PROPERTIES OF OH MEGAMASER GALAXIES

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1. Abstract

An analysis of a sample of OH megamaser galaxies is presented. It is shown that the dependence of OH luminosity on FIR (far infrared) luminosity is not quadratic, as previously assumed, but closer to linear. Using a luminosity function of the luminous infrared galaxies, as well as linear relationship between OH and FIR luminosities the expected number of OH megamaser galaxies has been estimated. Spectral energy distributions (SED) of 16 megamaser galaxies have been constructed using multiwavelength (from radio to X-ray) data. The SED of megamasers look closely similar from radio to X-ray. It is shown that the maser amplification coefficient depends both on the OH main line to 60 micron ratio and the main line to 2.2 micron ratio. The OH main lines ratio (f1667/f1665) decreases, while the flux density at 10 micron is increasing.

2. Results

About 50 OH megamaser galaxies have been described by various authors (Kandalyan, 1996 and references therein), although according to Baan (1997) there are about 60 kilo- and megamasers together and some of them are unpublished. The quadratic relationship between OH and FIR luminosities has been discussed by Martin et al. (1988) and Baan (1989). According to Kandalyan (1996) the dependence of OH isotropic luminosity on FIR luminosity is not quadratic, but closer to linear and for a sample of 49 megamaser galaxies this relationship has the following form:

$L_{OH} = cL_{FIR}{}^{1.38}$ (see, Kandalyan 1996, for more detail), where luminosities are in solar units.

Following Baan (1989, 1991) we have estimated the dependence of the expected total number of megamasers on L_{OH}, but using the above stated relationship between L_{OH} and L_{FIR}, and the luminosity function of luminous infrared galaxies constructed by Saunders et al. (1990). Fig.1 presents the luminosity histogram of 49 detected OH megamaser galaxies. The dotted curve is the expected distribution of megamasers on OH luminosity. One can see from Fig.1 that a large number of megamasers with $logL_{OH} > 2$ has not been detected yet. The vast majority of these galaxies should be at high redshifts and part of these will comprise a population of so-called OH gigamasers (Burdyuzha and Komberg, 1990; Baan, 1991; Baan et al. 1992).
Let us now discuss the SED of OH megamaser galaxies. We have combined the flux densities measurements of megamasers from radio to X-ray wavelengths using the NED database. For 16 out of 49 galaxies we were able to construct an SED. In Fig.2, as an example of an SED of megamaser galaxies the spectral energy distribution of Mkn 273 is presented. Such a form for the SED is very typical among megamasers, namely the existence of two bumps at 60 and at 3 microns. For comparison in the same figure we have plotted the SED of IRAS 05189-2524, which belongs to the class of ultraluminous infrared galaxies as Mkn 273, but does not show OH emission. It seems likely that the 3 micron bump in megamasers is a common feature, while in the luminous infrared galaxies without OH emission this bump does not necessarily exist. The existence of 3 micron bump could either be due to hot dust (800 K) or, possibly, to nonthermal component associated with AGN

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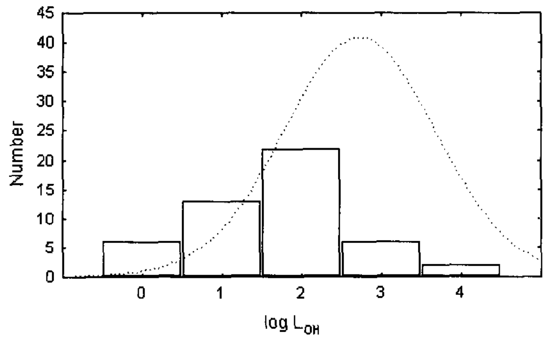

Figure 1. A histogram of 49 detected OH megamaser luminosities. The dotted curve is the expected number of megamaser galaxies.

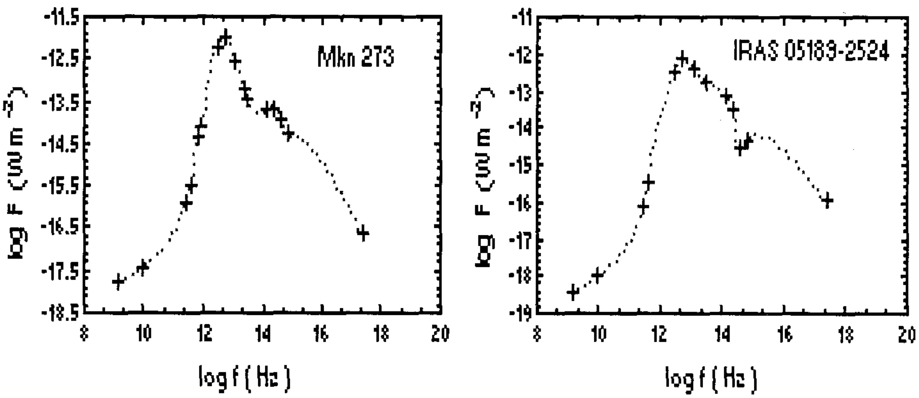

Figure 2. Spectral energy distributions of Mkn 273 (megamaser) and IRAS 05189-2524 (non-megamaser).

(Sanders et al. 1988).

In our recent paper (Kandalyan, 1996), we have discussed the relationship between the OH main line amplification coefficient (i.e. flux density ratio between the 1667 MHz line and the radio continuum) and the pumping efficiency (i.e. flux density ratio between 1667 MHz and $60\mu m$) for 35 megamaser galaxies. Since the megamaser galaxies exhibit substantial emission in the 1-3 micron range, we have examined the dependence of the amplification coefficient on the ratio f1667/f2.2, where f1667 and f2.2 are flux densities at 1667 MHz and 2.2 micron respectively. We find a tight correlation between them (corr.coeff = 0.91 at significance 0.0001). There is also a tight correlation between the OH main lines ratio (f1667/f1665) and the flux density at 10 micron, namely that the main line ratio decreases with an increasing flux density at 10 micron (corr.coeff. = - 0.78 at significance 0.01) (Fig.3).

New detections of mega- and gigamasers galaxies, as well as multiwavelength observations of these objects, will allow further investigation of their nature and actual relationship between starburst and nuclear activities.

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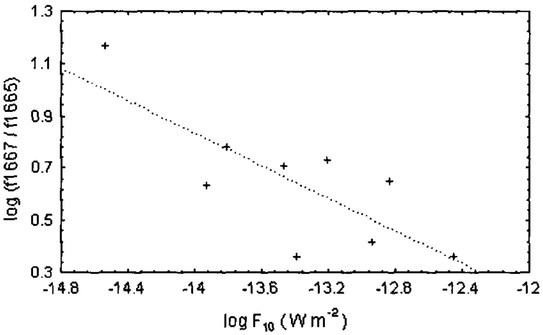

Figure 3. Dependence of the OH main line ratio (f1667/f1665) and the flux density at 10 micron. The dotted line is the regression line.

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