Faint early-type stars in the neighbourhood of the H11 region RCW 38

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Summary. We used UBV photographic photometry to search for faint earlytype stars in a region of about 1200 arcmin² in the neighbourhood of the HII region RCW 38. The limiting magnitude of the search is V = 15.49, B = 16.43 and U = 16.83 mag. Fifteen new early-type stars were found and most of them are probably related to the HII region.

1 Introduction

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Muzzio (1979) used UBV and H β photoelectric photometry to study early-type stars in the neighbourhood of the H II region RCW 38 (Rodgers, Campbell & Whiteoak 1960); the stars had been selected from the catalogue of Stephenson & Sanduleak (1971) and from the list of Muzzio & Orsatti (1977), and they were brighter than B = 15 mag. Muzzio found that the bulk of the stars in this zone belong to a new, anonymous, open cluster related to the nebula and he derived a distance to the Sun of 1.7 kpc. This result, combined with the radio continuum observations of Goss & Shaver (1970), led him to conclude that RCW 38 is a giant H II region and, thus, an excellent spiral tracer.

It seems, therefore, appropriate to perform a search for early-type stars in this region down to a fainter magnitude limit in order to find new stars belonging to this complex.

2 Method and results

We used two sets of UBV plates obtained by one of us (JCM) and by A. M. Orsatti with the Curtis Schmidt telescope at Cerro Tololo Inter-American Observatory (CTIP). The plates were measured with the Askania iris photometer of La Plata Observatory, and the photoelectric sequence of Miller & McCarthy (1974), which reaches magnitudes as faint as V = 15.49, B = 16.43 and U = 16.83 mag, was used to calibrate the plates. Stars 70, 71, 73, 75 and 76 of Muzzio & Orsatti (1977), observed photoelectrically by Muzzio (1979), which

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also lie within the region under study but separated from those of Miller & McCarthy (1974), were used to check for any possible zone effects, but no appreciable difference was found.

All the stars within the limits of the standard sequence lying on a $30' \times 40'$ region, shown in Plate 1, were measured. The measurements were reduced using the colour equation:

$$V_{\rm pg} = V_{\rm pe} - 0.1(B - V)_{\rm pe} \tag{1}$$

for the V magnitude, while no colour terms were needed for the B and U magnitudes. The mean square error of a magnitude obtained as the average from two plates is about 0.05 mag.

Intrinsic colours were computed as indicated by Muzzio & Forte (1975), and all stars with $(U-B)_0$ values more negative than -0.56 mag (which corresponds to a B5 V star in the calibration of Johnson (1958)) were selected. Fifteen new early-type stars were discovered; besides, the four previously known OB stars not included among those used to calibrate the plates were rediscovered during the search. A finding chart for the new stars is provided in Plate 1; Table 1 gives the *UBV* values, the intrinsic (U-B) colour, the (B-V) colour excess, and the apparent visual magnitude corrected for absorption.

Star	. V	B-V	<i>UB</i>	$(U-B)_0$	E_{B-V}	Vo	Notes
1	14.20	1.49	0.24	-1.25	1.84	8.68	
2	13.23::	1.98::	0.39:	-1.66::	2.44::	5.91::	1
3	14.01	1.47	0.25	-1.21	1.81	8.58	
4	14.82	1.07	0.27	-0.73	1.28	10.98	
5	13.26	0.61	-0.03	-0.63	0.79	10.89	
6	13.71	0.73	0.11	-0.57	0.89	11.04	
7	13.80	1.52	0.62	-0.78	1.74	8.58	
8	13.56	1.08	0.14	-0.91	1.33	9.57	
9 .	13.41	0.81	-0.08	-0.90	1.06	10.23	
10	13.65:	1.23:	0.41:	-0.73:	1.43:	9.36:	2
11	13.13	0.90	0.01	-0.88	1.15	9.68	
12	12.57	1.72	0.80	-0.79	1.94	6.75	
13	14.53	1.58	0.75	-0.68	1.77	9.22	
14	14.51	1.05	0.29	-0.68	1.24	10.79	
15	12.65:	1.75:	0.70	-0.96:	2.02:	6.59:	2

Table 1. New faint early-type stars found in the neighbourhood of RCW 38.

Notes:

1. Extremely doubtful values due to a nearby star.

2. Doubtful values due to a nearby star.

3 Discussion

The purpose of this paper is to provide a finding list of faint early-type stars in the region of RCW 38 which, through further photoelectric and spectroscopic studies, will help to improve the distance estimate of the complex and to understand the relation of the stars to the nebula. Some preliminary results can be obtained from the photographic photometry alone, however.

Fig. 1 presents the V_0 versus $(U-B)_0$ diagram for the new early-type stars together with the zero-age main-sequence (ZAMS) of Blaauw (1963) shifted vertically by $V_0 - M_V =$ 11.2 mag, the distance modulus derived by Muzzio (1979) for the cluster and the exciting stars of the nebula. The dispersion is large, as may be expected from values derived from photographic photometry, but we notice that there is an acceptable fitting of the new stars to the sequence, suggesting that most of the new stars belong to the complex.

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Plate 1. Finding chart for the new early-type stars, obtained from one of our V plates. Chart size is about $40' \times 30'$; north is up, east to the right.





Figure 1. The diagram of apparent visual magnitude corrected for absorption versus the intrinsic (U-B) colour for the new early-type stars. The full line is the ZAMS of Blaauw (1963) shifted vertically by $V_0 - M_V = 11.2$ mag. Photometric values for star 2 are extremely uncertain and that star was not included in the diagram.

A comparison of our Plate 1 with plate II of Muzzio (1979) shows that most of the new stars are concentrated towards the south-west section of the region, i.e., the zone where the anonymous cluster is located, while several stars (interestingly, some of them with the bluest $(U-B)_0$ values) fall on the nebular region; they may contribute to the excitation of the HII region, but it should be noted that no early-type star was found near the main radio peak, G 268.0 - 1.1. A minimum estimate of the total visual absorption that affects the exciting star of that peak may be obtained considering that, in order to be as faint as the U limit of our search, an O5 V star at 1.7 kpc from the Sun should lie beyond a total visual absorption of about 8 mag, while the corresponding value for a B0 V star is about 7 mag.

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