# STAR FORMATION IN THE SOUTHERN COMPLEX REGION NGC 3576

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NGC 3576 (RCW 57) is a very bright optically visible nebula ($\sim$10' in size) located near the galactic plane at a distance of 3.6kpc. The region is associated with the HII region G291.28-0.71 (Retallack & Goss), and with a giant molecular cloud of $M \simeq 9 \times 10^4$ $M_\odot$ (Cheung et al.1980) The source is reported in the IRAS Small Scale Structure Catalog. From the observed far-IR fluxes we derive a total luminosity of $L(FIR) \simeq 7 \times 10^5$ $L_\odot$, suggesting that at least seven possible O7-O9 stars could ionize the entire observed region. A cluster of five IR sources and extended 10$\mu$m emission were found by Frogel & Persson (1974). IRS 1 is a very compact object ($<3'$), while IRS 2-5 show diffuse infrared emission. In addition IRS 2, very close to IRS 1, is coincident with the radio emission peak. An $H_2O$ maser source and $NH_3$ emission are present in the complex region.

We present multidiaphragm photometry from 1 to 20$\mu$m of IRS 1, IRS 3 and IRS 4 and CVF observations between 2-4$\mu$m and 8-13$\mu$m of IRS 1, collected at the 1m and 3.6m ESO telescopes.

## Results

The observed energy distribution of IRS 1 between 1 and 20$\mu$m is reported in Fig.1. Between 1 and 2.2$\mu$m the spectrum is very flat. This could be explained by the contamination of the nearby source IRS 2. IRS 1 shows absorption features at 9.7$\mu$m and 3.08$\mu$m due to "silicate" and "ice" bands. The derived optical depths are respectively: $\tau(9.7\mu m) \simeq 4.6$ and $\tau(3.1\mu m) \simeq 0.73$. These values are very similar to those of massive "protostellar" objects observed by Willner et al.(1982). Adopting the relationship $A_V/\tau(9.7\mu m)=16$ (Rieke & Lebofsky 1985) we derive for IRS 1 $A_V=74$. The observed luminosity between 1-20$\mu$m is $L \simeq 6 \times 10^4$ $L_\odot$. This luminosity and the observed features in IRS 1 are consistent with the presence of a very young object, probably a deeply embedded O7-8 (ZAMS) star. In the direction of IRS 1 we observed the Br$\gamma$ and Br$\alpha$ lines with an intensity ratio of $I(Br\alpha)/I(Br\gamma)=6.75 \pm 0.63$. Comparing the observed ratio with the nebular ratio for $T_e=10^4$ K and Menzel's case B ($Br\alpha/Br\gamma=2.83$) and assuming $A_\gamma=0.126$ $A_V$ and $A_\alpha=0.04$ $A_V$, we derive a visual extinction of $A_V=11$. This could imply that the Brackett lines ori-



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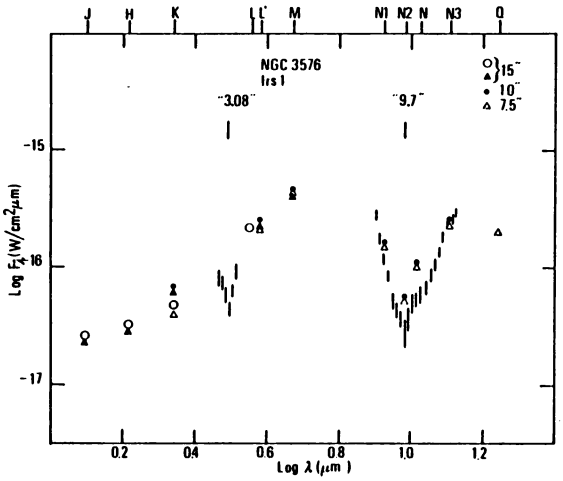


Fig.1: IR energy distribution of IRS 1

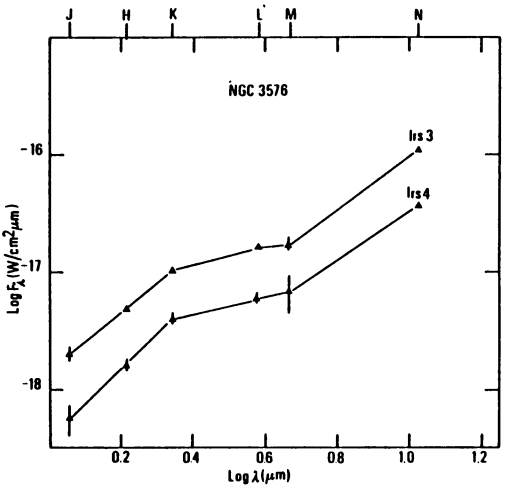


Fig.2: IR energy distributions of IRS 3 and IRS 4

ginate in the HII region (observed from the radio continuum) located in front of the molecular cloud. The sources IRS 3 and IRS 4 show infrared energy distributions very similar (Fig. 2). The derived 1-10μm luminosity for both the sources is $6.8 \times 10^3 L_\odot$ and $1.8 \times 10^3 L_\odot$, consistent with the presence of a B0.5 and a B2 (ZAMS) star respectively. Assuming that no IR excess is present in the near-IR (1-2.2μm), we derive $A_V$=15-20 for the sources. This implies that IRS 3 and IRS 4 are associated with the HII region.

## Conclusions

The complex region NGC 3576 could represent an example of sequential star formation as described by Elmegreen & Lada (1977), in which the optical nebula lies just outside the cloud. A cluster of at least seven OB (ZAMS) stars could be responsible for the excitation of the nebula and the younger HII region, located probably at the edge of the molecular cloud. Deeply embedded into the cloud, a very young object (IRS 1) is present, inferring that continuum star formation occurs in NGC 3576.

## References

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