Recent Advances in Star Formation: Observations and Theory
ASI Conference Series, 2012, Vol. 4, pp 195 – 196
Edited by Annapurni Subramaniam & Sumedh Anathpindika

Deep NIR JHK_s observations of HII region Sh 2-311

Ram Kesh Yadav*, A. K. Pandey, Saurabh Sharma, M. R. Samal
and Neelam Chauhan
Aryabhatta Research Institute of Observational Sciences, Nainital 263129, India

Abstract. The HII region Sh 2-311 contains three young clusters (NGC 2467, Haffner 18ab and Haffner 19). Spitzer observations revealed several young stellar object (YSO) candidates at the edge of the HII region (Snider et al. 2009), indicating a possible site of induced star formation. We present our preliminary results of the study to search for low mass YSOs in this region using the deep near-infrared (NIR) observations. The (J-H)/(H-K) color-color diagram is used to identify low luminosity embedded YSOs. The spatial distribution of the YSOs has also been shown.

Keywords : HII regions – interstellar matter – star formation process –pre-main-sequence

1. Introduction

The HII region NGC 2467, also known as Sharpless 311, is located at a distance of 4.1 kpc (Feinstein & Vazquez 1989). The region is ionized by an O6 Vn star, HD 64315. Hubble Space Telescope Survey data show a large number of brightened ridges and cloud fragments in NGC 2467 region (De Macro et al. 2006). The region also has two additional stellar clusters viz., Haffner 19 (H19) and Haffner 18ab (H18ab), which contain one late O type star and a few B type stars, however, most ($\sim$ 70%) of the ionizing radiation comes from O6 star (Snider et al. 2009).

2. Data analysis and results

Deep NIR observations for NGC 2467 were obtained with ISPI camera on CTIO 4m Blanco Telescope. ISPI is a 2048×2048 HgCdTe array, having $\sim$10′.5 square field of view with an image scale of 0′′.3 (van der Bliek et al. 2004). Other details of the

*e-mail:ramkesh@aries.res.in

instrument can be found on ISPI homepage. We observed the Sh 2-311 region with the $J(\lambda = 1.25\mu\text{m})$, $H(\lambda = 1.63\mu\text{m})$ and $K_s(\lambda = 2.17\mu\text{m})$ filters on March 03, 2010. Stars brighter than 11 mag were saturated in CTIO data and have been taken from 2MASS. We obtained 27 dithered exposures (20 sec. each) of the target centered at $(\alpha, \delta) = (07^h52^m23^s.5, -26^o24'54''.6)$ (J2000), simultaneously for each band. Data reduction was done using the DAOPHOT package in IRAF. The calibration of the photometric data was done using the 2MASS data. The NIR data has been converted to California Institute of Technology (CIT) system using the color transformation equations given by Carpenter (2001). The NIR excess stars have been identified using the J-H/H-K color-color diagram (for details see Pandey et al. 2008). Our NIR color-

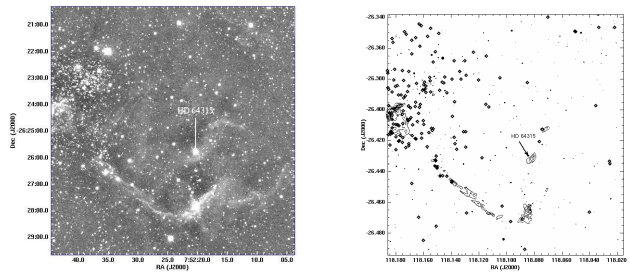

Figure 1. *Left panel:* K_s-band image of Sh 2-311, *Right panel:* Spatial distribution of NIR-excess sources. The Spitzer 8 μm emission contours are also superimposed onto the source distribution.

color analysis detects 156 objects with circumstellar disks (i.e., YSOs) suggesting that Sh 2-311 is a site of active star formation. Spatial distribution of YSOs shown in Fig. 1 (right panel) indicates that majority of the YSOs are found to be preferentially distributed at the eastern border of Sh 2-311. Fig. 1 (right panel) also shows the contours of 8.0 μm emission from the Spitzer. The Spitzer-IRAC band centered on 8.0 μm contains the 7.7 μm and 8.6 μm emission bands generally attributed to poly-cyclic aromatic hydrocarbon (PAH) molecules. Infrared emission from PAHs is observed in the direction of photo-dissociation regions (PDRs). The PDR generally traces the interaction of expanding HII region with molecular clouds. Fig. 1 (right panel) shows that majority of the YSOs are distributed at the periphery of HII region. The analysis of the V, I_c optical data is in progress to estimate the age of the YSOs.

References

Carpenter J. M., Meyer M. R. et al., 1997, 114, 198C
De Marco et al., 2006, AJ, 131, 2580
Feinstein A., Vazquez R. A., 1989, A&AS, 77, 321
Pandey A. K. et al., 2008, MNRAS, 383, 1241
Snider Keely D., et al. 2009, ApJ, 700, 506
van der Bliek N. S., et al., 2004, Proc. SPIE, 5492, 1582