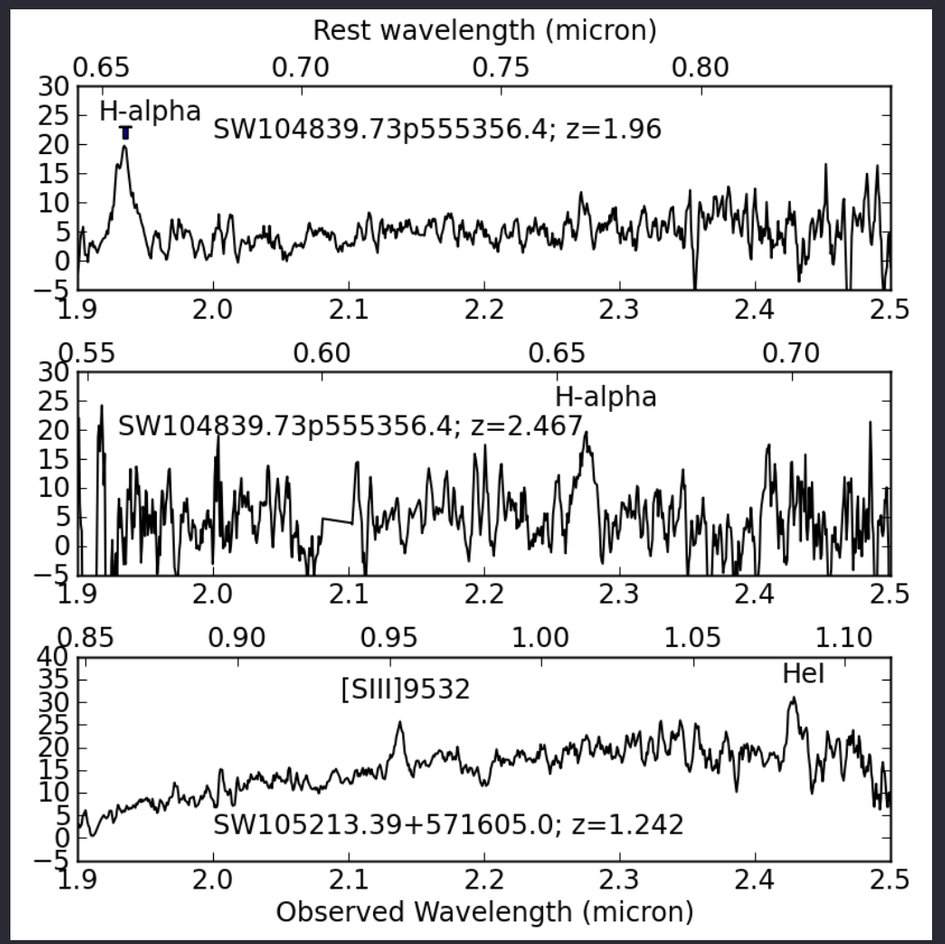
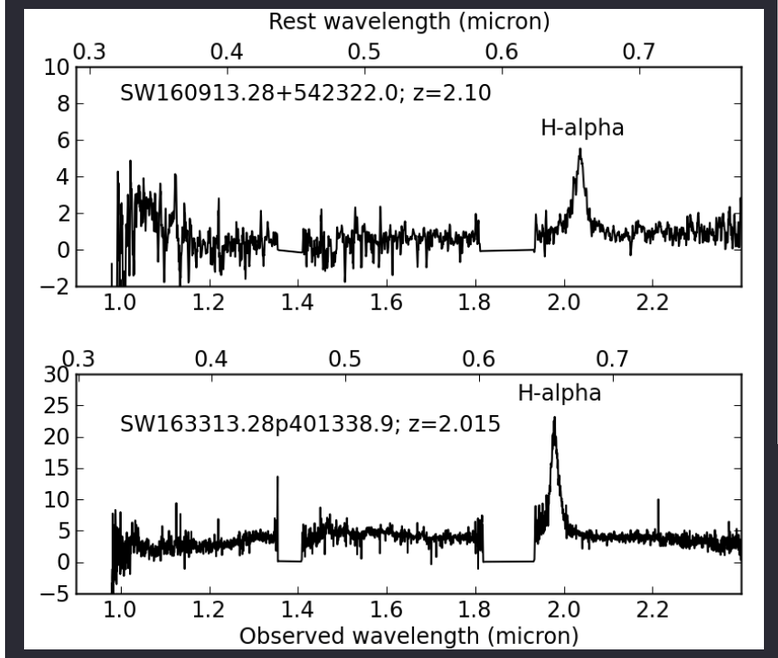
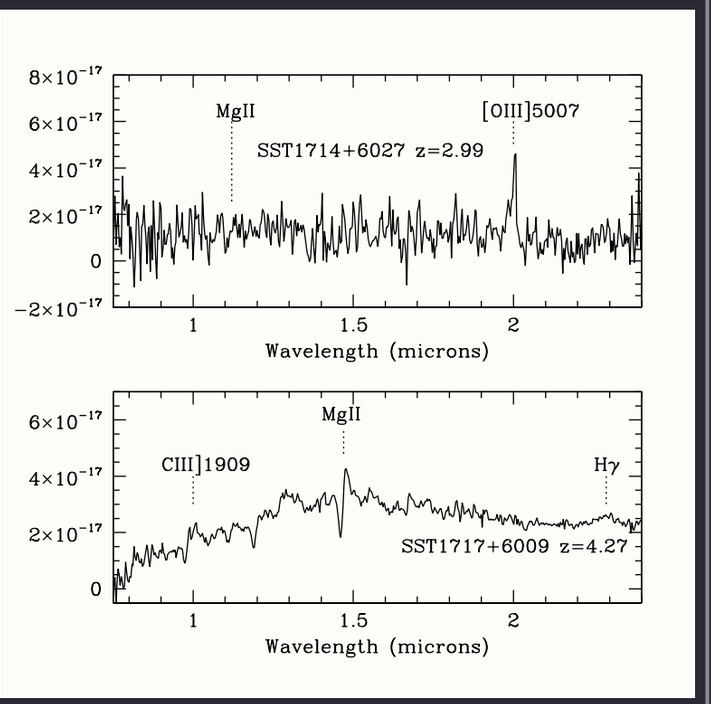






The Spitzer Mid-Infrared Quasar Survey (SMIRQS)

Mark Lacy (NRAO), Andreea Petric (Caltech, see poster), Susan Ridgway (NOAO), Anna Sajina (Tufts), Tanya Urrutia (AIP), Duncan Farrah (Sussex), Elinor Gates (UCO/Lick), Danielle Nielsen (Wisconsin)

Mid-infrared selection

- Selection on the basis of red mid-IR continuum to answer question of how obscured and unobscured quasar populations are related.

- SMIRQS selected in the “Lacy wedge” (2004; 2007) from SWIRE and XFLS.

- Did need to confirm AGN/quasar nature via optical/IR spectroscopy (only about 50% of mid-IR selected obscured quasars are X-ray detected in ~50ks+ exposures).

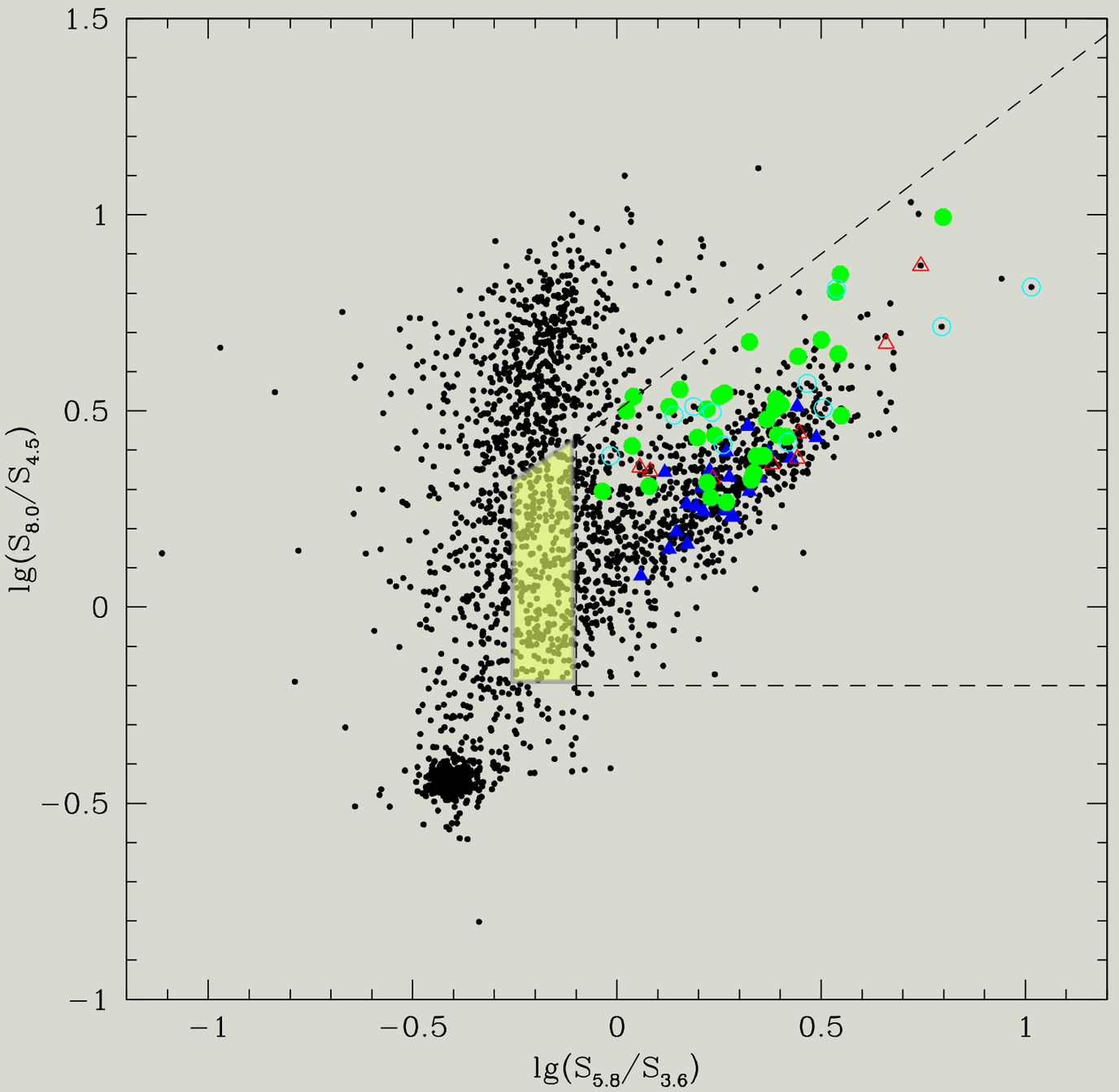
- SMIRQS now has over 700 optical/IR spectra, 542 of which are in the “90% complete” sample.

Wedge selection

On the basis of red continuum emission in mid-infrared from IRAC colors, plus 24 micron flux limit

DIRECT comparison of properties of obscured and unobscured objects selected in the same way

Expanded slightly for fibre-based sub-samples



Survey strategy

- Nested survey strategy - whole SWIRE+XFLS searched for bright candidates (>4-8mJy at 24 microns). Follow-up spectra from Palomar/Hale, Lick/Shane, SOAR, IRTF.

- Deeper subsamples (0.6-1mJy) selected for fibre-based follow-up with MMT/Hectospec, CTIO/Hydra. Line strength correlated with 24micron flux, so subsequent deeper spectroscopy with Gemini was needed on objects with missing/ambiguous redshifts.

- ~x10 dynamic range in luminosity at a given redshift to decouple redshift and luminosity effects.

- Overall 90% complete sample defined by descending in 24 micron flux in each subsample until <90% of objects had

Classifications

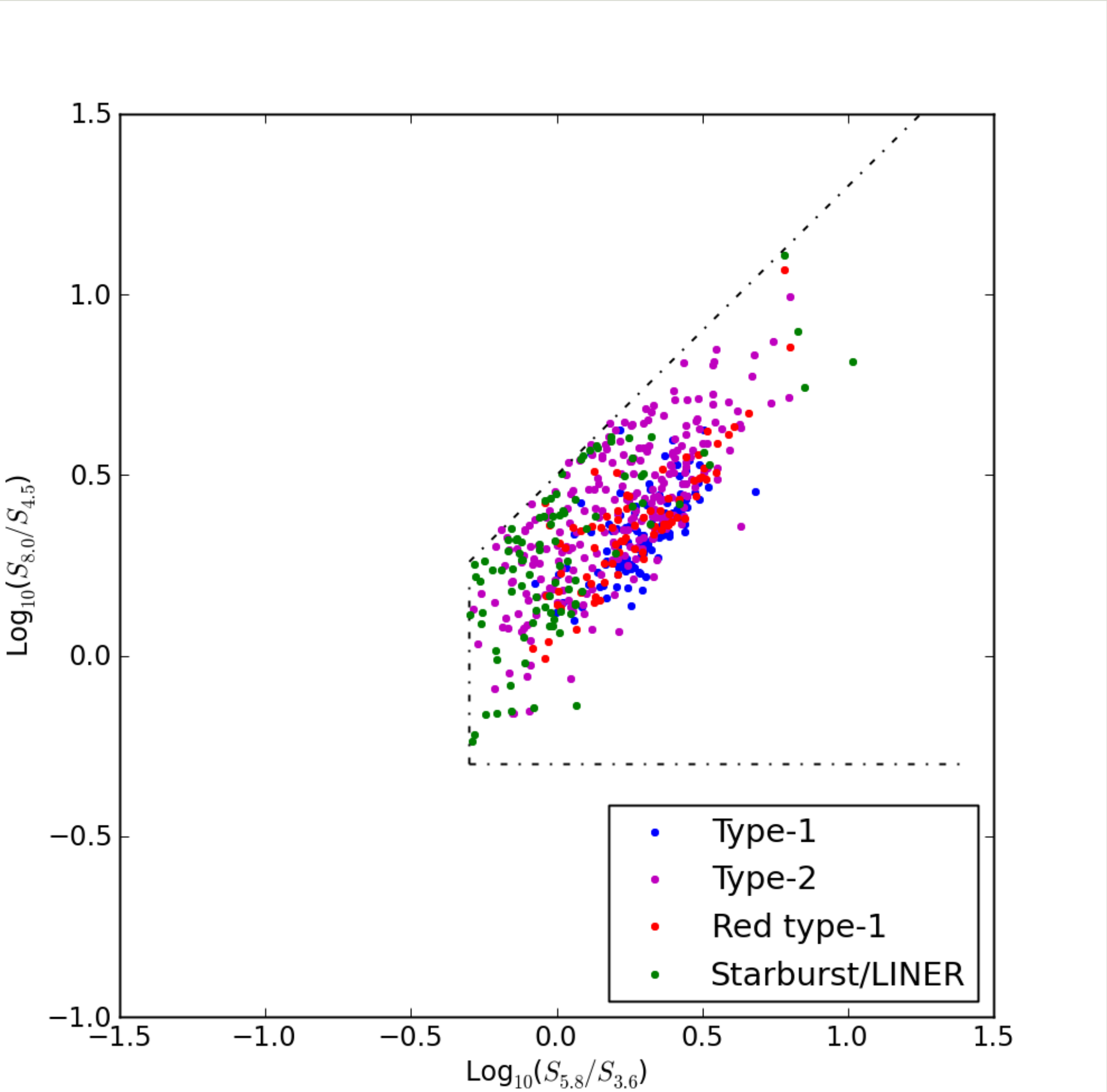
- Type-1 (broad lines, blue continuum)

- Red type-1 (broad lines, red continuum). Rest-frame *E(B-V)* > 0.15, reddenings up to *E(B-V)*~1 before broad lines lost in near-IR.

- Type-2 (narrow lines only; high ionization or line ratios [BPT] to confirm AGN).

- Classifications helped by SED fitting when uncertain.

Types within the wedge



The results…

- In the 90% complete sample:
  - 446 confirmed AGN (Seyferts and quasars) from z=0-4.27
  - 312 objects bright enough to be classified as quasars
  - 94 (low IR luminosity) objects with optical spectra lacking AGN features (probably mostly starbursts, but some highly obscured AGN and LINERS).

Completeness and reliability

- Reliability of wedge selection a strong function of 24 micron flux, ~90% at >6mJy, ~80% at 1mJy. Also poor at z<0.1 when 6.2micron PAH feature is in IRAC-3.

- Overall completeness to AGN much less well-constrained.

  - Missing objects with AGN too obscured to show up in the IRAC bands.

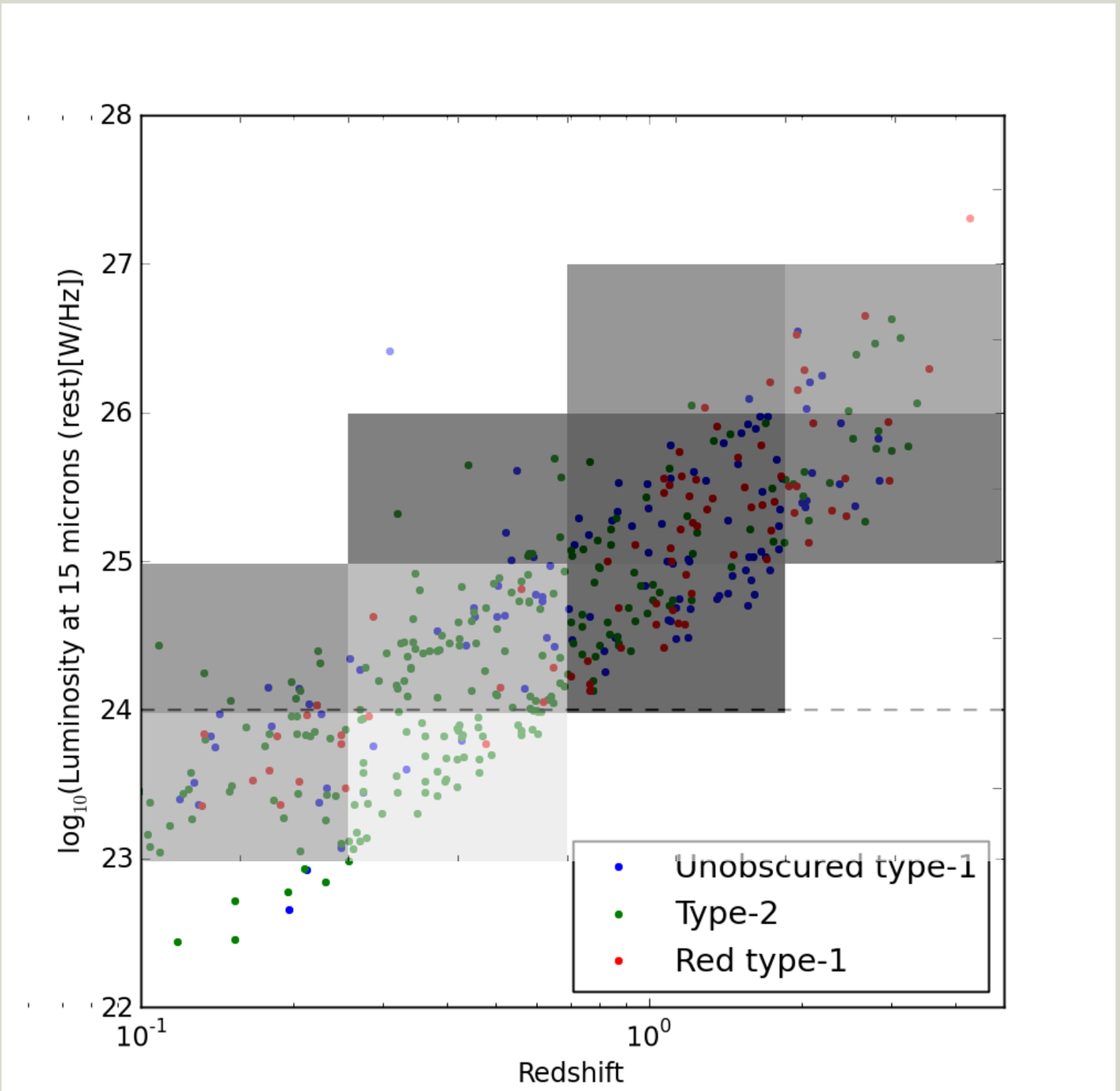
  - Missing objects at high-z with low-luminosity hosts (dropouts in shorter IRAC bands).

  - Missing objects at z<0.3 with strong PAH emission.

The bottom line

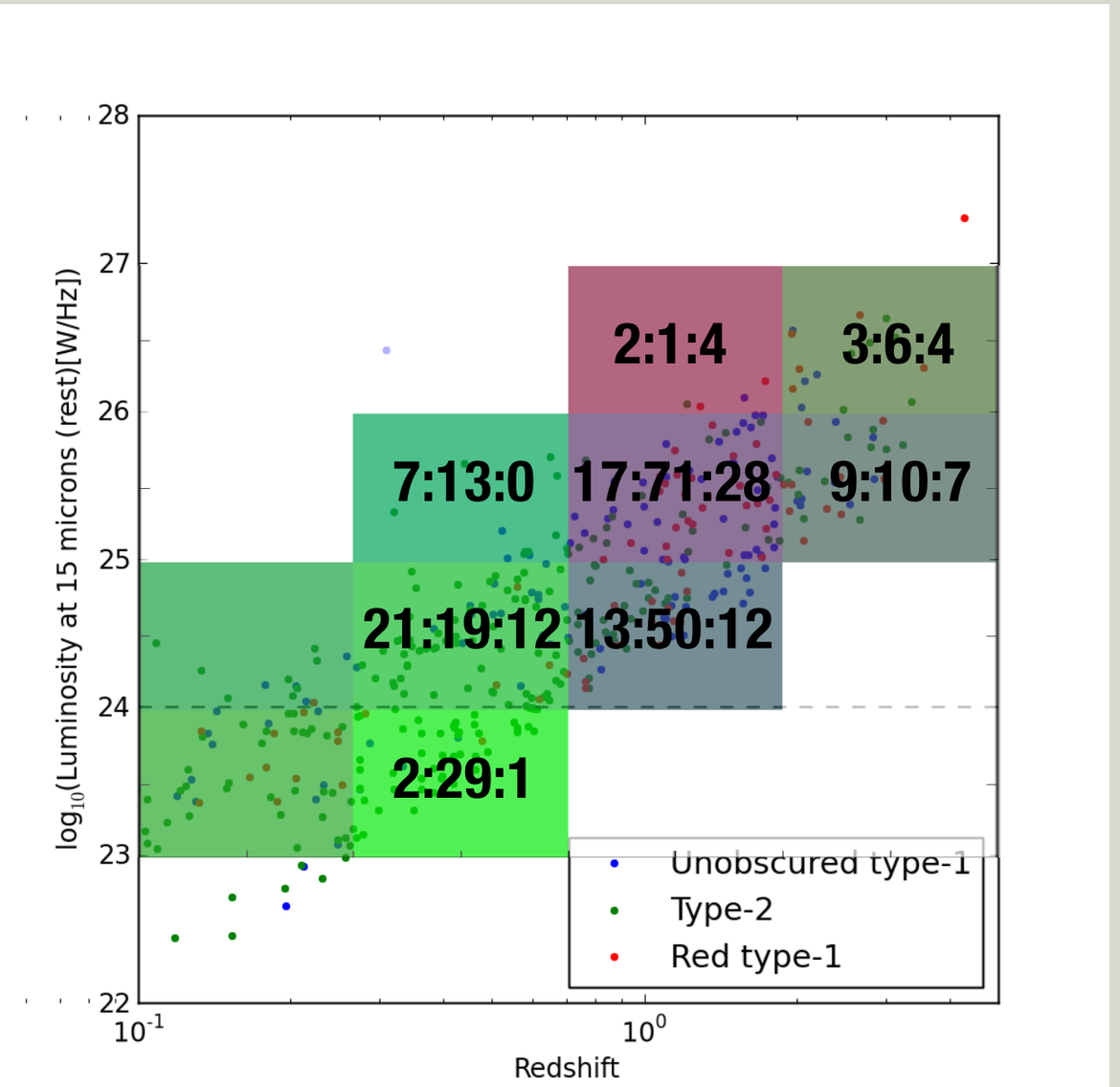
OBSCURED QUASARS OUTNUMBER THEIR UNOBSCURED COUNTERPARTS BY >~2:1 AT ALL REDSHIFTS AND LUMINOSITIES

SELECTION EFFECTS AND EVOLUTION COMPETE



Detailed trends

- At low-z, Type-1:Type-2 ratio increases with luminosity.
- At high-z, dust-reddened type-1s more common.
  - No clear trends with luminosity at high-z (modulo selection effects and small



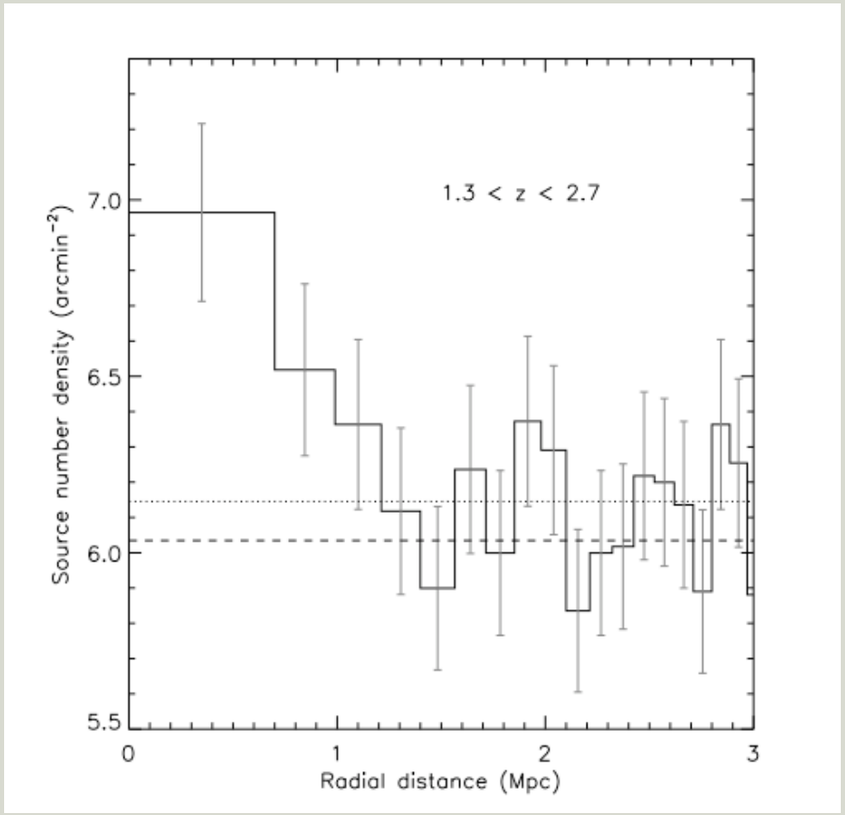
R-RED TYPE-1; G-TYPE-2; B-TYPE-1

SMIRQs and SERVS

- SERVS (the Spitzer Extragalactic Representative Volume Survey) is an 18deg^2, microJy depth survey at [3.6] and [4.5]

- The SMIRQS quasars are (mostly) also in the SERVS fields.

- Will use this to perform a comparative study on clustering around red quasars, and compare to normal quasars.



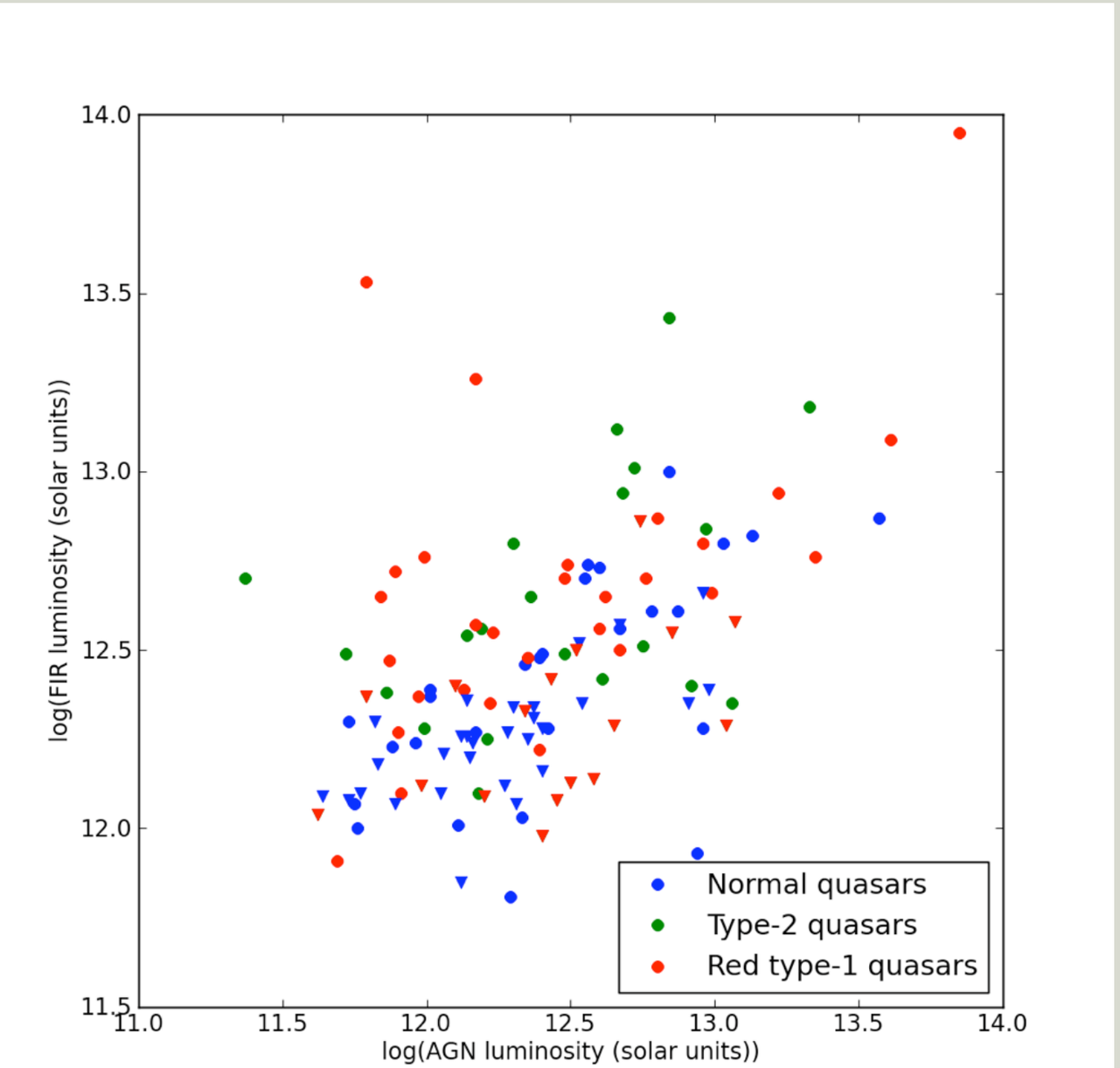
FALDER ET AL. (2011): CLUSTERING AROUND SDSS QUASARS IN SERVS

Star formation

- Overlap with Herschel/HerMES allows us to study the FIR emission (z>1 in this plot).

- FIR luminosities imply star formation properties not dissimilar between the dusty and dust-free objects.

- Most very high



Summary

- We have found the first large samples of heavily obscured quasars at z>1 that can be matched to unobscured objects selected in the same way.

- Behavior of obscured fraction at z>1 different to low-z

  - Recover known luminosity effects at z<1. At z>1, cold (host) dust absorption more common.

- Only a weak trend for more star formation in the hosts of some dust-obscured objects.

- Next steps: ALMA/EVLA/GBT follow-up. Constraining numbers of very highly obscured quasars e.g. with VLBI.

Redshift within the wedge

~~NO "MAGIC BULLET" FOR HIGH-Z~~