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Zeeman Effect Observations in Class I Methanol Masers

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Abstract. We report the detection of the Zeeman effect in the 44 GHz Class I methanol maser line toward the star forming region DR21W. The 44 GHz methanol masers in this source occur in a $\sim 3''$ linear structure that runs from northwest to southeast, with the two dominant components at each end, and several weaker maser components in between. Toward a 93 Jy maser in the dominant northwestern component, we find a significant Zeeman detection of -23.4 ± 3.2 Hz. If we use the recently published result of Lankhaar *et al.* (2018) that the $F = 5 - 4$ hyperfine transition is responsible for the 44 GHz methanol maser line, then their value of $z = -0.92\,\mathrm{Hz\,mG^{-1}}$ yields a line-of-sight magnetic field of $B_{\rm los} = 25.4 \pm 3.5$ mG. If Class I methanol masers are pumped in high density regions with $n \sim 10^{7-8}\,\mathrm{cm^{-3}}$, then magnetic fields in these maser regions should be a few to several tens of mG. Therefore, our result in DR21W is certainly consistent with the expected values.

Using the above noted splitting factor in past Zeeman effect detections in Class I methanol masers reported by Sarma & Momjian (2011) and Momjian & Sarma (2017) in the star forming regions OMC-2 and DR21(OH) result in $B_{\rm los}$ values of 20.0 ± 1.2 mG and 58.2 ± 2.9 mG, respectively. These are also consistent with the expected values.

Keywords. Masers, magnetic fields, techniques: interferometric, radio lines: ISM

References

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