THE W75 – CYGNUS - X IRAS LOOP:- OB - 'BUBBLE' OR SNR ?

D.Ward-Thompson & E.I.Robson

School of Physics & Astronomy, Lancashire Polytechnic, Preston, UK

Abstract. IRAS Calibrated Raw Detector Data (CRDD) are presented of a part of the Cygnus-X region, incorporating W75, DR21 and W75N, and a previously unknown loop of dust emission is observed. This loop is interpreted as a spherical shell-like shock front, and two alternative explanations for its origin are explored – a wind-blown bubble around an OB association, and an old supernova remnant. The arguments for each are outlined, and it is deduced that there are insufficient OB stars old enough to have formed the loop by combined stellar wind action, although a SNR appears consistent with the data.

IRAS Data

The W75 region lies on the north-eastern edge of the Cygnus-X complex, at an approximate distance of 2kpc. It contains the molecular clouds W75 and W75N, and the bipolar outflow source DR21. IRAS CRDD of a 2^o-field around W75 were obtained from the UK Rutherford Appleton Laboratory, and a new method of destriping the data was used (Ward-Thompson *et al.* 1989 – Paper I; Ward-Thompson & Robson 1990a – Paper II). Figure 1 a & b show isophotal contour maps of the region at 12 and 100μm. The previously known infrared sources are marked. The spatial correlation between the point sources and extended emission suggests embedded stars within extensive dust clouds.

A ridge of emission stretches from the south-east of the maps and ends in a loop in the centre of the field. The brightest part of the loop is a knot at its western edge, centred roughly at 20h33m $+42°15'$ and extending some 20 arcmin to both north and south, hereafter called K1. The loop does not correspond spatially with any previously known feature, although the centre of the loop corresponds to a minimum of CO emission (Dame & Thaddeus 1985). All of these observations can be interpreted in terms of a shell of gas and dust, whose edge can be seen by limb-brightening. We therefore suggest that the loop seen in the IRAS raw data in Figure 1 is an expanding shell-like shock front, which is sweeping up material in the arc of K1 (Ward-Thompson & Robson 1990b – Paper III). The mass of dust in a region 35pc across was calculated from the 100-μm flux to be $450M_{\odot}$. If the canonical gas-to-dust mass ratio of 100 is used, the mass of the cloud is $4.5\times10^4 M_{\odot}$.

(i) OB Association

One explanation for the shell is a wind-blown bubble around an OB association. The only possible location for this association is within W75N, as that is the only place near to the loop centre with

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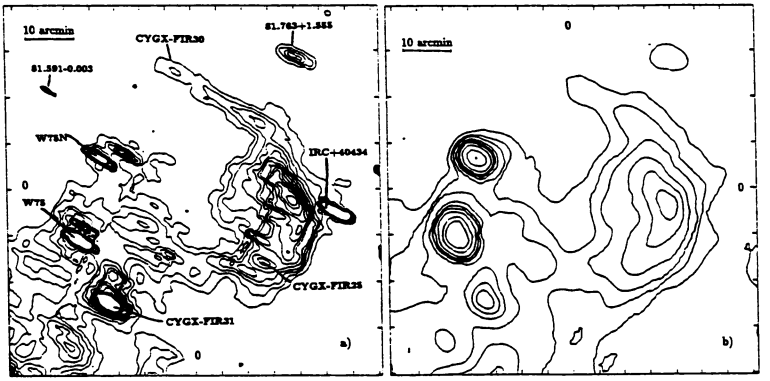

Figure 1: W75-CygX at (a)12μm & (b)100μm, (0,0) is 20h35m+42°20′.

a high enough A_V to mask such an association. The radius of a wind-blown OB shell is given by $R = 27(L_w t^3/n_o)^{1/5}$, where: R is the radius of the loop in pc = 35pc; L_w is the combined stellar wind luminosity (in units of 10^{36}erg/s); t is the age of the loop (in units of 10^6year); and n_o is the mean ambient cloud density = 50cm^{-3}.

This gives the total combined stellar wind luminosity, L_w as 2×10^{35}erg/s, and the age of the association, t as 10^7years. This stellar wind corresponds to 2 stars of type B0 or earlier, whose combined stellar winds must act on the surrounding interstellar medium for $\sim 10^7$years. W75N contains 3 stars of type B0.5, mass $\sim15M_\odot$ and age $\leq10^6$years. In fact one of the stars may be $\leq10^4$years old (Moore *et al.* 1988). After 5×10^6years each one should typically become a supernova. So there is **not enough time** for the bubble to have formed. If the required age of the bubble is taken in the above equation to be only 10^6years, then L_w must be 2×10^{38}erg/s, or the equivalent of 200 O7III stars, which is clearly impossible.

(ii) Supernova remnant

Another possible origin of the shell is an old supernova remnant. If this were the cause of the shell, any optical remnant in the centre of the loop would be extinguished by the large A_V. The age of the SNR can be calculated from the equation: $R = (2Et^2/\rho_o)^{1/5}$, where: R is the radius of the loop = 17pc; E is the energy of the supernova explosion = 10^{51}erg; t is the age of the loop; and ρ_o is the mean pre-explosion density of the cloud = 8×10^{-20}kgm^{-3}.

Thus the age of the SNR, t = 10^5years. This is consistent with the age of W75N(B) calculated by Moore et al. (1988), and provides an explanation for their theory of coeval formation of the embedded stars. So it appears that a supernova remnant is **consistent** with all of the attributes of the dust loop in the W75 region.

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