

Radio galaxies and their environment at $1 < z < 3$ (and beyond...)

Joël Vernet (ESO)

Carlos De Breuck, Audrey Galametz, Jack Mayo, Dan Stern,
Nick Seymour, Nina Hatch, George Miley, Alessandro
Rettura, Adam Stanford and the SHizRaG team

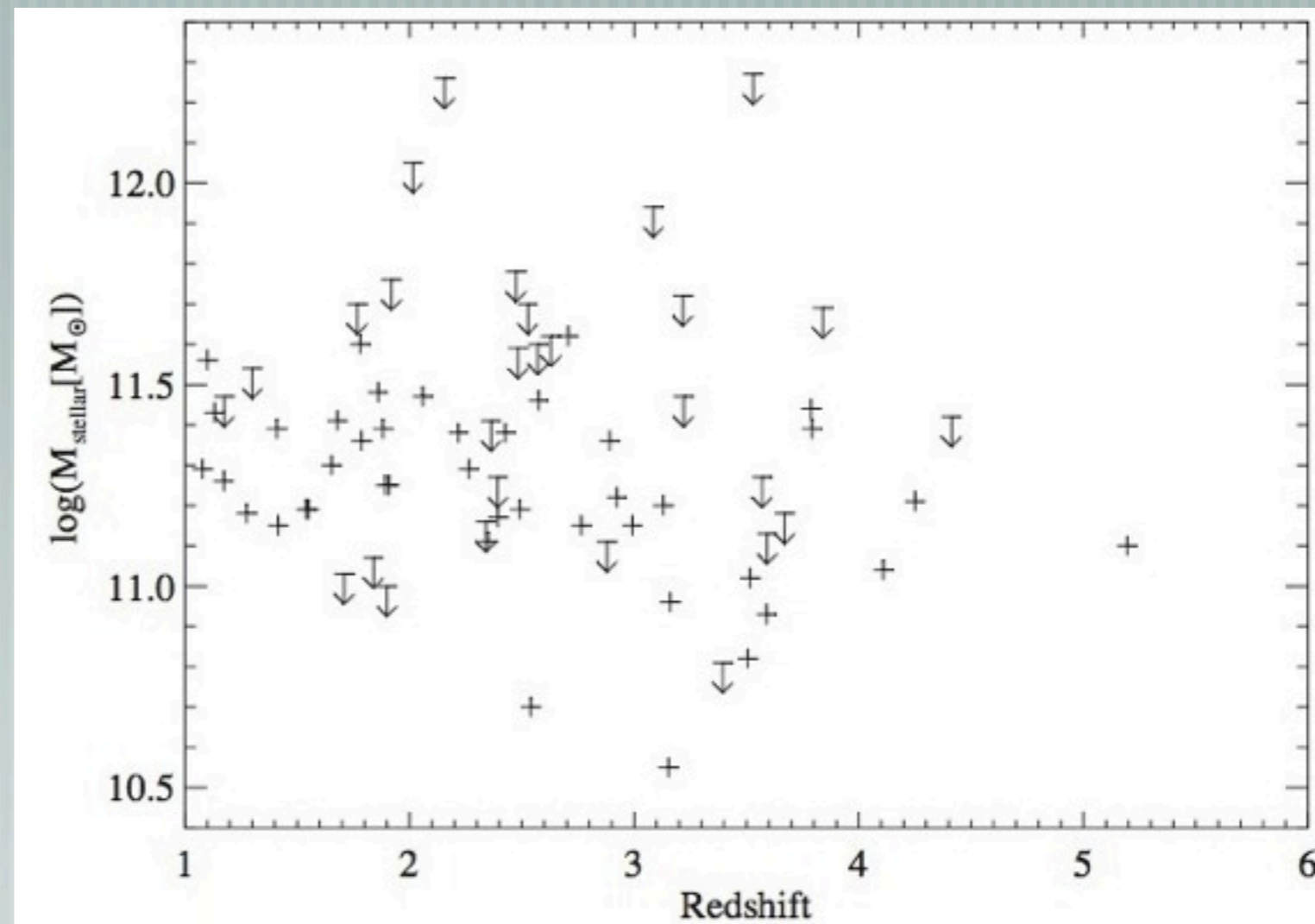
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Why around RG?

- [Among the largest, most luminous, most massive galaxies at every epoch
- [Progenitors of BCGs
- [Exist from $z=0$ to $z>5$



De Breuck et al. 2010

Environment of High Redshift Radio Galaxies

Narrow line emitters searches

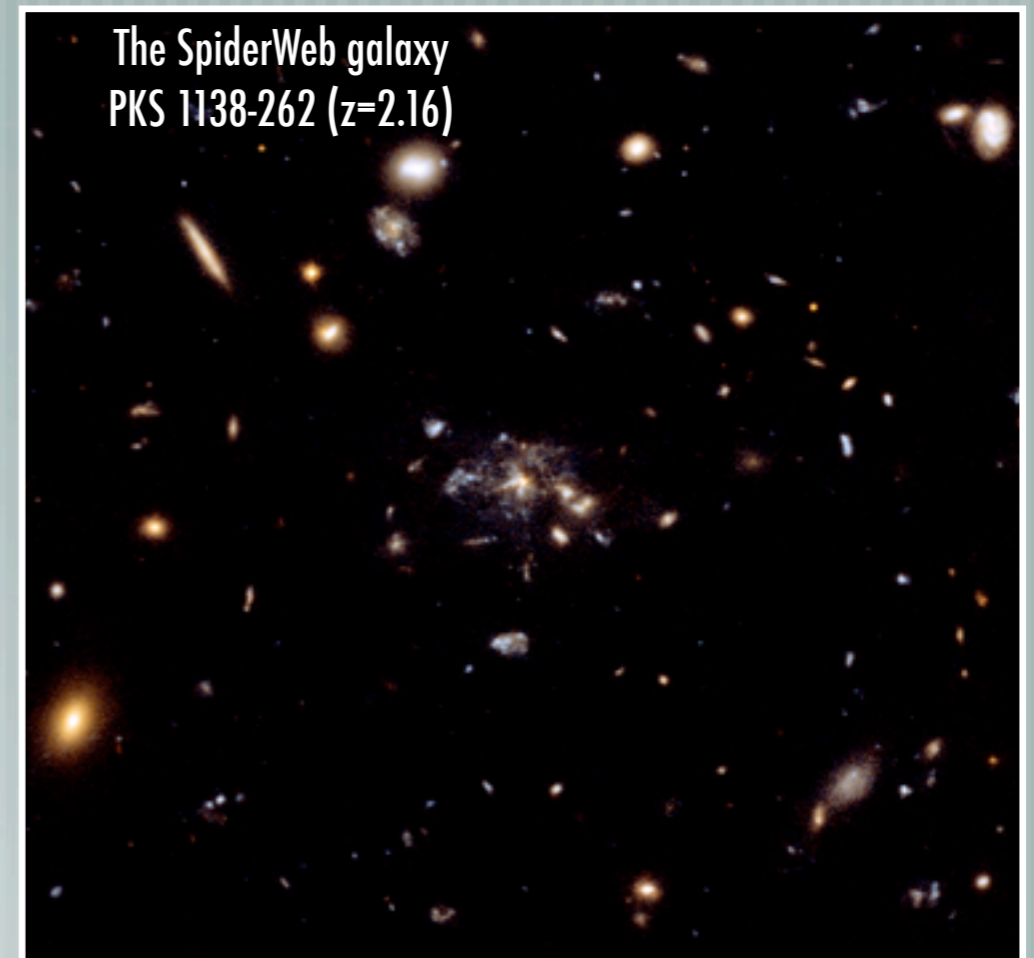
(narrow band imaging+spectroscopic confirmation, led by G. Miley and coll.)

Pro: redshift is known, little contamination from interlopers

Cons: samples only a small fraction of the total mass of the proto-cluster

More recently: search for evolved (red sequence) galaxies around RGs

(Kodama+, Zirm+, Hatch+, Galametz+ ...)



The SpiderWeb galaxy
The most studied proto-cluster at $z > 2$
Ly α and H α emitters, EROs, Lyman break galaxies
... And now massive red cluster members

The SHizRaG sample

Cover the radio luminosity - redshift plane as uniformly as possible in the range $1 < z < 4$, covering two orders of magnitude in radio luminosity

Spitzer 3.6, 4.5, 5.8, 8.0, 16 and 24 μm

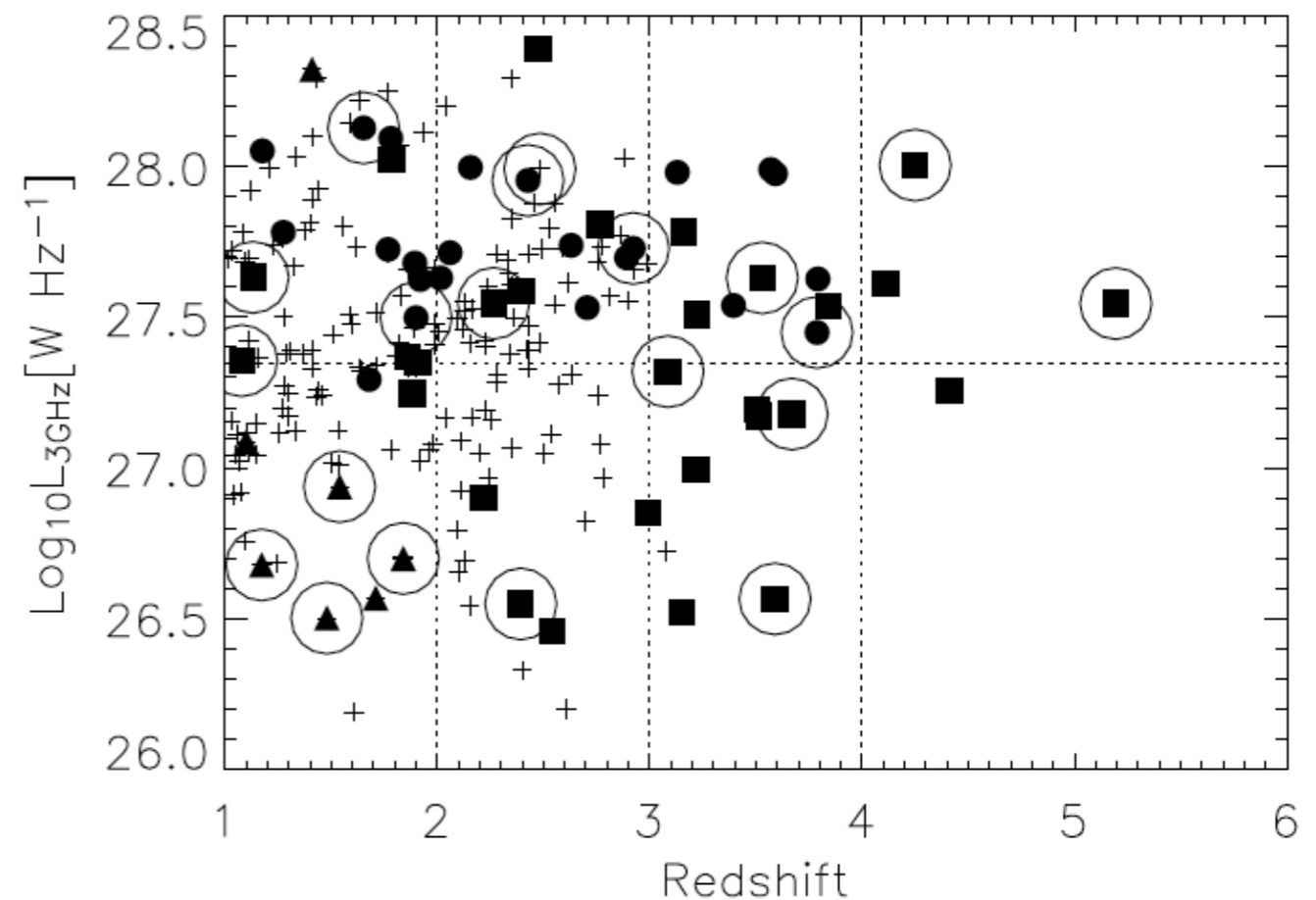
Solid symbols - HzRGs in our Spitzer sample with IRAC/IRS imaging

Large circles - MIPS observations as well

Filled circles - HzRGs with HST data

Filled squares - HzRGs with SCUBA data

Plusses - parent sample of 225 HzRGs from which our sample of 70 was drawn



Two global studies

- [IRAC Ch. 1 & 2 (Galametz et al. 2012, ApJ 749,169)
- [MIPS 24 μ m (Mayo et al. 2012, A&A 539, 33)
 - Count in cells & Comparison with SWIRE, shallow but a good match to our data
 - Have a statistical measurement + identify good proto-cluster candidates

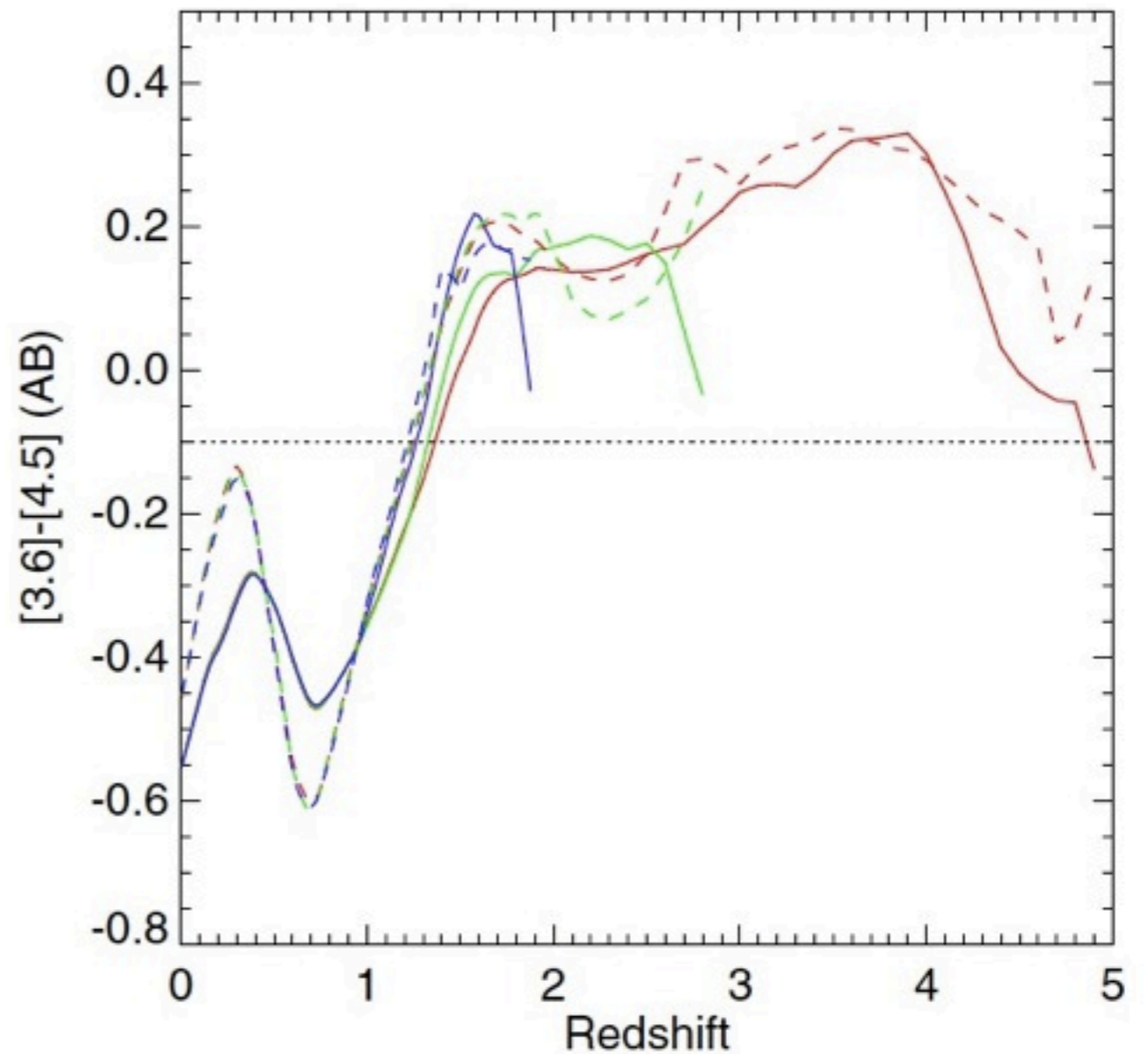
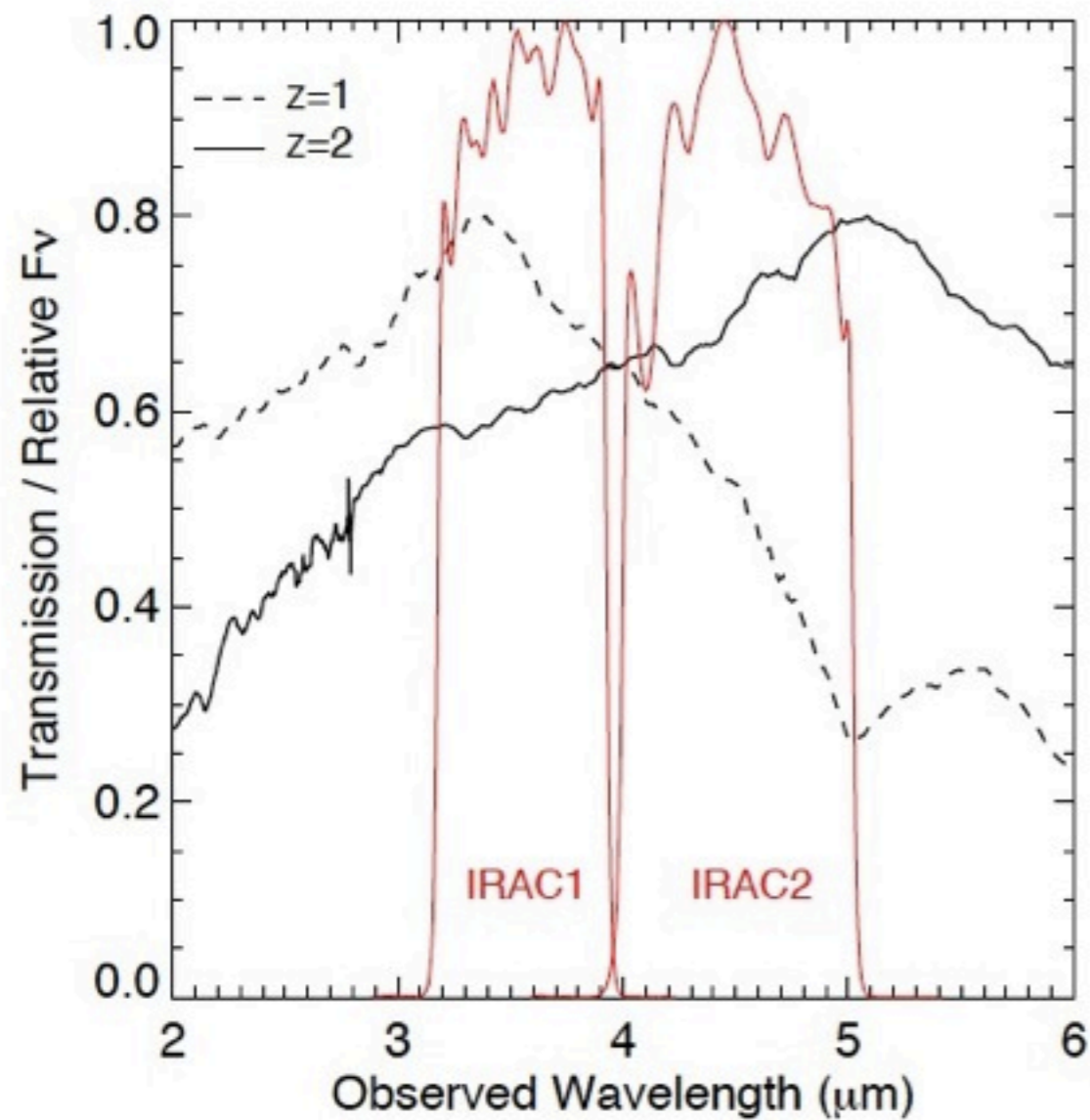
The quiet neighborhood

Galametz et al. 2012, ApJ 749, 169

- 120s exp. time in IRAC 1 & 2
- conservative 5sig cut at:
11.0 μJy at 3.6 μm
13.4 μJy at 4.5 μm
- about **1 mag fainter than L^*** at $z=1.2$
- 1.6 μm bump selection $[3.6]-[4.5] > -0.1$ to select galaxies at $z > 1.2$ (Papovich et al. 2008)
- Limit to 48 fields with RG at $1.2 < z < 3$

The quiet neighborhood

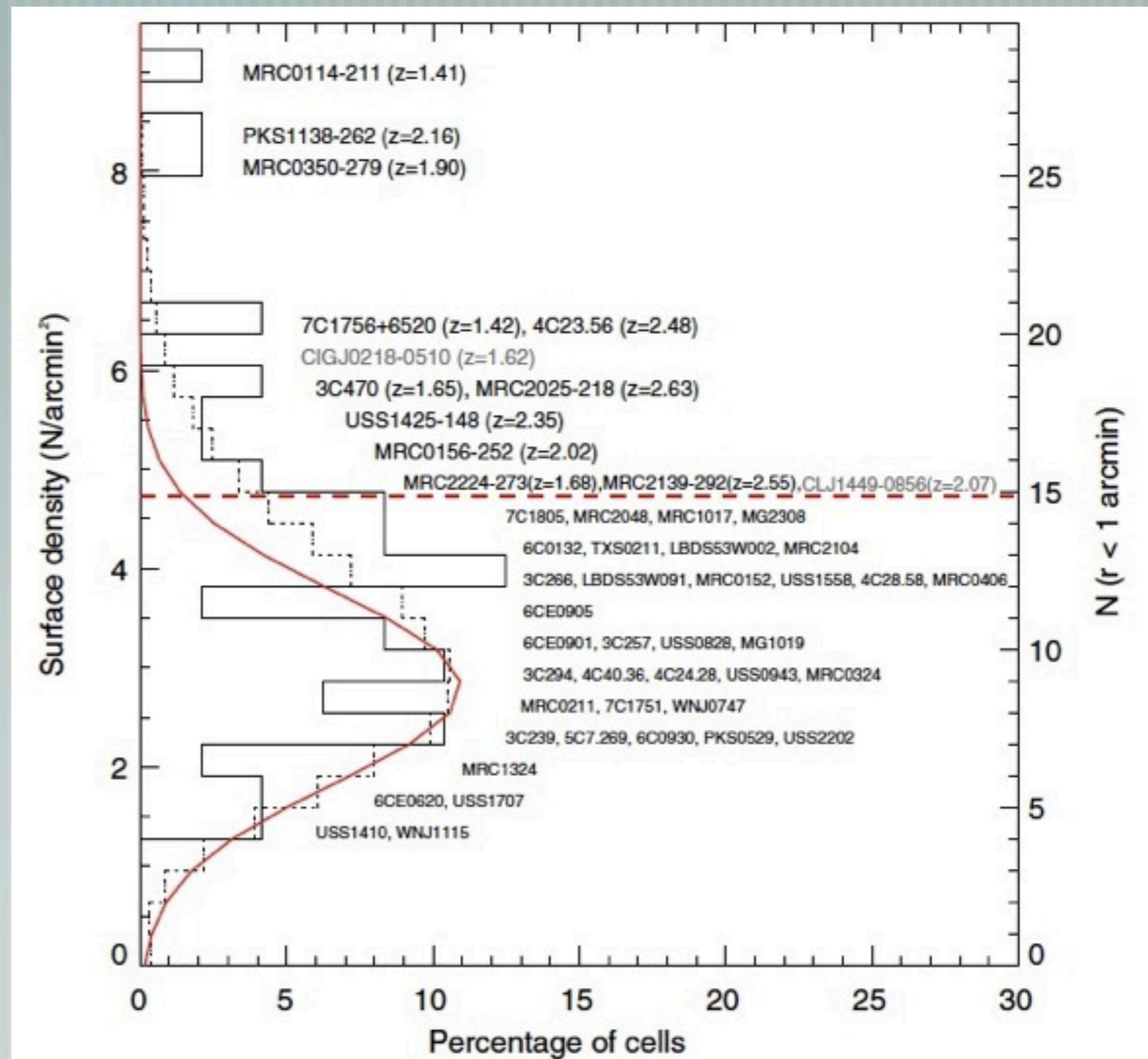
Galametz et al. 2012, ApJ 749, 169



The quiet neighborhood

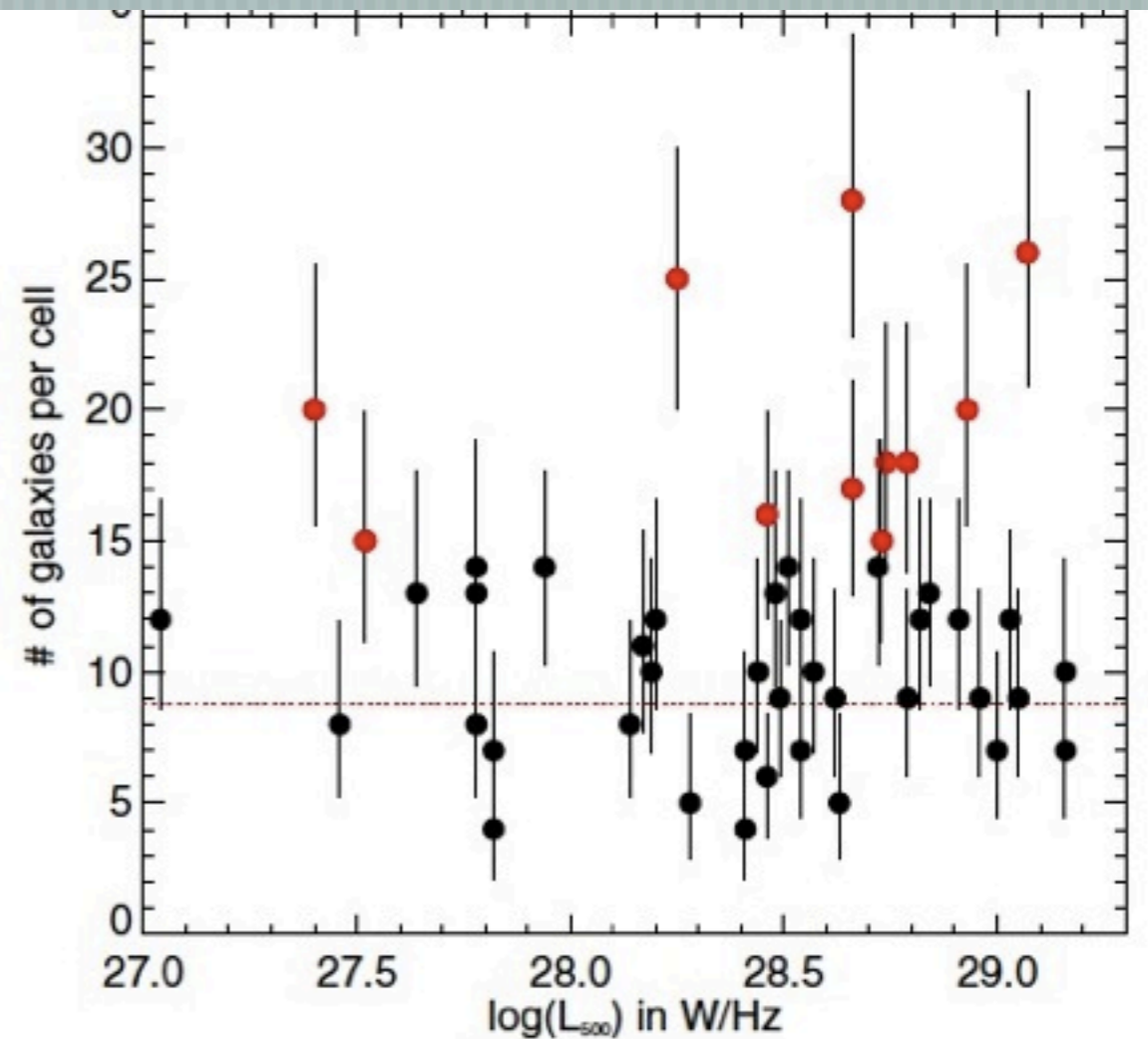
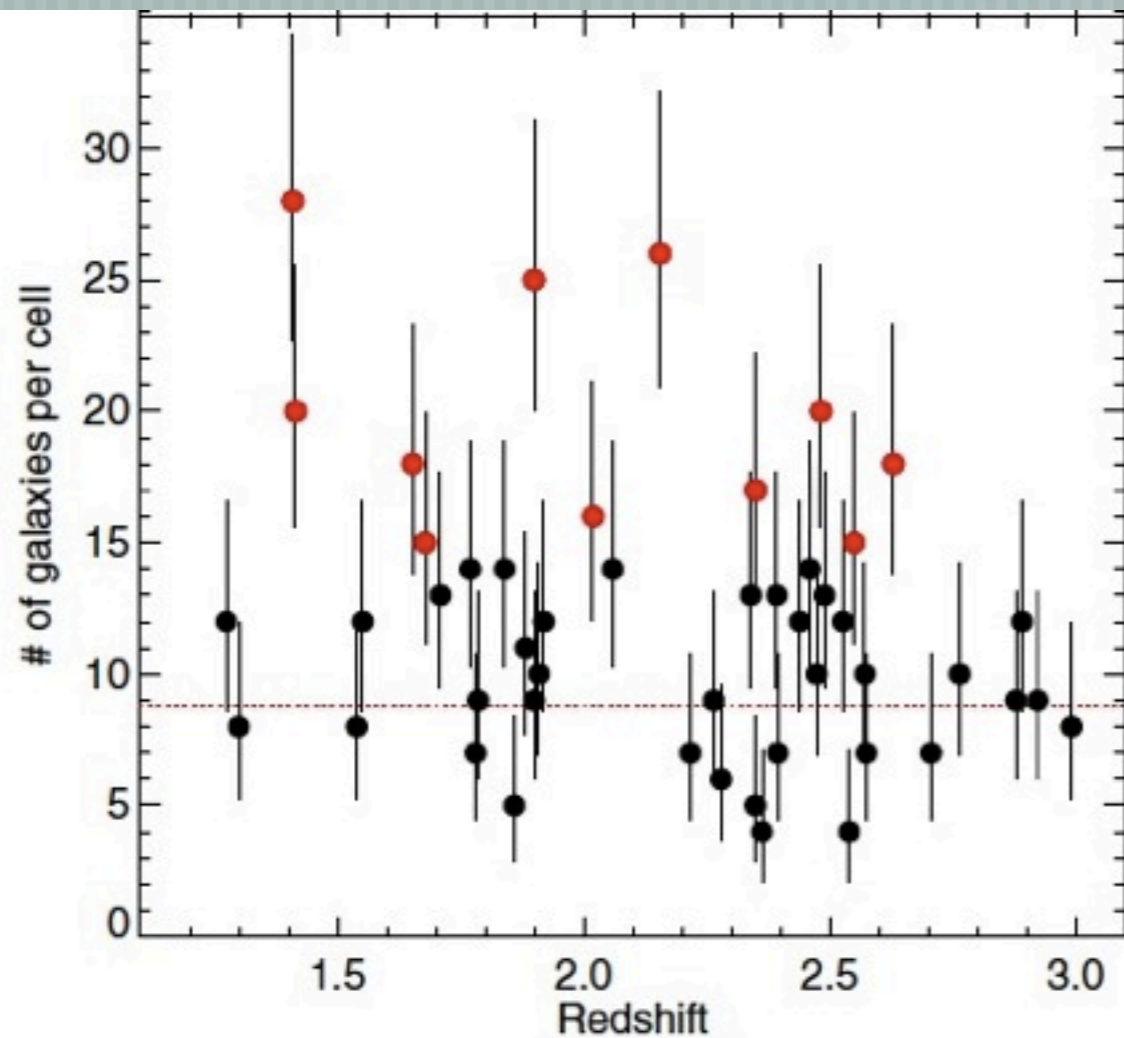
Galametz et al. 2012, ApJ 749, 169

- Counts in 1' radius cells
- Compare to wide area blank fields from SWIRE
- 11 fields $> 2\sigma$ overdensity which is more than 15 red sources within 1'
- 6 of these were known overdensities, 5 new
- 1.3% chance than SWIRE and RG fields are drawn from the same sample



The quiet neighborhood

Galametz et al. 2012, ApJ 749, 169



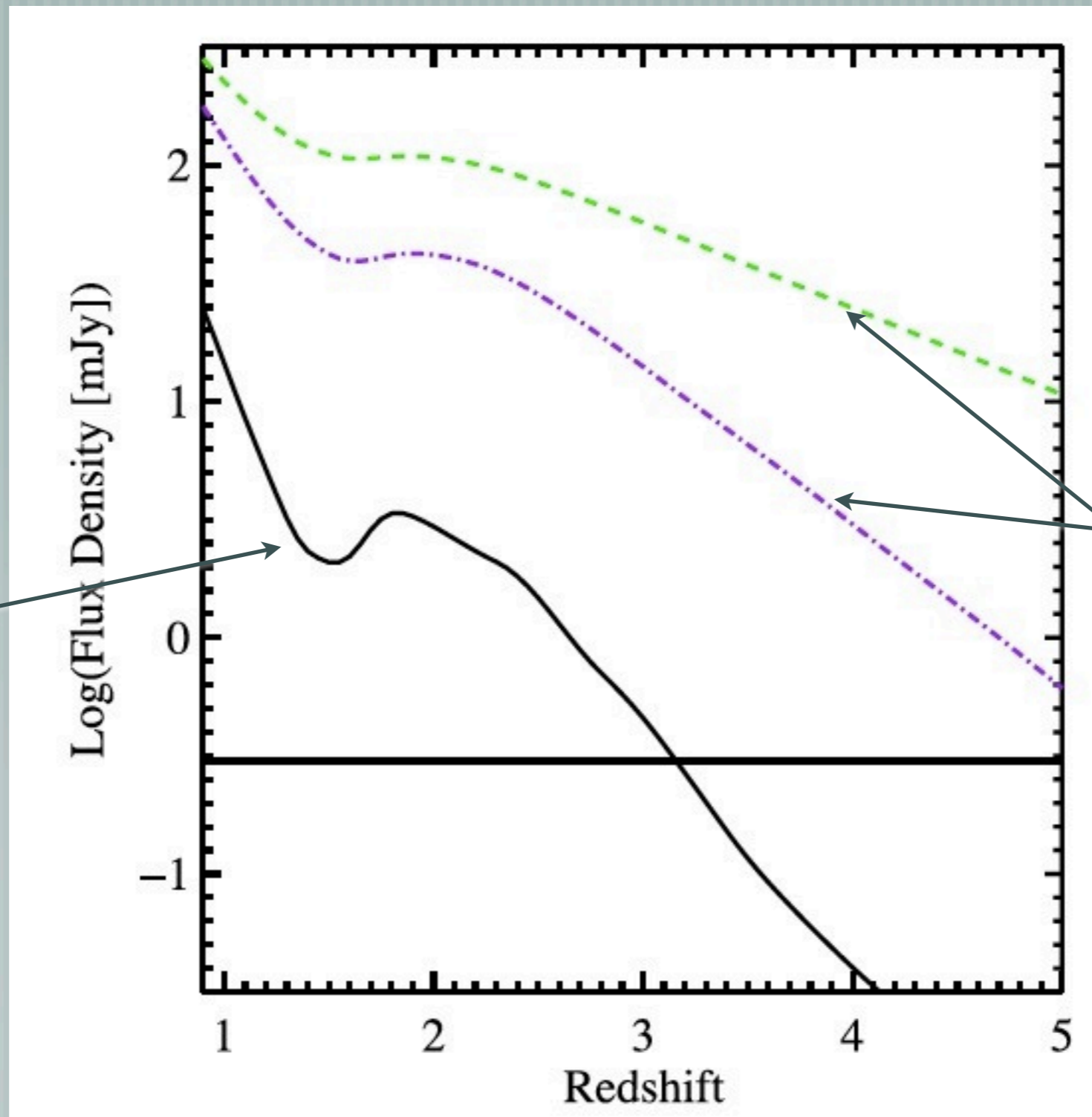
The violent neighborhood

Mayo et al. 2012, A&A 539, 33

- counting 24 μ m sources
- 63 RG fields with suitable MIPS 24 data
- exposure time adapted to background level to reach similar rms for all fields
- adopt a conservative **flux cut of 0.3 mJy** corresponding to 5sig cut for the shallowest field
- 1.75' radius cells around the RG
- select violent starbursts and AGN

The violent neighborhood

Mayo et al. 2012, A&A 539, 33



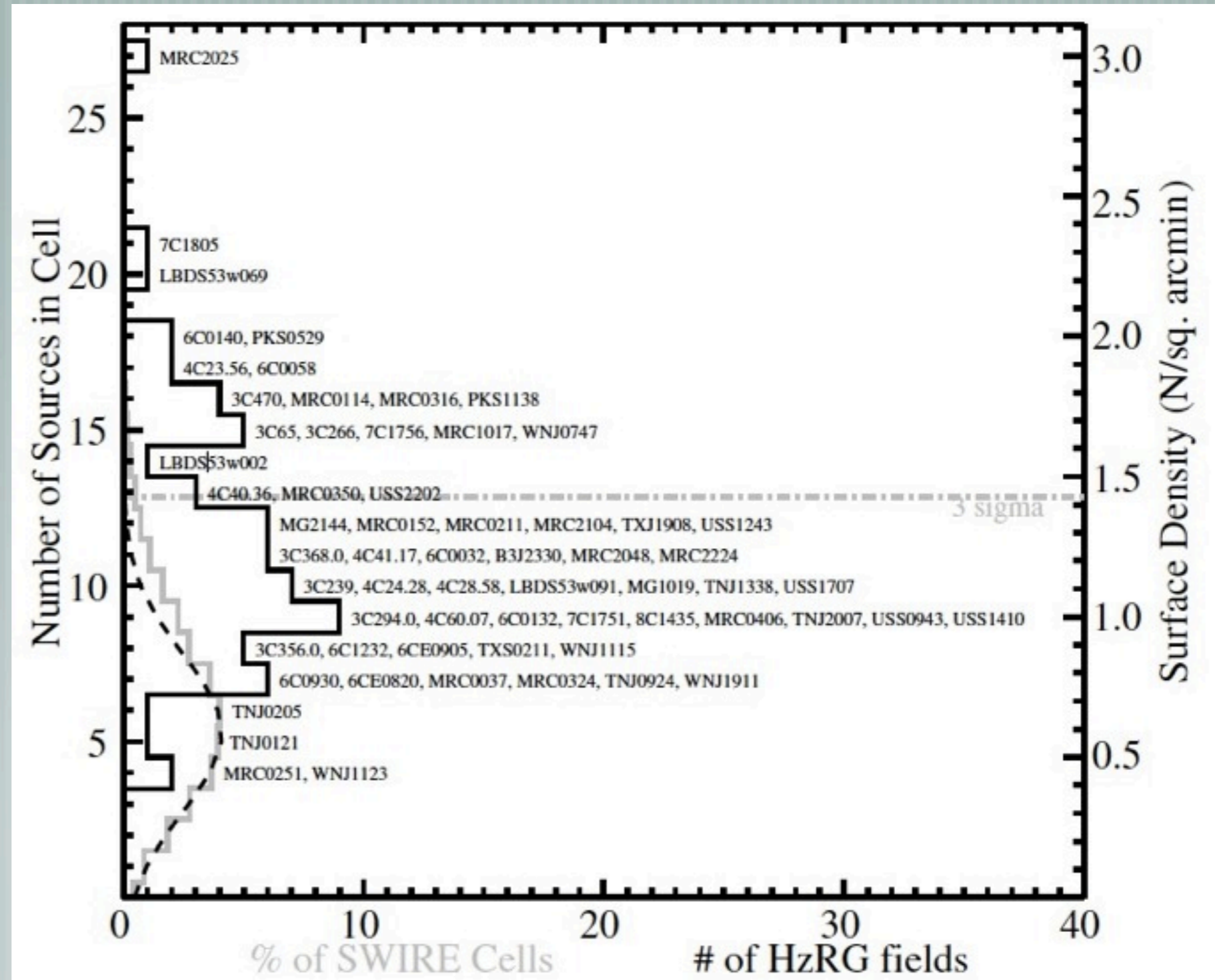
1000 M_{sun} /
yr starburst

type 1 and 2 10^{45}
erg/s quasar

The violent neighborhood

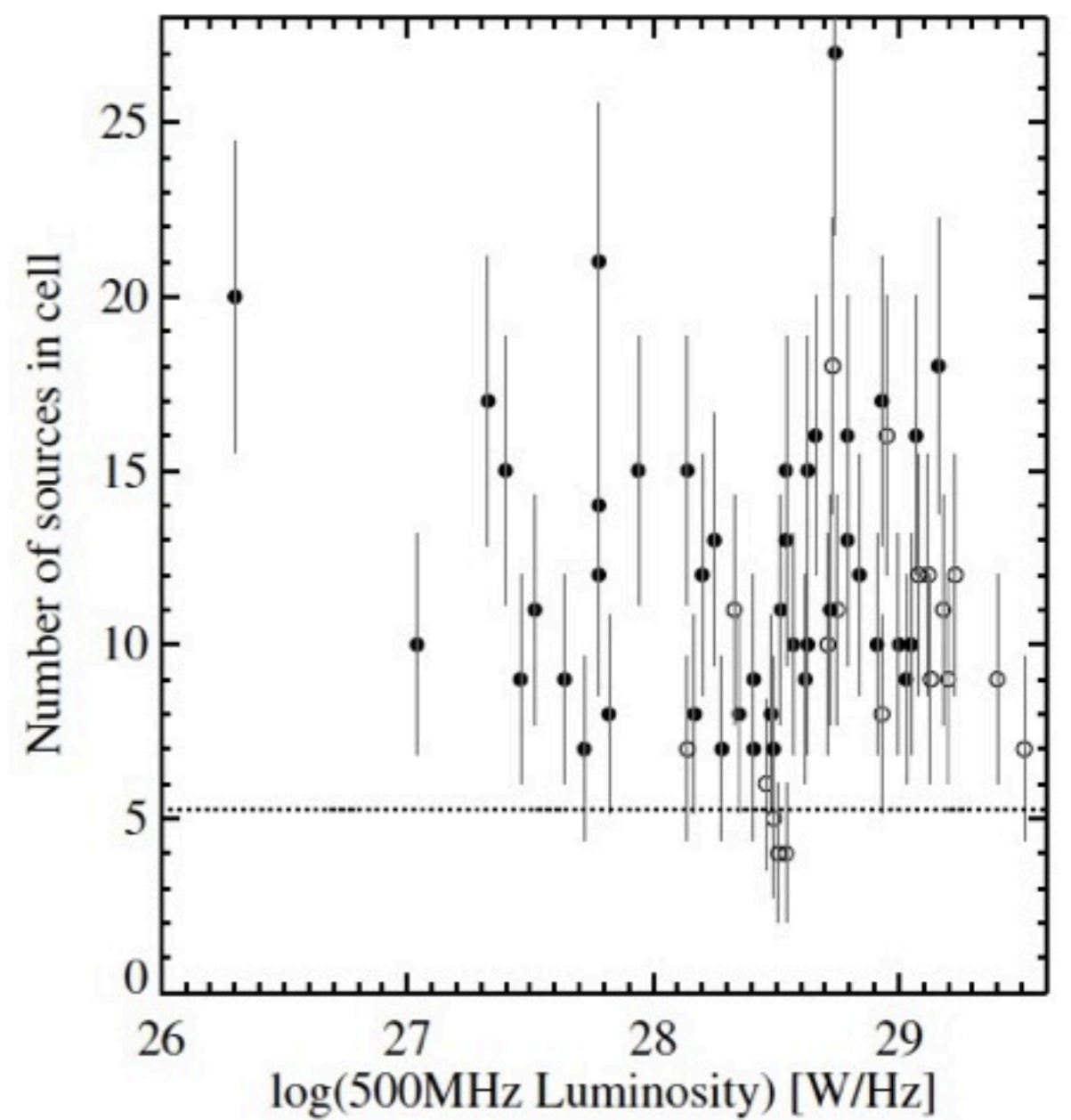
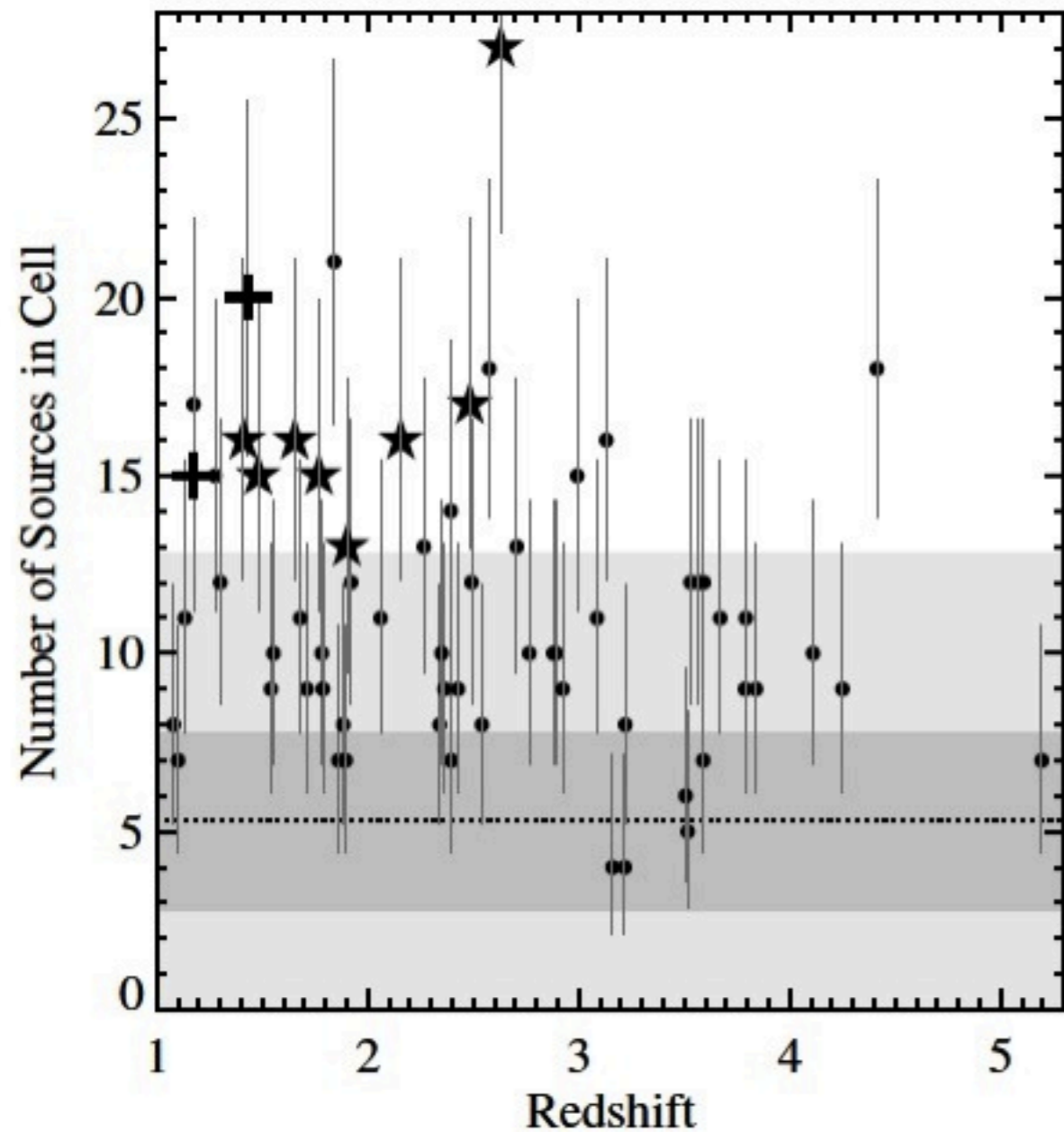
Mayo et al. 2012, A&A 539, 33

- RG fields are about 2 times overdense in bright $24\mu\text{m}$ sources
- probability that SWIRE cells and RG field are drawn from the same distribution is $1.2 \cdot 10^{-12}$

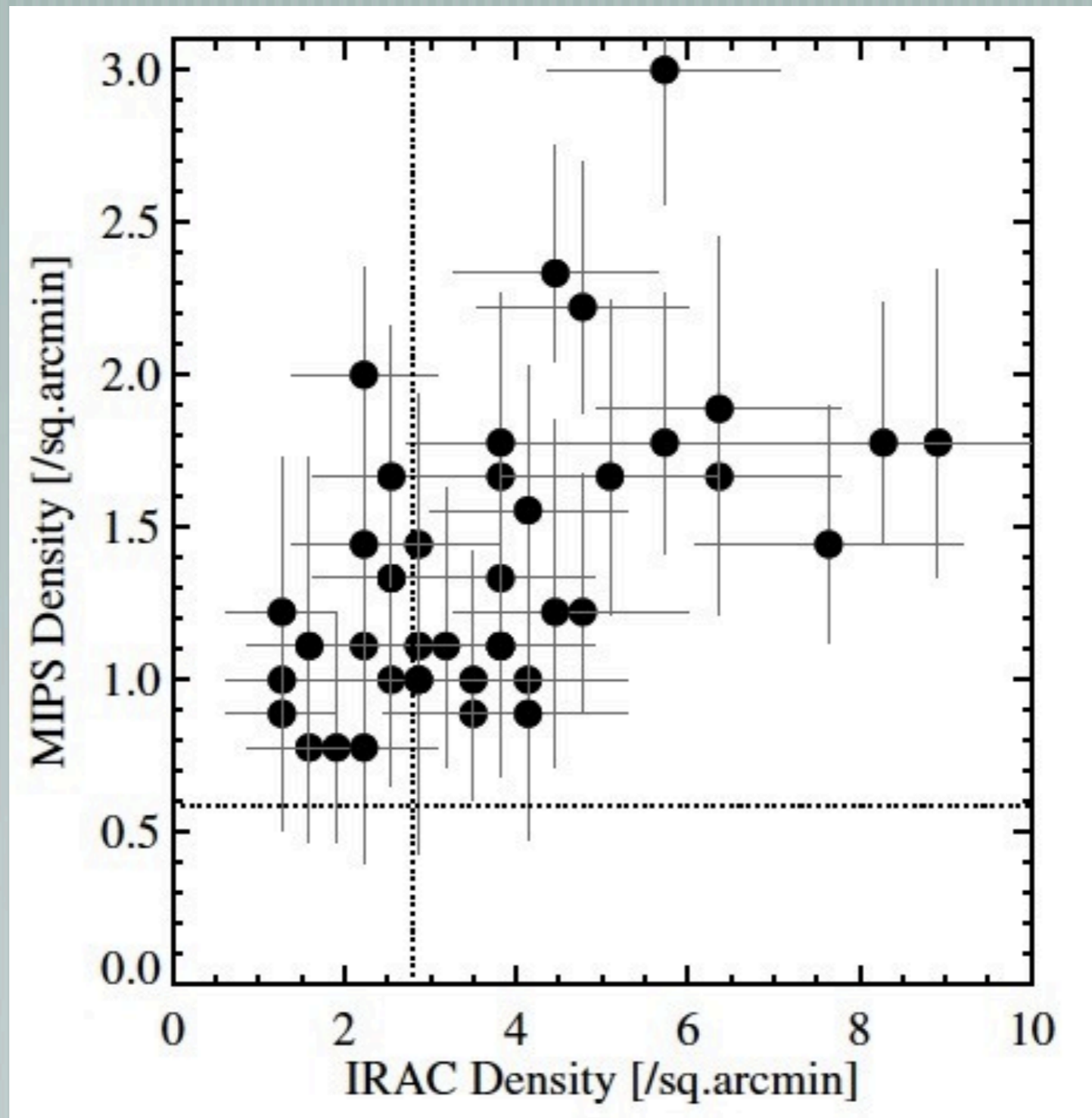


The violent neighborhood

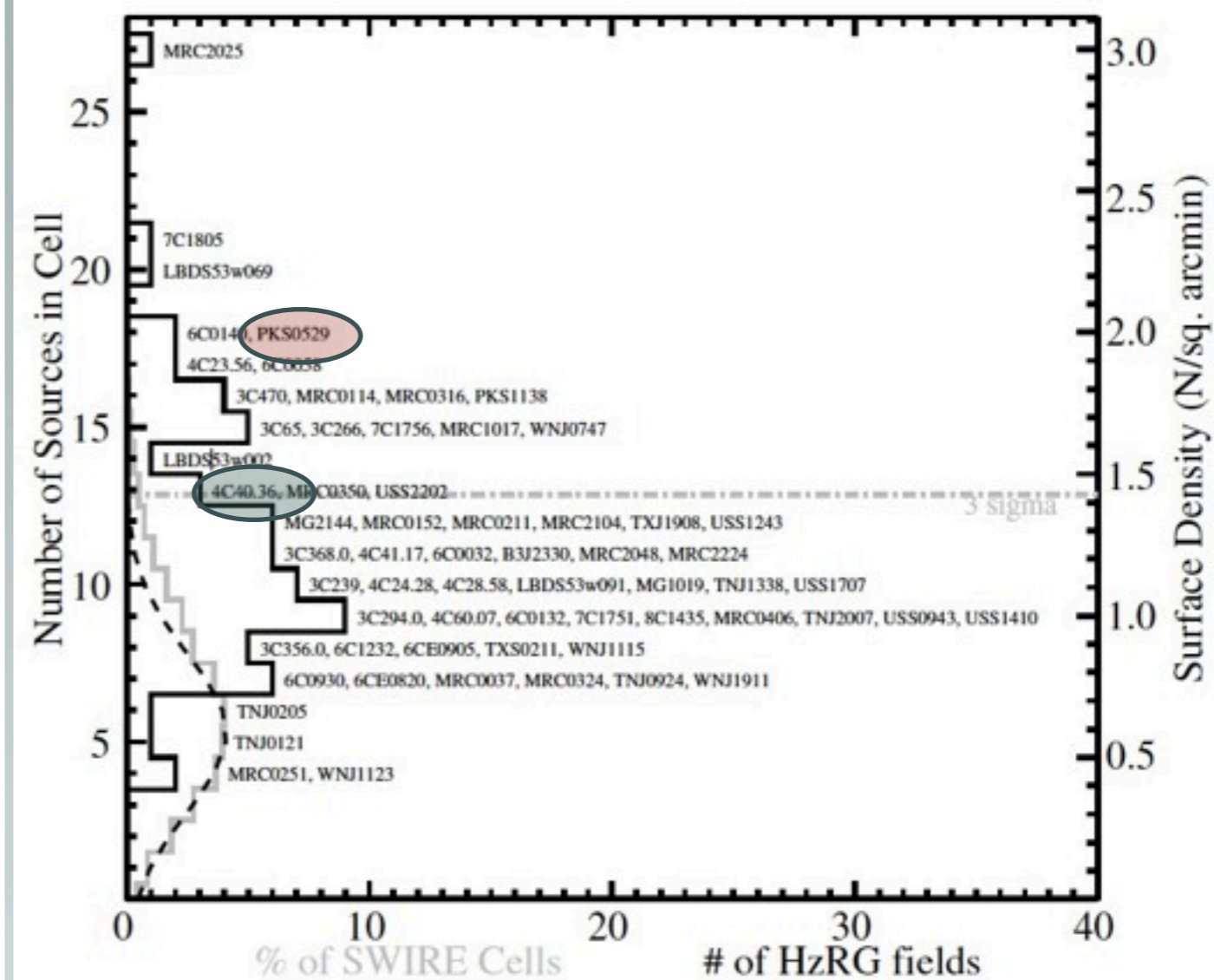
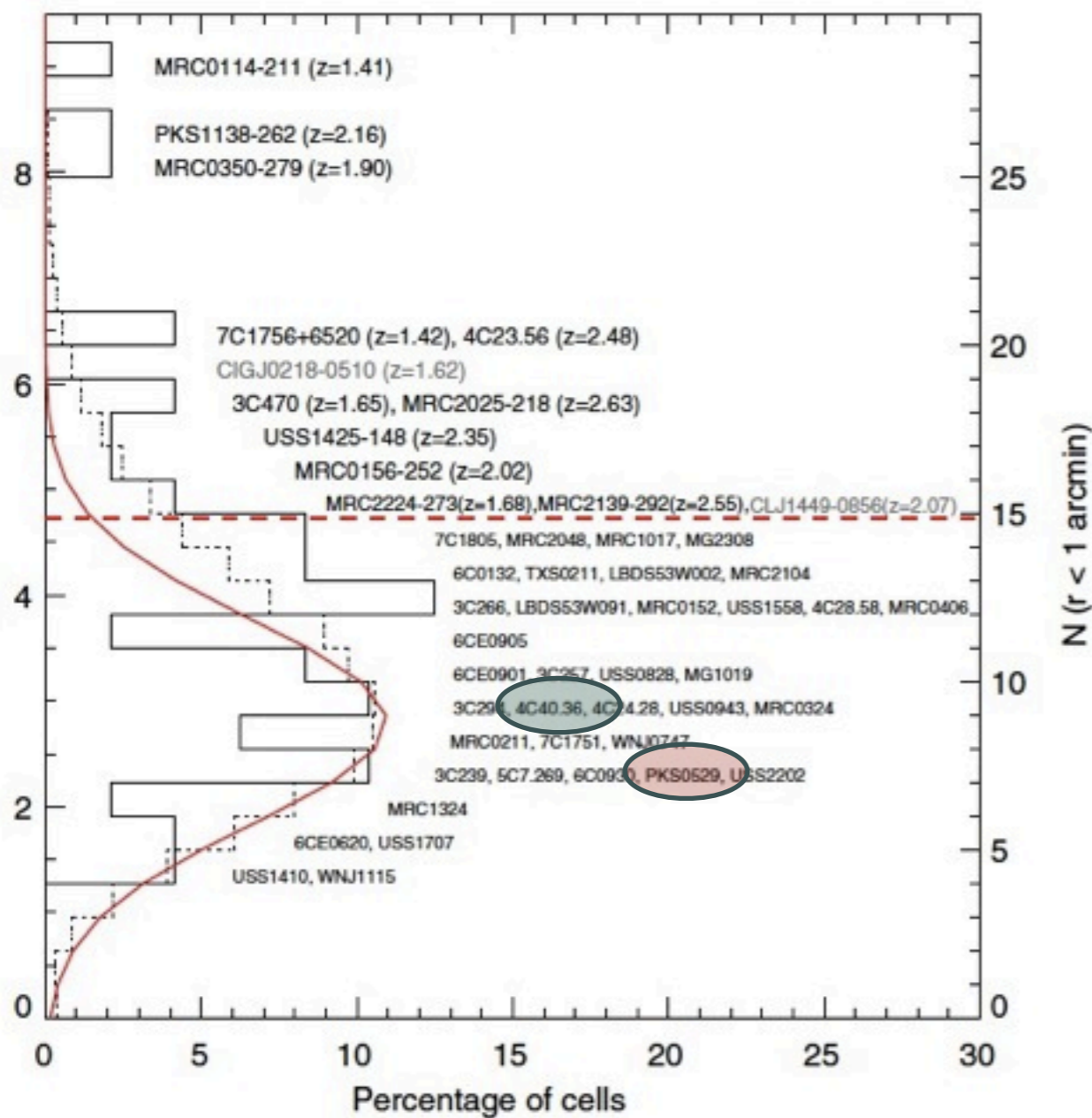
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How do the two compare...



How do the two compare...



Conclusions

— [RG in general live in denser than average environment

— [The two techniques are in good agreement

— [More contrast with respect to field for active galaxies selection

— [Many new high over-density fields identified

— [Spectroscopic followup on going

— [Much larger, much deeper IRAC selected sample around type 1&2 radio loud AGN: CARLA project presented by Dominika Wylezalek tomorrow