# SPECTRAL CLASSIFICATION OF FAINT STARS AND ITS APPLICATION TO THE STUDY OF OPEN CLUSTERS, STAR FORMING REGIONS AND THE GALAXY. I. SPECTRAL TYPES AND LUMINOSITIES OF STARS TO $22.0^m$ ($V$) IN THE STELLAR CLUSTERS NGC 2244, NGC 2264, AND NGC 6913

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СПЕКТРАЛЬНАЯ КЛАССИФИКАЦИЯ СЛАБЫХ ЗВЕЗД И ЕЕ ПРИМЕНЕНИЕ К ИССЛЕДОВАНИЮ РАССЕЯННЫХ СКОПЛЕНИЙ, ОБЛАСТЕЙ ЗВЕЗДООБРАЗОВАНИЯ И ГАЛАКТИКИ. I. СПЕКТРАЛЬНЫЕ ТИПЫ И СВЕТИМОСТИ ЗВЕЗД ДО $22.0^m$ ($V$) В ЗВЕЗДНЫХ СКОПЛЕНИЯХ NGC 2244, NGC 2264 И NGC 6913, Кузнецов В. И., Бускомб В., Бутенко Г. З., Лазоренко Г. А., Лазоренко П. Ф. – Описывается двумерная спектральная классификация 203 членов молодого звездного скопления NGC 2264, соответствующая опубликованным фотометрическим $UBV$-данным. Для NGC 6913 мы приводим спектральные типы и $UBV$-величины 36 звезд, полученные с 2-м телескопом обсерватории Терскол.

The two-dimensional spectral classifications of 203 members of the young star cluster NGC 2264 corresponding to published $UBV$ photometry are described. For NGC 6913 we present spectral types and $UBV$ photometry of 36 stars derived with the 2-m RCC telescope of the Terskol Observatory.

## INTRODUCTION

A one-dimensional technique of spectral classification for faint O–M stars from their temperature parameters on the basis of $UBV$ photometry was described previously by Kuznetsov *et al.* [9]. Characteristics of the interstellar light absorption dependence on distance in the given direction of the sky are used as a main criterion for excluding possible multiple spectral classifications on the basis of a particular set of values for $Q_{UBV}$. Spectra for stars to $V = 22^m$ were thus obtained by Kuznetsov *et al.* [9].

In this study we derive the new and improve the existing two-dimensional spectral classifications for members of the open cluster NGC 2264 using the published $UBV$ photometric data. The list for 203 member stars in the open cluster NGC 2264 which were used for the study is given in Table 1. The list has been compiled by Prof. W. Buscombe in the catalogue series of stellar data retrieval under the general title "MK Spectral Classifications" [1]. For this particular region, the data were taken from studies at the Lick Observatory [14, 15], the Uttar Pradesh Observatory [11], the Vatican Observatory [3] and the Siding Spring Observatory [10]. Unfortunately, it contains rather approximate spectra (enclosed in brackets in the column 10 of Table 1) for about a half of faint $13$–$16^m$ ($V$) stars. It was a reason to carry out a new study to obtain better spectral estimates for this cluster.

Table 1. Photometric and spectral characteristics of NGC 2264 stars

| N | Name of the star | $\alpha$ | $\delta$ | $V$ | $B$–$V$ | $U$–$B$ | Ref. | $Sp(UBV)$ | $Sp'$ | Com. | Ref. | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1 | W2 V 588 Mon 261331 | 06 39.0 | +09 41 | 9.68 | 0.27 | 0.12 | W | A7 III | A7 III-IV | | W | |
| 2 | AB 47469 | 06 39.2 | +09 39 | 7.74 | –0.11 | –0.65 | W | B3 V | B: V | | B | |
| 3 | V 589 Mon 261446 | 06 39.4 | +09 42 | 10.27 | 0.43 | 0.10 | W | F2 III | F2 III | | W | |
| 4 | Walker 26 | 06 39.6 | +09 23 | 11.78 | 0.48 | –0.02 | W | G0 IV | (F5 V) | | B | |
| 5 | Vas. 1 | 06 39.7 | +09 44 | 12.58 | 0.62 | 0.23 | S | G2 IV | GO(IV) | S | B | |
| 6 | Vas. 2 | 06 39.7 | +09 35 | 13.33 | 0.74 | 0.14 | S | G4 IV | (G8 IV) | S | B | |
| 7 | Vas. 5 | 06 39 | +09 | 13.89 | 0.87 | 0.37 | S | G2 V | (KO IV) | S | B | |
| 8 | BD+ 09 1326 261585 | 06 39.8 | +09 28 | 10.75 | 0.05 | –0.02 | W | A0 V | A0 V | | Y | |
| 9 | BD+ 09 1325 261586 | 06 39.8 | +09 22 | 10.25 | 0.34 | –0.04 | W | F5 III | A7 IV(p?) | | W | $U$: |
| 10 | Vas. 12 | 06 39.9 | +09 31 | 13.73 | 0.62 | –0.23 | S | G2 III | (G0 V) | S | B | |
| 11 | BD+ 09 1327 261658 | 06 40.0 | +09 23 | 10.32 | 0.05 | 0.07 | B | A1 V | A0 V | | B | |
| 12 | Walker 36 | 06 40.1 | +09 26 | 10.88 | 0.03 | 0.04 | W | B9 V | B9 V | | Y | |
| 13 | Vas. 20 261657 | 06 40.0 | +09 34 | 11.29 | 0.57 | 0.04 | S | G2 III | F9(IV) | | B | |
| 14 | Vas. 22 | 06 40.2 | +09 42 | 13.22 | 0.78 | 0.29 | S | G0 IV | F5 V | S X2 | Y | |
| 15 | Vas. 25 | 06 40 | +09 | 13.01 | 0.92 | 0.37 | S | G1 III | K3(IV) | | B | ~ |
| 16 | Vas. 26 | 06 40.3 | +09 29 | 13.32 | 0.47 | 0.14 | S | F3 V | G2(V) | S | B | |
| 17 | Herbig 5 QX MON | 06 40.2 | +09 38 | 16.8 | – | – | B | – | M1 IV | E | B | |
| 18 | BD+ 09 1329 261737 | 06 40.3 | +09 42 | 10.50 | 0.29 | 0.13 | W | A6 III | A7 III | N | W | |
| 19 | Walker 42 VAS.29 | 06 40.3 | +09 37 | 13.24 | 0.84 | 0.49 | W | G7 IV | (G8 IV) | | B | |
| 20 | Walker 41 VAS.28 | 06 40.3 | +09 36 | 14.06 | 0.80 | 0.36 | W | G5 IV | (K0 IV) | | B | |
| 21 | Herbig 11 LL MON | 06 40.4 | +09 51 | – | – | – | – | – | K2 (IV) | (E) | B | |
| 22 | BD+ 09 1330 261736 | 06 40.4 | +09 46 | 9.19 | 0.21 | 0.13 | W | A6 III | A5 III | NE | W | |
| 23 | Walker 45 VAS.33 | 06 40.4 | +09 36 | 15.25 | 0.94 | 0.74 | W | K0 V | (K2 V) | | B | |
| 24 | Walker 44 KY MON | 06 40 | +09 | 15.85 | 0.58 | 0.06 | W | G2 IV | F9 V | E | B | ~ |
| 25 | Vas. 35 | 06 40.4 | +09 59 | 13.62 | 0.97 | 0.61 | S | K0 IV | K3 (IV) | S | B | |
| 26 | Walker 49 | 06 40.4 | +09 33 | 15.34 | 1.00 | 0.88 | W | K5 V | (K5 IV | | B | |
| 27 | Vas. 36 | 06 40.4 | +09 25 | 13.33 | 0.70 | 0.37 | F | G0 IV | (G5 V) | S | B | |
| 28 | Herbig 14 PT MON | 06 40.5 | +09 50 | – | – | – | – | – | K5 IV | (E) | B | |
| 29 | Walker 54 VAS.40 | 06 40.5 | +09 50 | 14.25 | 1.25 | 1.03 | W | K4 IV | (K7 IV) | | B | |
| 30 | A V 641 Mon 47732 | 06 40.5 | +09 49 | 8.16 | –0.17 | –0.75 | S | B3 V | B3 V | N+B 2 | Y | |
| 31 | V 413 Mon WAL.58 | 06 40.5 | +09 49 | 15.50 | 0.97 | 0.63 | W | K2 V | (K3 IV) | E | B | |
| 32 | Walker 51 | 06 40.5 | +09 36 | 15.95 | 1.52 | 1.2 | W | M4 IV | (M0 IV) | | B | |
| 33 | Walker 55 NT MON | 06 40.5 | +09 35 | 14.60 | 1.32 | 0.96 | W | K5 IV | (M0 IV) | E | B | ~ |
| 34 | Vas. 38 | 06 40.5 | +09 31 | 14.40 | 1.10 | – | V | – | (K5 IV) | | B | |
| 35 | Walker 56 VAS.41 | 06 40.5 | +09 31 | 14.96 | 1.48 | 1.32 | W | K5 V | (M0 IV) | | B | |
| 36 | Herbig 17 LM MON | 06 40.6 | +09 51 | 15.28 | 1.56 | – | B | – | (M3 IV) | E | B | |
| 37 | Walker 66 VAS.47 | 06 40.6 | +09 47 | 12.34 | 0.71 | 0.12 | S | G4 IV | (G5 V) | | B | |
| 38 | A V 684 Mon 47755 | 06 40.6 | +09 47 | 8.44 | –0.13 | –0.60 | W | B4 V | B3 V | N X2 | B | |
| 39 | Walker 67 VAS.47 | 06 40.6 | +09 47 | 10.83 | 0.62 | –0.43 | S | B0 V | B2 V | N | Y | |
| 40 | BD+ 09 1333 261783 | 06 40.6 | +09 36 | 8.28 | 1.39 | 1.56 | B | – | K3 II-III | | W | $U$: |
| 41 | Walker 75 | 06 40.6 | +09 36 | 15.64 | 1.38 | 0.16 | W | – | (M0 IV) | | B | $U$: |
| 42 | Walker 72 NV MON | 06 40.6 | +09 35 | 16.49 | 1.61 | – | B | – | (M2 IV) | E | B | |
| 43 | BD+ 10 1217 261809 | 06 40.7 | +10 08 | 10.74 | 0.23 | 0.07 | B | A4 IV | (B9 V) | | B | |
| 44 | Walker 68 VAS.48 | 06 40.7 | +09 55 | 11.71 | 0.62 | 0.15 | S | G1 IV | G0 IV-V | N | W | |
| 45 | Walker 79 | 06 40.7 | +09 55 | 15.92 | 0.50 | 1.02 | W | – | K0 IV | E | B | ~ |
| 46 | Vas. 55 | 06 40.7 | +09 54 | 13.68 | 0.84 | 0.24 | S | G4 V | (K0 V) | E | B | |
| 47 | Walker 78 LP MON | 06 40.7 | +09 52 | 15.40 | 1.23 | –0.42 | W | – | M0 IV | E | B | ~ |
| 48 | Walker 80 | 06 40.7 | +09 52 | 15.25 | 1.54 | 0.72 | W | M6 IV | (M0 IV) | | B | ~ |
| 49 | Walker 81 | 06 40.7 | +09 50 | 16.27 | 1.26 | 0.08 | W | – | (K7 IV) | | B | $U$: |
| 50 | BD+ 09 1335 261810 | 06 40.7 | +09 46 | 9.02 | –0.10 | –0.66 | W | B3 V | B5 V | N | W | |
| 51 | BD+ 09 1334 47777 | 06 40.7 | +09 39 | 7.93 | –0.14 | –0.84 | W | B1 V | B2 V | HE-STG | Y | |
| 52 | Walker 77 NW MON | 06 40.7 | +09 35 | 14.12 | 1.18 | 0.88 | W | K3 IV | K4 IV | E | B | ~ |
| 53 | Walker 86 | 06 40.7 | +09 34 | 16.33 | 1.51 | – | W | – | (M0 IV) | | B | ~ |
| 54 | Walker 84 VAS.59 | 06 40.7 | +09 33 | 12.01 | 0.66 | 0.09 | W | G2 IV | G0 V | E | Y | |
| 55 | Walker 85 | 06 40.7 | +09 32 | 14.98 | 1.09 | 0.78 | W | K5 V | (K5 IV) | | B | |
| 56 | Cohen 75 | 06 40.7 | +09 05 | – | – | – | – | – | K3(IV) | E | B | |
| 57 | Walker 96 LR MON | 06 40.8 | +09 50 | 14.00 | 0.96 | 0.45 | S | K5 IV | K6 (IV) | E | B | |
| 58 | Walker 92 VAS.67 | 06 40.8 | +09 49 | 11.69 | 0.86 | 0.48 | W | G9 IV | K0 IV p | X2 | W | |
| 59 | V 590 Mon WAL.90 | 06 40.8 | +09 48 | 12.76 | 0.14 | 0.08 | S | A0 V | B8 (V) | PEQ | B | |
| 60 | Walker 89 LQ MON | 06 40.8 | +09 47 | 16.34 | 1.05 | – | W | – | (K5 IV) | E | B | ~ |
| 61 | Walker 93 VAS.68 | 06 40.8 | +09 46 | 13.22 | 0.92 | 0.65 | W | K0 IV | G5 (IV) | | B | |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 62 | Walker 112 261879 | 06 40.8 | +09 39 | 10.81 | −0.02 | −0.12 | B | B8 V | A0 V | | W | |
| 63 | Walker 105 LT MON | 06 40.8 | +09 37 | 14.94 | 0.89 | −0.28 | W | – | K1 (IV) | E | B | ∼ |
| 64 | Walker 97 | 06 40.8 | +09 37 | 16.77 | 1.17 | 0.5 | W | M5 IV | (M3 IV) | | B | |
| 65 | Walker 101 | 06 40.8 | +09 33 | 16.33 | 1.72 | – | W | – | (M3 IV) | | B | |
| 66 | Walker 102 | 06 40.8 | +09 33 | 15.67 | 1.39 | 1.26 | W | K9 IV | (M0 IV) | | B | |
| 67 | Walker 95 NY MON | 06 40.8 | +09 33 | 15.74 | 1.11 | −0.14 | W | – | (K6 IV) | E | B | |
| 68 | Vas. 65 | 06 40.8 | +09 29 | 14.35 | 1.04 | 0.46 | S | K1 V | (K0 IV) | | B | |
| 69 | Vas. 66 | 06 40.8 | +09 24 | 14.47 | 0.98 | 0.69 | S | K0 V | (K0 IV) | | B | |
| 70 | BD+ 09 1337 261842 | 06 40.8 | +09 22 | 10.03 | 0.02 | −0.16 | B | B9 V | (B7 V) | | B | |
| 71 | BD+ 10 1219 W.107 | 06 40.9 | +10 02 | 8.81 | −0.06 | −0.44 | W | B6 V | B6 V | N | Y | |
| 72 | Walker 104 VAS.74 | 06 40.9 | +09 53 | 11.36 | 0.26 | 0.14 | W | A7 IV | A5 IV | | W | |
| 73 | F BD+ 09 1338 261878 | 06 40.9 | +09 52 | 9.08 | −0.10 | −0.56 | W | B5 V | B6 V | N | W | |
| 74 | BD+ 09 1336 261841 | 06 40.9 | +09 51 | 9.98 | 0.14 | 0.07 | W | A3 IV | A2 IV | E | W | |
| 75 | V 347 Mon HER.37 | 06 40.9 | +09 49 | 16.55 | – | – | B | – | M1 IV | (E) | B | |
| 76 | Walker 108 VAS.78 | 06 40.9 | +09 45 | 11.87 | 0.55 | 0.06 | W | G1 IV | G0 III-IVp | E | W | |
| 77 | V 345 Mon HER.33 | 06 40.9 | +09 43 | 14.50 | 1.02 | 0.30 | W | – | (K5 IV) | E | B | ∼ |
| 78 | Walker 119 | 06 40.9 | +09 37 | 15.70 | 1.38 | 0.67 | P | M5 IV | (K7 IV) | | B | |
| 79 | BD+ 09 1339 261902 | 06 41.0 | +09 34 | 10.23 | −0.03 | −0.32 | W | B8 V | B8 V | | Y | |
| 80 | V 419 Mon W.115 | 06 40.9 | +09 33 | 14.38 | 1.03 | 0.59 | W | G8 IV-V | K4 (IV) | E | B | |
| 81 | Walker 116 VAS.83 | 06 40.9 | +09 31 | 11.64 | 0.53 | 0.05 | S | F9 IV | F7 V | | Y | |
| 82 | Walker 127 | 06 40.9 | +09 30 | 15.66 | 1.54 | 0.96 | W | M6 V | (K7 IV) | | B | ∼ |
| 83 | Vas. 89 | 06 41.0 | +09 56 | 13.86 | 0.93 | 0.37 | S | G2 IV | K2 (IV) | N | B | |
| 84 | Vas. 90 | 06 41.0 | +09 54 | 10.50 | 0.01 | −0.31 | S | B7 V | (B6 V) | | B | |
| 85 | Walker 134 VAS.92 | 06 41.0 | +09 55 | 12.38 | 0.84 | 0.05 | W | G3 IV | G5 V | | Y | |
| 86 | AB S Mon 47839 | 06 41.0 | +09 54 | 4.62 | −0.24 | −1.08 | W | O8 V | O7 V | (F) | Y | |
| 87 | C BD+ 10 1220 | 06 41.0 | +09 54 | 9.88 | −0.06 | −0.40 | W | B7 V | B5 V | | Y | |
| 88 | E1 47839 E | 06 41.0 | +09 53 | 7.6 | – | – | B | – | B5 V | | B | |
| 89 | E2 47839 | 06 41.0 | +09 53 | – | – | – | – | – | A0 V | | B | |
| 90 | V 353 Mon | 06 41.0 | +09 51 | – | – | – | – | – | K0 (IV) | | B | |
| 91 | Walker 125 VAS.87 | 06 41.0 | +09 48 | 12.40 | 0.57 | 0.06 | S | G1 IV | F6-G0 III-Vp | | W | |
| 92 | Walker 144 VAS.99 | 06 41.0 | +09 48 | 13.83 | 1.38 | 0.33 | W | M2 IV | K7(IV) | S | B | |
| 93 | Walker 153 LW MON | 06 41.0 | +09 40 | 15.86 | 1.15 | −0.13 | W | – | K7 IV | E | B | ∼ |
| 94 | Vas. 103 W.146 | 06 41.0 | +09 39 | 14.63 | 1.11 | 0.62 | W | G7 IV-V | (K6 IV) | | B | |
| 95 | Walker 126 LU MON | 06 41.0 | +09 38 | 15.03 | 1.15 | 0.32 | B | M6 IV | K6 IV | SE | B | ∼ |
| 96 | Walker 122 GQ MON | 06 41.0 | +09 36 | 15.98 | 1.53 | 0.55 | W | M5 IV | (M2 IV) | E | B | ∼ |
| 97 | V 350 Mon W.123 | 06 41.0 | +09 36 | 16.54 | 1.40 | −0.35 | W | – | (M0 IV) | E | B | ∼ |
| 98 | Vas. 105 W.149 | 06 41.0 | +09 35 | 14.20 | 0.99 | 0.68 | W | K6 V | (K5 IV) | | B | ∼ |
| 99 | V 421 Mon W.136 | 06 41.0 | +09 35 | 15.16 | 1.58 | 1.07 | B | M5 IV | (M2 IV) | E | B | |
| 100 | Walker 150 | 06 41.0 | +09 35 | 15.44 | 1.28 | 1.22 | B | K7 IV | (K7IV) | | B | ∼ |
| 101 | V 356 Mon W.140 | 06 41.0 | +09 35 | 16.16 | 1.59 | 0.50 | W | M5 IV | (M2 IV) | | B | |
| 102 | Vas. 100 W.141 | 06 41.0 | +09 34 | 14.70 | 1.15 | 0.87 | W | K2 IV | (K6 IV) | | B | |
| 103 | Walker 135 VAS.93 | 06 41.0 | +09 33 | 14.93 | 1.03 | 0.07 | W | – | (K5 IV) | | B | : |
| 104 | BD+ 09 1342 261940 | 06 41.0 | +09 33 | 10.09 | −0.15 | −0.36 | B | B7 V | B8 V | | Y | |
| 105 | Walker 139 IP MON | 06 41.0 | +09 33 | 13.25 | 1.29 | 0.82 | W | – | K6(IV) | S | B | ∼ |
| 106 | Vas. 109 W.154 | 06 41.0 | +09 31 | 12.74 | 0.71 | 0.12 | W | G2 IV | G3 III-IV | | W | |
| 107 | Walker 133 IO MON | 06 41.0 | +09 31 | 13.77 | 1.08 | 0.78 | W | K6 IV | K6(IV) | E | B | ∼ |
| 108 | Vas. 102 W.145 | 06 41.0 | +09 28 | 10.66 | 0.05 | 0.01 | B | A1 V | A0 V | | W | |
| 109 | BC 261903 W.152 | 06 41.0 | +09 27 | 9.10 | −0.07 | −0.38 | W | B7 V | B8 V | N | B | |
| 110 | Walker 138 261904 | 06 41.0 | +09 24 | 10.21 | −0.07 | −0.02 | F | B9 V | (B8 V) | | B | |
| 111 | Herbig 52 SS MON | 06 41.1 | +10 26 | 13.40 | 1.30 | 0.94 | B | G6 IV | K3 IV | E | B | |
| 112 | BD+ 10 1224 261937 | 06 41.1 | +09 55 | 10.36 | 0.36 | 0.12 | B | F0 III | F2 (IV) | N | B | |
| 113 | AB 261938 W.142 | 06 41.1 | +09 53 | 8.97 | −0.07 | −0.58 | W | B4 V | B6 V | N | B | |
| 114 | BD+ 10 1222 W.137 | 06 41.1 | +09 52 | 9.96 | −0.37 | −0.37 | S | B8 V | B5 V | N | Y | |
| 115 | Walker 156 | 06 41.1 | +09 48 | 14.66 | 1.25 | 0.69 | W | K1 IV | (K7 IV) | | B | |
| 116 | Walker 161 LX MON | 06 41.1 | +09 48 | 14.96 | 0.67 | −0.61 | W | – | K5 IV | E | B | ∼ |
| 117 | Vas. 107 W.151 | 06 41.1 | +09 47 | 12.53 | 0.52 | −0.07 | W | G2 IV | F8(V) | | B | |
| 118 | Walker 169 NG2264 | 06 41.1 | +09 44 | 13.48 | 0.68 | 0.26 | W | G2 V | K0(IV) | | B | |
| 119 | Walker 173 | 06 41.1 | +09 43 | 16.41 | 1.29 | 0.77 | W | M0 V | (K7 IV) | | B | |
| 120 | Vas. 129 W.174 | 06 41.1 | +09 41 | 15.17 | 1.02 | – | S | – | (K5 IV) | | B | |
| 121 | Herbig 50 PW MON | 06 41.1 | +09 38 | 16.3 | – | – | B | – | M2 IV | E | B | |
| 122 | Walker 159 261939 | 06 41.1 | +09 36 | 10.96 | 0.06 | 0.00 | P | – | A0 V | | W | |
| 123 | V 360 Mon W.164 | 06 41.1 | +09 36 | 13.43 | 0.85 | 0.36 | P | G2 IV | G8 V | SE | Y | ∼ |
| 124 | Vas. 120 W.163 | 06 41.1 | +09 36 | 14.05 | 0.89 | 0.52 | S | G9 V | (K2 IV) | | B | |
| 125 | Vas. 123 W.167 | 06 41.1 | +09 36 | 14.09 | 0.89 | 0.14 | S | G9 V | (K2 IV) | | B | |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 126 | Herbig 49 LY MON | 06 41.1 | +09 35 | 15.46 | 1.02 | – | B | – | K5 IV | (E) | B | |
| 127 | V 608 Mon W.166 | 06 41.1 | +09 35 | 16.26 | 1.53 | 0.40 | W | – | (M2 IV) | | B | ∼ |
| 128 | Vas. 115 W.157 | 06 41.1 | +09 33 | 10.06 | –0.06 | –0.35 | W | B6 V | B8 V | | Y | |
| 129 | Walker 160 | 06 41.1 | +09 33 | 14.85 | 0.96 | 0.67 | W | K3 V | (K5 IV) | | B | |
| 130 | Vas. 111 | 06 41.1 | +09 31 | 12.74 | 0.71 | 0.36 | F | G2 IV | G8 V | | Y | |
| 131 | Walker 162 | 06 41.1 | +09 31 | 15.28 | 1.34 | 0.84 | W | – | (M0 IV) | | B | |
| 132 | Walker 175 | 06 41.1 | +09 31 | 15.65 | 1.20 | 1.09 | P | – | (K5 IV) | | B | ∼ |
| 133 | Vas. 124 | 06 41.1 | +09 28 | 12.95 | 1.11 | 0.12 | S | – | K6(IV) | S | B | |
| 134 | V 426 Mon HER.54 | 06 41.1 | +09 28 | 13.16 | 1.14 | – | B | – | K6(IV) | E | B | |
| 135 | Vas. 116 | 06 41.1 | +09 24 | 14.46 | 0.71 | 0.04 | S | G2 IV-V | (G5 V) | | B | |
| 136 | BD+ 09 1343 261941 | 06 41.1 | +09 23 | 10.99 | 0.15 | 0.15 | S | A2 V | A2 V | E | Y | |
| 137 | BD+ 10 1225 261936 | 06 41.2 | +10 08 | 10.04 | –0.05 | –0.45 | B | B6 V | B8:IV | | B | |
| 138 | A BD+ 10 1227 221969 | 06 41.2 | +09 53 | 9.93 | –0.03 | –0.20 | B | B9 V | B8 V | N | B | |
| 139 | B Vas. 136 W.181 | 06 41.2 | +09 53 | 10.03 | –0.04 | –0.32 | W | B8 V | B9 V | N | Y | |
| 140 | Walker 184 MM MON | 06 41.2 | +09 53 | 14.14 | 1.00 | –0.01 | W | K4 V | K3(IV) | E | B | ∼ |
| 141 | BD+ 09 1346 262013 | 06 41.2 | +09 36 | 9.21 | –0.06 | –0.40 | W | B7 V | B8 V | N | Y | |
| 142 | Vas. 141 W.190 | 06 41.2 | +09 35 | 12.38 | 0.63 | 0.15 | S | G2 IV | G4(V) | | B | |
| 143 | Walker 176 | 06 41.2 | +09 35 | 15.79 | 1.59 | 0.85 | W | M5 IV | (M2 IV) | | B | |
| 144 | Walker 191 | 06 41.2 | +09 33 | 15.37 | 1.34 | 0.98 | W | K6 IV | (K7 IV) | | B | ∼ |
| 145 | AFGL 899 431 MON | 06 41.2 | +09 30 | 16.12 | 1.41 | – | B | – | (M0 IV) | E | B | |
| 146 | A 47887 A/W.178 | 06 41.2 | +09 28 | 7.14 | –0.20 | -0.97 | W | B1 V | B1.5 | | B | |
| 147 | Vas. 140 W.189 | 06 41.2 | +09 27 | 11.20 | 0.47 | 0.21 | W | F0 III | F2 V | | Y | |
| 148 | Vas. 132 | 06 41.2 | +09 27 | 14.50 | 1.24 | – | B | – | (K5 IV) | | B | |
| 149 | V 365 Mon VAS.139 | 06 41.2 | +09 26 | 13.81 | 0.92 | – | P | – | K4 IV | (E) | B | |
| 150 | V 591 Mon HER.61 | 06 41.2 | +09 26 | 13.55 | 0.84 | 0.23 | S | G3 IV | G – ? | E | Y | |
| 151 | V 363 Mon W.183 | 06 41.2 | +09 26 | 15.22 | 0.97 | 0.66 | W | K0 V | (K3 IV) | E | B | ∼ |
| 152 | Vas. 149 W.196 | 06 41.3 | +09 57 | 11.46 | 0.53 | –0.05 | W | G0 IV | F6-F8 IV | | W | |
| 153 | V 368 Mon W.200 | 06 41.3 | +09 40 | 16.95 | 1.40 | –0.67 | W | – | (M0 IV) | E | B | ∼ |
| 154 | V 432 Mon W.199 | 06 41.3 | +09 34 | 15.00 | 1.09 | 0.29 | W | – | K5(IV) | SE | B | ∼ |
| 155 | Walker 201 | 06 41.3 | +09 40 | 15.76 | 1.04 | 0.44 | W | G2 IV | (K5 IV) | | B | |
| 156 | Vas. 152 W.198 | 06 41.3 | +09 34 | 15.32 | 1.25 | 0.89 | W | K6 IV | K7(IV) | | B | |
| 157 | Vas. 165 W.209 | 06 41.3 | +09 34 | 11.31 | 0.35 | –0.02 | S | F5 III-IV | F2 V | | Y | |
| 158 | Vas. 155 | 06 41.3 | +09 32 | 14.39 | 1.06 | 1.12 | S | K5 IV | (K5 IV) | | B | |
| 159 | Vas. 150 | 06 41.3 | +09 30 | 14.80 | 1.39 | 1.13 | P | – | (M0 IV) | | U | |
| 160 | Vas. 154 | 06 41.3 | +09 30 | 14.02 | 1.05 | 0.91 | S | K2 V | (K0 IV) | | B | |
| 161 | Vas. 151 | 06 41.3 | +09 28 | 15.08 | 0.92 | –0.24 | S | – | (K0 IV) | | B | ∼ |
| 162 | Vas. 156 W.203 | 06 41.3 | +09 27 | 12.90 | 0.76 | 0.18 | W | G2 IV | (G8 IV) | | B | |
| 163 | Walker 205 262041 | 06 41.3 | +09 22 | 10.60 | 0.34 | –0.04 | W | F1 III | (F2 V) | | B | |
| 164 | AB 47934 W.206 | 06 41.4 | +09 44 | 8.70 | –0.08 | –0.43 | W | B7 V | B7 V | N | B | |
| 165 | Walker 207 | 06 41.4 | +09 43 | 13.62 | 1.03 | – | B | – | K2 (IV) | S | B | |
| 166 | Vas. 170 | 06 41.4 | +09 35 | 14.39 | 0.84 | – | V | – | (K3 IV) | | B | |
| 167 | Walker 204 OV MON | 06 41.4 | +09 34 | 15.30 | 1.15 | 0.47 | W | G5 IV | (K5 IV) | E | B | ∼ |
| 168 | Vas. 166 | 06 41.4 | +09 34 | 13.34 | 0.57 | 0.11 | S | G2 V | (F8 V) | | B | |
| 169 | Vas. 164 W.208 | 06 41.4 | +09 27 | 12.63 | 0.76 | 0.23 | S | G0 IV | (G8 V) | | B | |
| 170 | Vas. 167 W.210 | 06 41.4 | +09 26 | 13.43 | 0.79 | 0.22 | S | G2 IV | (G8 V) | | B | |
| 171 | Vas. 169 | 06 41.4 | +09 24 | 12.70 | 0.44 | 0.19 | S | F0 V | F5: V: | | B | |
| 172 | BD+ 09 1348 262042 | 06 41.4 | +09 13 | 8.98 | 0.09 | –0.63 | B | B2 V | B2 V | | B | |
| 173 | C BD+ 09 1350 47961 | 06 41.5 | +09 51 | 7.48 | –0.14 | –0.80 | S | B2 V | B2.5 V | | W | |
| 174 | A Vas. 175 262066 | 06 41.5 | +09 50 | 9.32 | 0.04 | –0.14 | B | B9 III-IV | A0 IV-V | | W | |
| 175 | Vas. 174 W.214 | 06 41.5 | +09 40 | 13.12 | 0.80 | 0.22 | S | G1 IV | K0 (IV) | S | B | |
| 176 | Vas. 178 W.215 | 06 41.5 | +09 27 | 13.76 | 0.93 | 0.34 | S | – | (K0 IV) | | B | |
| 177 | Walker 217 MO MON | 06 41.5 | +09 27 | 13.54 | 1.22 | – | B | – | K5 IV: | SE | B | |
| 178 | BD+ 09 1352 262110 | 06 41.5 | +09 19 | 9.69 | 0.48 | –0.04 | W | G0 III | A7: IV: | | B | |
| 179 | Herbig 73 OW MON | 06 41.6 | +10 09 | 14.51 | – | – | B | – | K2 IV | (E) | B | |
| 180 | BD+ 09 1353 262108 | 06 41.6 | +09 51 | 9.92 | 0.14 | 0.15 | B | A3 III | A3 IV | N | B | |
| 181 | Herbig 74 | 06 41.6 | +09 45 | 15.4 | – | – | B | – | K6 IV | E | B | |
| 182 | Vas. 193 | 06 41.6 | +09 33 | 12.84 | 0.54 | –0.10 | B | G2 IV | F9 (IV) | S | B | |
| 183 | Vas. 189 | 06 41.6 | +09 32 | 14.95 | 1.30 | – | V | – | (K5 V) | | B | |
| 184 | Vas. 188 W.224 | 06 41.6 | +09 21 | 11.53 | 0.66 | 0.17 | S | G2 IV | G2 (IV) | S | B | |
| 185 | Herbig 75 OX MON | 06 41.7 | +10 10 | 14.5 | – | – | B | – | K2 IV | E | B | |
| 186 | BD+ 10 1228 48012 | 06 41.7 | +10 02 | 8.52 | 1.20 | 1.18 | W | K2 III | K2 II-III | | W | |
| 187 | BD+ 09 1355 262138 | 06 41.7 | +09 47 | 9.59 | 0.15 | 0.12 | W | A4 III | A3-A4 III | | W | |
| 188 | Vas. 196 W.228 | 06 41.7 | +09 43 | 11.07 | 0.36 | 0.09 | W | F1 III | F0 V | | Y | |
| 189 | Vas. 200 OZ MON | 06 41.7 | +09 41 | 14.05 | 0.96 | 0.52 | S | G9 IV | K5(V) | E | B | |
| 190 | Vas. 191 OY MON | 06 41.7 | +09 40 | 14.06 | 1.00 | 0.22 | S | K1 IV | K5 (IV) | SE | B | |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 191 | Vas. 204 | 06 41.7 | +09 34 | 14.70 | 0.94 | 0.86 | S | K4 IV | (K5 IV) | | B | |
| 192 | Vas. 192 | 06 41.7 | +09 34 | 14.43 | 1.95 | 1.58 | S | M4 IV | (M3 IV) | | B | |
| 193 | V 370 Mon HER.76 | 06 41.7 | +09 32 | 15.3 | – | – | B | – | K4 IV | E | B | |
| 194 | Vas. 199 W.230 | 06 41.7 | +09 27 | 12.45 | 0.89 | 0.68 | S | K1 IV | K1 IV | S | B | |
| 195 | Vas. 205 | 06 41.8 | +09 43 | 13.18 | 0.75 | 0.35 | S | G6 IV | K1(IV) | | B | |
| 196 | Vas. 207 | 06 41 | +09 | 13.85 | 0.97 | 0.44 | S | G6 IV | K2 (IV) | S | B | |
| 197 | BD+ 09 1356 48055 | 06 41.8 | +09 30 | 8.96 | –0.13 | –0.66 | W | B3 V | B3 V | N | B | |
| 198 | Vas. 217 | 06 41 | +09 | 14.12 | 0.89 | 0.49 | S | K1 IV | G7 (IV) | S | B | |
| 199 | BD+ 10 1230 262177 | 06 41.9 | +10 01 | 9.78 | –0.12 | –0.08 | W | B9 V | B9 V | | B | |
| 200 | Vas. 228 | 06 42 | +09 | 13.53 | 1.67 | 1.25 | S | M0 IV | (K9 IV) | S | B | |
| 201 | Vas. 238 | 06 42.2 | +09 44 | 11.21 | 1.01 | 1.11 | S | K1 IV | K1 (IV) | SE | B | |
| 202 | Herbig 83 MQ MON | 06 42.2 | +09 41 | 14.56 | 1.32 | 0.42 | B | K4 IV | K3 IV | (E) | B | |
| 203 | BD+ 09 1358 262320 | 06 42.2 | +09 32 | 9.44 | 1.44 | 1.27 | B | K1 III | K2 II-III | | B | |

Notes to Table 1:

B – Buscombe [1];
F – Flaccomio *et al.* [3];
P – Park *et al.* [10];
S – Sagar & Joshi [11];
V – Vasilevskis *et al.* [14];
W – Walker [15];
Y – Young [16];
$\sim$ – variable star;
$U$:$B$:$V$: – unreliable estimates.

Table 2. Possible photometric and spectral characteristics of the star number 29

| N | *Sp* | $(B–V)_0$ | $E(B–V)$ | $A_V$ | $V_0$ | $M_V$ (MS) | $V_0 - M_V$ (MS) | $r$ (MS) | $M_V$ (ZAMS) | $V_0 - M_V$ (ZAMS) | $r$ (ZAMS) | *Sp* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A0 V | –0.02 | 1.27 | 4.06 | 10.19 | 0.65 | 9.54 | 814 | 1.3 | 8.89 | 597 | |
| 2 | A5 V | 0.15 | 1.10 | 3.52 | 10.75 | 1.95 | 8.78 | 570 | 2.1 | 8.65 | 535 | |
| 3 | K3 V | 1.12 | 0.13 | 0.42 | 13.83 | 6.65 | 7.18 | 270 | 6.56 | 7.17 | 257 | K3 V |
| 4 | A0IV | –0.02 | 1.27 | 4.06 | 10.19 | 0.30 | 8.89 | 950 | – | – | – | |
| 5 | A7IV | 0.21 | 1.04 | 3.33 | 10.92 | 1.70 | 9.22 | 700 | – | – | – | |
| 6 | K1IV | 0.97 | 0.28 | 0.90 | 13.35 | 3.10 | 10.25 | 1120 | – | – | – | K1 IV |
| 7 | A0III | –0.02 | 1.27 | 4.06 | 10.19 | 0.00 | 10.19 | 1100 | – | – | – | |
| 8 | A7III | 0.21 | 1.04 | 3.33 | 10.92 | 1.10 | 9.82 | 920 | – | – | – | |
| 9 | K1III | 0.97 | 0.28 | 0.90 | 13.35 | 0.60 | 12.75 | 3550 | – | – | – | |
| 10 | M5III | 1.63 | –0.38 | 0.00 | 14.25 | –0.30 | 14.55 | 8130 | – | – | | |
| 11 | A7I | 0.21 | 1.04 | 3.33 | 10.92 | –6.60 | 17.52 | 32000 | – | – | | |
| 12 | F8I | 0.53 | 0.72 | 2.30 | 11.95 | –6.50 | 18.45 | 50000 | – | – | | |
| 13 | K1 I | 0.97 | 0.28 | 0.90 | 13.35 | –6.00 | 12.35 | 75000 | – | – | | |
| 14 | M0 I | 1.48 | –0.23 | 0.00 | 14.25 | –5.60 | 19.85 | 93000 | – | – | | |

## TECHNIQUE OF THE SPECTRAL CLASSIFICATION

We describe here a technique of the two-dimensional spectral classification of O–M stars on temperature parameters and luminosity classes in application to members of the cluster NGC 2264.

As an example we use the photometric data for star 29 in Table 1, for which [15] gives $V = 14.25$, $B-V = 1.25$ and $U-B = 1.03$. From these data we calculate the value $Q_{UBV} = (U-B)-X(B-V) = -0.03$, where $X = E(U-B)/E(B-V) = 0.85$ [13]. Using the value $Q = -0.03$, we find a set of 14 possible spectra and other individual characteristics of the star which are listed in Table 2.

Distances $r$ to the stars and intrinsic distance module $V_0 - M_V$ for the dwarf luminosity class were calculated and given in Table 2 for the two absolute magnitude scales: the cluster zero-age-main-sequence (ZAMS) scale and a background main sequence (MS) scale [12].

To eliminate the multiplicity of spectral classifications, we used information on the distribution

Table 3. Photometric and spectral characteristics of the star number 29 for spectra K4 V and K4 IV

| $Sp$ | $(B-V)_0$ | $E(B-V)$ | $A_V$ | $V_0$ | $M_V(MS)$ | $V_0-M_V(MS)$ | $M_V(ZAMS)$ | $V_0-M_V(ZAMS)$ | $Sp$ |
|---|---|---|---|---|---|---|---|---|---|
| K4 V | 1.06 | 0.19 | 0.61 | 13.64 | 7.0 | 6.64 | 6.9 | 6.74 | K4 V |
| K4 IV | 1.22 | 0.03 | 0.10 | 14.15 | 3.5 | 10.65 | – | – | K4 IV |

of absorbing dust in the interstellar medium along the given direction. According to [6] and [15], up to distances smaller than $r = 760$ pc from the Sun where the cluster NGC 2264 is located, there is practically no dust matter. Circumstellar light absorption is here $A_V = 0.26^m$. Beyond the cluster, at distances 1.0 to 1.5 kpc from the Sun, which corresponds to the distance modulus 10 to 11 mag, there are located dust clouds with immersed T Tau stars, and with an absorption up to $A_V = 2.60$ [8]. At yet greater distances, there is a much denser practically opaque dust cloud that totally shields the light of background stars.

The pairs of real values $E(B-V)$ and $(V_0-M_V)$ from Table 2 should conform with the described picture of the absorption of light for cluster members and satisfy the following conditions:

$$E(B-V) = \overline{E(B-V)} \pm 3\sigma_{E(B-V)}, \quad (V_0-M_V) = \overline{(V_0-M_V)} \pm 3\sigma_{(V_0-M_V)}, \tag{1}$$

where $\overline{E(B-V)}$ and $\overline{(V_0-M_V)}$ are average values for the cluster, and $\sigma_{E(B-V)}$, $\sigma_{(V_0-M_V)}$ are standard errors of their determination.

It should be noted that some field stars can contaminate a list of cluster members and condition (1) could not be satisfied for any spectrum from Table 2. In these rare cases it is necessary to use spectra which satisfy inequalities (2), (3) with distance moduli calculated on a scale of absolute magnitudes $M_V(MS)$:

$$E(B-V) < \overline{E(B-V)} \pm 3\sigma_{E(B-V)}, \quad (V_0-M_V) < \overline{(V_0-M_V)} \pm 3\sigma_{(V_0-M_V)} \tag{2}$$

for foreground stars and

$$E(B-V) > \overline{E(B-V)} \pm 3\sigma_{E(B-V)}, \quad (V_0-M_V) > \overline{(V_0-M_V)} \pm 3\sigma_{(V_0-M_V)} \tag{3}$$

for stars of the remote background, *i. e.*, stars located far behind the cluster. Conditions (1) – (3) are criteria useful to bypass possible errors in membership studies.

An average colour excess $\overline{E(B-V)} = 0.08^m$ and average distance modulus $\overline{(V_0-M_V)} = 9.40$ for the cluster NGC 2264 have been derived in [8], [6] and [15]. According to [7], errors in determination of colour excesses and intrinsic distance moduli are $\sigma_{E(B-V)} = 0.10^m$ and $\sigma_{(V_0-M_V)} = 0.80^m$, though in some rare cases the errors $\sigma_{(V_0-M_V)}$ can reach $\pm 1.00^m$. Therefore, a system of inequalities (1) – (3) in our case can be rewritten as: $-0.22^m < E(B-V) < 0.38^m$, $7.00^m < (V_0-M_V) < 11.80^m$ for cluster members; $-0.30^m < E(B-V) < 0.38^m$, $0.00^m < (V_0-M_V) < 11.80^m$ for stars of the foreground; and $-0.38^m < E(B-V)$, $11.80^m < (V_0-M_V)$ for background stars.

The two possible spectra K3 V and K1 IV in Table 2 satisfy the system of inequalities (1). The average of these two estimates is K2 IV–V. Having calculated a value $Q_{UBV}$ with a coefficient $X = 0.95$ valid for the spectral type K2 IV–V [13], we obtain $Q_{UBV} = -0.16$. So, the final estimate of the spectrum is $Sp$ = K4 IV–V.

Now the luminosity class of the star with the serial number 29 can be determined more accurately. For this purpose we calculate individual characteristics of this star with the spectra K4 V and K4 IV (Table 3). The mean value of $V_0$ for spectra K4 V and K4 IV is $13.90^m$. With this value, using condition (1) we find $V_0 - M_V = 9.40^m \pm 2.40^m$ which yields $2.10^m < M_V < 6.70^m$. The last limitation allows to reject a value $M_V = 7.0^m$, thus $Sp(UBV)$ = K4 IV is finally obtained with $M_V = 3.5^m$. This is an improved estimate which agrees relatively well with a preliminary spectrum K7 IV given in [1].

Table 4. Photometric and spectral characteristics of NGC 6913 stars

| N | $\alpha$ | $\delta$ | $V$ | $U-B$ | $B-V$ | $Sp$ | N | $\alpha$ | $\delta$ | $V$ | $U-B$ | $B-V$ | $Sp$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20 23 25 | 38 33 55 | 15.507 | 0.185 | 1.023 | G2V | 19 | 20 23 47 | 38 31 34 | 15.052 | 0.594 | 0.931 | G0 |
| 2 | 20 23 29 | 38 33 50 | 14.214 | 0.325 | 0.912 | G0V | 20 | 20 23 27 | 38 31 37 | 15.158 | 0.066 | 0.986 | B5 |
| 3 | 20 23 38 | 38 34 50 | 15.280 | 0.485 | 0.942 | G1V | 21 | 20 23 29 | 38 31 36 | 14.871 | 0.508 | 1.232 | B7V |
| 4 | 20 23 46 | 38 34 39 | 13.678 | 0.053 | 0.645 | G2V | 22 | 20 23 49 | 38 31 11 | 15.424 | 0.780 | 0.918 | K5V |
| 5 | 20 23 54 | 38 34 37 | 14.521 | 0.448 | 0.833 | G1V | 23 | 20 23 36 | 38 31 11 | 16.876 | 0.282 | 0.969 | G2 |
| 6 | 20 23 36 | 38 34 28 | 14.597 | 0.055 | 0.745 | G2V | 24 | 20 23 28 | 38 31 26 | 13.822 | 0.582 | 0.946 | G7 |
| 7 | 20 23 51 | 38 34 15 | 14.685 | 0.540 | 1.021 | G3V | 25 | 20 23 24 | 38 31 20 | 12.945 | 1.226 | 1.771 | M5 |
| 8 | 20 23 23 | 38 33 29 | 14.709 | 0.522 | 0.957 | G2V | 26 | 20 23 46 | 38 31 16 | 12.321 | 0.039 | 0.658 | B5 |
| 9 | 20 23 22 | 38 33 26 | 15.095 | 0.596 | 0.982 | G0V | 27 | 20 23 55 | 38 30 49 | 15.326 | 0.329 | 0.930 | G0 |
| 10 | 20 23 57 | 38 33 12 | 15.432 | 0.782 | 0.946 | K2V | 28 | 20 23 33 | 38 30 45 | 15.225 | 0.714 | 0.892 | K6 |
| 11 | 20 23 54 | 38 33 11 | 13.565 | 0.864 | 0.851 | K3IV | 29 | 20 23 46 | 38 30 39 | 16.292 | 0.691 | 0.867 | G3V |
| 12 | 20 23 24 | 38 32 36 | 14.276 | 0.663 | 1.224 | K0 | 30 | 20 23 34 | 38 30 36 | 15.411 | 0.392 | 1.048 | G4V |
| 13 | 20 23 50 | 38 32 33 | 15.195 | 0.293 | 0.840 | G0V | 31 | 20 23 36 | 38 30 29 | 14.087 | 0.157 | 0.768 | G3V |
| 14 | 20 23 50 | 38 32 17 | 13.905 | 0.647 | 0.935 | G2V | 32 | 20 23 51 | 38 30 21 | 14.622 | 0.377 | 0.982 | G3 |
| 15 | 20 23 23 | 38 32 09 | 15.023 | 0.406 | 1.061 | K5V | 33 | 20 23 35 | 38 30 20 | 14.619 | 0.501 | 0.910 | G2 |
| 16 | 20 23 57 | 38 32 02 | 14.693 | 0.943 | 0.940 | K5V | 34 | 20 23 48 | 38 30 18 | 14.266 | 0.643 | 1.046 | G3 |
| 17 | 20 23 47 | 38 31 46 | 15.452 | 0.823 | 0.907 | K5V | 35 | 20 23 49 | 38 30 15 | 14.449 | 0.437 | 1.020 | G2 |
| 18 | 20 23 56 | 38 31 50 | 14.564 | 0.497 | 0.902 | F7 | 36 | 20 23 29 | 38 30 05 | 14.182 | 0.218 | 0.843 | G2 |

## SPECTRAL CLASSIFICATIONS FOR OPEN CLUSTERS NGC 2244, NGC 2264, AND NGC 6913

Spectra of stars, obtained in the way described are given in Table 1. In the first seven columns of the table, serial numbers, star names, coordinates $\alpha$ and $\delta$ at the epoch J2000.0, magnitudes $V$, and colour indices are given. The eighth column contains references to the photometric data sources; in the ninth column the spectral characteristics of stars $Sp(UBV)$ obtained in this study on the basis of $UBV$ photometry are given. In the tenth, eleventh and twelfth columns are given spectral characteristics found by other authors, remarks to these spectra, and references on data sources. The thirteenth column contains supplementary notes.

Spectral types of $17–22^m$ $(V)$ stars in the direction of NGC 2264, and of $14^m$ $(V)$ stars in the direction of NGC 2244 derived from $UBV$ data are given in [9]. The $UBV$ magnitudes for stars of NGC 6913 were measured with the two-channel focal reducer [4] at the 2-m RCC telescope of the Terskol Observatory. During the observations we used the $U$ filter DUG11 ($\lambda_0^\alpha = 338$ nm, $\Delta\lambda = 93$ nm); the $B$ filter BB+BG39/2 ($\lambda_0^\alpha = 431$ nm, $\Delta\lambda$=128 nm) and the $V$ filter ($\lambda_0^\alpha = 531$ nm, $\Delta\lambda = 93.3$ nm). The exposures ranged from 10 to 600 s in the $U$ band, from 10 to 300 s in the $B$ band, and from 10 to 600 s in the $V$ band. The reduction of the measured $ubv$ magnitudes was performed using $11–14^m$ photoelectric standards [5] in the same frame. A linear transformation $U = a_1 + b_1 u$, $B = a_2 + b_2 b$, $V = a_3 + b_3 v$ with $a_1 = 23.64$, $a_2 = 25.78$, $a_3 = 26.09$, $b_1 = 0.96$, $b_2 = 0.97$, $b_3 = 0.96$ was applied. Standard deviations for photometric magnitudes of stars used as standards [5] were estimated to be $\pm 0.02^m$, $\pm 0.03^m$ and $\pm 0.01^m$ in the $UBV$ bands, respectively. An internal accuracy for the target stars was found to be $\pm 0.09^m$ for $U$, $B$ magnitudes and $\pm 0.005^m$ for $V$. For 36 stars of NGC 6913 in Table 4 we give their positions $\alpha$ and $\delta$ at the epoch J2000.0, $V$ magnitudes, colours $U-B$, $B-V$ and spectra $Sp$ derived from the photometric data.

In this study we present first results of the spectral classification for faint stars that can be applied for solving many problems of modern astrophysics and stellar astronomy.

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[1] *Buscombe W.* MK Spectral Classifications (Series of General Catalogues).– Evanston, Illinois: Northwestern University, 1974–1999.

[2] *Cohen M., Kuhi L. V.* Observational studies of "PPE-main sequence evolution" // Astrophys. J. Suppl. Ser.–1979.–**4**.–P. 743–843.

[3] *Flaccomio E., Micela G., Sciortuno S., et al.* BVRI photometry of the star-forming region NGC 2264: the initial mass function and star-forming rate // Astron. and Astrophys.–1999.–**345**.–P. 521–531.

[4] *Jockers K., Credner T., Bonev T., et al.* Exploration of the Solar System with the two-channel focal reducer of the 2m-RCC telescope of Pik Terskol Observatory // Kinematics and Physics of Celestial Bodies.–2000.–**3**.–P. 13–18.

[5] *Kazanasmas M., Zaversheva L., Tomak L.* Atlas and catalogue of stellar photoelectric standard magnitudes.– Kiev: Naukova dumka, 1982.–220 p. (in Russian).

[6] *Khalandadze N. B., Kuznetsov V. I., Voroshylov V. I.* The investigation of the NGC 2264 star formation region // Kinematics and Physics of Celestial Bodies.–1986.–**2**.–P. 27–34.

[7] *Kuznetsov V. I.* Classification of stars according to unwidened low-dispersion spectra and some results of its application for studying the Galactic structure // Astrometriya i Astrofizika–1978.–**34**.–P. 30–43. (in Russian).

[8] *Kuznetsov V. I.* The structure and evolution of star-forming regions.–Kiev: Naukova dumka, 1990.–222 p. (in Russian).

[9] *Kuznetsov V. I., Butenko G. Z., Lazorenko G. A., Lazorenko P. F.* Spectral classification of O–M stars on the basis of UBV photometry // Astron. and Astrophys. Suppl. Ser.–2000.–**142**.–P. 389–398.

[10] *Park B.* The pre-main-sequence stars and initial mass function of NGC 2264 // Astron. J.–2000.–**120**.–P. 894–908.

[11] *Sagar R., Joshi U. C.* Study of the open cluster NGC 2264 // Mon. Notic. Roy. Astron. Soc.–1983.–**205**.–P. 747–758.

[12] *Schmidt-Kaler Th.* Physical parameters of the star. Landolt-Bornstein Numerical data and functional relationship in science and technology.–Berlin: Springer Verlag, 1982.–P. 1–34.

[13] *Strayzis V.* Multicolour photometry of stars. Photometric systems and methods.–Vilnius: Mokslas, 1977.–250 p.

[14] *Vasilevskis S., Sanders W. L., Balz A. G.* Membership of the open cluster NGC 2264 // Astron. J.–1965.–**70**.–P. 797–805.

[15] *Walker M. F.* Studies of extremely young clusters: I.NGC 2264 // Astrophys. J. Suppl. Ser.–1956.–**2**.–P. 365–387.

[16] *Young A.* Differential reddening in the young cluster NGC 2264 // Publs Astron. Soc. Pacif.–1978.–**534**.–P. 144–148.