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Trans-ethyl methyl ether, the struggle for the detection of a complex molecule in hot cores

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Abstract. Many large and complex molecules of prebiotic importance have been found as constituents of interstellar clouds but their detection remains difficult and sometimes doubtful (Snyder et al. 2005). The complex spectrum of trans-ethyl methyl ether (EME) has been investigated in the laboratory (Fuchs et al. 2003) up to 350 GHz and is now known with high frequency precision, see Fig. 1. In this work we present an extensive search for EME towards G34.26, NGC6334(I), Orion KL, SgrB2(N) and W51e2 in the 1 to 3 mm wavelength region. These sources have previously been shown to have a rich chemistry of complex molecules. The IRAM 30m telescope at Pico Veleta, Spain and the SEST 15m radio telescope in La Silla, Chile have been used for the observations. We looked at 5 - 11 frequency bands where EME has strong transitions. All sources were examined using long integration times up to 220 min (on+off), elevations greater 40° and under good weather conditions. For our analysis of the data we used the method of rotational-temperature-diagrams but also the myXCLASS (written by Peter Schilke) extension program to the GILDAS (Grenoble Image and Line Data Analysis Software) software which enabled us to simulate spectra of several molecules including their linewidth and intensities at the same time, see Fig. 2. With this program a consistency check of molecular abundances and overall composition is possible even in dense spectra with many overlapping lines. The effect of the source size on the measured intensities has been considered and cross checks with other important molecules such as methanol, ethanol and di-methyl ether have been performed. Charnley et al. (2001) assigned one line in W51 e1/e2 and one line in Orion KL at 160.1 GHz, as well as a line in SgrB2(N) at 79.6 GHz to trans-ethyl methyl ether. From their isolated measurements, the column density of EME was estimated to be in the range 10^{14} - 10^{15} cm^{-2} in Sgr B2(N) corresponding to a fractional abundance of 10^{-10} - 10^{-9} and in the W51 region they estimate a fractional abundance of 10^{-10}. However, our observations cannot confirm the tentative detection of EME in Orion KL within their given column density limits. There is evidence for the existence of the trans-ethyl methyl ether towards W51e2 with a column density of N=2×10^{14} cm^{-2} based on the detection of 14 lines which coincide with EME transition frequencies. We present new upper limits of 7-8$\times 10^{13}$ cm^{-2} for the column densities of EME toward Orion KL, G34.26, NGC6334(I) and estimate the column density of SgrB2(N) to be of the same order. The W51e2 observations are discussed in more detail.

Keywords. astrochemistry – line: identification – ISM: abundances – ISM: molecules –

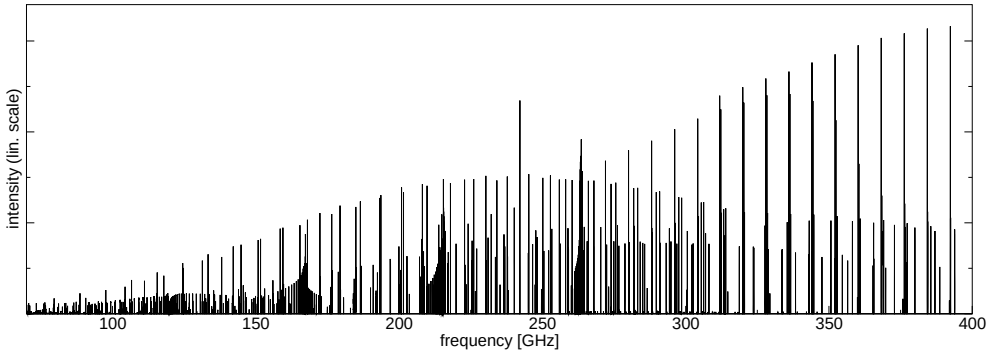

Figure 1. Calculated spectrum of EME at 130 K.

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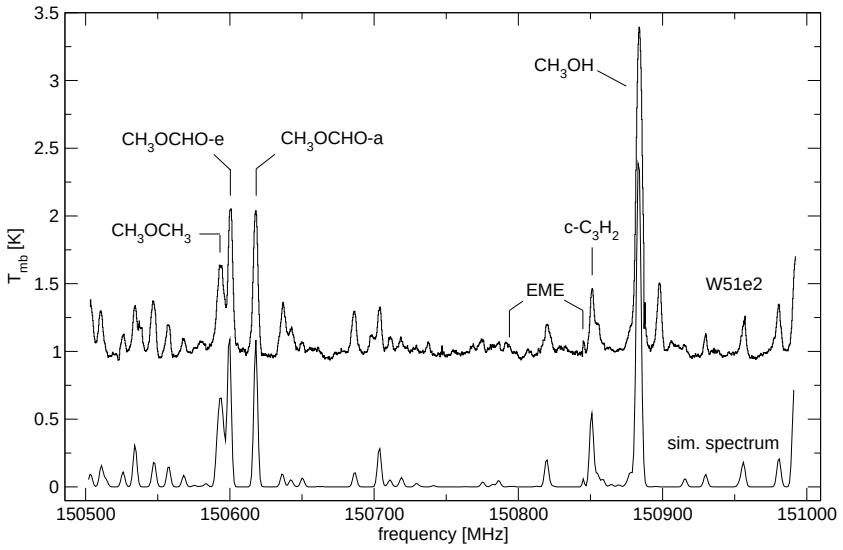

Figure 2. Observed spectrum of W51e2 at 151 GHz (top) and simulated spectrum using myXCLASS (bottom).