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MONITORING THE POLARISATIONS OF THE HYDROXYL MASERS IN THE PERIODIC METHANOL MASER SOURCE G9.62 + 0.20E

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Abstract

This study investigates the environment of the high mass star forming region G9.62 + 0.20E by employing the monitoring of galactic hydroxyl and methanol masers known to be associated with this natal phase. A monitoring campaign was instituted to study the left and right circular polarization components of the 1.6 GHz mainline hydroxyl masers and the 6.7 GHz methanol masers. This campaign revealed continual variability of the flux density of the 6.7 GHz methanol masers and the left and right circular polarization components of the 1.6 GHz OH mainline masers.

1 Introduction

Modelling the conditions necessary for maser formation has revealed that OH and methanol masers are likely pumped by the same excitation mechanism. Hence, a spatial association between the two species is expected [1]. Observations of the OH mainline masers in G9.62 + 0.20E using KAT-7 revealed intensity variations similar to those seen in the 6.7 GHz and 12.2 GHz methanol maser transitions [3]. Interestingly, a drop in OH maser flux density was observed to coincide with a rise in the 12.2 GHz methanol transition, suggesting possible interactions between the two species ([3]). While no polarisation variations were reported for G9.62 + 0.20E, the left and right circularly polarised OH masers are thought to originate from different regions within the molecular cloud. As a result, differences in the behaviour of the polarisation components of the OH masers are expected, providing further insight into the physical conditions of the star-forming region.

Presented in this paper are the results of the observation, reduction and analysis of data obtained from the monitoring of the polarisation of the 1665 MHz and 1667 MHz hydroxyl masers and the regularly varying 6.7 GHz methanol maser in G9.62 + 0.20E. The aim is to find correlated variation between the 6.7 GHz methanol masers and the left and right circular polarisations of the OH masers. Such information is valuable for identifying the source of the periodic variation observed in some maser species.

2 Observation, Results and Discussion

Data for both OH and methanol maser observations were obtained using the 26 m HartRAO microwave telescope. Two monitoring windows, a regular and an intensive window, were employed for the collection of the data. The regular monitoring data (2011 day 294 to 2015 day 189) had been taken by HartRAO staff and archived whereas the intensive window data (2017 day 007 to day 130 a flare window) were the product of a follow up proposal for monitoring of the source led by Benedicta Woode which was accepted by HartRAO. The 6668 MHz methanol maser data for the regular monitoring window were supplied by Dr. Sharmila Goedhart from her monitoring campaign data taken at HartRAO. A total of 144 observations for the 1665 MHz OH line , 66 1667 MHz OH line, and 48 for 6668 MHz methanol were recorded. The monitoring campaign revealed the variation of the LCP and RCP components of the mainline OH maser transitions associated with the 6.7 GHz methanol line in G9.62 + 0.20E. Presented in Figure 1 and Figure 2 are the time series of the most varying features of the LCP and RCP components of the OH as well as the methanol lines. The flaring behaviour of the time series was in different forms for both methanol and OH. The LCP components of the 1665 MHz and 1667 MHz OH masers showed the same flare pattern. They both showed flares which were preceded by dips in flux densities which is consistent with those reported by [3]. The RCP component in both transitions showed sporadic variation which was only within the noise. The similarity in the individual flare profiles of the 1665 MHz and 1667 MHz LCP components suggests that the characteristics of the mechanism underlying the flaring affects both OH masers in the same way. Both show a dip in flux density before a steep rise and gentle decay followed by a quiet phase after which they dip and slowly increase to the next flare. However in comparison with methanol whose flares are as well consistent with those reported by [2], there is a time delay in the onset of the flare of the hydroxyl masers of about 30 days, suggesting a correlated variation between the OH and methanol masers. Following the discussion in [3] the time lags are likely due in part to the difference in the distances between the methanol and the OH masers from the HII region associated with them. This is evidenced by the distribution of the OH and methanol masers relative to the HII region in Figure 1 of [4], from which it is clear that the OH masers are excited further from the HII region than the methanol masers. Both methanol and OH masers flare within the same time window separated by a quiescent level which remains unchanged between flares indicating that the source of the flare is intrinsic to the masers themselves.

The profile of the methanol line has a steep decay profile compared to the OH line. The slower decay of the OH masers has been discussed by [3] within the colliding wind binary model to be due to a lower electron density for the background part of the HII region associated with it. This is consistent with the OH masers being further out in the HII region that has a decreasing radial density distribution as is needed for the radio SED as is discussed in the next

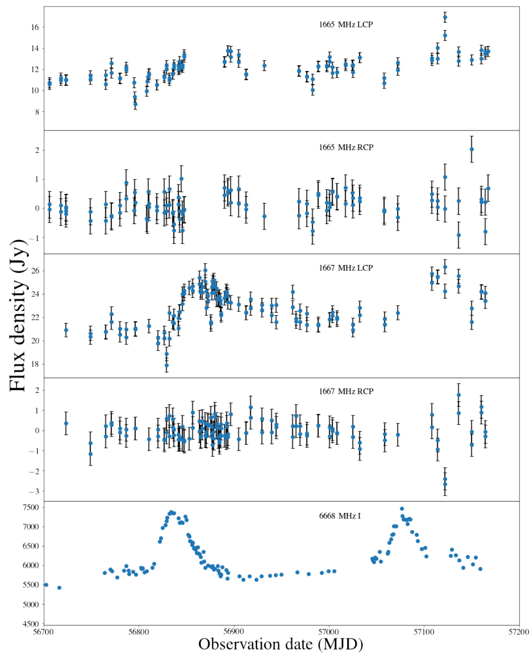

Figure 1. Some selected channels of the 1665 MHz and 1667 MHz hydroxyl lines in both polarizations and the 6668 MHz methanol line during the regular monitoring window.

3 Conclusion and recommendation

In this work the left and right circular polarization components of the 1.6 GHz mainline hydroxyl masers and the 6.7 GHz6:7 GHz methanol masers have been used to study the massive star forming region G9.62 + 0.20E. This is the first time the LCP and RCP components of the mainline OH masers in G9.62 + 0.20E have been monitored. Monitoring ofG9.62 + 0.20E from 2011 to 2017 has shown the continual variability of the flux density of the 6.7 GHz methanol masers and the left and right circular polarization components of the 1.6 GHz OH mainline masers. The variability profile for the separate polarizations of the 1.6 GHz OH mainline masers also confirmed the observed behaviour

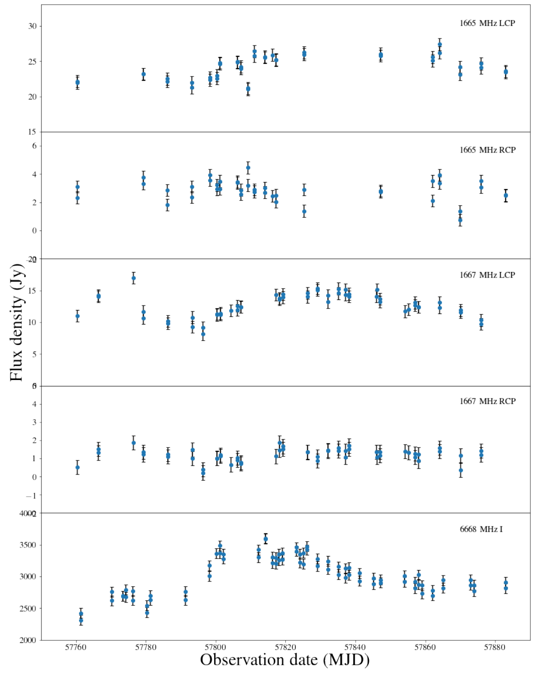

Figure 2. Some selected channels of the 1665 MHz and 1667 MHz hydroxyl lines in both polarizations and the 6668 MHz methanol line during the intensive monitoring window.

seen in [3] 's total intensity monitoring. Between the OH and the methanol profiles, the OH masers exhibited a dip before a steep rise and a slow fall whereas the methanol exhibited a steep rise as well as a fast fall. Time delays between the two species were recorded.

4 Acknowledgements

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