

RU CAM: A CEPHEID WHICH HAS STOPPED PULSATING?

RU Cam (HD 56167, BD+69°417) is a variable star generally designated as a Population II Cepheid with a period of about 22 days. Published light-curves (Mitchell, Iriarte, Steinmetz, and Johnson 1964) show a broad maximum and rather sharp minimum, and the spectrum shows the Balmer series in emission during rising light (Sanford 1928). At maximum the spectrum is that of a K supergiant. The star also shows frequent period changes, which is often the case among W Virginis stars. However, RU Cam is unusual in that its spectrum shows strong carbon characteristics over most of the cycle (Sanford 1928; Bidelman 1954). Furthermore, the phase relations of the light- and velocity-curves are such that the star appears brightest when smallest and vice versa (Sanford 1928). In this it is reminiscent of Mira, which also appears to violate simple black-body pulsation laws.

In the course of a photometric survey of W Virginis stars, one of us (S. D.) was unable to find any significant variation in the light of RU Cam. Proceeding on the most probable explanation that the star had been misidentified, the other of us (J. D. F.) quite independently drew up a finding chart and carried out a number of observations. Our results in both charts and observations are in agreement. We were unable to detect light variations exceeding 0.1–0.2 mag., although the expected amplitude was about 1 mag. We feel quite certain that we have correctly identified the star for the following reasons: (1) Our independently drawn charts indicate the same star; (2) the chart published by Lenouvel (1957) agrees with ours made up from the *BD* catalogue and atlas; (3) the star is relatively bright, the field uncrowded and particularly easy to identify; (4) our *UBV* results for the comparison stars listed by Lenouvel agree with his; (5) as indicated below, the average values of V , $B - V$, and $U - B$ that we now find are in almost perfect agreement with those obtained from integration of earlier light- and color-curves. Furthermore, our results cannot be explained as due to an instrumental fault. They were obtained with our 19-inch reflector and photoelectric photometer, variously equipped with different DC amplifiers and a Weitbrecht integrator. The equipment is in continuous use on other *UBV* programs with entirely satisfactory results. Also, some of our observations were obtained by Demers with the 24-inch reflector and equipment of the Dyer Observatory. Finally, the magnitudes of two of the comparison stars (Lenouvel 1957) are such that they and RU Cam can be observed without having to change the gain of the amplifier.

Our results are listed in Table 1, and shown superimposed on earlier light- and color-curves with a revised period of 22^d.160 (Demers 1966) in Figure 1. Since our measurements have errors of probably no more than about 0.02 mag., the star is apparently still unstable with irregular fluctuations of the order of 0.2 mag. In particular, we draw attention to the values of $U - B$ during cycles 401 and 402 (not shown in the figure), when the star was about 0.5 mag. fainter in the ultraviolet than usual. There exists an extensive literature on RU Cam (see Schneller [1957] for references) which we have searched for a precedence to its present behavior. Nothing comparable, however, seems to have been observed during the past seventy or eighty years since the star was discovered as a variable, although Sanford (1928) makes reference to epochs in 1888, 1894, and 1896 when the star was unusually faint. We also note that the photoelectric observations of Eggen, Gascoigne, and Burr (1957) indicate an amplitude to the V light-curve about 0.1 mag. less than the observations of Mitchell *et al.* (1964). The latter observations, carried out in 1960, are the most recent published results that we have been able to find, although three isolated measures by Williams (1963) in 1962 show a range of 0.6 mag.

but do not fit the light-curve. In 1960 the visual light-curve had its usual amplitude of about 0.9–1.0 mag.

The top line of Table 2 lists the average of our results given in Table 1 but omits the grossly different values of $U - B$ during cycles 401 and 402. The second line of Table 2 gives the average values obtained by planimentering the earlier light- and color-curves (V has first been converted to intensity, planimentered, and then reconverted to a magnitude). The agreement of the two sets of numbers indicates that, apart from the present irregular fluctuations, the pulsation has indeed died away and the star taken up the “stable” power output that would have been predicted from the earlier light-curves. That it should have been able to accomplish this in only four years is most remarkable,

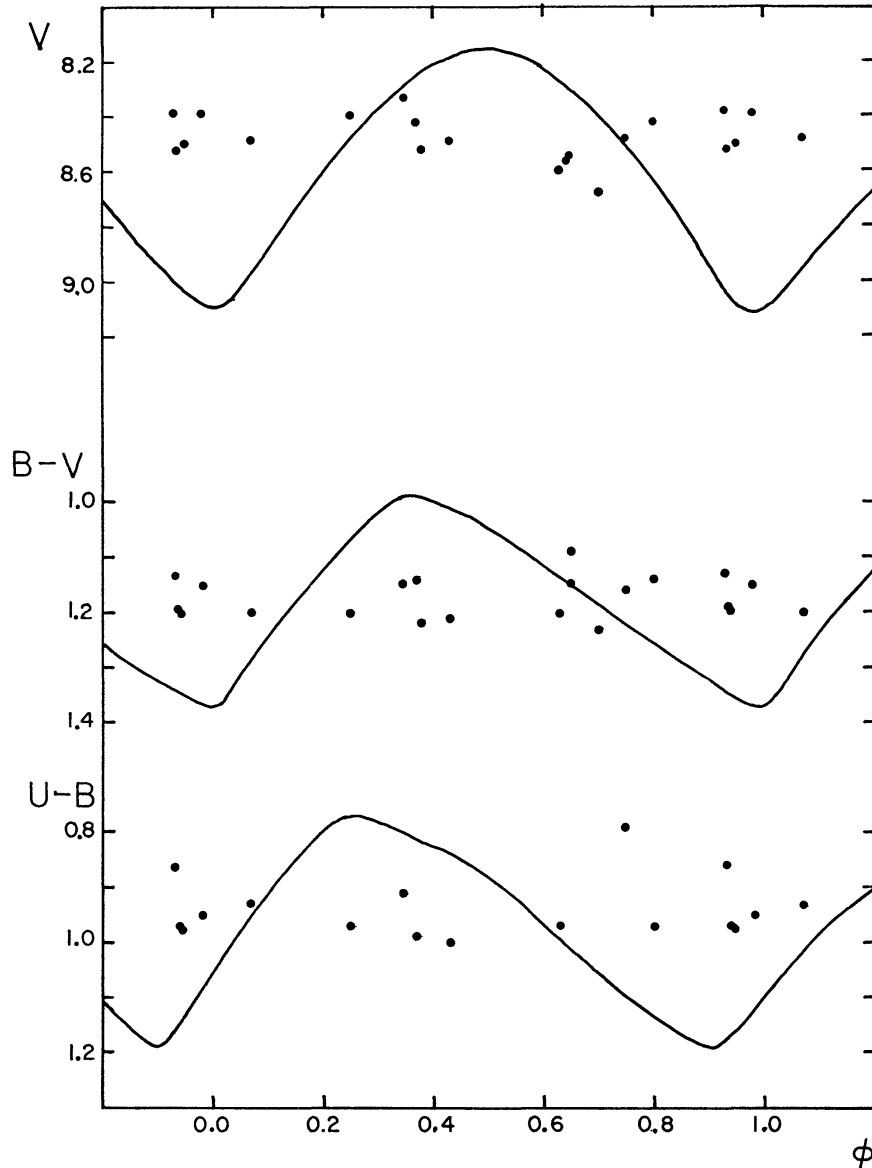


FIG. 1.—Present observations of RU Cam superimposed on earlier light- and color-curves

since simple theory (Eddington 1926) would indicate a required time scale of the order of 10^3 to 10^4 years.

A spectrogram obtained with our 74-inch telescope on JD 2439147.747, phase 412.80, at 40 Å/mm, shows a distinctly abnormal K-supergiant spectrum with strong CN bands and perhaps weak C₂ bands. The hydrogen lines are not in emission. The radial velocity obtained from this plate is -21 ± 3 km/sec, which may be compared to Sanford's (1928) γ -velocity of -24 km/sec and $2K = 30$ km/sec.

TABLE 1
OBSERVATIONS OF RU CAM

JD	V	B-V	U-B	Phase*
243 8672 842	8 42	1 14	0 99	391 373
8700 760	8 60	1 20	0 91	392 633
8880 626	8 49	1 16	0 79	400 750
8894 621	8 52	1 22	1 55	401 381
8900 685	8 56	1 09	1 38	401 654
8901 658	8 68	1 23	1 26	401 699
8922 621	8 56	1 15	1 55	402 645
9039 853	8 52	1 19	0 97	407 935
9039 909	8 50	1 20	0 97	407 938
9042 875	8 48	1 20	0 93	408 071
9046 850	8 40	1 20	0 97	408 251
9048 945	8 33	1 15	0 91	408 345
9050 816	8 49	1 21	1 00	408 430
9147 571	8 42	1 14	0 97	412 796
9150 568	8 38	1 13	0 86	412 932
9151 542	8 39	1 15	0 95	412 976

* Phase = (JD - 2430000)/22 160.

TABLE 2
AVERAGE PHOTOMETRIC PARAMETERS

	V	B-V	U-B
Average of present observations	8 48	1 17	0 94
Average of previous light-curves	8 53	1 15	0 94

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