

OH Megamasers: Luminous Radio Beacons of Merging Galaxies

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What are OH Megamasers?

OH Megamasers and Galaxy Mergers

The Arecibo OH Megamaser Survey

- OH Megamaser Hosts
- The OH-FIR Relation
- The OH Luminosity Function

OH Megamasers at High Redshift

Tracers of Galaxy $\dot{N}$?

The Arecibo OH Megamaser Survey

Conduct OHM search to:

- (1) Determine the OHM fraction in LIGs.
- (2) Augment (double) OHM sample for a statistical study of OHM environments, engines, lifetime, and structure.
- (3) Estimate the merger rate at various z , through “bootstrapping” the sample.
- (4) Confirm the OHM-LIG connection.

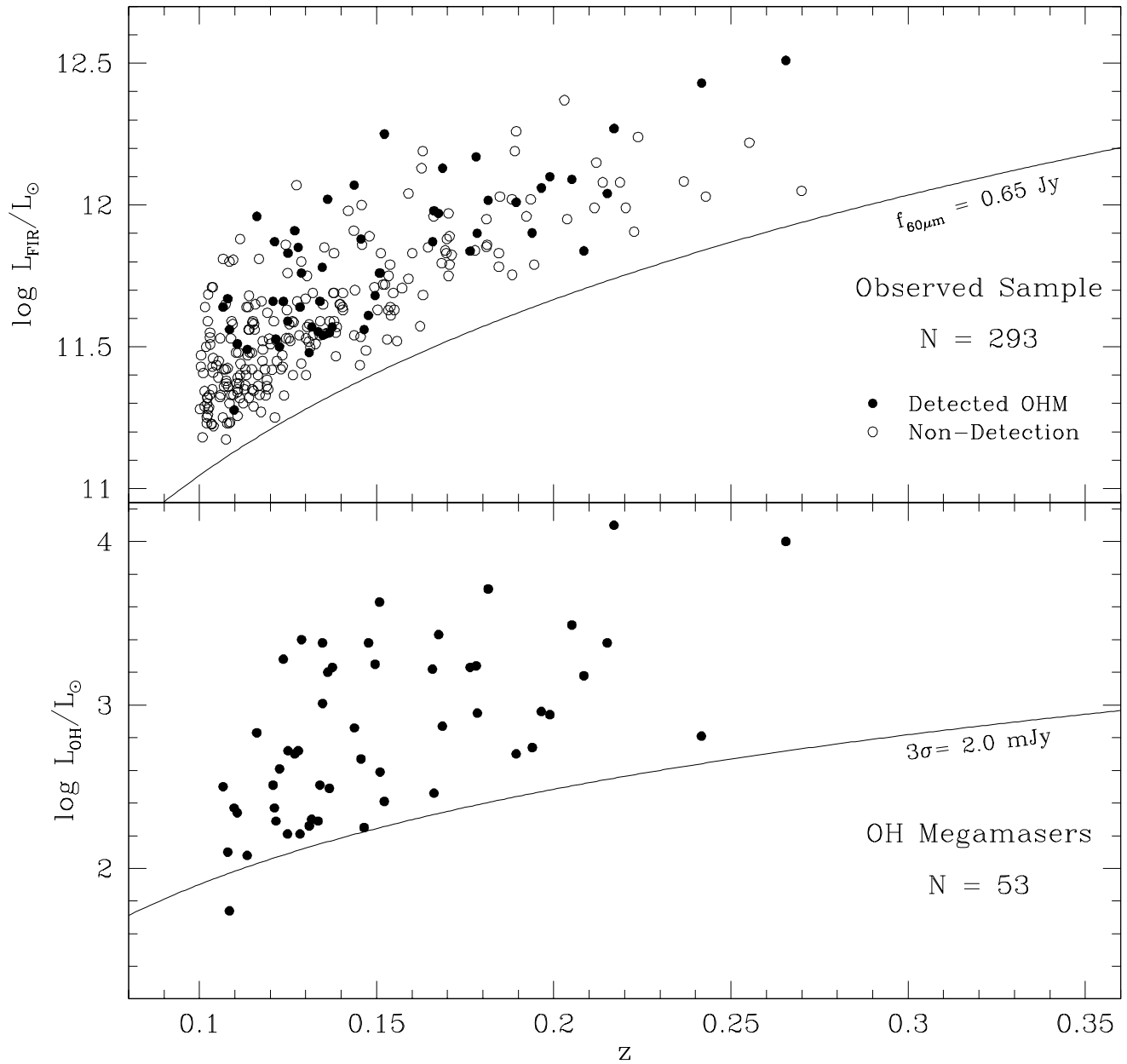
Candidate Selection:

IRAS Point Source Catalog Redshift Survey
(PSCz - Saunders et al. 1999)

- (1) $0.1 < z < 0.45$
- (2) *IRAS* $f_{60\mu m} > 0.6$ Jy
- (3) $0^\circ < \delta < 37^\circ$

These criteria identify a sample of 311 candidate OHMs.

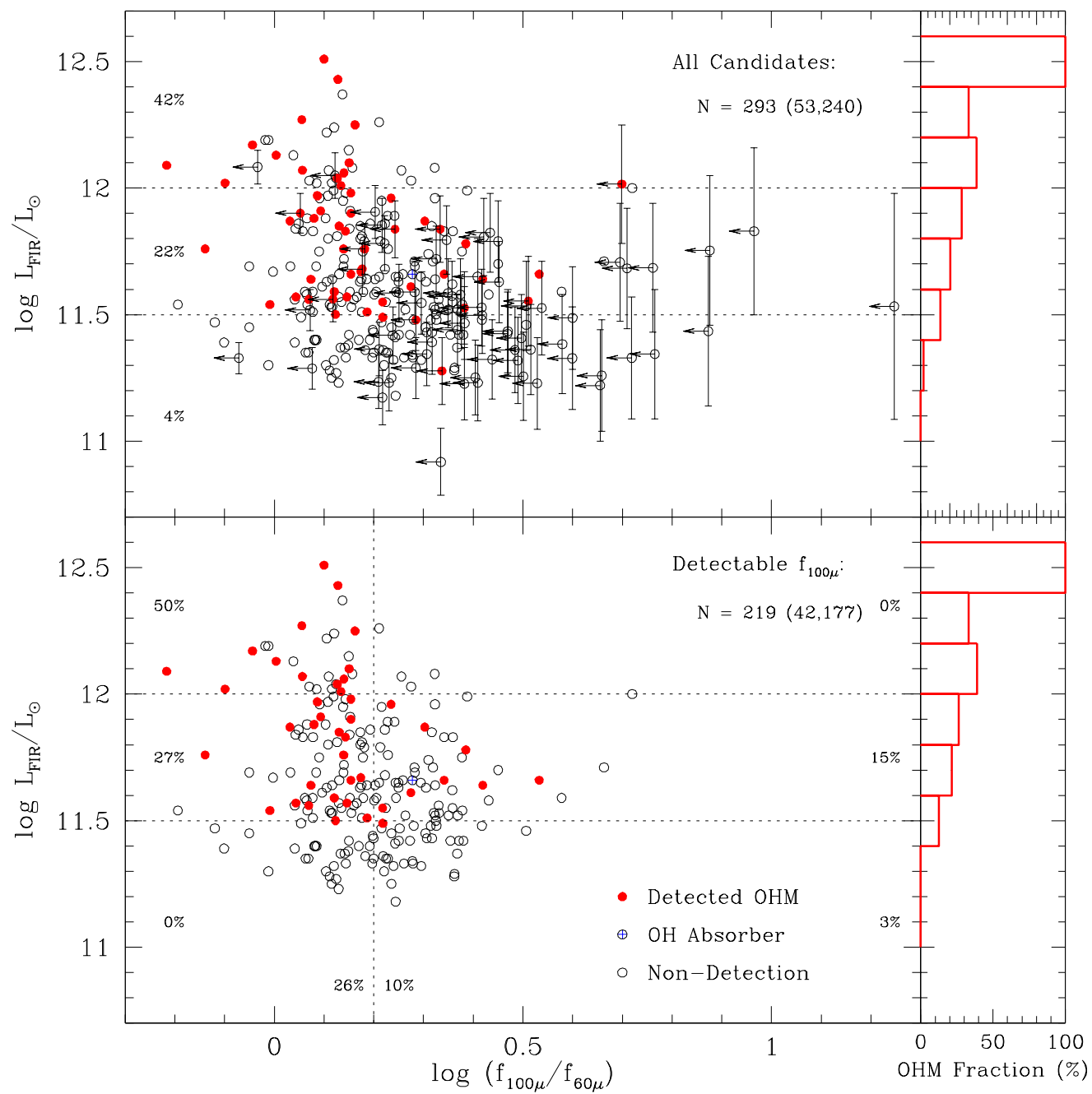
Arecibo OH Megamaser Search: IRAS PSCz Sample



— 50 New OH Megamasers Detected

— Detection Rate of 1 in 5.5

Arecibo OH Megamaser Search: OHM Fraction in LIRGs



FIR Luminosity Influence on OHM Activity

FIR luminosity is correlated with both:

- OH luminosity (L_{OH}), and
- OHM fraction in LIGs.

L_{OH} - L_{FIR} relation

- Simple view for *unsaturated* masing:

$$L_{OH} \propto L_{pump} L_{continuum} \propto L_{FIR}^2$$

- Simple view for *saturated* masing:

$$L_{OH} \propto L_{pump} \propto L_{FIR}$$

- Baan (1991) empirically confirmed the quadratic (unsaturated) relationship.
- Kandalian (1996) corrected the relationship for the Malmquist bias:

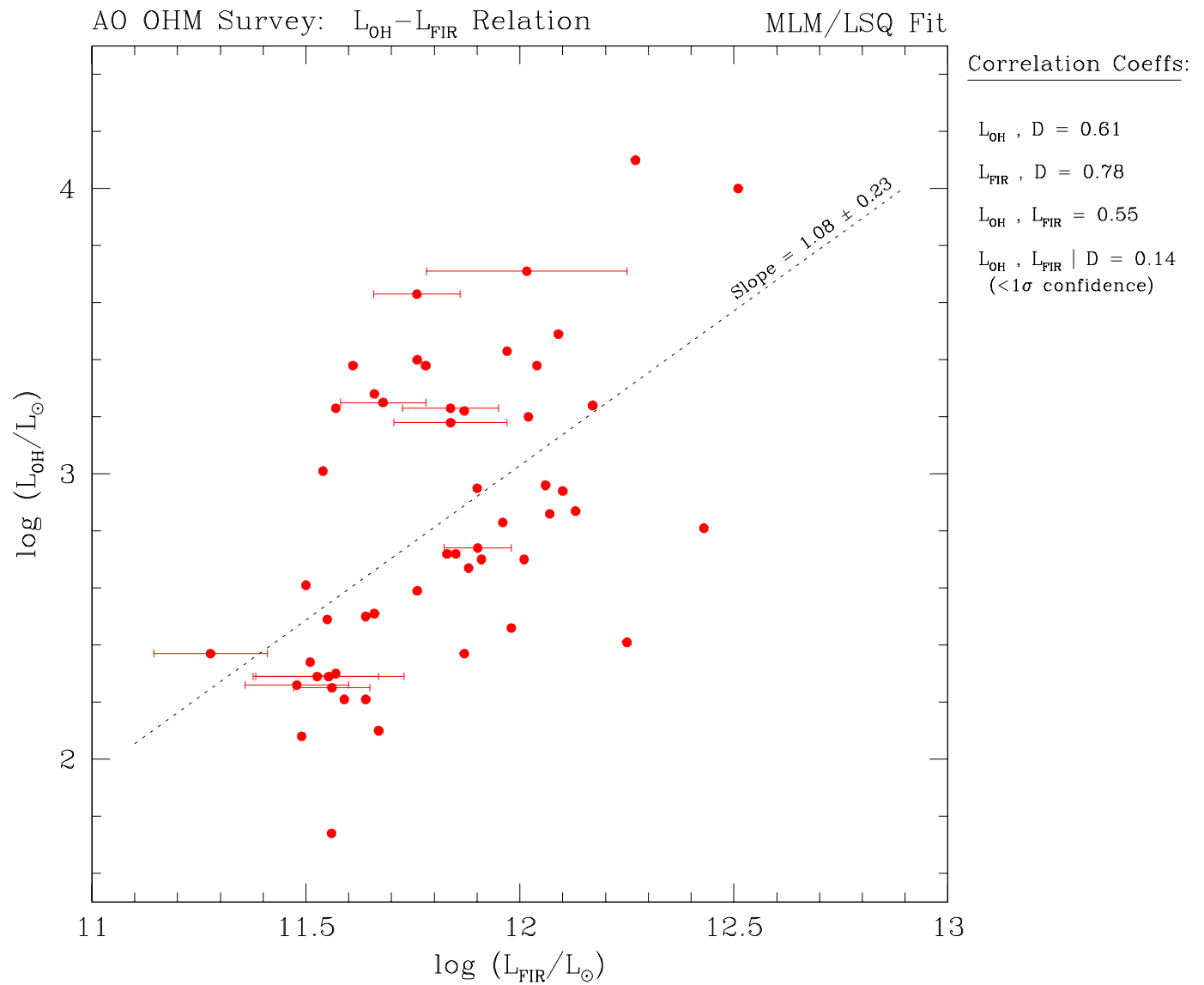
$$\log L_{OH} = (1.38 \pm 0.14) \log L_{FIR} - (14.02 \pm 1.66)$$

$\Rightarrow$ *There may be two distinct types of emission in OHMs.*

(Diamond *et al* (1999) VLBI work supports a dichotomy)

OHM fraction in LIGs:

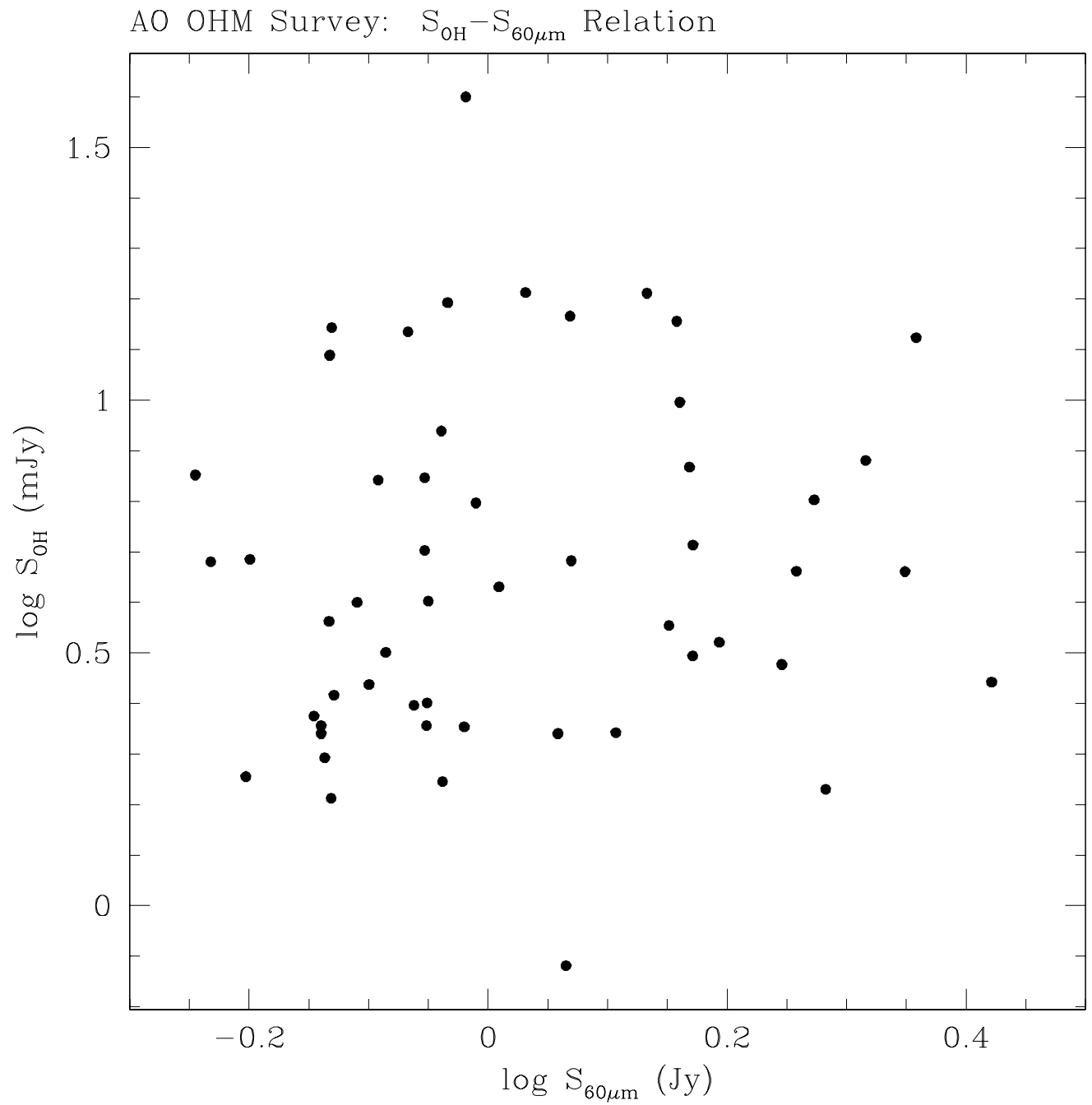
- The fraction is a strong function of L_{FIR} , but it is *not* due to the L_{OH} - L_{FIR} relation alone!
- Viewing geometry and OH concentration must be relevant.
- Merger stage should be important (correlated with L_{FIR})



Both L_{OH} and L_{FIR} are correlated with distance.

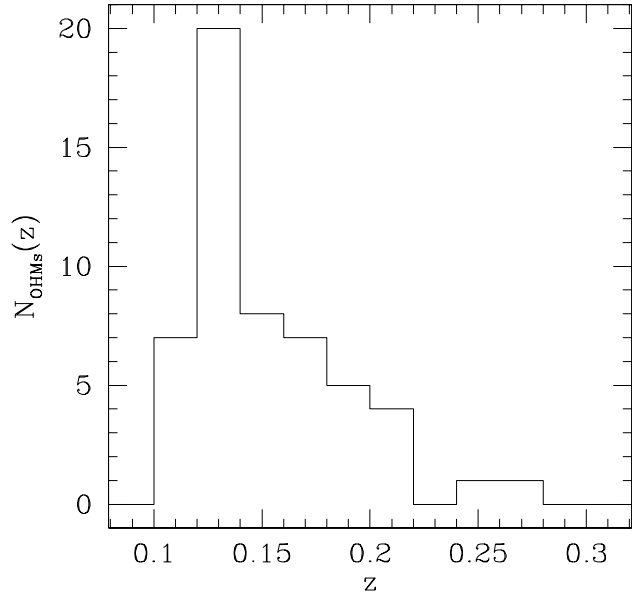
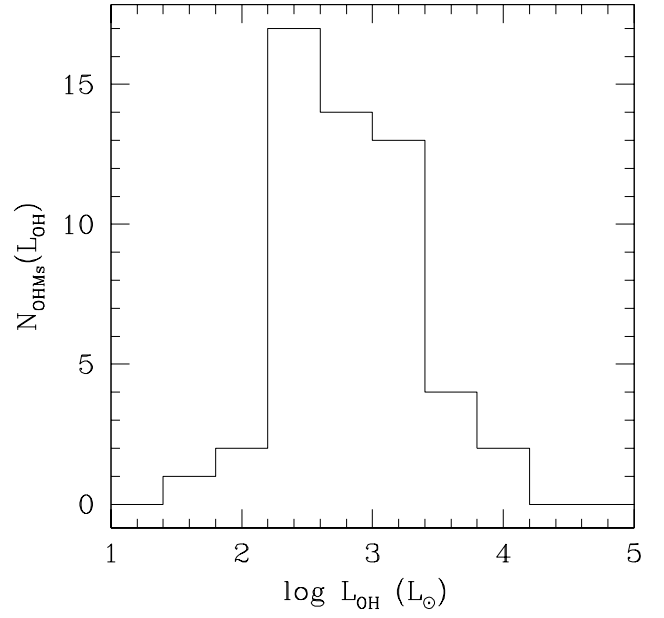
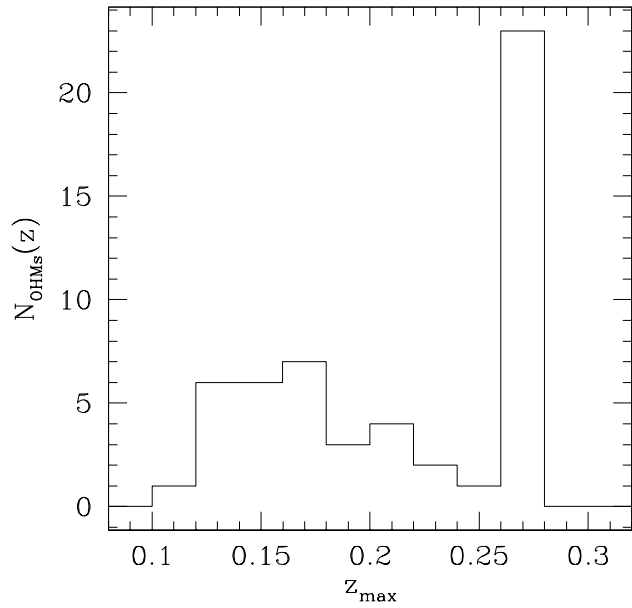
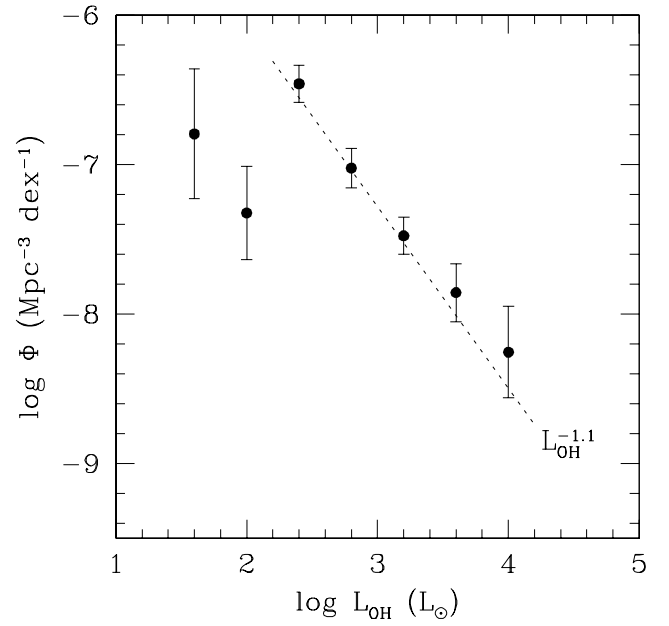
Removing the correlation with distance also removes the artificial relationship between L_{OH} and L_{FIR} .

→ This can be seen in flux-flux plots...



No Correlation!

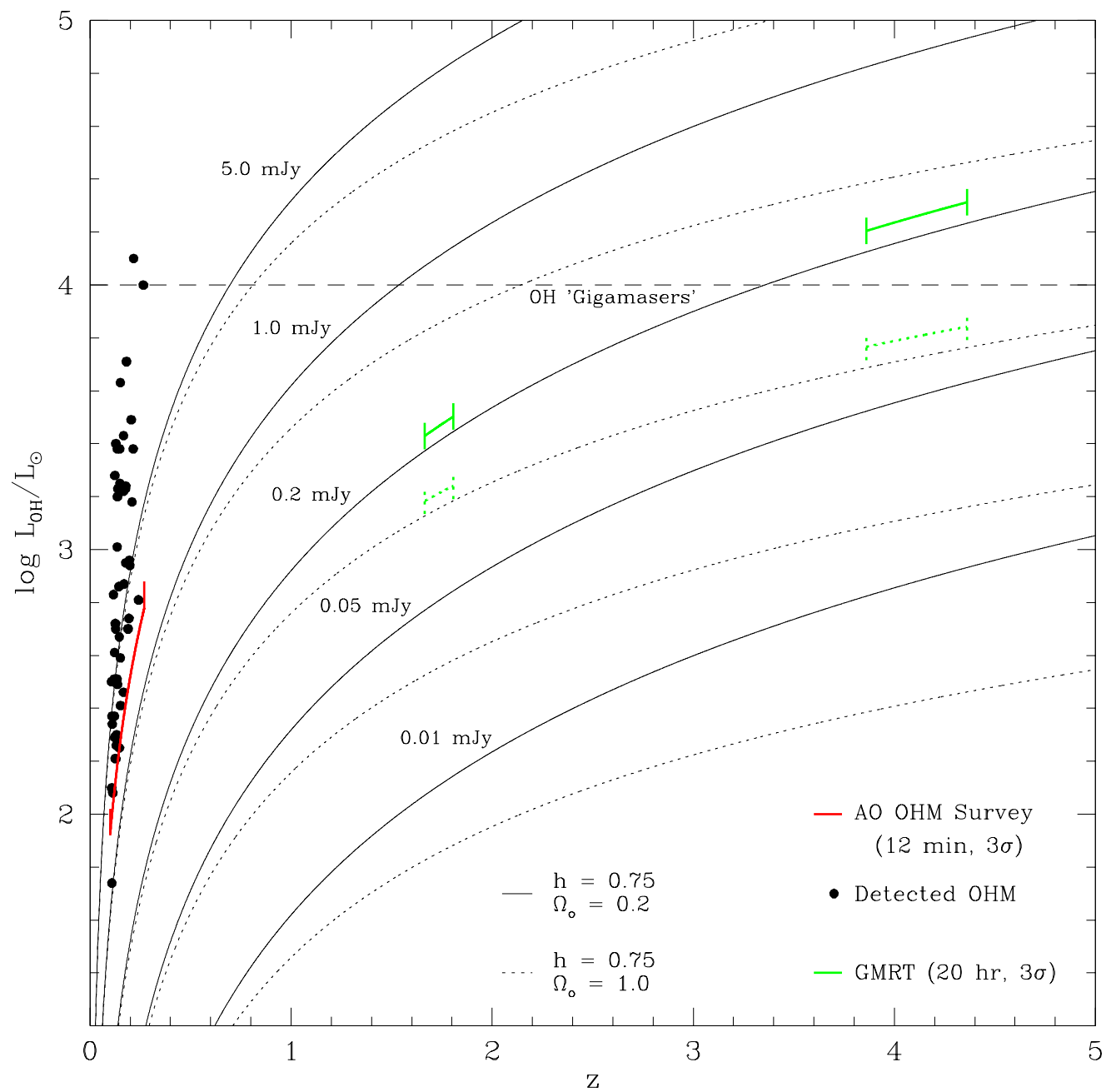
→ OH Megamaser strength does NOT depend on the global FIR emission.



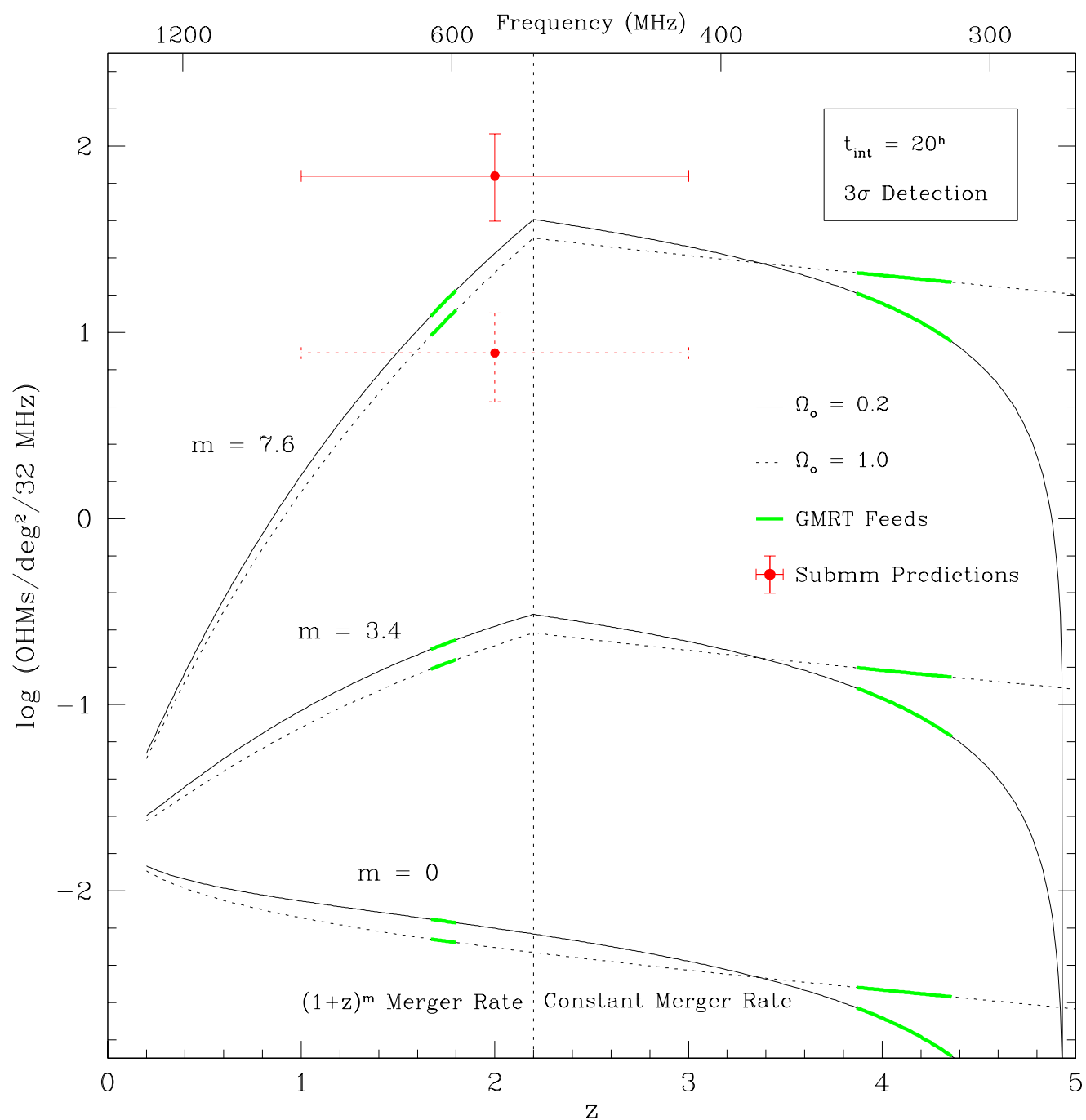
Nearly half of the sample is detectable beyond the limits of the survey.

$\Phi \propto L_{\text{OH}}^{-1.1} (\text{Mpc}^{-3} \text{ dex}^{-1})$ — consistent with ULIRGs (Kim & Sanders 1998).

OH Megamaser Detectability



OH Megamaser Detection Rates: GMRT



Summary: OH Megamasers and Merging Galaxies

- 50 new OH megamasers detected in ULIRGs.
- ULIRGs with high L_{FIR} and high T_{dust} are most likely to produce OH megamasers, BUT
- The strength of OH megamasers is unrelated to L_{FIR} or the radio continuum.
- Power law OH luminosity function.
- Detecting OH megamasers at high redshift is straightforward.
- Deep OH megamaser surveys may provide a measure of the galaxy merger rate versus cosmic time.