B03a ALMA Observations of Dense Molecular Condensation MC27(=L1521F)

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Starless dense cores eventually collapse to form protostars in them, and the physical properties of the cores decide the nature of the forming protostars. Recently, the importance of the first protostellar core (first quasi-hydrostatic object) has been stressed because it can drive a low-velocity outflow eventually suppressing the star formation activity and also because it is a possible formation site of close multiples. One of such objects is MC27(= L1521F) in Taurus. Here we report ALMA observations of dust continuum emission and molecular rotational lines (HCO^+(3–2), $H^{13}CO^+$(3–2), HCN(3–2), CS(5–4), SiO(6–5)) toward the object. The synthesized beam size is $\sim 1''.1 \times 0''.8$ (154 AU $\times$ 112 AU). Dust continuum and $H^{13}CO^+$(3–2) data show a high-density starless core with a density of $\sim 2 \times 10^7 \mathrm{cm}^{-3}$ and a diameter of $\sim$ 300 AU at the southwest of the Spitzer source, which is the densest starless core in low-mass star forming regions, and thus, the strong candidate for the object containing the first protostellar core. A very compact outflow with a dynamical time scale of 100 $\sim$ 200 yr is found toward the very low luminosity Spitzer source. Several cores with arc-like structures are found in this system, possibly due to the dynamical gas interaction. These complex structures revealed in the present observations suggest that the initial condition of star formation is highly dynamical.