Visual multiples. III. ADS 11745 (β Lyrae group)

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New spectroscopic data on the apparent visual companions of β Lyrae show that component B is probably not double and that its mean radial velocity agrees very well with that of β Lyrae. This latter result strengthens the evidence for membership of B in the group. Component E is found to be an Am star with a mean radial velocity that is very different than that of β Lyrae; this discrepancy strengthens the evidence against membership of E in the group. Component F is a pronounced Am star.

IN A previous study (Abt *et al.* 1962) five faint stars near β Lyrae were investigated for physical membership with β Lyrae. On the basis of astrometry, spectroscopy, and photometry, it was concluded that components B and F are members of a physical group with β Lyrae (= component A) and that components C, D, and E are probably nonmembers. The physical membership of B and F with A permitted the derivation of an absolute magnitude of $M_V = -3.9$ for this evolved peculiar eclipsing binary.

Several questions were left unanswered in the previous study. Component B appeared to be a spectroscopic binary with poorly determined orbital elements and a γ velocity that differs significantly from that of component A. Component E seemed to be an Ap star and this group may be relatively young (Wolff 1975) for the occurrence of an Ap star. Finally, the principal objection to the membership of component E in the group was a discrepant radial velocity based on only two measures. These questions are mostly resolved with the present material.

Eighteen spectra each of reciprocal dispersion 39 Å mm^{-1} were obtained with the 2.1-m Cassegrain spectrograph in 1967–1974 for components B and E. Velocity corrections were obtained from 22 concurrent measures of Vega; the corrections applied to the velocities listed in Table I are +8.8 km sec^{-1} in 1967–1969 and +10.6 km sec^{-1} in 1974. The velocities measured on a PDS microphotometer with a program written by the second author are listed in Table I; they are based on five He I and Mg II lines for component B and ten metallic and H I lines for component E.

For the broad-lined component B the mean external probable error of ±6.6 km sec^{-1} per measure is less than twice the mean internal probable error of ±4.4 km sec^{-1}, so there is no evidence in these measures of variability. A similar analysis of the previous measures does not support the previous conclusion that this star is a spectroscopic binary. The mean radial velocity from the present measures is −18.3 ± 1.6 (p.e. in the mean) km sec^{-1}. This velocity is in good agreement with the γ velocity of component A, which is probably in the range of −17.5 to −19.5 km sec^{-1} (Abt 1962). We have classified the spectrum of component B against standards by Morgan and Keenan (1973) and obtained B7 V, which is the same as the previous classification. We conclude that the evidence for the physical association of component B with component A is strengthened and the lack of evidence that component B is double makes its position on the zero-age main sequence more likely.

For component E the mean external probable error of ±3.2 km sec^{-1} in the radial velocities is no more than twice the mean internal probable error of ±1.6 km sec^{-1}, so there is no convincing evidence for variability, although a small-amplitude long-period variation is not excluded by these measures. The mean radial velocity of +10.9 ± 0.7 (p.e. in the mean) km sec^{-1} disagrees with the γ velocity of component A. Therefore, the evidence against a physical association of component E with component A is strengthened.

For component E we have classified broad spectra of

TABLE I. Radial velocities.

Helio. JD 2400000+	Component B Rad. Vel. (km sec^{-1})	p.e.	Component E Rad. Vel. (km sec^{-1})	p.e.
39748.64	−11	±6	+ 8.3	±1.0
39749.65	−29	5	+ 9.6	0.7
39775.65	−11	8	+ 7.3	1.4
39776.59	−28	6	+ 4.3	1.0
39777.60	−18	3	+ 2.7	1.5
39952.89	−15	7	+ 5.2	1.4
40107.78	− 7	3	+11.9	1.1
40108.77	−16	3	+13.7	1.8
40109.75	−14	6	+12.5	1.9
40110.67	− 8	3	+12.0	1.7
40139.73	−21	8	+18.0	1.3
40398.86	− 8	6	+12.8	2.4
40399.76	−31	1	+10.1	1.3
40400.90	−21	1	+ 9.2	1.0
42265.74	−45	0	+21.7	3.6
42266.87	−17	7	+14.0	1.3
42287.72	−11	6	+ 9.1	1.8
42288.83	−18	±2	+13.7	±2.8

* Operated by AURA, Inc., under contract with the National Science Foundation.

two dispersions (39 and 128 Å mm^{-1}) against an extensive collection of standards and derived the type Am(*K/H/M* = A5/F2 V/F4). Most Am stars are spectroscopic binaries (Abt 1961) but the radial velocity measures for this star are numerous enough and extended over a long enough time interval that even if this star is double, its γ velocity is unlikely to be about 30 km sec^{-1} less than the measured mean velocity. We conclude that this star is a foreground field Am star, rather than an Ap star as previously stated.

Component F has been classified with broad spectra of two dispersions and is now classified as Am(*K/H/M* = A7/F1 V/F3). We have no further evidence regarding membership in the group, but the previous evidence was fairly convincing.

If component F is fitted (Johnson 1963) to the zero-age main sequence (ZAMS) corrected by 0.2 mag for the revised distance to the Hyades (Hanson 1975), the distance modulus is 7.4 mag, the distance is 300 pc, and component B is 0.1 mag above the ZAMS. The revised luminosity of component A is $M_V = -4.2$ mag. Using the method of Schlesinger (1972), the group age from component B is 2×10^8 yr. This might be an upper limit because the star is about 3 mag below the turnoff point and may not be significantly evolved from the ZAMS. We hesitate to use the method on component A because of its duplicity and peculiar nature, but a formal solution gives 4×10^7 yr. Probably the age of the group is well in excess of the 10^6 yr derived by Smith (1972) for the metallic-line abnormality to stabilize in a young star, so it is not surprising to find a well-developed Am star in this group.

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