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A PHOTOELECTRIC SEARCH FOR OPTICAL VARIABILITY IN BLUE STRAGGLERS

In several of the oldest galactic clusters, a few members lie above and to the left of the main sequence turn-off on the color-magnitude diagram. One hypothesis interprets these "blue stragglers" as the result of mass exchange in a close binary system in which the original secondary has received mass from the evolving primary and now lies beyond the turn-off (McCrea 1964), while the original primary has become a cool giant or sub-giant or a white dwarf. Strom and Strom (1970) have found support for this hypothesis in their photometric and radial velocity observations of blue stragglers in NGC 7789, from which they conclude that "all blue stragglers studied are probably spectroscopic binaries."

In order to test the binary hypothesis we initiated a photometric program to search for periodic low-amplitude light variability of blue stragglers. Candidates were chosen by searching published color-magnitude diagrams, principally compilations by Hoag *et al.* (1961) and Hagan (1970). Proper motion data indicating cluster membership were available for all objects observed except NGC 6633-H159, NGC 6834-F121 and NGC 559-L85.

Sixteen objects were monitored between June 1976 and April 1977, and are listed in Table I. The 38-cm siderostat refractor equipped with the Pierce-Blitzstein simultaneous dual channel, pulse-counting photometer and the 72-cm reflector of the Flower and Cook Observatory were used. Each comparison star was checked nightly against a third star to assure its constancy. The fainter objects were observed without color filtering.

Table I includes results of our observations. Each object is listed according to its familiar designation within the cluster, along with other identifications. The values of V, B-V, and spectral type are taken from Mermilliod (1976), Fünfschilling (1967) and Cudworth (1976). The ninth, tenth, and eleventh columns contain the number of nights, filters used, and the total number of filtered or unfiltered observations. The

standard deviation of an individual magnitude difference from the mean (σ), and the standard deviation of an individual magnitude difference calculated from Poisson statistics (σ_1) are listed for each object in the last two columns. The value of σ_1 depends in part on the integration time and the telescope aperture, and shows consistency when reduced to a common scale.

No periodic variations have been identified in any of these objects. The following stars have, however, shown some variability.

Coma-T146 (HR 4752, AI Com, 17 Com) has been found by Preston, Stepien, and Wolff (1969) to show periodic magnetic and light variations. A similarly low-amplitude variation is observed in our data, but it would require a shift in phase to be consistent with their value for the period. NGC 752-Hm209 may be an object similar to AI Com, and variations of $0.^m05$ in B have been observed.

A secular variation was observed in the magnitude difference between NGC 6633-H66 and its comparison star. Over about 80 days, H66 decreased $0.^m08$ and $0.^m05$ in B and V, respectively.

The observations of NGC 6834-F121 show four minima of $0.^m15$ depth in B. Two minima and one maximum, with a light variation of about $0.^m1$ appear to be present in the data for NGC 7062-J155.

M67-F190 deserves special note. Deutsch (1968) found it to be a spectroscopic binary with a period of 4.198 days. We were unable to find a light variation corresponding to this period. From its position in the color-magnitude diagram, Eggen (1971) indicated that it might be a δ Sct-type star. Our observations rule out any magnitude variation greater than $0.^m02$ during this interval.

NGC 6633-H159 was observed by Hintzen, Scott, and Whelan (1974) and noted as a possible velocity variable. Our limited coverage indicates some variation. Perhaps further observations might show it to be both a velocity and light variable. However, the cluster membership of this star is uncertain.

Although not ruling out the binary mass exchange hypothesis, the absence of periodic light variations in these observations does set restrictions on the values of the periods and inclinations possible for these systems. We intend to continue monitoring some of these objects.

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References:

- Cudworth, K.M. 1976, *Astron. Astrophys. Suppl.* 24, 143.
Deutsch, A.J. 1968, quoted in *Annual Report, Mount Wilson and Palomar Observatories, 1967-68*, p. 24.
Eggen, O.J. 1971, *Pub. Astron.Soc. Pac.* 83, 762.
Fünfschilling, H. 1967, *Z. Astrophys.* 66, 440.
Hagan, G.L. 1970, *Pub. David Dunlap Obs.* 4.
Hintzen, P., Scott, J., and Whelan, J. 1974, *Astrophys. J.* 194, 657.
Hoag, A.A., Johnson, H.L., Iriarte, B., Mitchell, R.J., Hallam, K.L., and Sharpless, S. 1961, *Pub. U.S. Naval Obs.*, 17, part 7.
McCrea, W.H. 1964, *Mon. Not. R. Astron. Soc.* 128, 147.
Mermilliad, J.-C. 1976, *Astron. Astrophys. Suppl.* 24, 143.
Preston, G.W., Stepien, K., and Wolff, S.C. 1969, *Astrophys. J.* 156, 653.
Strom, K.M., and Strom, S.E. 1970, *Astrophys. J.* 162, 523.

TABLE I

Summary of Blue Straggler Monitoring Program

Cluster	Object	HD	BD	V	B-V	Sp	N	Filter	n	σ	σ_1
NGC 559	L85			+10.60	+0.36		9	none	113	± 0.055	± 0.011
NGC 752	Hm209		+36 ^o 0367	9.70	+0.05	B9.5(p?)	8	V B	108 110	.012 .024	.006 .005
M 67	F81			10.03	-0.073	B8 V	7	none	37	.017	.005
	F124			12.14	+0.45		4	none	11	.061	.011
	F131			11.22	+0.415	F0 IV	5	none	29	.028	.007
	F136			11.31	+0.63	G3 III-IV	5	none	23	.020	.007
	F153			11.31	+0.13	Am	6	none	30	.022	.008
	F156			10.99	+0.11	A2 V	5	none	25	.018	.006
	F190			10.98	+0.245	A8 IV-V	15	none	79	.013	.006
	III-12			12.27	+0.27		5	none	22	.137	.012
Coma	T146		+26 ^o 2354	5.23	-0.049	A0p	4	V B	188 203	.011 .011	.005 .004
NGC 6633	H32	169959	+ 6 ^o 3762	7.57	+0.09		20	V B	351 360	.023 .026	.008 .007
	H66	170054	+ 6 ^o 3772	8.18	+0.03		19	V B	280 270	.033 .040	.008 .007
	H153	170563	+ 6 ^o 3816	8.15	-0.15		6	V B	64 67	.024 .037	.010 .009
NGC 6834	F121			11.14	+0.48		20	V B	171 180	.074 .077	.015 .013
NGC 7062	J155			+11.87	+0.50		16	none	200	± 0.062	± 0.016