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ON THE PHYSICAL-ASSOCIATION OF THE PECULIAR EMISSION - LINE STARS HD 122669 AND HD 122691

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ABSTRACT

Spectroscopic and photometric observations indicate a physical association between the peculiar early-type emission-line stars HD 122669 and HD 122691. The latter has undergone a drastic change in the strength of its emission lines during the past twenty years. There is some indication that both stars vary with shorter time scales.

Key words: peculiar spectra - emission-line stars - photometry

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I. Introduction

In scanning the low-dispersion objective prism plates used for the southern luminous stars survey (Stephenson and Sanduleak, 1971) one of us (N.S.) noted that the emission-line OB stars HD 122669 and HD 122691, which are only five minutes of arc apart, are very closely matched in apparent magnitude, color, and spectral characteristics. They would appear to form an unusually wide double system isolated in a region (l=311°3, b=-0°9) sparsely populated by OB stars. The new and existing photometric and spectroscopic data contained in Table I and discussed below support the possibility that the stars are physically paired and therefore may have a common origin and age.

II. Observations

The new observations were made as part of the survey of southern OB stars brighter than tenth magnitude by Garrison, Hiltner and Schild (1975). The UBV photometry was carried out (by W.A.H.) using the 24-inch (61-cm) telescope at Cerro Tololo. The classification-dispersion slit spectrograms were obtained (by R.F.G.) using the 36-inch (91-cm) telescope at Cerro Tololo with the Hiltner two-prism spectrograph. The spectra were widened to 0.6 mm at a reciprocal dispersion of 91 Å/mm at Hγ.

Crampton (1971) observed the two stars during his work on southern H II regions. His data are included in Table I and discussed below.

III. Discussion

Both stars are extremely blue, the colors probably being affected by Balmer continuum emission. Our photometric results are in excellent agreement with those of Crampton (1971). There is no reason to believe that either star is variable in light from the new and existing data, but it would be well to investigate this possibility further.

The spectra are typical of extreme Be stars. In both cases, the absorption lines are broad (particularly so in HD 122691) and have the washed-out appearance characteristic of most hot Be stars. This makes the classification more difficult than for normal stars, but the spectral types are definitly in the range BO-Bl and the luminosities are between IV and II, with HD 122669 the more luminous commensurate with its slightly brighter apparent magnitude. Because of the washed out appearance it is difficult to be certain, but NII is stronger in HD 122669 than in HD 122691 and nitrogen may be generally enhanced in both stars; thus carbon and oxygen may be deficient (e.g. Walborn, 1970), further complicating the luminosity classifications. With these problems, it is not safe to rely on hydrogen, carbon, nitrogen or oxygen lines for luminosity classification. The primary luminosity criteria used for this paper were thus silicon and helium line ratios, primarily 4121/4144. In any case, the relative luminosities of the two stars are reliable and HD 122669 is the more luminous by all criteria. It is not surprising that our luminosity classifications differ from those of Crampton (1971) who relied heavily on the oxygen lines (Crampton, 1975). On one plate of HD 122691, the iron doublet at λ4172-79 is faintly visible (sharp) in absorption and Hδ exhibits a weak shell core.

On our slit spectra, taken during the interval 1968-72, the hydrogen emission is very strong in both stars, but stronger in HD 122669. The Fe II emission between Hγ and Hβ, however, is stronger in HD 122691.

On an objective prism plate taken in July, 1967, both stars show Hα strongly in emission with nearly identical intensities relative to the continuum. The catalogue of early-type emission-line stars by Wackerling (1970) lists HD 122669, but not HD 122691, suggesting that neither Henize nor Wray (1966) saw emission in the latter star on objective prism survey plates taken in 1949-51. At our request Dr. Henize kindly inspected his plates and confirmed that Hα emission was indeed absent in HD 122691 in August 1950 and was extremely weak, if present, in March 1951. Strong Hα emission (comparable to the recently observed intensity) was present in HD 122669 on these same dates. There is no mention of emission in several spectra taken in 1954 by Feast, Thackeray and Wesselink (1957). In notes to his Table I, Crampton (1972) also noted the appearance of emission taken on his plates and the apparent lack of emission on previous Radcliffe plates. We can therefore conclude that the strong hydrogen emission recently observed in HD 122691 emerged sometime during the interval 1954-1967. Our series of slit spectra give some indication of shorter-term variability in the emission line strengths for both stars. Neither, however, is known to be variable in light.

Using the non-hydrogen line luminosity criteria and the absolute magnitude calibration of Walborn (1972) we would assign HD 122691 a spectroscopic absolute magnitude of $M_V = -4.7$, in agreement with the value derived by Beer (1961) from an Hγ equivalent width measurement made from the Radcliffe plates taken in 1954 when the emission was absent. When combined with the data of Table I, this absolute magnitude results in a distance estimate of 2.6 Kpc. If the two stars are equidistant, as seems likely, the projected separation is about 4 pc.

Crampton (1971) has identified these stars as a possible source of excitation of the HII regions RCW 83 (Rodgers, Campbell and Whiteoak, 1960). Curtis Schmidt plates in B and V, used in the survey of southern reflection nebulae by van den Bergh and Racine (1973) reveal no obvious nebulosity associated with the two stars; they lie well outside the apparent boundaries of RCW 83 and are not symmetrical with it (see also Plate 22 in the paper by Georgelin and Georgelin, 1970). We also note that our distance estimate of 2.6 kpc places these stars well beyond the derived distance of 1.42±0.34 Kpc assigned to RCW83 by Georgelin, Georgelin, and Roux (1973).

In attempting to verify the physical association of these stars, one can turn to the available kinematical data but is quickly discouraged. For HD 122669, Crampton (1972) obtained a radial velocity of -42 km/sec based on five plates. In the case of HD 122691, the broad lines make the measurements difficult and the uncertainty large; Crampton found -2 km/sec from a single plate while Feast, Thackeray and Wesselink (1957) give -9 Km/sec. If significant, the disparity in radial velocities indicates that the stars do not possess parallel space motions, but may be diverging from a point of common origin. Verification of this would require accurate proper motions. The Cape Annals (vol. 20) lists the proper motion of HD 122691 as $\mu_\alpha = -0\overset{''}{.}007$ and $\mu_\delta = -0\overset{''}{.}002$ per annum. There appear to be no published kinematical data for HD 122669. The lack of data and the uncertainties involved for such distant, broad-line stars precludes, in our opinion, any meaningful kinematical conclusions.

If the two stars were formed together in space and time and since they now have slightly different luminosities, they probably have slightly different masses. It would be interesting to know whether HD 122691, the less luminous, "turned on" later than HD 122669 or whether it just had a quiescent phase in the early 1950's.

In conclusion, the spectra of HD 122669 and HD 122691 are nearly identical and of very rare type. The distances seem to be the same and since their separation is only five minutes of arc, it is probable that they have a common origin and age. The emission spectrum of HD 122691 has changed markedly over the past 20 years.

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TABLE I

SPECTROSCOPIC AND PHOTOMETRIC DATA

Star	Sp	V	B-V	U-B	E_{B-V}	Source
HD 122669	B0.5 IIep	8.97	0.33	-0.72	0.60	1
	B0.5 Ve	8.96	0.38	-0.74		2
HD 122691	B0.5 IIInep	9.20	0.34	-0.73	0.60	1
	B0.5 Vne	9.20	0.36	-0.76		2

Source : 1. Garrison, Hiltner and Schild (1975)

2. Crampton (1971)

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