ROSAT OBSERVATION OF THE HII REGION RCW 49

Possible discovery of a new Wolf-Rayet ring nebula

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Abstract. We have observed the southern HII region RCW 49 with the *ROSAT* PSPC instrument. Part of the diffuse X-ray and optical emission present in this region might be associated with the X-ray selected WR star Th35-42 (WR20c). The young star cluster Westerlund 2 (which contains WR20a) is seen in X-rays as a centrally peaked, resolved source, surrounded by fainter diffuse emission.

The optical and radio nebula RCW 49 (Rodgers, Campbell & Whiteoak 1960; Caswell & Haynes 1987) was observed for about 9000 seconds with the *ROSAT* PSPC instrument (0.1–2.4 keV) in July 1992. Extended diffuse emission and more than 20 X-ray point sources were clearly detected in this observation (Belloni & Mereghetti 1994), which was at least an order of magnitude more sensitive than the previous *Einstein Observatory* images of RCW 49 (Goldwurm, Caraveo & Bignami 1987). The X-ray diffuse emission consists of two separate regions (see Fig. 1) with different properties and which might be physically unrelated. In the western region the X-ray and optical emissions are rather well correlated. Both peak at the position of the young star cluster Westerlund 2, which is probably the energy source for the nebula (Moffat & Vogt 1975). The flux and the spatial distribution of the central peak are compatible with emission from the massive early type stars and the WR star present in this cluster (WR20a, Moffat, Shara & Potter 1991). The surrounding diffuse emission has a thermal spectrum ($kT \approx 1$ keV) and an X-ray luminosity of $0.5\text{–}1.4\times10^{34}$ erg s^{-1} (for $d = 8$ kpc). It is probably an X-ray bubble powered by the winds of the O stars of the cluster (Castor, McCray & Weaver 1975). The eastern region has a lower surface brightness (it was not detected with *Einstein*), but, being more extended, has a total luminosity comparable to that of the western region. It has a softer spectrum which might result from a lower temperature (~ 0.5 keV) and/or interstellar absorption ($\sim 10^{21}$ cm^{-2}). The X-ray emission is anticorrelated with the optical one, being almost completely surrounded by a bright, arc-shaped structure. It is possible that this nebula is associated to the Wolf-Rayet star Th35-42 (Mereghetti *et al.* 1994). This star does not lie

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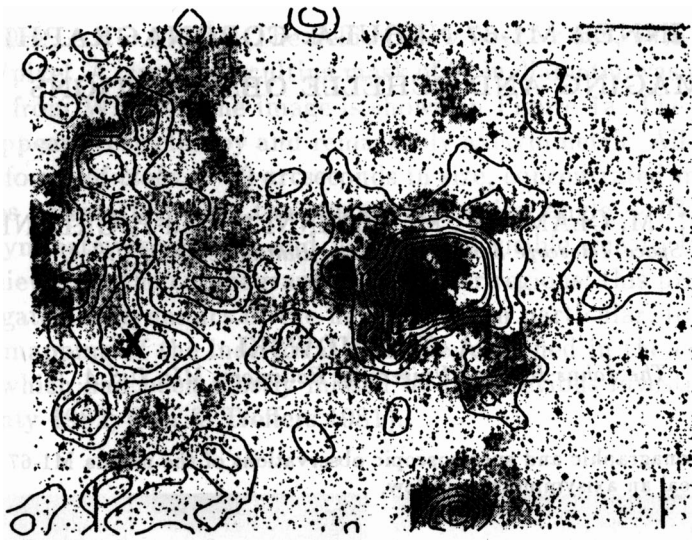

Fig. 1. Contour plot of the X-ray diffuse emission overlaid on an *ESO* red plate. The point sources, as well as the peaked emission at the center of RCW 49, have been removed and replaced by a polynomial interpolation of the surrounding regions. The cross marks the position of Th35-42 (WR20c).

exactly at the center of the bright Hα arc. However, if the fainter optical and X-ray emission in the southern region are part of the same structure, the star is quite centrally located. Assuming a reasonable distance of, *e.g.*, 5 kpc, the size of $\sim 30'$ in the N–S direction corresponds to ~ 40 pc. This is quite large, but still compatible with the observed sizes of ring nebulae around WR stars, which are usually in the range from several parsecs to a few tens of parsecs (Chu, Treffers & Kwitter 1983). For example, RCW 78 around the WN7 star (WR55) HD 117688 has a comparable angular size ($35' \times 25'$) and is at a larger distance of 7 kpc. Further observations at optical, X-ray and radio wavelengths are required to establish if this emission is part of the whole RCW 49 complex or it is another example of a nebula associated with a WR star.

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