A SPECTROSCOPIC AND STATISTICAL STUDY OF COLLINDER 140

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Spectra of 140 stars in a 1.36 square degree field centered on the open cluster Collinder 140 (Cr 140: l=245°.2, b=-7°.8), 17 outside this field, and 125 in two neighbouring fields of the same total area, have been classified on the MK system. Twenty of these were classified on slit spectra in the manner described by FitzGerald *et al.* (1979) and the balance on objective prism plates obtained at Cerro Tololo with a disperson of 280 A mm^{-1}. All spectra were classified at least twice, usually by more than one author. The internal accuracy was ±0.9 spectral sub-classes and ±0.4 luminosity classes. Comparison with the Michigan 10° classes of Houk (1979) for 34 stars in common gives the difference (Houk-FHM): 0.2 ± 0.2 (s.e. mean) for spectral classes and -0.1 ±0.1 for luminosity classes. All stars brighter than V=14.35-0.65 S were classified in the above regions, where S is a numerical representation of the spectral class ranging from 2.0 to 6.7 for BO to M7 stars respectively. Members are shown in Figure 1.

Poisson statistics were used to compare the Cr 140 field with the neighbouring fields. These showed that the Cr 140 field should contain 15 ± 5 F8 to K4 giants with V < 7.2 + 0.65 S and 19 ± 5 B2 to A4 main sequence stars with V < 10.3. No A to F main sequence stars fainter than this are expected. This result is in agreement with the 29 stars assigned membership in the 1.36 square degree field; seven other stars immediately outside this region are also assigned membership.

Based on the main sequence members the cluster has a distance of 410 ± 30 pc, colour excess E_{B-V} = 0.04, and an age of 20 ± 6 x 10^6 y This is in substantial agreement with the results of Claria and Rosenzweig (1978) and Williams (1978), based on photometric studies. Our results are based on cluster fitting in the HR diagram of Figure 1.

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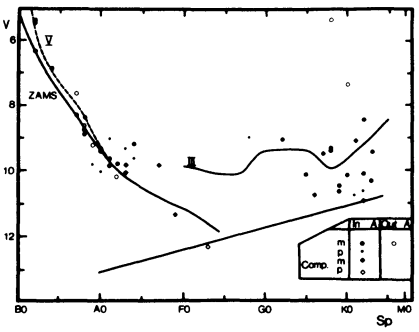

Figure 1. The H-R diagram for Collinder 140.

The F8 to K4 giants have the same spectroscopic parallax as the B2 to A4 stars, and appear to be members on a statistical basis. However they are too faint, except for one or two stars, to be evolved members of the cluster; they populate the same part of the HR diagram as the giant clump stars in such *old* galactic clusters as NGC 752 and IC 4651 (Eggen 1971). This discrepancy could result from a number of causes none of which we find truly satisfactory:

(a) the giants are a chance concentration not physically related to the cluster;
(b) they are a real physical group, but not associated with the B2 to A4 cluster;
(c) they are captured field stars;
(d) they are genuine members. This contention is supported by the Poisson statistics (although it is possible that Cr 140 was detected above the background field stars only because of the superposition of two loose open clusters), and by the presence of four stars with composite spectra, three of which have one component in each of the two spectral groupings. One of these, G9 III + A2 V, is also a proper motion member.

Resolution of the actual nature of the giant members, and the resulting astrophysical implications, must await a thorough study of their membership based on proper motion and radial velocity studies.

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