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The bursting variability of 6.7 GHz methanol maser of G33.641-0.228

Y. Kojima, K. Fujisawa and K. Motogi

Graduated School of Sciences and Technology for Innovation, Yamaguchi University, Yoshida 1677-1, Yamaguchi, 753-8512 Japan

Abstract. From 2014 to 2015, we conducted a total of 469 days observation of the 6.7 GHz methanol maser in a star forming region G33.641-0.228, known to be a bursting maser source. As a result, eleven bursts were detected. On MJD 57364, the flux density grew by more than six times w.r.t the day before. Moreover, during the largest burst, the flux density repeatedly increased and decreased rapidly with time-scale as short as 0.24 day. Since these characteristics of the burst are similar to the solar burst, we speculate that the burst of the 6.7 GHz methanol maser in G33.641-0.228 might occur with a similar mechanism of the solar burst.

Keywords. masers, stars : formation

1. Introduction

G33.641-0.228 is a high-mass star-forming region at the distance of 4 kpc and with a bolometric luminosity of 12000 $L_{\odot}$. The 6.7 GHz methanol maser of this source was first reported by Szymczak *et al.* (2000). The spectrum of the source consists of four distinct peaks (component I - IV) and two additional separate peaks (component V, VI). Fujisawa *et al.* (2012, 2014) reported that the flux density of the methanol maser spectral component II ($V_{\rm LSR}$ = 59.6kms^{-1}) increased seven times within one day, confirming it was a burst event. The time-scale of the burst is the shortest among the variability of the all masers known so far. Moreover, there might be variability with time-scale less than one day, so we conducted continuous observations for several hours by Yamaguchi 32m radio telescopes to investigate the variability during bursts into detail.

2. Results and Discussions

We conducted a total of 469 days observations of G33.641-0.228 from 2014 to 2015. The bursting variabilities of the 6.7GHz methanol maser in G33.641-0.228 were detected 11 times for component II, while the flux density of the other components varied slowly. Fig 2. shows the details of variations of the burst from 57321 to 57329 (MJD) in which short time-scale variations were detected both in rise and fall. The overall time-scale of the burst is about five days, while the time-scale of the fast variability is less than 1 day. The shortest e-folding time was about 0.24 days.

Since these characteristics of the bursting variability are similar to solar radio bursts, the mechanism of the burst could be explained as follows: an energy accumulated by the magnetic fields on the surface of the young stellar object in G33.641-0.228 is released in a short time, and the radiation generated by this energy release is maser-amplified.

3. Summary

We conducted a total of 469 daily observations of the 6.7 GHz methanol maser in G33.641-0.228 from 2014 to 2015, and detected eleven bursts. While the overall time-scale

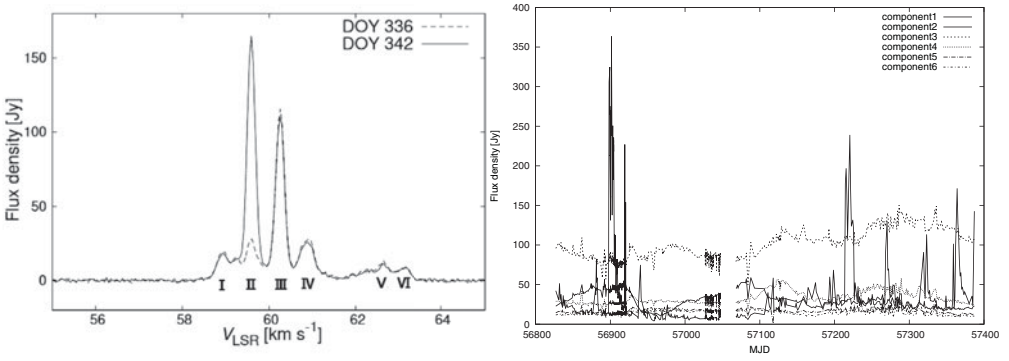

Figure 1. The 6.7 GHz methanol maser in G33.641-0.228. Left) Spectra of G33.641-0.228 at DOY336 (dashed line) and DOY342 (solid line) in 2015. Right) Light curves from 2014 to 2015. Each line shows flux density of each spectral component.

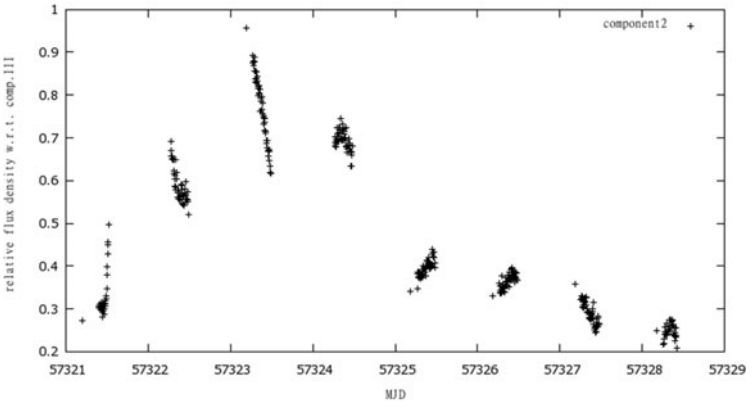

Figure 2. The details of the light curve of a burst from MJD 57321 to 57329. Vertical axis is shown as relative flux density of component Ⅱ to that of component Ⅲ in order to remove systematic error.

of the burst was five days, rapid variabilities were detected and the shortest time-scale was 0.24 days. These characteristics suggests that the burst of G33.641-0.228 might occur with a mechanism similar to solar radio burst.

References

Fujisawa, K., Sugiyama, K., & Aoki, N., 2012, *PASJ*, 64, 17
Fujisawa, K., Aoki, N., & Nagadomi, Y., 2014, *PASJ*, 66, 109
Szymczak, M., Hrynek, G., & Kus, A,J., 2000, *A&A*, 143, 269

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