STAR FORMATION AND AGN ACTIVITY IN (U)LIRGS
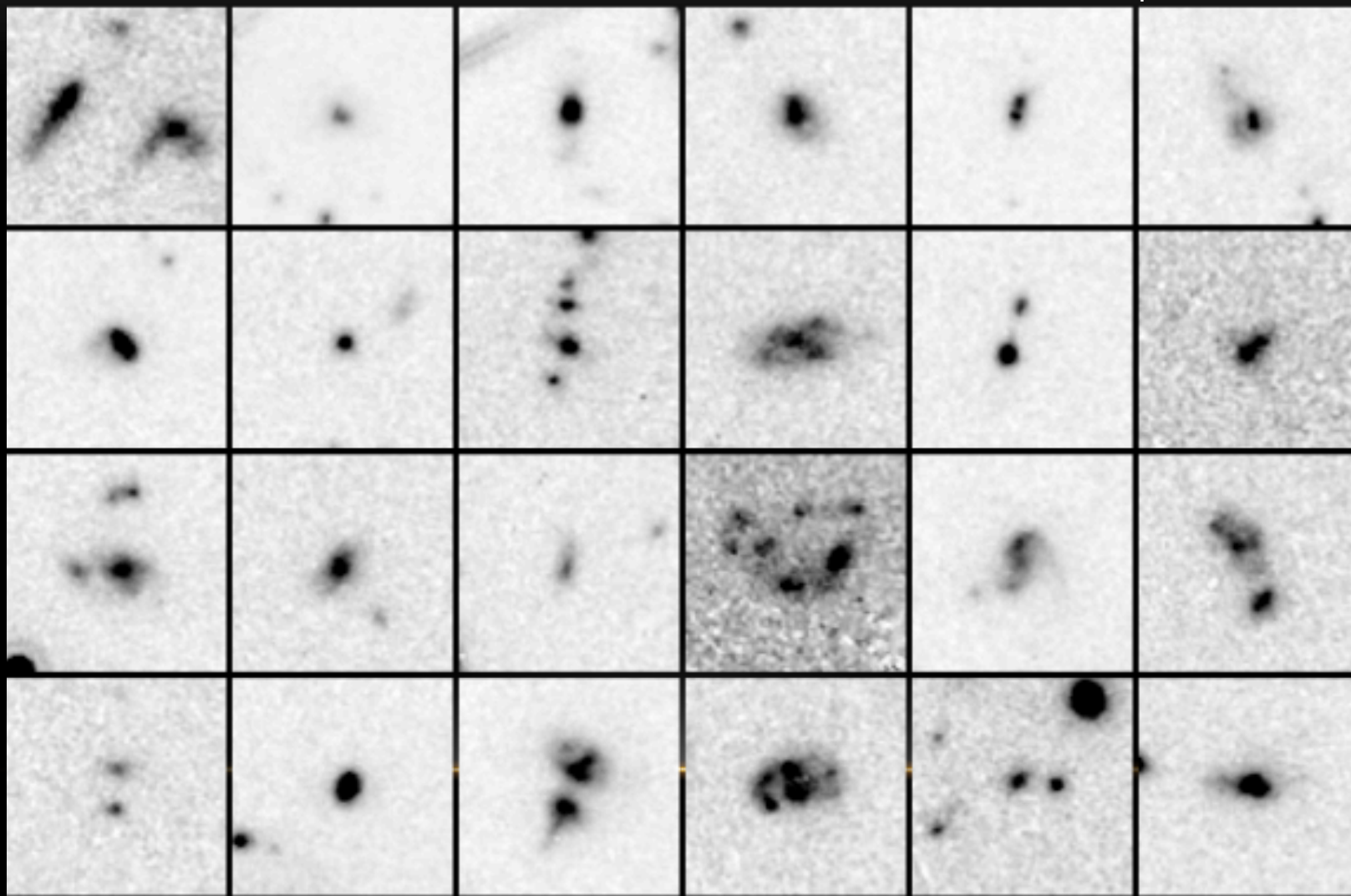
http://arxiv.org/abs/1505.03527

Jeyhan S. Kartaltepe
NOAO

D. B. Sanders, J. D. Silverman, D. Kashino,
J. Chu, H. Zahid, G. Hasinger, L. Kewley,
K. Matsuoka, T. Nagao, L. Riguccini, M. Salvato,
K. Schawinski, Y. Taniguchi, E. Treister, P. Capak,
E. Daddi, K. Ohta

MORPHOLOGY OF Z~2 ULIRGS

Kartaltepe et al. 2012
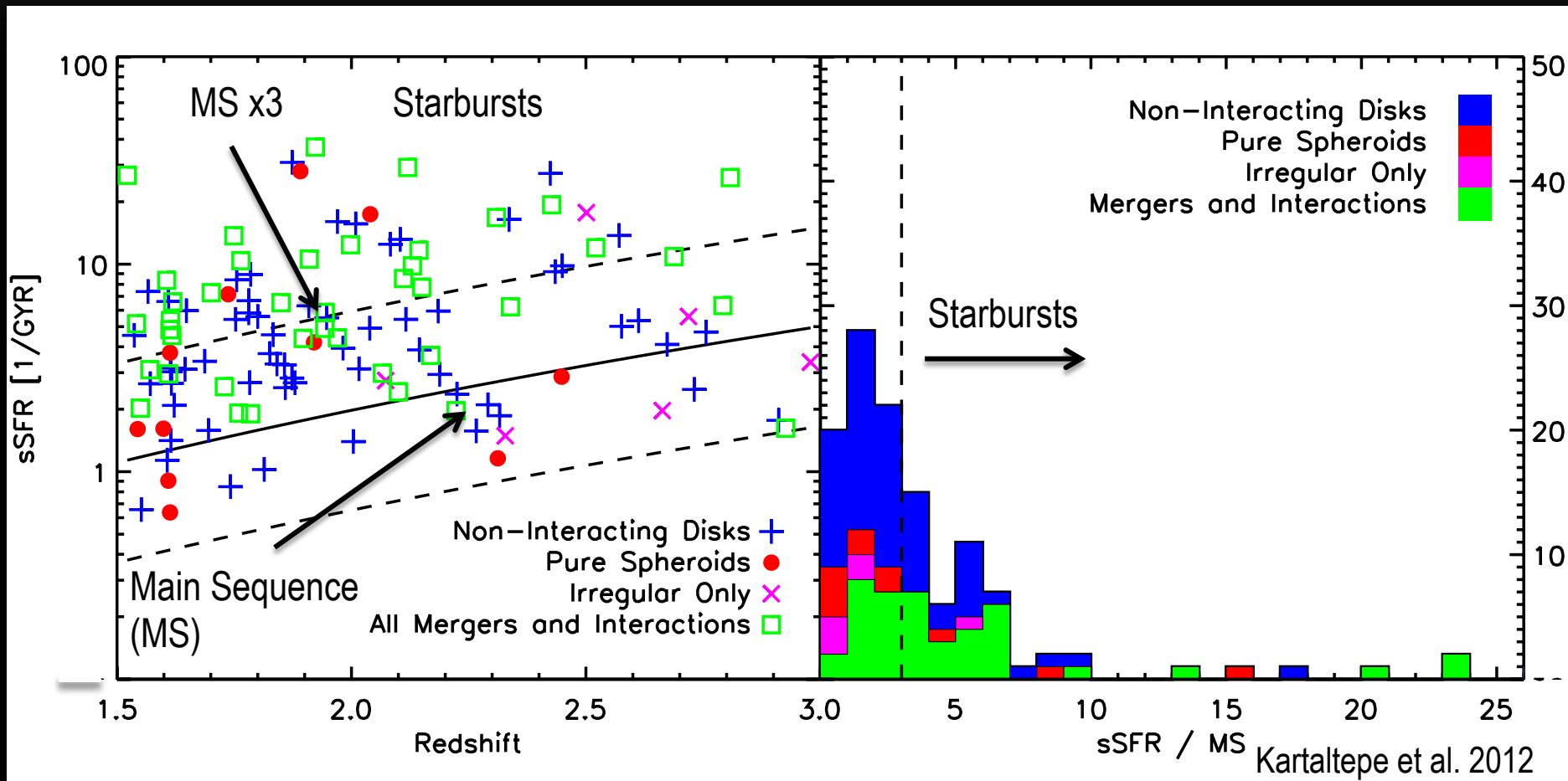
MORPHOLOGY OF Z~2 ULIRGS

Kartaltepe et al. 2012

~50% are clear mergers/interactions
Dominated by earlier stage mergers

An additional ~20% are irregular
in some way
Minor mergers? Disk instabilities?

WHAT IS THE ROLE OF MERGERS AMONG STARBURSTS?


Kartaltepe et al. 2012

SPECTROSCOPIC AGN SELECTION

- Based on optical emission line ratios (i.e., BPT: Baldwin et al. 1981)

- Classes: SF, AGN dominated, and composites based on

  - Maximal starburst line - red (Kewley et al. 2001)

  - Empirical AGN/Starburst division - blue (Kauffmann et al. 2003)

  - Classification scheme of Kewley et al. 2006

- Study the relative role of SB and AGN

  - Function of L_{IR} and redshift

  - What are composite objects?
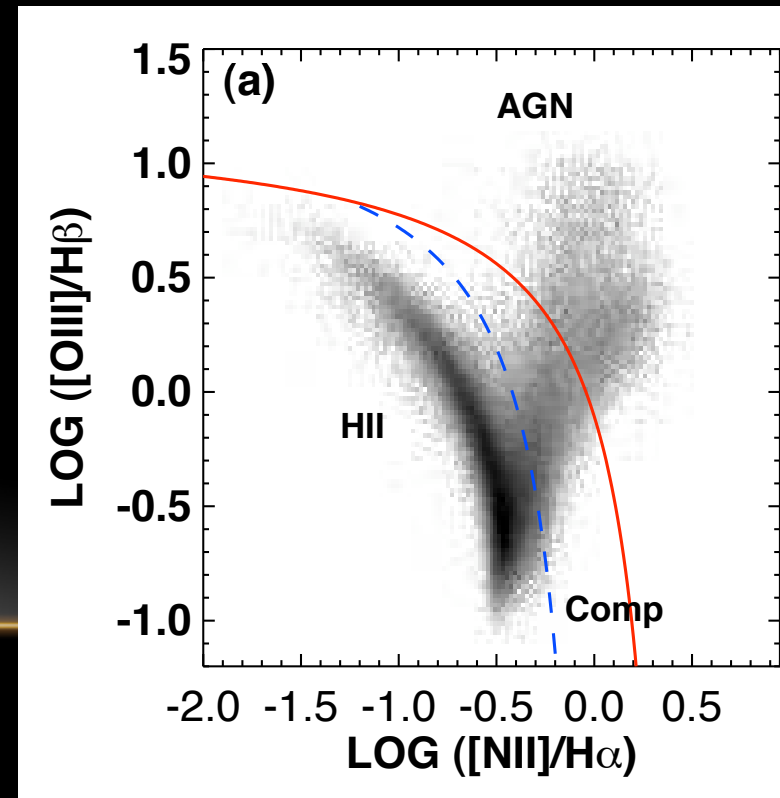
Kewley et al. 2006
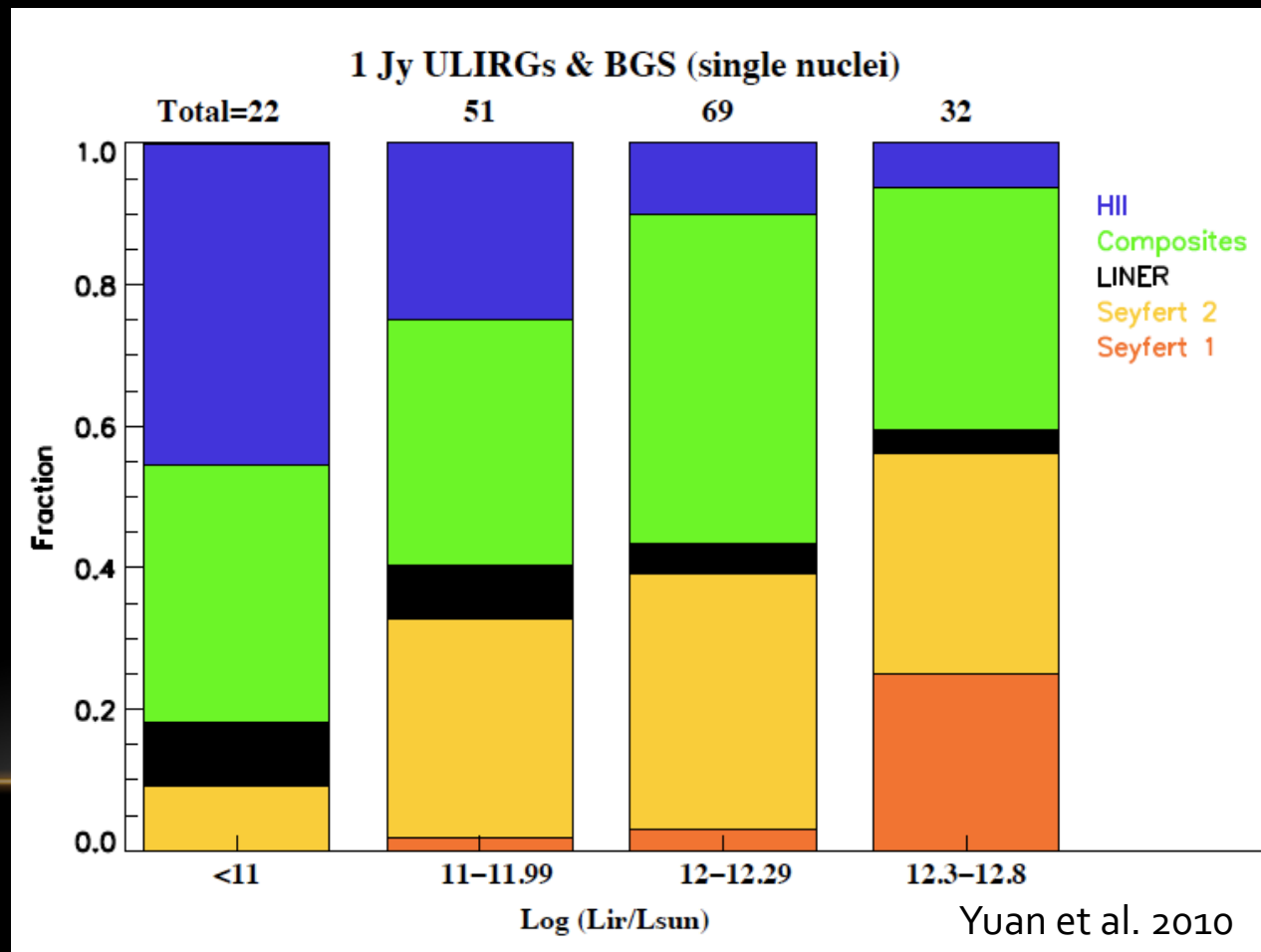
LOCAL GALAXIES
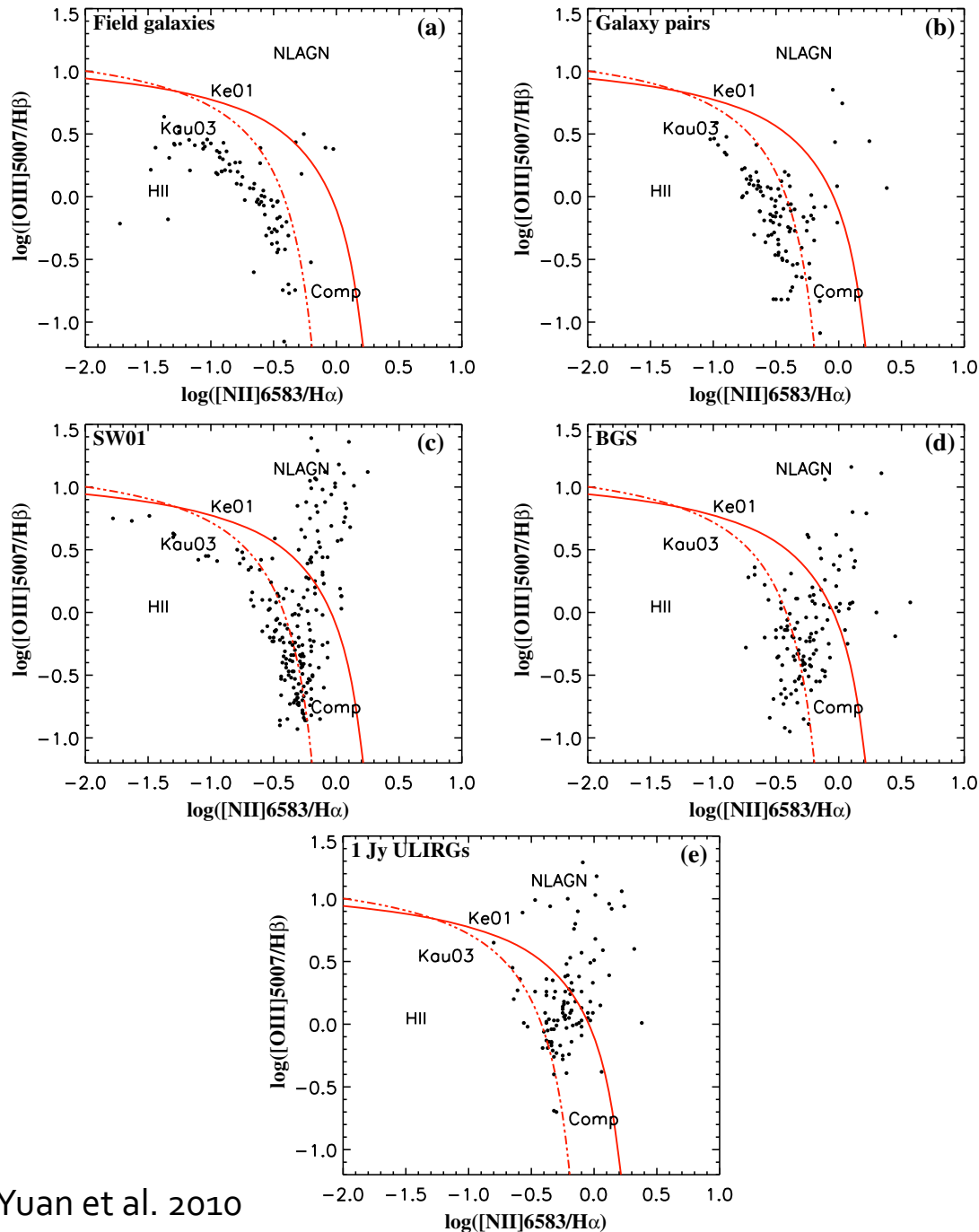
Yuan et al. 2010

- Yuan, Kewley, & Sanders 2010

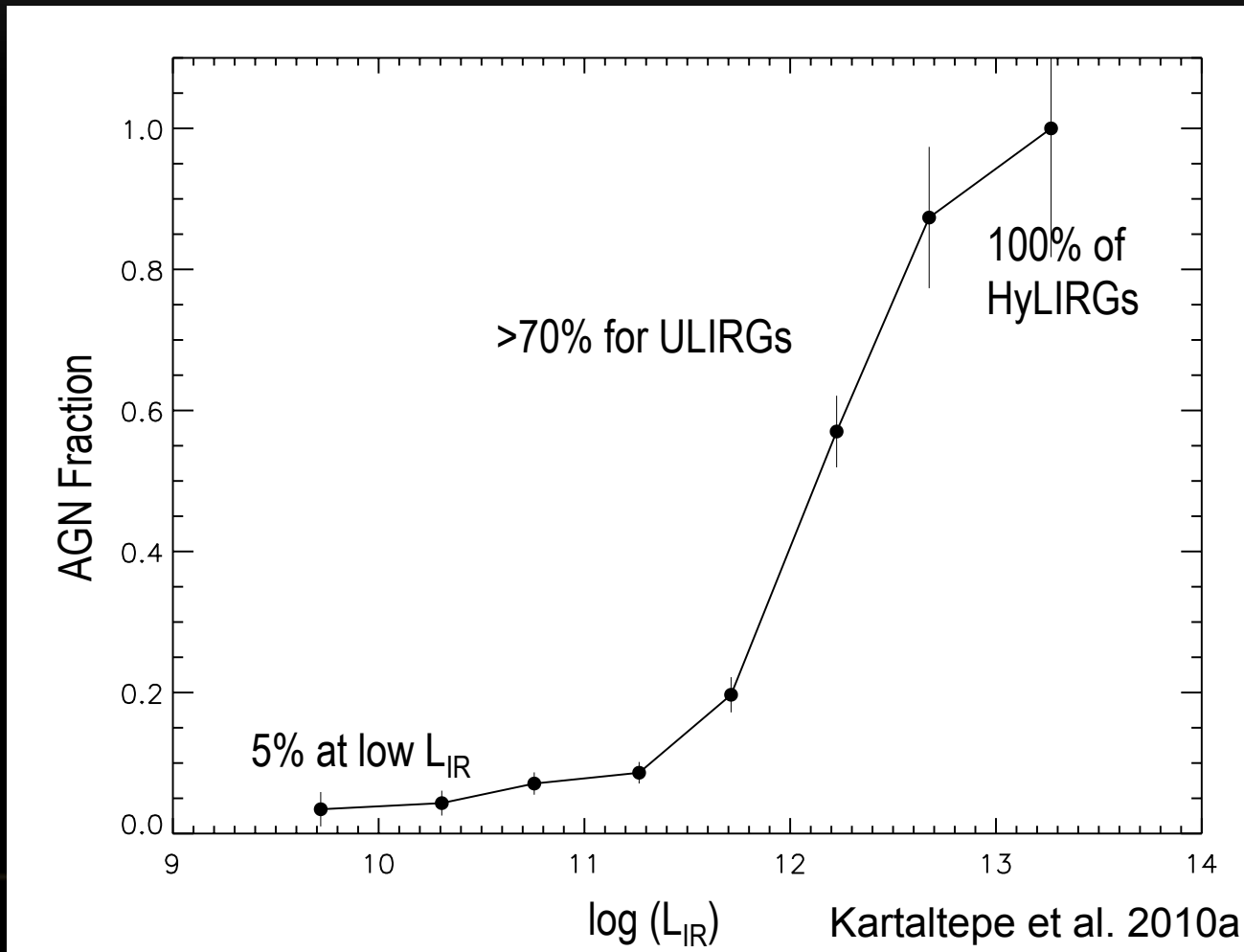- Fraction of objects that are AGN/composites increases with IR luminosity

AGN AMONG LOCAL IR GALAXIES

Fraction of (U)LIRGs
with an AGN increases
with L_{IR}

Veilleux et al. 1995,
1999; Tran et al. 2001;
Yuan et al. 2010

Yuan et al. 2010

AGN FRACTION AT HIGH(ER) REDSHIFT (Z = 0 – 3)

AGN Fraction increases systematically with L_{IR} (as it does locally)!

- Current and future surveys with NIR spectrographs

  - Until now, only small samples possible with longslit spectographs

  - Several multi-object spectrographs now online
    MOSFIRE, FMOS, LUCI, etc.

- It is now possible to measure emission line ratios at
  z = 1 - 3 for large
  samples

FIBER MULTI-OBJECT SPECTROGRAPH (FMOS)

- Low-res (R~600)

- High-res (R~2200)

- In low-res mode, can cover 0.9-1.8 μm at once

- 400 fibers

  - Target 200 galaxies at once

- 30' diameter FOV

  - Ideal for COSMOS!

COSMOS FMOS SURVEY

- ## Low-resolution survey (Kartaltepe et al. in prep)

  - 20 pointings over 15 nights

  - Dec 2010 – Feb 2012

  - PIs: D. Sanders, J. Silverman, E. Treister, and Y. Taniguchi

- ## High-resolution survey (Silverman et al. 2015, submitted)

  - Began in Spring 2013, ongoing

  - PIs: D. Sanders, J. Silverman

- ## Mixture of science goals (X-ray AGN, obscured AGN, IR galaxies)

  - Shared targets across pointings to optimize coverage

- **Papers so far:** Matsuoka et al. 2013, Kashino et al. 2014, Zahid et al. 2014, Kartaltepe et al. 2015, Silverman et al. 2015, submitted
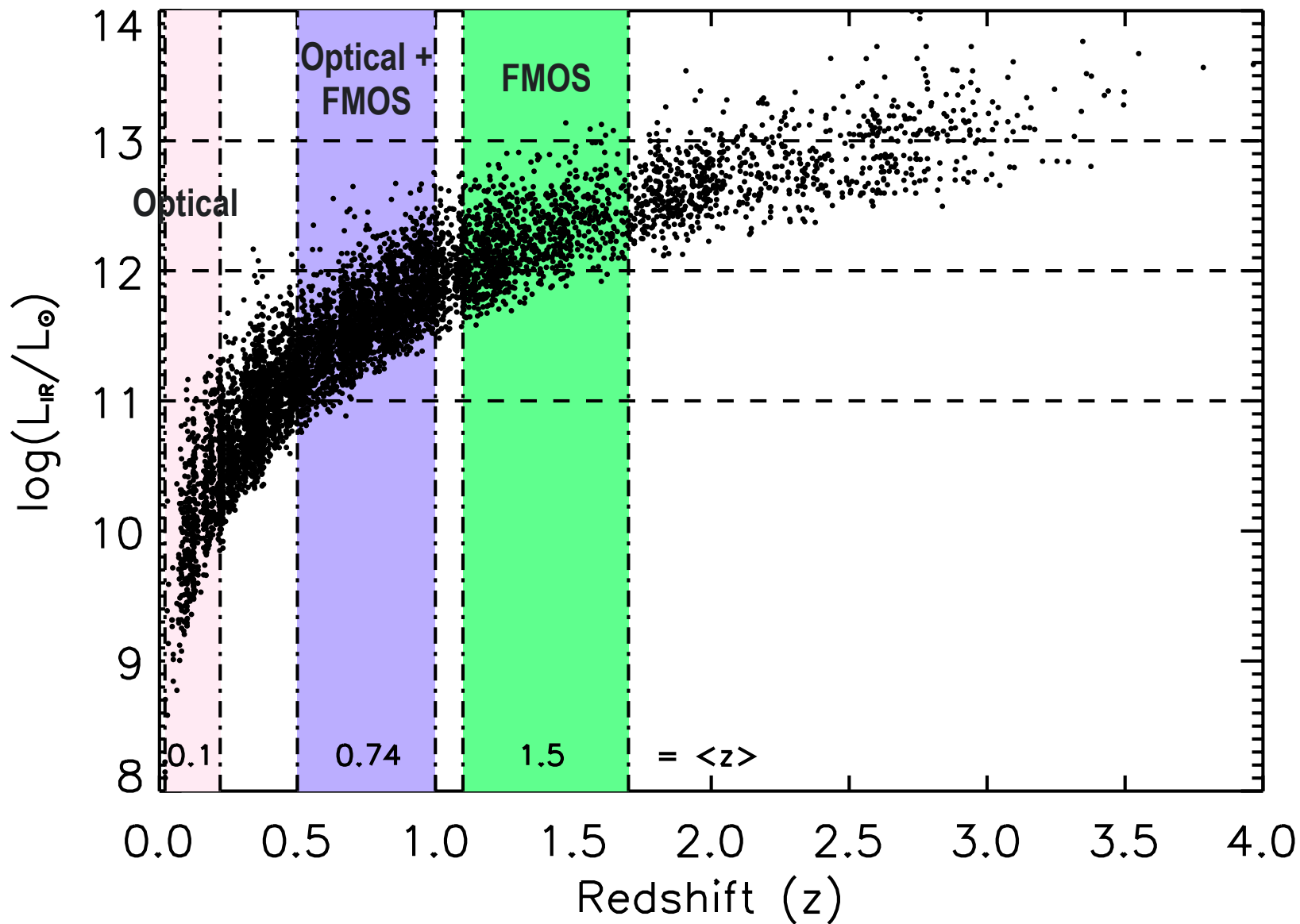
COSMOS FMOS LOW-RES SURVEY

Kartaltepe et al. 2015, in prep
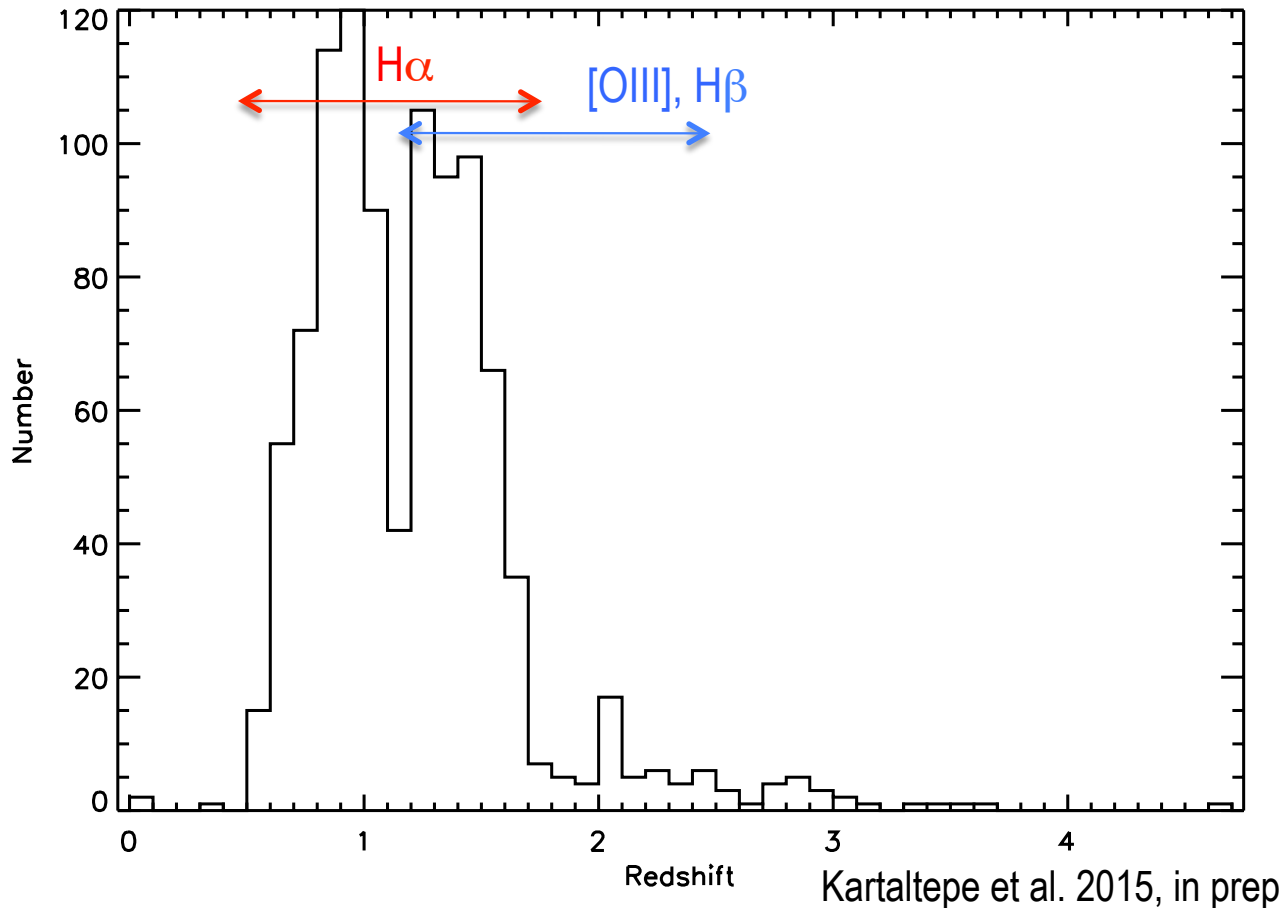
Redshift Distribution for ~ 1000 galaxies
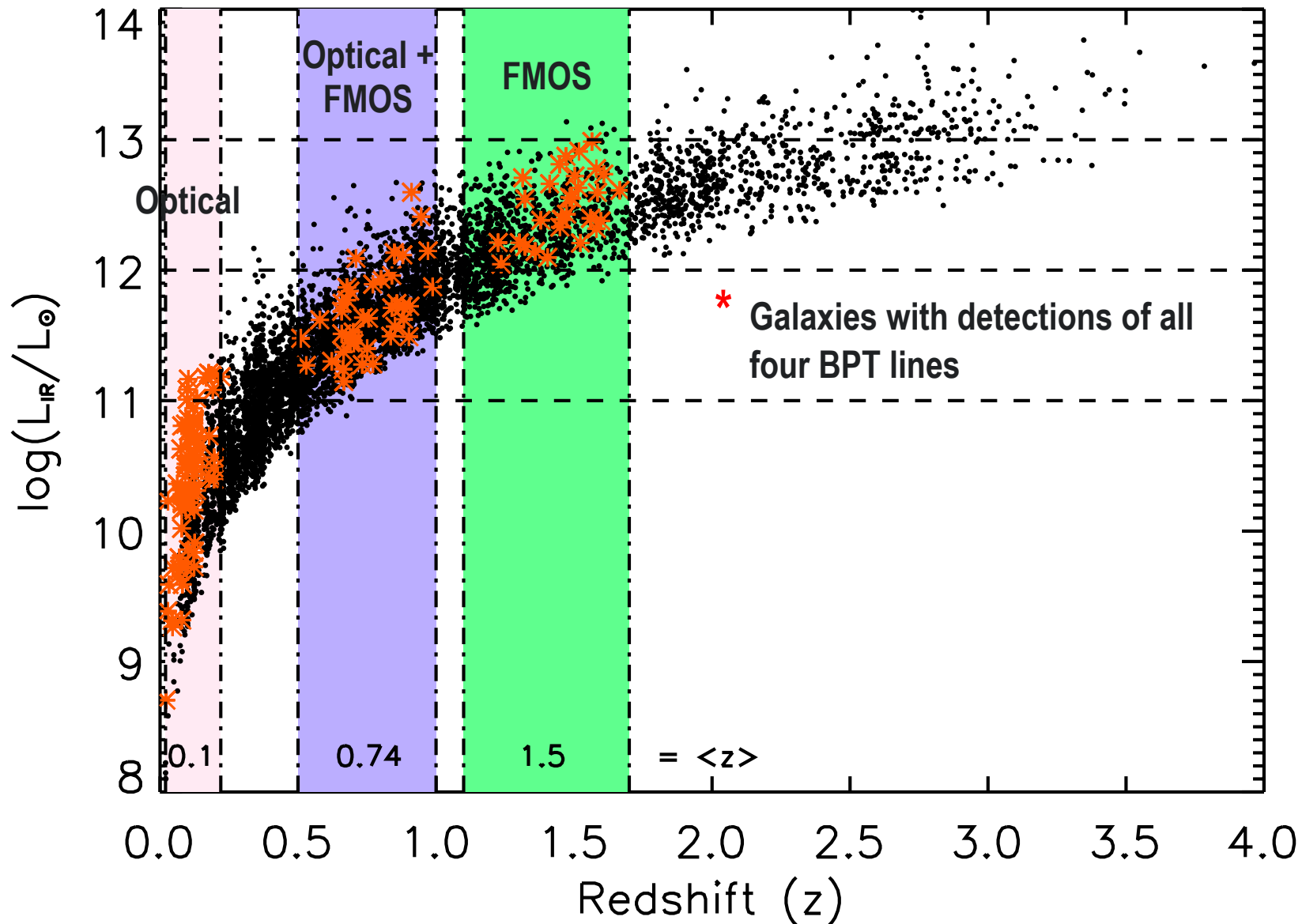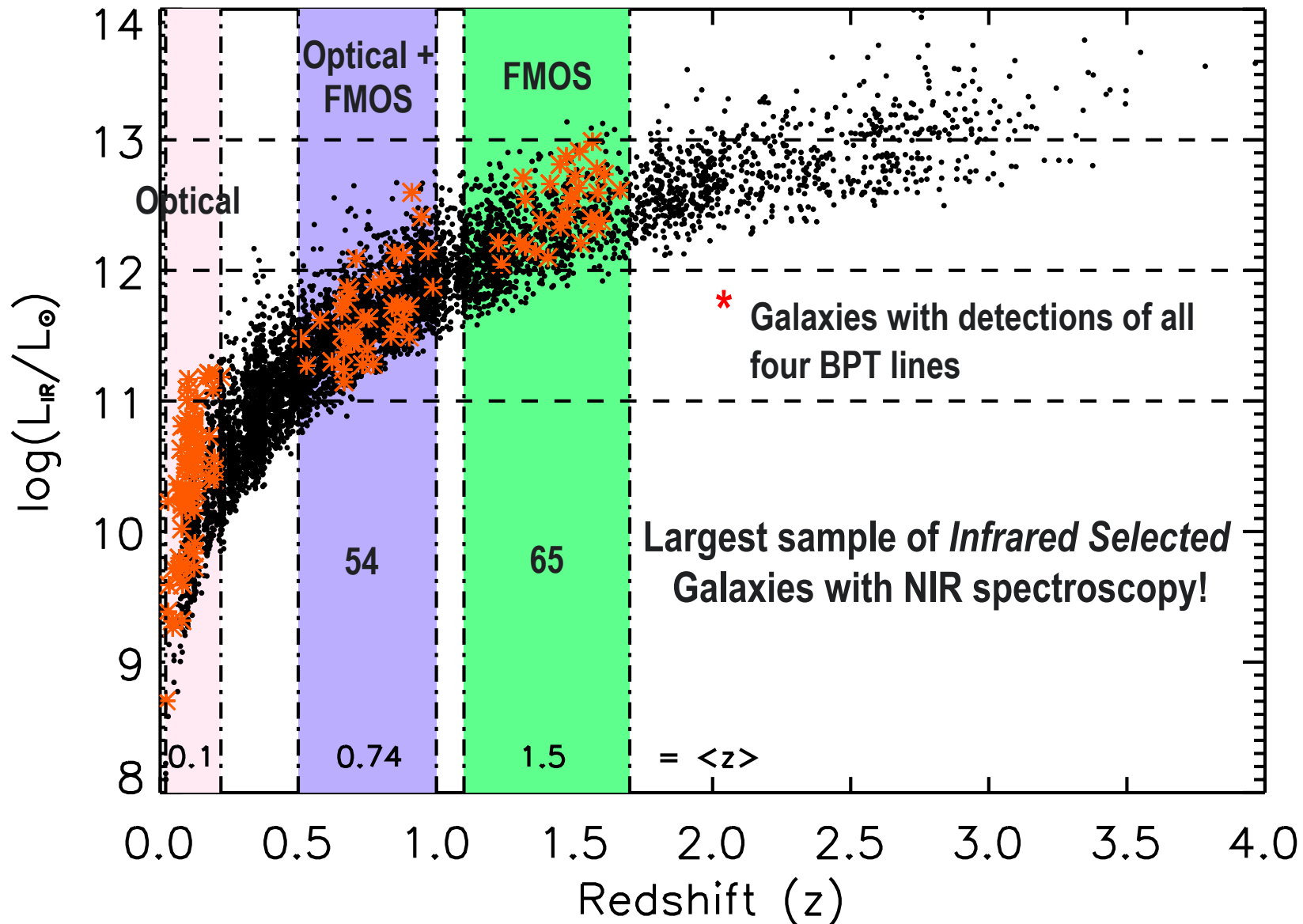
Each redshift measured independently by 2 people

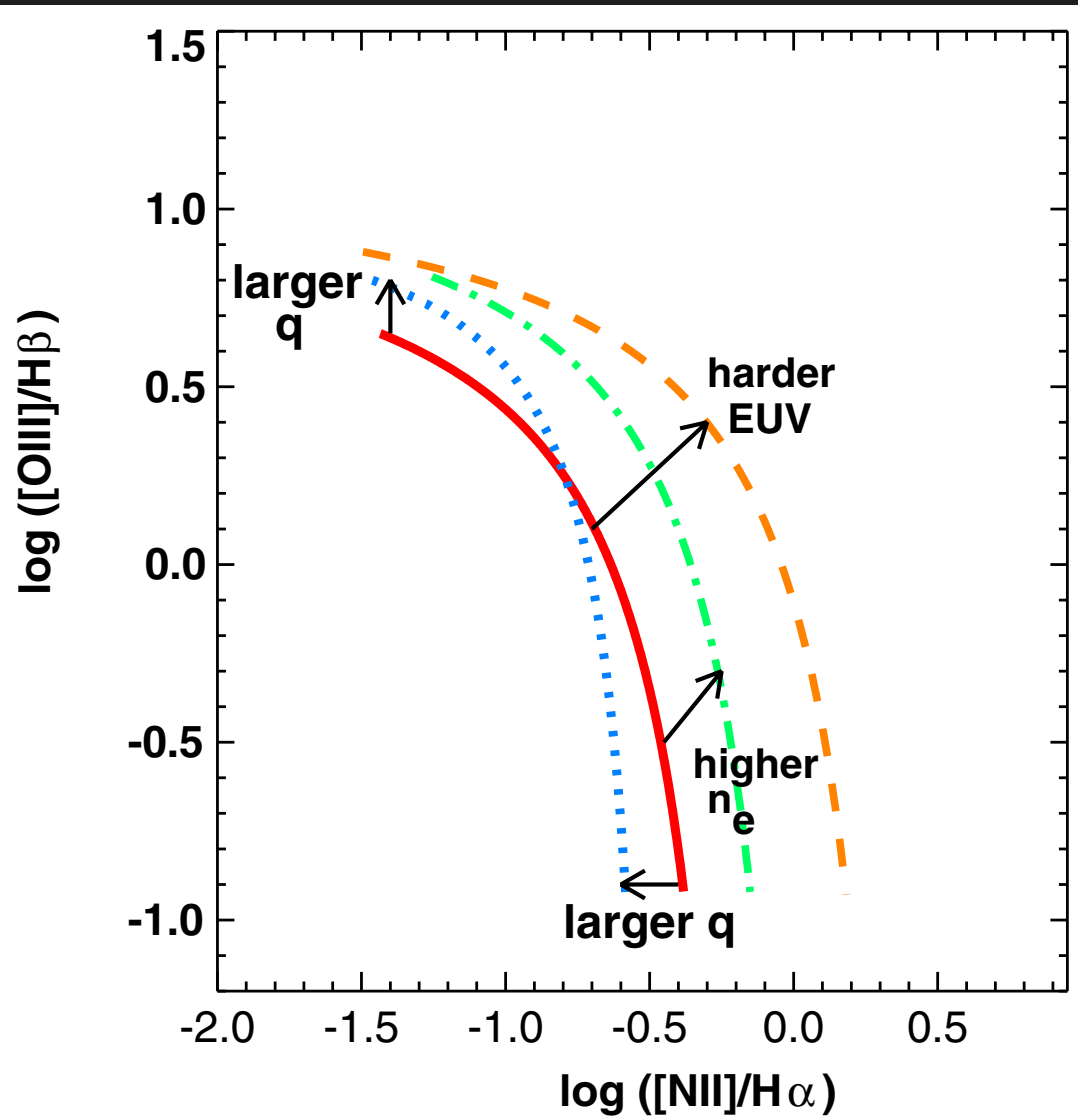# HERSCHEL FIR SELECTED SAMPLE

HERSCHEL FIR SELECTED SAMPLE

HERSCHEL FIR SELECTED SAMPLE

WHAT AFFECTS THE SF SEQUENCE?

- Red: SDSS star-forming sequence

- Orange: Hardness of the ionizing radiation field

- Green: Higher electron density
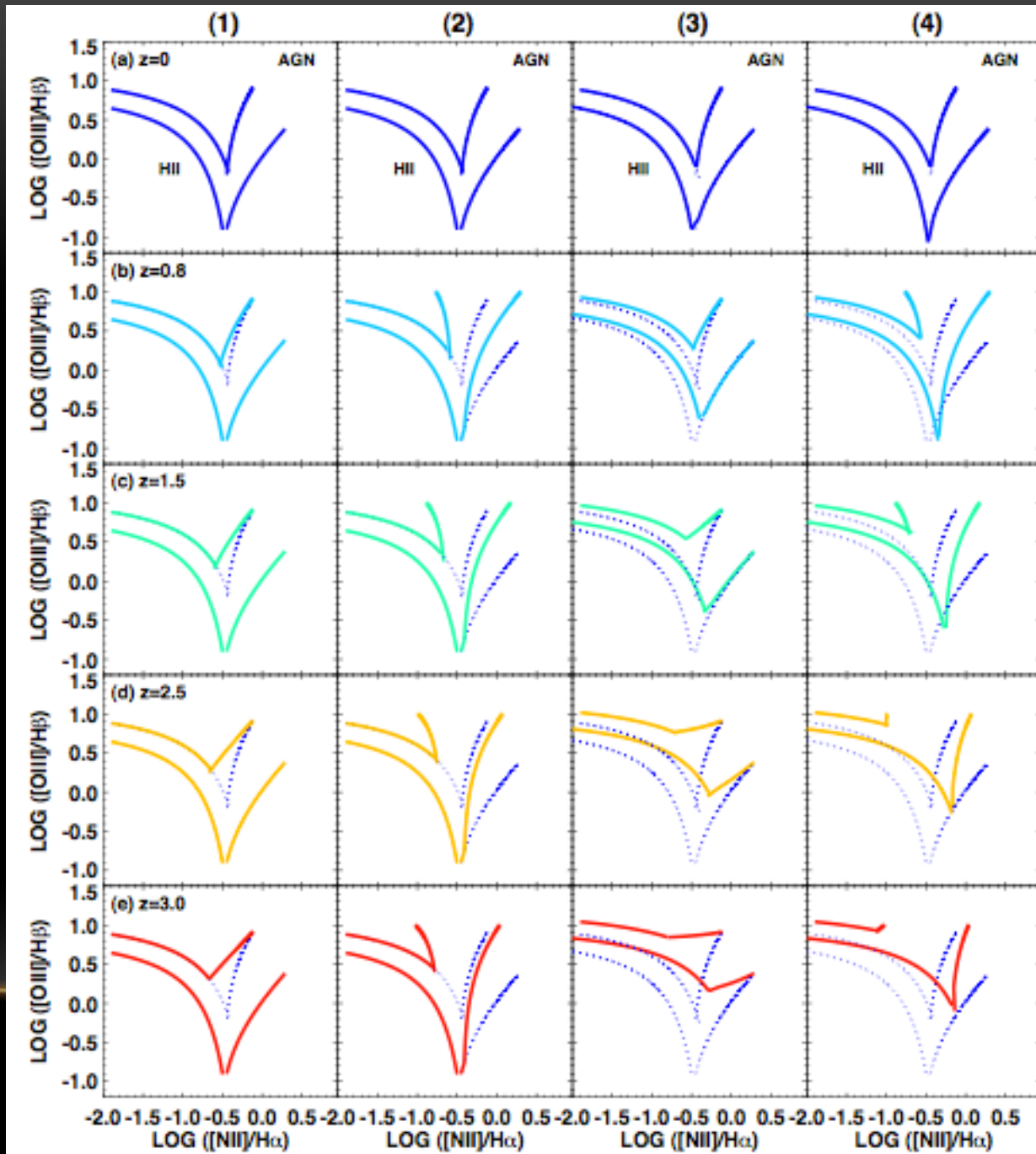
- Blue: larger ionization parameter

Kewley et al. 2013

EVOLUTION OF 'BPT' LINES
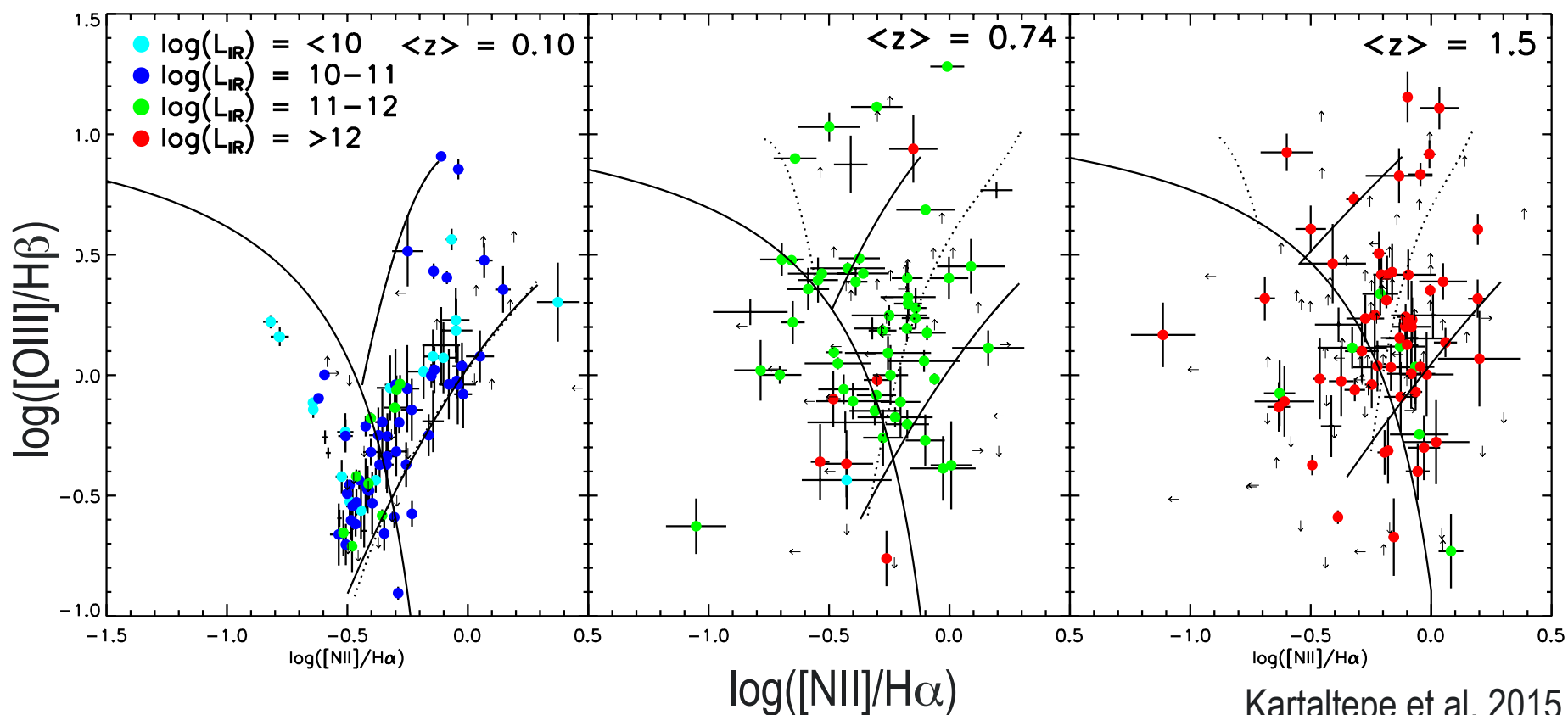
z = 0

z = 0.8

z = 1.5

z = 2.5

z = 3.0

Kewley et al. 2013
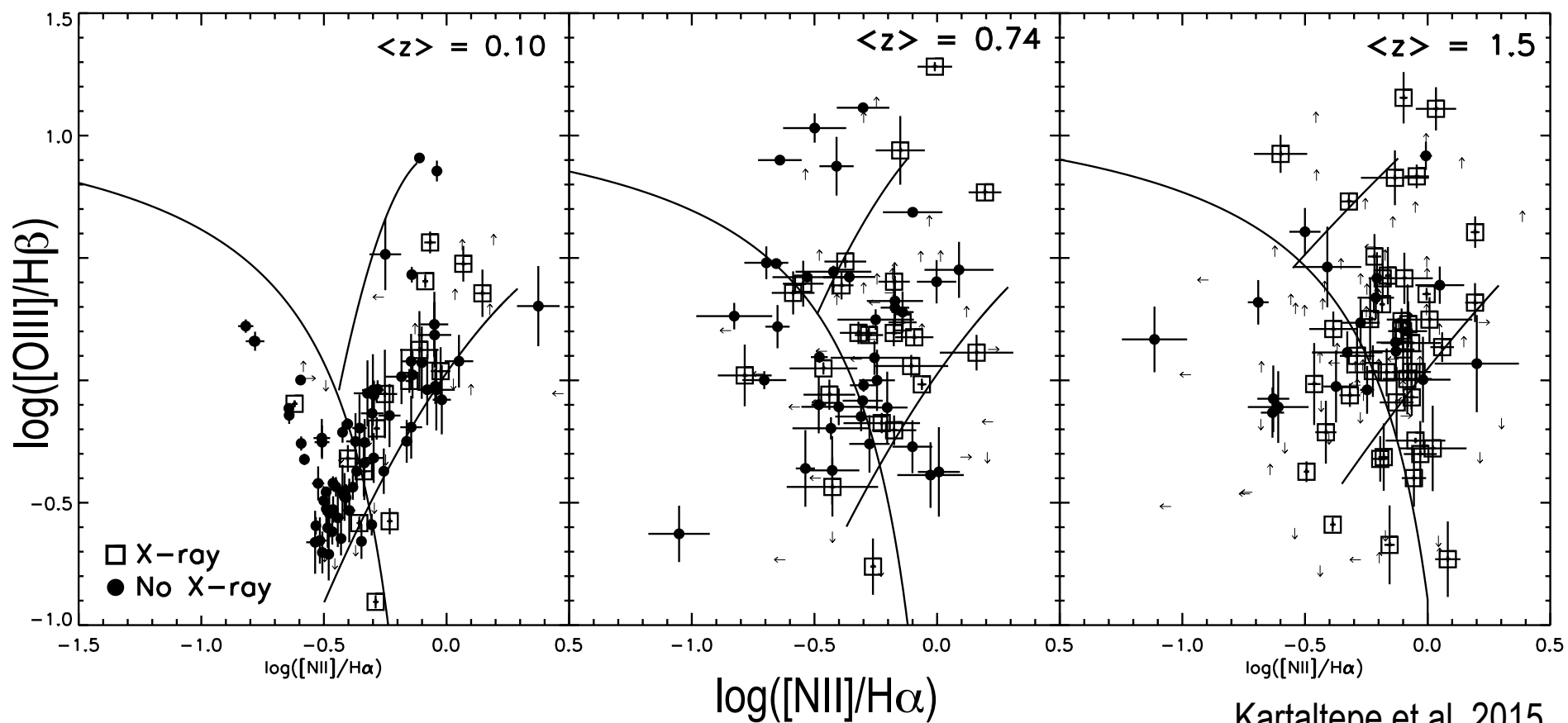
BPT DIAGRAM FOR (U)LIRGS

Large AGN fraction for (U)LIRGs – some X-ray undetected

Kartaltepe et al. 2015

BPT DIAGRAM FOR (U)LIRGS

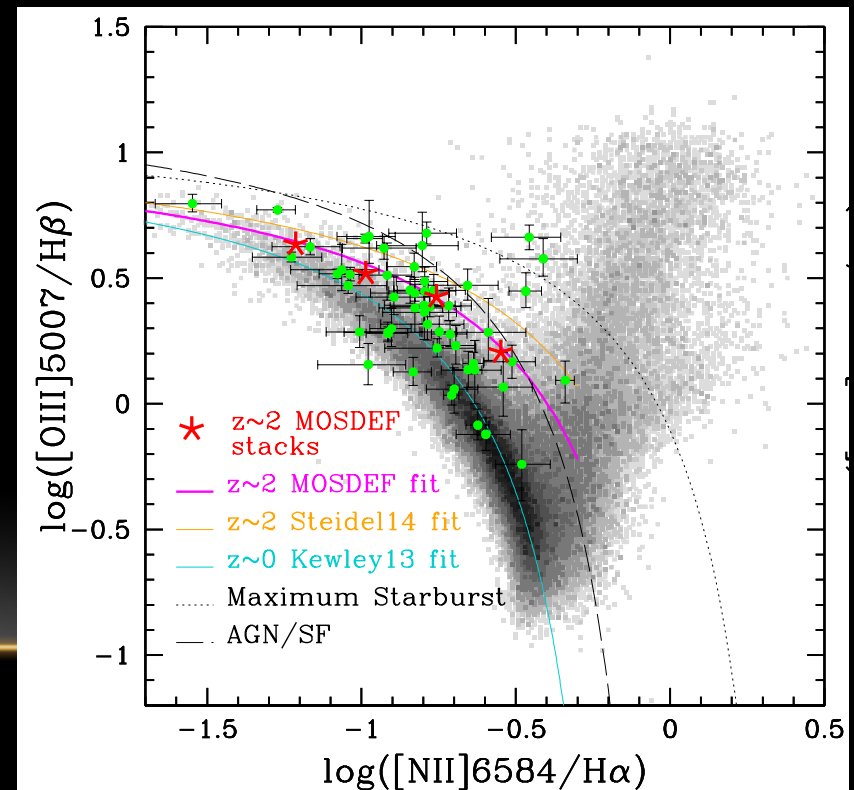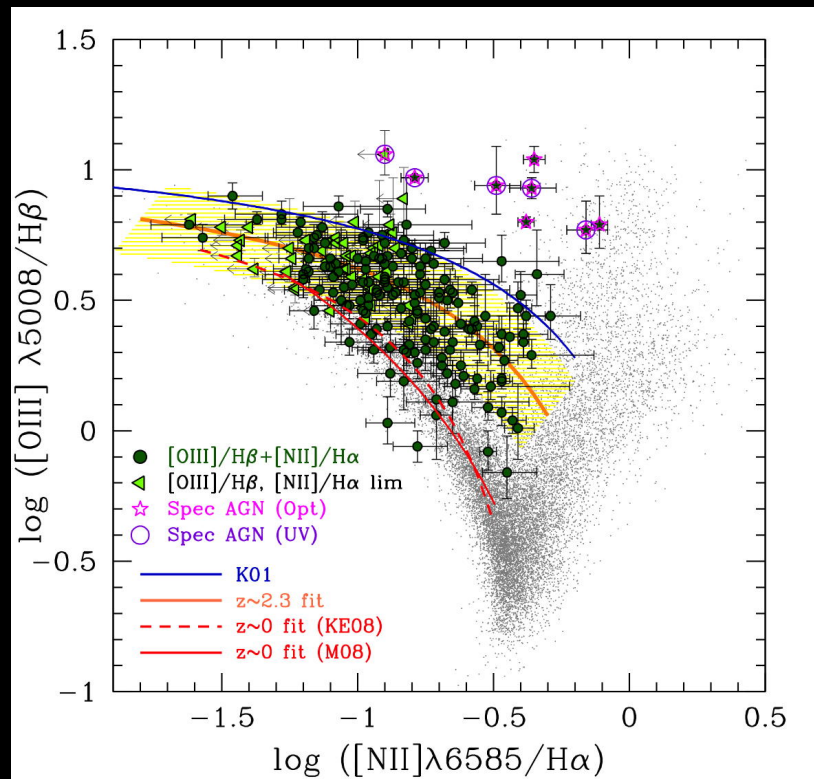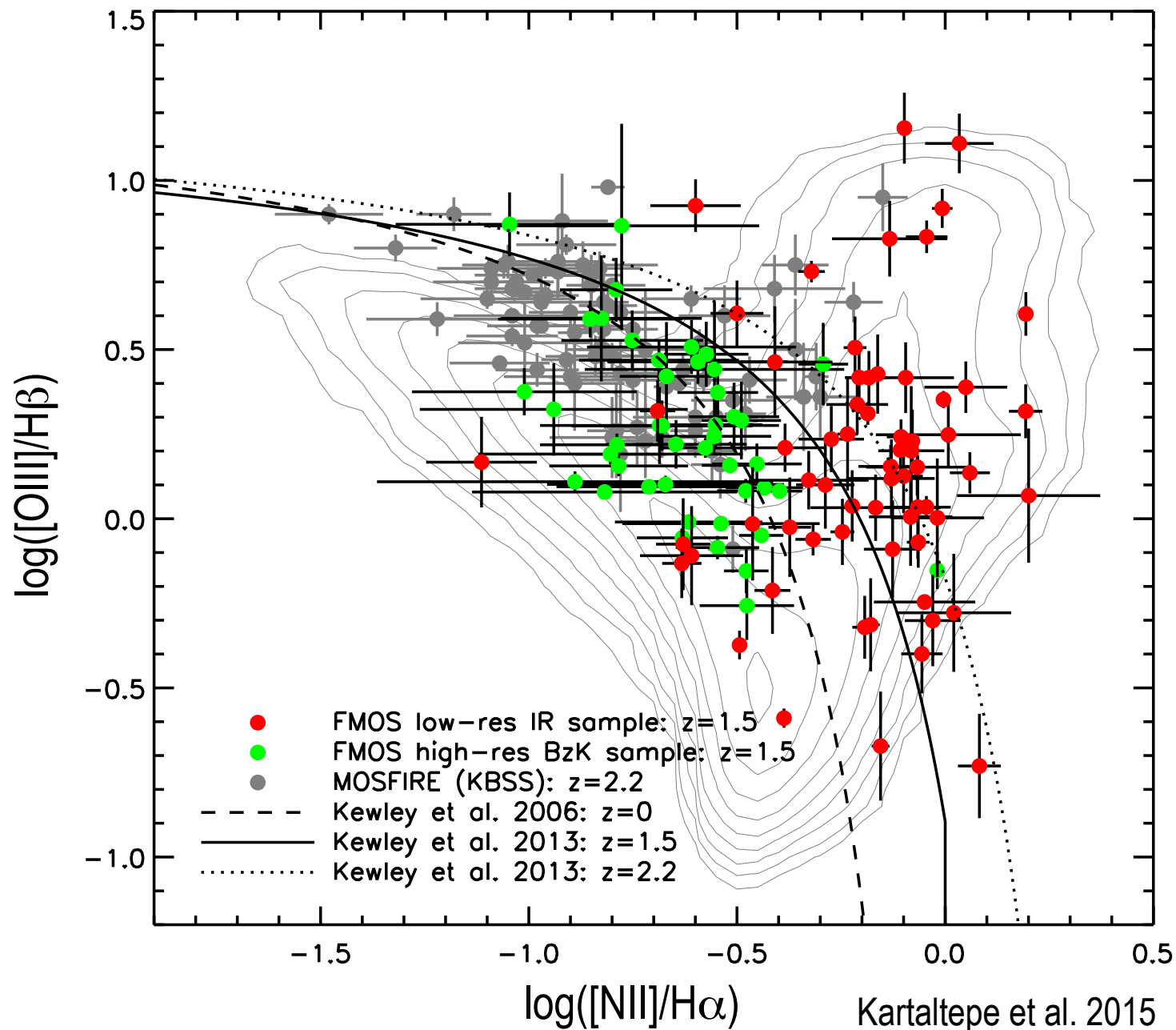Large AGN fraction for (U)LIRGs – some X-ray undetected

Kartaltepe et al. 2015

COMPARISON WITH OTHER SURVEYS

Steidel et al. 2014
KBSS-MOSFIRE
Optical, mass, specz Selected
168 Sources

Shapley et al. 2015
MOSDEF-MOSFIRE
Spectroscopic/Photometric
Redhift/magnitude Selected
53 Sources

Kartaltepe et al. 2015

SUMMARY AND FUTURE WORK

- Sample of ~120 (U)LIRGs with all four lines in two z-bins

- Large fraction in AGN portion of diagram

  - Are those below the line composites?

- Some X-ray undetected, possibly obscured AGN

- FIR selected sources span different range of the diagram compared to other high redshift samples

- Future work

  - Stacking of undetected sources

  - Fold in Hi-res data

  - Compare with other diagnostics

http://arxiv.org/abs/1505.03527