Optical and Infra-red Survey of the Young Stellar Population associated with the Star-forming Complex Sh2-252 (NGC2175)

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Introduction

- Sh2-252 is an extended HII region (l=190^0.04, b=$+0^o$.48) associated with the Gemini OBI association. The HII region is being ionized by the central massive star HD 42088 of spectral type O6.5V (Walborn 1972).

- Felli et al. (1977) detected six radio sources towards Sh2-252, namely A to F of which A,B,C and E have been identified as Compact HII regions.

- The ^{13}CO map by Lada & Wooden (1979) showed that the complex can be separated in to two cloud fragments towards its east and west by a long rift at the middle.

Goals

- Our main goal is to understand whether or not the circumstellar disk properties and Initial mass function (IMF) in an HII region environment differs from those in low-UV radiation environment (Taurus-like) or extreme UV radiation environment (Orion like).

- Sh2-252 is an excellent example to study the evolution of pre main sequence (PMS) population and IMF in the HII region environment.

- Present deep optical and IR imaging survey help us identifying the candidate PMS stars, their properties and the IMF

Data

- Optical Imaging and Spectroscopy : 1-m ST, ARIES, Nainital, 2-m HCT, Hanle, India
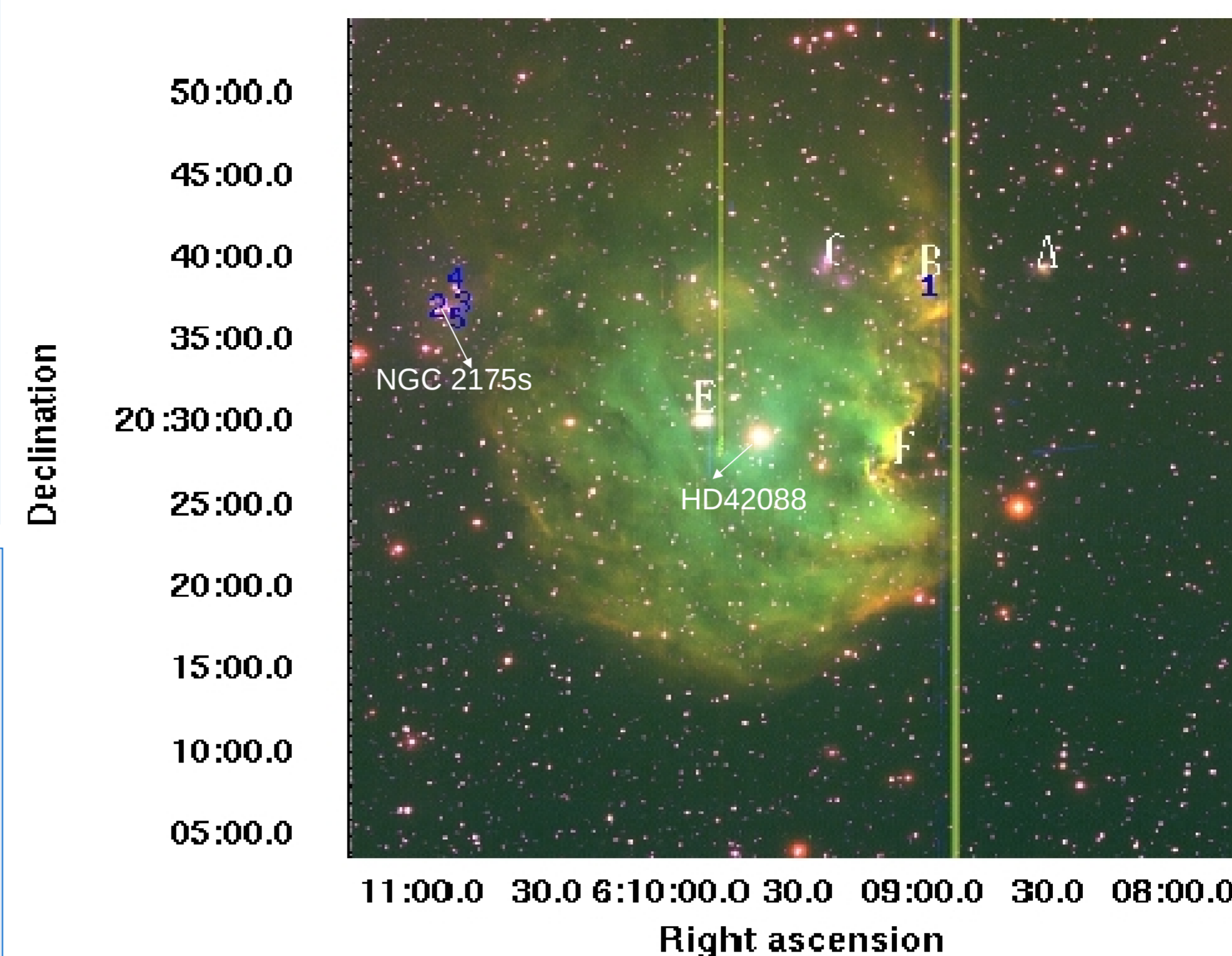- IR imaging : 2MASS, Spitzer-IRAC

Fig. 1 Color composite image of Sh2-252 for an area ~50' x 50' using V, Hα, and SII bands of KISO 1-m telescope, Japan. The important sub-regions are marked in the figure.
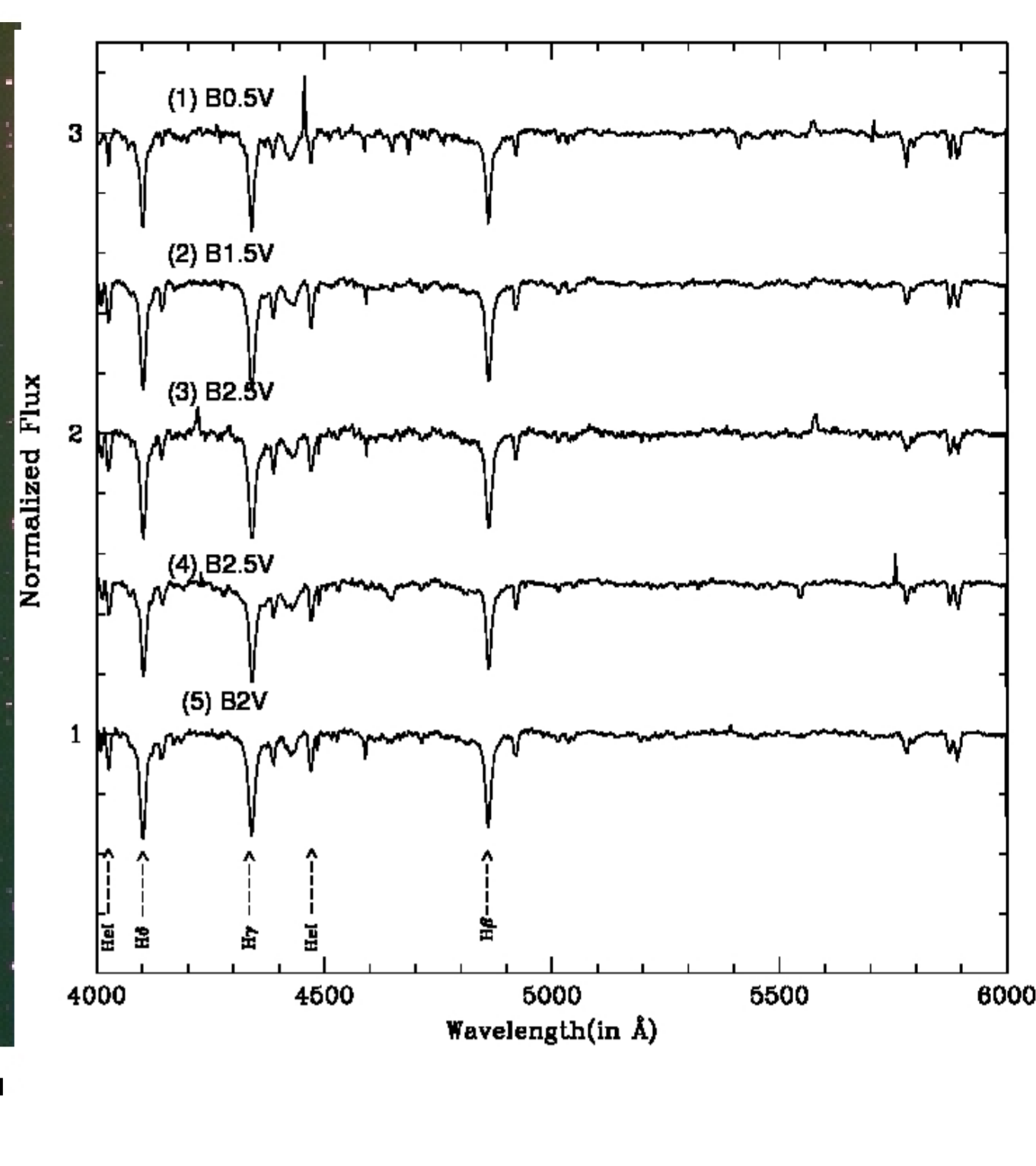

Fig.2 Low resolution spectra of the bright sources in Sh2-252. The star ID s are shown in Fig.1, and the spectral class is mentioned above each spectra.

Probable PMS candidates in Sh2-252

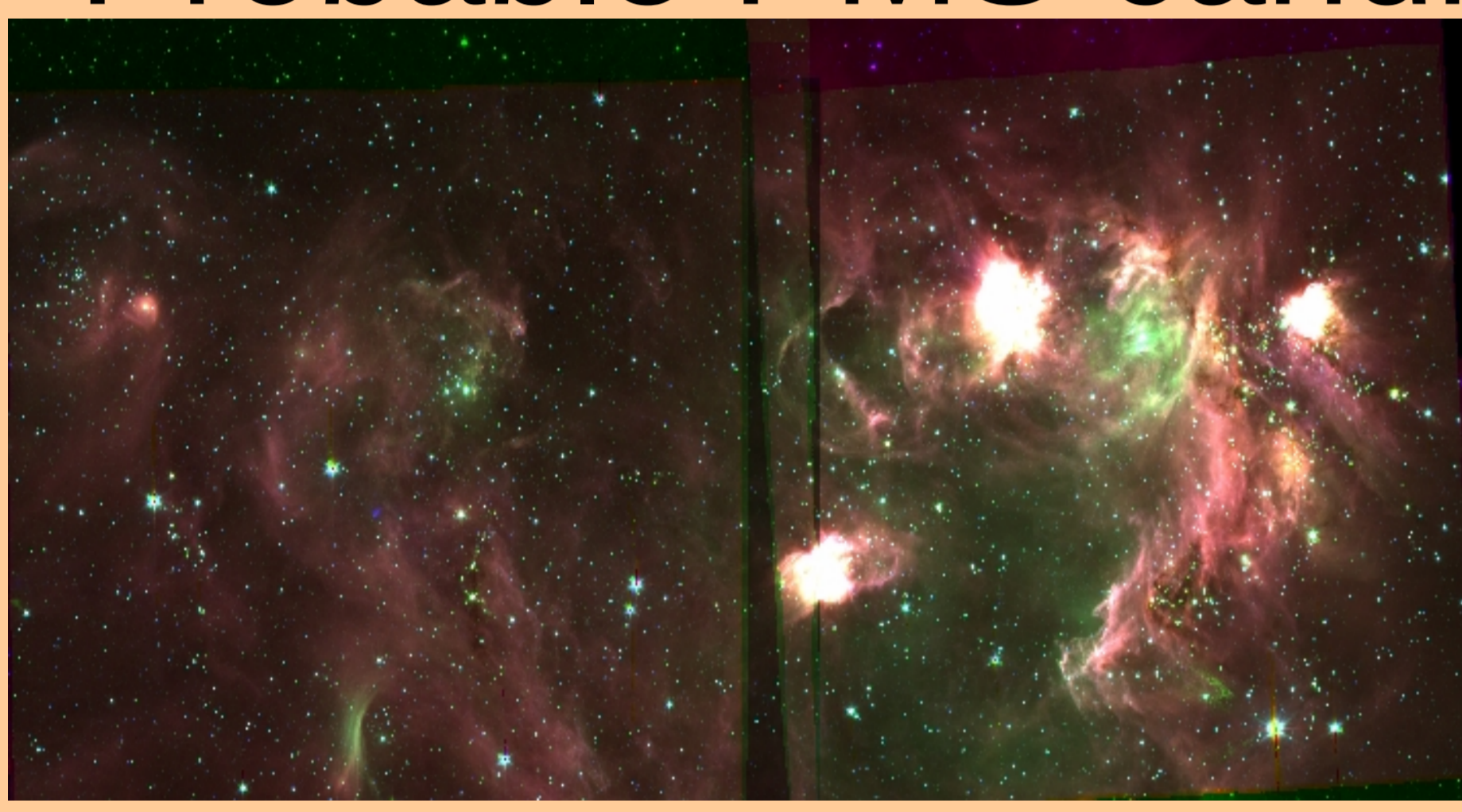

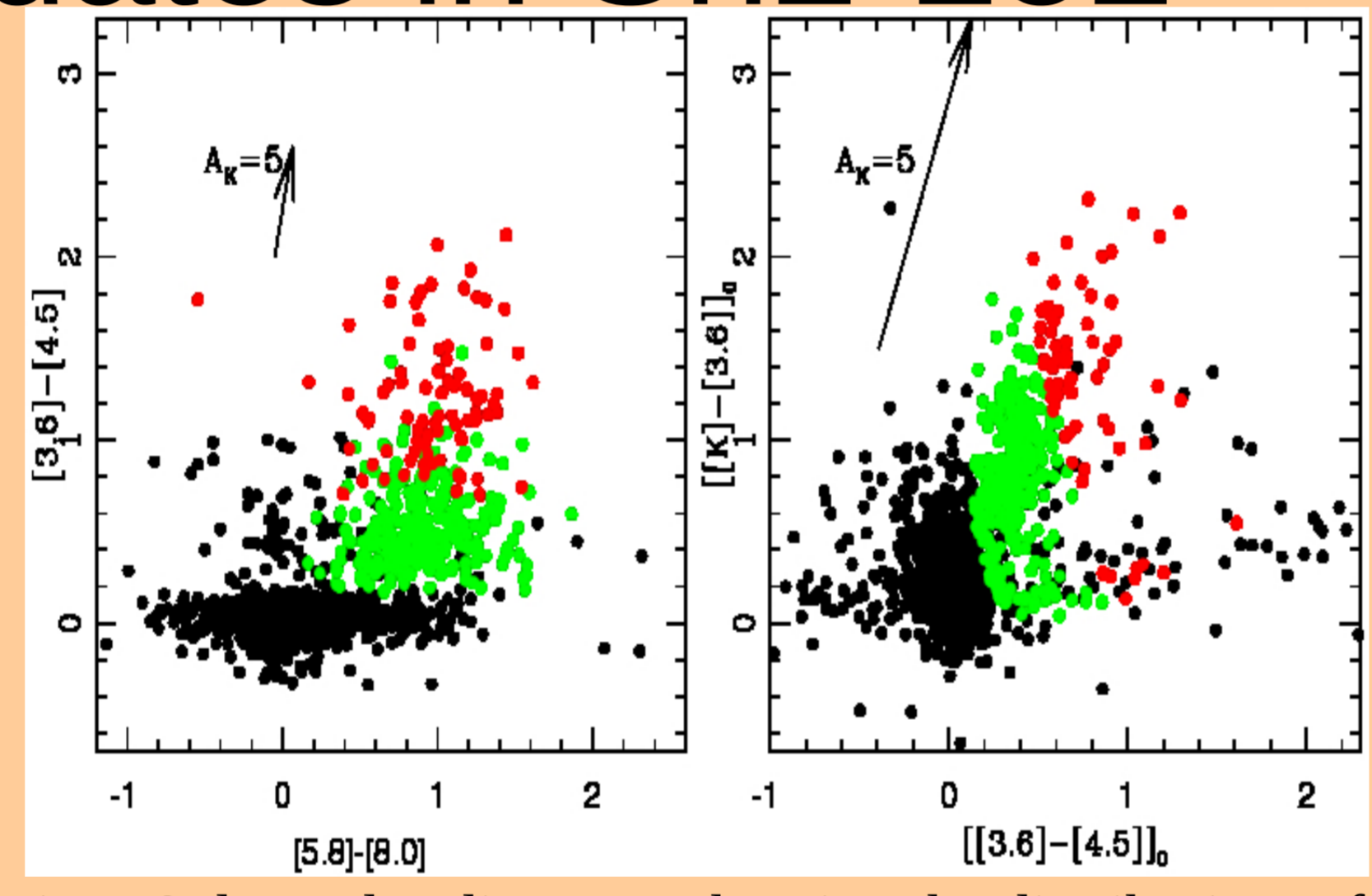Fig.3 Color composite image using 3.6, 4.5 and 8.0 μm Bands of Spitzer-IRAC data

Fig.4 Color-color diagrams showing the distribution of probable PMS stars (Class I: red; Class II:green) of the region identified using the selection criteria by Gutermuth et al. (2009).
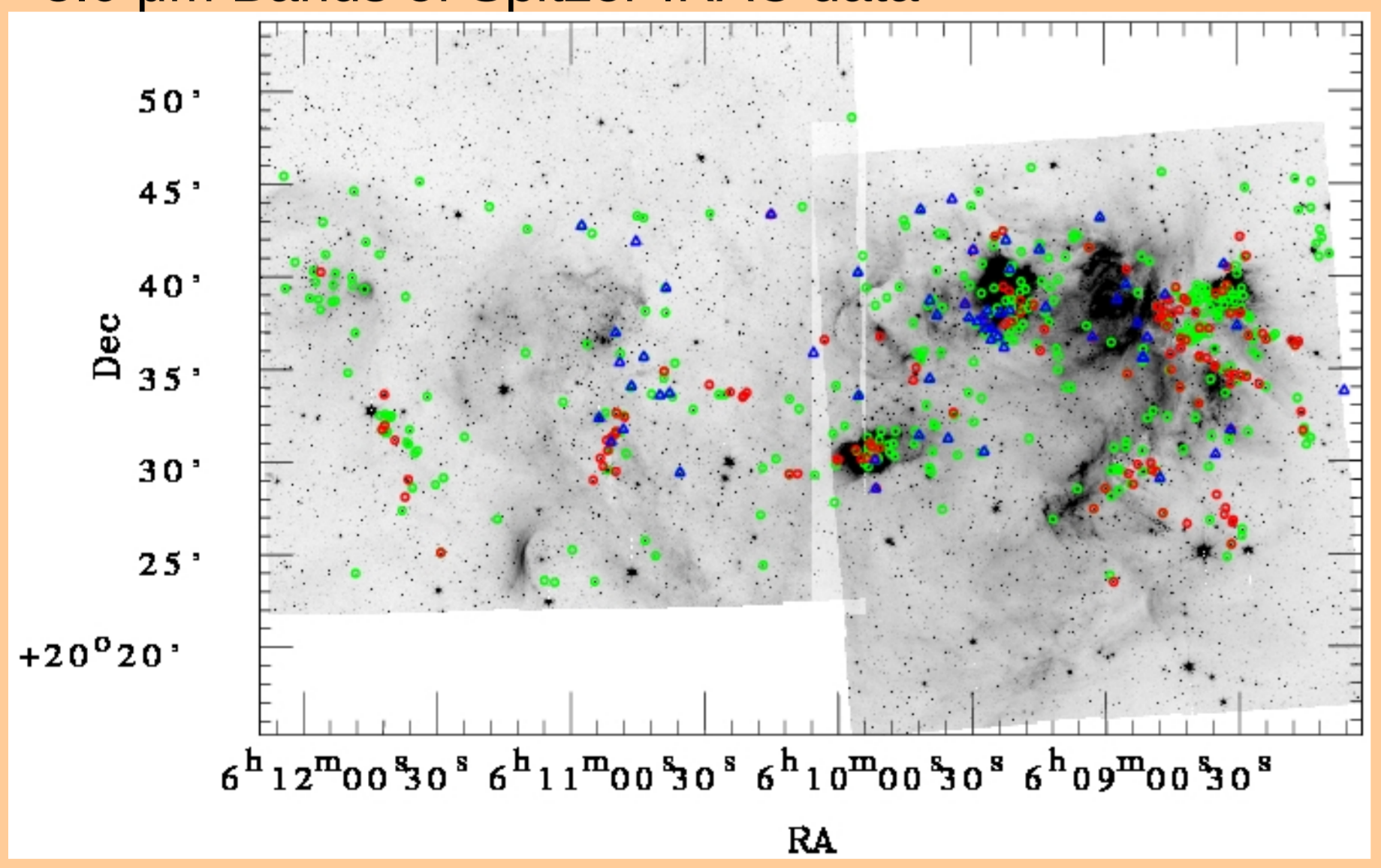

Fig.5 Spatial distribution of identified probable PMS candidates marked on the 4.5 μm IRAC image. The blue sources are the Hα emission sources identified using slitless spectroscopy. Red are Class I and green are Class II sources, respectively.
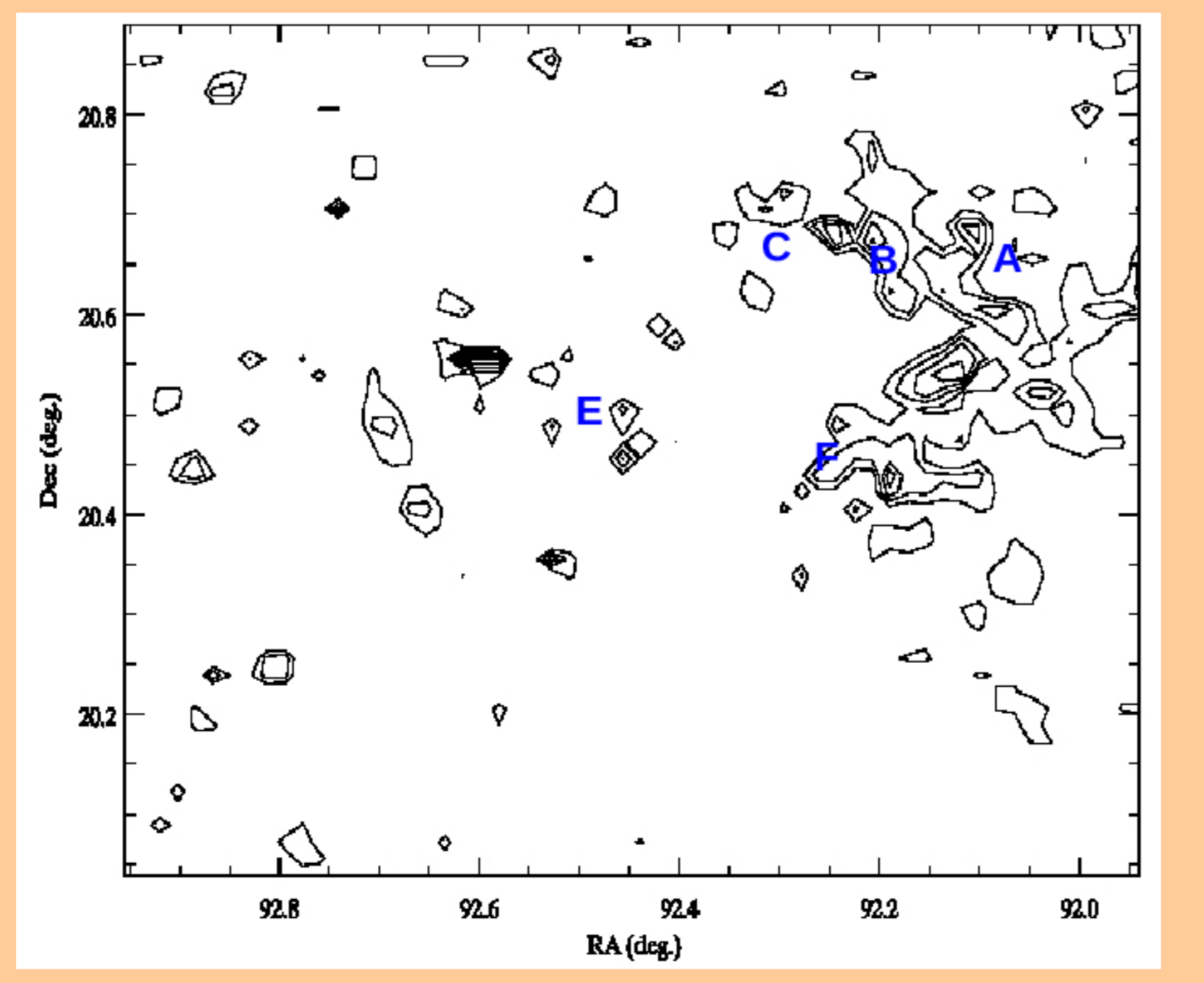

Fig.6 Av map of the region generated using the 2MASS H,K data. The location of the sub-regions of Sh2-252 are marked in the figure.
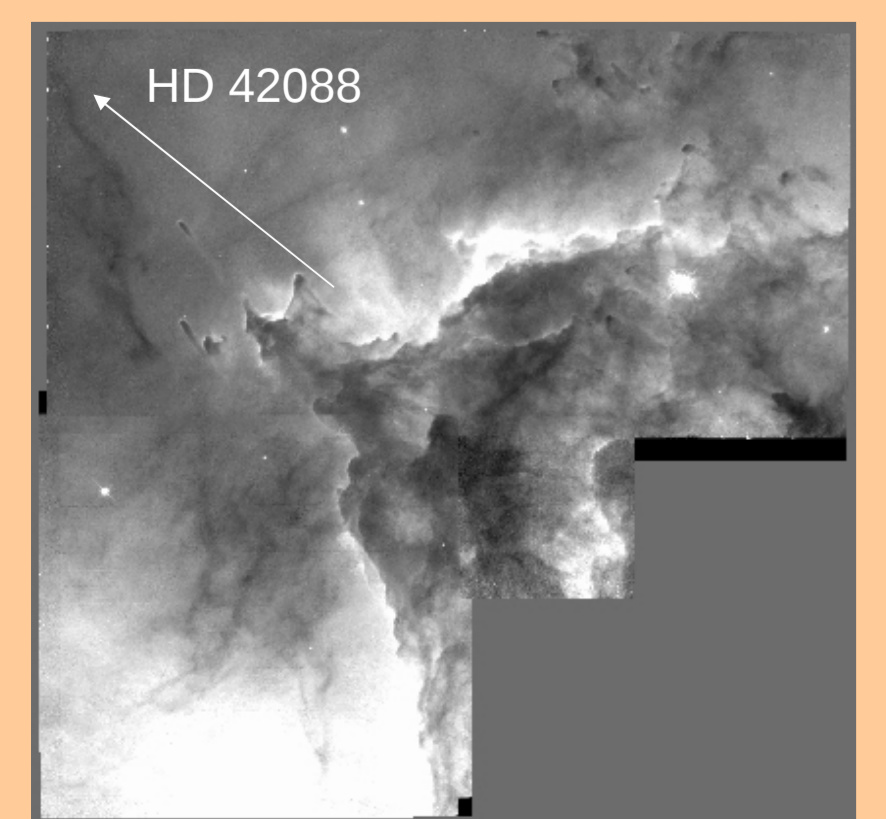

Fig 7 Enlarged view of Region 'E' From the HST-WFPC2 archival data showing the 'finger-tip' like features pointing towards the ionizing source as well as the photoevaporation of the region.

References

Felli et al. 1977, A&A, 59,43
Girardi et al. 2002, A&A, 391, 195
Lada & Wooden, 1979, ApJ, 232, 158
Siess et al. 2000, A&A, 358, 593
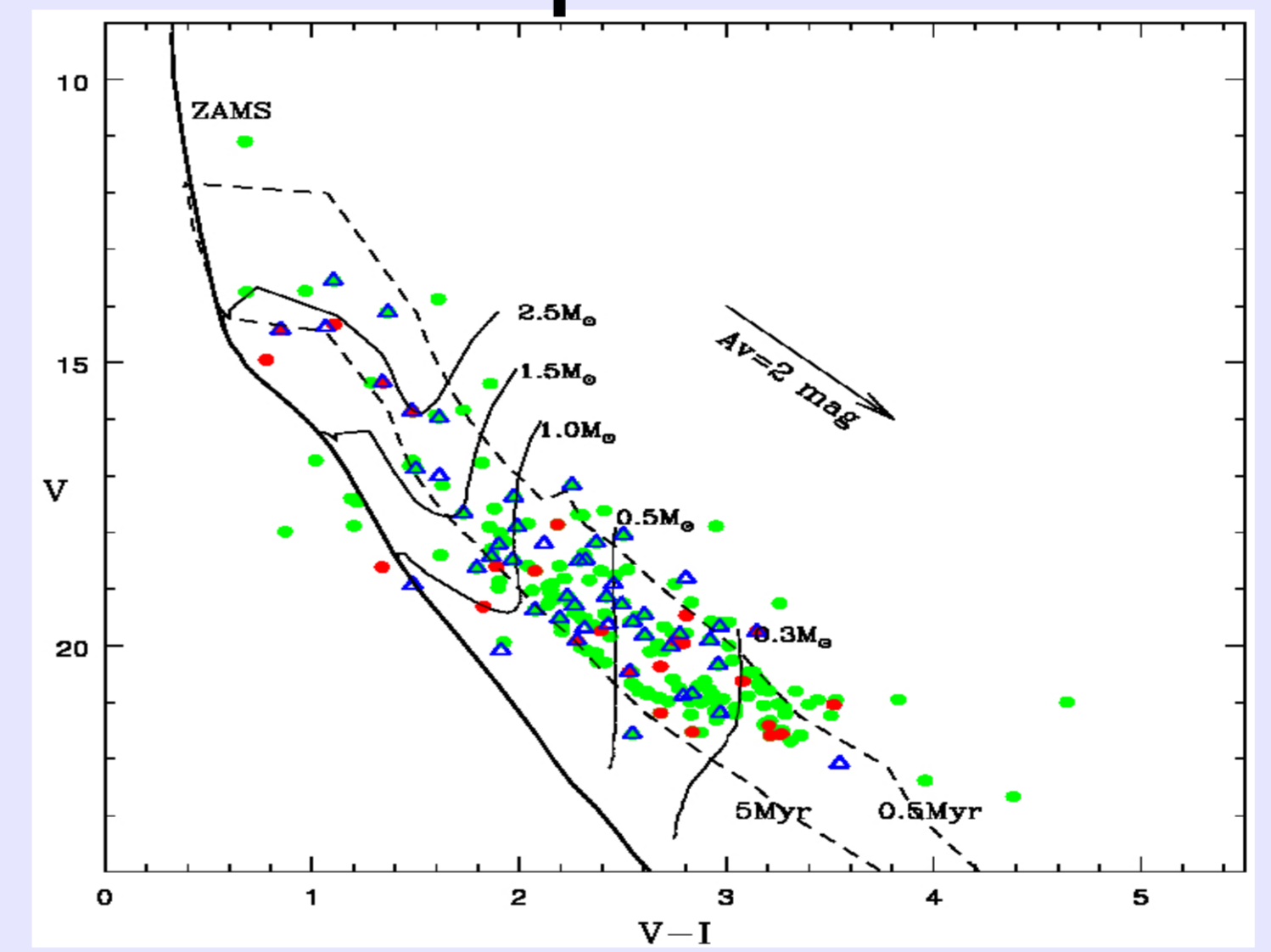Walborn 1972, AJ, 77, 312

Properties of PMS candidates

Fig. 8 (V-I)/V color-magnitiude diagram of the candidate PMS sources (blue: Hα; green: Class II; red: Class I sources). The solid and dashed curves are the ZAMS from Girardi et al. (2002), and PMS isochrones of 0.5, 5 Myr respectively from Siess et al. (2000). The evolutionary tracks from Siess et al. (2000) for various masses are also shown.
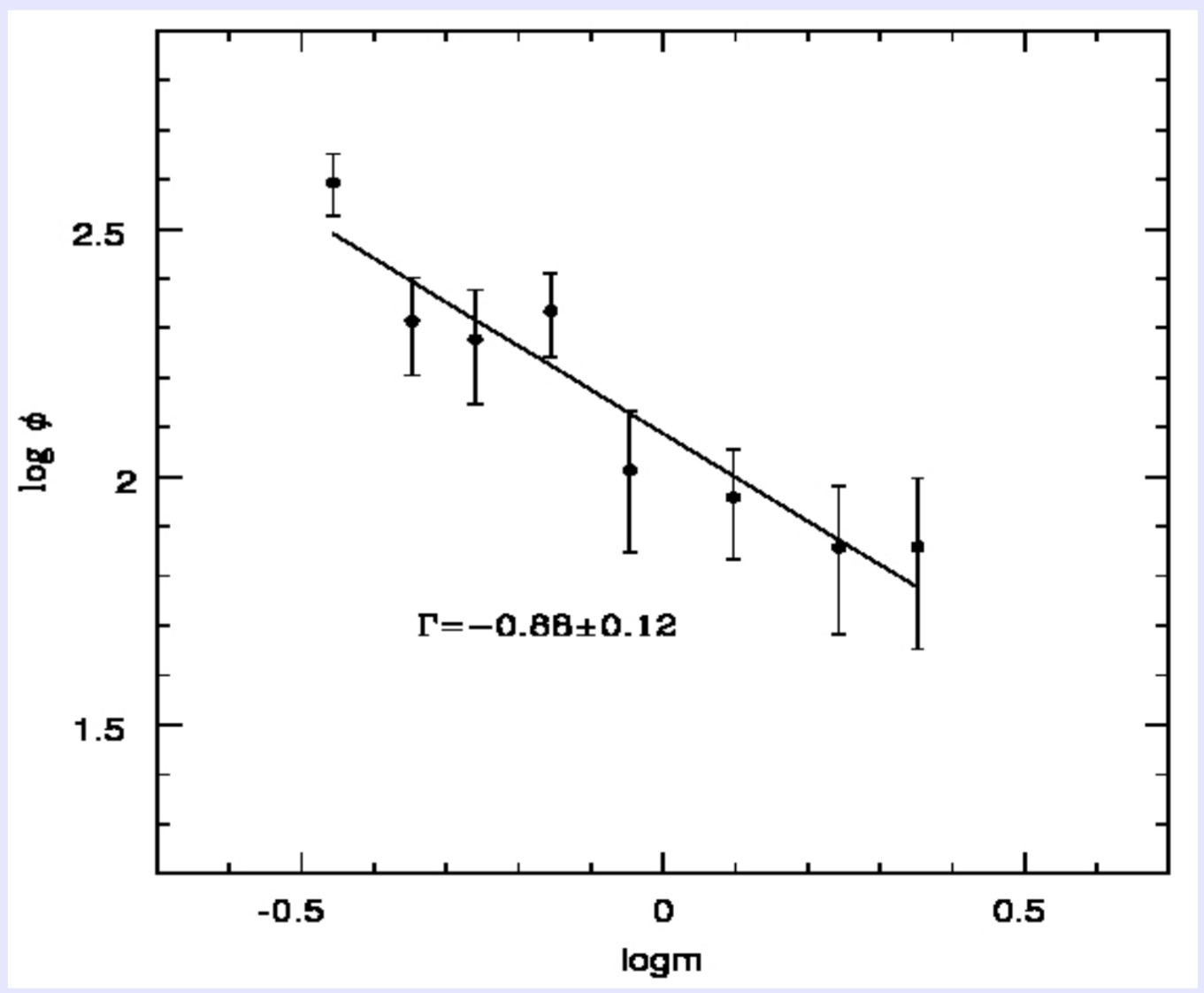

Fig. 9 The IMF of PMS candidates in Sh2-252 for the mass range $0.3 \leq M/M_o < 2.5$. The slope obtained is mentioned in the figure.

Results

- A total of 131 Class I, 400 Class II sources and 61 Hα emission sources, are identified, indicating the richness of the region with young stellar population.
- Four of the identified members of NGC 2175s are seen to be above B3V spectral class and there is a lack of YSOs towards this region.
- Majority of the YSOs are located near the sub-regions A, C, E and F suggests that the eastern part of the cloud is more active compared to west.
- Few cases of isolated sub-clustering are identified in the region which are seem to be optically obscured.
- Class I sources are mostly located near the molecular cloud regions
- The 'finger tip' like features in this region as probably created due to the radiation from the massive stars.
- The Class I/Class II ratio is in the decreasing order for the regions F,A,E and C respectively suggesting a probable evolutionary sequence.
- YSOs are having an age spread of ~5 Myr, with a median age of 2-3Myr with majority of them are having masses < 1Mo and slope of the IMF is -0.88+/-0.12