The middle infrared properties of OH megamaser host galaxies[★]

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ABSTRACT

We compiled all 119 OH maser galaxies (110 out of them are megamasers, i.e., $L_{\text{OH}} > 10 L_{\odot}$) published so far and cross-identified these OH masers with the Wide-Field Infrared Survey Explorer (WISE) catalog, to investigate the middle infrared (MIR) properties of OH maser galaxies. The WISE magnitude data at the 3.4, 4.6, 12 and 22 μm (W1 to W4) are collected for the OH maser sample and one control sample, which are non-detection sources. The color-color diagrams show that both OH megamaser (OHM) and non-OHM (ultra)luminous infrared galaxies ((U)LIRGs) are far away from the single blackbody model line and many of them can follow the path described by the power-law model. The active galaxy nuclei (AGN) fraction is about $\sim 40\%$ for both OHM and non-OHM (U)LIRGs, according to the AGN criteria $W1-W2 \geq 0.8$. Among the Arecibo survey sample, OHM sources tend to have a lower luminosity at short MIR wavelengths (e.g., 3.4 μm and 4.6 μm) than that of non-OHM sources, which should come from the low OHM fraction among the survey sample with large 3.4 μm and 4.6 μm luminosity. The OHM fraction tends to increase with cooler MIR colors (larger $F_{22\mu\text{m}}/F_{3.4\mu\text{m}}$). These may be good for sample selection when searching OH megamasers, such as excluding extreme luminous sources at short MIR wavelengths, choosing sources with cooler MIR colors. In the case of the power-law model, we derived the spectral indices for our samples. For the Arecibo survey sample, OHM (U)LIRGs tend to have larger spectral index α_{22-12} than non-OHM sources, which agrees with previous results. One significant correlation exists between the WISE infrared luminosity at 22 μm and the color [W1]–[W4] for the Arecibo OHM hosts. These clues should provide suitable constraints on the sample selection for OH megamaser surveys by future advanced telescopes (e.g., FAST). In addition, the correlation of maser luminosity and the MIR luminosity of maser hosts tends to be non-significant, which may indirectly support the pumping of OHM emission that is dominated by the far infrared radiation, instead of the MIR radiation.

Key words. masers – galaxies: active – galaxies: nuclei – infrared: galaxies

1. Introduction

Extragalactic OH maser emission has been observed for 40 years or so, since the first detection in NGC 253 ($\lambda \sim 18 \text{ cm}$, Whiteoak & Gardner 1974). Emission has been reported from 119 galaxies so far (e.g., Darling & Giovanelli 2002; Chen et al. 2007; Fernandez et al. 2010; Willett 2012). About 90% of all published OH maser sources (106/119) have an isotropic luminosity larger than $10 L_{\odot}$, which is million times more luminous than typical Galactic OH masers (hereafter taken as megamasers). The OH megamaser (OHM) emission was mostly detected in the main line of 1667 MHz, and the main line of 1665 MHz was normally weak or absent. The satellite transitions at 1612 MHz and 1720 MHz were only detected in a few nearby galaxies (e.g., McBride & Heiles 2013) and one gravitational lens source, PMN J0134-0931 ($z \sim 0.765$, Kanekar et al. 2005). The spectral lines of OHM emission are normally broad, with individual components broader than 10 km s^{-1} and total linewidths of $\sim 100\text{--}1000 \text{ km s}^{-1}$ (e.g., Lockett & Elitzur 2008). These properties of OHM are different from those of Galactic OH masers, which have a linewidth that are typically narrower than 1 km s^{-1}

and an emission at 1665 MHz stronger than 1667 MHz. The differences of maser line properties should reflect differences in the environment in which the masing occurs and in the mechanism by which the maser inversion is produced (McBride et al. 2013).

The hosts of OHMs are almost all luminous infrared galaxies (LIRGs, $L_{\text{FIR}} > 10^{11} L_{\odot}$, 102/106), where about one third of them are ultra luminous infrared galaxies (ULIRGs, $L_{\text{FIR}} > 10^{12} L_{\odot}$, 35/106). The OHM detection rate increases with the far infrared (FIR) luminosity of the maser host galaxy, up to $\frac{1}{3}$ for ULIRGs (Darling & Giovanelli 2002; Baan 1991). The high IR luminosity galaxies mostly show signs of interaction or merging from their optical imaging observations (Clements et al. 1996). Thus OHMs are believed to be related to galaxy interaction or merging. However, the majority of (U)LIRGs ($\sim 80\%$) was not detected with OHM emission at all (e.g., Staveley-Smith et al. 1992; Bann et al. 1992; Darling & Giovanelli 2002). Do OHM (U)LIRGs represent some kind of distinct population? Do they have some kind intrinsic properties? Comparisons of multi-band properties in detail between samples of OHM (U)LIRGs and non-OHM (U)LIRGs are, thus, important and helpful to answer above questions. Many related works have been done, and no significant difference could be found between OHM and non-OHM (U)LIRGs in the radio, optical, and X-ray regimes

[★] Tables 4–7 are available in electronic form at <http://www.aanda.org>

(e.g., Lonsdale et al. 1998; Baan et al. 1998; Vignali et al. 2005; Kandalian 1996; Darling & Giovanelli 2002). Since OHMs in (U)LIRGs were generally believed to be pumped by infrared radiation (e.g., Henkel & Wilson 1990; Randell et al. 1995; Lockett & Elitzur 2008; Willett et al. 2011b), more related studies thus focused on the infrared properties of OHM hosts, which is important for understanding the pumping mechanism of megamaser and its physical nature. Existing infrared studies to date are mainly based on IRAS photometry data, *Spitzer* spectra and photometry observations. Studies of IRAS photometry data show that OHM (U)LIRGs tend to have FIR color excess (at 25 μm and 60 μm , Henkel et al. 1986; Darling & Giovanelli 2002) and steep FIR spectral indices in the 25–60 μm region (Chen et al. 2007). Willett et al. (2011a, b) performed a comparison analysis of *Spitzer* middle infrared (MIR) spectra and photometry for 51 OHM and 15 non-OHM ULIRGs. With respect to non-OHM ULIRGs, OHM ULIRGs have warmer dust, a steeper continuum from 15 μm to 35 μm , and deeper silicate absorption associated with a smooth, thick dust shell surrounding the nucleus.

The Wide-field Infrared Survey Explorer (WISE) is the most sensitive infrared satellite to date, with a sensitivity more than one hundred times better than IRAS in the 12 μm band (Wright et al. 2010). And the Galactic absorption is negligible at all WISE bands, with respect to near infrared observations (e.g., $J-H-K$ bands by 2MASS, Massaro et al. 2012). The ULIRGs is one of its main science goals and WISE will be sensitive enough to detect the most luminous ULIRGs out to a lookback time of when the Universe was only 3 billion years old. The WISE all-sky mapping data at 3.4, 4.6, 12, and 22 μm (W1, W2, W3, and W4, with an angular resolution of 6.1'', 6.4'', 6.5'' and 12.0'', respectively) has been released (e.g., Wright et al. 2010). Here, WISE data are searched and analyzed for all published OHM host (U)LIRGs to investigate their mid-infrared properties. For comparison, a sample of non-OHM (U)LIRGs is also compiled.

Both samples with their WISE data are presented in Sect. 2. In Sect. 3, we analyze their MIR properties, including distributions of luminosities at four bands, mutual spectral indices, color–color properties etc. Furthermore, possible connection between OHM emission and MIR emission of maser hosts are explored. Section 4 summarizes our main results.

2. Sample and data

All OH maser galaxies published so far were cross-correlated to the All-Sky data release¹ using the default search radius of 10''. The retrieved WISE sources were found for all maser sources except IRAS 11257+5850 and IRAS 20550+1655. The position difference (in arcseconds) was checked from the source position in the 2MASS PSC reference frame to the WISE cataloged position of this source. The position difference of all cross-correlated sources is mostly less than 1'' (Δr in Table 4, 103/117), and over 96% (113/117) are less than 2'', which ensure the reliability of our cross-identification. For all WISE detections of cross-correlated sources, the signal-to-noise ratio in all four WISE bands is mostly larger than 10 (i.e., the flux quality indicator $ph_{\text{qual}} = A$). Upper limits are listed for three sources at the W3 band (IRAS 14586+1432, 17161+2006, and 21077+3358), and four sources at the W4 band (IRAS 09513+1430, 17161+2006, 14586+1432, and 21077+3358), with its parameter *Sigmp* (instrumental profile-fit photometry flux uncertainty in mag units)

value of *null*. Table 4 lists all OH maser galaxies (about 10% are kilomasers in italics, i.e., $L_{\text{OH}} < 10 L_{\odot}$) with their WISE magnitudes and uncertainties at four bands (W1, W2, W3, and W4).

For the control sample, we chose all non-detection sources among the updated Arecibo survey sample (Darling & Giovanelli 2002). The survey sample was selected from the flux-limited IRAS catalog ($f_{60\mu\text{m}} > 0.6\text{Jy}$, Saunders et al. 2000) and successfully detected 52 OHMs out of the selected 311 IRAS luminous galaxies (with a redshift range of 0.1–0.3). Similar to OHMs, the WISE counterparts of those 259 non-OHM (U)LIRGs were also checked (with the default radius of 10''). Among them, there are 223 sources (86%) with WISE magnitude values (mostly at 10- σ level or above). Some sources with upper limits are listed with the parameter *Sigmp* value of *null*. Sources without WISE data represent that they are nominally detected, but no useful brightness estimate could be made. The position difference for those matched sources was also checked. The position difference is less than 1'' for 141 sources (62.9%) and less than 5'' for 200 sources (~90%), which reflects the reliability of our cross-identification. The control sample with corresponding WISE data are shown in Table 5.

Tables 6 and 7 present derived physical parameters from WISE measurements for our samples, including luminosities at four bands and spectral indices. For the OH maser galaxy sample, the measured isotropic OH line luminosity (logarithmic scale, in $L_{\odot}$) of each source was listed in Table 6, and the upper limit of OH luminosity for the control sample was also listed in Table 7, which was derived from their non-detection spectra (Darling & Giovanelli 2000, 2001, 2002):

$$L_{\text{OH}}^{\text{max}} = 4\pi D_L^2 1.5 \sigma \frac{\Delta v}{c} \frac{v_0}{1+z},$$

where D_L is the luminosity distance, σ is the rms noise value of the nondetection spectra, v_0 is the rest frequency of the 1667 MHz transition line, and Δv is the assumed rest-frame width of 150 km s^{-1} , respectively. We note that upper limits of some sources are larger than maser luminosities of some maser sources, which implies that some masers among non-detections were missed due to the low sensitivity.

3. Analysis and discussion

3.1. WISE luminosity distributions

For both the OH maser galaxy sample and the control sample, the WISE magnitudes were converted into flux densities using the formula, $F = F_0 \times 10^{-W/2.5}$, where F_0 is the published flux density at zero-magnitude (309.54, 171.787, 31.674, and 8.363 Jy at 3.4, 4.6, 12, and 22 μm , respectively²). Then the corresponding luminosities at four bands were calculated from derived flux densities and the luminosity distance (Darling & Giovanelli 2000, 2001, 2002: $\log(\nu L_{\nu}) = \log(4\pi D_L^2 \nu F_{\nu})$, hereafter luminosity in units of $L_{\odot}$). The upper limits of luminosity were given for those sources with limits of magnitudes (see details in Sect. 2 and also Tables 6 and 7). For all OHMs with WISE detection (hereafter our statistics excluding those ~10% kilomasers, since they should not be powered by the same physical processes that dominate OHMs), the distributions of the luminosities at four WISE bands were plotted in Fig. 1 (in histograms with filled slash lines). Among them, the distributions for those OHMs from the Arecibo survey were shown in a gray color. For comparison, the distributions for the non-OHM sample (i.e., the

¹ <http://wise2.ipac.caltech.edu/docs/release/allsky/>

² <http://wise2.ipac.caltech.edu/docs/release/allsky/expSUP>

Fig. 1. Distributions of WISE luminosities (logarithmic scale, in $L_{\odot}$) for OHM and non-OHM sources. Histograms with slash lines represent the distributions for the whole OHM sample. Among them, those filled in gray show the distributions for OHMs in the Arecibo survey. The distributions of non-OHM sources in the survey are presented in empty histograms.

control sample) were plotted in empty histograms. Since upper limits were given for the luminosity of some sources, a survival analysis thus should be applied. The logrank test was used here to check the significance of difference on the luminosity distributions. For the entire OHM sample and the non-OHM sample, the distributions of luminosity at WISE bands (except W4 band) are significantly different (with a chance probability less than 0.05, see details in Table 1). However, comparison of the entire OHM sample and the non-OHM sample should introduce the selection bias due to the Arecibo survey detection limits ($z > 0.1$). Thus, comparison should be more appropriate between the Arecibo OHM and the non-OHM sample, which were selected and observed with uniform criteria. For the Arecibo OHM and the non-OHM sample, the logrank test results show that the difference of the luminosity distribution at short wavelengths (i.e., $3.4 \mu\text{m}$ and $4.6 \mu\text{m}$) is significant with a chance probability less than 0.01. The difference at W3 and W4 bands are statistically non-significant. The mean luminosities with its error (throughout the paper, given errors are the standard deviation of the mean) at four bands were also listed in Table 1 for the entire OHM sample, the Arecibo OHM and the non-OHM sample. With regard to non-OHM sources, OHMs tend to have lower luminosities, especially at short wavelengths, which can be supported by t-Test results (see details in Table 1). The t-Test probability that the difference of luminosity means at W1 and W2 band between the Arecibo OHM and the non-OHM sample is not significant is 0.012 and 0.033 (less than 0.05), respectively. Figure 2 presents the luminosity at four bands of our samples as a function of redshift. The Arecibo survey targeted sources with redshift of 0.1–0.3, while other OHM sources include many nearby luminous source with redshift less than 0.1. It shows clearly that the luminosity difference between OHMs and non-OHM sources should come from low OHM fraction at large $3.4 \mu\text{m}$ and $4.6 \mu\text{m}$ luminosity. This important point is discussed further in Sect. 3.4.

3.2. Color–color properties

Based on WISE magnitude values (see Tables 4 and 5), we obtained colors ($[W1] - [W2]$, $[W2] - [W3]$, and $[W3] - [W4]$) for all sources in our samples. The mean WISE color values of OHMs

Table 1. Average WISE luminosities of OHM and non-OHM samples ($\log \nu L_{\nu}$, in $L_{\odot}$).

Samples	$\log \nu_1 L_1$	$\log \nu_2 L_2$	$\log \nu_3 L_3$	$\log \nu_4 L_4$
All OHMs	9.92 ± 0.04	9.88 ± 0.05	10.41 ± 0.05	10.78 ± 0.05
Arecibo OHMs	9.98 ± 0.05	9.93 ± 0.06	10.45 ± 0.06	10.84 ± 0.06
Non-OHMs	10.18 ± 0.04	10.12 ± 0.04	10.56 ± 0.04	10.88 ± 0.03
Logrank-Prob. ^a	1.8E-6	7.0E-4	0.02	0.17
Logrank-Prob. ^b	4.4E-4	0.008	0.16	0.31
t-Test Prob. ^a	2.70E-5	7.35E-4	0.016	0.106
t-Test Prob. ^b	0.012	0.033	0.159	0.565

Notes. ^(a) Logrank test and t-Test probabilities for comparisons between the entire OHM and the non-OHM sample. ^(b) Logrank test and t-Test probabilities for comparison between the Arecibo OHM and the non-OHM sample.

Fig. 2. WISE luminosities of our samples as a function of redshift. Filled and empty circles represent OHM detections and non-detections from the Arecibo survey, respectively (e.g., Darling et al. 2002). Filled triangles show other OHM sources.

Table 2. Average color values of OHM and non-OHM samples.

Samples	W1–W2	W2–W3	W3–W4
All OHMs	0.84 ± 0.05	4.15 ± 0.05	3.06 ± 0.05
Arecibo OHMs	0.80 ± 0.05	4.17 ± 0.07	2.96 ± 0.06
Non-OHMs	0.76 ± 0.03	3.91 ± 0.05	2.79 ± 0.03
t-Test Prob. ^a	0.574	0.002	1.48E-6
t-Test Prob. ^b	0.171	0.018	0.012

Notes. t-Test probabilities for comparisons between: ^(a) the entire OHM and the non-OHM sample ; and ^(b) the Arecibo OHM and the non-OHM sample.

(both Arecibo OHMs and other OHMs) appear to be slightly larger than those of non-masing sources. A t-Test was used to check if the difference is significant between OHM and non-OHM sources. For the Arecibo OHM and the non-OHM sample, the difference on the mean color W2–W3 and W3–W4 is significant with a chance probability of ~ 0.01 . The difference on W1–W2 mean values between them is not supported by the statistical test results (Table 2).

Figure 3 presents the $W1-W2$ vs. $W2-W3$ and $W1-W2$ vs. $W3-W4$ color-color diagrams for our samples. It is not clear yet whether the central engine of OHM host (U)LIRGs is dominated by an active galactic nucleus (AGN) or star formation activity, which is the key issue to understand production and physics of OHM in (U)LIRGs. The AGN fraction of OHM hosts is still open from previous studies at different wavelengths, such as optical spectroscopy (Baan et al. 1998; Darling & Giovanelli 2006), radio, FIR (Kandalyan 2005; Baan & Klöckner 2006), MIR properties (Willett et al. 2011a,b) etc. An existence of the AGN fraction difference is still uncertain between OHM and non-OHM (U)LIRGs (e.g., Darling & Giovanelli 2006; Willett et al. 2011b). To discuss possible radiation mechanisms of the MIR emission of OHM and non-OHM (U)LIRGs, we derived theoretical WISE colors from the blackbody model and the power-law model. According to the formula, $F = F_0 \times 10^{-W/2.5}$ (F_0 : the zero-magnitude flux density, see Sect. 2), we can get equations for WISE colors as follows,

$$[W1]-[W2] = 2.5 \log(F_2/F_1) + 2.5 \log(F_{01}/F_{02})$$

$$[W2]-[W3] = 2.5 \log(F_3/F_2) + 2.5 \log(F_{02}/F_{03})$$

$$[W3]-[W4] = 2.5 \log(F_4/F_3) + 2.5 \log(F_{03}/F_{04}).$$

If the origin of radiation is the thermal emission described by the blackbody model ($I(\nu, T) = \frac{2h\nu^3}{c^2} \frac{1}{e^{h\nu/kT} - 1}$), we can obtain the flux density ratio at different frequencies as a function of temperature. Then the color values from the blackbody model at different temperatures can be derived from above equations. Similarly, if the radiation originate from the non-thermal emission by the power-law model ($F_\nu \propto \nu^{-\alpha}$), the flux density ratio at different frequency can be obtained as a function of the spectral index. Then the colors from the power-law model can be derived. In both color-color diagrams, color results from the blackbody model (marked with two typical temperature values) and the power-law model (marked with four typical spectral index of 0, 1, 2, 3) were also plotted. There is one common striking feature in both color-color diagrams (which also appears in other color-color diagrams in which two examples among them, $W1-W3$ vs. $W1-W4$ and $W2-W3$ vs. $W2-W4$ were shown at the bottom of Fig. 3) that both OHM and non-OHM host (U)LIRGs are far away from the blackbody model line and many of them can follow the path described by the power-law model.

However, polycyclic aromatic hydrocarbon (PAH) emission and silicate absorption are critical in the MIR for star-forming galaxies (Mateos et al. 2012). (U)LIRGs are complex interacting or merging system with intense starburst activity and thus star-forming template with more than one blackbody component is likely more appropriate.

Further, various WISE AGN criteria were also presented in Fig. 3. Consistent with previous results (e.g., Lake et al. 2011), part of both OHM and non-OHM host (U)LIRGs match these AGN criteria. For example, for the AGN criteria $W1-W2 > 0.8$ defined by Stern et al. (2012), about 45% (48/106) of the entire OHMs sample and 42% (22/53) of the Arecibo OHM subsample match this AGN criteria. This AGN fraction is consistent with previous results from optical and radio studies (Baan et al. 1998; Baan & Klöckner 2006; Darling & Giovanelli 2006). The fraction is similar for our non-OHM (U)LIRGs sample (92/219, ~42%), which supports no difference for the AGN fraction between OHMs and non-OHM (U)LIRGs (Darling & Giovanelli 2006). Our results also support the existence of different types of ULIRGs, that is, ULIRGs can be classified into HII-like ULIRGs, AGN-like ULIRGs (with larger $W1-W2$ value), and

Fig. 3. WISE color-color diagrams (upper left: $[W1]-[W2]$ vs. $[W2]-[W3]$, upper right: $[W1]-[W2]$ vs. $[W3]-[W4]$; lower left: $[W1]-[W4]$ vs. $[W1]-[W3]$, lower right: $[W2]-[W4]$ vs. $[W2]-[W3]$) for OHMs and non-OHM sources. All symbols are the same as Fig. 2. The dashed lines show results from the blackbody model at different temperatures (squares for typical temperature values) and the solid lines present results from the power-law model with different spectral index ($F \propto \nu^{-\alpha}$, four typical spectral index of 0, 1, 2, 3 are shown). Various AGN criteria were also shown in upper panels represented by dotted line (defined by Stern et al. 2012), a dashed line wedge (Mateos et al. 2012), and a dash-dotted line wedge (Jarrett et al. 2011), respectively.

composite ULIRGs, based on their optical emission line properties (Su et al. 2013).

3.3. WISE spectral indices

Given that the MIR radiation of our samples was described by the power-law model ($F \propto \nu^{-\alpha}$), the spectral index α can be thus derived as

$$\alpha_{21} = \log(F_{\lambda_2}/F_{\lambda_1}) / \log(\lambda_2/\lambda_1).$$

Figure 4 presents the distributions of the spectral indices between four WISE bands. Unlike the distributions of $\alpha_{4.6-3.4\mu m}$ and $\alpha_{12-4.6\mu m}$ (Fig. 4), different distributions of $\alpha_{22-12\mu m}$ can be obviously found between OHM (both the entire OHM sample and the Arecibo OHM subsample) and non-OHM sample. This is supported by the Kolmogorov-Smirnov test (K-S test) results (see details in Table 3) where the difference on the distribution of $\alpha_{22-12\mu m}$ is statistically distinguishable. Both the Arecibo OHM and the non-OHM sample come from the same parent population at a probability of 5×10^{-3} . Their mean values of $\alpha_{22-12\mu m}$ are 2.16 ± 0.09 and 1.90 ± 0.04 for the Arecibo OHM and the non-OHM sample, respectively. The difference is statistically significant with a chance probability of 0.008. This is consistent with previous results from the *Spitzer* spectra and photometry, where OHMs show steeper continuum from $15 \mu m$ to $35 \mu m$ (Willett et al. 2011b).

This difference can also be found in the distribution of $\alpha_{22-3.4\mu m}$ (Fig. 4). The distribution of $\alpha_{22-3.4\mu m}$ peaks at the ~2.5 for OHM sample (both megamaser samples) and at the 1.5–2 bin for non-OHM sample. The K-S test probability that both the Arecibo OHM and the non-OHM sample come from

Fig. 4. Distributions of the WISE spectral indices of OHM and non-OHM host (U)LIRGs. All pattern types are the same as Fig. 1.

Table 3. WISE spectral indices of our samples.

Samples	α_{21}	α_{32}	α_{43}	α_{41}
All OHMs	0.57 ± 0.14	2.32 ± 0.05	2.29 ± 0.07	2.42 ± 0.06
Arecibo OHMs	0.47 ± 0.16	2.33 ± 0.07	2.16 ± 0.09	1.96 ± 0.07
Non-OHMs	0.36 ± 0.08	2.08 ± 0.07	1.90 ± 0.04	1.77 ± 0.03
KS-Prob. ^a	0.356	0.014	1.64E-5	4.01E-19
KS-Prob. ^b	0.265	0.06	0.005	0.007
t-Test Prob. ^a	0.171	0.001	1.22E-6	5.61E-25
t-Test Prob. ^b	0.574	0.011	0.008	0.004

Notes. 1, 2, 3 and 4 denote four WISE bands at 3.4, 4.6, 12 and 22 μm , respectively. K-S test and t-Test probabilities for comparisons between ^(a) the entire OHM and the non-OHM sample ; and ^(b) the Arecibo OHM and the non-OHM sample.

the same parent population is 7×10^{-3} . The mean value is $\langle \alpha_{22-3.4\mu\text{m}} \rangle = 1.96 \pm 0.06$ and 1.77 ± 0.03 for the Arecibo OHM and the non-OHM sample, respectively. The difference can be supported by the t-Test results, and the probability that the difference on $\alpha_{22-12\mu\text{m}}$ means between the Arecibo OHM and the non-OHM sample is not significant is 0.004.

3.4. WISE infrared luminosities versus colors

Previous statistical studies indicated that the OHM fraction in (U)LIRGs tends to rise with increasing FIR luminosity and warmer far-IR color (larger $60\mu\text{m}/100\mu\text{m}$, e.g., Baan et al. 1992; Darling & Giovanelli 2002). Here, possible relations were investigated between OHM fraction and WISE MIR luminosity, which are colors of megamaser host (U)LIRGs. As analyzed in Sect. 3.1, for OHM and non-OHM samples, it shows significant different distributions of the luminosity at W1 band and similar distributions of their W4 luminosities. Figure 5 plots the WISE luminosity (left panel: $3.4\mu\text{m}$, right panel: $22\mu\text{m}$) versus color $[W1]-[W4]$ ($[3.4\mu\text{m}]-[22\mu\text{m}]$) for our samples. The fraction of OHMs tends to increase with cooler MIR colors (larger color values, or, larger $F_{22\mu\text{m}}/F_{3.4\mu\text{m}}$). For the Arecibo survey sample, the fraction is about 12%, 20%, 32%, and 50% in $[W1]-[W4]$ bins of <7 , 7–8, 8–9, and >9 , respectively.

Fig. 5. WISE luminosity at $3.4\mu\text{m}$ (left panel) and $22\mu\text{m}$ (right panel) versus color ($[3.4\mu\text{m}]-[22\mu\text{m}]$) for OHMs and non-OHM sources. All symbols are the same as Fig. 2. The solid line shows linear fits for the Arecibo OHMs, and its error ranges were presented by two dashed lines. The Arecibo OHM sources mostly locate within the region limited by these two dashed lines.

The OHM fraction is much lower in large MIR luminosity at $3.4\mu\text{m}$, which causes the different distribution of the $3.4\mu\text{m}$ luminosity between OHMs and non-OHM sources (see Sect. 3.1). Among the Arecibo sample, there is only one OHM source among 18 sources with a $3.4\mu\text{m}$ luminosity ($\log \nu_1 L_{\nu_1}$) that is larger than 10.5. It may hint that OHM emission is not related to MIR emission at short wavelengths, which is far from the FIR emission and the pumping energy of OHMs (e.g., radiation at $35\mu\text{m}$, Skinner et al. 1997; or $53\mu\text{m}$, Lockett & Elitzur 2008). In addition, high $3.4\mu\text{m}$ luminosity may mean a harder radiation environment, and its strong UV radiation can dissociate OH even in the ice phase (Andersson & van Dishoeck 2008). If so, samples without extreme luminous $3.4\mu\text{m}$ sources may improve detection rate of OHMs in the future survey.

No significant difference on the OHM fraction can be found in each bin of the $22\mu\text{m}$ luminosity, which is consistent with our previous result (Sect. 3.1) where both the Arecibo OHM and the non-OHM sample have similar distributions of the $22\mu\text{m}$ luminosity. Among the Arecibo sample, the OHM fraction is about 25%, 20%, and 19% in the $22\mu\text{m}$ luminosity bins of 9–10, 10–11, and 11–12, respectively. However, one trend of a rising $22\mu\text{m}$ luminosity with increasing MIR color value ($[W1]-[W4]$) is apparent, especially for the subsample of Arecibo OHM alone. The linear fit gives $\log L_{22\mu\text{m}} = (0.27 \pm 0.06)([W1]-[W4]) + (8.68 \pm 0.46)$ for the Arecibo OHM subsample with a Spearman's rank correlation coefficient $R = 0.59$. The candidates of the successful Arecibo OHM survey were (U)LIRGs, which were selected from the IRAS Point Source Catalog Redshift Survey (15000 IRAS galaxies with $f_{60\mu\text{m}} > 0.6\text{ Jy}$, Saunders et al. 2000) within Arecibo sky coverage (declination range: $0^\circ-37^\circ$). This correlation of MIR luminosity (at $22\mu\text{m}$) and color for OHMs should be good to place further constraints on OHM candidates and, thus, enhance detection rate by future advanced telescopes. The OHM-hosted (U)LIRGs mostly lie in a distinct region of luminosity-color diagram (limited by two dashed lines in Fig. 5, which were plotted from the linear fitting line with intercept error). Although many of the non-detection sources also located in the limited region, there are about 20% of non-detections that are located outside this region. It implies the detection rate could be increased much ($\sim 25\%$), if those non-detections outside the limited region among the Arecibo survey candidates are excluded. With respect to Arecibo, the future FAST (the Five-hundred meter Aperture Spherical radio Telescope) has a better sensitivity and a larger sky coverage (declination range of $-15^\circ-65^\circ$ with a zenith angle of 40 degrees, Nan et al. 2011; Li et al. 2013), which provides

Fig. 6. Maser luminosity versus the WISE MIR luminosity (*upper panels* for $3.4\,\mu\text{m}$ and $4.6\,\mu\text{m}$, *lower panels* for $12\,\mu\text{m}$ and $22\,\mu\text{m}$ luminosity) of maser hosts. The Arecibo OHMs are shown in filled circles and other OHMs in filled triangles. The upper limits on OH line luminosity of the non-OHM sample were also presented (cross-triangles). The solid and the dashed line show linear fits without and with considering the Malmquist effect, respectively.

enormous potential for searching and studying OHMs (Zhang et al. 2012). Providing this correlation exists, WISE (U)LIRGs sources located in the limited region (Fig. 5) will be OHM candidates for future surveys.

3.5. Maser emission and MIR luminosities of OHM hosts

Infrared radiation pumping of OHMs were supported by both observations (e.g., Skinner et al. 1997; Baan et al. 1998; Kegel et al. 1999; He & Chen 2004; McBride et al. 2013) and theoretical models (Baan 1985; Henkel et al. 1987; Henkel & Wilson 1990; Burdzyuzha & Vikolov 1990; Randell et al. 1995; Lockett & Elitzur 2008). The statistical analysis showed that the OHM luminosity was found to be increasing with the FIR luminosity of maser hosts as $L_{\text{OH}} \propto L_{\text{FIR}}^\gamma$ ($1 < \gamma \leq 2$, Martin et al. 1988; Baan 1989; Kandalian 1996; Diamond et al. 1999; Darling & Giovanelli 2002). In the MIR, Willett et al. (2011b) combined both theory and *Spitzer* observation to explore the fundamental causes of OHM activity and found that OHMs prefer deeper $9.7\,\mu\text{m}$ silicon absorption and warmer dust. Here, the relation between maser emission and the WISE MIR luminosity of maser hosts was investigated.

In Fig. 6, the OH maser luminosity was plotted against the MIR luminosity (the WISE luminosity at four bands was presented, respectively) for both the Arecibo OHMs and other OHMs. For the non-OHM sample, the upper limits on OH line luminosity were also presented. Although there are a few overlap between the detections and non-detections in the Arecibo survey, many known OHMs mix with non-OHM sources, even with some lower than the non-OHM sources. It implies that some low-level OHMs (e.g., $L_{\text{OH}} < 100\,L_\odot$) should be undetected in the non-OHM sample (Darling & Giovanelli 2002), and it should be pointed out that this may affect statistical relation of maser

luminosity and the MIR luminosity of its host. All panels show no significant correlation between luminosities for the Arecibo OHM sample alone. Since the Arecibo survey sample is limited to the upper end of the LIRG population, the entire megamaser sample is a more appropriate sample to resolve the relationship (Darling & Giovanelli 2002). For the entire megamaser sample, it appears that the maser luminosity increases along with the increases of the MIR luminosity of maser host galaxies. For example, for the panel of $22\,\mu\text{m}$ luminosity versus the OH maser luminosity, a linear least-square fit gives Spearman's rank correlation coefficient $R = 0.42$. However, the Malmquist bias should be considered, since both luminosities are correlated with the luminosity distance. After taking the Malmquist effect into account (e.g., Kandalyan & Al-Zyout 2010; Darling & Giovanelli 2002), the maser-MIR luminosity correlation becomes nonsignificant ($R \sim 0.25$). Unlike the strong correlation of FIR and maser luminosity, the marginal correlation of MIR and maser luminosity may support indirectly that the OHM emission is pumped by FIR radiation with values, such as $35\,\mu\text{m}$ (e.g., Skinner et al. 1997) or $53\,\mu\text{m}$ (Lockett & Elitzur 2008).

4. Summary

To investigate MIR properties of OHM host (U)LIRGs, the entire OHM sample and one (U)LIRGs sample without detected maser emission were compiled, and cross-identifications of these (U)LIRGs with WISE catalog were made. Our results show the following:

- 1) Based on their color-color diagrams, both OHM- and non-OHM-hosted (U)LIRGs are far away from the single black-body model line and many of them follow the path described by the power-law model well. According to one AGN WISE criteria, the AGN fraction is similar for both OHM and non-OHM samples with a value of $\sim 40\%$.
- 2) The spectral indices are derived for both the OHM sample and the non-OHM sample devoid of detected OH emission. For the Arecibo OHM sample and the non-OHM sample, the distribution of the spectral index $\alpha_{22-12\,\mu\text{m}}$ is significantly different, where OHMs tend to have larger spectral indices $\alpha_{22-12\,\mu\text{m}}$ than non-OHM sources. The mean values of $\langle \alpha_{22-12\,\mu\text{m}} \rangle$ are 2.16 ± 0.09 and 1.90 ± 0.04 for the Arecibo OHM sample and the non-OHM sample, respectively.
- 3) The Arecibo OHMs tend to have a lower luminosity at short MIR wavelengths than non-OHM sources, which should come from the low OHM fraction among the Arecibo sample with large $3.4\,\mu\text{m}$ and $4.6\,\mu\text{m}$ luminosity, and OHM fraction tends to increase with cooler MIR colors (larger $F_{22\,\mu\text{m}}/F_{3.4\,\mu\text{m}}$). These clues should be helpful for guiding a future OHM survey, such as choosing samples that exclude extreme luminous sources at short MIR wavelength (e.g., at $3.4\,\mu\text{m}$) and choosing sources with cooler MIR colors.
- 4) For the Arecibo OHMs alone, the MIR luminosity at $22\,\mu\text{m}$ is found to be correlated with the MIR color $[W1]-[W4]$. A linear fit gives $\log L_{22\,\mu\text{m}} = (0.27 \pm 0.06)([W1]-[W4]) + (8.68 \pm 0.46)$ with a Spearman's rank correlation coefficient $R = 0.59$. This possibly provides suitable constraints on sample selections for OHM surveys by future advanced telescopes (e.g., FAST).
- 5) Unlike the strong correlation of the FIR and the maser luminosity, the correlation of the MIR luminosity and the maser luminosity tends to be marginal. It suggests that the pumping of OHM emission is dominated by the FIR radiation, instead of the MIR radiation.

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Table 4. WISE data of of OH maser host galaxies.

IRAS Name	RA	Dec	Δr	W1	Sigmp	W2	Sigmp	W3	Sigmp	W4	Sigmp
00057+4021	00 08 20.44	+40 37 56.0	1.555	12.369	0.023	12.209	0.023	7.985	0.017	3.792	0.015
00335-2732	00 36 00.37	-27 15 33.8	0.109	12.376	0.024	11.228	0.022	6.502	0.015	2.875	0.015
<i>00450-2533</i>	00 47 33.07	-25 17 19.0	1.609	5.865	0.032	5.264	0.022	0.074	0.050	-2.725	0.001
00461-0728 ^a	00 48 39.5	-07 12 21	0.239	15.129	0.044	14.136	0.059	9.860	0.046	7.200	0.105
00509+1225	00 53 34.92	+12 41 35.9	0.201	8.862	0.024	7.802	0.018	4.775	0.014	2.369	0.020
01298-0744 ^a	01 32 21.4	-07 29 08	0.389	14.194	0.029	12.559	0.026	7.577	0.016	4.689	0.021
01355-1814 ^a	01 37 57.4	-17 59 21	0.787	14.701	0.035	13.423	0.036	8.874	0.025	5.529	0.033
01364-1042	01 38 52.86	-10 27 11.6	0.101	12.644	0.024	11.744	0.021	7.729	0.017	4.023	0.024
01417+1651	01 44 30.54	+17 06 08.8	0.081	11.495	0.023	10.880	0.021	6.650	0.015	2.783	0.015
01562+2528	01 59 02.60	+25 42 36.8	1.034	13.963	0.031	13.515	0.040	9.694	0.044	8.293	0.344
01569-2939 ^a	01 59 13.8	-29 24 35	0.048	13.861	0.027	12.940	0.029	8.142	0.018	4.889	0.028
<i>02401-0013</i>	02 42 40.7	-00 00 48	0.215	4.541	0.071	2.880	0.070	-0.899	0.063	-2.534	0.001
02483+4302	02 51 35.83	+43 15 11.4	0.431	11.388	0.022	11.242	0.020	8.085	0.019	4.769	0.024
02524+2046	02 55 17.12	+20 58 57.7	0.379	14.296	0.032	13.379	0.040	9.487	0.071	6.692	0.089
03056+2034	03 08 30.73	+20 46 20.1	0.409	11.354	0.023	10.967	0.021	6.358	0.015	2.928	0.018
03260-1422	03 28 24.33	-14 12 06.8	0.235	12.571	0.024	12.264	0.026	8.475	0.023	5.178	0.034
<i>03316-3618</i>	03 33 36.65	-36 08 21.1	4.596	7.662	0.021	6.908	0.018	3.028	0.014	-0.391	0.014
03521+0028	03 54 42.22	+00 37 03.2	0.196	13.662	0.028	12.946	0.030	8.401	0.022	5.001	0.027
03566+1647	03 59 28.49	+16 56 24.5	0.341	12.205	0.023	10.466	0.021	6.695	0.017	3.912	0.020
04121+0223	04 14 47.1	+02 30 36	3.404	14.445	0.057	14.040	0.076	9.784	0.068	6.860	0.143
<i>04332+0209</i>	04 35 48.46	+02 15 29.9	0.296	11.753	0.023	10.222	0.021	5.988	0.015	2.686	0.021
04454-4838	04 46 49.52	-48 33 30.0	0.147	13.146	0.026	11.991	0.022	7.188	0.013	3.698	0.018
05100-2425	05 12 09.18	-24 21 56.2	0.077	11.777	0.023	11.449	0.021	7.505	0.017	4.164	0.023
05189-2524	05 21 01.40	-25 21 45.3	0.065	8.663	0.024	7.549	0.020	4.310	0.016	1.261	0.019
<i>05414+5840</i>	05 45 47.89	+58 42 03.9	0.971	9.528	0.022	9.125	0.020	5.066	0.013	2.867	0.017
06206-3646	06 22 22.61	-36 47 45.1	0.225	13.528	0.025	12.783	0.024	8.971	0.023	5.375	0.029
06487+2208	06 51 45.74	+22 04 27.3	0.096	13.028	0.025	11.768	0.023	7.320	0.017	4.124	0.021
07163+0817	07 19 05.5	+08 12 07	0.636	14.084	0.031	13.459	0.036	9.087	0.028	6.110	0.046
07556+2859 ^a	07 58 45.9	+28 51 33	0.013	14.02	0.029	13.453	0.037	9.061	0.028	6.967	0.091
07572+0533	07 59 59.75	+05 24 51.3	0.791	13.436	0.026	12.336	0.026	7.955	0.018	4.711	0.030
08071+0509	08 09 47.21	+05 01 09.0	0.430	11.556	0.022	11.079	0.021	6.535	0.015	3.542	0.020
08201+2801	08 23 12.61	+27 51 39.9	0.125	14.193	0.03	13.182	0.034	8.332	0.021	5.035	0.028
08279+0956	08 30 39.32	+09 46 36.9	0.709	14.671	0.035	13.924	0.066	10.013	0.080	6.883	0.101
08449+2332	08 47 50.22	+23 21 10.2	0.240	13.044	0.027	12.436	0.030	8.432	0.024	5.651	0.048
08474+1813	08 50 18.34	+18 02 01.2	0.705	14.442	0.033	13.674	0.044	9.765	0.048	6.151	0.057
09039+0503	09 06 34.04	+04 51 27.6	0.139	13.470	0.027	12.808	0.029	8.576	0.023	5.767	0.040
09320+6134	09 35 51.60	+61 21 11.7	0.173	10.007	0.024	8.319	0.020	5.619	0.014	2.660	0.017
09531+1430	09 55 49.98	+14 16 06.7	0.751	14.273	0.043	13.939	0.062	11.148	0.164	≥8.516	null
09539+0857	09 56 34.34	+08 43 06.2	0.211	14.218	0.031	13.130	0.033	8.411	0.023	5.645	0.038
10038-3338	10 06 04.61	-33 53 06.0	0.335	10.454	0.024	7.905	0.019	5.271	0.014	2.695	0.018
10035+2740	10 06 26.36	+27 25 46.9	0.730	13.549	0.027	12.979	0.028	9.502	0.033	6.405	0.05
10173+0828	10 20 00.21	+08 13 33.9	0.125	12.839	0.024	12.486	0.027	8.254	0.021	3.984	0.021
10339+1548	10 36 37.97	+15 32 41.5	0.659	14.060	0.029	13.501	0.042	9.473	0.041	6.152	0.056
10378+1108	10 40 29.18	+10 53 18.0	0.302	13.408	0.026	12.048	0.025	8.183	0.021	4.487	0.023
10485-1447	10 51 03.07	-15 03 21.8	0.348	13.740	0.027	12.354	0.024	8.269	0.021	4.885	0.028
10597+5926 ^a	11 02 47.4	+59 10 43	6.867	14.49	0.032	13.764	0.039	9.536	0.032	6.762	0.063
11011+4107	11 03 53.85	+40 51 00.1	1.187	11.120	0.023	10.638	0.019	6.366	0.015	3.943	0.026
11028+3130	11 05 37.54	+31 14 32.1	0.154	15.153	0.037	14.700	0.064	10.282	0.050	6.991	0.067
11069+2711	11 09 38.89	+26 54 56.0	0.401	13.381	0.028	13.065	0.033	8.648	0.024	6.551	0.058
11180+1623	11 20 41.78	+16 06 56.6	0.327	14.379	0.033	13.645	0.041	9.083	0.028	5.961	0.044
11257+5850	11 28 32.2	+58 33 51	...	...	...	...	...	...	...	...	...
11506-3851	11 53 11.70	-39 07 49.0	0.346	9.333	0.022	8.992	0.021	4.666	0.014	1.825	0.018
11524+1058	11 55 05.14	+10 41 22.8	0.826	14.455	0.044	13.733	0.049	9.652	0.048	7.016	0.122
12005+0009	12 03 04.43	-00 07 27.7	0.303	13.257	0.025	12.384	0.025	8.758	0.026	5.657	0.038
12018+1941	12 04 24.55	+19 25 10.0	0.066	13.630	0.027	12.195	0.024	7.187	0.015	3.785	0.024
12032+1707	12 05 47.74	+16 51 08.2	0.312	14.059	0.029	13.055	0.032	8.144	0.019	5.007	0.025

Notes. All 119 published extragalactic OH maser galaxies (kilomassers marked by italics), a) from Willett (2012) and b) from Fernandez et al. (2010). Other 109 sources from Chen et al. (2007). Sources with no WISE data represent they are nominally detected, but no useful brightness estimate could be made. Column 1: IRAS name of OHM sources; Cols. 2 and 3: Equatorial coordinates in J2000 from 2MASS PSC reference frame; Cols. 4: the distance (in arcsec) between the positions of the OHM source in 2MASS PSC and the associated WISE source; Cols. 5 and 6: WISE 3.5 μm magnitude and corresponding uncertainties; Cols. 7 and 8: WISE 4.6 μm magnitude and corresponding uncertainties; Cols. 9 and 10: WISE 12 μm magnitude and corresponding uncertainties, three sources (IRAS 14586+1432, 17161+2006, and 21077+3358) with Sigmp value of *null* show that their W3 profile-fit magnitude is a 95% confidence upper limit or the source is not measurable; Cols. 11 and 12: WISE 22 μm magnitude and corresponding uncertainties, four sources (IRAS 09513+1430, 14586+1432, 17161+2006, and 21077+3358) with Sigmp value of *null* show that their W4 profile-fit magnitude is a 95% confidence upper limit, or the source is not measurable.

Table 4. continued.

IRAS Name	RA	Dec	Δr	W1	Sigmp	W2	Sigmp	W3	Sigmp	W4	Sigmp
12071-0444 ^a	12 09 45.1	−05 01 14	0.746	12.006	0.024	10.677	0.022	6.584	0.017	3.329	0.023
12112+0305	12 13 45.98	+02 48 40.1	0.479	12.233	0.023	11.417	0.022	6.917	0.016	3.602	0.021
12162+1047	12 18 47.77	+10 31 14.1	0.455	14.053	0.032	13.265	0.033	9.118	0.029	6.266	0.053
12243-0036	12 26 54.62	−00 52 39.5	0.317	10.750	0.024	9.487	0.021	3.887	0.015	0.323	0.012
12540+5708	12 56 14.23	+56 52 25.2	0.205	7.446	0.027	6.354	0.020	3.197	0.010	0.250	0.015
12549+2403	12 57 20.03	+23 47 46.3	0.296	13.427	0.024	12.998	0.028	9.415	0.037	6.689	0.071
13097-1531	13 12 26.36	−15 47 52.3	0.789	9.499	0.022	9.119	0.019	5.128	0.014	2.746	0.014
13126+2453	13 15 03.51	+24 37 07.8	0.103	10.953	0.022	10.810	0.020	7.001	0.015	2.653	0.022
13218+0552	13 24 19.89	+05 37 04.6	0.215	9.640	0.023	8.230	0.019	5.659	0.015	3.744	0.022
13225-4245	13 25 27.6	−43 01 09	0.188	5.715	0.034	5.194	0.023	2.633	0.013	0.277	0.016
13254+4754	13 27 32.72	+47 39 03.5	0.202	12.680	0.025	12.172	0.023	8.078	0.018	4.983	0.027
13428+5608	13 44 42.08	+55 53 13.0	0.405	10.397	0.022	9.223	0.020	5.336	0.014	1.796	0.017
13451+1232	13 47 33.41	+12 17 24.1	0.514	11.395	0.022	10.122	0.021	6.267	0.015	3.086	0.014
14043+0624	14 06 49.82	+06 10 36.0	0.140	13.121	0.024	12.746	0.026	9.246	0.026	6.680	0.056
14059+2000	14 08 18.73	+19 46 22.7	0.121	12.890	0.024	12.024	0.022	8.846	0.022	6.132	0.037
14070+0525	14 09 31.26	+05 11 31.4	0.338	14.209	0.028	13.255	0.028	8.734	0.021	6.029	0.036
14553+1245	14 57 42.46	+12 33 21.1	0.016	13.442	0.024	12.706	0.025	8.239	0.018	5.323	0.030
14586+1432	15 01 01.98	+14 19 48.2	0.374	15.314	0.038	15.442	0.097	≥13.232	null	≥9.578	null
15065-1107	15 09 16.09	−11 19 18.2	0.277	10.917	0.025	9.656	0.020	5.636	0.014	2.754	0.016
15107+0724	15 13 13.09	+07 13 32.0	0.300	11.041	0.022	10.733	0.020	6.671	0.015	3.147	0.014
15179+3956	15 19 47.11	+39 45 37.2	1.721	12.592	0.022	10.834	0.019	6.724	0.013	2.982	0.012
15224+1033	15 24 51.13	+10 22 49.0	1.422	14.194	0.028	12.965	0.027	8.632	0.022	5.886	0.036
15233+0533	15 25 49.55	+05 22 48.6	0.149	12.207	0.022	11.683	0.020	7.319	0.015	3.705	0.020
15250+3608	15 26 59.41	+35 58 37.3	0.260	12.347	0.022	10.846	0.020	5.992	0.012	2.401	0.009
15247-0945	15 27 27.73	−09 55 42.1	1.817	12.006	0.024	11.834	0.024	8.066	0.019	5.647	0.040
15327+2340	15 34 57.24	+23 30 11.4	0.221	10.068	0.022	9.327	0.019	4.587	0.015	0.644	0.008
15587+1609	16 01 02.88	+16 01 02.4	1.724	13.883	0.028	13.086	0.030	9.175	0.030	6.361	0.048
16090-0139 ^a	16 11 40.4	−01 47 07	0.370	13.013	0.026	11.470	0.023	7.288	0.017	4.252	0.027
16100+2527	16 12 05.39	+25 20 23.3	0.346	14.684	0.036	14.240	0.054	9.537	0.035	6.340	0.054
16145+4231	16 16 11.18	+42 23 55.5	3.905	11.465	0.022	11.230	0.020	7.088	0.014	5.003	0.023
16255+2801	16 27 33.71	+27 54 33.5	0.321	14.734	0.033	12.860	0.029	9.019	0.024	5.539	0.032
16300+1558	16 32 21.41	+15 51 45.8	0.126	13.684	0.027	12.634	0.026	8.577	0.023	5.928	0.041
16399-0937	16 42 40.12	−09 43 13.3	1.400	10.401	0.021	9.958	0.018	5.553	0.014	2.518	0.021
17161+2006	17 18 14.39	+20 03 08.5	0.066	13.585	0.026	13.571	0.033	≥12.522	null	≥9.441	null
17207-0014	17 23 21.96	−00 17 00.8	0.108	10.782	0.022	10.053	0.022	5.728	0.014	2.369	0.019
17526+3253	17 54 29.45	+32 53 13.7	0.317	11.098	0.026	10.759	0.023	6.627	0.017	4.558	0.025
17539+2935	17 55 56.11	+29 35 26.4	0.069	12.864	0.024	12.226	0.025	8.108	0.018	4.823	0.028
18368+3549	18 38 35.41	+35 52 20.0	0.215	12.722	0.024	12.136	0.023	8.067	0.016	5.542	0.029
18544-3718	18 57 52.62	−37 14 40.3	0.492	13.247	0.030	10.671	0.021	6.847	0.016	4.304	0.028
18588+3517	19 00 41.17	+35 21 26.3	0.298	13.340	0.025	12.093	0.022	7.768	0.016	4.854	0.023
20100-4156	20 13 29.56	−41 47 35.1	0.327	12.989	0.025	11.459	0.022	7.204	0.016	3.816	0.023
20248+1734	20 27 08.12	+17 44 21.7	0.437	13.876	0.027	12.938	0.027	8.444	0.024	5.392	0.028
20286+1846	20 30 54.48	+18 56 37.6	0.495	14.150	0.028	13.492	0.033	9.346	0.037	6.358	0.058
20450+2140	20 47 14.34	+21 51 12.5	0.573	13.004	0.024	12.561	0.026	8.367	0.019	5.769	0.031
20491+1846	20 51 25.92	+18 58 04.3	0.325	10.625	0.023	10.360	0.020	6.076	0.014	4.033	0.021
20550+1655	20 57 23.63	+17 07 44.2	...	...	...	...	...	...	...	...	...
21077+3358	21 09 47.27	+34 10 25.7	7.570	14.120	0.032	14.180	0.050	≥12.251	null	≥9.114	null
21272+2514	21 29 29.40	+25 27 54.4	0.281	14.090	0.028	13.147	0.031	8.984	0.025	5.812	0.034
22025+4204	22 04 36.01	+42 19 39.2	0.356	10.528	0.023	10.165	0.020	6.129	0.015	2.936	0.018
22055+3024	22 07 49.67	+30 39 39.7	0.304	13.482	0.029	12.379	0.023	7.899	0.015	4.436	0.022
22088-1831	22 11 33.81	−18 17 06.5	0.324	13.940	0.03	13.350	0.035	8.770	0.026	5.279	0.035
22116+0437	22 14 10.42	+04 52 26.3	0.185	14.136	0.03	13.059	0.031	8.013	0.019	5.177	0.029
22135+0043 ^a	22 16 02.7	+00 58 11	0.073	14.155	0.038	12.481	0.026	9.130	0.033	6.490	0.069
22491-1808	22 51 49.28	−17 52 24.1	0.702	12.740	0.027	12.244	0.029	7.296	0.016	3.401	0.021
23019+3405	23 04 21.20	+34 21 47.5	0.695	12.472	0.024	11.799	0.021	7.540	0.016	4.711	0.023
23028+0725	23 05 19.88	+07 41 43.0	0.407	13.992	0.030	13.127	0.031	8.152	0.020	4.372	0.025
23050+0359	23 07 35.77	+04 16 02.2	0.060	11.560	0.024	11.177	0.022	6.806	0.015	3.532	0.021
23129+2548	23 15 21.40	+26 04 32.3	0.122	14.181	0.03	13.419	0.032	8.356	0.020	5.317	0.028
23135+2517	23 16 00.69	+25 33 23.9	0.283	10.467	0.023	9.185	0.020	5.350	0.015	2.060	0.020
23199+0123	23 22 31.61	+01 39 28.1	0.332	13.267	0.033	12.561	0.035	8.455	0.038	6.246	0.136
23234+0946	23 25 56.14	+10 02 49.5	0.412	13.439	0.026	12.578	0.028	8.359	0.022	5.101	0.033
23327-2913 ^b	23 35 11.9	+29 30 00	0.446	12.838	0.025	11.979	0.024	7.884	0.016	4.209	0.021
23365+3604	23 39 01.27	+36 21 08.6	0.108	11.868	0.024	11.074	0.021	6.524	0.015	2.947	0.016

Table 5. WISE data of of non-masing galaxies.

IRAS Name	RA	Dec	Δr	W1	Sigmp	W2	Sigmp	W3	Sigmp	W4	Sigmp
00020+3636	00 04 38.8	+36 53 31	0.904	13.418	0.026	12.877	0.028	8.877	0.025	6.022	0.041
00051+2657	00 07 39.8	+27 13 39	0.236	12.202	0.023	11.427	0.021	7.828	0.018	5.568	0.034
00085+3107	00 11 10.0	+31 24 15	0.654	12.501	0.023	12.081	0.024	7.590	0.017	5.174	0.029
00109+0228	00 13 31.4	+02 45 11	0.408	13.458	0.026	13.007	0.033	9.078	0.037	7.634	0.253
00128+2817	00 15 23.5	+28 34 00	0.469	13.308	0.025	12.150	0.024	8.024	0.017	4.903	0.026
00242+3344	00 26 52.0	+34 01 22	1.362	13.941	0.025	12.783	0.025	8.443	0.019	5.766	0.033
00268+2413	00 29 30.4	+24 30 07	0.597	13.067	0.026	12.509	0.027	8.335	0.021	5.197	0.027
00302+3625	00 32 57.6	+36 41 56	0.851	14.405	0.031	13.338	0.035	8.953	0.025	6.079	0.047
00310+1437	00 33 37.7	+14 53 40	0.829	14.360	0.033	13.594	0.039	9.905	0.051	6.632	0.065
00331+2656	00 35 49.3	+27 12 40	0.099	13.620	0.035	12.790	0.035	8.544	0.029	6.281	0.080
00486+0004	00 51 14.1	+00 20 49	0.896	13.484	0.043	12.980	0.044	8.955	0.041	5.928	0.075
00507+0426	00 53 21.8	+04 42 37	4.446	13.833	0.030	13.400	0.037	9.360	0.034	6.915	0.078
00523+1643	00 54 57.5	+16 59 56	1.288	13.196	0.024	12.708	0.027	8.668	0.022	6.062	0.042
01097+2733	01 12 30.4	+27 49 02	4.308	14.671	0.030	13.396	0.029	9.510	0.030	6.698	0.053
01185+2547	01 21 18.0	+26 03 03	1.388	14.062	0.028	13.277	0.030	9.086	0.026	5.302	0.027
01208+3525	01 23 43.4	+35 40 55	0.678	12.974	0.024	12.352	0.023	7.905	0.017	5.069	0.026
01236+3504	01 26 28.4	+35 20 12	1.416	14.386	0.061	13.956	0.081	9.847	0.082	≥7.760	null
01348+3254	01 37 41.3	+33 09 35	0.227	11.055	0.023	9.986	0.019	7.089	0.016	4.433	0.026
01411+1551	01 43 48.3	+16 06 10	...	...	...	...	...	...	...	...	...
01478+1254	01 50 28.4	+13 08 58	0.423	14.298	0.029	12.960	0.027	8.622	0.022	5.745	0.034
01506+2554	01 53 28.3	+26 09 40	0.893	10.529	0.023	9.459	0.020	7.103	0.015	4.852	0.024
01572+0009	01 59 50.2	+00 23 41	0.703	10.752	0.023	9.757	0.020	6.362	0.015	3.129	0.018
02054+0835	02 08 06.8	+08 50 02	2.339	12.225	0.023	10.976	0.021	7.006	0.015	4.359	0.020
02072+2336	02 10 08.5	+23 50 48	0.859	13.280	0.038	12.608	0.033	8.601	0.030	6.074	0.062
02077+2255	02 10 35.3	+23 09 19	0.502	13.349	0.024	12.883	0.033	9.116	0.038	6.611	0.085
02124+2550	02 15 21.2	+26 04 24	0.178	13.503	0.034	13.040	0.044	8.663	0.037	6.250	0.104
02173+2143	02 20 14.4	+21 57 30	0.699	12.789	0.024	12.449	0.029	8.918	0.039	6.343	0.062
02183+2254	02 21 10.4	+23 08 27	0.680	12.722	0.023	12.100	0.024	7.992	0.021	5.342	0.034
02290+3139	02 32 04.8	+31 52 45	0.641	13.487	0.026	12.519	0.027	8.567	0.023	5.653	0.037
02323+0626	02 34 51.2	+06 39 28	...	...	...	...	...	...	...	...	...
02354+1926	02 38 15.6	+19 39 50	0.263	12.457	0.023	11.969	0.025	7.592	0.019	5.499	0.037
02411+0353	02 43 46.1	+04 06 37	0.903	12.750	0.024	11.877	0.023	7.432	0.017	4.359	0.025
02459+2236	02 48 47.4	+22 48 49	...	...	...	...	...	...	...	...	...
02477+2654	02 50 40.2	+27 06 56	0.351	13.192	0.025	12.645	0.028	8.451	0.022	5.094	0.034
02488+3542	02 51 57.9	+35 55 05	...	...	...	...	...	...	...	...	...
03248+1756	03 27 40.3	+18 07 12	4.552	13.547	0.026	13.037	0.031	9.313	0.034	6.629	0.074
03250+1606	03 27 49.8	+16 17 00	0.660	12.935	0.024	12.310	0.025	8.138	0.021	5.311	0.033
03477+2611	03 50 46.2	+26 20 58	0.496	12.873	0.025	12.020	0.023	8.730	0.030	6.005	0.048
03533+2606	03 56 22.5	+26 14 52	0.211	12.706	0.024	11.321	0.021	7.485	0.015	4.609	0.022
04046+1011	04 07 25.2	+10 19 28	0.975	13.559	0.027	13.106	0.031	8.906	0.028	6.595	0.056
04137+1217	04 16 34.1	+12 25 04	3.745	13.711	0.027	12.116	0.025	8.498	0.024	5.547	0.033
04229+0056	04 25 30.5	+01 03 06	3.238	13.625	0.027	13.001	0.031	8.778	0.024	5.612	0.029
04413+2608	04 44 30.9	+26 14 10	0.798	11.657	0.024	10.256	0.020	7.390	0.017	4.616	0.027
04479+0616	04 50 36.9	+06 21 43	0.412	12.753	0.025	12.097	0.024	8.055	0.021	5.418	0.031
05324+0252	05 35 01.8	+02 54 32	0.081	13.555	0.027	12.866	0.029	8.756	0.024	6.137	0.049
05559+1020	05 58 44.4	+10 20 58	...	...	...	...	...	...	...	...	...
06268+3509	06 30 13.3	+35 07 50	0.206	13.571	0.029	12.838	0.030	8.500	0.025	5.440	0.036
06368+2812	06 39 56.9	+28 09 56	1.004	12.524	0.025	11.897	0.025	7.462	0.021	5.389	0.041
06561+1902	06 59 05.5	+18 58 20	3.748	14.035	0.031	13.343	0.039	8.921	0.029	5.119	0.029
06587+3043	07 01 58.6	+30 39 22	...	...	...	...	...	...	...	...	...
07178+1952	07 20 44.9	+19 46 53	...	...	...	...	...	...	...	...	...
07188+0407	07 21 28.1	+04 01 46	2.161	13.088	0.026	12.585	0.027	8.563	0.024	5.811	0.041
07241+3052	07 27 18.7	+30 45 53	1.016	12.993	0.025	12.566	0.027	8.337	0.022	5.341	0.036
07328+0457	07 35 29.3	+04 50 28	5.032	13.133	0.025	12.268	0.025	8.394	0.022	5.113	0.029
07381+3215	07 41 23.0	+32 08 11	0.600	13.841	0.030	13.023	0.031	8.609	0.024	5.901	0.040
07488+0501	07 51 31.5	+04 53 33	0.928	13.576	0.026	12.986	0.030	8.992	0.027	6.338	0.057
08003+0734	08 03 03.0	+07 25 39	4.252	13.037	0.023	12.569	0.028	8.577	0.024	6.339	0.059
08007+0711	08 03 22.0	+07 03 33	1.161	13.236	0.029	12.629	0.029	8.116	0.021	5.075	0.034
08012+0125	08 03 50.2	+01 16 47	...	...	...	...	...	...	...	...	...
08122+0505	08 14 53.5	+04 56 14	0.318	12.018	0.023	11.140	0.021	7.519	0.016	4.728	0.025
08132+1628	08 16 03.0	+16 19 39	...	...	...	...	...	...	...	...	...
08147+3137	08 17 55.2	+31 28 27	0.231	13.132	0.026	11.459	0.023	7.670	0.018	4.709	0.025
08200+1931	08 22 53.1	+19 21 37	6.962	16.640	0.138	16.238	0.348	≥11.917	null	≥8.369	null

Notes. (U)LIRGs without OH detections in the Arecibo survey, taken from Darling & Giovanelli (2000, 2001, 2002). Notes of Columns are the same as those of Table 4.

Table 5. continued.

IRAS Name	RA	Dec	Δr	W1	Sigmp	W2	Sigmp	W3	Sigmp	W4	Sigmp
08206+3111	08 23 42.9	+31 01 18	1.045	13.233	0.025	12.710	0.026	8.495	0.023	5.893	0.039
08224+1329	08 25 12.6	+13 19 46	3.499	13.591	0.030	12.919	0.030	8.226	0.021	5.324	0.036
08232+0058	08 25 48.0	+00 49 03	6.752	11.918	0.023	10.791	0.020	7.843	0.020	5.152	0.031
08235+1334	08 26 18.6	+13 24 40	...	...	...	...	...	...	...	...	...
08349+3050	08 38 00.7	+30 39 40	0.298	13.929	0.030	13.530	0.038	9.461	0.038	6.442	0.053
08409+0750	08 43 35.6	+07 39 26	...	...	...	...	...	...	...	...	...
08433+2702	08 46 18.1	+26 51 28	...	...	...	...	...	...	...	...	...
08519+2017	08 54 48.9	+20 06 31	0.392	10.386	0.023	9.346	0.020	6.619	0.017	4.343	0.035
08559+1053	08 58 41.7	+10 41 22	0.856	11.514	0.024	10.456	0.021	7.269	0.017	4.719	0.026
09049+0137	09 07 34.2	+01 25 07	8.764	13.492	0.026	12.868	0.028	9.114	0.029	6.798	0.071
09116+0334	09 14 13.8	+03 22 01	0.418	12.688	0.025	12.152	0.025	8.115	0.019	5.420	0.037
09302+3241	09 33 11.3	+32 28 44	0.833	13.849	0.027	13.196	0.031	9.059	0.028	6.155	0.046
09425+1751	09 45 21.3	+17 37 53	0.624	13.036	0.024	11.135	0.024	6.851	0.016	3.562	0.019
09517+1458	09 54 25.1	+14 44 37	...	...	...	...	...	...	...	...	...
09525+1602	09 55 17.0	+15 48 02	0.196	14.667	0.035	14.324	0.054	10.146	0.055	6.943	0.077
09540+3521	09 56 58.9	+35 07 10	0.790	13.535	0.027	13.097	0.030	9.196	0.029	6.533	0.055
09576+1858	10 00 23.7	+18 44 28	0.858	12.500	0.024	12.029	0.023	7.650	0.018	5.324	0.033
10034+0726	10 06 06.3	+07 11 09	...	...	...	...	...	...	...	...	...
10040+0932	10 06 43.5	+09 17 28	0.407	14.048	0.029	12.991	0.032	8.586	0.023	5.629	0.035
10086+2621	10 11 28.2	+26 06 55	1.115	11.880	0.022	11.017	0.020	7.592	0.017	5.095	0.026
10113+1736	10 14 02.0	+17 21 56	0.617	13.928	0.029	13.295	0.033	9.306	0.031	6.247	0.048
10120+1653	10 14 47.9	+16 38 50	0.510	13.604	0.027	13.061	0.033	9.159	0.033	6.576	0.071
10138+0913	10 16 32.2	+08 58 43	1.554	13.490	0.042	13.114	0.047	8.737	0.041	6.490	0.135
10156+1551	10 18 23.9	+15 36 31	1.089	13.639	0.026	13.114	0.033	9.133	0.031	5.943	0.043
10201+3308	10 23 00.3	+32 53 17	7.461	13.618	0.026	12.943	0.029	8.205	0.020	5.198	0.030
10214+0015	10 24 01.5	+00 00 39	0.213	13.071	0.025	12.387	0.026	8.205	0.022	4.965	0.029
10218+1511	10 24 33.2	+14 56 20	0.169	13.216	0.027	12.567	0.028	8.103	0.022	5.090	0.036
10222+1532	10 24 58.3	+15 17 46	9.500	12.785	0.024	12.474	0.026	8.371	0.025	6.223	0.054
10482+1909	10 50 57.0	+18 53 23	6.736	13.209	0.029	12.314	0.029	8.318	0.025	5.722	0.051
10579+0438	11 00 34.3	+04 21 59	...	...	...	...	...	...	...	...	...
10597+2736	11 02 26.5	+27 20 36	...	...	...	...	...	...	...	...	...
11009+2822	11 03 42.5	+28 06 11	1.399	13.411	0.026	11.921	0.025	7.848	0.018	4.623	0.023
11119+3257	11 14 38.9	+32 41 33	0.603	9.901	0.022	8.830	0.020	6.154	0.016	3.596	0.022
11175+0917	11 20 06.1	+09 01 36	0.647	13.800	0.028	13.159	0.031	8.744	0.028	6.536	0.067
11188+1138	11 21 29.0	+11 22 26	0.153	13.176	0.025	12.273	0.026	8.196	0.020	5.322	0.032
11233+3451	11 26 02.4	+34 34 48	0.802	11.215	0.023	10.078	0.018	6.767	0.011	4.381	0.019
11243+1655	11 26 59.2	+16 39 11	4.845	14.744	0.035	14.373	0.060	12.109	0.316	≥8.372	null
11268+1558	11 29 24.0	+15 41 51	...	...	...	...	...	...	...	...	...
11347+2026	11 37 19.2	+20 10 04	...	...	...	...	...	...	...	...	...
11415+0927	11 44 11.0	+09 10 46	0.721	12.716	0.024	12.189	0.024	7.850	0.018	5.505	0.035
11434+0159	11 46 01.5	+01 42 11	0.773	13.390	0.027	13.009	0.033	9.181	0.033	6.235	0.047
11477+2158	11 50 21.2	+21 41 57	0.588	14.367	0.032	13.826	0.043	9.448	0.036	6.676	0.066
11506+1331	11 53 14.2	+13 14 28	0.585	12.864	0.024	11.450	0.021	7.400	0.018	4.583	0.027
11511+0946	11 53 41.3	+09 30 25	0.776	13.708	0.029	13.219	0.034	9.208	0.033	5.609	0.038
11582+3020	12 00 46.8	+30 04 14	0.779	14.336	0.031	13.392	0.033	8.407	0.020	5.726	0.035
11595+1144	12 02 05.6	+11 28 12	0.229	13.584	0.026	12.643	0.028	8.526	0.024	5.684	0.037
12107+3157	12 13 19.9	+31 40 53	0.802	14.302	0.030	13.389	0.034	9.012	0.026	5.621	0.035
12111+2848	12 13 39.3	+28 32 15	1.047	12.323	0.024	11.836	0.022	7.438	0.016	4.884	0.026
12114+3244	12 14 00.4	+32 28 15	0.041	13.572	0.025	12.836	0.027	8.265	0.021	4.590	0.021
12202+1646	12 22 47.1	+16 29 30	0.190	13.815	0.029	13.494	0.035	10.534	0.068	≥8.889	null
12265+0219	12 29 06.7	+02 03 09	0.332	8.369	0.022	7.407	0.019	5.147	0.014	2.944	0.020
12461+0416	12 48 42.9	+03 59 41	1.668	13.695	0.030	13.121	0.035	8.508	0.025	5.608	0.043
12468+3436	12 49 16.6	+34 19 53	...	...	...	...	...	...	...	...	...
12491+0811	12 51 37.0	+07 55 09	...	...	...	...	...	...	...	...	...
12514+1027	12 54 00.8	+10 11 12	0.599	11.007	0.023	9.694	0.020	7.231	0.017	4.707	0.024
12526+1025	12 55 08.6	+10 09 01	1.029	12.864	0.024	12.456	0.025	8.080	0.020	5.885	0.037
12551+0825	12 57 39.3	+08 09 32	0.531	12.014	0.023	11.013	0.022	8.247	0.021	5.289	0.028
12569+3135	12 59 19.9	+31 19 01	0.706	13.849	0.028	12.837	0.027	8.786	0.022	5.679	0.035
13014+3524	13 03 50.1	+35 08 33	0.254	14.300	0.029	13.652	0.035	9.734	0.035	6.456	0.052
13034+0017	13 06 00.3	+00 01 31	8.315	14.005	0.028	13.193	0.033	8.826	0.025	5.666	0.040
13064+2057	13 08 51.6	+20 41 24	0.515	12.653	0.025	12.162	0.024	7.980	0.019	5.622	0.032
13145+2356	13 16 54.0	+23 40 46	0.542	13.834	0.029	12.331	0.024	9.155	0.028	6.391	0.057
13156+0435	13 18 10.3	+04 19 20	8.464	12.993	0.024	12.118	0.024	8.139	0.020	5.084	0.027
13163+3209	13 18 38.3	+31 54 00	0.234	13.686	0.032	13.131	0.032	9.310	0.029	6.151	0.041
13180+0133	13 20 38.1	+01 17 29	1.614	12.941	0.024	12.223	0.024	7.284	0.016	4.823	0.025
13243+2042	13 26 48.0	+20 27 05	1.067	13.599	0.027	12.894	0.027	8.549	0.021	5.391	0.029

Table 5. continued.

IRAS Name	RA	Dec	Δr	W1	Sigmp	W2	Sigmp	W3	Sigmp	W4	Sigmp
13349+2438	13 37 18.7	+24 23 03	0.468	8.257	0.023	7.128	0.019	4.585	0.014	2.642	0.015
13380+3339	13 40 14.4	+33 24 45	0.571	13.560	0.024	12.647	0.025	8.886	0.023	5.315	0.030
13442+2321	13 46 39.2	+23 06 18	0.969	13.245	0.024	12.944	0.027	9.746	0.035	5.805	0.036
13446+1623	13 47 02.3	+16 09 03	2.119	12.672	0.023	11.666	0.023	8.421	0.020	5.553	0.030
13451+1232	13 47 33.3	+12 17 24	1.217	11.395	0.022	10.122	0.021	6.267	0.015	3.086	0.014
13457+3513	13 47 57.4	+34 58 30	0.218	13.594	0.027	12.876	0.027	8.536	0.020	5.330	0.029
13478+1643	13 50 16.5	+16 28 11	5.154	13.253	0.024	12.690	0.026	8.454	0.020	5.498	0.030
13509+0442	13 53 31.6	+04 28 05	0.378	13.284	0.024	12.350	0.024	7.971	0.016	5.073	0.024
13539+2920	13 56 10.0	+29 05 35	0.293	12.843	0.023	12.055	0.021	7.749	0.016	5.015	0.024
13542+1040	13 56 46.1	+10 26 09	0.223	12.849	0.024	11.428	0.022	7.569	0.017	4.078	0.022
14020+1036	14 04 31.1	+10 22 28	0.643	12.821	0.023	12.329	0.023	7.927	0.017	5.853	0.036
14030+3526	14 05 09.6	+35 12 07	0.895	13.470	0.025	12.523	0.025	8.322	0.019	6.011	0.035
14041+0117	14 06 38.2	+01 02 55	0.362	12.463	0.023	10.677	0.021	6.526	0.015	3.851	0.019
14060+2919	14 08 19.0	+29 04 47	0.290	12.713	0.024	11.983	0.022	7.411	0.016	4.484	0.023
14111+1819	14 13 32.7	+18 05 29	2.514	13.650	0.025	13.030	0.026	8.697	0.020	5.569	0.031
14183+0009	14 20 56.7	-00 04 24	0.298	12.793	0.025	12.408	0.026	8.729	0.026	6.615	0.074
14197+0813	14 22 11.6	+07 59 28	1.364	13.177	0.024	12.696	0.024	8.592	0.019	5.042	0.023
14202+2615	14 22 31.4	+26 02 05	0.464	12.000	0.023	10.890	0.021	7.508	0.015	4.729	0.024
14219+2009	14 24 18.1	+19 55 54	1.847	9.808	0.022	9.908	0.020	8.991	0.023	6.297	0.041
14228+2742	14 25 03.9	+27 29 10	1.080	13.221	0.023	12.655	0.024	8.294	0.018	5.522	0.032
14232+0735	14 25 41.5	+07 21 42	1.639	13.854	0.047	13.637	0.052	10.227	0.065	8.151	0.281
14312+2825	14 33 27.5	+28 12 00	1.047	12.950	0.023	12.148	0.022	7.993	0.016	5.361	0.026
14405+2634	14 42 44.9	+26 21 31	0.568	13.334	0.022	12.603	0.023	8.442	0.018	5.421	0.027
14459+1745	14 48 16.0	+17 33 06	0.678	13.439	0.024	13.144	0.028	9.497	0.029	6.309	0.044
14469+1402	14 49 19.7	+13 50 33	0.338	13.309	0.025	12.953	0.028	8.721	0.022	6.917	0.076
14488+3521	14 50 54.1	+35 08 38	0.934	12.918	0.023	12.087	0.021	7.860	0.016	5.452	0.027
14538+1730	14 56 08.5	+17 18 34	0.733	12.154	0.024	11.671	0.022	7.551	0.017	5.117	0.024
14550+0715	14 57 31.0	+07 03 33	0.802	12.651	0.023	12.121	0.022	7.712	0.016	5.548	0.031
14575+3256	14 59 36.5	+32 44 59	0.779	12.913	0.023	12.326	0.022	7.694	0.016	4.756	0.020
15001+1433	15 02 31.9	+14 21 35	0.576	12.328	0.023	11.037	0.021	7.429	0.015	4.316	0.020
15005+3555	15 02 33.7	+35 44 15	0.832	11.590	0.030	11.467	0.029	11.420	0.110	≥9.068	null
15059+2835	15 08 06.6	+28 24 20	...	...	...	...	...	...	...	...	...
15069+1808	15 09 13.8	+17 57 10	...	...	...	...	...	...	...	...	...
15158+2747	15 17 58.5	+27 36 16	0.277	13.109	0.024	12.424	0.023	8.063	0.017	5.787	0.027
15165+1553	15 18 50.5	+15 42 58	...	...	...	...	...	...	...	...	...
15168+0045	15 19 24.0	+00 34 57	3.128	13.581	0.036	13.177	0.040	9.801	0.052	7.733	0.183
15206+3342	15 22 38.0	+33 31 36	1.152	12.474	0.023	11.245	0.021	6.797	0.015	3.602	0.018
15225+2350	15 24 43.9	+23 40 10	0.568	13.016	0.023	11.783	0.021	7.771	0.016	4.681	0.021
15438+0438	15 46 20.3	+04 29 18	2.786	17.115	0.161	≥17.084	null	≥12.142	null	≥8.674	null
15445+3312	15 46 30.3	+33 03 52	0.859	14.552	0.028	14.097	0.035	10.293	0.040	7.442	0.076
15543+3013	15 56 23.3	+30 04 43	0.659	13.664	0.024	13.037	0.024	8.520	0.018	5.310	0.025
15563+1233	15 58 40.8	+12 24 44	4.129	13.889	0.029	12.987	0.030	8.909	0.028	6.154	0.054
15597+3133	16 01 44.7	+31 25 13	1.735	14.464	0.027	14.073	0.035	9.865	0.030	7.200	0.060
16045+2733	16 06 36.8	+27 24 58	0.350	12.484	0.023	11.905	0.021	7.503	0.016	4.953	0.027
16075+0059	16 10 10.3	+00 51 25	0.483	12.814	0.024	12.389	0.026	8.048	0.019	5.627	0.037
16121+2611	16 14 13.2	+26 04 16	0.260	11.092	0.023	10.191	0.020	7.366	0.015	4.747	0.024
16142+0321	16 16 44.8	+03 14 14	...	...	...	...	...	...	...	...	...
16156+0146	16 18 09.4	+01 39 21	0.914	13.098	0.024	10.706	0.020	6.980	0.016	3.897	0.028
16280+0531	16 30 33.2	+05 24 57	...	...	...	...	...	...	...	...	...
16283+0442	16 30 52.0	+04 35 50	0.496	12.606	0.023	12.025	0.022	7.869	0.017	5.476	0.034
16336+1019	16 36 01.0	+10 13 43	5.350	13.409	0.025	13.323	0.031	≥12.655	null	≥9.209	null
16380+1508	16 40 18.7	+15 02 19	6.255	14.223	0.032	13.474	0.037	9.512	0.036	6.768	0.068
16474+3430	16 49 14.2	+34 25 10	0.090	12.326	0.023	11.511	0.021	7.286	0.015	4.510	0.020
16523+3126	16 54 16.2	+31 21 31	0.346	13.929	0.027	12.669	0.027	8.073	0.018	4.706	0.023
16525+3322	16 54 23.5	+33 18 03	0.170	13.856	0.027	12.862	0.028	8.303	0.020	5.064	0.025
16544+3212	16 56 23.4	+32 08 00	0.766	13.580	0.037	12.650	0.085	≥8.130	null	≥4.970	null
17023+0232	17 04 52.5	+02 28 35	8.369	11.785	0.022	10.797	0.020	7.717	0.017	5.090	0.028
17030+0457	17 05 30.3	+04 53 53	1.941	14.127	0.030	13.835	0.047	10.179	0.058	7.419	0.108
17114+2059	17 13 36.1	+20 56 04	0.679	13.004	0.025	12.462	0.027	8.974	0.031	5.608	0.047
17129+1004	17 15 21.3	+10 00 59	0.426	13.515	0.025	13.001	0.030	9.100	0.044	6.235	0.061
17156+1238	17 17 56.6	+12 35 04	5.142	13.725	0.026	12.589	0.025	8.569	0.025	5.462	0.028
17225+0256	17 25 01.7	+02 54 14	1.321	15.437	0.050	15.558	0.145	≥12.355	null	≥9.018	null
17281+3120	17 30 02.3	+31 18 16	...	...	...	...	...	...	...	...	...
17481+2135	17 50 17.5	+21 34 25	8.000	15.123	0.040	14.960	0.078	≥12.927	null	≥9.256	null
17490+2659	17 51 05.6	+26 59 03	0.738	9.902	0.024	8.898	0.022	6.153	0.015	3.933	0.025
17491+1531	17 51 26.3	+15 30 30	...	...	...	...	...	...	...	...	...

Table 5. continued.

IRAS Name	RA	Dec	Δr	W1	Sigmp	W2	Sigmp	W3	Sigmp	W4	Sigmp
17546+1356	17 56 58.3	+13 56 10	1.475	13.201	0.053	12.451	0.058	8.505	0.056	6.156	0.145
17574+0629	17 59 53.9	+06 29 12	1.051	12.305	0.023	11.481	0.021	6.931	0.014	3.866	0.018
18030+0705	18 05 27.1	+07 05 58	...	...	...	...	...	...	...	...	...
18040+2141	18 06 13.0	+21 41 35	0.277	14.341	0.040	14.112	0.065	11.263	0.173	≥8.543	null
18065+3117	18 08 24.2	+31 18 22	...	...	...	...	...	...	...	...	...
18147+1553	18 17 00.2	+15 54 49	0.998	12.226	0.024	9.828	0.022	6.872	0.015	4.113	0.022
18222+1440	18 24 31.8	+14 41 57	...	...	...	...	...	...	...	...	...
18286+2808	18 30 37.3	+28 10 33	0.692	12.704	0.026	11.626	0.022	8.002	0.021	5.357	0.040
18315+2249	18 33 36.0	+22 52 03	0.337	12.551	0.023	10.851	0.021	7.547	0.015	4.253	0.021
18407+3558	18 42 28.6	+36 01 17	0.315	11.822	0.022	11.088	0.021	7.572	0.015	5.150	0.024
18585+2148	19 00 40.5	+21 53 26	2.405	13.689	0.027	13.877	0.047	≥12.971	null	≥9.372	null
19040+3356	19 05 54.7	+34 00 52	...	...	...	...	...	...	...	...	...
19084+3719	19 10 14.8	+37 24 10	2.450	≥18.812	null	≥17.364	null	12.153	0.211	≥8.669	null
19348+3400	19 36 42.9	+34 06 51	7.714	15.115	0.072	15.749	0.268	≥12.395	null	≥9.366	null
19458+0944	19 48 15.7	+09 52 05	0.335	12.447	0.025	11.652	0.024	7.532	0.017	4.339	0.027
19559+1618	19 58 10.9	+16 26 17	0.522	12.817	0.025	12.209	0.026	8.561	0.029	5.189	0.030
20090+0129	20 11 36.0	+01 38 05	1.572	13.986	0.077	13.436	0.083	9.006	0.071	6.514	0.198
20246+0106	20 27 12.7	+01 16 22	0.679	12.851	0.023	12.000	0.023	7.472	0.017	4.479	0.026
20318+2343	20 34 04.2	+23 53 47	0.610	13.054	0.030	12.629	0.030	8.714	0.024	5.573	0.045
20322+1849	20 34 29.8	+19 00 08	0.880	12.415	0.024	11.342	0.022	7.858	0.019	5.220	0.028
20344+0619	20 36 54.1	+06 30 14	7.935	13.487	0.026	12.708	0.031	8.351	0.023	5.507	0.037
20361+1216	20 38 32.1	+12 27 26	3.121	13.423	0.027	12.821	0.027	8.459	0.019	5.616	0.037
20394+2302	20 41 38.5	+23 12 57	0.150	12.787	0.026	11.959	0.023	7.622	0.018	4.538	0.021
20398+2745	20 42 00.1	+27 56 16	0.308	12.145	0.022	10.782	0.020	6.475	0.014	3.389	0.016
20402+1642	20 42 30.9	+16 53 16	0.283	14.035	0.028	13.182	0.032	8.645	0.024	5.570	0.032
20450+0913	20 47 30.8	+09 24 24	0.372	12.523	0.023	12.052	0.025	7.625	0.017	5.477	0.036
20460+1925	20 48 17.3	+19 36 54	2.173	9.736	0.023	8.501	0.021	5.545	0.014	3.131	0.015
20551+2441	23 08 33.9	+05 21 30	0.802	9.797	0.023	8.595	0.020	5.678	0.016	3.189	0.020
21026+1042	21 05 05.4	+10 54 01	0.330	12.729	0.024	12.350	0.026	8.159	0.020	5.572	0.036
21064+2155	21 08 43.7	+22 07 39	0.291	12.391	0.024	11.989	0.023	8.060	0.019	6.136	0.044
21135+0553	21 15 59.7	+06 05 25	1.313	12.745	0.025	12.258	0.024	8.285	0.022	5.487	0.037
21167+0819	21 19 10.6	+08 31 42	0.274	12.963	0.025	12.531	0.029	8.387	0.022	6.429	0.058
21251+1114	21 27 37.1	+11 27 51	2.867	15.885	0.063	15.830	0.185	≥12.712	null	≥9.097	null
21256+0219	21 28 12.3	+02 32 32	1.390	12.765	0.024	10.971	0.020	6.976	0.013	4.207	0.022
21329+0705	21 35 24.2	+07 19 15	3.523	13.393	0.026	12.551	0.025	8.018	0.019	4.907	0.026
21444+3534	21 46 33.6	+35 48 36	0.584	12.573	0.025	10.769	0.021	7.307	0.016	4.561	0.025
21477+0502	21 50 16.3	+05 16 03	0.559	14.083	0.031	13.129	0.035	8.662	0.026	5.009	0.033
21534+3504	21 55 35.6	+35 18 55	3.342	≥18.60	null	≥17.222	null	11.156	0.104	≥8.663	null
22057+0739	22 08 15.3	+07 54 07	...	...	...	...	...	...	...	...	...
22068+2703	22 09 08.5	+27 17 59	...	...	...	...	...	...	...	...	...
22139+2448	22 16 14.0	+25 02 50	...	...	...	...	...	...	...	...	...
22285+3555	22 30 47.1	+36 10 44	0.494	12.615	0.024	11.929	0.022	7.561	0.017	4.701	0.026
22368+0904	22 39 22.6	+09 20 37	...	...	...	...	...	...	...	...	...
22416+1621	22 44 05.1	+16 36 52	5.044	12.190	0.024	12.235	0.024	12.755	0.483	≥8.764	null
22428+3215	22 45 10.6	+32 31 32	1.370	14.477	0.039	14.571	0.066	≥12.187	null	8.703	0.360
22541+0833	22 56 42.3	+08 49 23	1.021	13.775	0.028	13.066	0.031	8.791	0.025	5.456	0.032
22583+1703	23 00 50.0	+17 19 29	0.825	11.829	0.021	10.945	0.021	7.584	0.016	5.046	0.031
22584+2348	23 00 50.0	+24 04 32	0.736	12.980	0.033	12.571	0.034	8.694	0.035	6.068	0.076
23018+0333	23 04 21.0	+03 49 49	5.928	14.535	0.037	13.197	0.036	9.132	0.033	6.001	0.047
23055+2127	23 08 03.4	+21 43 25	0.764	12.342	0.024	11.955	0.023	7.970	0.019	5.421	0.031
23060+0505	23 08 33.9	+05 21 30	0.802	9.797	0.023	8.595	0.020	5.678	0.016	3.189	0.020
23068+3014	23 09 20.4	+30 30 31	0.468	13.134	0.027	12.607	0.025	8.434	0.021	5.682	0.038
23073+0005	23 09 55.1	+00 21 49	0.578	13.243	0.027	12.777	0.029	8.642	0.026	6.426	0.070
23113+0314	23 13 54.5	+03 30 55	1.138	14.189	0.030	12.831	0.030	8.207	0.020	4.600	0.027
23140+0348	23 16 35.2	+04 05 18	0.461	13.089	0.025	12.239	0.025	8.991	0.028	5.541	0.036
23152+1318	23 17 48.5	+13 35 23	0.868	13.375	0.028	13.036	0.031	9.237	0.033	6.755	0.086
23219+2919	23 24 27.0	+29 35 37	6.150	17.290	0.179	≥16.439	null	12.640	0.380	≥9.379	null
23233+2817	23 25 49.4	+28 34 21	0.395	12.494	0.022	11.216	0.021	7.103	0.015	3.916	0.024
23317+1141	23 34 19.2	+11 58 01	...	...	...	...	...	...	...	...	...
23327+2913	23 35 11.9	+29 30 00	0.446	12.838	0.024	11.979	0.024	7.884	0.016	4.209	0.021
23444+0441	23 46 59.6	+04 57 57	6.678	12.916	0.026	12.164	0.024	8.147	0.022	5.786	0.040
23498+2423	23 52 26.0	+24 40 17	0.977	11.508	0.022	10.363	0.021	7.620	0.017	4.908	0.026
23539+2322	23 56 30.7	+23 38 51	7.642	13.466	0.027	11.354	0.021	6.923	0.016	4.342	0.021
23580+2636	00 00 41.1	+26 53 18	3.821	14.352	0.031	13.677	0.044	9.482	0.036	7.432	0.105

Table 6. Physical parameters of OHM host galaxies.

IRAS Name	W1	$\log \nu_1 L_1$	W2	$\log \nu_2 L_2$	W3	$\log \nu_3 L_3$	W4	$\log \nu_4 L_4$	α_{21}	α_{32}	α_{43}	α_{41}	$\log L_{\text{OH}}$
00057+4021	12.369	9.47	12.209	9.16	7.985	9.70	3.792	10.54	-1.39	2.39	3.91	2.73	1.90
00335-2732	12.376	9.86	11.228	9.94	6.502	10.68	2.875	11.29	1.48	2.89	3.10	3.28	2.61
00461-0728 ^a	15.129	9.85	14.136	9.87	9.860	10.43	7.200	10.66	1.03	2.44	1.73	2.35	3.12
00509+1225	8.862	11.15	7.802	11.21	4.775	11.27	2.369	11.39	1.22	1.19	1.37	1.51	1.78
01298-0744 ^a	14.194	9.72	12.559	10.00	7.577	10.84	4.689	11.16	2.89	3.15	2.05	3.28	3.1
01355-1814 ^a	14.701	9.81	13.423	9.95	8.874	10.62	5.529	11.12	1.86	2.71	2.70	3.08	3.25
01364-1042	12.644	9.43	11.744	9.42	7.729	9.88	4.023	10.52	0.76	2.18	3.22	2.76	2.00
01417+1651	11.495	9.39	10.880	9.27	6.650	9.81	2.783	10.51	-0.07	2.39	3.44	2.81	2.65
01562+2528	13.963	9.98	13.515	9.79	9.694	10.17	8.293	9.89	-0.56	1.99	-0.06	1.03	3.25
01569-2939 ^a	13.861	9.88	12.94	9.88	8.142	10.64	4.889	11.10	0.82	2.96	2.57	2.97	2.95
02483+4302	11.388	10.05	11.242	9.66	8.085	9.78	4.769	10.27	-1.43	1.32	2.66	1.58	2.49
02524+2046	14.296	9.93	13.379	9.92	9.487	10.33	6.692	10.61	0.81	2.06	1.92	2.16	3.74
03056+2034	11.354	9.45	10.967	9.23	6.358	9.93	2.928	10.46	-0.73	2.77	2.82	2.65	1.28
03260-1422	12.571	9.37	12.264	9.12	8.475	9.48	5.178	9.96	-0.97	1.95	2.63	2.04	1.99
03521+0028	13.662	10.03	12.946	9.94	8.401	10.61	5.001	11.13	0.22	2.71	2.78	2.78	2.44
03566+1647	12.205	10.50	10.466	10.83	6.695	11.18	3.912	11.45	3.20	1.94	1.90	2.57	2.32
04121+0223	14.445	9.52	14.040	9.31	9.784	9.87	6.860	10.19	-0.68	2.42	2.10	2.15	2.32
04454-4838	13.146	9.32	11.991	9.41	7.188	10.18	3.698	10.73	1.50	2.97	2.91	3.25	2.88
05100-2425	11.777	9.48	11.449	9.24	7.505	9.67	4.164	10.16	-0.90	2.11	2.70	2.17	2.07
05189-2524	8.663	10.91	7.549	10.98	4.310	11.13	1.261	11.51	1.38	1.40	2.28	2.04	2.16
06206-3646	13.528	9.78	12.783	9.71	8.971	10.09	5.375	10.68	0.31	1.98	3.06	2.49	3.33
06487+2208	13.028	10.23	11.768	10.37	7.320	11.00	4.124	11.43	1.80	2.61	2.49	2.93	2.82
07163+0817	14.084	9.59	13.459	9.46	9.087	10.06	6.110	10.41	-0.04	2.54	2.18	2.38	2.37
07556+2859 ^a	14.020	9.721	13.453	9.58	9.061	10.18	6.967	10.18	-0.21	2.56	0.92	1.84	2.39
07572+0533	13.436	10.31	12.336	10.38	7.955	10.98	4.711	11.43	1.34	2.55	2.56	2.82	2.74
08071+0509	11.556	9.94	11.079	9.76	6.535	10.42	3.542	10.78	-0.47	2.71	2.20	2.40	2.25
08201+2801	14.193	9.90	13.182	9.94	8.332	10.72	5.035	11.20	1.08	3.01	2.63	3.08	3.45
08279+0956	14.671	9.90	13.924	9.83	10.013	10.24	6.883	10.65	0.31	2.08	2.40	2.27	3.23
08449+2332	13.044	10.27	12.436	10.14	8.432	10.59	5.651	10.86	-0.09	2.17	1.90	2.04	2.59
08474+1813	14.442	9.67	13.674	9.61	9.765	10.02	6.151	10.63	0.37	2.07	3.08	2.57	2.70
09039+0503	13.470	9.93	12.808	9.83	8.576	10.37	5.767	10.65	0.07	2.40	1.94	2.22	2.83
09320+6134	10.007	10.31	8.319	10.61	5.619	10.54	2.660	10.88	3.05	0.86	2.15	2.01	1.61
09531+1430	14.273	10.08	13.939	9.85	11.148	9.81	≥8.516	≤10.02	-0.89	0.96	...	...	3.42
09539+0857	14.218	9.66	13.130	9.73	8.411	10.46	5.645	10.73	1.30	2.88	1.88	2.73	3.48
10038-3338	10.454	10.01	7.905	10.66	5.271	10.56	2.695	10.75	5.55	0.80	1.61	2.25	2.92
10035+2740	13.549	10.14	12.979	10.00	9.502	10.24	6.405	10.64	-0.20	1.64	2.35	1.89	2.50
10173+0828	12.839	9.35	12.486	9.13	8.254	9.67	3.984	10.53	-0.83	2.40	4.02	2.90	2.68
10339+1548	14.060	10.09	13.501	9.94	9.473	10.40	6.152	10.89	-0.23	2.19	2.67	2.34	2.65
10378+1108	13.408	10.03	12.048	10.21	8.183	10.60	4.487	11.24	2.09	2.03	3.20	2.94	3.54
10485-1447	13.740	9.88	12.354	10.06	8.269	10.55	4.885	11.06	2.17	2.25	2.76	2.90	2.91
10597+5926 ^a	14.490	9.92	13.764	9.83	9.536	10.38	6.762	10.65	0.25	2.39	1.89	2.24	3.13
11011+4107	11.120	9.77	10.638	9.59	6.366	10.15	3.943	10.28	-0.46	2.44	1.39	1.91	2.02
11028+3130	15.153	9.66	14.700	9.48	10.282	10.09	6.991	10.57	-0.54	2.58	2.63	2.49	2.97
11069+2711	13.381	9.47	13.065	9.22	8.648	9.84	6.551	9.84	-0.94	2.58	0.93	1.71	...
11180+1623	14.379	9.82	13.645	9.74	9.083	10.41	5.961	10.82	0.28	2.73	2.38	2.64	2.34
11257+5850	...	...	...	...	...	...	...	...	...	...	...	...	1.45
11506-3851	9.333	9.48	8.992	9.24	4.666	9.82	1.825	10.12	-0.87	2.49	1.98	2.11	1.64
11524+0058	14.455	9.61	13.733	9.53	9.652	10.01	7.016	10.22	0.24	2.25	1.69	2.07	2.98
12005+1009	13.257	10.01	12.384	9.98	8.758	10.28	5.657	10.68	0.68	1.79	2.35	2.16	2.62
12018+1941	13.630	10.13	12.195	10.33	7.187	11.18	3.785	11.70	2.31	3.17	2.78	3.48	2.87
12032+1707	14.059	10.18	13.055	10.21	8.144	11.02	5.007	11.44	1.06	3.08	2.41	3.01	4.15
12071-0444 ^a	12.006	10.54	10.677	10.70	6.584	11.19	3.329	11.65	2.00	2.26	2.57	2.79	3.07
12112+0305	12.233	9.96	11.417	9.92	6.917	10.57	3.602	11.05	0.51	2.66	2.66	2.77	2.96
12162+1047	14.053	9.84	13.265	9.79	9.118	10.29	6.266	10.59	0.43	2.31	2.00	2.27	2.25
12540+5708	7.446	11.40	6.354	11.46	3.197	11.57	0.250	11.91	1.32	1.32	2.14	1.92	2.87
12549+2403	13.427	10.00	12.998	9.80	9.415	10.08	6.689	10.33	-0.61	1.75	1.82	1.65	2.37
13097-1531	9.499	9.97	9.119	9.75	5.128	10.20	2.746	10.31	-0.75	2.16	1.33	1.66	1.11
13218+0552	9.640	11.90	8.230	12.09	5.659	11.97	3.744	11.89	2.24	0.74	0.67	1.16	3.45

Notes. Column 1: IRAS name of OHM sources; Cols. 2 and 3: WISE 3.5 μm magnitude and corresponding luminosity ($\log \nu L_\nu$, in units of $L_\odot$), the luminosity was derived from corresponding flux density, which can be converted from the magnitude value using the published (iso)zero values (http://wise2.ipac.caltech.edu/docs/release/prelim/expsup/figures/sec4_3gt4.gif); Cols. 4 and 5: WISE 4.6 μm magnitude and corresponding luminosity; Cols. 6 and 7: WISE 12 μm magnitude and corresponding luminosity; Cols. 8 and 9: WISE 22 μm magnitude and corresponding luminosity; Cols. 10–13: spectral indices α_{21} , α_{32} , α_{43} , α_{41} , 1, 2, 3 and 4 denote four WISE bands at 3.4, 4.6, 12, and 22 μm , respectively. Column 14: the measured isotropic OH line luminosity (logarithmic scale, in $L_\odot$), which are taken from Darling & Giovanelli (2000, 2001, 2002); Fernandez et al. (2010); Willett (2012).

Table 6. continued.

IRAS Name	W1	$\log \nu_1 L_1$	W2	$\log \nu_2 L_2$	W3	$\log \nu_3 L_3$	W4	$\log \nu_4 L_4$	α_{21}	α_{32}	α_{43}	α_{41}	$\log L_{\text{OH}}$
13254+4754	12.680	9.61	12.172	9.45	8.078	9.93	4.983	10.33	-0.38	2.26	2.35	2.22	1.91
13428+5608	10.397	10.13	9.119	10.23	5.336	10.63	1.796	11.21	1.55	2.05	2.98	2.75	2.55
13451+1232	11.395	10.74	10.122	10.88	6.267	11.27	3.086	11.70	1.84	2.02	2.47	2.58	2.38
14043+0624	13.121	9.99	12.746	9.77	9.246	10.02	6.680	10.21	-0.77	1.66	1.59	1.48	2.10
14059+2000	12.890	10.16	12.024	10.13	8.846	10.26	6.132	10.50	0.66	1.34	1.80	1.67	3.34
14070+0525	14.209	10.29	13.255	10.30	8.734	10.96	6.029	11.20	0.91	2.69	1.79	2.50	4.40
14553+1245	13.442	9.95	12.706	9.87	8.239	10.51	5.323	10.83	0.28	2.63	2.09	2.47	2.27
14586+1432	15.314	9.34	15.442	8.92	≥ 13.232	≤ 8.65	≥ 9.578	≤ 9.27	-2.23	...	...	...	3.41
15107+0724	11.041	8.94	10.733	8.69	6.671	9.17	3.147	9.73	-0.96	2.23	2.96	2.33	1.06
15179+3956	12.592	9.45	10.834	9.79	6.724	10.28	2.982	10.93	3.25	2.27	3.27	3.34	1.81
15224+1033	14.194	9.71	12.965	9.83	8.632	10.41	5.886	10.67	1.71	2.50	1.85	2.58	3.04
15233+0533	12.207	9.71	11.683	9.55	7.319	10.14	3.705	10.75	-0.326	2.44	3.20	2.30	...
15250+3608	12.347	9.67	10.846	9.90	5.992	10.69	2.401	11.29	2.50	3.02	3.05	3.54	2.58
15247-0945	12.006	9.53	11.834	9.23	8.066	9.58	5.647	9.71	-1.36	1.93	1.38	1.43	2.11
15327+2340	10.068	9.61	9.327	9.54	4.587	10.28	0.644	11.02	0.30	2.90	3.55	3.23	2.59
15587+1609	13.883	9.85	13.086	9.80	9.175	10.22	6.361	10.50	0.46	2.08	1.95	2.11	3.26
16090-0139 ^a	13.013	10.174	11.470	10.42	7.288	10.94	4.252	11.32	2.63	2.35	2.26	2.84	3.35
16100+2527	14.684	9.49	14.240	9.30	9.537	10.03	6.340	10.46	-0.57	2.87	2.49	2.60	2.29
16145+4231	11.465	9.27	11.230	8.99	7.088	9.50	5.003	9.49	-1.18	2.31	0.91	1.49	1.84
16255+2801	14.684	9.49	12.860	9.87	9.019	10.25	5.539	10.80	3.59	2.01	2.89	3.10	2.57
16300+1558	13.684	10.42	12.634	10.47	8.577	10.94	5.928	11.16	1.19	2.22	1.71	2.25	2.85
16399-0937	10.401	9.83	9.958	9.63	5.553	10.25	2.518	10.62	-0.57	2.57	2.26	2.33	1.69
17161+2006	13.585	9.77	13.571	9.40	≥ 12.522	≤ 8.67	≥ 9.441	≤ 9.06	-1.82	...	...	...	2.39
17207-0014	10.782	10.08	10.053	10.00	5.728	10.58	2.369	11.08	0.26	2.49	2.72	2.64	3.04
17539+2935	12.864	10.06	12.226	9.94	8.108	10.44	4.823	10.91	0.00	2.28	2.62	2.42	1.76
18368+3549	12.722	10.17	12.136	10.03	8.067	10.51	5.542	10.68	-0.15	2.23	1.54	1.91	2.85
18544-3718	13.247	9.56	10.671	10.21	6.847	10.59	4.304	10.77	5.63	1.99	1.56	2.95	2.41
18588+3517	13.340	9.85	12.093	9.98	7.768	10.56	4.854	10.88	1.77	2.49	2.09	2.68	2.52
20100-4156	12.989	10.15	11.459	10.40	7.204	10.95	3.816	11.46	2.59	2.42	2.76	3.08	4.05
20248+1734	13.876	9.74	12.938	9.75	8.444	10.39	5.392	10.77	0.87	2.66	2.29	2.68	2.53
20286+1846	14.150	9.73	13.492	9.62	9.346	10.13	6.358	10.48	0.05	2.31	2.19	2.27	3.41
20450+2140	13.004	10.14	12.561	9.95	8.367	10.47	5.769	10.67	-0.57	2.36	1.64	1.95	2.24
20491+1846	10.625	10.66	10.360	10.40	6.076	10.96	4.033	10.94	-1.09	2.45	0.85	1.57	1.07
20550+1655	...	...	...	...	...	...	...	...	...	...	...	...	2.13
21077+3358	14.120	9.97	14.180	9.58	≥ 12.251	≤ 9.20	≥ 9.11	≤ 9.61	-2.03	...	...	...	3.26
21272+2514	14.090	9.85	13.147	9.86	8.984	10.37	5.812	10.80	0.88	2.33	2.46	2.56	3.66
22055+3024	13.482	9.94	12.379	10.01	7.899	10.65	4.436	11.20	1.35	2.64	2.87	3.01	2.73
22088-1831	13.940	10.01	13.350	9.88	8.770	10.56	5.279	11.11	-0.14	2.74	2.91	2.78	3.28
22116+0437	14.136	10.05	13.059	10.11	8.013	10.98	5.177	11.27	1.27	3.21	1.98	2.96	2.77
22135+0043 ^a	14.155	10.12	12.481	10.42	9.130	10.61	6.490	10.82	3.01	1.52	1.70	2.20	2.58
22491-1808	12.740	9.79	12.244	9.62	7.296	10.45	3.401	11.17	-0.42	3.11	3.48	3.18	2.39
23019+3405	12.472	10.21	11.799	10.10	7.540	10.66	4.711	10.95	0.10	2.42	1.97	2.26	2.12
23028+0725	13.992	9.88	13.127	9.86	8.152	10.70	4.372	11.37	0.66	3.14	3.32	3.35	3.29
23050+0359	11.560	9.85	11.177	9.63	6.806	10.23	3.532	10.70	-0.74	2.45	2.71	2.00	...
23129+2548	14.181	9.96	13.419	9.90	8.356	10.77	5.317	11.14	0.36	3.23	2.27	2.90	3.27
23199+0123	13.267	10.09	12.561	10.01	8.455	10.50	6.246	10.54	0.19	2.27	1.09	1.82	2.38
23234+0946	13.439	9.97	12.578	9.94	8.359	10.48	5.101	10.94	0.64	2.38	2.58	2.59	2.75
23327-2913 ^b	12.838	10.16	11.979	10.13	7.884	10.62	4.209	11.25	0.64	2.26	3.17	2.76	2.04
23365+3604	11.868	10.01	11.074	9.95	6.524	10.62	2.947	11.21	0.45	2.71	3.03	2.94	2.45

Table 7. Physical parameters of non-masing galaxies.

IRAS Name	W1	$\log \nu_1 L_1$	W2	$\log \nu_2 L_2$	W3	$\log \nu_3 L_3$	W4	$\log \nu_4 L_4$	α_{21}	α_{32}	α_{43}	α_{41}	$\log L_{\text{OH}}^{UL}$
00020+3636	13.418	9.91	12.877	9.75	8.877	10.20	6.022	10.49	-0.29	2.16	2.00	1.70	1.8
00051+2657	12.202	10.45	11.427	10.38	7.828	10.67	5.568	10.73	0.39	1.76	1.16	1.33	1.76
00085+3107	12.501	10.15	12.081	9.95	7.590	10.59	5.174	10.71	-0.64	2.66	1.38	1.66	1.52
00109+0228	13.458	10.15	13.007	9.96	9.078	10.38	7.634	10.11	-0.55	2.09	0.00	0.93	2.02
00128+2817	13.308	10.10	12.150	10.19	8.024	10.69	4.903	11.09	1.51	2.29	2.38	2.19	1.84
00242+3344	13.941	10.04	12.783	10.12	8.443	10.71	5.766	10.93	1.51	2.50	1.75	2.08	2.27
00268+2413	13.067	9.98	12.509	9.83	8.335	10.35	5.197	10.76	-0.24	2.34	2.41	1.93	1.45
00302+3625	14.405	10.33	13.338	10.38	8.953	10.99	6.079	11.29	1.24	2.55	2.03	2.15	2.93
00310+1437	14.360	9.51	13.594	9.44	9.905	9.77	6.632	10.23	0.37	1.85	2.60	1.86	1.65
00331+2656	13.620	10.25	12.790	10.21	8.544	10.76	6.281	10.81	0.55	2.41	1.16	1.67	2.2
00486+0004	13.484	9.84	12.980	9.67	8.955	10.13	5.928	10.49	-0.39	2.19	2.25	1.78	1.73
00507+0426	13.833	9.61	13.400	9.41	9.360	9.87	6.915	10.00	-0.60	2.20	1.42	1.46	1.51
00523+1643	13.196	10.14	12.708	9.96	8.668	10.42	6.062	10.62	-0.44	2.20	1.65	1.57	1.84
01097+2733	14.641	9.49	13.396	9.63	9.510	10.03	6.698	10.31	1.85	2.05	1.94	1.98	1.79
01185+2547	14.062	10.04	13.277	9.98	9.086	10.50	5.302	11.17	0.42	2.36	3.33	2.36	2.08
01208+3525	12.974	10.03	12.352	9.91	7.905	10.53	5.069	10.82	-0.05	2.61	1.98	1.95	1.72
01236+3504	14.386	9.63	13.956	9.43	9.847	9.92	≥ 7.76	≤ 9.91	-0.61	2.27	...	...	1.93
01348+3254	11.055	11.84	9.986	11.89	7.089	11.90	4.433	12.11	1.25	1.06	1.72	1.32	3.03–3.31
01411+1551	...	...	...	...	...	...	...	...	...	...	...	...	1.5
01478+1254	14.298	9.75	12.960	9.91	8.622	10.49	5.745	10.80	2.03	2.50	2.04	2.26	1.85
01506+2554	10.529	11.95	9.459	12.00	7.103	11.79	4.852	11.85	1.25	0.52	1.15	0.86	3.06
01572+0009	10.752	11.26	9.757	11.28	6.362	11.49	3.129	11.93	1.03	1.56	2.54	1.81	2.08
02054+0835	12.225	11.32	10.976	11.44	7.006	11.88	4.359	12.09	1.77	2.13	1.71	1.93	2.78–3.30
02072+2336	13.280	9.91	12.608	9.80	8.601	10.25	6.074	10.42	0.10	2.17	1.54	1.60	1.58
02077+2255	13.349	9.80	12.883	9.61	9.116	9.96	6.611	10.12	-0.50	1.93	1.51	1.38	1.54
02124+2550	13.503	9.90	13.040	9.71	8.663	10.31	6.250	10.43	-0.51	2.54	1.38	1.63	1.67
02173+2143	12.789	10.05	12.449	9.81	8.918	10.07	6.343	10.25	-0.87	1.70	1.61	1.23	1.53
02183+2254	12.722	10.40	12.100	10.28	7.992	10.77	5.342	10.98	-0.05	2.27	1.71	1.69	1.94
02290+3139	13.487	10.39	12.519	10.40	8.567	10.83	5.653	11.15	0.96	2.12	2.09	1.91	2.11
02323+0626	...	...	...	...	...	...	...	...	...	...	...	...	1.75
02354+1926	12.457	10.44	11.969	10.26	7.592	10.86	5.499	10.85	-0.44	2.54	0.92	1.48	1.9
02411+0353	12.750	10.35	11.877	10.32	7.432	10.95	4.359	11.33	0.68	2.61	2.31	2.18	1.89
02459+2236	...	...	...	...	...	...	...	...	...	...	...	...	1.98
02477+2654	13.192	9.98	12.645	9.82	8.451	10.35	5.094	10.84	-0.27	2.36	2.72	2.04	1.71
02488+3542	...	...	...	...	...	...	...	...	...	...	...	...	1.69
03248+1756	13.547	9.91	13.037	9.74	9.313	10.08	6.629	10.31	-0.38	1.89	1.76	1.46	1.81
03250+1606	12.935	10.18	12.310	10.05	8.138	10.57	5.311	10.86	-0.04	2.34	1.96	1.81	1.97
03477+2611	12.873	10.33	12.020	10.30	8.730	10.46	6.005	10.71	0.62	1.45	1.82	1.44	1.98
03533+2606	12.706	10.60	11.321	10.78	7.485	11.16	4.609	11.46	2.17	2.00	2.03	2.04	1.85
04046+1011	13.559	10.24	13.106	10.05	8.906	10.58	6.595	10.65	-0.54	2.36	1.23	1.49	2.05
04137+1217	13.711	10.26	12.116	10.53	8.498	10.82	5.547	11.16	2.78	1.78	2.14	2.07	2.19
04229+0056	13.625	10.05	13.001	9.93	8.778	10.47	5.612	10.88	-0.04	2.39	2.45	2.00	1.92
04413+2608	11.657	10.94	10.256	11.12	7.390	11.12	4.616	11.38	2.21	1.03	1.89	1.52	2.04
04479+0616	12.753	10.16	12.097	10.05	8.055	10.51	5.418	10.72	0.05	2.21	1.69	1.67	1.46
05324+0252	13.555	10.08	12.866	9.98	8.756	10.48	6.137	10.68	0.14	2.27	1.67	1.71	1.61
05559+1020	...	...	...	...	...	...	...	...	...	...	...	...	2
06268+3509	13.571	10.16	12.838	10.08	8.500	10.67	5.440	11.04	0.27	2.50	2.30	2.06	2.07
06368+2812	12.524	10.32	11.897	10.19	7.462	10.82	5.389	10.80	-0.04	2.60	0.89	1.57	1.69
06561+1902	14.035	10.07	13.343	9.97	8.921	10.59	5.119	11.26	0.15	2.59	3.35	2.44	2.12
06587+3043	...	...	...	...	...	...	...	...	...	...	...	...	1.97–2.43
07178+1952	...	...	...	...	...	...	...	...	...	...	...	...	1.67
07188+0407	13.088	9.93	12.585	9.75	8.563	10.21	5.811	10.46	-0.40	2.19	1.86	1.64	1.57
07241+3052	12.993	10.03	12.566	9.82	8.337	10.36	5.341	10.71	-0.62	2.39	2.21	1.82	1.62
07328+0457	13.133	10.11	12.268	10.08	8.394	10.48	5.113	10.94	0.66	2.04	2.61	2.00	1.82
07381+3215	13.841	10.06	13.023	10.01	8.609	10.63	5.901	10.86	0.52	2.58	1.80	1.96	1.94
07488+0501	13.576	10.18	12.986	10.04	8.992	10.49	6.338	10.70	-0.14	2.16	1.72	1.62	2.29
08003+0734	13.037	10.06	12.569	9.87	8.577	10.32	6.339	10.37	-0.50	2.16	1.13	1.36	1.71
08007+0711	13.236	10.13	12.629	10.00	8.116	10.66	5.075	11.02	-0.09	2.68	2.27	2.07	1.79
08012+0125	...	...	...	...	...	...	...	...	...	...	...	...	2.24
08122+0505	12.018	10.35	11.140	10.33	7.519	10.62	4.728	10.89	0.69	1.79	1.91	1.65	1.61
08132+1628	...	...	...	...	...	...	...	...	...	...	...	...	1.59
08147+3137	13.132	10.07	11.459	10.36	7.670	10.73	4.709	11.06	3.00	1.95	2.16	2.20	1.8

Notes. (U)LIRGs without OH detections in the Arecibo survey taken from Darling & Giovanelli (2000, 2001, 2002). Notes of Cols. 1–13 are the same as those of Table 6. Column 14: the upper limit of OH maser luminosity was derived from their non-detection spectra (Darling & Giovanelli 2000, 2001, 2002).

Table 7. continued.

IRAS Name	W1	$\log v_1 L_1$	W2	$\log v_2 L_2$	W3	$\log v_3 L_3$	W4	$\log v_4 L_4$	α_{21}	α_{32}	α_{43}	α_{41}	$\log L_{\text{OH}}^{UL}$
08200+1931	16.640	8.93	16.238	8.72	≥ 11.917	≤ 9.30	≥ 8.369	≤ 9.87	-0.69	...	...	...	2.05
08206+3111	13.233	10.19	12.710	10.03	8.595	10.56	5.893	10.76	-0.34	2.38	1.64	1.67	2.04
08224+1329	13.591	9.94	12.919	9.84	8.226	10.56	5.324	10.88	0.10	2.86	2.07	2.12	1.79
08232+0058	11.918	11.14	10.791	11.21	7.843	11.24	5.152	11.47	1.42	1.11	1.77	1.39	2.38
08235+1334	...	...	...	...	...	...	...	...	...	...	...	...	1.79
08349+3050	13.929	9.63	13.530	9.42	9.461	9.89	6.442	10.25	-0.70	2.23	2.24	1.74	1.66
08409+0750	...	...	...	...	...	...	...	...	...	...	...	...	1.6
08433+2702	...	...	...	...	...	...	...	...	...	...	...	...	1.65
08519+2017	10.386	11.95	9.346	11.99	6.619	11.93	4.343	11.99	1.16	0.89	1.18	1.04	3.14
08559+1053	11.514	10.87	10.456	10.92	7.269	11.04	4.719	11.21	1.22	1.35	1.57	1.40	1.69
09049+0137	13.492	9.75	12.868	9.63	9.114	9.98	6.898	10.06	-0.04	1.92	1.24	1.35	1.71
09116+0334	12.688	10.39	12.152	10.23	8.115	10.69	5.420	10.92	-0.30	2.20	1.78	1.64	1.97
09302+3241	13.849	9.70	13.196	9.59	9.059	10.09	6.155	10.40	0.04	2.30	2.07	1.84	1.83
09425+1751	13.036	10.13	11.135	10.52	6.851	11.08	3.562	11.55	3.67	2.45	2.62	2.71	1.82
09517+1458	...	...	...	...	...	...	...	...	...	...	...	...	1.85
09525+1602	14.667	9.40	14.324	9.17	10.146	9.69	6.943	10.12	-0.86	2.34	2.50	1.86	1.68
09540+3521	13.535	9.72	13.097	9.52	9.196	9.93	6.533	10.15	-0.59	2.07	1.73	1.51	1.59
09576+1858	12.500	10.20	12.029	10.01	7.650	10.61	5.324	10.69	-0.49	2.54	1.25	1.59	1.6
10034+0726	...	...	...	...	...	...	...	...	...	...	...	...	1.83
10040+0932	14.048	9.98	12.991	10.03	8.586	10.64	5.629	10.97	1.21	2.57	2.15	2.20	2.09
10086+2621	11.880	10.52	11.017	10.49	7.592	10.71	5.095	10.86	0.65	1.59	1.50	1.40	1.72
10113+1736	13.928	9.68	13.295	9.56	9.306	10.01	6.2247	10.38	-0.02	2.15	2.29	1.84	1.73
10120+1653	13.604	9.88	13.061	9.72	9.159	10.14	6.576	10.32	-0.28	2.07	1.62	1.52	1.54
10138+0913	13.490	9.76	13.114	9.53	8.737	10.13	6.490	10.18	-0.77	2.54	1.14	1.50	1.63
10156+1551	13.639	9.77	13.114	9.60	9.133	10.04	5.943	10.47	-0.33	2.15	2.48	1.84	1.68
10201+3308	13.618	9.88	12.943	9.78	8.205	10.52	5.198	10.88	0.10	2.90	2.22	2.20	1.79
10214+0015	13.071	10.10	12.387	10.00	8.205	10.52	4.965	10.97	0.13	2.35	2.55	2.04	1.84
10218+1511	13.216	9.93	12.567	9.82	8.103	10.45	5.090	10.81	0.03	2.63	2.23	2.05	1.69
10222+1532	12.785	10.10	12.474	9.85	8.371	10.34	6.223	10.35	-0.95	2.27	1.00	1.29	1.67
10482+1909	13.209	10.53	12.314	10.51	8.318	10.96	5.722	11.15	0.74	2.16	1.64	1.74	2.23
10579+0438	...	...	...	...	...	...	...	...	...	...	...	...	2.24
10597+2736	...	...	...	...	...	...	...	...	...	...	...	...	1.73
11009+2822	13.411	10.00	11.921	10.22	7.848	10.70	4.623	11.14	2.47	2.24	2.53	2.38	1.77
11119+3257	9.901	11.72	8.830	11.78	6.154	11.70	3.596	11.87	1.25	0.84	1.58	1.16	2.05
11175+0917	13.800	9.84	13.159	9.72	8.744	10.34	6.536	10.37	0.00	2.58	1.08	1.63	1.79
11188+1138	13.176	10.40	12.273	10.38	8.196	10.86	5.322	11.16	0.77	2.24	2.03	1.92	2.13
11233+3451	11.215	10.74	10.078	10.82	6.767	10.99	4.381	11.10	1.45	1.48	1.34	1.42	1.68
11243+1655	14.744	9.36	14.373	9.13	12.109	8.89	≥ 8.372	≤ 9.53	-0.78	0.43	...	...	1.68
11268+1558	...	...	...	...	...	...	...	...	...	...	...	...	2
11347+2026	...	...	...	...	...	...	...	...	...	...	...	...	1.73
11415+0927	12.716	10.12	12.189	9.96	7.850	10.54	5.505	10.63	-0.33	2.50	1.28	1.61	1.66
11434+0159	13.390	9.83	13.009	9.60	9.181	9.99	6.235	10.32	-0.75	1.99	2.13	1.58	1.62
11477+2158	14.367	9.76	13.826	9.60	9.448	10.20	6.676	10.46	-0.29	2.54	1.89	1.84	1.93
11506+1331	12.864	10.20	11.450	10.39	7.400	10.86	4.583	11.14	2.25	2.21	1.95	2.13	1.91
11511+0946	13.708	9.93	13.219	9.75	9.208	10.21	5.609	10.80	-0.44	2.18	3.06	2.04	1.92
11582+3020	14.336	10.09	13.392	10.10	8.407	10.94	5.726	11.17	0.89	3.15	1.76	2.29	2.45
11595+1144	13.584	10.27	12.643	10.27	8.526	10.77	5.684	11.06	0.88	2.28	1.99	1.94	2.23
12107+3157	14.302	10.04	13.389	10.03	9.012	10.63	5.621	11.14	0.80	2.54	2.77	2.33	...
12111+2848	12.323	10.23	11.836	10.05	7.438	10.66	4.884	10.83	-0.44	2.56	1.58	1.72	1.76
12114+3244	13.572	9.75	12.836	9.67	8.265	10.35	4.590	10.97	0.28	2.74	3.17	2.47	1.67
12202+1646	13.815	10.12	13.494	9.88	10.534	9.91	≥ 8.889	≤ 9.72	-0.93	1.12	...	...	2.15
12265+0219	8.369	12.18	7.407	12.19	5.147	11.95	2.944	11.98	0.94	0.42	1.08	0.73	2.47
12461+0416	13.695	9.71	13.121	9.56	8.508	10.26	5.608	10.57	-0.19	2.78	2.07	2.04	1.64
12468+3436	...	...	...	...	...	...	...	...	...	...	...	...	1.83
12491+0811	...	...	...	...	...	...	...	...	...	...	...	...	1.59
12514+1027	11.007	11.74	9.694	11.89	7.231	11.72	4.707	11.88	1.96	0.63	1.53	1.16	2.45
12526+1025	12.864	10.06	12.456	9.85	8.080	10.45	5.885	10.48	-0.67	2.54	1.07	1.49	1.63
12551+0825	12.014	11.19	11.013	11.21	8.247	11.17	5.289	11.51	1.05	0.93	2.15	1.37	2.38
12569+3135	13.849	9.61	12.837	9.64	8.786	10.11	5.679	10.51	1.08	2.22	2.36	2.08	1.54
13014+3524	14.300	10.16	13.652	10.05	9.734	10.47	6.456	10.93	0.03	2.08	2.61	1.92	2.53
13034+0017	14.005	9.80	13.193	9.75	8.826	10.35	5.666	10.77	0.50	2.53	2.44	2.16	1.96
13064+2057	12.653	10.19	12.162	10.01	7.980	10.53	5.622	10.63	-0.43	2.35	1.30	1.52	1.99
13145+2356	13.834	9.88	12.331	10.10	9.155	10.22	6.391	10.48	2.51	1.34	1.88	1.72	1.92
13156+0435	12.993	10.04	12.123	10.02	8.139	10.46	5.084	10.83	0.69	2.14	2.29	1.95	1.68
13163+3209	13.686	9.88	13.131	9.73	9.310	10.10	6.151	10.52	-0.25	1.99	2.44	1.77	1.92
13180+0133	12.941	9.99	12.223	9.90	7.284	10.72	4.823	10.86	0.23	3.10	1.44	2.05	1.6

Table 7. continued.

IRAS Name	W1	$\log v_1 L_1$	W2	$\log v_2 L_2$	W3	$\log v_3 L_3$	W4	$\log v_4 L_4$	α_{21}	α_{32}	α_{43}	α_{41}	$\log L_{\text{OH}}^{UL}$
13243+2042	13.599	9.95	12.894	9.85	8.549	10.44	5.391	10.86	0.19	2.51	2.44	2.09	1.86
13349+2438	8.257	11.89	7.128	11.97	4.585	11.84	2.642	11.77	1.42	0.71	0.71	0.83	1.69
13380+3339	13.560	10.50	12.647	10.49	8.886	10.85	5.315	11.43	0.80	1.93	3.02	2.11	2.88
13442+2321	13.245	10.14	12.944	9.89	9.746	10.01	5.805	10.74	-0.98	1.36	3.55	1.72	1.89
13446+1623	12.672	10.72	11.666	10.75	8.421	10.90	5.553	11.20	1.07	1.41	2.02	1.56	2.39
13451+1232	11.395	10.74	10.122	10.88	6.267	11.27	3.086	11.69	1.84	2.02	2.47	2.14	2.36
13457+3513	13.594	9.82	12.876	9.73	8.536	10.32	5.330	10.75	0.23	2.50	2.50	2.12	1.77
13478+1643	13.253	9.93	12.690	9.78	8.454	10.33	5.498	10.66	-0.22	2.40	2.15	1.87	1.67
13509+0442	13.284	10.09	12.350	10.08	7.971	10.69	5.073	11.00	0.86	2.54	2.07	2.10	2.07
13539+2920	12.843	10.07	12.055	10.01	7.749	10.58	5.015	10.82	0.43	2.47	1.83	1.91	1.67
13542+1040	12.849	10.18	11.428	10.37	7.569	10.76	4.078	11.31	2.27	2.02	2.91	2.37	1.67
14020+1036	12.821	10.02	12.329	9.84	7.927	10.45	5.853	10.44	-0.43	2.57	0.89	1.49	1.54
14030+3526	13.470	9.81	12.523	9.81	8.322	10.34	6.011	10.42	0.89	2.37	1.23	1.73	1.73
14041+0117	12.463	10.90	10.677	11.24	6.526	11.74	3.851	11.97	3.33	2.32	1.75	2.29	2.48
14060+2919	12.713	10.18	11.983	10.10	7.411	10.78	4.484	11.10	0.26	2.74	2.11	2.10	1.65
14111+1819	13.650	9.77	13.030	9.64	8.797	10.22	5.569	10.63	-0.06	2.50	2.39	2.03	1.68
14183+0009	12.793	10.03	12.408	9.81	8.729	10.13	6.615	10.13	-0.74	1.84	0.95	1.10	1.59
14197+0813	13.177	10.10	12.796	9.91	8.592	10.40	5.042	10.98	-0.46	2.27	2.99	2.06	1.72
14202+2615	12.000	10.73	10.890	10.80	7.508	11.01	4.729	11.27	1.37	1.55	1.90	1.64	1.82
14219+2009	9.808	11.28	9.908	10.86	8.991	10.08	6.297	10.31	-2.15	-0.92	1.78	-0.20	1.52
14228+2742	13.221	10.12	12.655	9.98	8.294	10.57	5.522	10.83	-0.21	2.53	1.89	1.85	1.78
14232+0735	13.854	9.97	13.637	9.68	10.227	9.90	8.151	9.88	-1.23	1.57	0.90	0.87	1.98
14312+2825	12.950	10.44	12.148	10.38	7.993	10.90	5.361	11.10	0.47	2.32	1.69	1.79	2.07
14405+2634	13.334	9.86	12.603	9.78	8.442	10.29	5.421	10.65	0.27	2.33	2.24	1.95	1.69
14459+1745	13.439	10.13	13.144	9.87	9.597	10.18	6.309	10.61	-1.00	1.81	2.48	1.57	1.97
14469+1402	13.309	9.84	12.953	9.61	8.721	10.15	6.917	10.03	-0.82	2.40	0.51	1.21	1.58
14488+3521	12.918	10.59	12.087	10.55	7.860	11.09	5.448	11.20	0.56	2.39	1.37	1.73	2.27
14538+1730	12.154	10.30	11.671	10.12	7.551	10.62	5.117	10.74	-0.45	2.28	1.41	1.52	1.67
14550+0715	12.651	10.36	12.121	10.20	7.712	10.81	5.548	10.83	-0.32	2.57	1.02	1.55	1.91
14575+3256	12.913	10.08	12.326	9.94	7.694	10.64	4.756	10.97	-0.15	2.80	2.12	2.07	1.8
15001+1433	12.328	10.62	11.037	10.77	7.429	11.06	4.316	11.46	1.89	1.77	2.37	2.00	2.01
15005+3555	11.590	10.68	11.467	10.35	11.420	9.22	≥ 9.068	≤ 9.31	-1.50	-1.88	...	...	1.78
15059+2835	...	...	...	...	...	...	...	...	...	...	...	...	1.67
15069+1808	...	...	...	...	...	...	...	...	...	...	...	...	2.08
15158+2747	13.109	10.30	12.424	10.20	8.063	10.79	5.787	10.85	0.13	2.53	1.18	1.66	1.94
15165+1553	...	...	...	...	...	...	...	...	...	...	...	...	1.72
15168+0045	13.581	10.07	13.177	9.86	9.801	10.06	7.733	10.04	-0.68	1.54	0.89	0.94	2.09
15206+3342	12.474	10.33	11.245	10.45	6.797	11.08	3.602	11.51	1.71	2.61	2.49	2.42	1.84
15225+2350	13.016	10.21	11.783	10.33	7.771	10.78	4.681	11.17	1.73	2.18	2.34	2.16	1.86
15438+0438	17.115	9.04	≥ 17.084	≤ 8.67	≥ 12.142	≤ 9.50	≥ 8.674	≤ 10.04	...	...	...	...	2.72
15445+3312	14.552	9.70	14.097	9.50	10.293	9.87	7.442	10.17	-0.54	1.97	2.00	1.56	2.12
15543+3013	13.664	9.83	13.037	9.71	8.520	10.37	5.310	10.80	-0.04	2.68	2.51	2.17	1.85
15563+1233	13.889	10.19	12.987	10.18	8.909	10.66	6.154	10.92	0.76	2.24	1.86	1.86	2.24
15597+3133	14.464	9.66	14.073	9.44	9.865	9.98	7.200	10.19	-0.72	2.37	1.73	1.63	1.88
16045+2733	12.484	10.25	11.905	10.11	7.503	10.72	4.953	10.89	-0.18	2.57	1.57	1.76	1.61
16075+0059	12.814	10.47	12.389	10.26	8.048	10.85	5.627	10.97	-0.62	2.51	1.39	1.60	1.88
16121+2611	11.092	10.93	10.191	10.92	7.366	10.90	4.747	11.09	0.76	0.99	1.67	1.18	1.92
16142+0321	...	...	...	...	...	...	...	...	...	...	...	...	1.59
16156+0146	13.098	10.13	10.706	10.72	6.980	11.06	3.897	11.44	5.09	1.89	2.33	2.58	1.82
16280+0531	...	...	...	...	...	...	...	...	...	...	...	...	1.95-2.21
16283+0442	12.606	10.27	12.025	10.13	7.869	10.64	5.476	10.75	-0.17	2.32	1.35	1.57	1.59
16336+1019	13.409	10.09	13.323	9.75	≥ 12.655	≤ 8.87	≥ 9.209	≤ 9.40	-1.61	...	...	...	1.98
16380+1508	14.233	9.86	13.474	9.79	9.512	10.22	6.768	10.47	0.32	2.13	1.85	1.73	1.67
16474+3430	12.326	10.30	11.511	10.25	7.286	10.79	4.510	11.05	0.51	2.39	1.89	1.90	1.66
16523+3126	13.929	9.58	12.669	9.71	8.073	10.40	4.706	10.90	1.80	2.76	2.73	2.59	1.64
16525+3322	13.856	9.85	12.862	9.88	8.303	10.55	5.064	11.00	1.03	2.72	2.55	2.38	1.93
16544+3212	13.580	9.44	12.650	9.01	≥ 8.130	≤ 10.62	≥ 4.970	≤ 11.06	0.84	...	...	...	2.03
17023+0232	11.785	10.70	10.797	10.72	7.717	10.80	5.090	11.01	1.01	1.24	1.68	1.36	1.89
17030+0457	14.127	9.63	13.835	9.37	10.179	9.69	7.419	9.94	-1.01	1.82	1.87	1.36	1.63
17114+2059	13.004	10.10	12.462	9.94	8.974	10.18	5.608	10.68	-0.28	1.65	2.73	1.70	1.87
17129+1004	13.515	9.83	13.001	9.66	9.100	10.07	6.235	10.37	-0.36	2.07	2.02	1.64	1.74
17156+1238	13.725	9.75	12.589	9.83	8.569	10.29	5.462	10.68	1.44	2.18	2.36	2.12	1.81
17225+0256	15.437	9.05	15.558	8.63	≥ 12.355	≤ 8.76	≥ 9.018	≤ 9.25	-2.21	...	...	...	1.59
17281+3120	...	...	...	...	...	...	...	...	...	...	...	...	2.61
17481+2135	15.123	9.22	14.960	8.91	≥ 12.927	≤ 8.57	≥ 9.256	≤ 9.19	-1.38	...	...	...	1.78
17490+2659	9.902	11.50	8.898	11.52	6.153	11.47	3.933	11.51	1.06	0.91	1.10	1.00	1.83

Table 7. continued.

IRAS Name	W1	$\log v_1 L_1$	W2	$\log v_2 L_2$	W3	$\log v_3 L_3$	W4	$\log v_4 L_4$	α_{21}	α_{32}	α_{43}	α_{41}	$\log L_{\text{OH}}^{UL}$
17491+1531	...	...	...	...	...	...	...	...	...	...	...	...	2.37
17546+1356	13.201	10.01	12.451	9.94	8.505	10.37	6.156	10.46	0.32	2.11	1.28	1.53	1.57
17574+0629	12.305	10.29	11.481	10.24	6.931	10.91	3.866	11.29	0.54	2.71	2.30	2.21	1.48
18030+0705	...	...	...	...	...	...	...	...	...	...	...	...	1.85
18040+2141	14.341	9.41	14.112	9.13	11.263	9.12	≥ 8.543	≤ 9.36	-1.19	1.01	...	...	1.42
18065+3117	...	...	...	...	...	...	...	...	...	...	...	...	1.7
18147+1553	12.226	10.26	9.828	10.85	6.872	10.88	4.113	11.13	5.11	1.12	1.87	2.05	1.45
18222+1440	...	...	...	...	...	...	...	...	...	...	...	...	1.75
18286+2808	12.704	10.09	11.626	10.15	8.002	10.45	5.357	10.66	1.28	1.79	1.71	1.67	1.58
18315+2249	12.551	10.35	10.851	10.65	7.547	10.82	4.253	11.29	3.08	1.47	2.63	2.14	1.68
18407+3558	11.822	10.44	11.088	10.36	7.572	10.61	5.150	10.73	0.28	1.68	1.39	1.34	1.63
18585+2148	13.689	9.75	13.877	9.30	≥ 12.971	≤ 8.51	≥ 9.372	≤ 9.10	-2.40	...	...	...	1.7
19040+3356	...	...	...	...	...	...	...	...	...	...	...	...	2
19084+3719	≥ 18.812	≤ 7.68	≥ 17.364	≤ 7.89	12.153	8.82	≥ 8.669	≤ 9.37	...	...	...	...	1.57
19348+3400	15.115	9.11	15.749	8.48	≥ 12.395	≤ 8.67	≥ 9.366	≤ 9.04	-3.70	...	...	...	1.49
19458+0944	12.447	10.15	11.652	10.10	7.532	10.59	4.339	11.02	0.45	2.28	2.49	2.05	1.53
19559+1618	12.817	10.29	12.209	10.16	8.561	10.47	5.189	10.97	-0.09	1.81	2.74	1.81	1.78
20090+0129	13.986	9.55	13.436	9.40	9.006	10.02	6.514	10.17	-0.26	2.59	1.49	1.73	1.55
20246+0106	12.851	10.11	12.000	10.08	7.472	10.74	4.479	11.09	0.62	2.69	2.20	2.17	1.76
20318+2343	13.054	9.92	12.629	9.72	8.714	10.13	5.573	10.54	-0.62	2.08	2.41	1.74	1.49
20322+1849	12.415	10.22	11.342	10.28	7.858	10.52	5.220	10.73	1.26	1.65	1.70	1.60	1.76
20344+0619	13.487	10.17	12.708	10.11	8.351	10.70	5.507	10.99	0.41	2.52	1.99	1.98	1.99
20361+1216	13.423	10.00	12.821	9.87	8.459	10.46	5.616	10.75	-0.11	2.53	1.99	1.90	1.77
20394+2302	12.787	10.06	11.959	10.02	7.622	10.60	4.538	10.99	0.55	2.50	2.33	2.11	1.34
20398+2745	12.145	10.30	10.782	10.47	6.475	11.04	3.389	11.42	2.10	2.47	2.33	2.36	1.71
20402+1642	14.035	9.80	13.182	9.76	8.645	10.43	5.570	10.81	0.62	2.70	2.32	2.22	1.84
20450+0913	12.523	10.29	12.052	10.11	7.625	10.73	5.477	10.74	-0.49	2.59	1.00	1.53	1.84
20460+1925	9.736	11.75	8.501	11.87	5.545	11.90	3.131	12.02	1.73	1.12	1.38	1.31	2.12
20551+2441	9.797	11.98	8.695	12.09	5.678	12.11	3.189	12.25	1.64	1.08	1.48	1.31	2.93
21026+1042	12.729	10.11	12.350	9.88	8.159	10.41	5.572	10.60	-0.76	2.36	1.62	1.58	1.4
21064+2155	12.391	10.24	11.989	10.03	8.060	10.45	6.136	10.37	-0.69	2.09	0.68	1.14	1.65
21135+0553	12.745	10.08	12.258	9.90	8.285	10.34	5.487	10.61	-0.44	2.14	1.92	1.63	1.6
21167+0819	12.963	9.96	12.531	9.76	8.387	10.27	6.429	10.20	-0.60	2.31	0.73	1.28	1.41
21251+1114	15.885	8.89	15.830	8.54	≥ 12.712	≤ 8.64	≥ 9.097	≤ 9.23	-1.70	...	...	...	1.5
21256+0219	12.765	10.85	10.971	11.19	6.976	11.64	4.207	11.90	3.36	2.16	1.88	2.27	2.37
21329+0705	13.393	9.91	12.551	9.87	8.018	10.53	4.907	10.93	0.59	2.70	2.37	2.23	1.59
21444+3534	12.573	10.47	10.769	10.81	7.307	11.05	4.561	11.30	3.39	1.63	1.85	2.00	1.89
21477+0502	14.083	9.96	13.129	9.97	8.662	10.61	5.009	11.22	0.91	2.63	3.14	2.52	2.04
21534+3504	≥ 18.601	≤ 7.72	≥ 17.222	≤ 7.90	11.156	9.18	≥ 8.663	≤ 9.33	...	...	...	...	1.66
22057+0739	...	...	...	...	...	...	...	...	...	...	...	...	1.66
22068+2703	...	...	...	...	...	...	...	...	...	...	...	...	1.97
22139+2448	...	...	...	...	...	...	...	...	...	...	...	...	1.88
22285+3555	12.615	10.23	11.929	10.13	7.561	10.72	4.701	11.02	0.14	2.53	2.01	1.95	1.72
22368+0904	...	...	...	...	...	...	...	...	...	...	...	...	1.67
22416+1621	12.190	10.83	12.235	10.44	12.755	9.08	≥ 8.764	≤ 9.83	-1.99	-2.36	...	...	2.04
22428+3215	14.477	9.73	14.571	9.32	≥ 12.187	≤ 9.12	8.703	9.67	-2.13	...	...	...	1.99
22541+0833	13.775	10.06	13.066	9.97	8.791	10.53	5.456	11.02	0.20	2.44	2.69	2.15	1.86
22583+1703	11.829	10.55	10.945	10.53	7.584	10.73	5.046	10.89	0.71	1.53	1.55	1.40	1.69
22584+2348	12.980	9.96	12.571	9.75	8.694	10.15	6.068	10.35	-0.67	2.04	1.68	1.46	1.6
23018+0333	14.535	9.47	13.197	9.63	9.132	10.10	6.001	10.51	2.03	2.23	2.40	2.25	1.68
23055+2127	12.342	10.21	11.955	9.99	7.970	10.44	5.421	10.61	-0.73	2.15	1.57	1.47	1.61
23060+0505	9.797	11.69	8.595	11.80	5.678	11.81	3.189	11.96	1.64	1.08	1.48	1.31	2.43
23068+3014	13.134	10.11	12.607	9.95	8.434	10.47	5.682	10.72	-0.33	2.34	1.86	1.73	1.72
23073+0005	13.243	9.87	12.777	9.68	8.642	10.18	6.426	10.22	-0.50	2.30	1.10	1.41	1.6
23113+0314	14.189	10.43	12.831	10.59	8.207	11.29	4.600	11.89	2.09	2.79	3.07	2.77	3.28
23140+0348	13.089	10.58	12.239	10.55	8.991	10.69	5.541	11.23	0.61	1.41	2.85	1.77	2.46
23152+1318	13.375	9.84	13.036	9.61	9.237	9.97	6.755	10.12	-0.87	1.96	1.47	1.32	1.48
23219+2919	17.290	8.98	≥ 16.439	≤ 8.94	12.640	9.31	≥ 9.379	≤ 9.77	...	...	...	...	2.57–2.95
23233+2817	12.494	10.25	11.216	10.39	7.103	10.88	3.916	11.31	1.86	2.28	2.48	2.28	1.65
23317+1141	...	...	...	...	...	...	...	...	...	...	...	...	1.62
23327+2913	12.838	10.05	11.979	10.02	7.884	10.51	4.209	11.13	0.64	2.26	3.17	2.30	1.68
23444+0441	12.916	10.44	12.164	10.36	8.147	10.82	5.786	10.92	0.33	2.18	1.30	1.57	2.33
23498+2423	11.508	11.18	10.363	11.27	7.620	11.21	4.908	11.45	1.47	0.91	1.80	1.31	2.22
23539+2322	13.466	10.60	11.354	11.07	6.923	11.69	4.342	11.87	4.28	2.60	1.61	2.54	2.45–2.80
23580+2636	14.352	9.71	13.677	9.60	9.482	10.13	7.432	10.10	0.10	2.36	0.86	1.47	1.85