Far infrared imaging survey of the Chamaeleon region with AKARI: column density maps of molecular and atomic clouds resolving star forming cores

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Molecular clouds are the major form of interstellar matter in the Galaxy and are the birthplaces of stars. It is thought that molecular clouds are formed from atomic clouds, which have densities of ~1 - 10 cm^{-3} and temperatures of ~ several×10 - 100 K, through the phase transition process [1]. It is well known that the structures of molecular clouds are highly hierarchical. Especially, the scale of 0.1 pc “core”, in which gravitational collapse into a star occurs, is important for star formation. A recent study [2] reported that the core structures have been already determined in relatively tenuous (10^{4-3} cm^{-3}) gas, strongly suggesting that the formation process of molecular cloud/core structures from atomic cloud is a key to understanding the origin of stars. Therefore, it is highly required to derive the column density distributions of molecular and atomic clouds with spatial resolutions high enough to resolve the cores. We carried out imaging observations toward the Chamaeleon star forming regions by Far-Infrared Surveyor (FIS) [3] onboard AKARI satellite. In the FIS bands of 60 - 160 microns we separate thermal radiation from cold (~ 10 K) and warm (tens of kelvins) dust components associated with the molecular and atomic clouds, respectively. With the spatial resolutions in the FIS bands of 30 - 60 arcsec, we succeeded in the construction of the molecular/atomic column density maps, covering 210 pc^2 with the linear resolution of 0.04 pc, which is enough to resolve the cores in the region (160 pc; [5]). There are five subregions named Cha I, II, III, Major Filament and Cha East [6]. Active star formations occur in Cha I and II, while little star formation is known in the other regions. We found a significant correlation between the star-formation activities and the ratio of the molecular to the atomic cloud mass among the subregions: the ratio is almost unity for Cha I and II, but is 0.5 for Cha III and 0.1 for the others. On the other hand, the column density histograms for the atomic components in the subregions are similar to each other and the upper end of the histograms are ~$5\text{-}9\times10^{20}$ cm^{-2}, corresponds to ~0.2-0.4 mag for A_V. Considering that UV flux is responsible for molecular cloud formation, the observed low-extinction requires that the atomic component should be highly clumpy[6], and the core formation is probably related to the clumpiness of the atomic clouds.

References

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