The 1.1 mm Continuum Survey of the Small Magellanic Cloud: Physical Properties and Evolution of the Dust-selected Clouds

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The Small Magellanic Cloud (SMC) is a dwarf galaxy that provides a unique opportunity to study the physics of the interstellar medium (ISM) because of its proximity (~60 kpc) and low metallicity (~1/5 $Z_\odot$). These peculiarities make the SMC an ideal laboratory to investigate the physics of the ISM under the extreme conditions such as galaxies forming in the early Universe. Previously, observations of giant molecular clouds (GMCs) in the SMC has been conducted by CO lines (e.g., [1]). On the other hand, recent study suggests that, in a low-metallicity environment, the fraction of “CO-dark” gas in the GMCs can be a dominant component [2]. Therefore, it is essential to investigate GMCs in low-metallicity environments by means other than CO line observations, and dust continuum observations using a submillimeter imager can provide an alternative method to investigate the GMC.

In this study, we conducted a 1.1 mm continuum survey using the AzTEC instrument on the ASTE telescope to investigate the physical properties of the GMCs in the SMC. The observations covered a total of a 4.5 deg^2 field of the SMC, and noise levels of 5–12 mJy beam^{-1} are achieved with a effective resolution of 40″, which corresponds to 12 pc.

Figure 1 shows the obtained 1.1 mm continuum map. Most of the representative star-forming regions in the SMC, such as N27, N66, N81, N83, N84, and N88, were detected with sufficient S/N ratios of > 10 at the peak positions. We identified a total of 44 objects, and the physical properties were derived by the SED analysis under the assumption of single-temperature thermal dust emission using 1.1 mm and *Herschel* bands. As the result, the 1.1 mm objects displayed masses of 4×10^3–3×10^5 $M_\odot$, and dust temperatures of 17–45 K.

We found three important facts from the detail investigation of the 1.1 mm objects. First, the dust temperature of the 1.1 mm objects show good correlation with the *Spitzer* 24 μm, and this supports that the heating source of the cold dust is mainly local star-formation activity. Second, the 1.1 mm objects in the SMC should trace dense gas objects corresponding to the GMC in our galaxy or nearby galaxies, because the mass, size, density, and mass function are very similar to those of GMCs in our galaxy and the Large Magellanic Cloud. In addition, the 1.1 mm objects displayed good spatial correlation with the 24 μm and CO emission. Third, the classification of the 1.1 mm objects in terms of star-formation activity revealed that the starless objects harbor lower dust temperatures and smaller gas masses and radii compared to those of the star-forming objects, suggesting that starless objects are younger evolution phase of the GMC.

These results were published in the Astrophysical Journal [3].

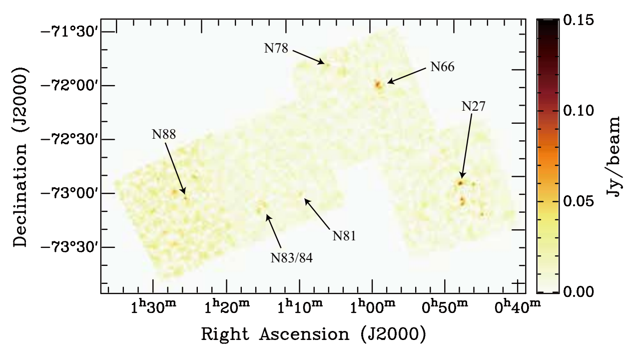

Figure 1: The 1.1 mm continuum map of the SMC.

References

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