

IN THE RECENT JOURNALS

A summary of selected articles on variable stars published during 1986.

"HD 47147: A Small-amplitude Extreme Poor-metal RRab Pulsating Variable," M. Grenon (Observatoire de Geneve, CH-1290 Sauverny, Switzerland), C. Waelkens, 1986, **Astron. Astrophys.** 155, 24-32.

HD 47147 is a ninth magnitude RR Lyrae star with an unusually long period (0.79732 day) and a small amplitude ($A_v = 0.17$). The properties and the red color of the star suggest that it is near the red edge of the pulsational instability strip. Its variability was discovered in a statistical study of a photoelectric catalogue, and the second author obtained 32 seven-color observations with a 70-cm telescope at La Silla Observatory, Chile, in 1982.

The star is at galactic latitude -22 degrees in a region of very small interstellar absorption; assuming an absolute magnitude $M_v = 0.6$ gives a distance of 515 parsecs. The star is deficient in metals, and the colors indicate a mean temperature of about 6150 degrees K. The evolutionary stage of the star is uncertain, but future determinations of period changes can distinguish the direction of evolution.

The space velocity of HD 47147 shows that it is in a highly elongated orbit that loops between distances of 10.7 and 2.4 parsecs from the galactic center. The orbit is retrograde and lies close to the disc of the Milky Way. (Its maximum distances above and below the disc are about 600 parsecs.)

The visual light-amplitude of HD 47147 is the smallest of any known field RR Lyrae variable, although there are several with smaller amplitudes in globular clusters. The authors suggest that this scarcity among field stars may be a selection effect against discovery of small-amplitude variables, and they state, "It remains a matter for further study whether the low amplitude of HD 47147 is truly exceptional or whether it indicates that the transition from the instability strip to the nonvariable stars redward from it is a smooth one.

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"The Eclipsing System ER Orionis," P. Rovithis (National Observatory of Athens, P.O. Box 20048, Gr-Athens 118 10, Greece), and H. Rovithis-Livaniou, 1986, **Astron. Astrophys.** 155, 46-50.

ER Orionis is a W Ursae Majoris eclipsing star with a variable period of about 0.4234 day. Its spectral type is G1 and the light curve shows two minima of slightly unequal depth with rounded maxima. About 390 three-color observations on the UBV system were obtained in 1982 and 1983 with an estimated uncertainty of 0.005 magnitude in B. The authors' analysis of the light curve, using the Frequency Domain technique of Kopal, shows that the stars have expanded so that the material at their surfaces is very loosely bound, and the system may be losing or exchanging mass. Their masses are only 0.4 and 0.3 of the sun's mass and their radii are about 0.9 and 0.7 of the sun's radius. A new ephemeris is given, and it is pointed out that previous authors have suggested that this system might be a multiple one, showing period changes due to a light-time effect.

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"A Beta Cephei Variable in an Eclipsing Binary in the Cluster NGC 3293," C. A. Engelbrecht and L. A. Balona (South African Astronomical Observatory, P.O. Box 9, Observatory 7935, Cape, South Africa), 1986, *Month. Not. Roy. Astron. Soc.* **219**, 449.

The young open cluster NGC 3293 is now known to contain ten Beta Cephei variables. They all occupy a narrow region on the color-magnitude diagram where no constant stars are found. One of the stars (HD 92024) has been found to be an eclipsing binary with primary and secondary depths of 0.08 and 0.02 magnitudes in the Johnson B band. A Fourier analysis of the rapid pulsation (whose amplitude is 0.03 magnitude in the B band) shows two periods, 0.177 and 0.130 days; the eclipsing period is 8.323 days. Secondary maximum comes midway between the flat-bottomed primaries, so the orbit is assumed to be circular. The primary minimum is probably produced by the transit of a smaller cool companion over the face of the Beta Cephei star. The Beta Cephei component is about 4.5 magnitudes brighter than its companion.

HD 92024 is particularly interesting because its absolute magnitude may be determined from its membership in a well-observed cluster. Using the visual magnitude $V_0 = 8.37$ and the distance of the cluster determined by photometry of the main sequence, the authors obtain an absolute magnitude $M_v = -3.78$ for the pulsating star, which corresponds to a spectral type B8 on the main sequence. More observations are planned to resolve an ambiguity in the pulsation periods.

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"Detection of Cepheid Variables by the Infrared Astronomical Satellite," C. W. McAlary (Steward Observatory, University of Arizona, Tucson, AZ 85721) and D. L. Welch, 1986, *Astron. Journ* **91**, 1209.

Classical Cepheids are presumed to have evolved from fairly massive main-sequence stars (5-12 solar masses), but pulsation calculations indicate semi-empirical masses that are 30 to 50 percent smaller. This suggests that Cepheids may have lost mass during evolution, perhaps through the pulsation itself.

The authors have attempted to detect the lost mass directly by examining infrared data for signs of excess emission such as might be produced by dust grains surrounding the stars. They compared the positions of 723 Cepheids with stars detected by the Infrared Astronomical Satellite (IRAS) and found 68 positive identifications.

Sixteen classical Cepheids show infrared excesses, and these stars were divided into three groups. The first group contains two stars associated with reflection nebulae, SU Cas and RS Pup. Their emission is strong and indicates a dust cloud with a temperature of about 50 degrees K or less. The second group contains SZ Mon and EN TrA, which are probably not normal classical Cepheids. The third group contains 12 stars showing modest infrared excesses. The authors conclude that the "vast majority of classical Cepheids do not show infrared emission over the expected from the stellar photosphere, and therefore the mass-loss rate for these stars is low."

There were also seven confirmed or probable type II Cepheids in the sample, and five of them show large infrared excesses, indicating hot dust with temperatures greater than 300 degrees K. The authors discuss the quantitative implications of the data and estimate the rate of mass loss.

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C. A. W.