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A Speckle Duplicity Survey of the Hyades Cluster

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1. SEARCH FOR HYADES MEMBERSHIP

Due to its proximity to the Sun, the Hyades serves the critical role of luminosity calibration of all cluster main sequences, and hence is one of the lower rungs in the cosmic distance ladder. We attempt here to use the enhanced capabilities of speckle interferometry, in comparison with classical techniques, to add to the list of binary and multiple stars in the Hyades. New systems will not only eventually help to improve our knowledge of the cluster distance, but they will also help further our understanding of the formation and evolution of binary and multiple stars in the cluster environment.

The starting point for modern work on the Hyades is the survey and convegent point analysis of van Bueren (1952) who listed 152 bright Hyades members ($V < 9.0$) on the basis of radial velocity. Of these, 132 stars were listed as certain members. Two stars (vB 98 and vB 125) were later rejected by Wayman *et al.* (1965), who also added 11 more members brighter than $V \approx +10$ on the basis of proper motions and radial velocities. Van Altena (1969) provided three more bright Hyades stars with a high probability of membership. More recently, Schwan (1991) again investigated Hyades membership using proper motion criteria and rejected four more van Bueren stars (3, 61, 80, and 110) along with one of the stars selected by Wayman *et al.* , HD 25202. Schwan (1991) also added 13 more Hyades members. Considering stars brighter than $V = 10$ and rejecting any non-members from the above lists, generated a final total of 153 Hyades stars to comprise our duplicity survey sample.

2. OBSERVATION, REDUCTION, AND RESULTS

The binary star speckle program at GSU is a continuation of an effort begun at KPNO in 1975 by one of the authors (HAM). The Hyades survey observations were taken during a run at the KPNO 4-m Mayall telescope on 23–27 November 1991. These data were collected using a new ITT camera with a single stage intensified CCD allowing reliable detection to a magnitude limit of $V \approx + 10$ for 90 second integrations. The data were recorded on a Sony 8 mm videocassette recorder and then reduced using the modified autocorrelation method described by Bagnuolo *et al.* (1992). The sample was collected and reduced without prior knowledge of duplicity as a check on the reliability and completeness of detection.

Seven new or suspected binaries were found. This is somewhat surprising because none of these new systems has an angular separation making it inacces-

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sible to visual observers; however, the typically low contrast of the DVA peaks for these objects implies Δm's that might challenge micrometer observers.

The results for the new systems are summarized in Table 1. The first three columns contain various identifications: The first in the 2000 coordinate given in the manner of the WDS designation (from the "Washington Double Star Catalog" maintained at the U.S. Naval Observatory by C.E. Worley), van Bueren number, and the HD number. The fourth column is a one letter code which indicates whether the new binary is "suspected" (S), "probable" (P), or "definite" (D). Suspected binaries are those which may exhibit duplicity, but the DVA peak of the secondary is not strong. Probable binaries are those which have secondary peaks which are convincing but would still require confirmation. Definite binaries are those whose peaks are significantly stronger and in one case have confirmation from reanalysis of an observation from an earlier epoch. The fifth column is the epoch of the observation expressed as fractional Besselian year. The sixth column contains the visual magnitude of the star, and the seventh column the spectral type. Columns seven and eight give the measured position angle (θ) and angular separation (ρ). Columns nine and ten give crude estimates of the orbital period (P) and velocity amplitude (K) of these stars assuming equal mass components in a circular orbit centered in the Hyades with a distance modulus of 3.42 mag. All of these are slow moving binaries but their K values and wealth of spectral features (since they are mostly late type stars) makes them potential candidates for precse radial velocity programs. This could eventually lead to geometrically determined distances.

Measurements for nine known visual and interferometric binaries (McAlister & Hartkopf 1988) are summarized in Table 2. The first four columns contain various identifications: WDS designation, star name, the HD number, and the discoverer designation. The fifth column is the epoch of the observation expressed as fractional Besselian year. The sixth column contains approximate visual magnitude of the star, and the seventh column the spectral type. The final two columns give the position of the secondary.

TABLE 1. New binaries.

WDS	vB	HD	Gr	Epoch (-1900)	V	Sp.	θ (°)	ρ (″)	P (yr)	K (km/s)
03327+3540	—	21847	S	91.899	7.3	F8	358.7	0.222	25	13
04229+1733	41	27697	P	91.900	3.8	KOIII	354.9	0.273	23	17
04242+1446	50	27836	P	91.899	7.6	GIV	8.3	0.262	33	11
04268+1052	—	286820	P	91.899	9.5	K5	77.6	0.175	24	10
04328+1600	91	28783	D	91.902	8.9	KO	166.5	0.192	25	11
04375+1509	102	29310	D	91.902	7.5	GO	232.6	0.235	29	12
				89.229			217.0	0.240		
04404+1631	185	29608	D	91.902	9.5	KO	30.8	0.659	167	5.7

Of the 153 stars observed, 137 exhibited no evidence of duplicity. The effective field of view of the CCD chip is about 1″.33×1″.08 centered on the primary star. Thus, the upper limit to angular separation was about 1″ ; the lower limit being 0″.035, the diffraction limit of the 4-m. The stars with negative results may belong to one or more of three cases: (1) separation is less than 0″.035, or greater than 1″ ; (2) magnitude difference is greater than ≈2.0 mag;

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TABLE 2. Known binaries.

WDS	Name	HD	Discoverer	Epoch	V	Sp.	θ (°)	ρ (″)
04185+2135	HR 1331	27176	McA 14	1991.894	5.6	A5	257.6	0.096
04256+1557	HR 1391	27991	Fin 342	1991.897	6.5	F7V	299.9	0.099
04286+1557	HR 1411	28307	McA 15	1991.897	3.8	K0III	150.9	0.048
04290+1610	ADS 3248	28363	Hu 1080	1991.897	6.6	F8	257.1	0.411
04340+1510	vB 96	285931	CHARA 17	1991.902	8.7	K1	280.1	0.192
04506+1505	vB 120	30712	CHARA 20	1991.902	8.1	G5	71.1	0.082
04512+1104	ADS 3475	30810	Bu 883	1991.897	7.0	F5	353.1	0.209
04518+1339	ADS 3483	30869	Bu 552	1991.897	6.7	F8	5.4	0.452
04598+2802	ADS 3730	33204	Bu 1047	1991.902	8.1	G7	251.0	0.290

or (3) they are single stars. The detection of close binaries can be effected by seeing conditions which were poor the first night of the run.

We conclude that we have not overlooked any definitively known binaries in our Hyades sample whose angular separation is within the "window" of detectability of our observing speckle program. We hope other observers will attempt to confirm the discoveries of the systems in Table 1. A more complete version of this paper will be published elsewhere.

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