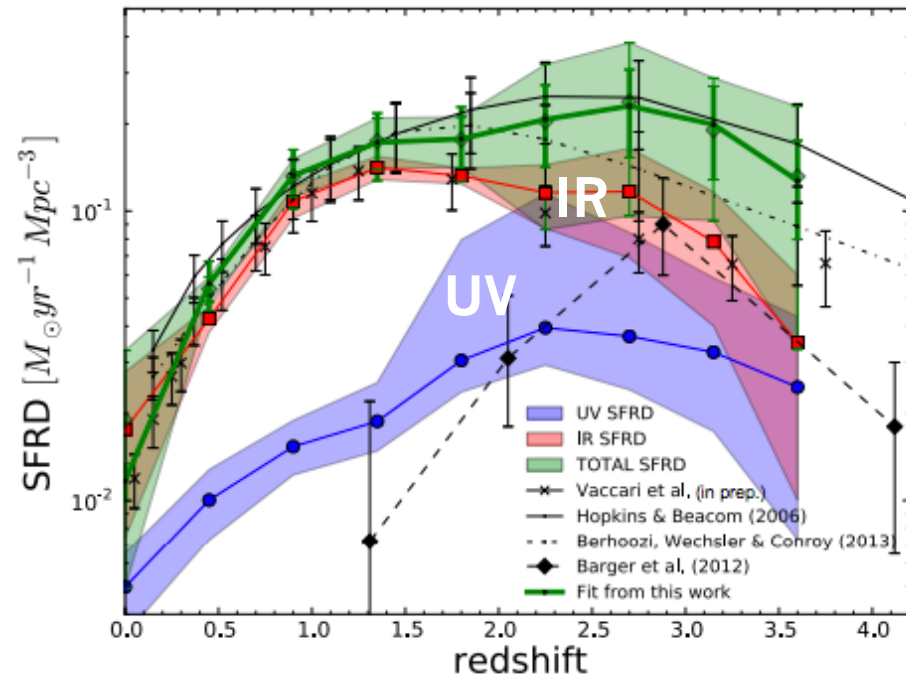
Galaxy Evolution from the Herschel + HST CANDELS programs

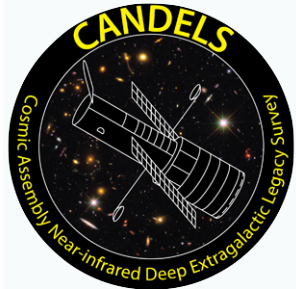
Hanae Inami (NOAO)

M. Dickinson, D. Elbaz, B. Magnelli,
P. Popesso, I. Valtchanov, D. Coia,
J. Kartaltepe, J. Pforr, CANDELS team

Galaxy Evolution

- The peak era of galaxy growth took place at $z \sim 1-3$
 - Dusty star formation
- SFRD of (U)LIRGs increase dramatically towards higher redshifts.





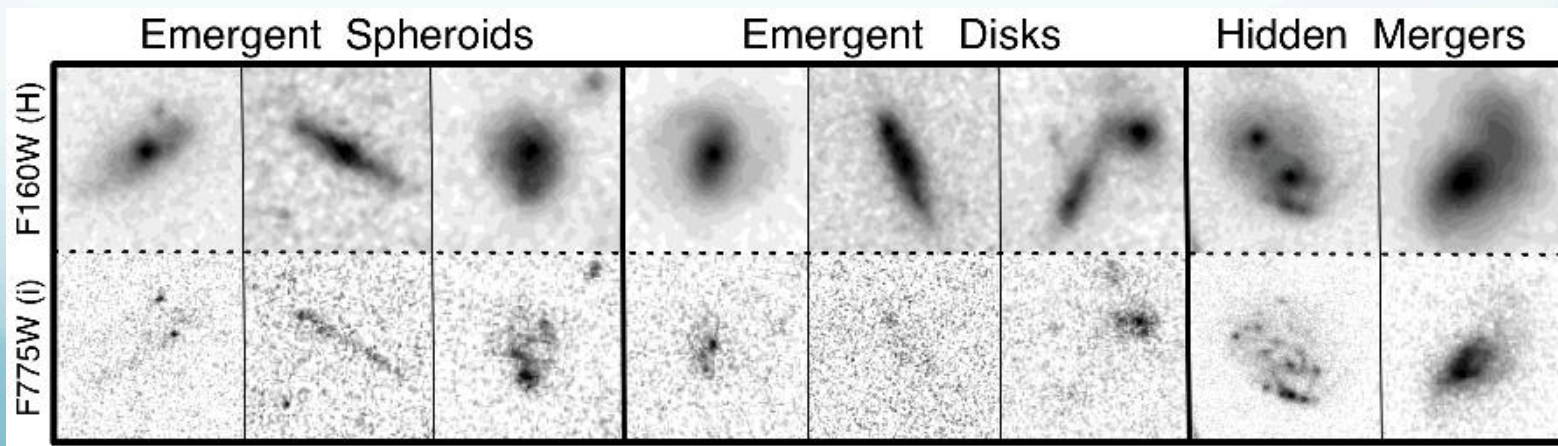
The CANDELS project

- Cosmic Assembly Near-Infrared Deep Extragalactic Legacy Survey (PIs: S. Faber & H. Ferguson)
- HST ACS & WFC3 deep imaging for GOODS-S and N, EGS, UDS, and COSMOS
 - High resolution (galaxy structure)
 - Deep imaging (detect all Herschel counterparts)

$z \sim 2$

Rest-frame

UV Optical



GOODS- & CANDELS- Herschel

- GOODS-Herschel (PI D. Elbaz, OTKP)

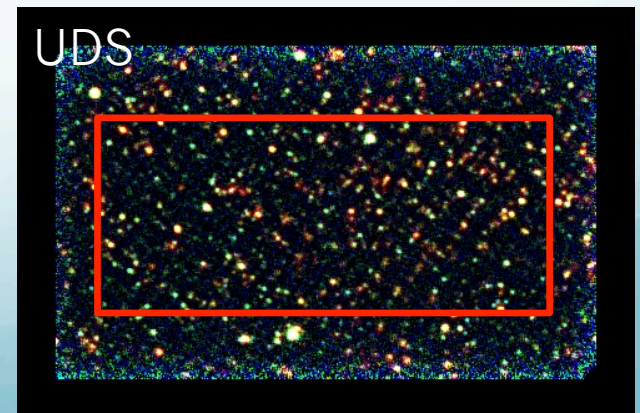
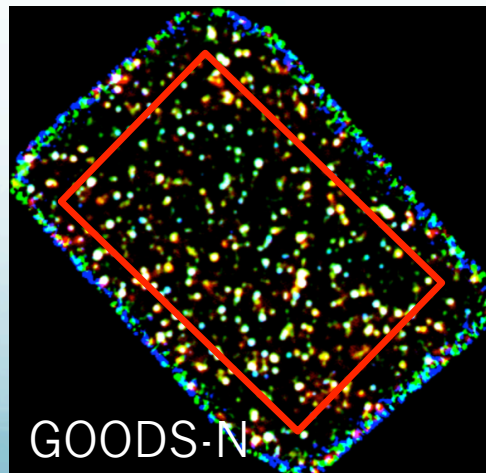
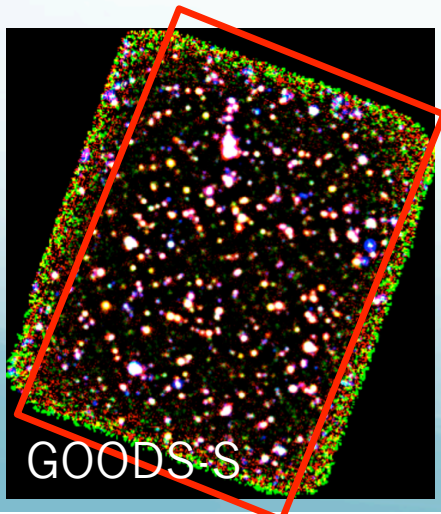
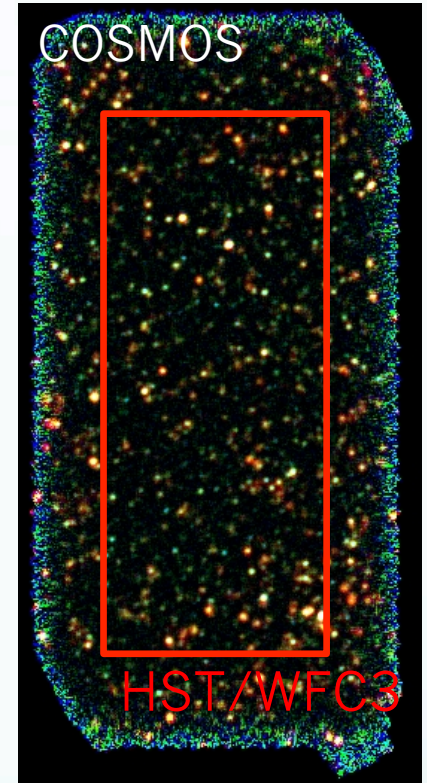


<http://hedam.oamp.fr/GOODS-Herschel/index.php>

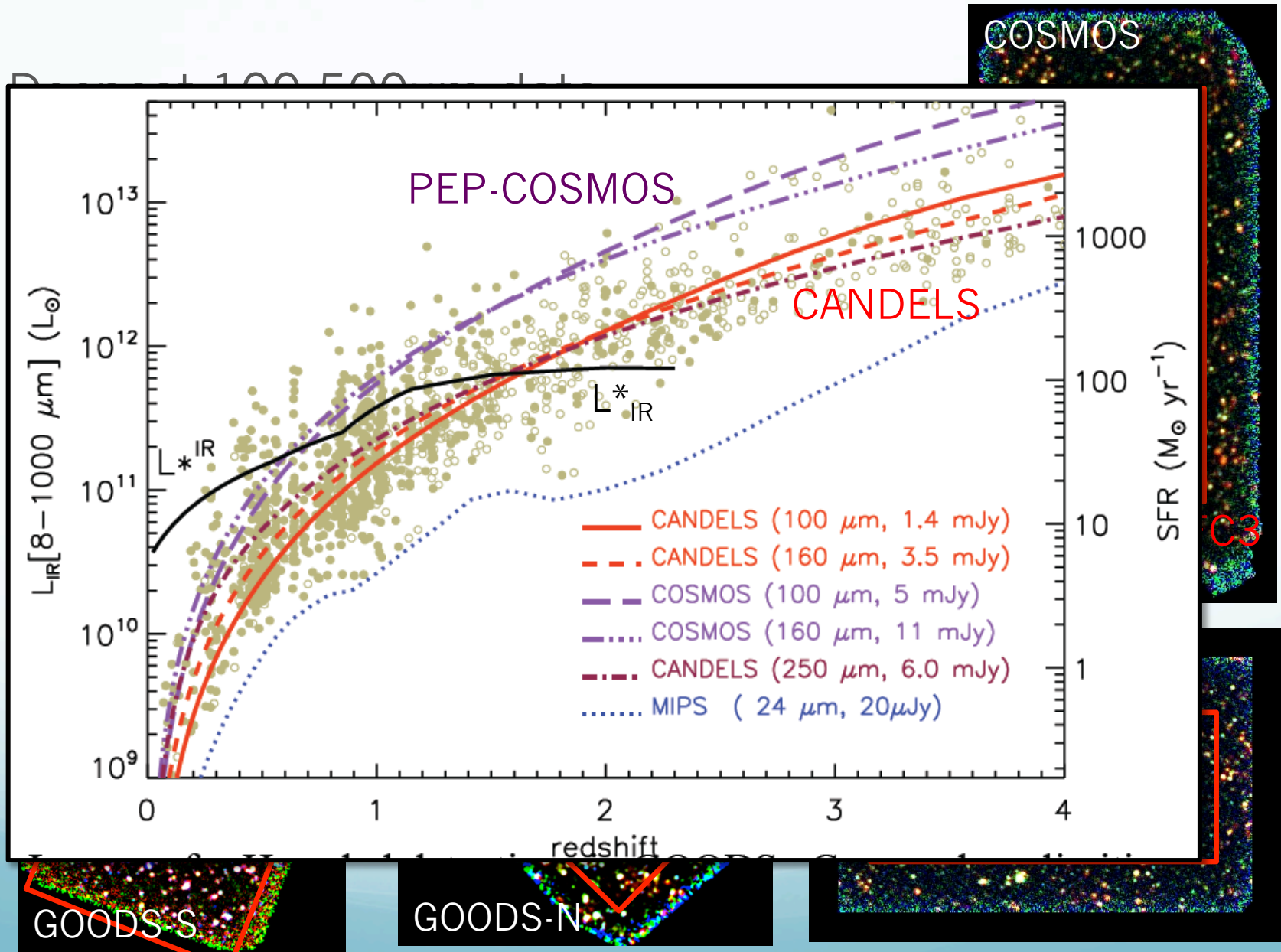
- CANDELS-Herschel (PI M. Dickinson, OT2)
 - COSMOS & UDS
 - PACS & SPIRE
 - Fully cover the CANDELS WFC3 fields
- PEP & HerMES
 - Coverage of the CANDELS fields

GOODS- & CANDELS-Herschel

- Deepest 100-500 μ m data
 - Typical star-forming galaxies up to $z \sim 2$
- Covering 4/5 CANDELS fields
 - Improved statistics and good control over cosmic variance
 - Increase accessible fields from ALMA
 - GOODS-S, UDS, & COSMOS

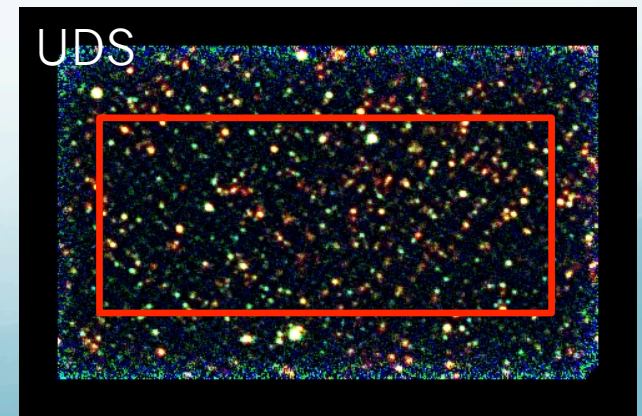
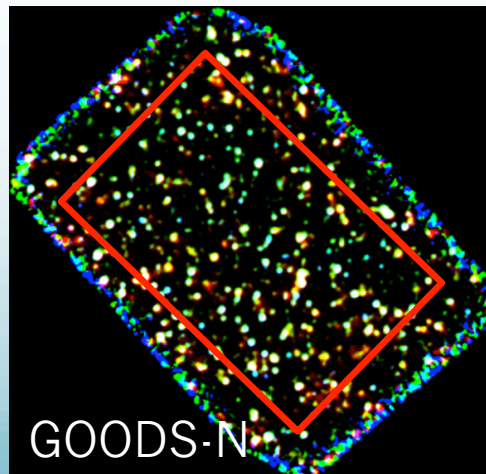
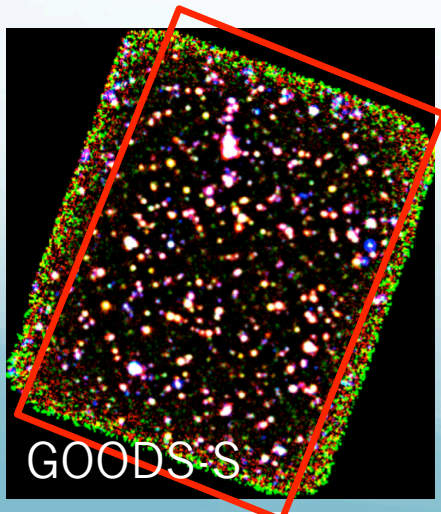
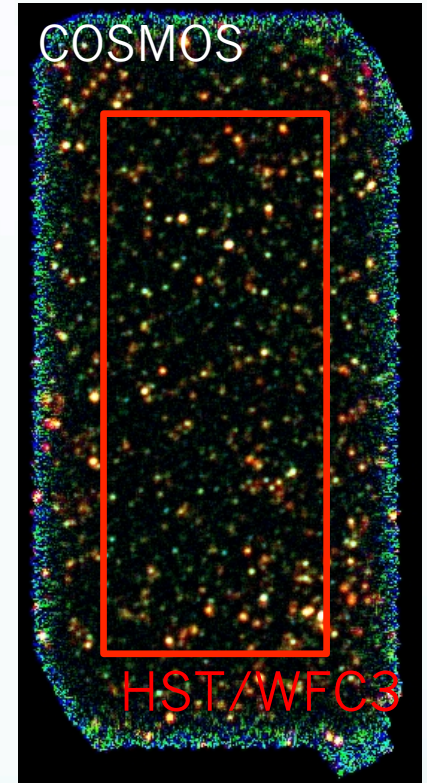


GOODS- & CANDELS-Herschel



GOODS- & CANDELS-Herschel

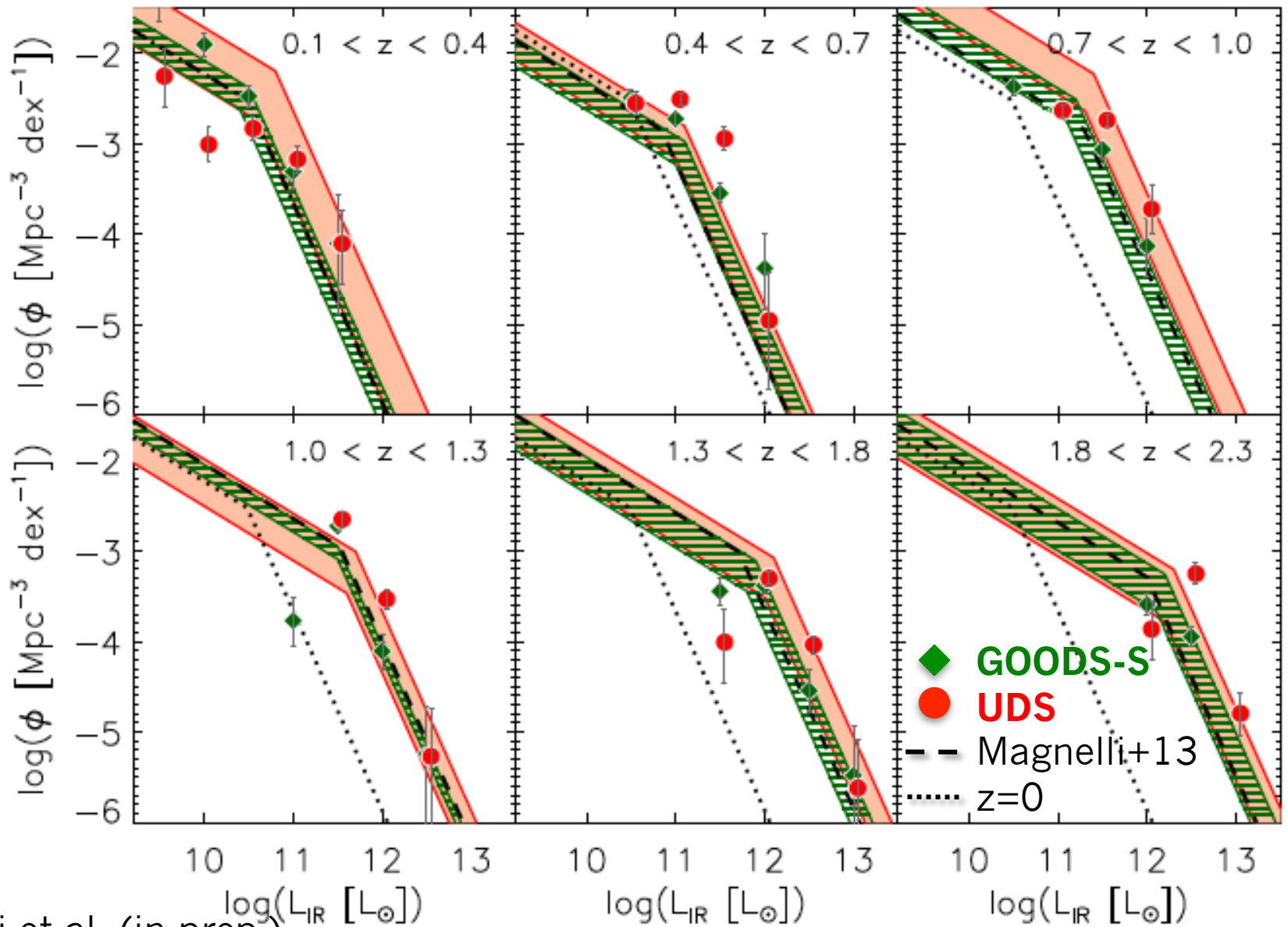
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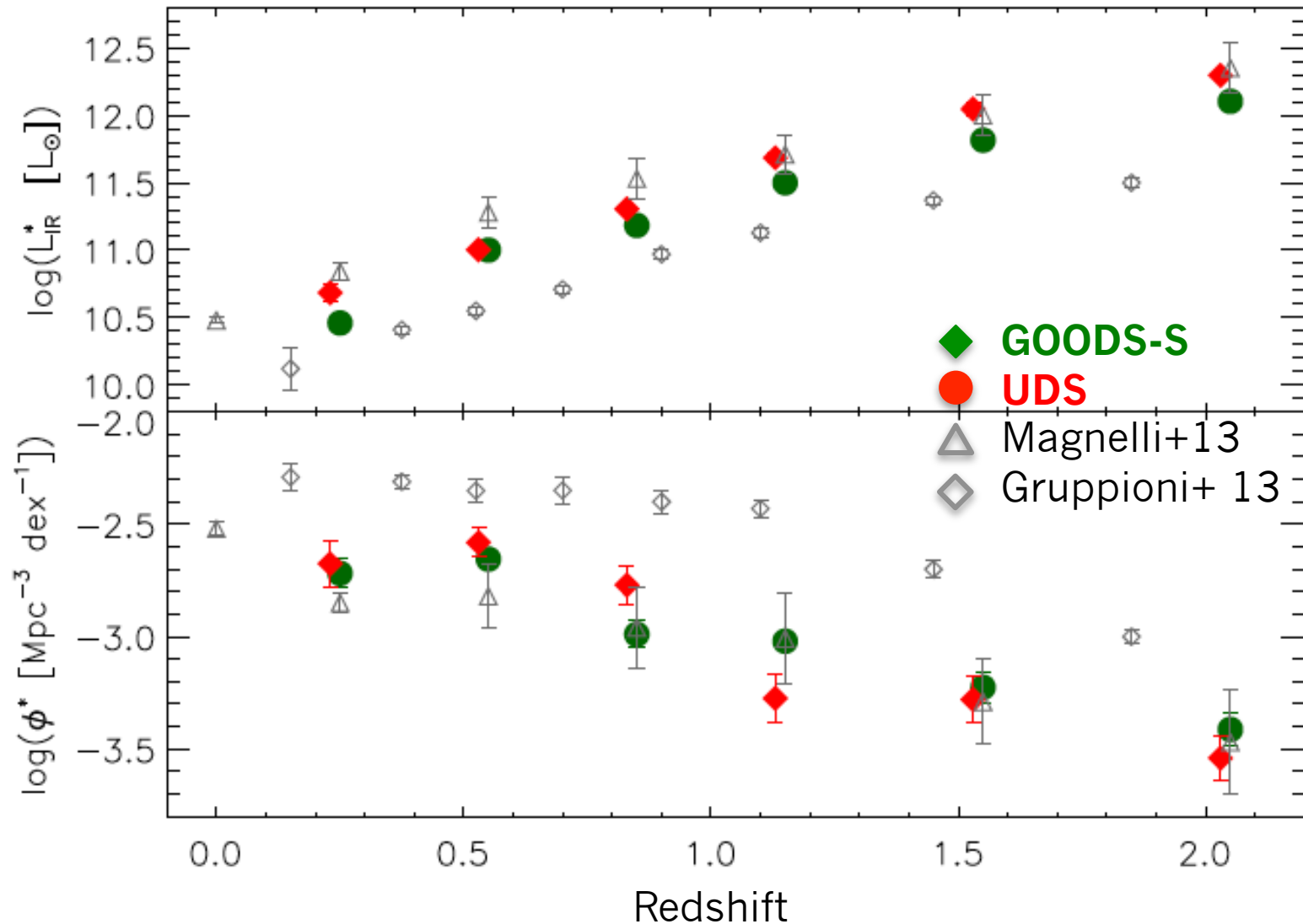
IR luminosity functions

- Herschel measures near the peak of the FIR dust emission, minimizing uncertainties in the bolometric corrections.
- Good control over cosmic variance
- Increased number of typical SF galaxies ($\leq L_{\text{IR}}^*$)
 - Constrain Faint-end slope
 - At $z \sim 1.5$
 - GOODS-H only: ~ 100 sources
 - GOODS-H + CANDELS-H (UDS+COSMOS): ~ 180 sources

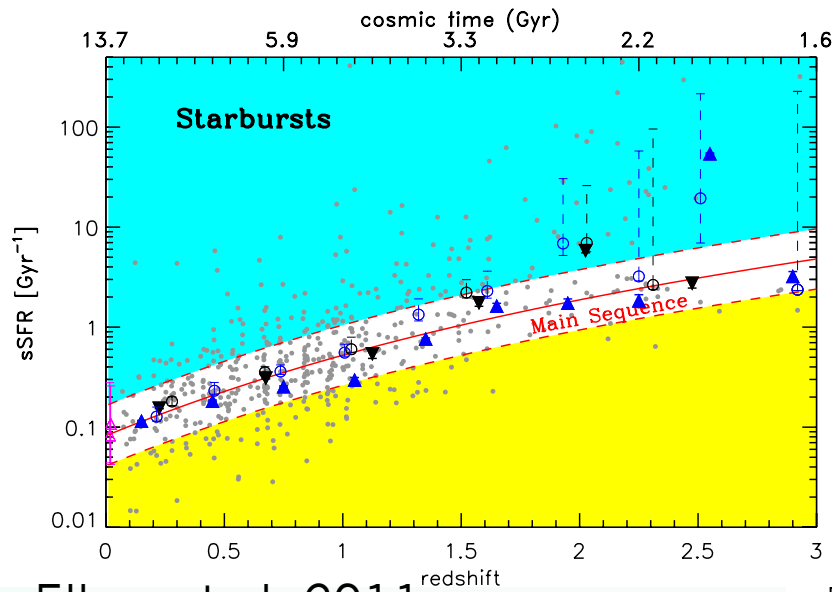
IR luminosity functions



Evolution in LFs



“Main Sequence” and Starburst Galaxies

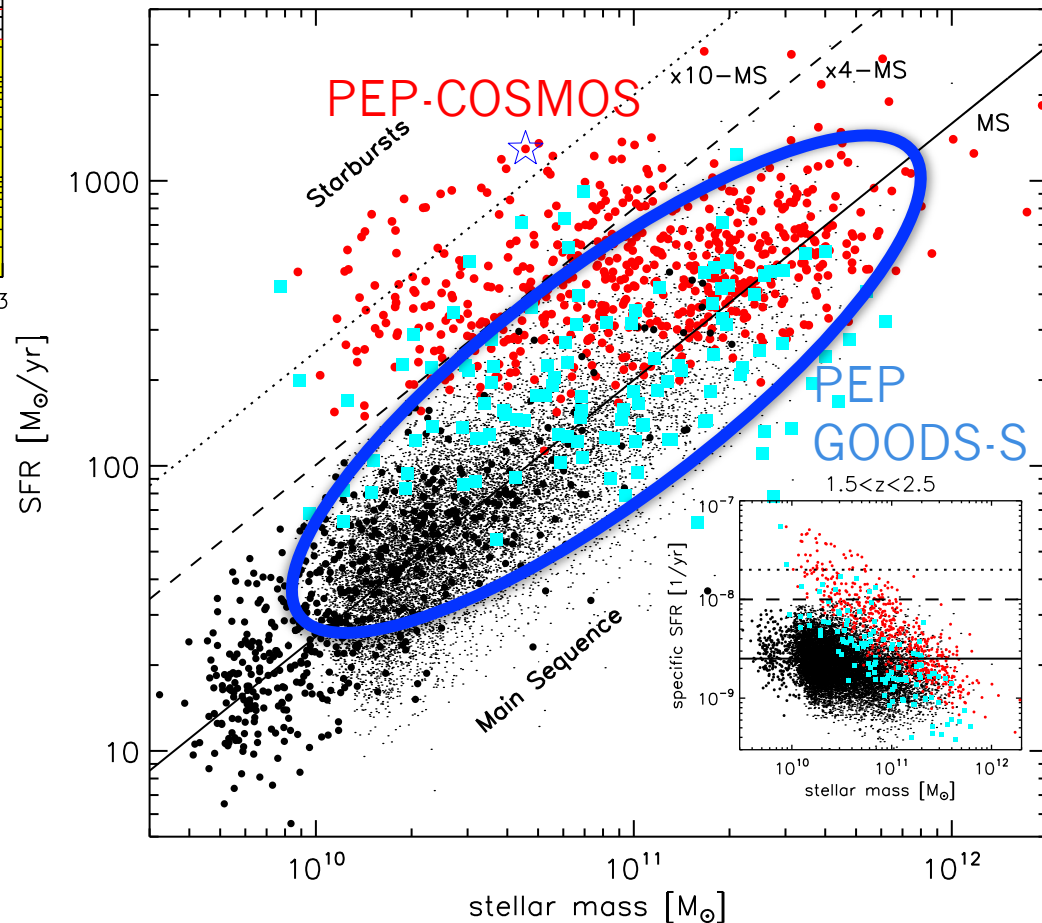


Elbaz et al. 2011

How does morphology
relate to the star
formation modes at
 $z \sim 2$?

Rodighiero et al. 2011

$1.5 < z < 2.5$

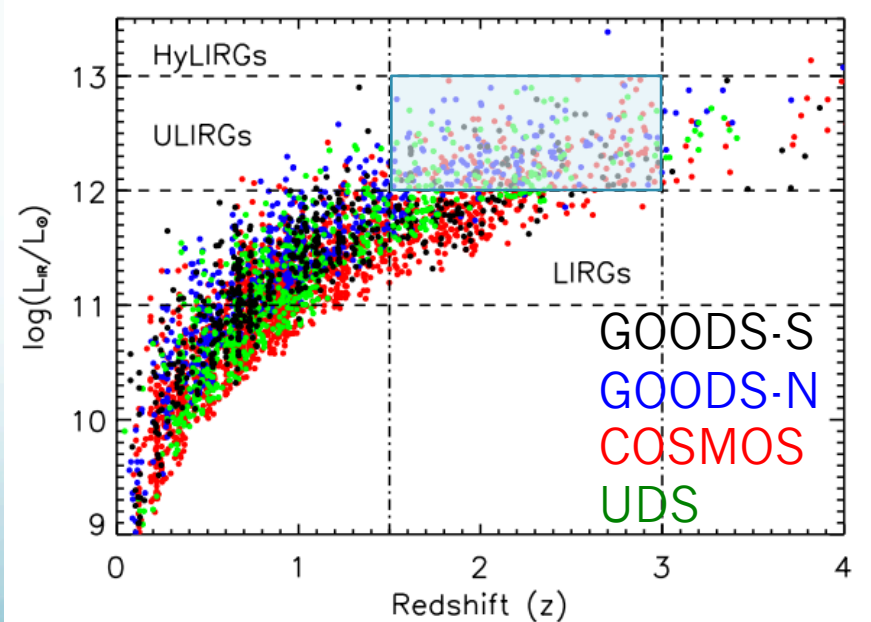
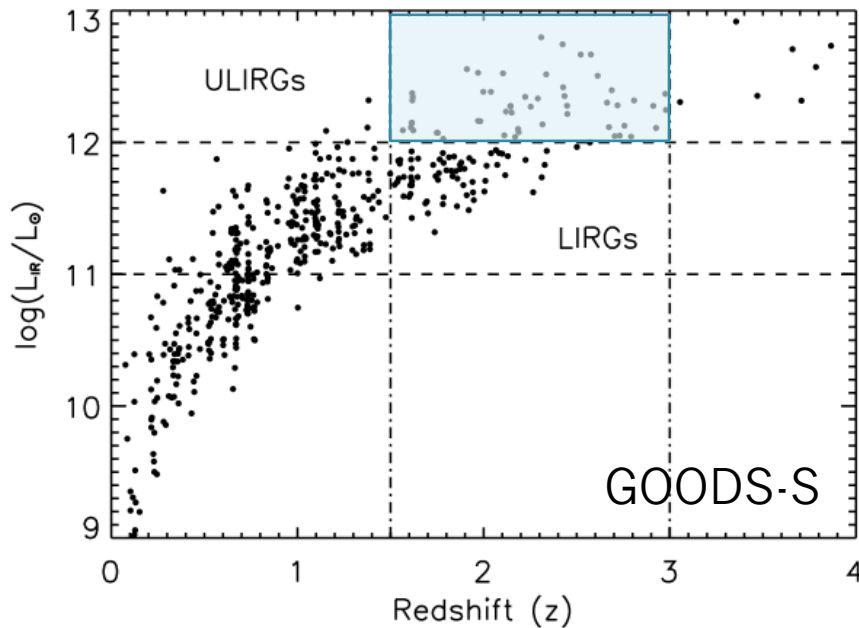
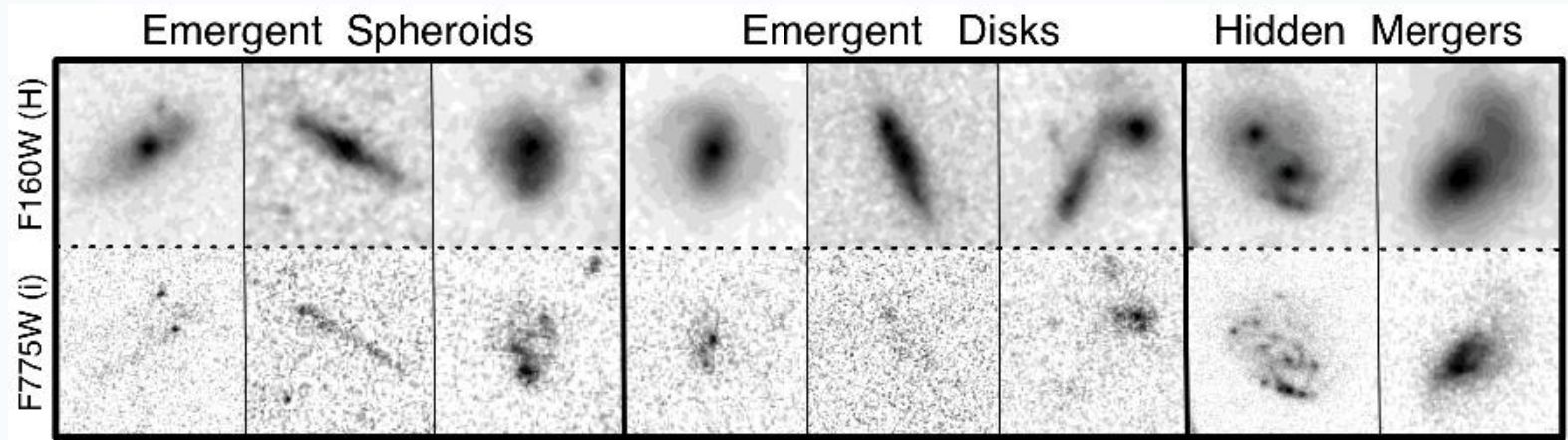


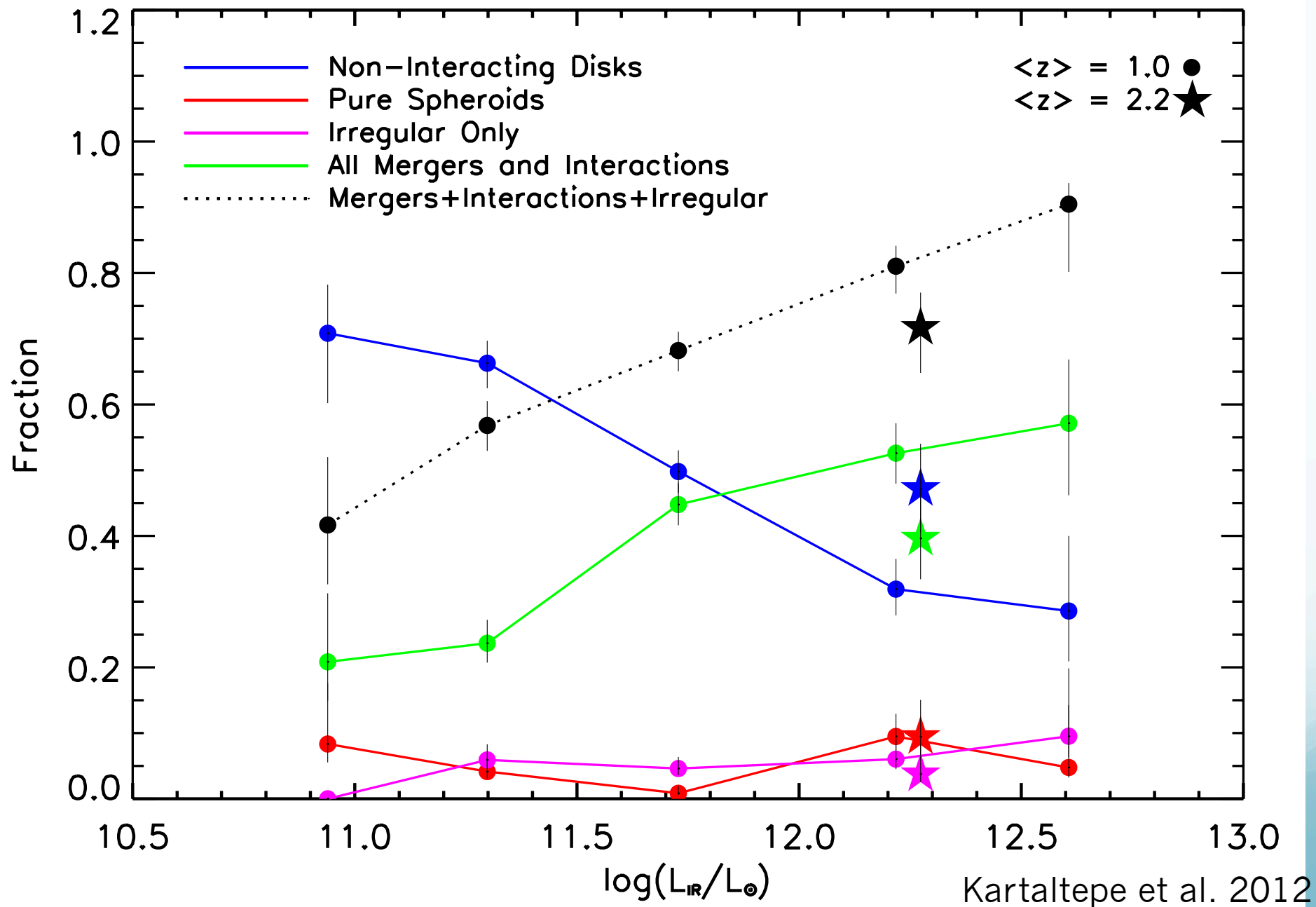
Galaxy Structure

$z \sim 2$

Rest-frame

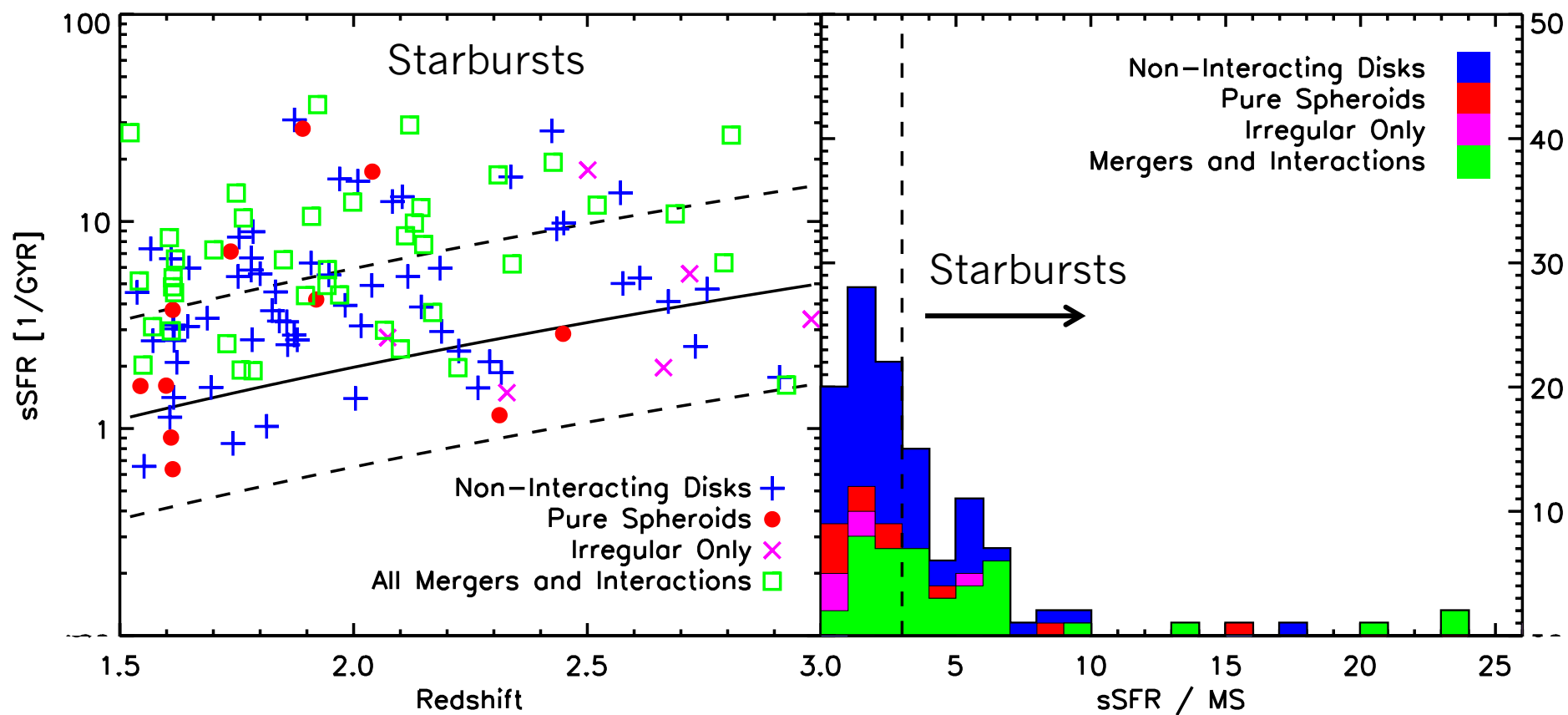
UV Optical





SFR/Stellar Mass Relation

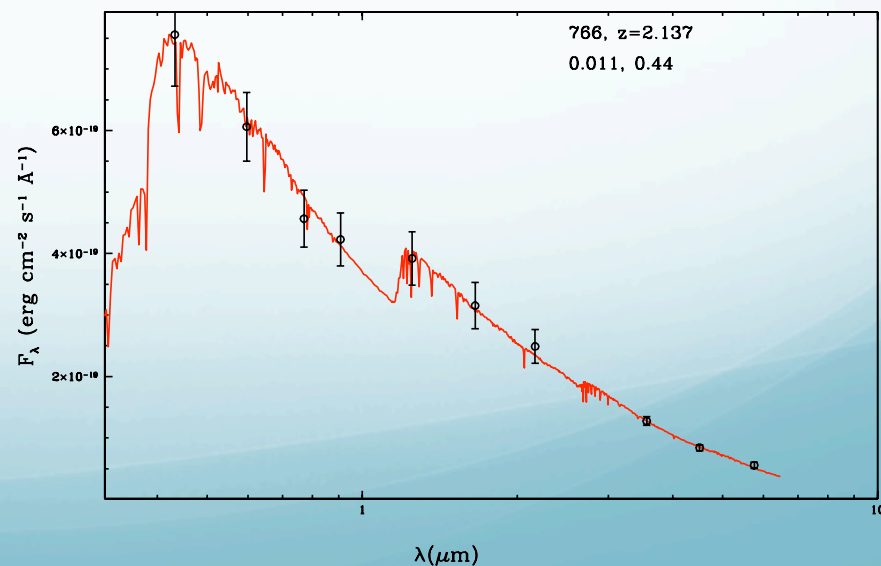
See poster by Kartaltepe (Session A, P23)



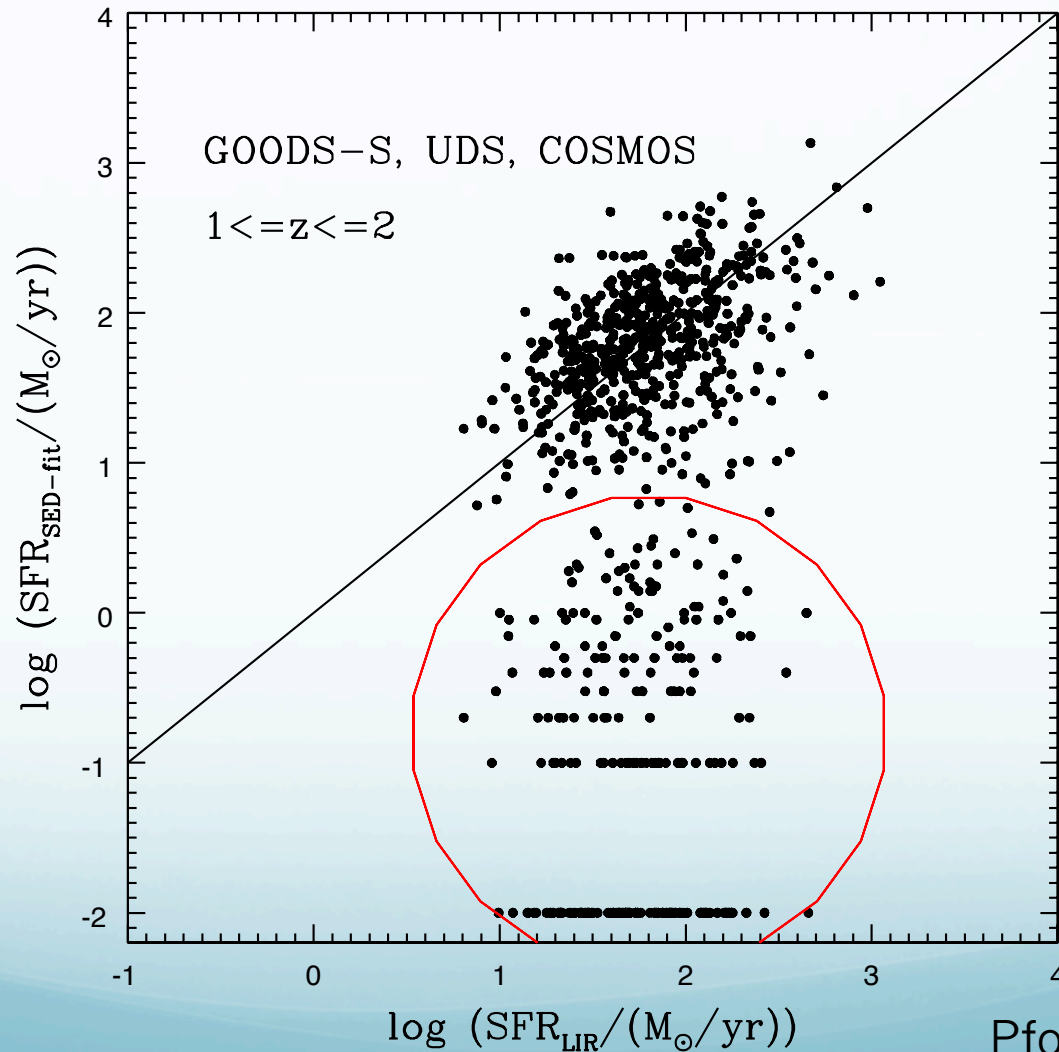
Star Formation Rates: Optical/NIR SEDs vs. IR



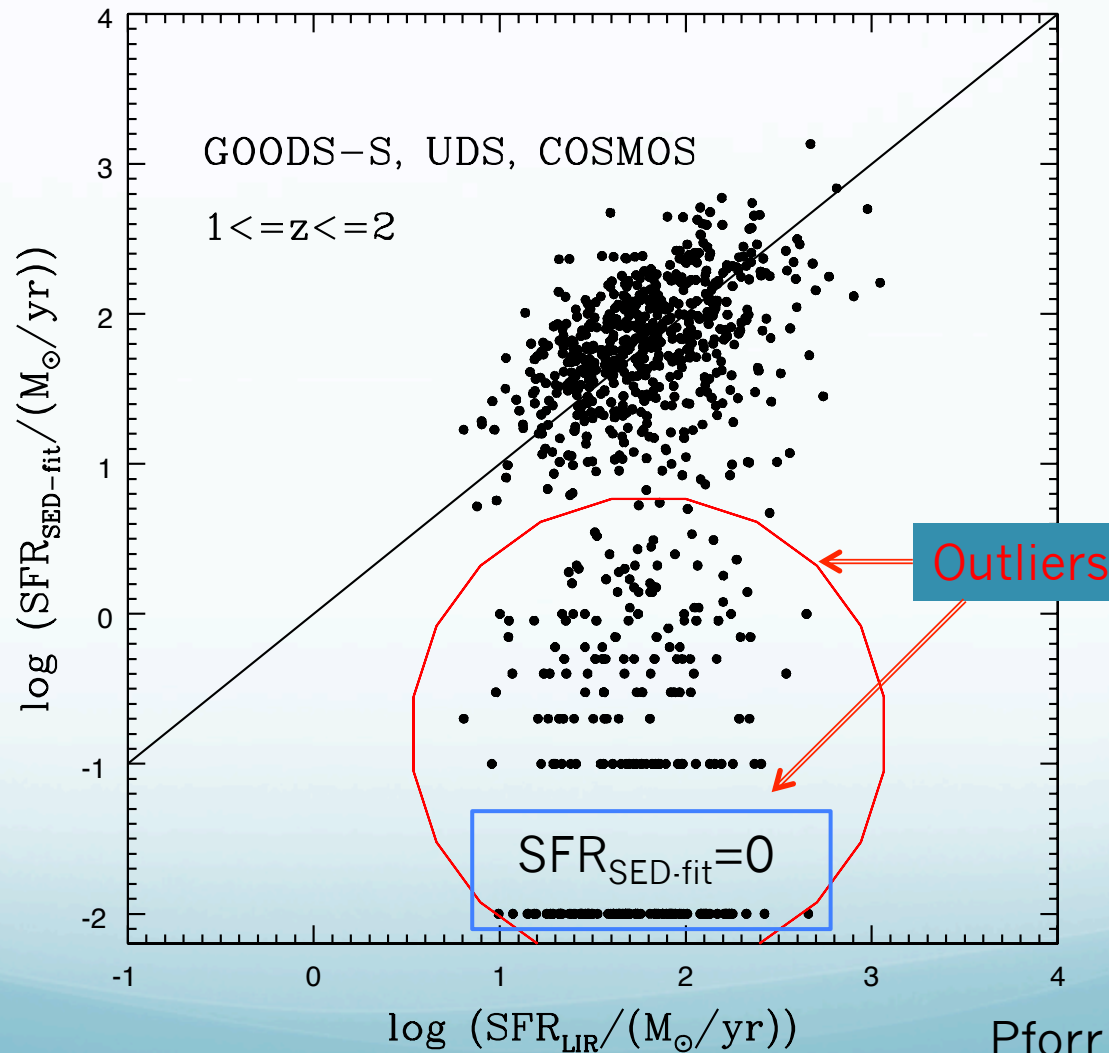
- SFR estimates using SED fitting
 - CANDELS Multi-wavelength catalogs
 - Optical to IR (Spitzer IRAC)
 - CANDELS spec-z + photo-z (Dahlen et al. 2013)
 - Maraston 2005 based templates
 - Fitting setups as in Pforr et al. 2012
 - Calzetti reddening



Star Formation Rates: Optical/NIR SED-fit vs. LIR



Star Formation Rates: Optical/NIR SED-fit vs. LIR



Summary

- 4/5 CANDELS fields have the deepest 100-500 μ m data
 - Improved statistics and good control over cosmic variance
 - 3x more typical SF galaxies can be observed from ALMA
- Dust-obscured star formation at high redshifts
 - IR luminosity functions
 - Better constrain on IR LF $< L_{\text{IR}}^*$
 - Direct measurement of the faint-end slopes at $z \leq 1$
 - SFR measurements using optical SED fits and LIR
- Galaxy structure from HST WFC3 H-band data
 - “Main sequence” vs. starburst