Investigation of IRAS 05168+3634 and IRAS 19110+1045 star-forming regions

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We report investigation results of structure, stellar content and gas-dust matter of molecular clouds surrounding the **IRAS 05168+3634** (Figure 1.1) and **IRAS 19110+1045** (Figure 2.1) sources. Two regions have more complicated structures in the far-infrared (FIR) wavelengths than in the near- and mid-infrared (NIR and MIR). In FIR wavelengths, the clouds filaments surrounding IRAS 05168+3634 and IRAS19110+1045 sources become more visible. From FIR images, it is obvious that IRAS 05168+3634 (distance: 1.44 or 6.1 kpc) and IRAS19110+1045 (distance: 7.9 kpc) star-forming regions are located within a 24 and 10 arcmin radii molecular clouds, respectively. Studying the molecular cloud surrounding the IRAS 05168+3634, it turns out that apart from it, there are four IRAS sources (IRAS 0518, IRAS 05177, IRAS 05162, and IRAS 05156) embedded in the same molecular cloud. There is very little information about these 4 additional IRAS sources. In turn, the molecular cloud surrounding the IRAS 19110+1045 source also contains other IRAS source (IRAS19111) and new-formed subregions at the same 7.9 kpc distance.

IRAS 05168+3634

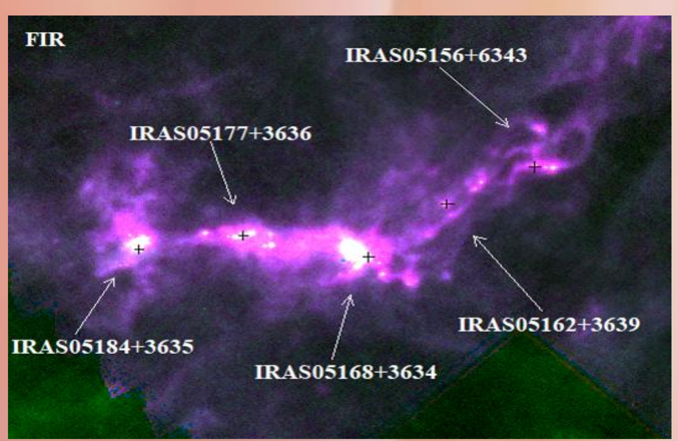

Figure 1.1

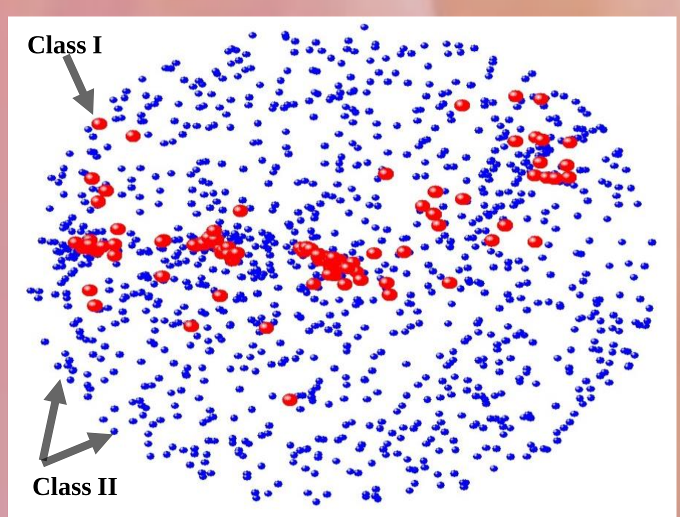

Figure 1.2

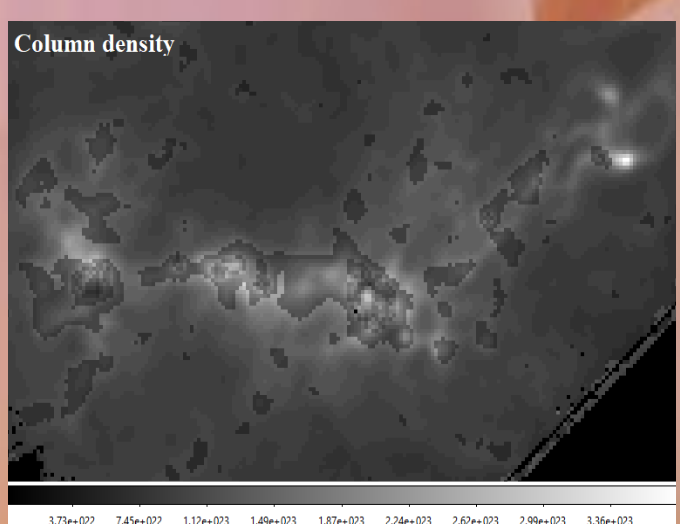

Figure 1.3

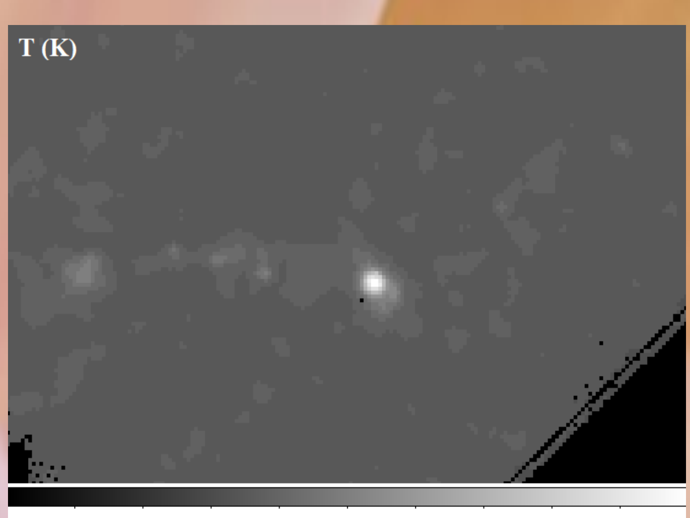

Figure 1.4

RESULTS

1. Color-color diagrams

We used data in NIR, MIR and FIR. They are GPS UKIDSS, GLIMPSE, MIPS, WISE, MSX, IRAS missions. Based on multi-color criteria (Figure 3), we identified a rich population of embedded young stellar object (YSO) candidates with infrared excess (Class 0/I and Class II) and their characteristics. The molecular cloud around IRAS 05168+3634 includes 240 candidates of YSOs within the radii of subregions around five IRAS sources. The local distribution of identified YSOs in IRAS05168+3634 star-forming region frequently shows elongation and subclustering (Azatyan 2019). The molecular cloud around IRAS 19110+1045 includes 856 candidates of YSOs within the radius of cluster region (IRAS19110+1045, IRAS19111 and new-formed subregions). The local distribution of identified YSOs in IRAS19110+1045 star-forming region shows subclustering but does not show elongation. The observed young subregions and parental molecular clouds morphologies are similar, especially when only the youngest Class I/0 sources are considered (Figure 1.2, 2.2).

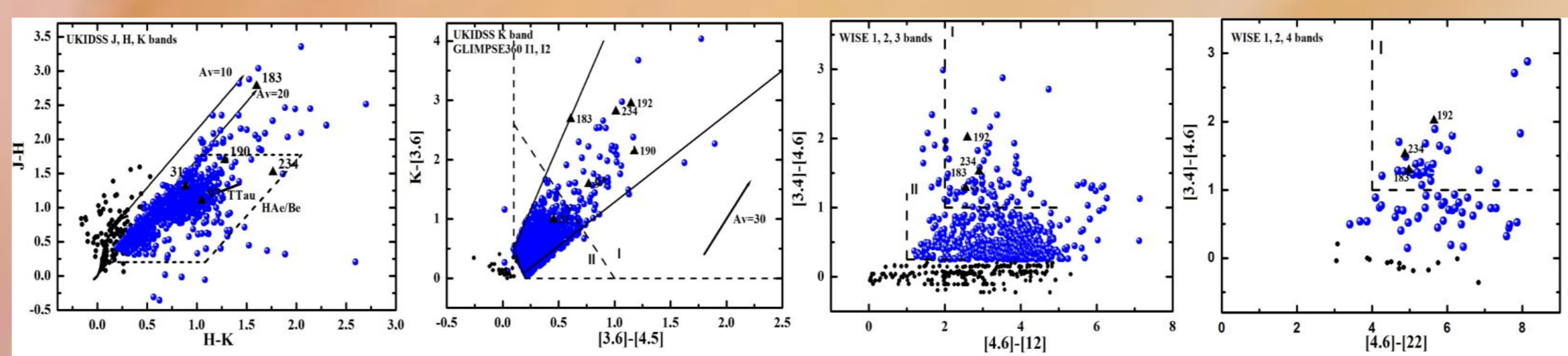

Figure 3. Color-color diagram

2. K luminosity function

We construct the K luminosity function (KLF) of the subregions of IRAS05168+3634 and it shows unusually low values for slope: 0.12–0.21. According to the values of the slopes of the KLFs, the age of the IRAS05168+3634 star-forming region can be estimated at 0.1–3 Myr. Unlike subregions of IRAS05168+3634, the value of KLF slope of IRAS19110+1045 is quite different: 0.36, which corresponds to ~1-2 Myr for the mean age of the IRAS19110+1045 star-forming region.

3. Parameters of molecular clouds

Herschel: PACS and SPIRE missions give an opportunity to make a complete picture of the regions. Thermal emission from cold dust lies in the FIR wavelength range, and thus its analysis can be used to obtain the physical parameters like dust temperature and column density of a gas-dust matter in the regions (Battersby et al. 2011). This was carried out for IRAS 05168+3634 and IRAS19110+1045 star-forming regions. Following the methods presented in Mallick et al. (2015), the Herschel temperature and column density maps are generated using Herschel FIR bands (160–500 μm). These maps are produced from a pixel-by-pixel spectral energy distribution (SED) fit with a modified blackbody to the cold dust emission at Herschel 160–500. After fitting, we constructed the column density (Figure 1.3, 2.3) and temperature (Figure 1.4, 2.4) maps. We obtained the peak values as 9.2 × 10^23 cm^(−2) and ~27 K, respectively, for IRAS 05168+3634. From temperature and column density maps, it is obvious that the peak values coincide with our central IRAS05168+3634 region. For IRAS 19110+1045, we obtained the peak values as ~95 K and 9.5 × 10^23 cm^(−2), respectively. In this case the obtained results are completely different. From temperature and column density maps, it can be seen that in the region where the temperature is the highest, the column density in that part is the smallest. On the other hand, by studying the composition of objects in that part of the region, one can be sure that there is a B type star in the region and, most likely, it has dispersed the gas-dust material because of its strong stellar wind. This is also evidenced by its spherical shape. Column density maps can be used for calculation of mass of star-forming regions, therefore star formation efficiency and star formation rate.

IRAS 19110+1045

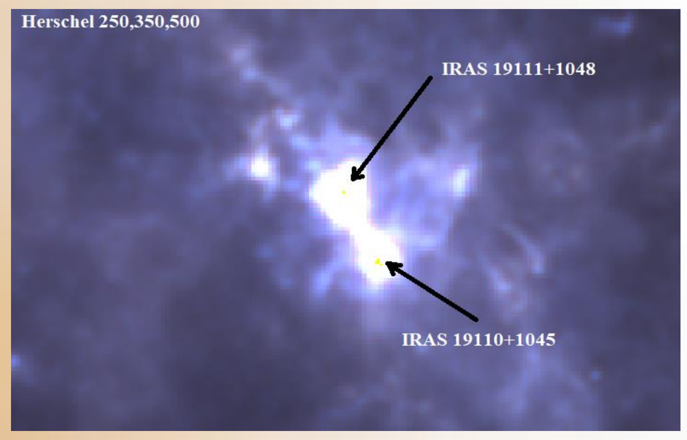

Figure 2.1

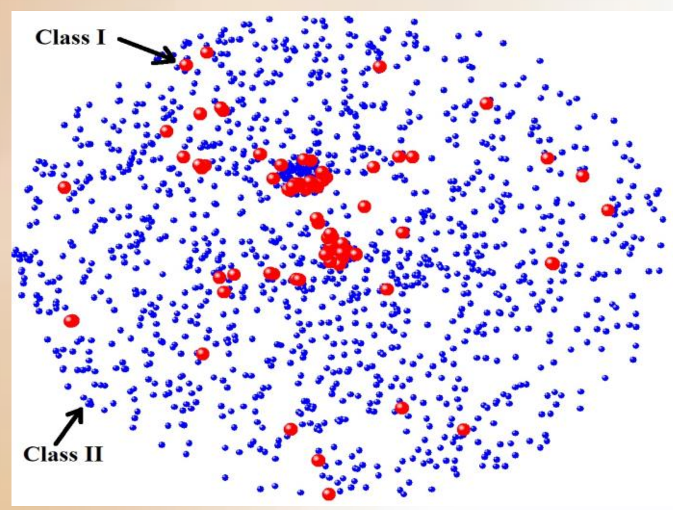

Figure 2.2

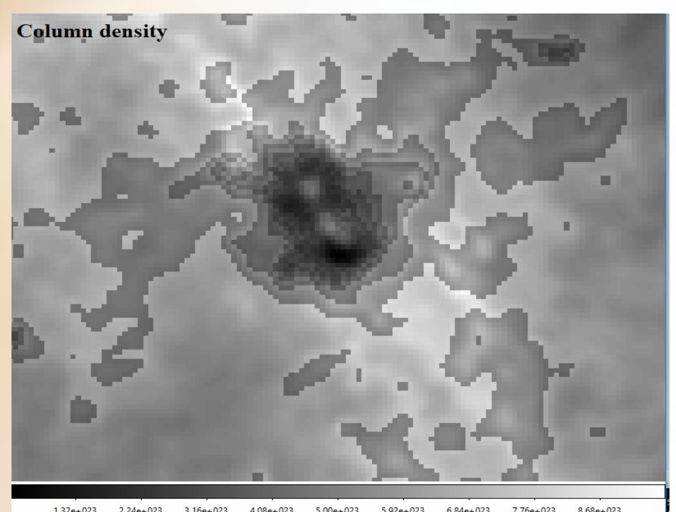

Figure 2.3

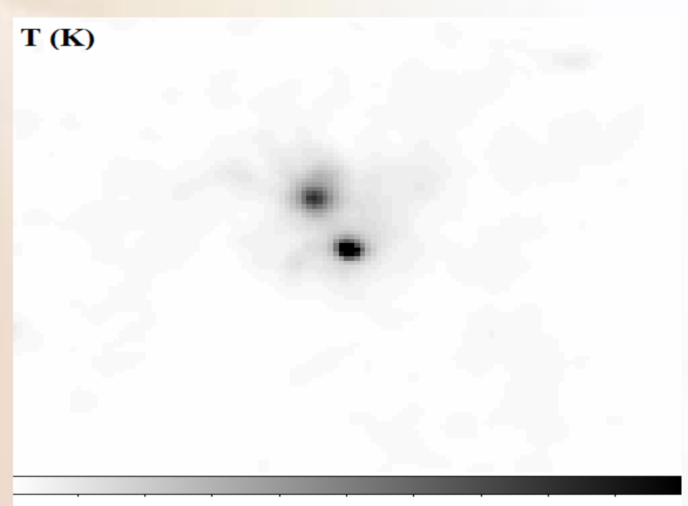

Figure 2.4

REFERENCES

1. Azatyan N., A&A, 622, A38 (2019), 2. Battersby C. et al., A&A, 535, A128 (2011), 3. Mallick, K. K., Ojha, D. K., Tamura, M., et al., MNRAS, 447, 2307 (2015)