

# Luminosity functions of YSO clusters in Sh-2 255, W3 Main and NGC 7538 star forming regions

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**Abstract.** We have conducted deep near-infrared surveys of the Sh-2 255, W3 Main and NGC 7538 massive star forming regions using simultaneous observations of the  $JHK_s$ -band with the near-infrared camera SIRIUS on the UH 88-inch telescope and with SUBARU. The near-infrared surveys cover a total area of  $\sim 72$  arcmin<sup>2</sup> of three regions with  $10\text{-}\sigma$  limiting magnitudes of  $\sim 19.5$ , 18.4 and 17.3 in  $J$ ,  $H$  and  $K_s$ -band, respectively. Based on the color-color and color-magnitude diagrams and their clustering properties, the candidate young stellar objects are identified and their luminosity functions are constructed in Sh-2 255, W3 Main and NGC 7538 star forming regions. A large number of previously unreported red sources ( $H-K > 2$ ) have also been detected around these regions. We argue that these red stars are most probably pre-main-sequence stars with intrinsic color excesses. The detected young stellar objects show a clear clustering pattern in each region: the Class I-like sources are mostly clustered in molecular cloud region, while the Class II-like sources are in or around more evolved optical HII regions. We find that the slopes of the  $K_s$ -band luminosity functions of Sh-2 255, W3 Main and NGC 7538 are lower than the typical values reported for the young embedded clusters, and their stellar populations are primarily composed of low mass pre-main-sequence stars. From the slopes of the  $K_s$ -band luminosity functions, we infer that Sh-2 255, W3 Main and NGC 7538 star forming regions are rather young (age  $\leq 1$  Myr).

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## Main Results:

- i) In NGC 7538, the young stellar objects in the central region are probably the result of the propagation of star forming activity from the north-western region due to the expansion of the H II region and the compression of the molecular cloud (sequential star formation). The south-eastern/southern region is independent of the above action. and presumably the star formation there is taking place in a spontaneous and gradual process.
- ii) Based on the comparison of models of pre-main-sequence stars with the observed color-magnitude diagram, we find that the stellar populations in W3 Main, NGC 7538 and Sh-2 255 are primarily composed of low-mass pre-main-sequence stars.
- iii) Follow-up deep  $JHK'$  imaging ( $J \sim 22$  mag at  $10\text{-}\sigma$ ) with CISCO/SUBARU 8.2-meter has been carried out for the search of young brown dwarfs in the cores of W3 Main and NGC 7538. The interpretation work is under way.