EVIDENCE FOR SEQUENCES IN THE COLOR-LUMINOSITY RELATIONSHIP FOR THE M-DWARFS

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The fact that the science of astronomy has always dealt mainly with small amounts of data gathered from a very large number of objects has made it a science of catalogues, tabulation, and classification. It is, consequently, also a science in which the statistical treatment of data is common, and in which final results may have significance only in a statistical sense. Classification of data has usually been used as an empirical device to bring order to large masses of observational data, and many times this ordering has preceded a discovery bearing on the explanation of some natural phenomenon. The physical nature of the stars has, in particular, been greatly clarified by means of classification processes. One of the first steps in this direction was taken when the relationship between the absolute luminosity and spectral type of stars was announced in 1926 by its discoverers, E. Hertzsprung and H. N. Russell. If the luminosities of stars in a group are plotted as a function of spectral type, it is found that the resulting Hertzsprung-Russell diagram (or simply H-R diagram) portrays a relationship showing rather moderate scatter. An important question in modern astrophysics concerns the origin of the scatter: Do stars follow only an approximate relationship between luminosity and spectral type, or is the scatter caused entirely by experimental error in the observations? This question is not nearly so easy to answer as it may seem. Luminosities of stars are very difficult to measure, while spectral types are not precisely measured quantities since they are based on an arbitrary step classification system, which in turn depends on visual estimates obtained from examination of spectrograms.

The spectral type of a star is a function mainly of its temperature. The color of a star, that is, its comparative brightness in two different regions of the spectrum, is also a function principally of temperature. The color of a star can be measured by well-established photometric methods, and, when properly done, the result is purely objective. The substitution of color for spectral type as an independent variable, therefore, may lead to a reduction of experimental error and result in a more significant dependence of luminosity on temperature. The substitution of color for spectral type is not a panacea, for although the former can be more accurately determined than spectral type, the color may be affected by interstellar reddening, whereas the spectral type is not. A plot of luminosity versus color is known as a color-magnitude diagram.

The first demonstration of a narrow sequence in a color-magnitude diagram was made in 1940 by Haffner and Heckman [1] for the Praesepe cluster by means of