EXTRAGALACTIC OH MEGAMASERS IN LUMINOUS IRAS GALAXIES

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1°) Statistical studies:

About 40 OH megamasers have been discovered up to now, occuring in luminous IR galaxies; their far-infrared (FIR) luminosities, however, span a rather large range, from a few 10^{10} to several times 10^{12} solar luminosities.

The isotropic OH 1667 MHz luminosity, L_{OH}, has been shown to be proportional to the square of L_{FIR} (Martin et al., 1988, Baan, 1989) which shows that, in the case of an optically thin medium, taking into account the proportionality between the radio continuum and FIR luminosities, the number of inverted molecules along the line of sight is proportional to L_{FIR}. This result has been interpreted in two different ways: (i) the number of inverted molecules per unit volume is proportional to L_{FIR}, which gives support to the FIR pumping mechanism (Baan,1989); (ii) the linear dimension of the galaxies increasing with L_{FIR}, (Bottinelli et al., herein) the depth of the molecular region along the line of sight is also expected to increase.

However, a clear segregation appears in the log L_{OH}, vs. log L_{FIR} relationship: galaxies with small OH line width (ΔV), at a given L_{FIR}, have larger OH luminosities (Martin et al., 1989b). This result can be interpreted in the case of a not optically thin medium, large Doppler effects preventing the OH photons emitted in a given place from inducing emission by other molecules.

We have studied this effect using the apparent optical depth τ_a, determined from 18-cm line to continuum intensity ratio, as an indicator of the true optical depth τ_t, assuming a rather constant covering factor (Henkel and Wilson, 1990). The available sample of τ_a data (Fig. 1) shows that τ_a depends on both L_{FIR} and ΔV, according to the relationship:

$$\log [\exp(-\tau_a) - 1] = 0.67 \log L_{FIR} - 2.0 \log L_{OH} + 2.75 \quad \text{(correlation coefficient 0.93)}$$

A similar result has been obtained using τ_t, obtained from the smaller set of hyperfine ratios determined from the intensity ratio of the the 2 OH main lines:

$$\log [\exp(-\tau_t) - 1] = 0.85 \log L_{FIR} - 2.6 \log L_{OH} + 6.13 \quad \text{(correlation coefficient : 0.52)}$$

which confirms our interpretation.

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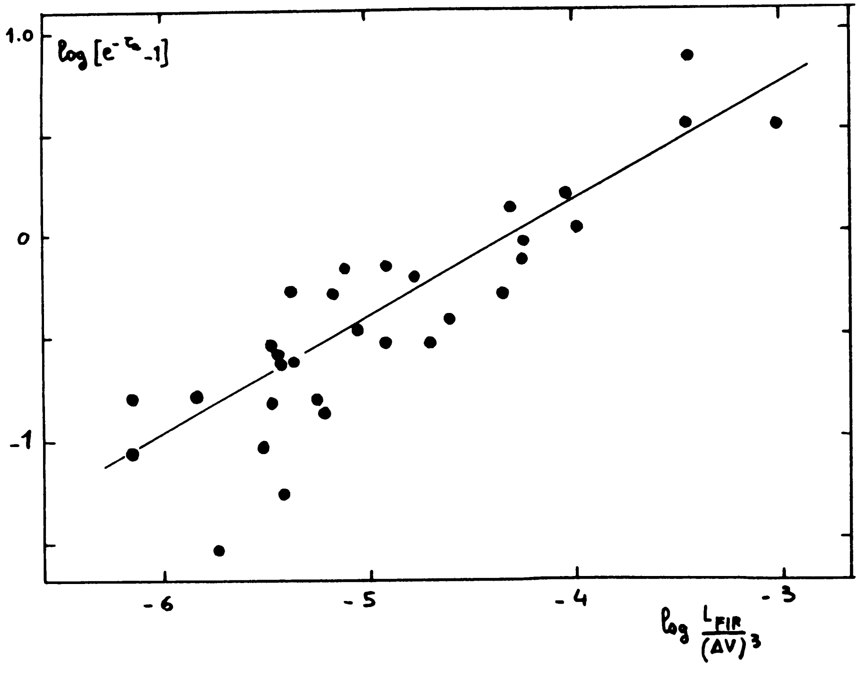

Figure 1

2°) Detailed observations of IRAS 17208-0014

VLA-A array interferometric observations with a 1.1" resolution give indications of sizes of a few 100 pc in the OH line and confirm the superposition of continuum and 18-cm line emitting regions. MERLIN continuum interferometric observations yield a more precise value for the size of the central source of 220 p x 270 pc. All the parameters are consistent with the classical interpretation of the OH megamaser phenomenon: a central continuum source is amplified by a foreground OH molecular cloud. (Martin et al., 1989a)

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