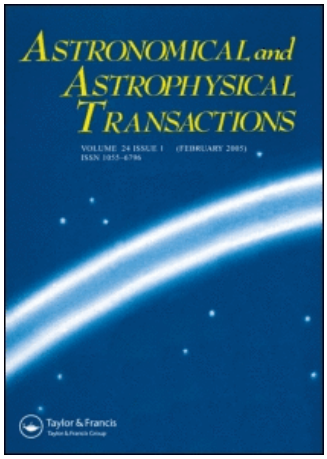

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

VARIABILITY OF CLASS II METHANOL MASERS IN THE 3 mm WAVE RANGE

S. V. Kalenskii [a]; V. I. Slysh [a]; A. Winnberg [b]
[a] Astro Space Center of Lebedev's Physical Institute, Profsoyuznaya, 84/32, Moscow 117997, Russia.
[b] Onsala Space Observatory, S-439 92, Onsala, Sweden.

Online Publication Date: 01 January 2002
To cite this Article: Kalenskii, S. V., Slysh, V. I. and Winnberg, A. (2002) 'VARIABILITY OF CLASS II METHANOL MASERS IN THE 3 mm WAVE RANGE', Astronomical & Astrophysical Transactions, 21:1, 23 - 25
To link to this article: DOI: 10.1080/10556790215575
URL: http://dx.doi.org/10.1080/10556790215575

Astronomical and Astrophysical Transactions, 2002, Vol. 21(1–3), pp. 23–25

VARIABILITY OF CLASS II METHANOL MASERS IN THE 3 mm WAVE RANGE

S. V. KALENSKII[a,*], V. I. SLYSH[a], A. WINNBERG[b]

[a]*Astro Space Center of Lebedev's Physical Institute, Profsoyuznaya, 84/32, Moscow 117997, Russia;* [b]*Onsala Space Observatory, S-439 92, Onsala, Sweden*

(Received 15 March 2002)

A survey of known methanol masers at 6.7 and 12.2 GHz was performed in the 3_1–4_0A^+ methanol line at 107.0 GHz. Maser emission was detected only towards already known sources. The masers at 107.0 GHz are observed towards the strongest sources at 6.7 GHz, but not necessarily towards the strongest maser features in these sources. The comparison with previous results showed that the 107.0 GHz maser in Cep A is variable.

Keywords: Molecules; Methanol masers; Variability

1 INTRODUCTION

The most interesting among methanol masers are so-called Class II masers, which are pumped by external radiation and often observed towards IR sources, HII-regions, and OH masers. These masers may be related to protoplanetary discs and/or planets around young massive stars (Slysh *et al.*, 1999). The strongest Class II masers have been found in the 5_1–6_0A^+ line at 6.7 GHz and the 2_0–$3_{-1}E$ line at 12.2 GHz. The fluxes of the strongest sources at 6.7 GHz may reach thousands Janskys and exceed OH maser fluxes from the same regions. Both the 6.7 and 12.2 GHz masers are variable (Caswell *et al.*, 1995).

Most studies of the Class II masers, performed so far, are limited to the 6.7 and 12.2 GHz lines. This information is unsuffisient to model maser sources, since one should take into account a number of parameters (the source geometry, the gas temperature and density, the external radiation etc.). Therefore observations in other maser lines are necessary.

Val'tts *et al.* (1995) discovered Class II masers in the 3_1–4_0A^+ line at 107.0 GHz with the 20-m millimeter wave radio telescope of the Onsala Space Observatory. Then these masers were searched for in the Southern hemisphere (Val'tts *et al.*, 1999). In March 2000, we performed the new set of observations at 107.0 GHz in the Northern hemisphere with the Onsala radio telescope. Our source list consisted of known 6.7 GHz masers to search for new 107.0 GHz masers, and the known masers at 107.0 GHz to search for their variability.[†] In

* Corresponding author.

[†] Cep A was additionally observed in July 2000 with the 12 m NRAO radio telescope and in May 2001 with the Onsala radio telescope.

ISSN 1055-6796 print; ISSN 1476-3540 online
DOI: 10.1080/1055679021000017358

addition to the 3_1–4_0A^+ line, we observed the 7_2–6_3A^+ line at 86.9 GHz; Class II masers may arise in this line as well (Sutton *et al.*, 2001).

2 RESULTS AND DISCUSSION

At 107 GHz we could detect only six already known masers, W 3(OH), S 252, G9.62+0.19, W 48, Cep A, and NGC 7358. At 86.9 GHz, we detected maser emission only towards W 3(OH), already found by Sutton *et al.* (2001).

Thus, the results of our survey, as well as the results of the surveys by Val'tts *et al.* (1995; 1999) show that the 3 mm masers are much more rare objects than the masers in

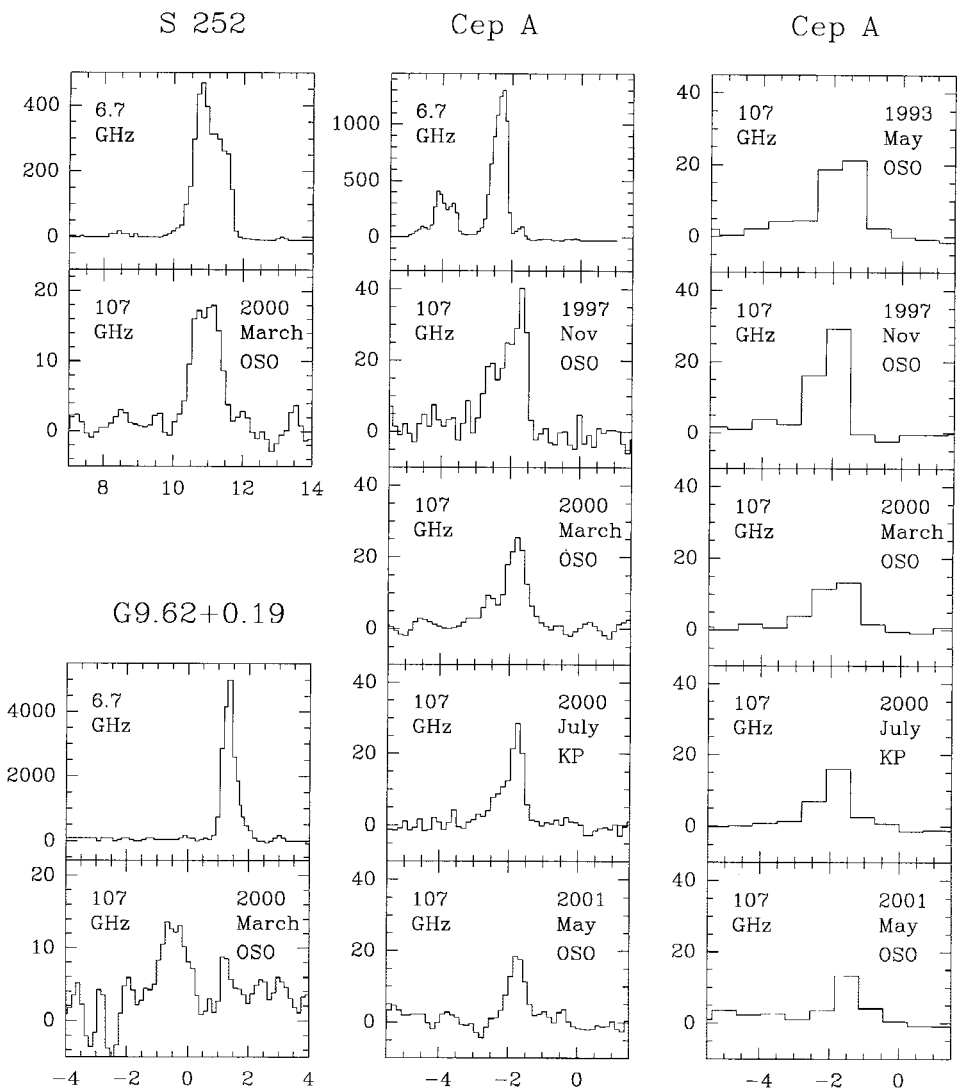

FIGURE 1 Spectra of three sources at 107.0 GHz. *X*-axis plots LSR velocity (km/s); *Y*-axis plots flux density (Jy). For comparison, the 6.7 GHz spectra of the same sources are presented (taken from Menten, 1991). The 1993 year data are taken from Val'tts *et al.* (1995); the 1997 year data are kindly presented by Dr. Minier. "OSO" means Onsala observations, "KP"—Kitt-Peak observations.

the centimeter wave range and can be found only towards the strongest masers at 6.7 and 107.0 GHz. On the other hand, the comparison of the spectra at 6.7 and 107.0 GHz shows that the radial velocities of the 12.2 GHz masers may coincide both with the strongest features at 6.7 GHz (W 3(OH), S 252), and relatively weak features at this frequency (G9.62 + 0.19, Cep A; see also Lyubchenko and Val'tts; this conference).

Figure 1 shows the spectra of Cep A, taken at different epochs. In 1997, the spectrum consisted of 2 components at −1.8 and −2.6 km/s, which did not coincide with the LSR velocities of the strongest features at 6.7 and 12.2 GHz. In 2000–2001, the line intregrated intensity appeared to be more than twice weaker than in 1997, the −2.6 km/s feature vanished at all. Thus, this source is variable at 107 GHz. Voronkov (personal communication) found that the intensity of the strongest feature at 6.7 GHz also decreased since 1991. Other sources did not show noticeable variations at 107 GHz.

One possible explanation of different LSR velocities of the strongest features at 6.7 and 107.0 GHz in some sources is as follows. It is known that cosmic masers may be strongly anisotropic. In particular, emission of background HII-regions may cause a strong beaming of maser radiation at centimeter wave range. It is possible that the masers at 107.0 GHz are accompanied by strong masers at 6.7 and 12.2 GHz, but the latter masers are not directed towards us. Since at 107.0 GHz the brightness of HII-regions is much smaller than at centimeter wavelengths, the beaming of the maser emission at 107.0 GHz is weaker, making it possible to observe these masers.

In such models the variability at 107.0 GHz is caused by the variability of pumping, and the variability at lower frequencies may be caused both by the variability of pumping and the variability of background; the latter may appear, *e.g.*, due to the maser motion relative to non-uniform background. Therefore it is important to conduct regular monitoring of maser sources both in the centimeter and millimeter wave ranges.

Acknowledgements

The authors thanks the staff of the Onsala Space Observatory for the help during the observations and Vincent Minier for presenting data prior to publication. The work was financially supported by the INTAS grant No. 97-11451.

References

Caswell, J. L., Vaile, R. A. and Ellingsen, S. P. (1995). *PASA*, **12**, 37.
Menten, K. M. (1991). *Astrophys. J.*, **380**, L75.
Slysh, V. I., Val'tts, I. E., Kalenskii, S. V. and Larionov, G. M. (1999). *Astronomy Reports*, **43**, 675.
Sutton, E. C., Sobolev, A. M., Ellingsen, S. P., Cragg, D. M., Mehringer, D. M., Ostrovskii, A. B. and Godfrey, P. D. (2001). *Astrophys. J.*, **554**, 173.
Val'tts, I. E., Dzura, A. M., Kalenskii, S. V., Slysh, V. I., Booth, R. and Winnberg, A. (1995). *Astron. Astrophys.*, **294**, 225.
Val'tts, I. E., Ellingsen, S. P., Slysh, V. I., Kalenskii, S. V., Otrupcek, R. and Voronkov, M. A. (1999). *Mon. Not. Roy. Astron. Soc.*, **310**, 1077.