OBSERVATIONS OF EXCITED STATE OH MASERS AT 6.0 AND 13.4 GHz

A. Baudry[1], S. Guilloteau[2], M. Walmsley[3], T.L. Wilson[3], A. Winnberg[4]
[1] Observatoire de l'Université de Bordeaux, 33270 Floirac, France
[2] Université Scientifique et Médicale de Grenoble, CERMO BP 68, 38402 Saint-Martin-d'Hères Cedex, France
[3] Max-Plank Institut für Radioastronomie, Auf dem Hügel 69, D-5300 Bonn 1, R.F.A.
[4] Onsala Space Observatory, 43900 Onsala, Sweden

This is a brief report on a sensitive search for excited OH absorption and emission sources made with the Effelsberg 100 m telescope towards several compact HII regions. Our data are discussed elsewhere (Guilloteau *et al.*, 1983) and we mainly present here our $\Pi_{3/2}$, J = 5/2 and 7/2 OH narrow emission results (masers). In the J = 5/2 state, 14 sources were observed with a typical 1 σ sensitivity of 0.2 Jy. Among 13 positive detections, 4 and may be 5 are new maser sources : G43.1, W48, K3-50, ON3 and G34.3 (?). With the exception of W3(OH) the 6035 MHz line is always much stronger than the 6030 MHz line. Comparison with spectra published by others suggests time variability in M17, W51 and Orion A. In W3(OH) a weak broad emission was also detected at 6049 MHz. In our j = 7/2 observations the peak to peak noise was the range 0.1 to 1 Jy. No masers were detected even in the strong 6035 MHz sources associated with M17 and W33 cont. Thus the F = 4-4 emission line in W3(OH) seems to be really exceptional (Baudry et al., 1981).

$\Pi_{3/2}$ excited state masers are expected from the collisional pumping model of Flower and Guilloteau (1982) provided that the kinetic temperature is larger than the dust temperature. Because the collisional mechanism tends to overpopulate the upper levels of the $\Pi_{3/2}$ Λ-doublets, collisional excitation is likely to be a dominant process in $\Pi_{3/2}$ excited OH emission sources. Present collision rates do not incorporate the dependence on hyperfine quantum numbers and thus one expects nearly equal inversion of the 6035 an 6030 MHz lines. However model calculations show that, in agreement with observations, W3(OH) excepted, inversion is more efficiently quenched at 6030 MHz than at 6035 MHz. One would also expect from a collisional model to detect J = 7/2 masers associated with strong J = 5/2 masers. Because J = 7/2 masers appear to be rare whereas J = 7/2 absorption features are often detected collisional models may also depend on $\Delta J = 2$ collisional cross-sections. Despite these uncertainties we derive, using the results of Dewangan and Flower (1982), that collisions are dominant if (with $T_K \simeq 100$ K) $n_{H_2} > 5 \times 10^6$ and 10^8 cm^{-3} for the $\Pi_{3/2}$, J = 5/2 and 7/2 states respectively.

R. Fanti et al. (eds.), VLBI and Compact Radio Sources, 319–320.

From various arguments including estimates of OH rotation temperatures we think that the OH *absorbing* region associated with a compact HII region lies close to the ionization front (Guilloteau *et al.*, 1983). Maser lines tend to appear on one side of the absorption features. This suggests that the absorption and maser sources are in close relationship but does not tell, without interferometric measurements, whether the masers are dense clumps within the OH absorbing region.

References

Baudry, A., Walmsley, C.M., Winnberg, A., Wilson, T.L. : 1981, Astron. Astrophys. 102, 287.

Dewangan, D.P., Flower, D.R. : 1982, Monthly Notices Roy. Astron. Soc. 199, 457.

Flower, D.R., Guilloteau, S. : 1982, Astron. Astrophys. 114, 238.

Guilloteau, S., Baudry, A., Walmsley, C.M., Wilson, T.L., Winnberg, A. : 1983, Astron. Astrophys., in press.

https://doi.org/10.1017/S0074180900078360 Published online by Cambridge University Press