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ALMA observations of the environments of G301.1364-00.2249A

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Abstract. *Context:* Theoretical scenarios describe the phenomenon of mass accumulation by high-mass young stellar objects (HMYSOs) through disk accretion. *Aims:* To find out whether the rotation of the core around hyper-compact (HC) HII regions is common *Methods:* The molecular core G301.1364-00.2249A was selected as the subject of investigation. Observations were carried out on CH_3CN, SO_2, H29α radio recombination line and continuum emission. Analysis involved the "Moment 0, 1, 2" and "Population-diagram" methods. *Result:* The structures of G301.1364-00.2249A exhibited clear definition. CH_3CN moment 0 images revealed multiple enhanced emission regions and an absorption area. The moment 1 image depicted a velocity gradient from southeast to northwest. *Conclusion:* The molecular gas has a rotational motion in the direction from the southeast to northwest. The rotational temperature was measured at 293 K.

Keywords. ISM: individual objects: G301.14AB—ISM: molecules—ISM: clouds—ISM: cores—stars: formation—stars: massive—ISM: kinematics and dynamics

1. Introduction

It is assumed that for an O-type star, 50% of the total mass is accreted after Kelvin-Helmholtz contraction (Hosokawa & Omukai 2009; Zhang, Tan, & Hosokawa 2014). These are the initial stages of ionizing radiation, the prerequisites for the emergence of the HC HII region. Therefore, in order to identify the phenomenon of mass accumulation by HMYSO, it is necessary to study the surrounding ionized region at an early stage. We observed the hot core G301.1364-00.2249A associated with HC HII region through the ALMA 6 band (256.302035 GHz – 259.599448 GHz), dust continuum and molecular line emission arising from two molecules, CH_3CN (J=14→13) ladder and SO_2 ($30_{4,26} - 30_{3,27}$ and $32_{4,28} - 32_{3,29}$).

The source G301.1364-00.2249 was catalogued as high-mass young stellar object (HMYSO) candidate by Urquhart *et al.* (2007). Due to its rising spectral index between 6.67 GHz and 8.64 GHz, Guzmán *et al.* (2012) considered this source as a jet candidate. The G301.1364-00.2249 core consists of two cores: G301.1364-00.2249A and G301.1364-00.2249B. Their peak positions are at (RA, Dec) (J2000) = ($12^h35^m35.13^s$, -63°02′31.7″)

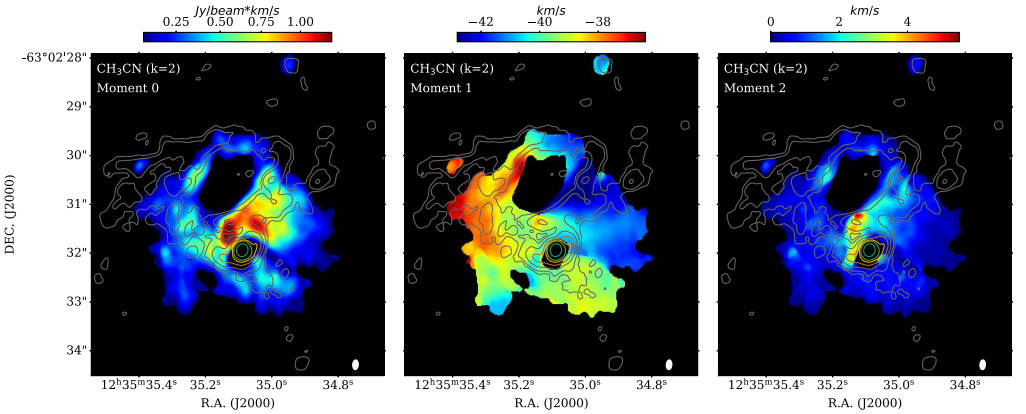

Figure 1. Moment 0, 1, 2 (colorscale) images of CH_3CN (K=2) toward G301.1364-00.2249A. Superimposed are contours of the continuum emission. Contour levels are 0.00448, 0.00896, 0.02689, 0.06274, 0.11652, 0.17926 and 0.44816 Jy beam^{-1}. The white ellipse shown at the bottom right corner indicates the beam size ($0.256'' \times 0.198''$).

and (RA, Dec) (J2000) = ($12^h35^m35.19^s$;-63°02′24.0″), respectively. Both of these cores are detected emission in the H29α radio recombination line (RRL) in our observations. In the following sections, we show the moment maps and rotational temperature analysis of G301.1364-00.2249A core.

2. Molecular gas dynamics

Moment 0 map in Figure 1 shows several enhanced emission areas (∼1 Jy beam^{-1} km s^{-1}), and an absorption area which corresponds to the peak of the continuum emission. Moment 1 map shows a velocity gradient from south-east to north-west. In the image of moment 2, the velocity dispersion showing a structure at the north-east (∼4 km s^{-1}) of the continuum peak. The images of moments 1, 2 determines the direction of rotation motion of the molecular gas, which is directed from south-east to north-west.

3. Rotation diagram analysis: estimation of gas temperature

Using the rotation transitions of the CH_3CN and the population-diagram method (see Araya *et al.* 2005), it is possible to determine the rotation temperature $T_{\rm rot}$=293 K and the column density $N_{\rm CH3CN}$=6,716·10^{16} cm^{-2}.

4. Future studies

In our follow-up studies, we will analyze the ionized gas, as well as the kinematics and dynamics of this source.

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