Mapping Observations of the Continuum Emission in Orion KL with ALMA

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We have carried out high-resolution observations of millimeter and submillimeter continuum emission from the Orion KL region, the nearest site of massive star-formation, using ALMA cycle 0 data [1]. Total 11 compact continuum sources are identified in both ALMA band 6 (245 GHz) and band 7 (339 GHz) images, including the Hot Core, Compact Ridge, SMA1, IRc4, IRc7, and Source I (Figure 1). A spectral energy distribution (SED) of each source can be determined to constrain physical properties such as size, mass, hydrogen number density, and column density assuming the dust graybody emission.

Among 11 identified compact continuum sources, Source I, which is a massive protostar candidate, is the brightest with an unresolved structure even in the longer uv length than 200 kλ. It is thought that the continuum emission from Source I is associated with a circumstellar disk around a massive protostar object. We investigate its SED from centimeter to submillimeter wavelengths employing previously published result (Figure 2). The SED of Source I can be approximately fitted with a single power-law index of 1.97 suggesting an optically thick black body emission. To explain this SED, we employ the H^- free-free emission as an opacity source, which is an interaction between neutral hydrogen atoms/molecules and electrons. The temperature, density, and mass of the circumstellar disk associated with Source I are constrained by the SED of H^- free-free emission. Nevertheless, the fitting result shows a significant deviation from the observed flux densities. We next calculate the SED by including the thermal dust graybody SED to explain excess emission at higher frequency. Future higher resolution and high frequency observations with ALMA will be crucial to constrain the emission mechanism and physical properties of the circumstellar disk associated with Source I.

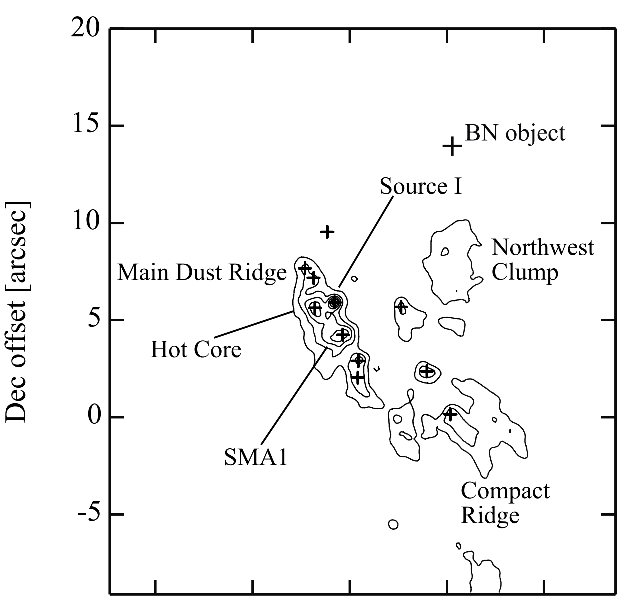

Figure 1: Continuum map of Orion KL observed with ALMA at band 7. The contours start at the −5σ level with an interval of 10σ (5, 15, 25, ...). Crosses indicate the positions of the point sources identified by our mapping.

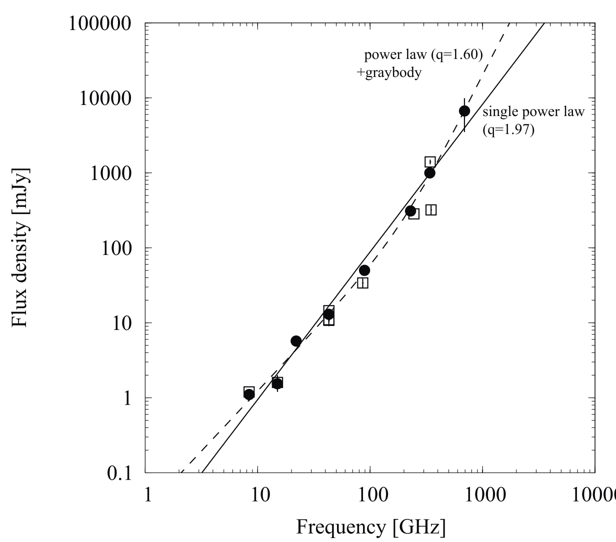

Figure 2: Spectral energy distribution of Source I, the most brightest continuum source in Orion KL. Flux densities are taken from previous literatures [2], except for our 245 GHz and 339 GHz data.A solid line indicates the best-fit single power-law model, $F_\nu = p\nu^q$, with the index of 1.97. A dashed line indicates the combination of power-law and graybody SEDs, with the power-law index of 1.60.

References

[1] Hirota, T., Kim, M. K., Kurono, Y., Honma, M.: 2015, *ApJ*, **801**, 82.
[2] Plambeck, R. L., et al.: 2013, *ApJ*, **765**, 40.