

3. PARALLAXES OF WHITE DWARFS

K. Aa. STRAND

*U.S. Naval Observatory
Washington, D.C., U.S.A.*

The U.S. Naval Observatory program on trigonometric stellar parallaxes with the 61-inch Astrometric Reflector has been in progress since 1964.

The program has been devoted entirely to stars fainter than visual magnitude $12^m.5$ for which there were reasonable assurances, from their proper motions, of their being intrinsically faint and, hence, either dwarfs, faint main sequence stars or subdwarfs. The parallaxes for the first 100 stars will appear in *Publ. U.S. Naval Observatory XX*, Part III. Part IIIA, by R. K. Riddle, will describe the astrometric data; Part IIIB will contain the photoelectric colors and magnitudes in the U, B, V system, as determined by J. B. Priser; and Part IIIC will have a general discussion of the data in relation to the H-R Diagram, by K. Aa. Strand and R. K. Riddle.

In this group of 100 stellar parallaxes, 18 stars are white dwarfs.

Data for a second group of 50 stars are nearing completion and include an additional 12 white dwarfs.

On the average, each parallax is based on 45 plates taken over a period of more than 3 years leading to a parallax determined with an internal mean error between $\pm 0''.003$ and $\pm 0''.004$. In view of the high stability of the optical system, the internal consistency of the material, the large number of plates involved, and the high accuracy of the auto-centering feature of the measuring machine, an external mean error of $\pm 0''.010$ is a conservative estimate and could possibly be as low as $\pm 0''.007$.

The H-R Diagram, as derived from the above, is shown in Figure 1. The large filled circles indicate stars with parallaxes greater than or equal to $0''.045$ ($\Delta M_V = \pm 0^m.6$ or less). Open circles indicate parallaxes less than $0''.045$ but larger than or equal to $0''.025$ ($\Delta M_V \sim \pm 1^m.0$), and the dots indicate parallaxes with values less than $0''.025$ ($\Delta M_V > 1^m.0$). The values in the parenthesis indicate the corresponding error in absolute magnitude based upon an external mean error of $\pm 0''.010$ of the parallax. The Johnson-Morgan (1953) standard main sequence is indicated by the drawn curve (Vyssotsky, 1963).

As seen from the diagram, the reddest white dwarfs for which parallaxes were obtained have a B-V of 1.0, leaving a substantial gap between the main sequence and the white dwarf branch. The star G7-17, which was considered a possible white dwarf by Eggen and Greenstein (1965) near the intersection of the normal M-type dwarf sequence, was included in the program. It turned out to have a very small parallax ($0''.015 \pm 0''.005$ (m.e.)) and not a parallax of $0''.068$ ($M_V = 14^m.7$), as assumed by the above authors. If the parallax determined at the Naval Observatory is correct, the star lies above the red end of the main sequence.

The bluest star in the program is G191-B2B, with a parallax of $0''.021 \pm 0''.003$ (m.e.),

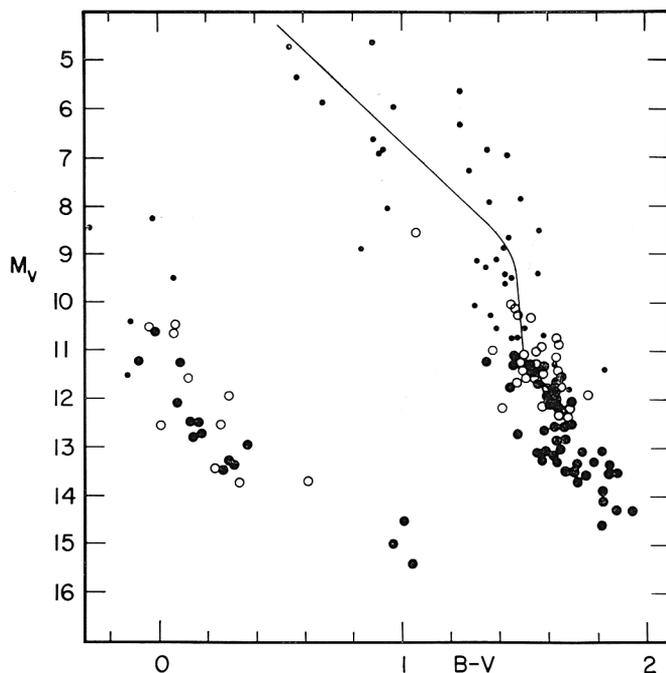


Fig. 1. The H-R diagram for stars for which parallaxes and photometric data were obtained at the U.S. Naval Observatory. The key to the symbols is described in the text.

leading to $M_V = 8^m.4$. The spectrum of the star, according to Eggen and Greenstein (1967), is sdO or DAwk. Its annual proper motion is $0''.093$, leading to a peculiar tangential velocity of only 2 km/sec. The star is the fainter companion to G191-B2A, which has been classified as a sdK4p by the same authors. The parallax determined here places the star on the main sequence.

The other bright white dwarf is AC82° 3818 with a parallax of $0''.011$, which is a preliminary value based on 19 plates only. If the parallax is confirmed by further observations, the absolute magnitude of this star will remain uncertain from trigonometric data. Eggen and Greenstein (1965) have classified it as DA, and estimate the absolute magnitude to be either $11^m.0$ or $12^m.5$ with corresponding parallaxes of $0''.040$ and $0''.079$.

In Figure 2 we find plotted in the M_V , $U-V$ diagram the white dwarfs shown in Figure 1, using the same symbols.

In addition are plotted stars (+) for which trigonometric parallaxes greater than $0''.040$ exist from other sources. Also plotted are the white dwarfs in the Hyades group (\square) and in the Praesepe Cluster (\diamond), listed in the paper by Eggen and Greenstein (1967).

This represents the inventory of absolute magnitudes of white dwarfs known at this time, as determined from astrometric data.

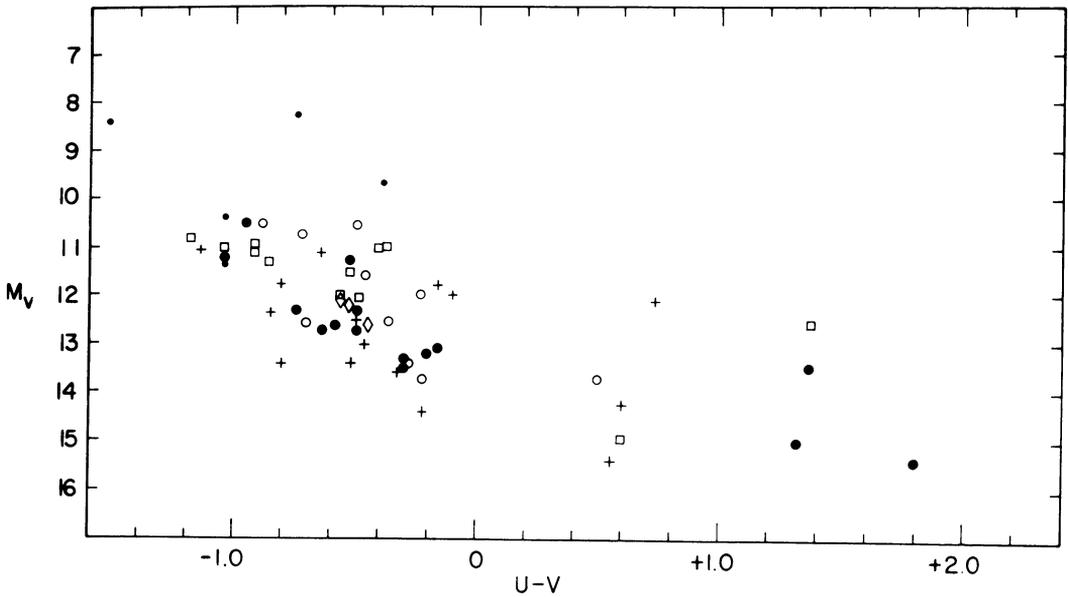


Fig. 2. A M_V , $U-V$ diagram of white dwarfs. The key to the symbols is described in the text.

Acknowledgement

It should be noted that the Naval Observatory team has substantially increased this inventory and, hopefully, will continue to do so in the years to come.

References

- Eggen, O. J. and Greenstein, J. L.: 1965, *Astrophys. J.* **141**, 83.
 Eggen, O. J. and Greenstein, J. L.: 1967, *Astrophys. J.* **150**, 927.
 Johnson, H. L. and Morgan, W. W.: 1953, *Astrophys. J.* **117**, 313.
 Vyssotsky, A. N.: 1963, *Basic Astronomical Data* (ed. by K. Aa. Strand), University of Chicago Press, Chicago, p. 192.