Cosmic Masers: Proper Motion toward the Next-Generation Large Projects
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Discovery of circular polarization of the 6.7 GHz methanol maser in G33.641-0.228

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Abstract. The 6.7 GHz methanol maser emitted by a high-mass star forming region G33.641-0.228 is known to exhibit fast flux density variability on timescales of less than one day. The mechanism of this variability, called burst, has not been known. We observed the circular polarization of this maser. As a result, we found that only the spectral components representing burst exhibit strong circular polarization exceeding 10%. This suggests that the two phenomena of the burst and circular polarization are related to each other.

Keywords. ISM:jets and outflows, accretion disks, stars: massive, stars: protostars

1. Introduction

High-mass star forming region G33.641-0.228 emits the 6.7 GHz methanol maser with multiple spectral peaks (Szymczak *et al.* 2000). One of them ($V_{\rm lsr}$ = 59.6 km s^{-1}) shows fast variability with a time scale of less than one day (Fujisawa *et al.* 2012, 2014), and this variability is called burst. The physical mechanism by which occurs the burst has not been known. The profile of the burst is characterized by an increase in a short period followed by a gradual decrease. Since this feature is similar to those of solar radio bursts or flares of a T Tau star (Phillips *et al.* 1996), the burst could be caused by the same mechanism as solar radio bursts or flare of T Tau stars. Since circular polarization is observed in such burst or flares, we searched circular polarization in the maser spectrum of G33.641-0.228.

2. Observation of circular polarization

Yamaguchi 32m radio telescope (Fujisawa *et al.* 2002) was used for observation. The observation system and parameters are described in Fujisawa *et al.* (2012). Data analysis was performed independently for left and right circular polarization. Observations were made intermittently from 2009 to 2016. Here we report the observation results on January 6, 2016. The observation time was 02:10 UT, the integration time was 595 seconds, and the 1 σ noise level was 0.56 Jy. Spectra obtained with left and right circularly polarization are shown in Figure 1. Filled circles are spectra of LHCP and open circles are spectra of RHCP.

Six peaks are seen in the spectrum. Although the spectra of LHCP and RHCP are almost identical, the flux density of RHCP (67.7 Jy) is clearly larger than that of LHCP (53.7 Jy) only at $V_{\rm lsr}$=59.6 km s^{-1}, and the circular polarization is 11.5 %. Other components have a polarization of 0 within the error range. The spectral peak at $V_{\rm lsr}$=59.6 km s^{-1} shows the burst. This spectral component alone exhibits burst and circular polarization, suggesting that the two phenomena are related to each other.

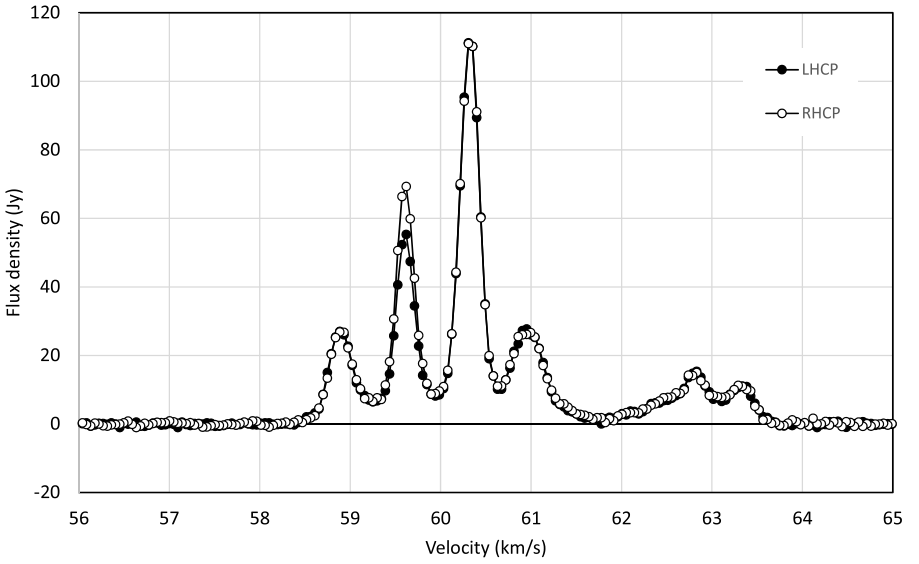

Figure 1. The maser spectra of LHCP and RHCP.

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