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NEW WATER MASER IN L 1251

We report the results of a water maser search carried out with the Effelsberg-100m telescope on Feb. 4 and 7, 1997 in the direction of two IRAS sources in the L1251 (Lynds, 1962) dark cloud. A 300 Jy emission was detected towards IRAS 22376+7455.

We observed the $6_{16} \rightarrow 5_{23}$ (22.23508 GHz) transition of H_2O with a beamwidth of 40″ during the night of Feb. 4/5, 1997, from 20:00 to 6:00 UTC. A liquid He cooled maser receiver was used with system temperature in the zenith of about 90K. We used the standard 1024 channel autocorrelator with bandwidths of 3.125 MHz and 6.25 MHz. This corresponds to 0.04 and 0.08 kms^{-1} resolution and 41 and 82 kms^{-1} velocity coverage respectively. We observed in the position switching mode with 3 minutes integration time on both the OFF and ON positions and 6 minutes ON and OFF for the high resolution spectra. NGC7027 was used for flux calibration. We adopted 5.86 Jy for its flux density at 22.235 GHz frequency corresponding to 8.2K brightness temperature (see Baars et al. 1977). The measured flux was 0.532 NTU (noise-tube unit), with good pointing.

The IRAS point sources IRAS 22343+7501 and IRAS 22376+7455 were observed on Feb. 4th between 21:00 and 24:00 UTC, and IRAS 22376+7455 was reobserved on Feb. 7th at 8:50 UTC.

IRAS22376+7455 H_2O maser emission was detected towards IRAS 22376+7455. The spectrum (obtained with 3.125 MHZ bandwidth, 6 min. integration time, RMS noise 0.3 Jy) is shown in Figure 1.

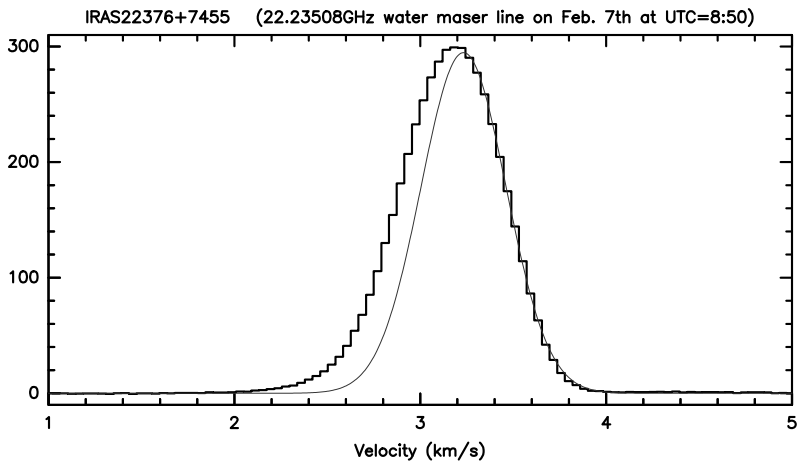

Figure 1. The H_2O $6_{16} \rightarrow 5_{23}$ spectrum of IRAS 22376+7455 (histogram) measured on 1997 Feb. 7 at $8^{\mathrm{h}}50^{\mathrm{m}}$ UTC with the Effelsberg-100 radiotelescope. The central part of the spectrum is presented as there were no other lines detected in the velocity range [−47 kms^{-1}, +37 kms^{-1}]. Gaussian fit to the blue-shifted side is overlaid (thin line). A redshifted excess of ≈ 10% of the total line area is seen.

There is a clear detection of an S =300 Jy line with total line area of W =207 Jykms^{-1}. It appears at a velocity of 3.2 kms^{-1} which is redshifted by about 7 kms^{-1} relative to the rest velocity of the NH_3 cloud core "H2" which is $v_{\rm LSR}(NH_3 core) = -3.9\,{\rm kms}^{-1}$ (see Tóth & Walmsley, 1996). There is no indication for other lines (i.e. $S > 3\sigma$ peaks) in the velocity range [$-47\,{\rm kms}^{-1}$, $+37\,{\rm kms}^{-1}$].

The corresponding total luminosity of the maser spot (upper limit, assuming isotropic radiation) is:

$$L_{H_2O} = 6.1 \times 10^{-7} L_\odot \ ,$$

if we adopt 300 pc for the distance of L1251, as derived by Kun and Prusti (1993) (their value has an uncertainty of $\pm$50 pc). This distance value is in agreement with Balázs' unpublished result being 350$\pm$60 pc. The uncertainty of the luminosity value is $\approx$ 40% which comes from the uncertainty in the distance.

The detected line is slightly asymmetric with a red-shifted wing contributing approximately 10 percent to the total line area. In Figure 1 the observed line is shown (histogram) with the Gaussian fit overlaid (thin line) which was fitted masking out the [2 km/s, 3.2 km/s] velocity range.

We note that the line may also be fitted with two Gaussian components with the following parameters: velocities of 3.11 $\pm$ 0.02 kms^{-1}, and 3.35 $\pm$ 0.02 kms^{-1}; FWHM of 0.44 $\pm$ 0.02 kms^{-1}, and 0.62 $\pm$ 0.02 kms^{-1} (correction for instrumental broadening is negligible with 0.04kms^{-1} channelwidth), a peak flux of 245.0 Jy and 97.9 Jy (rms=0.3 Jy), and line area of 161.0$\pm$0.12 Jykms^{-1} and 46.0$\pm$0.05 Jykms^{-1} respectively.

The far-infrared (FIR) colour indices of IRAS 22376+7455 are $\log(F_{25}/F_{12})$=0.842; $\log(F_{60}/F_{25})$= 0.765 and $\log(F_{100}/F_{60})$=0.316 (JISWG, 1989). Its total IRAS flux was calculated according to Emerson (1988) (i.e. $F_{\rm IRAS} = 20.653 \times F(12\mu m) + 7.538 \times F(25\mu m) + 4.578 \times F(60\mu m) + 1.762 \times F(100\mu m)[10^{-14}\,{\rm Wm}^{-2}]$). $F_{\rm IRAS}({\rm IRAS\,22376 + 7455}) = 3.24 \times 10^{-12}{\rm Wm}^{-2}$ which corresponds to $\approx 9.0 L_\odot (\frac{distance}{300pc})^2$ FIR luminosity, assuming isotropic FIR radiation.

FIR colors of both IRAS 22376+7455 and IRAS 22343+7501 are similar to those of other maser sources found in Cepheus by Wouterloot and Walmsley (1986).

Previous water maser observations of IRAS 22376+7455 were unsuccessful according to:

- Felli et al. (1992): $F < 2.8$ Jy in Feb. 1990,
- Tóth & Walmsley (1994): $F < 0.3$ Jy in Oct. 1993,
- Claussen et al. (1996): $F < 0.1$ Jy, regularly observed from Dec. 1991 to Oct. 1994.

Three HH objects were found in association with IRAS 22376+7455 by Eiroa et al. (1994). Near-infrared (K band) observations of the point source by Hodapp (1994) indicated a cluster of point sources there, the reddest one among them is possibly driving a CO outflow (Sato et al., 1994) associated with the IRAS point source.

IRAS 22376+7455 is one of the faintest IRAS point sources with detected water maser emission (see e.g. Wilking et al., 1994), and its water maser flux is relatively high as compared to the other known examples. The $L_{\rm H_2O} = 1.12 \times 10^{-9} (L_{\rm FIR})^{1.02}$ empirical relation of Felli et al. (1992) predicts $L_{\rm H_2O} = 1.1 \times 10^{-8} L_\odot$.

The maser emission may originate in the shocked clumps near the driving source of the outflow. Interferometric observations of this source with the aim at determining a precise position would help further interpretation.

IRAS 22343+7501 showed no water maser emission during our observations with a detection limit of 0.3 Jy (3 times the $T_{\rm RMS}$) in the velocity interval $-45\,{\rm kms}^{-1} < v_{\rm LSR} < +35\,{\rm kms}^{-1}$. Water maser emission of IRAS 22343+7501 was first detected by Wilking et al. (1994) in Jan. 1992. From Claussen et al. (1996) (see their Fig. 13) and from the detection by Tóth & Walmsley (1994) in Oct. 1993 we may assume the maser source can be seen at least once in a "quasi-period" of ≈ 5 months.

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ERRATUM

Dr. G. Williams has revealed a misprint in the 73rd Name-List of newly designated variable stars (IBVS No. 4471). In the introductory part, when listing mistakes in the earlier Name-Lists, V353 Pup was claimed to be NSV 03431. The correct cross-identification is, however, V353 Pup = NSV 03731.

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