SMA millimeter line observations of the chemical active outflow in DR21(OH)

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We present archival millimeter observations made with the Submillimeter Array of the east-west outflow in DR21(OH). We report the detection of the lines such as $H^{13}CO^+$, HC_3N, H_2S, and CH_3OH toward the outflow. These lines show morphological differences between each other, likely because of its excitation conditions. We discuss some possibilities to explain this phenomenon. Finally, our continuum images together with the maps of the molecular emission from the outflow suggest that the source called SMA 4 could be indeed its exciting source.

Introduction

DR21(OH) (also known as W75S) is a massive star-forming region located about 3' north of the H II region DR21 in the Cygnus X complex (see figure 1). DR21(OH) is located at a distance of about 1.5 kpc and the total mass and luminosity of the region are about 3×10^3 $M_\odot$ and 5×10^4 $L_\odot$ respectively. The region contains two main dusty condensations, MM1 and MM2, for which multiple molecular outflows have been detected and reported. We present maps of molecular emission (see figure 2) made with the SMA from the well-collimated east-west (E-W) bipolar flow driven from within the MM2 condensation, corresponding to the CH_3OH, HC_3N, H_2S, $(CH_3)_2CO$ and $H^{13}CO^+$. We also report some observational parameters of the lines.

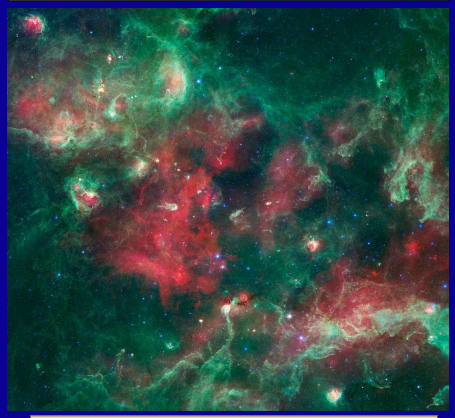


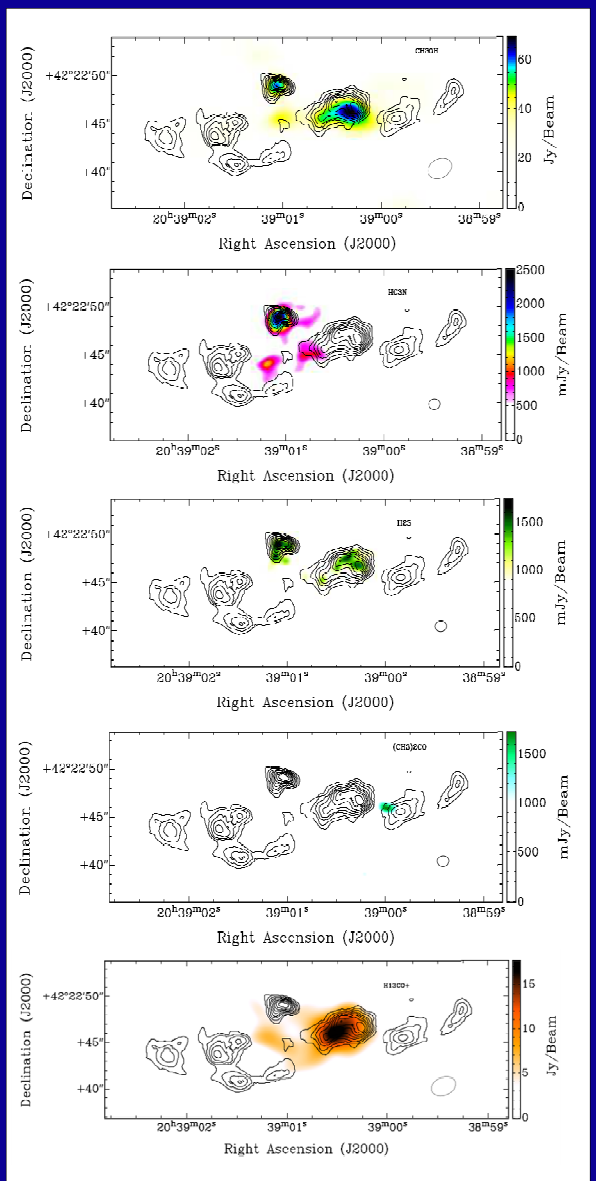
Figure 1. Cygnus X infrared image from the NASA's Spitzer Space Telescope.

Observations

Data were obtained from the SMA archive and were collected on 2006 August 21 (Freq. = 217-227 GHz) and 2006 May 23 (Freq. =337-347 GHz), when the SMA was in its "extended" configuration. The primary beam at 230 GHz has an FWHM diameter of about 55',while it has a diameter of 36' at 345 GHz. The spectral resolution was about 1 km s^{-1} for both dataset. The initial data reduction was performed using the IDL superset MIR package. The line maps were created using the MIRIAD package. The image analysis was made using the KARMA package.

Table 1. OBSERVATIONAL AND PHYSICAL PARAMETERS OF THE MILLIMETER LINES

Lines	Rest Frequency [GHz]	E_{lower} [K]	Range of Velocities [km s^{-1}]	Linewidth [km s^{-1}]	LSR Velocity [km s^{-1}]	Intensity Peak [mJy Beam^{-1}]
HC_3N *(J=24-23)*	218.32471	120.50	-10, +11	18	-2.3	40
$(CH_3)_2CO[52(41,12)-52(40,13)]$	217.14177	1184.02	-5,+12	19	+1.03	40
$H_2S[2(2,0)-2(1,1)]$	216.71044	73.57	-10,+7	11.7	-2.3	50
$CH_3OH[7(0,7)-6(0,6)]$	338.40872	48.73	-9,+9	10.1	-2.7	500
$H^{13}CO^+$ *(J=4-3)*	346.9985	24.98	-8,+4	6.15	-2.2	400



In Figure 2, we present the integrated intensity (moment 0) colour maps (from top to bottom) of the CH_3OH [7(0,7)-6(0,6)], HC_3N[J=24-23], H_2S[2(2,0)-2(1,1)] $(CH_3)_2CO$[52(41,12)-52(40,13)] and $H^{13}CO^+$[J=4-3] emission from the DR21(OH) region overlaid with the continuum emission (in contours) of the CH_3OH at 218 GHz from Zapata et al. (2009). The colour scale bar on the right of each map indicates the emission intensity in mJy $beam^{-1}$ of each of the molecules detected along the outflow. For the 217 GHz observations the beam was 1".3 × 1".086 with a P.A.=-86.09° and for the 337 GHz was 2".75 × 1".96 with a P.A.=-66.65° .

Results

In table 1, we reported some physical and observational parameters of the lines detected. The emission from CH_3OH, HC_3N and H_2S is more extended and includes the MM1 hotcore. There are four compact sources associated with the MM2 condensation (SMA 1-4). The difference between the parameters of the lines is supposed to be because of its excitation conditions. Actually, the source called SMA 4 could be its exiting source.

We also report the detection of millimeter emission of acetone ($(CH_3)_2CO$) around 217 GHz as well as formylium ($H^{13}CO^+$) at 347 GHz toward DR21(OH). Finally, the parameters of several more millimeter lines detected will be reported in the future.