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14 years of 6.7 GHz periodic methanol maser observations towards G188.95+0.89

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Abstract. We report the results of 14 years of monitoring of G188.95+0.89 periodic 6.7 GHz methanol masers using the Hartebeesthoek 26-m radio telescope. G188.95+0.89 (S252, AFGL5180) is a radio-quiet methanol maser site that is often interpreted as precursors of ultra-compact HII regions or massive protostar sites. At least five bright spectral components were identified. The maser feature at 11.36 km s^{-1} was found to experience an exponential decay during the monitoring period. The millimetre continuum reveals two cores associated with the source.

Keywords. ISM: individual (G188.95+0.89), ISM: molecules, stars: imaging.

1. Introduction

One property that is unique to massive young stellar objects (MYSO) is the presence of methanol masers in their early formative phases (Menten 1991; Caswell *et al.* 1995). This paper is devoted to a study of a radio-quiet methanol maser site G188.95+0.89 (S252, AFGL 5180) and its environment, which is particularly good candidate for hosting a massive protostar (Minier *et al.* 2003; Goedhart *et al.* 2004). Our aim of this study is to observe the long-term variation along 14 years (between 2003-2008 and 2010-2018) and reveal the origin of the flux variation of the 6.7-GHz methanol maser.

2. Results

Radio data were obtained from Hartebeesthoek Radio Astronomy Observatory (HartRAO) 26-m telescope for the ongoing methanol maser monitoring programme (Goedhart et al., 2004). We obtained Atacama millimeter/submillimeter Large Millimeter Array (ALMA) band 6 archival data of G188.95+0.89 (Project ID: 2015.1.01454.S) taken on 2016-April-23 (42 antennas), 2016-Sepember-17 (38 antennas) in its compact and extended configurations, respectively. The time series of the selected maser velocity channels associated with G188.95+0.89 are shown in sub-figure (a). The variations observed in five velocity channels covering the bright CH_3OH emission at 6.7 GHz, between 8 and 12 km s^{-1} are periodic (395 d) with exception of 11.36 km s^{-1} which is exponentially decaying as shown in sub-figures (a) and (b). The spectra and intensity map of

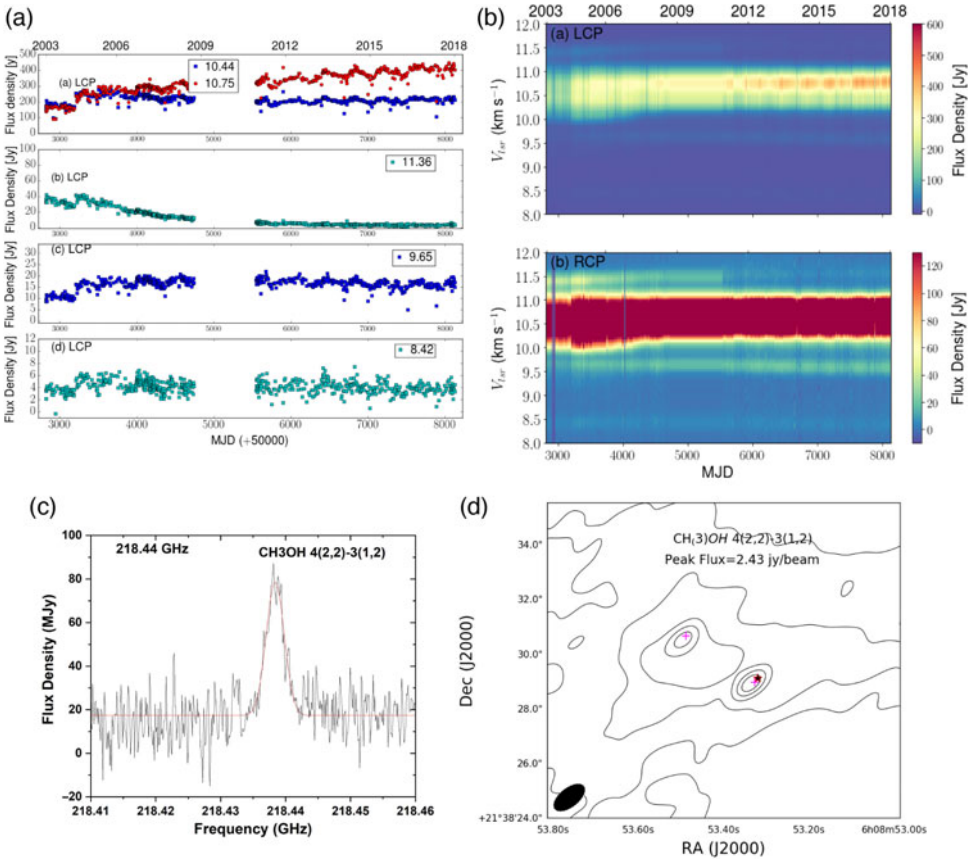

Figure 1. (a) Time series of G188.95+0.89. (b) Dynamic spectrum plot from 2003 to 2018. (c) Spectra of CH_3OH observed by ALMA. (d) CH_3OH integrated map of the emission. The star and plus signs show the position of the methanol maser and the peak positions of the 1.3 mm dust-continuum, respectively. The synthesized beam size is shown in the lower left-hand corner.

CH_3OH masers in G188.95+0.89 observed by ALMA are shown in sub-figures (c) and (d), respectively.

3. Conclusions

Observed changes in G188.95+0.89 masers are likely due to changes in the background free-free emissions which are amplified by the masers. The decay of 11.36 km s^{-1} maser can be explained in terms of the recombination of the ionized gas against which the maser is projected.

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