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RESULTS OF RECENT STUDIES OF THE TEMPORAL VARIABILITY OF SILICON MONOXIDE MASERS

Avelino Gómez Balboa

Observatorio Nacional - CNPq/SECT,
and Instituto de Pesquisas Espaciais - INPE/SECT

Eugenio Escalise Junior

Instituto de Pesquisas Espaciais - INPE/SECT

Resumen. Se presentan observaciones de VY CMa, W Hya, Orion A y R Leo en SiO J = 1-0 v = 1 y dos máseres tomadas en el Radio Telescopio de Itapetinga de marzo de 1988 a octubre de 1989.

ABSTRACT. We present here the preliminary results of the first long term program for the monitoring of SiO J = 1-0 v = 1 and two masers undertaken in the southern hemisphere. All observations were carried out at the Itapetinga Radio Telescope and covers the period from March 1988 to October 1989. The spacing between the observations were from 20 to 30 days. Several sources were monitored during this period but here we present only the results of the M5 Supergiant VY Cma, the SRa M7.5-M9 W Hya, Orion A and the M6-M9 Mira R Leo.

Key words: MASERS — STARS-FORMATION

I. INTRODUCTION

OH, H_2O and SiO maser emission has been detected in regions of star formation and in circumstellar envelopes of late type stars. Orion is one of the three SiO masers (Hasegawa et al. 1986) known to exist in regions of active star formation. The two others, Sgr B2 MD5 and W51 N, do not show the broad, double-peaked profile reminiscent of OH masers in expanding shells. The importance for the study of the SiO maser emission lies in the fact that it is originated from regions relatively close to the star (two to three stellar radii). Due to this proximity one could detect, when analyzing evenly spaced monitored data, the presence of schock waves moving upward, away from the stellar surface, successively in the v=2, v=1 transitions of SiO and later in H_2O. Those periodic atmospheric shock waves have been detected in the IR (Hinkle, Hall and Ridgway 1982) but still there is no radio evidences. One of the purposes of this monitoring program is to try to identify, in successive single or multiple structure maser profiles, evidences for this schock waves.

II. OBSERVATIONS

Observations of the 7 mm SiO maser lines were made with the 13.7 m radio-telescope of the Itapetinga Radio Observatory. Antenna temperatures were corrected for antenna gain degradation with zenith angle, radome and atmospheric attenuation. In figures 1 to 7 we present the spectra of the sources. We also have to stress out that during the execution of this program a new acoustic-optical radio spectrometer was put into operation. Since the resolution of the new system was of 40 kHz (0.28 km/s), much better then the old one that was of 70 kHz (0.49 km/s), we decided to use the new system then on. Our expectations are that after following some stellar cycles we will be able to identify or not those waves.

III. INDIVIDUAL OBJECTS

W Hya - It showed no evident periodicity during 1988-9. Around phase .55 (1988) its spectra, at both v=1 and v=2 presented peaks with intensity of the order of 15 K and 25 K respectively being both barely seen in the next cycle around the same phase. At v=1 it presented during 1988 many components blueshifted from the main peak whereas in the next cycle (1989) the components appeared redshifted.

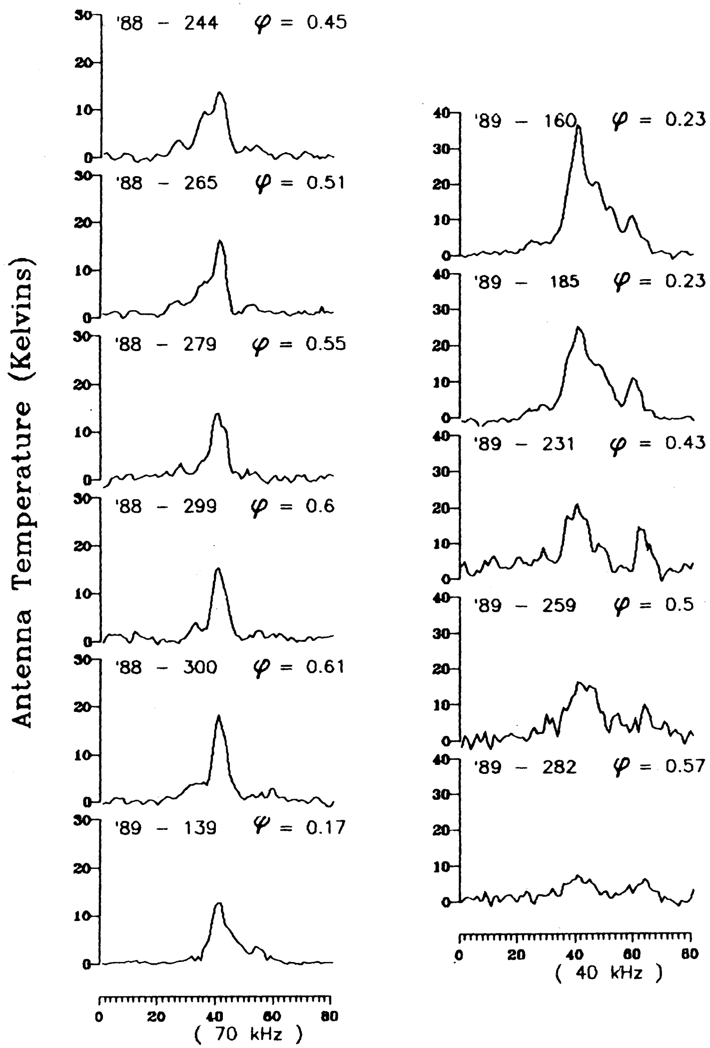

Fig. 1. Spectra of star W Hya in the v=1, J=1-0 line. The velocity is more positive from the right left. Channel 40 corresponds to 40 km/s.

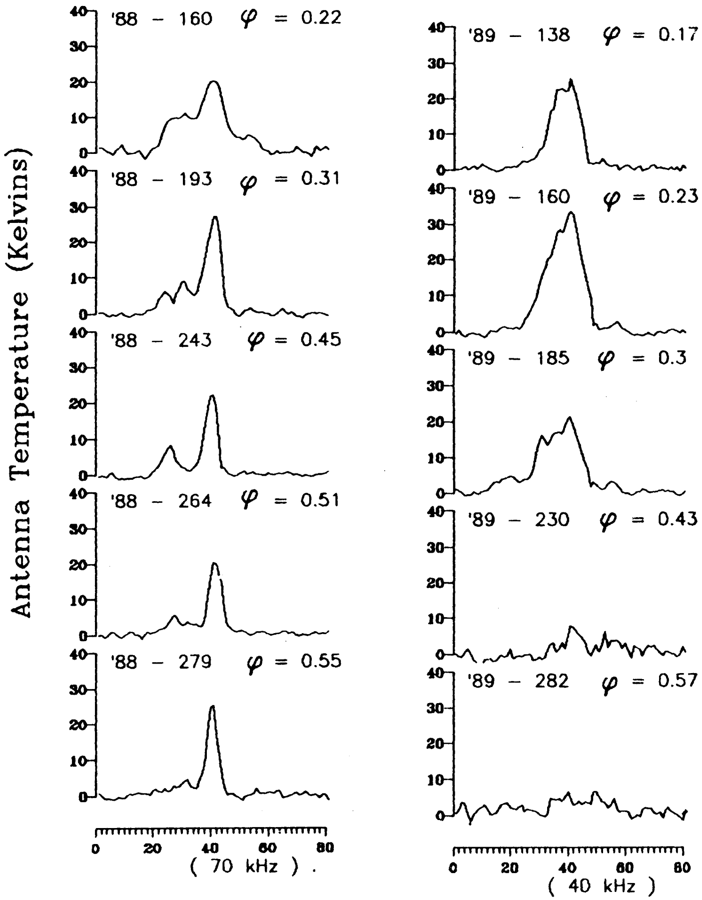

Fig. 2. Spectra of star W Hya in the v=2, J=1-0 line. The velocity is more positive from the right to the left. Channel 40 corresponds to 40 km/s.

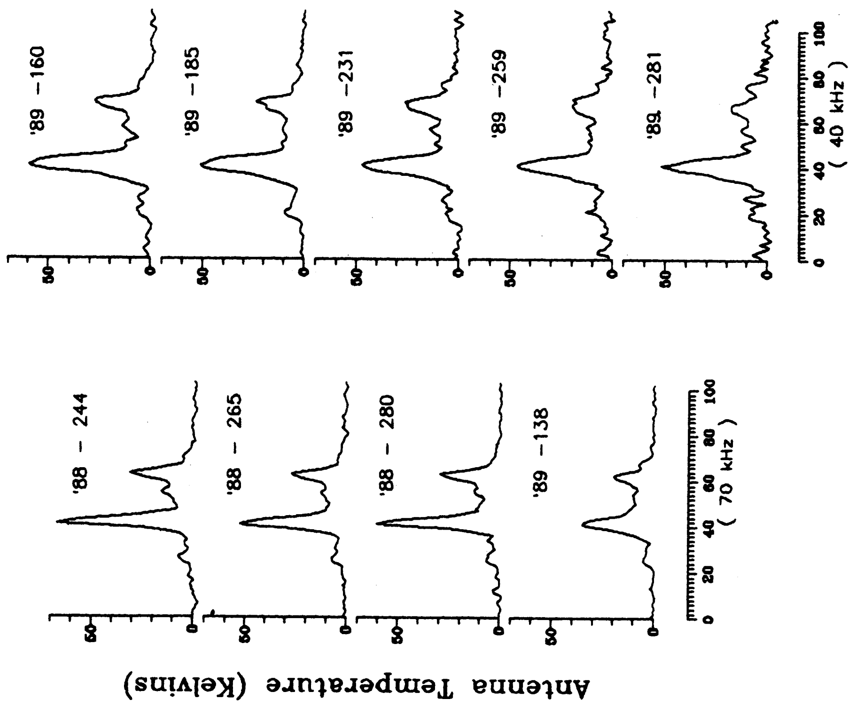

Fig. 3. Same as Fig. 1 for VY CMa. Channel 40 corresponds to 22 km/s.

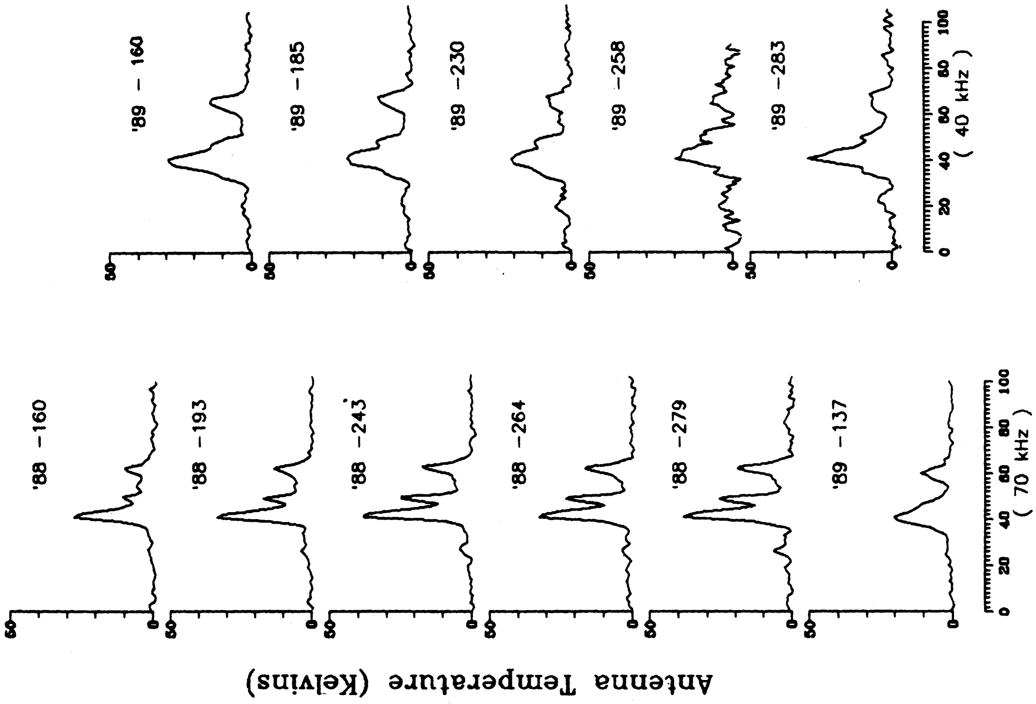

Fig. 4. Same as Fig. 2 for VY CMa. Channel 40 corresponds to 22 km/s.

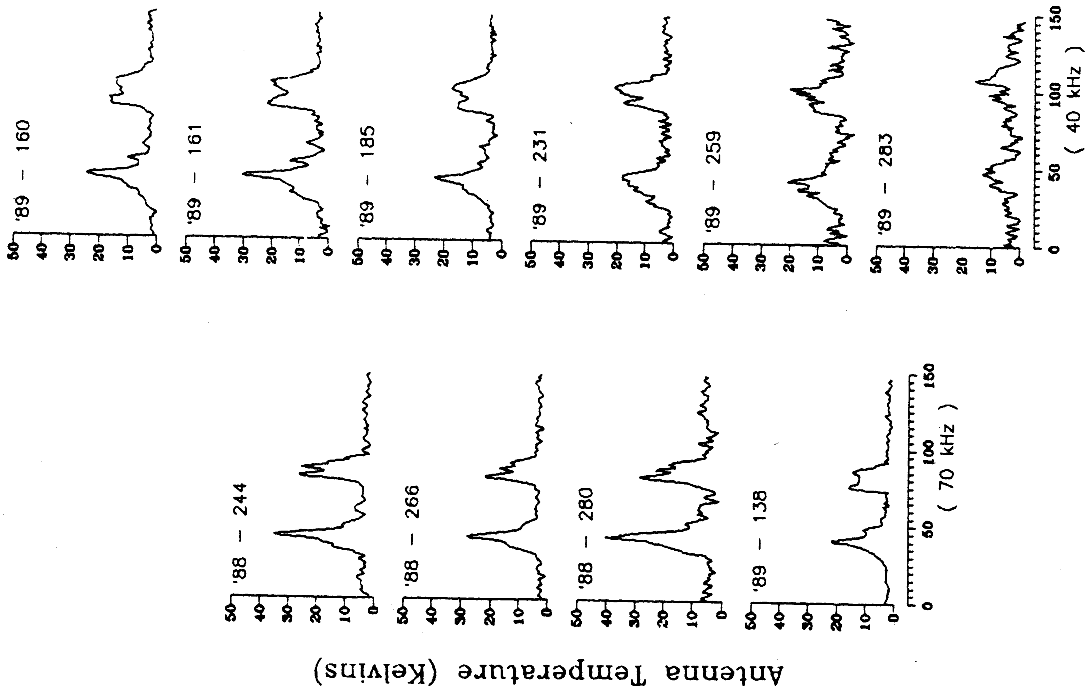

Fig. 5. Same as Fig. 1 for Orion A. Channel 40 corresponds to 17 km/s.

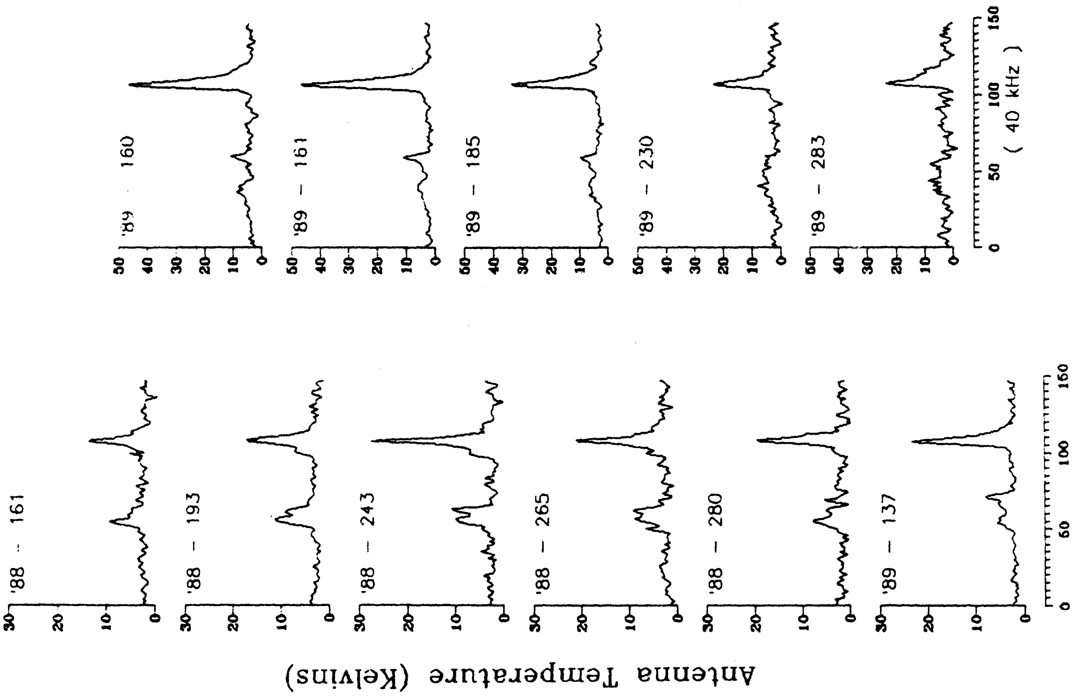

Fig. 6. Same as Fig. 2 for Orion A. Channel 40 corresponds to 20 km/s.

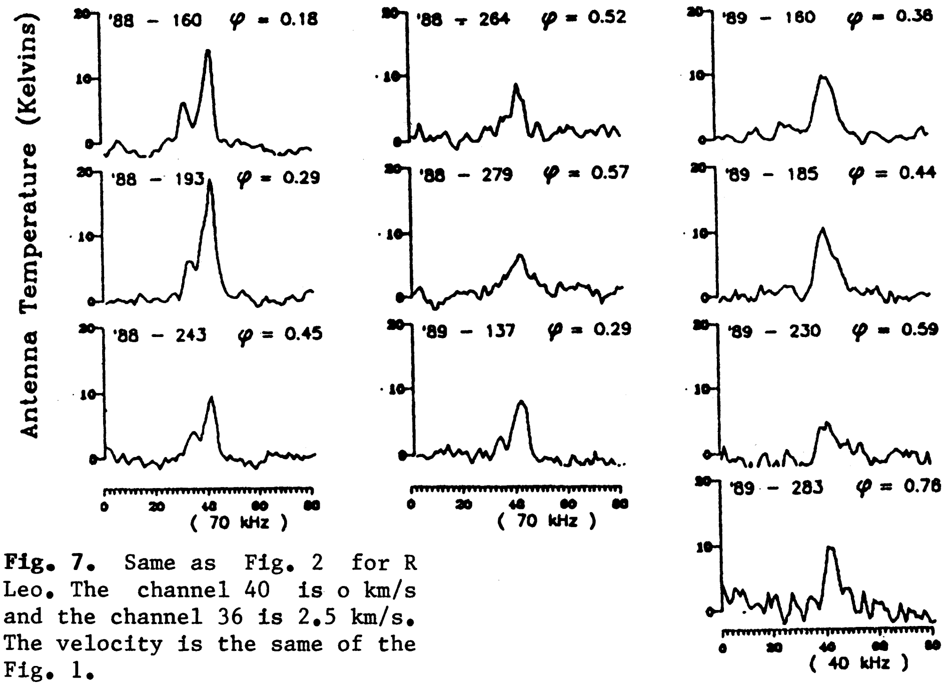

Fig. 7. Same as Fig. 2 for R Leo. The channel 40 is o km/s and the channel 36 is 2.5 km/s. The velocity is the same of the Fig. 1.

VY CMa - During 1988, at v=2, there was a feature placed at 20 kms-1 (channel 50) that presented clear variations, not seen in the neighboring features placed respectively at 22 and 17 kms-1 and it became completely blended in 1989. No strong variations were seen at v=1.
Orion A - At v=1 both the blueshifted and the redshifted components varied conjunctly. At v=2, during this period the redshifted component almost desappeared in 1989.
R Leo - This source is know to vary rapidly in time (Hajalmarson and Olofsson, 1979). Here we see clearly in its behaviour during 1988 when one of its features decreased from 20K to 5K in less then one third of its period. The observations of this star made in 1989 (day 137 to 283) presented very small variations in intensity.

IV. CONCLUSIONS

During the period of observations here described, the SiO masers from Orion and VY CMa did not preseted, strong variability, as dramatic as seen in W Hya and R Leo. This could be associated with the fact that SiO masers originated from Orion A and from Supergiants are placed in less chaotic regions then the ones originated from Miras. Longer periods of monitoring are necessary to have if one wants to analyze their short and long term variability.

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Avelino Gómez Balboa, Eugenio Scalise Jr.: Departamento de Astrofísica - INPE, C.P. 515, 12201 São José dos Campos, São Paulo, Brazil.