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METALLICISM, PULSATION, AND THE NATURE OF 32 VIRGINIS

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ABSTRACT

The object 32 Vir is an A8m system which has been reported to be a δ Scuti variable. We confirm the variability and find an "average" period of $0^d.0756$ with the amplitude ranging between 0.01 and 0.035 mag. A fine abundance analysis confirms the Am nature of the primary. The spectrum is shown to be double-lined. Rotational velocities of 24 ± 6 and 140 ± 25 km s^{-1} are derived for the primary and secondary, respectively, placing the secondary above the observed rotational cutoff for Am stars suggesting that it has normal abundances. We confirm the magnitude difference of 0.43 mag derived by Petrie and show from *uvby* photometry that the secondary is within the observed instability strip. The observed pulsation period matches the period expected from the derived magnitude and color of the secondary. A model of the star in which the primary is a slowly rotating Am star and the secondary is a fast rotating δ Scuti star is shown to fit all the data and explains all the previously unusual characteristics of the system including the K line radial velocities, uncertain duplicity, and apparent line variability.

We conclude that there still are no known exceptions to the observed exclusion between the classical Am stars and the δ Scuti pulsators.

Subject headings: stars: abundances — stars: binaries — stars: δ Scuti — stars: individual — stars: metallic-line

I. INTRODUCTION

The metallic-line A star, 32 Vir, is unusual in two respects: it has been reported to be a pulsating Am star, and it shows a variable line spectrum.

Bartolini, Grilli, and Parmeggiani (1972) reported that 32 Vir is a light variable, and it appears from their light curves that the star is a pulsating variable of the δ Scuti class. This is an extremely interesting development, since Breger (1970) has shown from observational surveys that, in general, classical Am stars do not pulsate. He hypothesized (Breger 1972) that within the diffusion model for Am stars either (i) pulsation would disrupt the extreme stability necessary for diffusion to occur to produce an Am star, or (ii) in a star in which diffusion occurs the helium would sink out of the He II ionization zone, thus damping the driving mechanism for pulsation in δ Scuti stars. The extensive work on Am stars by Smith (1971, 1973) showed that the diffusion hypothesis is, at present, the best working model for understanding the unusual abundances in Am stars. Vauclair, Vauclair, and Pamjatnikh (1974) calculated that in a star in which diffusion occurs, helium sinks rapidly from the He II ionization zone. It is therefore very difficult to understand from both observational and theoretical considerations how a star can both pulsate and be a classical Am star.

The object 32 Vir was first reported to be a spectroscopic variable by Adams (1914). Cannon (1915) obtained the first orbit and noted that on 12 of his 39 plates line doubling was observed. He concluded that the doubling was real, since it only occurred near maximum and minimum. Harper (1935) reobserved the star, and he also reexamined Cannon's plates. Although he reported some doubling, he concluded that most reports of line doubling were spurious. Petrie (1950) obtained additional plates from which he determined a magnitude difference between the primary and secondary of 0.43 mag based on apparently double spectra. Bertiau (1957) computed a new orbit for 32 Vir and observed no line doubling, although he did note that the lines of the primary were shallow as if filled in by the continuous spectrum of a secondary. He also noted that the probable errors of his radial velocities were twice as large as would normally be expected for a star with as low a $v \sin i$ as 32 Vir and at the dispersion at which he was working.

Roman, Morgan, and Eggen (1948) classified 32 Vir as an Am star; consequently, it was included by Abt (1961) in his study of the binary frequency among Am stars. Abt reported that 32 Vir was not double-lined, but showed spectrum variability rather like close binaries engaged in mass transfer such as

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α Vir. He concluded that it was this spectrum variability that had caused earlier investigators to believe the star was double-lined. Perplexingly, 32 Vir is not now a close binary system. With a period of 38^{d}3240 mass transfer is unlikely.

The system shows other disconcerting properties. Although Abt concluded that no secondary spectrum was present, he also noted that the mass function was such that the minimum mass ratio for the system is $\mathscr{M}_2/\mathscr{M}_1 = 0.94$ so that the secondary spectrum should be visible. In addition, the metal lines fit a normal radial velocity curve, whereas the Ca II K line seemed to show no radial velocity variations at all within the errors of measurement.

In this paper we investigate the problem of a pulsating Am star with a variable spectrum in the following manner. In § II new photometry is analyzed, and the δ Scuti pulsation is confirmed. In § III a fine abundance analysis is performed, and the classical Am characteristics of 32 Vir are confirmed. In § IV we show that two components are visible in the spectrum and derive rotational velocities for both components. Sections V and VI explain the apparent line variability of the system and estimate the luminosity ratio of the two components. In § VII, the position of the two components in the color-magnitude diagram are derived and the predicted pulsation period is compared with the observed period. The final section summarizes our knowledge of the relationship between metallicism and pulsation.

II. PHOTOMETRY

Bartolini, Grilli, and Parmeggiani (1972) reported 32 Vir to be a pulsating Am star with a period near 0^{d}07 and a variable amplitude of 0.02 to 0.05 mag. New photoelectric observations were carried out in order to (i) confirm the variability, (ii) study whether these variations are periodic or semiperiodic typical of a δ Scuti variable, and (iii) determine whether the variations of the physical parameters during the variability cycle are compatible with pulsation.

The photometric observations were carried out between 1973 and 1975 using the Volksphotometer attached to the 75 cm telescope at McDonald Observatory. Under clear weather conditions the equipment is capable of measuring magnitude differences between two stars to a precision of ±0.001 mag. The stars 30 Vir, 31 Vir, and 59 Vir were used as comparison stars, with two comparison stars being observed each night.

A journal of observations together with the deduced amplitude is given in Table 1, and some of the light curves are shown in Figure 1. The light curves are not completely stable, leading to an observed range in the visual amplitudes between 0.01 and 0.035 mag. The derived periods for the different nights range from 0.07 to 0.084 days. This derived range in periods is, however, affected by observational uncertainties. A single period (i.e., no beats) is ruled out by our observations. By averaging the different nights and including weights according to the number of data points, we find an "average" period of 0^{d}0756, in good agreement with the period of 0^{d}07 derived by Bartolini, Grilli, and Parmeggiani.

TABLE 1

PHOTOMETRIC OBSERVATIONS OF 32 VIRGINIS

Date (HJD) (2,440,000+)	V Amplitude (mag)	Observer
1755.80–0.95........	0.025	Sandmann
1757.74–0.97........	0.02	Sandmann
1762.75–0.93........	0.025	Sandmann
1765.78–0.98........	≤0.02	Sandmann
1766.75–0.95........	≤0.015 + 0.035	Sandmann
1769.71–0.90........	0.02	Sandmann
2148.60–0.82........	< 0.02*	Evans
2149.64–0.82........	0.01	Evans
2516.92–7.03........	0.015	Evans
2454.85–5.02........	0.01 + 0.025	Kurtz
2468.83–7.02........	0.02 + 0.02	Africano

* Observations on that date were of poor quality.

The variability of 32 Vir is therefore confirmed. The length of the period and associated instabilities are typical of a δ Scuti variable.

During five of the nights the observations were made with the four *uvby* filters. This allows us to analyze the variations in y ($=V$ for all practical purposes), $(b - y)$, and c_1. For pulsation the variations in these indices have to be coupled, since they represent the changes in effective temperature, luminosity, and effective surface gravity. The variations in the $(b - y)$ and c_1 indices are in phase with the y variations to a confidence level better than 99 percent. Furthermore, the ratio of these variations are similar to those found in a "normal" δ Scuti variable, HR 1170 (Breger 1969). Other mechanisms of light variability, such as gaseous streams, cannot be ruled out by our observations without further model calculations. Nevertheless, the similarity of the behavior between HR 1170 and 32 Vir in the variations of the physical parameters during the cycle suggests a δ Scuti origin of the light variability. The problem of a reported pulsating Am star cannot therefore be explained by previous faulty observations or a different mechanism for the light variability.

III. FINE ABUNDANCE ANALYSIS

A McDonald 204 cm telescope baked IIa-O plate was obtained of 32 Vir at a reciprocal dispersion of 8.9 Å mm^{-1} a projected slit width of 20 μ, and 0.9 mm widening. Spot sensitometer plates at 4100 Å and 4630 Å were used in conjunction with the *Skylab* PDS microphotometer and University of Texas CDC 6600 to produce an intensity tracing. Equivalent widths were measured treating all lines as triangles. Using Breger's (1974*a*, 1974*b*) calibrations of the *uvbyβ* photometric indices, we derived $T_{\text{eff}} = 7500$ K and $\log g = 4.0$. This temperature and gravity is consistent with the spectral type of the star, A8m (Cowley *et al.* 1969), and the excitation and ionization equilibria.

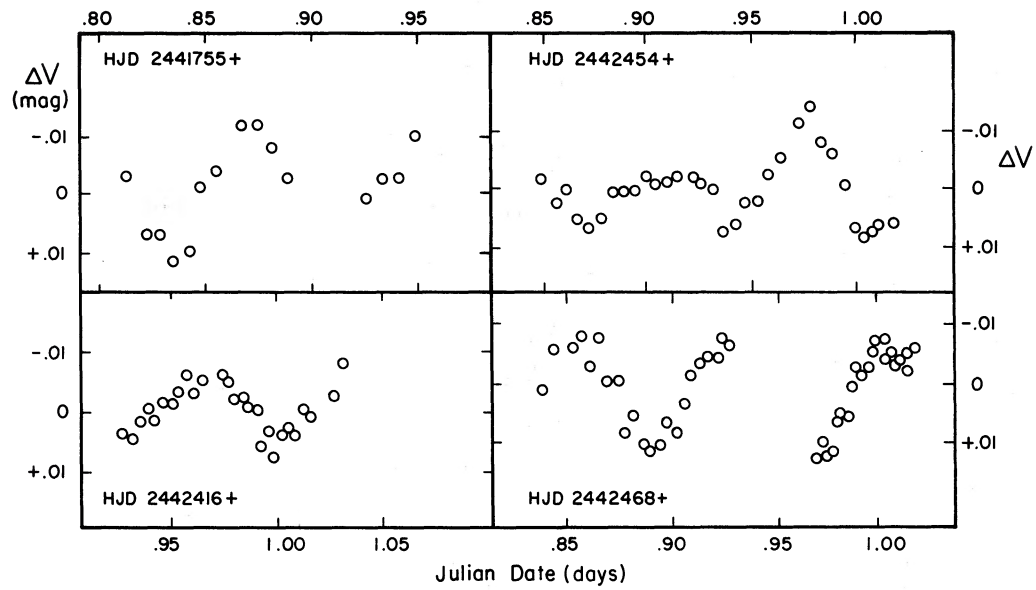

FIG. 1.—Observed light variability of 32 Vir. Observations of two comparison stars indicate that these observations have a precision of ±0.002 mag.

Abundances were computed using a radiative ATLAS (Kurucz 1970) model atmosphere and the WIDTH code. Abundances for four standard stars (HR 114, HR 4825, HR 8120, HR 8272) were computed in the same manner. A complete discussion of the equivalent width and abundance scales will be treated in a future publication. Table 2 lists the derived abundances for 32 Vir, the number of lines of each ion measured, the rms internal scatter, and the average abundance of each ion for the four standard stars.

Cowley *et al.* (1969) classified 32 Vir as an Am star, and this fine analysis confirms that classification. In Figure 2 the star shows the typical Am abundance pattern of deficient [Ca/Fe] and [Sc/Fe], overabundant Fe group elements, and greater overabundances of the rare earths. No account has been taken of the contamination by the secondary spectrum or the effect of hyperfine splitting on the Eu abundance (Hartoog, Cowley, and Adelman 1974).

IV. DUPLICITY AND ROTATIONAL VELOCITIES

Hale Observatories has generously loaned us 26 IIa-O and IIa-D 10 Å mm^{-1} plates taken with the 5 m and 2.5 m telescopes by Daniel Popper and the late Armin Deutsch in the early 1960s. We have concluded from these plates that 32 Vir is a double-lined binary system.

The two components are visible in density tracings of Hβ at orbital phases 0.502 and 0.976 (Fig. 3). In the figure, the dotted lines have been drawn to fit the side of the primary line uncontaminated by the secondary, and then reflected about line center. They are shown for illustrative purposes only. Figure 4 shows density tracings of the Ca II K line at phases 0.978 (when the two components are near maximum separation) and 0.275 (when the two components nearly overlap). No intensity calibrations are available for these plates, but the K line tracings shown are taken from plates of similar density, so that calibration effects cannot explain the different line shapes. The K line is narrow

TABLE 2

ABUNDANCES DERIVED FOR 32 VIRGINIS AND FOUR STANDARD STARS*

Ion	Abundance	N Lines	σ Internal	⟨AB⟩ Stand
C I.......	8.21	2	0.16	8.03
Al I......	5.20	2	0.58	4.84
S I.......	7.19	3	0.07	6.67
Ca I......	5.66	8	0.41	5.76
Sc II......	2.38	9	0.26	2.70
Ti II......	4.34	35	0.30	4.11
V II......	4.03	5	0.23	3.42
Cr I......	5.22	12	0.28	4.86
Cr II......	5.60	15	0.32	5.08
Mn I.....	4.84	11	0.37	4.54
Fe I......	6.55	128	0.33	6.17
Fe II......	6.55	27	0.29	6.18
Co I......	5.12	3	0.47	4.55
Ni I......	5.61	7	0.28	4.99
Ni II......	5.83	4	0.26	5.10
Zn I......	3.50	2	0.02	2.84
Sr II......	3.38	2	0.11	2.90
Y II......	3.29	6	0.32	2.31
Zr II......	3.45	6	0.25	2.60
Ba II......	2.60	1	...	1.54
La II......	2.43	7	0.27	1.67
Ce II......	2.64	6	0.35	1.92
Nd II.....	2.87	2	0.45	2.07
Sm II.....	2.60	2	0.78	1.61
Eu II.....	2.36	2	0.01	0.79
Gd II.....	2.24	1	...	1.45

* HR 114, HR 4825, HR 8120, HR 8272. For 32 Vir, $T_{\rm eff}$ = 7500 K, log g = 4.0, $V_{\rm turb}$ = 6.0 km s^{-1}.

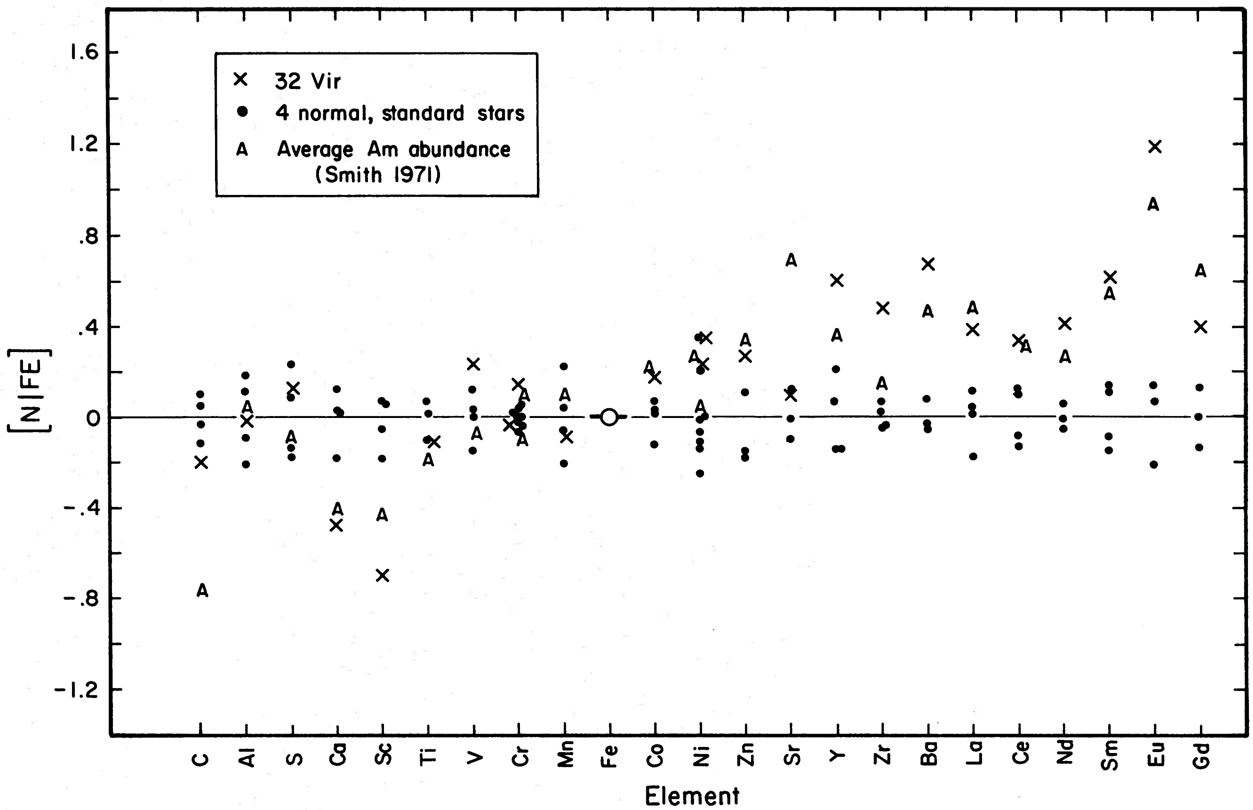

FIG. 2.—The differential abundances in 32 Vir normalized to Fe. [Fe/H] = +0.37.

and deep at phase 0.275 and broad and shallow at phase 0.978, indicating that two blended components are present.

Lines other than hydrogen and calcium can also be studied. The secondary components in these weaker lines are more difficult to detect due to the higher rotational velocity and the lower luminosity of the secondary. We have subtracted density plots at phases 0.484 and 0.978 for the Mg II λ4481 line, and have obtained density profiles of that line for both the primary and secondary. We find that the line centers of the primary and secondary components of λ4481 are separated by 1.5 ± 0.1 Å, which agrees well with the predicted separation of 1.43 Å calculated from the velocity curve for a mass ratio near unity. Bertiau (1957) derived a mass function of 32 Vir of $f(\mathscr{M}) = 0.438$. From this we have derived minimum mass ratios (at $i = 90°$) for various secondary masses as shown in Table 3. For inclinations less than $i = 80°$ the mass ratio becomes larger than unity for reasonable masses of the primary star. For the secondary to be less massive than the primary the mass ratio for the system must be near unity, and the inclination of the system must be near 90°.

We have derived a relation between the full-width at half maximum for λ4481 for 15 stars with published rotational velocities. Coupled with this relationship, the width of λ4481 for the primary and secondary components of 32 Vir give $v \sin i$ of 24 ± 6 and 140 ± 25 km s^{-1}, respectively. The rotational velocity of the primary is compatible with its metallic-line nature. The rotational velocity of the secondary places it above the observed cutoff for Am or Am: stars (Abt 1975). This makes it very probable that the secondary has normal abundances.

V. RADIAL VELOCITIES AND LUMINOSITY RATIOS

Radial velocities were measured from the Hale Observatories IIa-O plates using the KPNO Grant measuring engine. Several plates were measured in forward and reverse direction with no noticeable systematic effects, so that subsequent plates were

TABLE 3

MINIMUM MASS RATIOS ($i = 90°$) FOR VARIOUS ASSUMED MASSES IN SOLAR UNITS FOR THE SECONDARY USING $f(\mathscr{M}) = 0.438$ (Bertiau 1975)

$\mathscr{M}_2$	$\mathscr{M}_2/\mathscr{M}_1$	$\mathscr{M}_1$
2.00..........	0.88	2.27
1.95..........	0.90	2.16
1.90..........	0.92	2.06
1.85..........	0.95	1.95
1.80..........	0.97	1.85
1.75..........	1.00	1.75
1.70..........	1.03	1.65

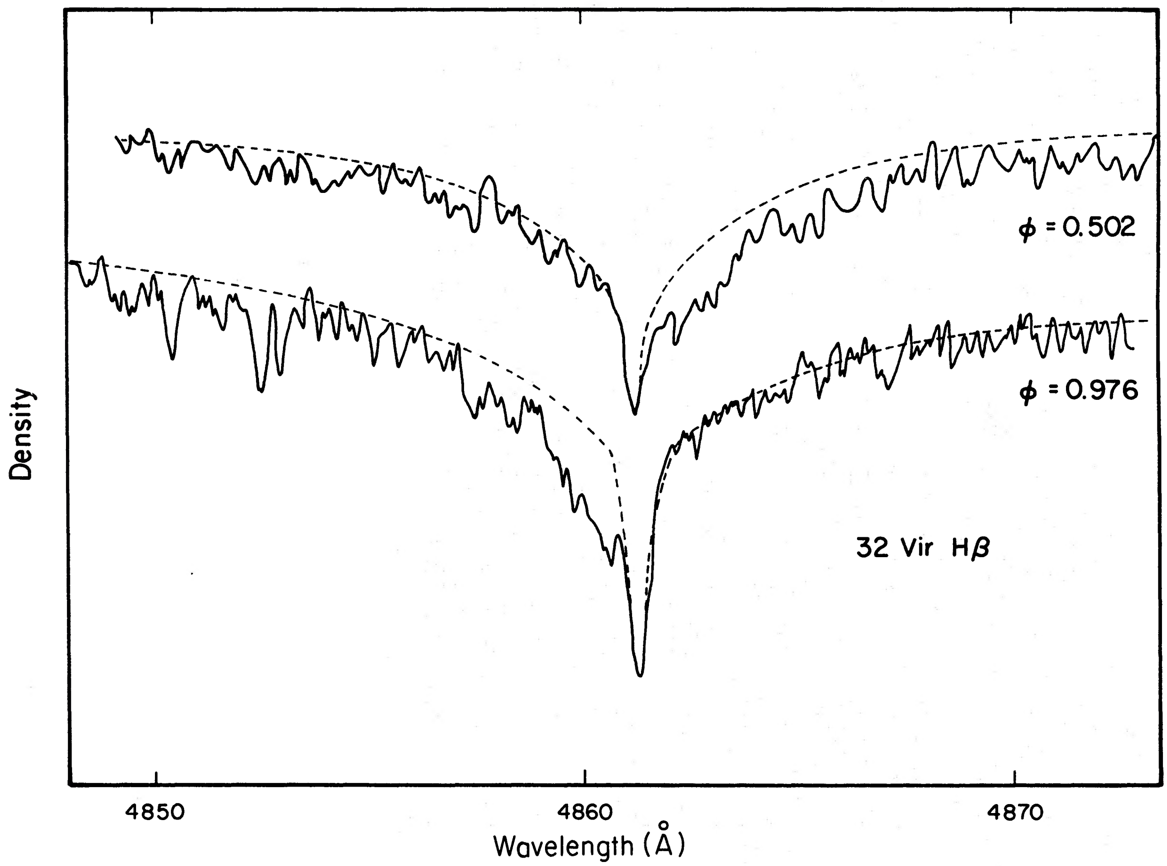

FIG. 3.—Density tracings of Hβ in 32 Vir at $\varphi = 0.502$ and $\varphi = 0.976$ confirming the double-line nature of the spectrum. The dotted line has been drawn to fit the unblended side of the line profile and then reflected about line center. It is shown for illustrative purposes only in order to make the secondary component of Hβ more readily apparent.

TABLE 4

RADIAL VELOCITIES OF 32 VIRGINIS

PLATE NUMBER	HJD (2,430,000+)	CYCLE AND PHASE	RADIAL VELOCITIES (km s^{-1})	
			Metals	Ca II K
Pc 8477......	8777.987	124.643	−37.8	−15.8
Pc 8614......	8866.776	125.960	+36.3	+2.6
Pc 8622......	8867.766	125.986	+33.6	−0.7
Pc 8711......	8900.774	126.847	+18.0	−7.8
Pc 8726......	8922.679	127.419	−54.3	−16.8
Pc 8806......	8956.719	128.307	−24.7	−13.6
Pc 8807......	8958.701	128.359	−39.1	−15.3
Pc 8810......	8959.702	128.385	−46.2	−21.0
Pc 9216......	9190.933	134.419	−57.1	−19.8
Pc 9300......	9226.932	135.358	−38.5	−15.1
Pc 9366......	9250.671	135.978	+31.1	−9.4
Pc 9864......	9492.029	142.275	−17.5	−13.1
Pc 10064.....	9657.674	146.597	−51.7	−20.1
Pc 10080.....	9659.718	146.651	−38.8	−16.3
Pc 10158.....	9691.652	147.484	−62.2	−24.7
B 9024.......	12475.688	220.129	+18.3	−9.7

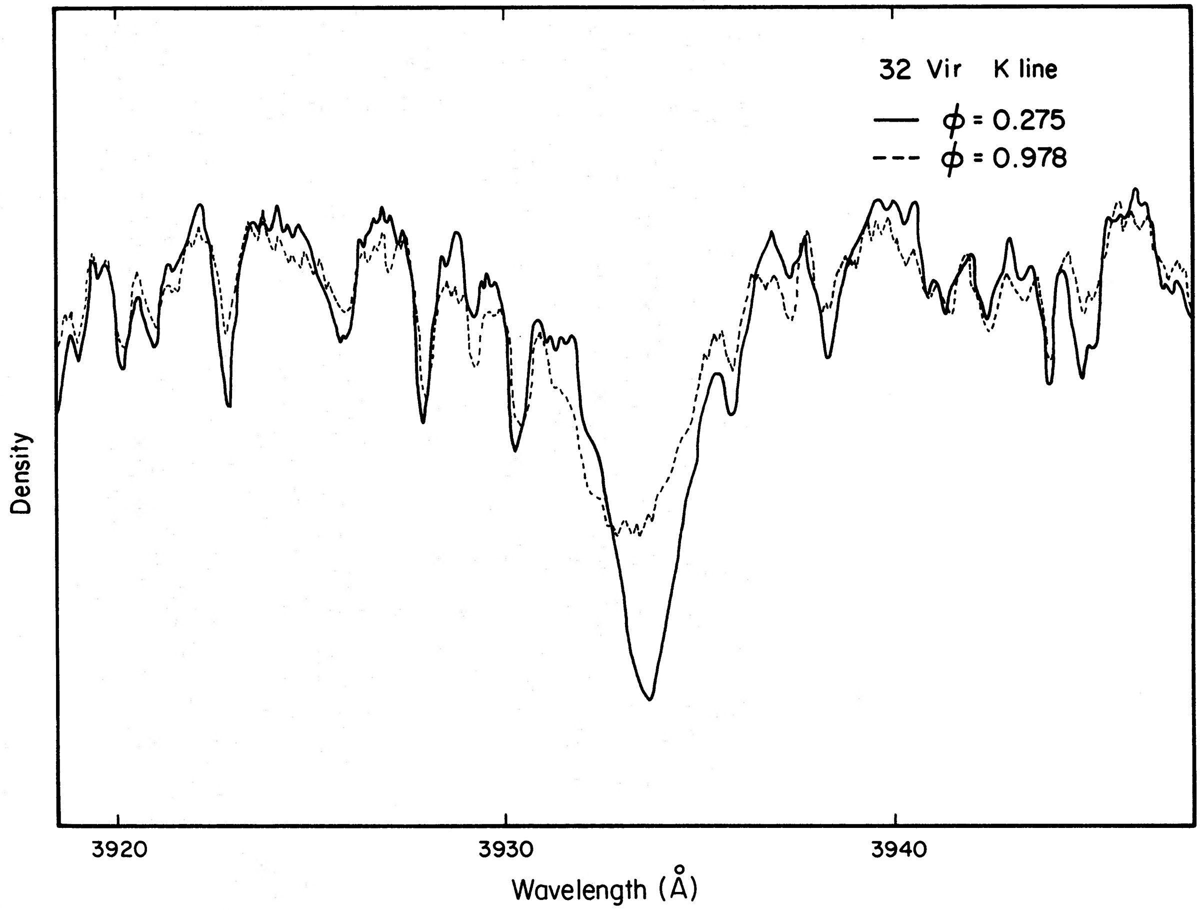

FIG. 4.—Density tracings of the Ca II K line showing variable line profiles indicating two components are present

measured in one direction only. Stellar lines measured were Fe I λλ4045, 4063, 4071, 4404, 4476; Fe II λλ4508, 4515, 4520, 4522; Ti II λλ4468, 4501; Sr II λλ4077, 4215; and Ca II K. Nineteen comparison lines were measured resulting in an average probable internal error per plate of 0.40 km s^{-1}. Table 4 lists the measured radial velocities, and Figure 5 is the new radial velocity curve with Bertiau's (1957) computed curve drawn in. No correction to Bertiau's γ velocity was necessary, so our velocities are also systematically greater than Abt's (by +3.2 km s^{-1}). The orbital elements are unchanged.

Petrie (1950) derived a magnitude difference of 0.43 mag from the core depths and equivalent widths of Fe I λλ4045, 4063, and Hδ at a prismatic dispersion of 30 Å mm^{-1} at Hγ. Because of the difficulty in seeing the secondary spectrum, because Petrie assumed that the two stars have identical abundances, and because he noted no rotational velocity effects, we desire an independent check of the magnitude difference. We have made the following calculations.

Given a mass ratio near unity and assuming identical ages, both components should have a similar temperature and surface gravity. If the stars were identical, the K line velocities would average to the γ velocity at all phases, yet Figure 5 shows this not to be the case. The K line velocities follow the metal line velocities but with lower amplitude. As will be shown later, the metal line velocities are those of the primary, indicating that the primary K line is stronger than that of the secondary.

Since the composite spectrum is the sum of the two component spectra, the radial velocity variations of the K line allow us to deduce a luminosity ratio for the two stars. If we assume equal intrinsic K line strengths for the two components, the radial velocity of the K line yields a luminosity ratio for the stars of $\log l_2/l_1 = -0.16$. This corresponds to a magnitude difference of 0.40 mag, which is in excellent agreement with Petrie's carefully measured 0.43 mag.

It was suggested earlier that the secondary very probably has normal abundances, while the primary is slightly deficient in calcium. Using the Ca abundance from our fine analysis, we obtain an abundance corrected magnitude difference of 0.53 mag. The above argument suffers from the weakness that we do not know the precise abundances and line-strengths of the two components. Nevertheless, our arguments tend to confirm Petrie's measured magnitude difference near 0.43 mag, which we hereby adopt.

We still have to answer the question why the K line does not follow the metal-line velocities. There are

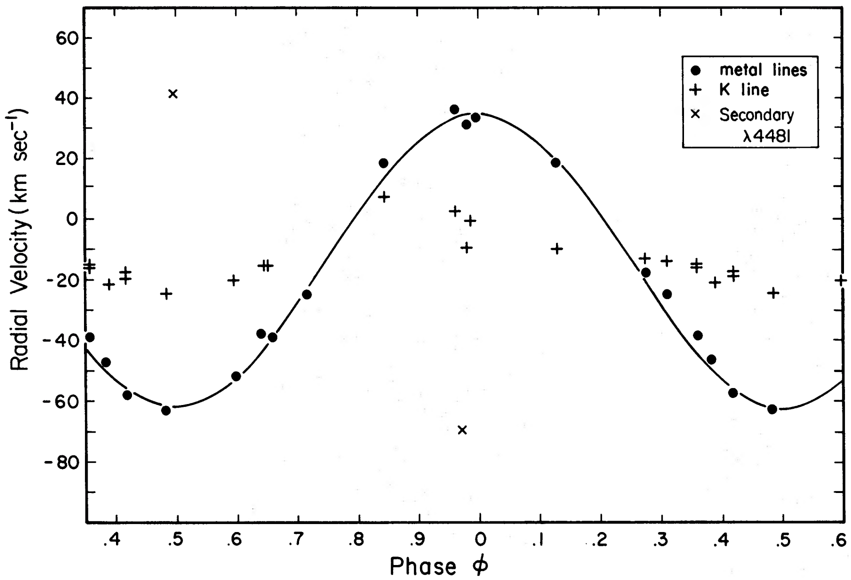

FIG. 5.—Radial velocities of 32 Vir measured in this study. The solid line represents Bertiau's computed curve.

three reasons why the metal-line velocities are predominantly those of the primary: (i) the primary is brighter; (ii) the primary rotates much slower and consequently has sharper, deeper lines; and (iii) the primary is a metallic-line A star with abundances in the measured metals of 2 to 3 times those of the secondary. The only effect the secondary has on the metal-line velocities is to increase the measured scatter near the nodes of the radial velocity curve. The Ca II K line, however, behaves differently. The damping wings of the line are so strong that the rotational broadening does not contribute greatly to the line profile. In addition, the Ca abundance of the primary is nearly normal rather than enhanced as are the heavier metals. The K line velocities are therefore a weighted average of the two components at *all* phases, giving rise to an amplitude of about 9 km s^{-1}.

VI. APPARENT LINE VARIABILITY

Abt (1961) noted that the spectrum of 32 Vir appeared to be variable with some line ratios changing as a function of phase. We can now fully explain this apparent variability in terms of the composite nature of the spectrum of 32 Vir.

A reexamination of Abt's Figure 6 shows that all of the apparently variable lines lie close in wavelength to a much stronger line. Our Figure 6 is a schematic representation of the spectral blending which gives rise to the variability. Figure 6*a* shows a strong narrow line, λ_1^P, in the slowly rotating primary bordered by a weaker line, λ_2^P. The same two lines, λ_1^S and λ_2^S, respectively, are shown for the faster rotating secondary in Figure 6*b*. The two spectra have been added in intensity and normalized with the secondary being weighted by the ratio l_2/l_1. The figure shows the resultant line profiles at different orbital phases.

The line strengths therefore *appear* quite variable as a function of orbital phase. As in the case shown, when λ_2 lies longward of λ_1, λ_2 will increase in apparent strength near phase $\varphi = 0.5$ and decrease near phase $\varphi = 0.0$. Examples of this in Abt's Figure 6 are the line ratios λλ4481:4482 and λλ4226:4227. The converse holds true if λ_2 lies shortward of λ_1. The line λ_2 then increases in strength near phase $\varphi = 0.0$ and decreases in strength near $\varphi = 0.5$. Note Abt's λλ4062:4063 and λλ4076:4077. There is also a correlation between the degree of variability and the separation of the lines λ_1 and λ_2. The farther λ_2 lies from λ_1, the less it varies in strength. Compare λλ4299:4300 with λλ4307:4309. The composite nature of the spectrum (composed of a sharp-lined star and a fast rotator) also explains why Bertiau thought the spectrum of 32 Vir appeared filled in by the continuous spectrum of a companion.

VII. POSITION OF THE COMPONENTS IN THE COLOR-MAGNITUDE DIAGRAM

Figure 7 is a plot of the allowed positions of the primary and secondary components of the binary system in the $(b - y)$, M_v-plane. The observed *uvby* values of 32 Vir are the sum of the individual intensities of the two components. Once a magnitude difference between the two components is assumed, their individual colors and absolute magnitudes (the latter from the c_1 index) can be computed. The magnitude differences between the two stars were varied from 0.2 to 0.6 mag, with the dashed line denoting Petrie's value of 0.43 mag (which we also adopt).

Temperature limits for the two components can be derived from the spectroscopic data. The hot edge of the primary's box and the cool edge of the secondary's box are limited by the K line velocities. The K line is increasing in strength very rapidly with decreasing temperature in this region. The secondary cannot be

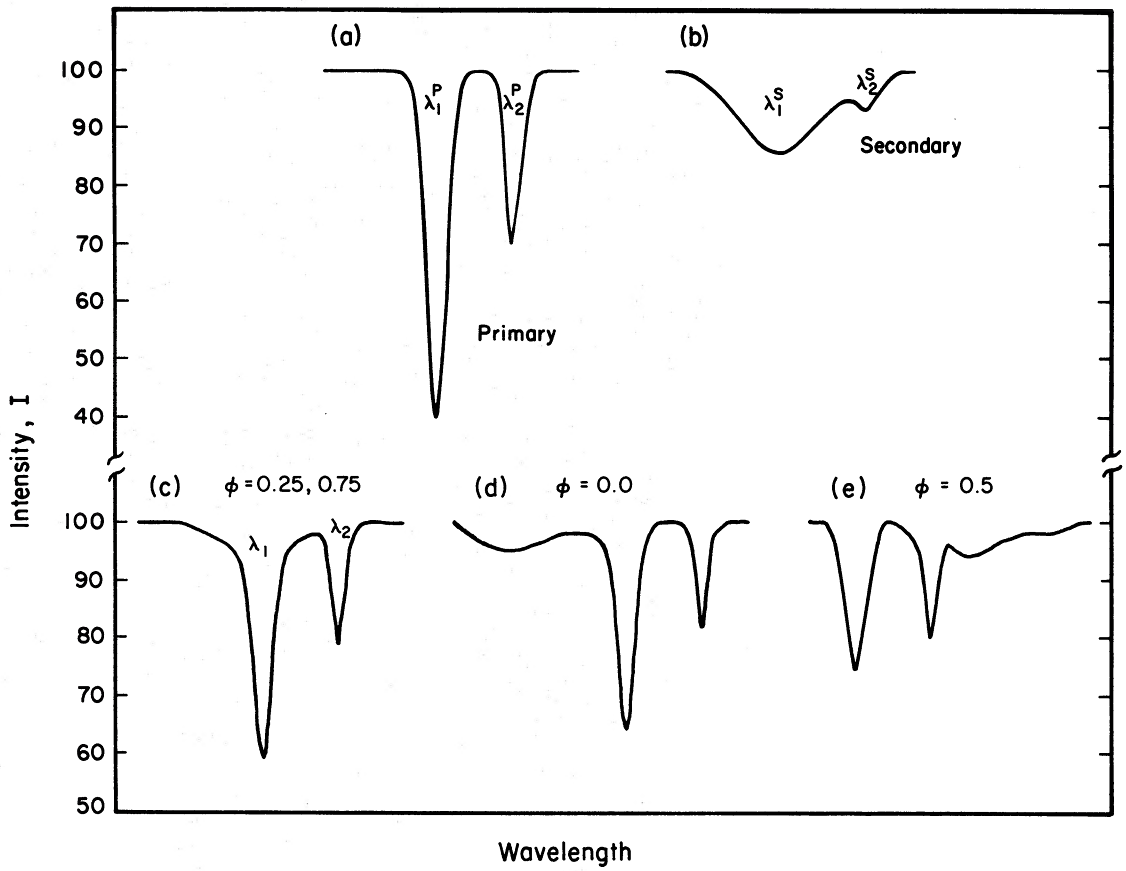

FIG. 6.—Explanation of apparent line variability. Schematic representation of the (*a*) primary and (*b*) secondary spectra of 32 Vir as they appear blended at various phases. Note the apparent change in the line strengths.

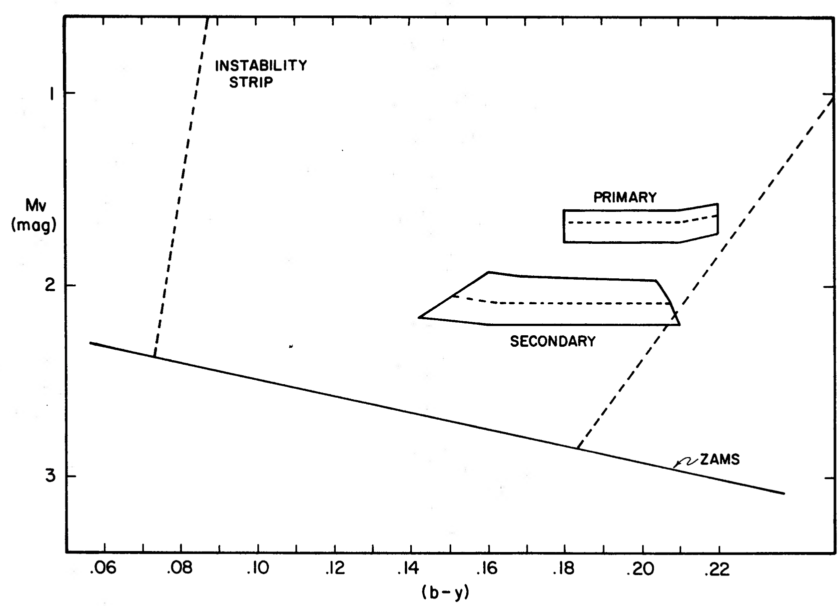

FIG. 7.—Color-magnitude plot of the allowed positions for the primary and secondary components of 32 Vir, indicating that the secondary lies within the observed instability strip.

much cooler than the primary or its K line would dominate the K line velocity curve, which is not observed. The cool edge of the primary's box and the hot edge of the secondary's box are limited by the observation that the Am star incidence drops rapidly to zero for $(b - y) > 0.22$.

The allowed positions of the secondary component in the color-magnitude diagram place the star inside the instability strip (Breger 1972). This, of course, does not prove that the star pulsates, since only about ⅓ of the non-Am stars inside the instability strip have detectable light variability. We can compare the observed period of pulsation with the period expected from the position of the secondary in the color-magnitude diagram. If we apply the period-luminosity-color relation derived for δ Scuti variables by Breger and Bregman (1975), then the box of the secondary predicts a period between $0^d.072$ and $0^d.084$. This is in excellent agreement with the observed period of $0^d.076$.

Short of observing the light variability during a (hypothetical) eclipse, we cannot prove that the pulsation occurs in the secondary, as opposed to the primary Am star. However, the absolute magnitude, color, rotational velocity, inferred abundance, and predicted pulsation period of the secondary are all consistent with the view that the secondary pulsates.

VIII. CLASSICAL Am STARS AND PULSATION

From extensive variability surveys of stars inside the instability strip it was noticed (Breger 1970) that classical Am stars do not pulsate. Since then the sample of stars has been enlarged: about 40 out of 120 stars with normal spectra show light variability, while 30 Am stars surveyed are constant in light. Since the original announcement, several Am stars have been reported to be variable. It is consequently important to examine these reports, in order to determine whether the Am-pulsation exclusion is absolute in nature or not. There are four possible candidates for Am pulsation.

HR 114.—This star has a period of $0^d.068$ and is listed in many catalogs as Am. A high-dispersion spectrum indicates that the star is normal. This is confirmed by an abundance analysis by Smith (1971), who adopted this star as a standard normal star.

HR 6555 = ν Draconis.—An irregular variability of up to 0.1 mag was announced by Gonzales, Gomez, and Mendoza (1974). In a subsequent paper (Mendoza and Gonzales 1974), they find no light variability and note that the original observations may have been afflicted by "a possible instability of the photoelectric equipment."

HR 5491.—This typical Am star was observed to be variable by Bessell and Eggen (1972). It has been reobserved since by several authors (Breger, Maitzen, and Cowley 1972; Eggen 1973) and found to be constant.

HR 4847 = 32 Virginis.—This star is discussed in this paper, where it is shown that the variability should originate in a normal-abundance companion. A magnitude difference between the two components of 0.43 mag and a light variability of the system of 0.035 mag indicates that the pulsational amplitude of the secondary is 0.09 mag.

At present, there is no convincing evidence for the pulsation of a single classical Am star. Winzer (1975) has reported light variability for several Am stars, which still requires confirmation. His periods, however, were on the order of days, which is incompatible with a pulsation origin of such variability.

Our conclusions about the classical Am stars cannot be extended to other types of stars with unusual spectra, i.e., pulsation and metallicism may not be mutually exclusive. Percy (1975) has found reasonably convincing short-period variability in the peculiar A star 21 Com. One of us (D. W. K.) is presently analyzing the abundance anomalies present in several pulsating, sharp-lined A giants of the δ Del spectral class.

It is a pleasure to thank Dr. Myron Smith for his generous assistance and many discussions. We also would like to thank Hale Observatories for the generous loan of the many spectrograms of 32 Vir, Kitt Peak National Observatory for the use of their radial velocity reduction program, and John Africano for obtaining a light curve of 32 Vir.

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