STUDY OF ABUNDANCE ANALYSIS OF STARS IN THE SPECTRAL RANGE B5 THROUGH G2

Grant NGR 22-024-001

Semiannual Progress Report No. 5

For the period June 1 through November 30, 1969

Stephen E. Strom

January 1970

Prepared for

National Aeronautics and Space Administration
Office of Space Science Application
Washington, D.C.

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Considerable progress was made in three research programs during the past 6 months: our studies of helium abundances, blue stragglers, and stars in a pre-main-sequence contraction phase. A brief review of the results obtained and questions raised by these investigations follows.

Helium Abundances

With Harry Shipman, Strom examined the problem of possible variations of helium content as a function of position in the galaxy. The helium line strengths measured by Walker and Hodge were used in conjunction with the model predictions of line strength by Shipman and Strom to allow determination of helium content for approximately 100 stars. The values of effective temperature were determined from the independent reddening parameter Q of the UBV system, while gravity determinations were made from comparisons of observed $H\gamma$ line strengths as measured by Petrie with computations of Peterson and Strom.

Two major indications were found:

A. There appears to be a small (0. 05 mass fraction) difference in the helium abundance in the Perseus arm (larger) and in the Cygnus arm (smaller). This spectroscopic prediction appears to be confirmed by the behavior of short-period Cepheids in these two arms. From the recent work of Stobie,

this behavior appears to be quite sensitive to the initial helium content of the Cepheids. The details of this work are summarized in "Possible Variations of Helium Content with Position in the Galaxy," by Shipman and Strom (submitted to Astrophysical Journal Letters).*

B. We found that individual clusters and associations appeared to have different helium contents. This conclusion rests on a rather small number of stars, and our investigations over the next year will be aimed at confirming or denying this prediction on the basis of a much more extensive survey.

Blue Stragglers

Over the past year, we have obtained spectrophotometric and spectroscopic observations of a number of blue stragglers, with particular emphasis on those in the cluster NGC 7789. The material for this investigation was obtained in part at Palomar, but primarily by use of the 50-inch and the 84-inch telescopes at the Kitt Peak National Observatory. The spectroscopic results suggest that at least some, if not all, of the blue stragglers are binaries, thus lending strong credence to the idea that they have reached their current position in the H-R diagram by virtue of mass exchange with a once more massive companion. Final reduction of the photometric data will await the completion of our run at Kitt Peak in December and January.

Pre-Main-Sequence Evolution

We hoped, by means of spectrophotometric observations, to determine the masses of stars in the pre-main-sequence phase of evolution in the cluster NGC 2264. Analysis of our data for the past 2 years suggests that most, if not all, of these stars are surrounded by a circumstellar shell. Both Balmer continuum emission and Hα emission are observed. Because the mass determinations depend on values of gravity deduced from Balmer discontinuity, the

*Preprint copies were forwarded to the NASA Technical Reports Officer on September 22, 1969.

presence of ultraviolet emission precludes the accurate determination of masses by means of spectrophotometry.

We have also obtained a series of 50 image-tube spectrograms at Kitt Peak using a dispersion of 35 Å/mm. We plan on using these spectra to determine rotational velocities, which in turn will be used to probe stellar angular-momentum changes in the early stages of evolution. We expect to complete reduction of this plate material during the next several months.

Travel

Dr. and Mrs. Strom traveled to the Kitt Peak National Observatory to use the 84-inch image-tube spectrograph for 6 nights in July, 6 in August, 3 in November, and 4 in December. The 50-inch telescope and associated photometer were used at Kitt Peak for 12 nights in October and 3 nights in December.