*Astrophysical Masers and their Environments*
*Proceedings IAU Symposium No. 242, 2007*
*J.M. Chapman & W.A. Baan, eds.*

doi:10.1017/S1743921307012707

# A variability study of the $H_2CO$ 6 cm maser in IRAS 18566+0408

**E. Araya[1,2], P. Hofner[1,2], S. Kurtz[3], H. Linz[4], M. Sewilo[5], L. Olmi[6,7] and C. Watson[8]**

[1]New Mexico Tech, Socorro, NM, USA. [2]NRAO, Socorro, NM, USA. [3]Centro de Radioastronomía y Astrofísica, UNAM, México. [4]MPIA, Heidelberg, Germany. [5] Space Telescope Science Institute, Baltimore, USA. [6]Istituto di Radioastronomia, INAF, Florence, Italy. [7]University of Puerto Rico at Rio Piedras, Puerto Rico. [8]Manchester College, USA.
email: earaya@nrao.edu

**Abstract.** We report the first detection of a short-duration (< 3 months) outburst of an $H_2CO$ 6 cm maser based on multi-epoch observations of IRAS 18566+0408 obtained with Arecibo, the Green Bank Telescope, and the Very Large Array. The $H_2CO$ maser was observed nine times between 2002 and 2005. In May 2006 we began a two-year program of monthly monitoring with the Arecibo Telescope. The $H_2CO$ maser in IRAS18566+0408 is coincident with a young massive stellar object and the line profile of the maser suggests that the $H_2CO$ emission originates from two different regions, perhaps associated with the kinematics of a circumstellar disk.

**Keywords.** masers, stars: formation, ISM: molecules, radio lines: ISM

## 1. Introduction

IRAS 18566+0408 is a massive star forming region located at a distance of 6.7 kpc (Araya *et al.* 2004). IRAS 18566+0408 was classified by Zhang (2005) as a massive circumstellar disk candidate. Araya *et al.* (2007a) report supporting evidence for the presence of a massive disk (torus) based on VLA continuum observations. $H_2CO$ 6 cm emission in the region was first detected by Araya *et al.* (2004) with Arecibo, and shown to be a maser via VLA observations (Araya *et al.* 2005). Here we present results from a variability study of the $H_2CO$ 6 cm maser in IRAS 18566+0408 based on Arecibo, GBT, and VLA data.

## 2. First detection of an $H_2CO$ maser flare

Using the GBT, we detected in November 2002 an outburst of the $H_2CO$ 6 cm maser in IRAS 18566+0408. The maser decayed to its pre-flare flux density value within a month based on Arecibo observations conducted one month after the GBT observations. This is the first detection of a short-duration (less than three months) outburst of an $H_2CO$ 6 cm maser. The $H_2CO$ maser has a double peaked Gaussian profile. Both components showed the maser flare and the relative intensity between the two components did not substantially change during the flare. An extensive discussion of this detection is presented by Araya *et al.* (2007b).

## 3. Arecibo monitoring of the $H_2CO$ and $CH_3OH$ 6.7 GHz masers

We are monitoring the $H_2CO$ 6 cm maser in IRAS 18566+0408 with Arecibo. The monitoring program began in May 2006 and is expected to continue up to May 2008. We report the detection of a second $H_2CO$ maser flare in IRAS 18566+0408 (Figure 1, upper panel). The superb sensitivity of Arecibo allows us to also monitor the $CH_3OH$ 6.7 GHz masers with just one minute on-source integration per observing run (Figure 1,

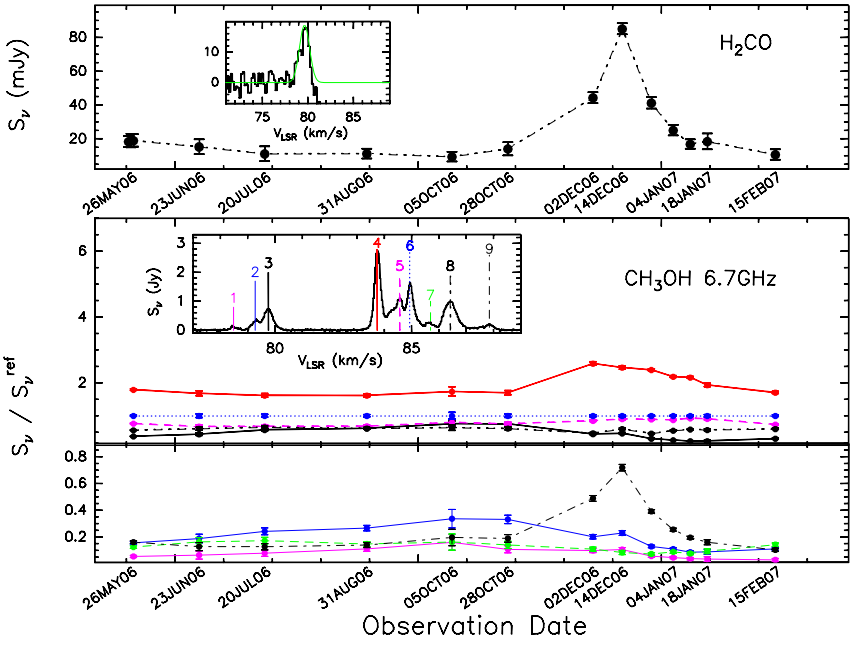


**Figure 1.** *Upper Panel:* Second detection of an $H_2CO$ 6 cm maser flare. The spectrum of the maser together with a Gaussian fit is shown in the inset. *Lower Panel:* Light-curve of the $CH_3OH$ 6.7 GHz masers in IRAS 18566+0408. The $CH_3OH$ spectrum from one of the observing epochs is shown in the inset. We show the flux density of the different maser components normalized to the flux density of maser 6. For clarity, two normalized flux densities scales are displayed, showing the bright and dim masers separately. (See on-line edition for a color version.)

lower panel). The $CH_3OH$ maser 9 showed the same outburst as the $H_2CO$ maser, however, the LSR velocity of the two masers is substantially different, i.e., the masers arise from different volumes. If the $CH_3OH$ maser 9 and the $H_2CO$ maser are unsaturated and collinear, then the flares could have been caused by amplification of variable background 6 cm radio continuum from the disk/jet system in IRAS 18566+0408. Future high angular resolution observations of the $CH_3OH$ masers are needed to verify the position coincidence between the $H_2CO$ maser and the $CH_3OH$ maser 9.

## Acknowledgements

E. A. is supported by a NRAO predoctoral fellowship. The Arecibo Observatory is part of NAIC, operated by Cornell University under contract with the National Science Foundation (NSF). The 100m Green Bank Telescope is operated by NRAO, a facility of the NSF operated under cooperative agreement by Associated Universities Inc. The authors thank H. Hernández for the flexibility in scheduling of the observations. E. A. thanks the IAU for a travel grant to attend this symposium.

## References

Araya, E., Hofner, P., Kurtz, S., Linz, H., Olmi, L., Sewiło, M., *et al.* 2005, *ApJ* 618, 339
Araya, E., Hofner, P., Linz, H., Sewiło, M., Watson, C., *et al.* 2004, *ApJS* 154, 579
Araya, E., Hofner, P., Sewiło, M., Goss, M.W., Linz, H., S. Kurtz, *et al.* 2007a, *ApJ* submitted
Araya, E., Hofner, P., Sewiło, M., Linz, H., Kurtz, S. , *et al.* 2007b, *ApJ* (Letters) 654, L95
Zhang, Q. 2005, in: R. Cesaroni, M. Felli, E. Churchwell, & M. Walmsley (eds.), *Massive Star Birth: A Crossroads of Astrophysics* (Cambridge: Cambridge Univ. Press), p. 135

https://doi.org/10.1017/S1743921307012707 Published online by Cambridge University Press