The search of correlation of ultraviolet and infrared fluxes of galaxies with and without H2O masers

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This work presents a photometric study of galaxies with and without water (H2O) masers in the infrared (IR) and ultraviolet (UV) range based on the data from KINGFISH (70, 100, 160 μm), SINGS (3.6, 8.0, 24 μm) and GALEX (~1500 and 2200 Å) surveys. We investigate whether the UV and IR fluxes and/or their ratios can serve as indicators of the H2O maser hosting galaxies. The initial sample of galaxies was taken from [1] where the authors compiled a list of 85 galaxies with H2O masers and 70 galaxies without detected H2O masers. From this initial sample we have selected the galaxies for which there are data in all bands of all considered surveys. In total, 17 galaxies have been selected: 12 maser hosting galaxies (NGC 253, NGC 520, NGC 598, NGC 1068, NGC 3034, NGC3079, NGC 4214, NGC 4258, NGC 5194, NGC 5253, NGC 5256, NGC 6240) and 5 galaxies without detected H2O masers (NGC 1097, NGC 1566, NGC 4579, NGC 4594, NGC 4725). For all selected galaxies the aperture photometry was carried out according to the method described in [2] with circular apertures comprising the full spatial extent of a galaxy.

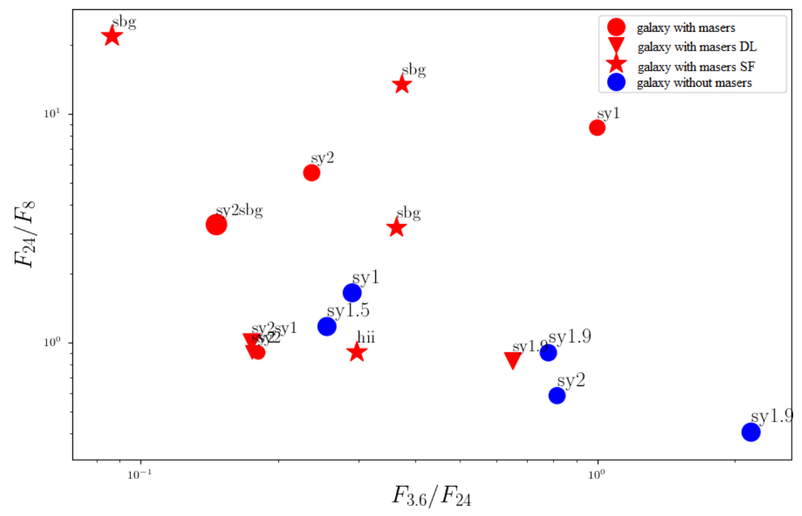


Figure 1 – Relation between $F3.6$ / $F24$ and $F24$ / $F8$ flux ratios. DL and SF denote galaxies where the masers are candidates for disk masers and galaxies with the masers associated with star formation regions, respectively. Point size is proportional to the logarithm of the maser luminosity. The points are labeled with a galaxy type (see [1]).

Results:

From Figure 1, it is seen that galaxies without masers and several galaxies with masers have $F24$ / $F8$ < 2 with a small scatter along the ordinate axis, which may indicate an almost identical amount of polycyclic aromatic hydrocarbons (PAHs) and very small grains (VSGs) in these galaxies. A half of galaxies with masers including all starburst galaxies (sbg) and galaxies with relatively high maser luminosity have $F24$ / $F8$ > 2 and form a distinct group in Figure 1. These galaxies with masers have a significantly lower flux at 8 μm that can be due to smaller contribution of large grains emission to the total flux at 8 μm in comparison to other galaxies. The contribution of large grains to the total flux at 8 μm can be lower due to the destruction of these grains by the emission of massive stars in star formation regions with which masers are associated in some of these galaxies.

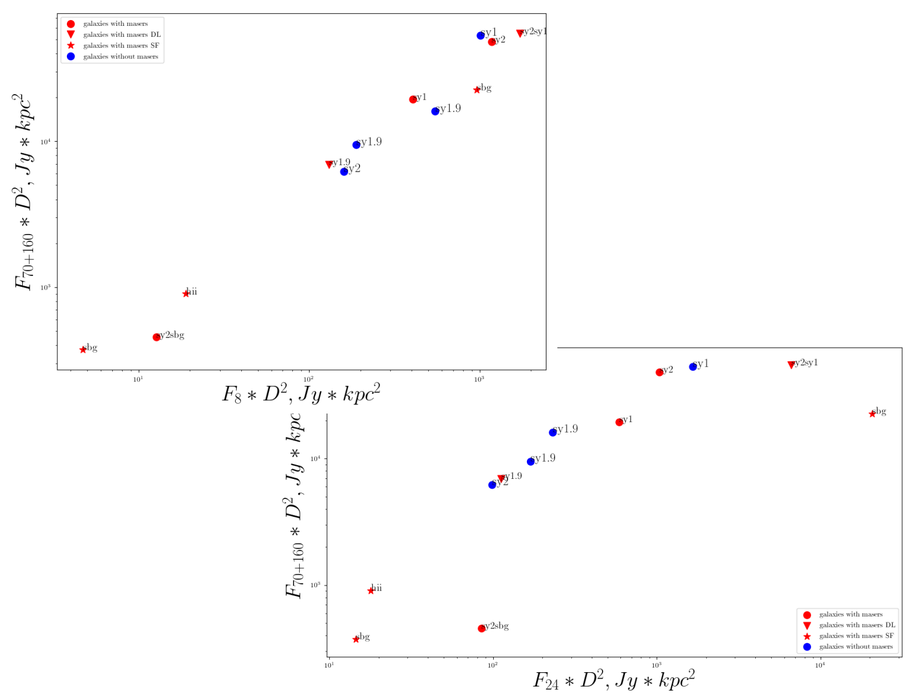
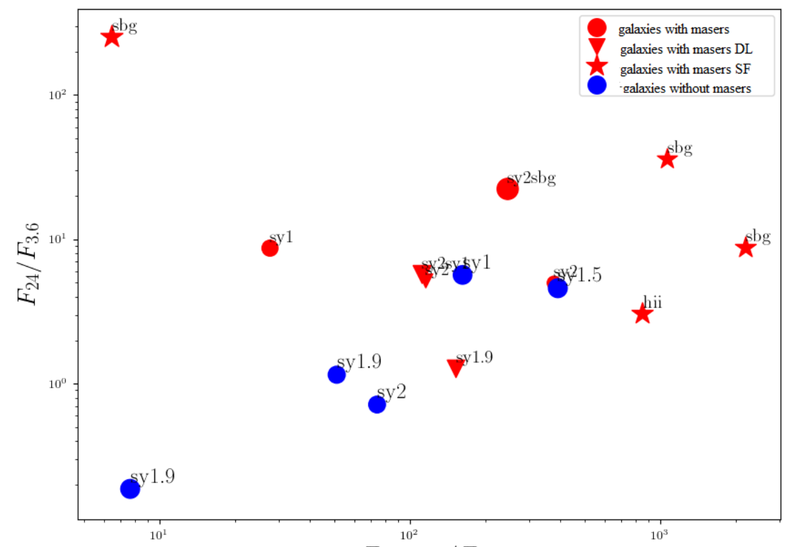


Figure 2 – Dependences of radiation fluxes at 8, 24 μm and total radiation of 70 and 160 μm, multiplied by the square of the distance to the galaxy (D). DL are candidates for disk masers, and SF are masers associated with star formation regions. Point size is proportional to the logarithm of luminosity masers.

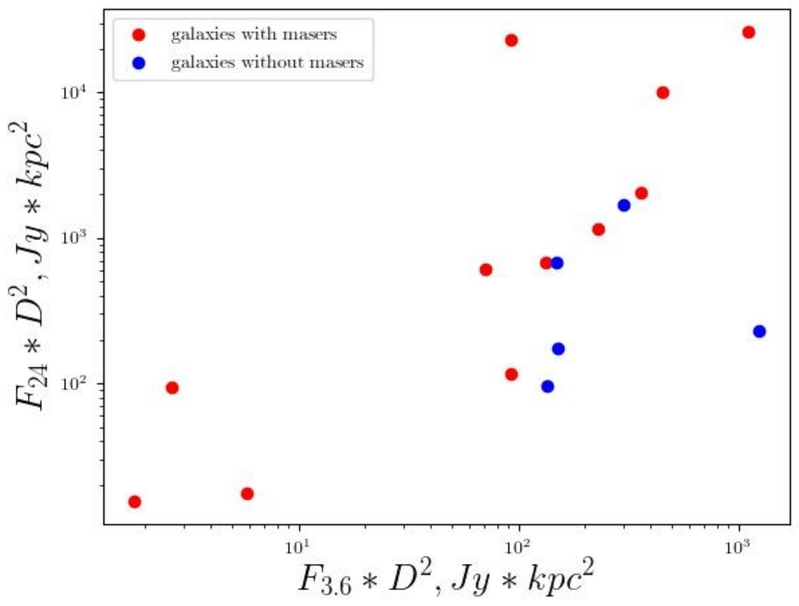
In Figure 2, it is seen that there is a correlation between the fluxes in the middle and far IR ranges taking into account the distance to galaxies. This correlation is characteristic of the hot dust emission in the vicinity of young stars. The correlation is the similar for the galaxies with and without masers except several galaxies with masers having low and high fluxes at 24 μm.

From the dependence of emission flux at 24 μm on UV flux shown in Figure 3 it follows that an increase in the UV emission corresponds to an an increase of the emission by PAHs and VSGs. This confirms the hypothesis expressed in many works (see e.g. [3]) that young stellar objects with the spectra having maximum in the UV range contribute to dust generation. The dependence is similar for both the galaxies with and without masers.



Figures 3 – Same as Figure 1 but for $FGALEX$ / $F3.6$ and $F24$ / $F3.6$ flux ratios.

Figure 4 clearly shows the correlation between the emission fluxes at 3.6 and 24 μm taking into the distance to galaxies. Three galaxies (NGC 598, NGC 4214, NGC 5253) have distinctly low fluxes at 3.6 and 24 μm in comparison to other galaxies. Such a difference in fluxes is explained neither by the difference in distance, nor by the galaxies morphological type and can be a subject for future studies.



Figures 4 – Relation between fluxes at 3.6 and 24 μm.

Conclusions:

The galaxies hosting H2O masers demonstrate the correlations between fluxes at different bands from UV to far-IR ranges that are similar to those for the galaxies without detected masers. There is a hint that the maser hosting galaxies may show higher $F24$ / $F8$ ratios in comparison to galaxies without masers which should be verified with larger samples of galaxies.

References

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