Molecular Gas, Dust, and Star Formation in Galaxies
Proceedings IAU Symposium No. 292, 2012
T. Wong & J. Ott, eds.

doi:10.1017/S1743921313000276

Star Formation in the Long Filamentary Infrared Dark Cloud at $l \sim 53°.2$

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Abstract. Massive stars govern the evolution of galaxies by providing ionizing photons and energy as well as enriching heavy elements into interstellar medium; however, their formation is still poorly understood. Infrared dark clouds (IRDCs) are cold (< 25 K) and very dense ($> 10^5$ cm^{-3}) interstellar clouds which are seen silhouette against the bright Galactic background in mid-IR. With very high column densities ($\sim 10^{23}$–10^{25}cm^{-2}), IRDCs are believed to be the precursors to massive stars and star clusters (Simon *et al.* 2006).

We report a remarkable IRDC at (l, b) $\sim$ (53°.2, 0°.0) which shows a number of bright mid-IR stellar sources along the cloud that are likely young stellar objects (YSOs). There are also several H_2 (at 2.122 μm) outflow features in the cloud revealed by UWISH2 (Ukirt Widefield Infrared Survey for H_2, Froebrich *et al.* 2011), in particular where earlier evolutionary stage of YSOs are located. The IRDC was previously partly identified as three separate IRDCs in the MSXDC catalog (Simon *et al.* 2006), whereas we have found that a long, filamentary cloud extending ~ 30 pc including these three IRDCs is very well coincident with a CO cloud at $v \sim 23.5$ km/s (or at $d \sim 2$ kpc) which is clearly distinct from the other velocity components. Therefore, in this study, we investigate the overall star formation activity in this IRDC (IRDC G53.2, hereafter).

We perform the PRF photometry of *Spitzer* MIPSGAL 24 μm data using MOPEX and build a catalog of YSOs by matching the detected 24 μm sources with published catalogs. The limiting magnitude in 24 μm is ~ 7.8 mag, and YSO candidates which have counterparts in GLIMPSE I catalog are 354. The YSO candidates are classified using spectral index derived between 2 and 24 μm, following Greene *et al.* (1994). We also remove the field-star contamination using reference fields where there is no CO cloud; the fraction of each class after reference field analysis is 18, 22, 45, 10, and 5% for Class I, Flat, Class II, Class III, and sources which cannot be classified due to the lack of data. The spatial distribution that earlier classes (i.e., Class I and Flat) are concentrated where far-IR or millimeter emission is strong and larger fraction of Flat objects compared to other low-mass star forming regions (e.g., Evans *et al.* 2009 and Billot *et al.* 2010) may imply that the IRDC G53.2 is indeed an active star-forming region in rather early evolutionary stage. Further investigation of each YSO such as SED modeling will reveal detailed information on star formation activity in this intriguing IRDC.

Keywords. infrared: ISM — ISM: clouds — stars: formation — stars: pre-main-sequence

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