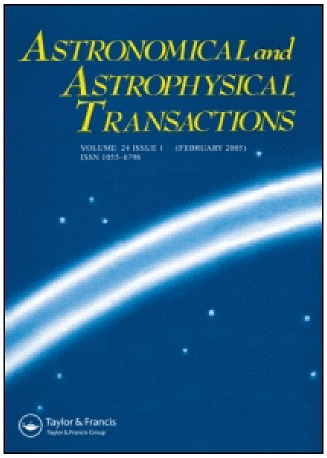

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STUDY OF THE EMISSION PROPERTIES OF CLASS II METHANOL MASER LINES

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STUDY OF THE EMISSION PROPERTIES OF CLASS II METHANOL MASER LINES

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Parameters of the dependence between the intensities of the 5_1–6_0A^+ (6.7 GHz) and 2_0–$3_{-1}E$ methanol maser lines are found: ($\log S_{6.7} = 0.8 \times \log S_{12.2} + 0.8$). In some maser condensations the ratio of the intensities of these lines differs significantly from this dependence. The interpretation was made that in these condensations an unknown factor acts to give additional amplification of the 5_1–6_0A^+ (6.7 GHz) line.

Keywords: Methanol masers

1 INTRODUCTION

We have analyzed the parameters of the 5_1–6_0A^+ (6.7 GHz) and 2_0–$3_{-1}E$ (12.2 GHz) spectral lines (methanol maser class II lines), trying to understand if there is physical connection between condensations forming maxima of these maser lines does exist. We used a sample of 131 sources from Caswell *et al.* (1995). All observed details of these lines were ordered into three groups. The first group contains features of the 2_0–$3_{-1}E$ (12.2 GHz) and 5_1–6_0A^+ (6.7 GHz) line with a maximum of the 5_1–6_0A^+ (6.7 GHz) line; that is sources, in which the maxima of the emission in the 2_0–$3_{-1}E$ (12.2 GHz) and 5_1–6_0A^+ (6.7 GHz) line do not coincide. The second group contains features of the 2_0–$3_{-1}E$ (12.2 GHz) and 5_1–6_0A^+ (6.7 GHz) line with a maximum of the 2_0–$3_{-1}E$ (12.2 GHz) line. The third group contains features of these lines in the spectra of sources, in which the maxima of these lines coincide.

Our analysis has shown the following.

The average intensity of the 5_1–6_0A^+ (6.7 GHz) line in the second and in the third group is different from that in the first group, and the ratio between the two lines in these groups is also different from the ratio in the first group. But this ratio in the second group is approximately the same as in the third group.

The distribution of the intensities in the three groups shows that in the first group the ratios are in a wide range, that is the intensities of the 5_1–6_0A^+ (6.7 GHz) and 2_0–$3_{-1}E$ (12.2 GHz) lines could be practically equal and could differ even by 4 orders of magnitude. In the second

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and in the most part of the third group the intensities are approximately equal – the difference is not more than one order of magnitude.

The dependence between the flux density of the 5_1–6_0A^+ (6.7 GHz) and 2_0–$3_{-1}E$ (12.2 GHz) line in the first group is approximated by $\log S_{6.7} = 0.4 \times \log S_{12.2} + 0.6$, the most evident dependence is in the second group – $\log S_{6.7} = 0.8 \times \log S_{12.2} + 0.8$, and in the third, which we believe represents a mix of the sources of the first and of the second groups, this approximation is $\log S_{6.7} = 0.7 \times \log S_{12.2} + 1.0$.

Thus, the groups of maser features differ not only by coincidence or noncoincidence of the maxima intensity, but also by the type of the intensity ratio of the lines. We found out this regular difference not only among spectral details incoincident in velocities, but also in the sample of sources, in which the maxima of the 5_1–6_0A^+ (6.7 GHz) and 2_0–$3_{-1}E$ (12.2 GHz) line coincide. We suppose that this fact is connected to physical properties of the sources, and suggest a division of class II methanol maser condensations into two subclasses: subclass IIa, with the brighter 5_1–6_0A^+ (6.7 GHz) line and subclass IIb, with the weaker 5_1–6_0A^+ (6.7 GHz) line (Val'tts & Lyubchenko, 2001).

2 CONCLUSIONS

1. Caswell *et al.* (1995) have established, that in the large amount of the sources LSR velocity of maximum of the emission in the 2_0–$3_{-1}E$ (12.2 GHz) line does not coincide with LSR velocity of maximum of the emission in the 5_1–6_0A^+ (6.7 GHz) line.
2. Val'tts and Lyubchenko (2001) have established, that
   (a) condensations forming a maximum of the 5_1–6_0A^+ (6.7 GHz) line and a maximum of the 2_0–$3_{-1}E$ (12.2 GHz) line have different intensity ratios of these lines;
   (b) concidence or discrepancy of these maxima is not important: from the group of the sources, in which the maxima coincide, it is possible to allocate a part, in which the intensity ratio of the 5_1–6_0A^+ (6.7 GHz) and 2_0–$3_{-1}E$ (12.2 GHz) lines are described by either the first, or the second relation;
   (c) one could attribute a part of such sources to a subclass IIa (with brighter 5_1–6_0A^+ (6.7 GHz) line or to a subclass IIb – with weaker 5_1–6_0A^+ (6.7 GHz) line).
3. The most evident relation between the intensities of the 5_1–6_0A^+ (6.7 GHz) and 2_0–$3_{-1}E$ (12.2 GHz) lines was found: ($\log S_{6.7} = 0.8 \times \log S_{12.2} + 0.8$). It should be taken into account in the calculations of the level population, interpretation of the observed line intensities and modeling of the sources.

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