Infrared Photometric Analysis of Massive Star Forming Regions

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Özet: Kırmızıöte ve submilimetre dalgaboylarında gözlem tekniklerindeki ve yıldız oluşumuna dair teorik bilgilerimizdeki ilerleme sayesinde, yıldız oluşum bölgelerinde çeşitli yoğunluklarda Genç Yıldızımsı Cisim (YSO) toplulukları keşfedilmektedir. Ancak büyük kütleli yıldızların nasıl oluştuğu halâ kesin olarak bilinmemektedir. Spitzer orta kızılötesi ve 2MASS/UKIDSS yakın kızılötesi verileri kullanarak, W49, W51 ve W43 üzerine yaptığımız araştırmada; W49'da, 232 adet Class 0/I YSO, 981 adet Class II/geçiş diski adaylarını, W43'de, 1177 adet Class 0/I YSO, 5358 adet Class II/geçiş diski adaylarını ve W51'de 418 Class 0/I YSO, 1243 Class II/geçiş diski adaylarını belirledik. Bu bölgelerin yıldız oluşum hikâyelerini açığa çıkarmak üzere YSO grup ve kümelerini inceledik. Büyük kütleli YSO'ları belirlemek üzere, Tayfsal Enerji Dağılımı (TED/SED) modellerini kullandık ve büyük kütleli yıldız oluşumuna işaret eden çok yoğun iyonize hidrojen bölgeleri (UCHII) ve mazerler ile olan ilişkilerini araştırdık.

Anahtar Kelimeler: kızılötesi: yıldızlar, yıldızlar: erken – tip, yıldızlar: oluşum, yıldızlar: ön-anakol

Abstract: Advances in the observational techniques in infrared and submillimeter and improved theoretical knowledge have revealed a broad range of stellar densities of young stellar objects (YSOs) in star-forming regions. However, our understanding for massive star formation is still lagging. We investigated W49, W51, and W43 by using Spitzer mid-infrared and 2MASS/UKIDSS near-infrared data and identified 232 Class 0/I YSOs, 981 Class II/transition disk candidates in W49, 1177 Class 0/I YSOs, 5358 Class II/transition disk candidates in W43, and 418 Class 0/I YSOs, 1243 Class II/transition disk candidates in W51. We investigated the groups and clusters of YSOs to understand the star formation history in these regions. We also used SED models to identify massive YSOs and investigated massive star formation tracers such as ultra-compact HII regions and masers.

Key words: infrared: stars, stars: early-type, stars: formation, stars: pre-main sequence

1.Analysis

We performed a detailed investigation of W49, W51 and W43 which are among the brightest and massive star-forming regions in the Galaxy. We used the mid-infrared Spitzer data from several programs obtained with the Spitzer /IRAC instrument and after performing the photometry in four IRAC bands (3.6, 4.5, 5.8, and 8.0 μm) detected sources are cross-matched to 2MASS/UKIDSS data (J, H, and K) and MIPSGAL Archive 24 μm data. To identify and classify the sources, we used color and magnitude criteria as we applied in Saral et al. (2015) for W49 and defined in Gutermuth et al. (2008, 2009). The Minimal Spanning Tree (MST) method (Cartwright and Whitworth 2004) was used to examine the substructures such as groups and clusters of YSOs in a similar fashion as in many studies (Saral et al. 2015; Gutermuth et al. 2009; Beerer et al. 2010; Koenig et al. 2008). We identified 3 MST groups and 7 subgroups in W49, 9 MST groups (Fig 1) and 16 subgroups in W51, and 57 MST groups and 102 subgroups in W43. We use the ratio of Class II/I to compare the relative ages of different groups. In both W51 and W43, the Class II/I ratio is suggesting several independent star formation events.

We identified tens of massive YSO (MYSO) candidates ($M \geq 8M$ 8) according to the SED fitting methods (Robitaille et al. 2007; Azimlu et al. 2015). Star-forming regions host HII regions, UCHII regions and methanol masers which are related to early stages of massive stars. Fig 1 shows two HII regions (G49.5-0.4, G49.4-0.3) which are positionally associated with the subgroups 2a and 2f in W51.

* G. S. acknowledges support from NASA Grant NNX12AI60G, Istanbul University grant BAP50195, Marie Sklodowska-Curie RISE grant ASTROSTAT (project number 691164), and Swiss National Science Foundation Sinergia project STARFORM (project number CH: CR- SII2-160759).

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Subgroup 2a also hosts 4 MYSO candidates which might be associated with the methanol masers (magenta diamonds). The other main HII region seems associated with subgroup 2 of where we identified 11 YSO candidates where 2 of them are MYSO candidates.

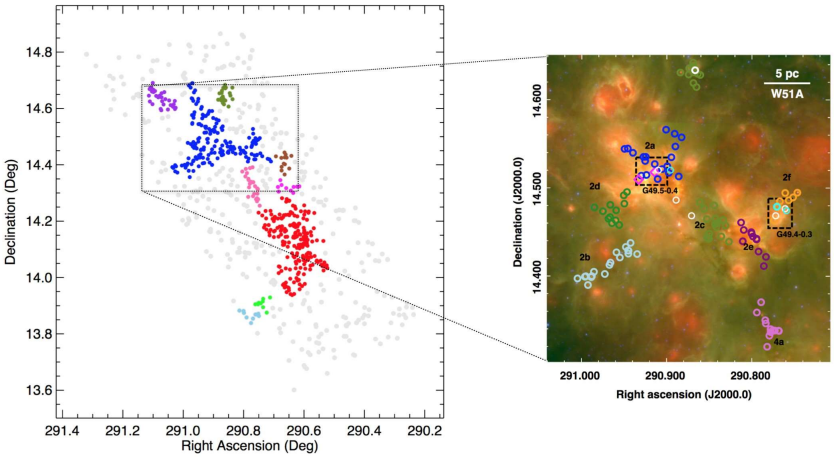

Figure. 1. Left; 9 YSO clusters are shown in W51. Right; The distribution of MYSO candidates in W51A. White circles are MYSO candidates, cyan circles are MYSO candidates with 24 μm data, and subgroups in clusters are shown with different colors.

2.Conclusion

In this study we generated the photometry catalogs for W49, W51 and W43, classified the YSOs and used SED models to identify the MYSO candidates. By identifying groups of YSOs we tried to understand the star formation histories. The detailed analysis and results can be seen in Saral et al. (2015); Saral et al., (2016).

3.References

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Saral, G., Hora, J., Audard, M., et al. 2016, ApJ, submitted