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$uvbyH_\beta$ photometry of main sequence A type stars*

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Abstract. — We present Strömgren *uvby* and H_β photometry for a set of 575 northern main sequence A type stars, most of them belonging to the Hipparcos Input Catalogue, with V from $5^{\rm m}$ to $10^{\rm m}$ and with known radial velocities. These observations enlarge the catalogue we began to compile some years ago to more than 1500 stars. Our catalogue includes kinematic and astrophysical data for each star. Our future goal is to perform an accurate analysis of the kinematical behaviour of these stars in the solar neighbourhood.

Key words: stars: distances — stars: early-type — stars: fundamental parameters — galaxy: kinematics and dynamics

1. Introduction

It has long been known that the kinematics of main sequence A type stars in the solar neighbourhood show some particular features which cannot be explained by the classical theory of ellipsoidal velocity distribution proposed by Schwarzschild (Palous 1986; Gómez et al. 1990). Knowledge of the mechanisms responsible for features such as the presence of moving groups – widely discussed by Eggen (1989) –, the strong vertex deviation in this spectral range, and the observed increase in the velocity dispersion with age, among others, may help us to understand the evolution, kinematics and dynamics of our Galaxy. Essential requirements to study these controversial problems are to have large samples with accurate kinematical and astrophysical data and to apply robust statistical methods.

From the kinematical point of view, the unprecedented accuracy achieved by the Hipparcos mission on position, parallax and proper motions of a large number of stars and the ongoing radial velocity observation programmes (among others, those at the Observatoire d'Haute Provence – OHP – and at the European Southern Observatory – ESO –), will lead to a substantial improvement in the near future. On the other hand, Strömgren photometry has proved to be a powerful tool to derive photometric distances, temperatures, gravities, luminosities and ages of early type stars.

Our observational programme aims to obtain Strömgren photometry for main sequence A type stars with published radial velocities – or included in the above mentioned observational programmes – and having incomplete or no *uvby* or H_β values in the compilation of Hauck & Mermilliod (1990, hereafter referred to as HM). Our first results were already published in Figueras et al. (1991, hereafter referred to as Paper I). After the publication of the Hipparcos Input Catalogue (Turon et al. 1992; hereafter referred to as HIC) the observing programme described in Paper I has been redefined, giving high priority to the main sequence A type stars belonging to the Hipparcos Survey (Gómez et al. 1989) with known radial velocities. Stars with new radial velocities obtained at OHP (i.e. Duflot et al. 1992) have been included in our compilation.

In this paper we present new photometric data for 575 stars, 479 of which are Hipparcos stars. The content of our catalogue of "normal" main sequence A type stars, at its present status, is described in Sect. 3.

2. Observations, data reduction and results

2.1. *Observations and data reduction*

The observations were carried out at Calar Alto (Almería, Spain) with the 1.23 m telescope at the Centro Astronómico Hispano-Alemán (C.A.H.A.) and the 1.52 m telescope of the Observatorio Astronómico Nacional (O.A.N.), and at the Observatorio del Roque de los Muchachos (O.R.M., Canary Islands, Spain) using the 1m Jakobus Kapteyn telescope. The photometer and filters used in the telescopes at Calar Alto were previously described in Paper I. The observations with the Jakobus Kapteyn telescope were made using the People's photometer, a two-channel one, which is equipped with EMI

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9658AM photomultipliers, the dead-time constants being 44 and 49 ns.

As in Paper I, the standard stars were taken from the lists of Perry et al. (1987), Crawford et al. (1972, 1973), and Olsen (1983). They were observed every hour and at the beginning and the end of each night, with a total of 15 – 25 standard stars observed per night.

Observations were performed between March 1990 and September 1993 in thirteen observing runs of 7-10 days: 3 runs at C.A.H.A., 6 at O.A.N. and 4 at O.R.M. In February 1992, at O.R.M., the weather was poor and only stars lacking H_β photometry in the HM catalogue were observed. For each programme star, a minimum of two observations on different nights were performed.

The reduction procedure was fully described in Paper I. Residuals of all transformations were checked against colour, magnitude and air mass, and no systematic trend was found. Linear time dependent corrections to the visual magnitude were required on several nights: 0.007 mag/h was the mean value of drift coefficient for "normal" nights. A linear dependence of this coefficient on water-vapour presure (P), as suggested by Reimann et al. (1992), was found to be $0.026P - 0.0031$, indicating that the drift coefficient grows with increasing moisture, although a rather poor correlation was found.

Following Lindemann & Hauck (1973) and Olsen (1993) we include Tables 1-4 showing the obtained photometry for the standard stars with more than one observation. The differences with standard values are negligible and no systematic differences were found between C.A.H.A., O.A.N. and O.R.M. observatories.

2.2. *Results*

Table 5 lists the *uvby* and H_β photometric data for 575 programme stars. The individual error quoted is the standard deviation of the average obtained following Rosselló et al. (1985). Mean values of these errors are $\sigma(V) = 0.006 \pm 0.006$, $\sigma(b-y) = 0.004 \pm 0.004$, $\sigma(m_1) = 0.006 \pm 0.006$, $\sigma(c_1) = 0.008 \pm 0.007$, $\sigma(\beta) = 0.007 \pm 0.007$.

The columns labelled N and N_β give the number of observations performed for each star. An asterisk in the N column means that the star was observed during February 1992 at O.R.M. and only H_β photometry was obtained. The *uvby* data quoted for these stars were taken from HM catalogue and their visual magnitude was taken from the General Catalogue of Photometric Data (GCPD; Hauck et al. 1990). A remark in the last column draws attention to a note after Table 5. These notes include information about duplicity (D) for optical pairs with separation less than 20 arcsec – following the notation given in Paper I –, variability (V), identification in clusters (C), V.R.V. or SB in Renson's (1991) catalogue (B) and other remarks (O). The spectral types quoted are from HIC or SIMBAD data base.

External comparison for the stars in Table 5 having either *uvby* or H_β photometry in the HM catalogue, has been performed. As the HM catalogue does not contain V magnitudes, the comparison on V has been made with the values quoted in GCPD. Significant differences have been found only for the stars HD 49581, HD 94978 and HD 192284. Our values for HD 49581 are coherent with the values given by Mendoza (1974), indicating that it is probably an Am star. In contrast, Alania et al. (1989) gave $m_1 = 0.055$ for this star, and stated explicitly that it is not an Am star. More observations are required to solve this discrepancy. HD 94978 and HD 192284 show discrepances on the V magnitude. In particular, HD 192284 is a double system (see Notes after Table 5), and the difference can be explained when including the companion. After rejecting these stars, the comparison (Table 6) shows that our data fully agree with the HM and GCPD compilations, so no systematic differences are present when deriving physical parameters.

Table 6. External errors with HM and GCPD compilations, expressed as our values minus catalogued values (units are $0\overset{m}{.}001$)

	Mean	scatter	N
$\Delta(V)$	3.5 ± 1.6	27.5	307
$\Delta(b-y)$	2.6 ± 0.9	7.8	82
$\Delta(m_1)$	0.2 ± 1.4	12.4	82
$\Delta(c_1)$	-3.8 ± 2.0	18.3	82
$\Delta(\beta)$	1.4 ± 1.7	17.8	111

3. The Catalogue

3.1. *Selection criteria*

To build up a catalogue that is useful for kinematic analysis, we compile those main sequence A type stars with known radial velocities and complete *uvby* and H_β photometry for which we are able to compute reliable physical parameters and ages. In this sense, it does not include stars known as variables or suspected variables, spectroscopic binaries, peculiar (Am, Ap, δ Del, ...) or those known to have variable radial velocity. Stars belonging to double and multiple systems for which only joint photometry is available have also been rejected. In order not to bias the kinematics, we have also eliminated those stars known as members of galactic open clusters. This selection has been done by consulting the SIMBAD data base and HIC. Finally, those stars with insufficient information on spectral type whose observed photometry indicates peculiarities or advanced evolutionary stages (mainly giants and supergiants) are not included in the final compilation.

3.2. *Present status of the compilation*

Our compilation, at its present status, contains a total of 1549 "normal" main sequence A type stars with computed physical parameters and ages. 1414 stars –91% of the sample – belong to the HIC, 1341 of which are included in the Hipparcos Survey (Gómez et al. 1989).

All the needed astrometric data were extracted from HIC, but for the stars not belonging to it, positions and proper motions were taken from PPM North and South (Roeser & Bastian 1988; Bastian et al. 1993). Radial velocities were extracted from the SIMBAD data base, Barbier-Brossat (1989), the series of publications of OHP (i.e. Duflot et al. 1992) and Andersen & Nordstrom (1983). Even with the inclusion of these two last observing programmes, in the North and South hemispheres respectively, radial velocities are still the main limitation when building up such a catalogue. The radial velocity programmes for early type Hipparcos stars in progress at OHP and at ESO (Duflot et al. 1992; Gerbaldi et al. 1990; Hensberge et al. 1990) will allow substantial enlargement of the sample.

The HM catalogue, the list published by Perry (1991) and our own observations were the source for the necessary Strömgren photometry. It is worthwhile noticing that our observations represent more than one third of the total sample.

3.3. *Computation of physical parameters*

Distances, effective temperatures and surface gravities have been obtained from Strömgren photometry according to Paper I. The algorithm described there was improved with the new interpolation programme by Napiwotzky et al. (1993) of the grids of Moon & Dworetsky (1985). This new procedure better reproduces the grids and avoids the interpolation problems in the boundaries – see Masana (1994) for the analysis of the systematic differences –. Concerning the "intermediate" group (A0-A2, defined by Strömgren 1966), we have adopted the dereddening expressions by Grosbol (1978) after realizing that Moon's (1985) expressions to interpolate the standard relations of Hilditch et al. (1983) create artificial empty zones in the colour-colour and the theoretical HR diagrams.

Individual ages have been computed with the algorithm developed by Asiain (1993) using the stellar evolutionary models of Schaller et al. (1992) for Pop I. A linear interpolation between points of corresponding evolutionary status has been performed and special care has been taken to assign an error to each age determination (Asiain 1996) according to the accuracy of the photometric determination of the effective temperature and the surface gravity (Torra et al. 1990). The distribution of the stars in the theoretical HR diagram is shown in Fig. 1. About 10% of the sample is placed below the ZAMS, so, no individual ages have been computed for them. Observational errors,

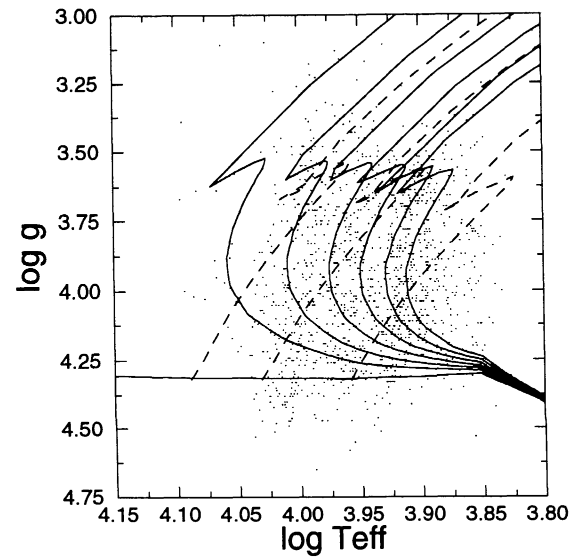

Fig. 1. The 1549 stars of the compilation in the theoretical HR diagram. Evolutionary tracks for 2, 2.5 and 3 solar masses, isochrones of 2, 3, 4, 5, 6 and 7 10^8 years and the ZAMS (Schaller et al. 1992; $Y = 0.30$, $Z = 0.02$) are overplotted

undetected peculiarities or problems in the calibrations used can be argued to explain this phenomenon. Figure 2 shows the histogram of ages and their relative errors. We should emphasize that the determination of ages may not be free from systematic trends caused by uncertainties in the photometric calibrations or the stellar evolutionary models.

3.4. *Future observations*

Our future observing programme is mainly centered on Hipparcos Survey stars with known radial velocities. More than 500 stars from this survey, selected according to the criteria mentioned above, have proper motion and radial velocity data but no complete Strömgren photometry.

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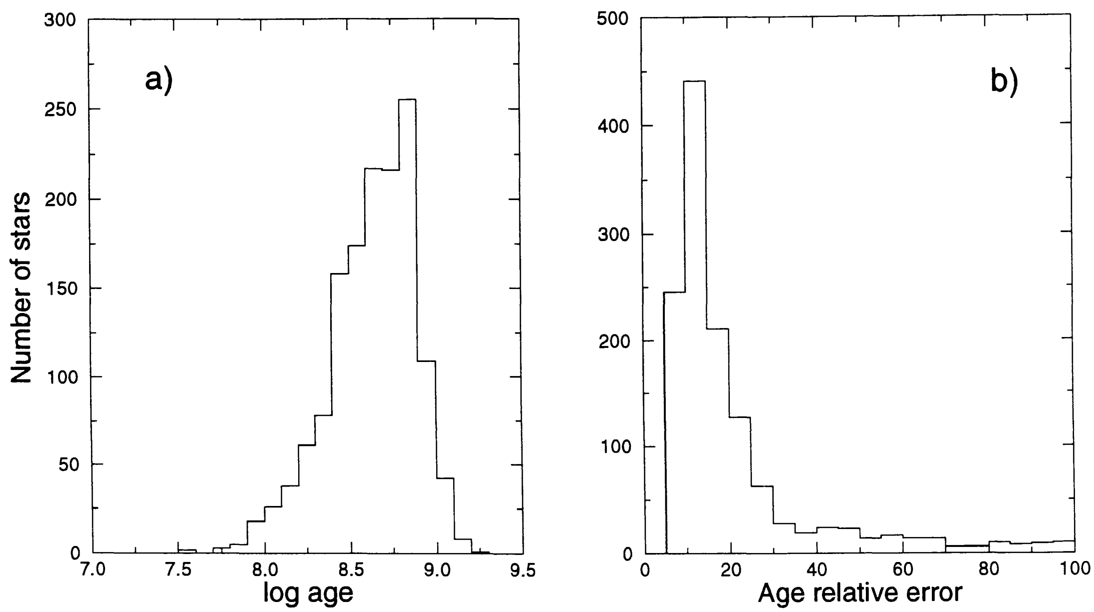

Fig. 2. The histogram of ages **a)** and relative errors **b)** for the stars above the ZAMS

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Table 1. Photometry of the standard stars observed at O.A.N. Quoted errors are the standard deviation of the average (Rosselló et al. 1985). N and N_β are the number of observations of colours and β, respectively. Last columns give the differences with standard values (standard - observed)

HD	$(b-y)$	error	V	error	m_1	error	c_1	error	N	β	error	N_β	$\Delta(b-y)$	$\Delta(V)$	$\Delta(m_1)$	$\Delta(c_1)$	$\Delta(\beta)$
2054	-.022	.002	5.734	.005	.124	.001	.693	.002	8	2.774	.002	8	.000	.006	-.001	.000	.001
6457	-.026	.001	5.563	.003	.141	.002	.874	.002	9	2.850	.001	9	.004	-.005	-.002	.007	-.002
11592	.315	.002	6.754	.006	.135	.003	.394	.008	3	2.623	.011	3	-.003	.013	.001	-.002	.007
12246	.298	.004	8.160	.003	.123	.011	.412	.007	2				.002	.014	.005	-.005	
16460	.360	.000	7.479	.002	.091	.002	.975	.003	6	2.703	.004	6	-.003	.004	.003	-.004	.002
20692	.334	.001	8.409	.002	.133	.001	.517	.003	13	2.672	.005	11	.004	-.004	.001	-.004	-.008
21050	-.022	.001	6.083	.001	.151	.001	.937	.002	6	2.881	.002	6	-.005	-.003	.005	-.005	-.003
23258	.012	.004	6.084	.007	.182	.001	.999	.000	4	2.920	.002	4	-.010	.006	.001	-.004	.000
23324	-.022	.001	5.669	.002	.107	.001	.642	.001	6	2.743	.001	6	.001	-.004	.000	-.004	.007
24357	.228	.001	5.959	.007	.167	.002	.604	.002	4	2.714	.001	4	-.007	.011	-.001	.006	-.002
24817	.025	.002	6.088	.004	.186	.001	1.011	.001	4	2.903	.004	4	.000	.004	-.001	.013	-.018
28395	.288	.000	8.005	.011	.122	.002	.430	.007	2	2.636	.002	2	.009	.002	-.001	-.008	.002
35076	-.020	.001	6.454	.000	.132	.005	.873	.008	3	2.826	.000	4	-.006	.006	.002	-.013	.004
42111	.054	.000	5.696	.008	.126	.001	1.223	.001	2	2.803	.004	2	-.002	.018	.012	-.003	.010
57362	.284	.001	8.162	.003	.137	.004	.461	.002	9	2.658	.001	8	.004	-.005	-.004	-.002	-.001
60107	.037	.001	5.276	.001	.142	.001	1.177	.001	29	2.842	.001	28	.000	.001	.001	.001	.000
65174	.298	.001	8.602	.003	.142	.002	.494	.002	6	2.653	.005	4	-.001	.004	-.003	.003	-.004
76398	.088	.001	5.451	.004	.206	.001	.970	.001	11	2.851	.002	11	-.004	-.004	-.001	.002	-.002
80064	.043	.001	6.411	.004	.163	.002	1.192	.001	8	2.872	.004	7	.004	-.011	.000	.005	-.011
93702	.022	.001	5.327	.006	.147	.001	1.131	.001	6	2.856	.003	6	.003	-.014	-.005	.006	.013
109860	.009	.002	6.334	.005	.137	.003	1.160	.004	4	2.853	.003	4	.001	.008	.003	-.006	.003
113036	.219	.002	8.725	.001	.160	.003	.658	.001	7	2.727	.003	4	.000	.001	.005	-.020	-.004
113713	.314	.001	7.956	.002	.138	.002	.404	.002	9	2.630	.003	6	-.001	.002	-.001	.000	-.009
118244	.316	.000	6.920	.003	.129	.001	.394	.002	9	2.626	.001	9	-.004	.006	.000	.002	.000
120874	.038	.002	6.452	.005	.204	.001	.988	.002	6	2.908	.004	5	-.001	-.016	.004	-.008	-.007
121409	-.011	.001	5.698	.006	.137	.001	1.045	.003	4	2.833	.002	4	.000	-.007	.000	.001	-.005
140775	.026	.002	5.563	.008	.150	.003	1.116	.004	5	2.880	.003	5	-.003	.015	.003	-.015	.000
142908	.232	.001	5.443	.001	.157	.002	.655	.001	6	2.703	.003	6	-.002	-.007	.004	-.001	.011
143840	.349	.002	8.113	.001	.133	.000	.562	.003	3				-.004	.004	-.001	.003	
144492	.298	.002	7.937	.002	.133	.000	.430	.015	3	2.658	.009	3	.000	.003	.002	-.002	-.005
148180	.293	.001	7.850	.004	.135	.004	.668	.003	6	2.724	.002	5	.001	.008	-.002	-.002	-.009
150378	-.008	.001	5.770	.002	.148	.002	1.010	.012	2	2.884	.000	2	.005	.001	-.008	.016	-.002
154431	.115	.000	6.093	.002	.201	.001	.855	.001	19	2.833	.001	19	.003	.000	.000	.001	.001
157373	.287	.001	6.358	.002	.122	.001	.431	.002	10	2.648	.002	10	.003	.000	.000	.003	.004
158261	-.009	.001	5.938	.002	.164	.001	.999	.002	15	2.899	.001	15	.000	.002	.001	-.002	.004
169578	.045	.001	6.714	.003	.086	.001	.844	.003	10	2.775	.001	6	.005	-.004	-.001	-.003	.005
186440	-.004	.001	6.084	.001	.160	.001	1.025	.002	10	2.903	.003	8	.000	.006	.000	.001	.008
192744	.267	.001	7.456	.002	.126	.001	.483	.001	20	2.663	.001	18	-.001	-.002	.002	-.003	-.002
195943	.026	.001	5.394	.002	.210	.001	.977	.002	9	2.923	.002	9	-.003	.004	-.003	.006	-.005
199373	.305	.002	7.727	.002	.141	.002	.435	.002	6	2.636	.004	6	.002	.003	-.003	.008	.012
204862	-.022	.001	6.100	.001	.142	.001	.924	.003	4	2.838	.002	4	.003	.012	-.007	.008	.005
205539	.242	.001	6.239	.004	.143	.001	.608	.002	10	2.700	.002	10	.000	.011	.000	.003	-.002
211242	-.026	.004	6.160	.000	.095	.003	.590	.003	3	2.702	.006	3	-.001	-.030	.002	-.001	-.011
215399	.283	.002	8.722	.003	.136	.002	.515	.003	13	2.667	.003	12	.000	-.006	-.003	.001	.003
222602	.059	.001	5.903	.004	.159	.002	1.088	.002	11	2.882	.001	11	-.002	.004	-.001	.001	-.007
223323	.302	.001	7.076	.004	.123	.001	.407	.001	9	2.640	.003	9	-.006	.004	.001	.005	.003
Mean		.001		.003		.002		.003			.003		.000	.001	.000	.000	.000
s.d.		.001		.002		.002		.003			.002		.004	.009	.003	.007	.007

Table 2. Same as Table 1 for the standard stars observed at C.A.H.A.

HD	$(b-y)$	error	V	error	m_1	error	c_1	error	N	β	error	N_β	$\Delta(b-y)$	$\Delta(V)$	$\Delta(m_1)$	$\Delta(c_1)$	$\Delta(\beta)$
16460	.356	.002	7.481	.012	.089	.006	.971	.005	3	2.703	.001	3	.001	.002	.005	.000	.002
35076	-.028	.007	6.473	.018	.122	.010	.843	.002	3	2.829	.007	3	.002	-.013	.012	.017	.001
60107	.037	.004	5.265	.006	.135	.004	1.178	.003	4	2.838	.005	4	.000	.012	.008	.000	.004
94028	.344	.000	8.235	.004	.081	.001	.254	.001	13	2.586	.002	8	.001	-.006	.000	.004	.001
111397	.014	.002	5.705	.006	.162	.009	1.126	.008	2				.006	-.005	-.006	.004	
113036	.219	.002	8.727	.003	.165	.004	.641	.008	5				.000	-.001	.000	-.003	
119537	.030	.002	6.528	.011	.171	.001	.975	.002	4				-.002	-.001	.001	.005	
120874	.037	.001	6.437	.002	.209	.000	.979	.000	23	2.904	.002	20	.000	-.001	-.001	.001	-.003
122866	.003	.001	6.151	.003	.179	.004	1.009	.001	4				.017	-.001	.002	.007	
127067	-.007	.000	7.121	.008	.142	.001	1.016	.008	2				.015	-.001	.004	.004	
134064	.033	.001	6.016	.003	.190	.001	1.017	.001	3				-.001	.004	.000	.000	
142908	.227	.002	5.439	.001	.159	.004	.650	.002	3	2.708	.000	3	.003	-.003	.002	.004	.006
143187	-.027	.000	6.316	.004	.145	.003	.947	.005	3	2.850	.007	2	.014	-.006	-.011	.008	.004
157373	.290	.000	6.359	.001	.123	.000	.436	.002	19	2.652	.002	18	.000	-.001	-.001	-.002	.000
168092	.236	.001	6.670	.001	.151	.001	.660	.001	4				.000	.000	.000	-.001	
Mean		.002		.006		.003		.003			.003		.004	-.001	.001	.003	.002
s.d.		.002		.005		.003		.003			.003		.006	.005	.005	.005	.003

Table 3. Same as Table 1 for the standard stars observed at R.G.O. (Romeo channel)

HD	$(b-y)$	error	V	error	m_1	error	c_1	error	N	β	error	N_β	$\Delta(b-y)$	$\Delta(V)$	$\Delta(m_1)$	$\Delta(c_1)$	$\Delta(\beta)$
1439	-.007	.001	5.881	.001	.139	.001	1.071	.002	33	2.855	.001	32	.002	-.003	.001	-.001	.001
2054	-.019	.001	5.731	.004	.115	.003	.702	.004	4	2.774	.001	3	-.003	.009	.008	-.009	.001
16460	.358	.003	7.493	.003	.095	.004	.969	.010	2				-.001	-.010	-.001	.002	
21050	-.024	.002	6.082	.004	.151	.001	.940	.005	2	2.875	.001	2	-.003	-.002	.005	-.008	.003
21203	.049	.003	6.486	.001	.099	.003	.688	.003	2				-.006	.004	.003	.009	
22243	.005	.002	6.242	.004	.168	.001	1.057	.004	6	2.895	.002	6	-.001	.004	-.004	.011	-.001
23258										2.926	.005	2					-.006
23288	.004	.001	5.457	.001	.099	.002	.642	.004	4	2.744	.001	3	.001	.004	-.002	.008	.006
23324	-.022	.002	5.664	.004	.108	.002	.640	.001	4	2.750	.002	3	.001	.001	-.001	-.002	.000
25152	.014	.003	6.417	.009	.119	.010	.957	.001	2	2.841	.003	4	.005	-.007	.006	.000	-.003
25867	.222	.001	5.219	.005	.158	.005	.574	.013	3	2.721	.001	3	.004	.011	.001	-.016	-.001
35076	-.026	.004	6.449	.011	.132	.010	.871	.009	2	2.824	.006	2	.000	.011	.002	-.011	.006
42111	.055	.002	5.724	.004	.131	.002	1.210	.005	2	2.820	.007	2	-.003	-.010	.007	.010	-.007
52479	.061	.002	6.636	.006	.113	.004	1.453	.000	5	2.814	.003	5	-.004	.006	-.005	.001	-.010
55055										2.713	.000	2					.008
60107	.041	.000	5.277	.004	.135	.002	1.182	.001	4	2.837	.001	4	-.004	.000	.008	-.004	.005
73143										2.869	.000	2					.003
76398	.085	.001	5.448	.002	.205	.001	.971	.001	22	2.848	.002	24	-.001	-.001	.000	.001	.001
79108										2.889	.001	3					-.005
80064										2.867	.003	19					-.006
93702	.025	.001	5.311	.002	.144	.001	1.134	.001	6	2.853	.005	7	.000	.002	-.002	.003	.016
97585										2.808	.004	4					.026
109704										2.904	.002	6					.002
113036	.218	.004	8.726	.003	.165	.005	.643	.005	3	2.725	.002	11	.001	.000	.000	-.005	-.002
120874	.039	.001	6.433	.004	.205	.002	.986	.000	2				-.002	.003	.003	-.006	
157373	.290	.004	6.355	.004	.120	.003	.436	.003	2	2.640	.002	2	.000	.003	.002	-.002	.012
169578	.048	.002	6.711	.002	.084	.002	.842	.002	4	2.768	.002	4	.002	-.001	.001	-.001	.012
171301	-.033	.001	5.469	.004	.112	.002	.691	.003	4				.002	.001	.001	.005	
175290	.316	.002	7.986	.004	.123	.002	.449	.004	3	2.643	.001	3	.001	.005	.002	-.001	-.008
186440	-.005	.001	6.106	.008	.165	.002	1.029	.003	2				.001	-.016	-.005	-.003	
192744	.265	.003	7.457	.006	.129	.002	.476	.001	2	2.665	.003	2	.001	-.003	-.001	.004	-.004
195943	.025	.002	5.395	.002	.206	.002	.989	.009	5	2.916	.005	4	-.002	.003	.001	-.006	.002
211242	-.021	.001	6.124	.004	.093	.003	.589	.005	3	2.697	.001	3	-.006	.006	.004	.000	-.006
222602	.058	.002	5.901	.003	.157	.003	1.090	.002	6	2.883	.001	6	-.001	.006	.001	-.001	-.008
223323	.300	.000	7.094	.002	.128	.005	.409	.004	2				-.004	-.014	-.004	.003	
223855	-.006	.004	6.288	.007	.153	.003	1.028	.008	3	2.902	.002	3	.001	.014	-.002	.006	-.006
Mean		.002		.004		.003		.004			.002		-.001	.001	.001	.000	.001
s.d.		.001		.002		.002		.003			.002		.003	.007	.004	.006	.008

Table 4. Same as Table 1 for the standard stars observed at R.G.O. (Julieta channel)

HD	$(b-y)$	error	V	error	m_1	error	c_1	error	N	β	error	N_β	$\Delta(b-y)$	$\Delta(V)$	$\Delta(m_1)$	$\Delta(c_1)$	$\Delta(\beta)$
1439	-.006	.001	5.881	.001	.139	.001	1.071	.001	32	2.854	.001	31	.001	-.003	.001	-.001	.002
2054	-.022	.000	5.728	.004	.126	.001	.697	.000	4	2.775	.002	4	.000	.012	-.003	-.004	.000
16460	.361	.001	7.490	.006	.095	.004	.971	.004	2				-.004	-.007	-.001	.000	
21050	-.025	.000	6.080	.003	.154	.006	.926	.013	2	2.865	.000	2	-.002	.000	.002	.006	.013
21203	.052	.001	6.480	.000	.080	.002	.698	.004	2				-.009	.010	.022	-.001	
22243	.010	.000	6.239	.002	.169	.002	1.065	.006	6	2.896	.001	6	-.006	.007	-.005	.003	-.002
23288	.003	.000	5.462	.001	.103	.000	.640	.001	4	2.741	.002	3	.002	-.001	-.006	.010	.009
23324	-.019	.001	5.659	.008	.107	.003	.642	.001	4	2.741	.004	4	-.002	.006	.000	-.004	.009
25152	.019	.001	6.393	.001	.115	.010	.954	.009	2	2.841	.007	3	.000	.017	.010	.003	-.003
25867	.223	.000	5.225	.004	.163	.002	.566	.007	3	2.717	.002	3	.003	.005	-.004	-.008	.003
42111	.055	.002	5.722	.006	.134	.004	1.215	.006	2				-.003	-.008	.004	.005	
52479	.056	.003	6.628	.003	.108	.001	1.457	.003	5	2.810	.002	5	.001	.014	.000	-.003	-.006
60107	.038	.003	5.275	.000	.141	.003	1.178	.000	3	2.838	.006	3	-.001	.002	.002	.000	.004
73143										2.865	.006	2					.007
76398	.086	.001	5.450	.001	.205	.001	.970	.002	18	2.849	.002	26	-.002	-.003	.000	.002	.000
79108										2.886	.002	3					-.002
80064										2.870	.002	17					-.009
93702	.023	.000	5.313	.002	.146	.002	1.131	.002	5	2.844	.003	7	.002	.000	-.004	.006	.025
97585										2.829	.007	5					.005
109704										2.907	.001	5					-.001
113036	.218	.001	8.725	.003	.165	.005	.643	.005	3	2.724	.002	11	.001	.001	.000	-.005	-.001
120874	.042	.001	6.438	.000	.199	.000	.991	.007	2	2.923	.004	2	-.005	-.002	.009	-.011	-.022
157373	.284	.001	6.357	.000	.125	.003	.436	.001	2	2.650	.008	2	.006	.001	-.003	-.002	.002
169578	.047	.001	6.711	.004	.085	.004	.842	.002	4	2.771	.004	4	.003	-.001	.000	-.001	.009
171301	-.031	.001	5.471	.003	.109	.001	.687	.005	4				.000	-.001	.004	.009	
175290	.319	.001	7.988	.003	.122	.001	.450	.005	3	2.644	.002	3	-.002	.003	.003	-.002	-.009
186440	-.004	.002	6.083	.008	.160	.006	1.022	.012	2	2.910	.008	2	.000	.007	.000	.004	.001
192744	.271	.002	7.454	.000	.123	.005	.479	.002	2	2.669	.000	2	-.005	.000	.005	.001	-.008
195922	.059	.004	6.541	.008	.151	.004	1.110	.007	2	2.848	.009	2	-.002	.011	.001	-.014	-.004
195943	.024	.003	5.397	.007	.208	.001	.970	.004	5	2.920	.005	4	-.001	.001	-.001	.013	-.002
211242	-.022	.001	6.131	.002	.091	.002	.589	.004	3	2.701	.002	3	-.005	-.001	.006	.000	-.010
222602	.059	.001	5.904	.003	.159	.001	1.081	.003	6	2.883	.002	6	-.002	.003	-.001	.008	-.008
223323	.299	.000	7.089	.001	.120	.000	.406	.001	2				-.003	-.009	.004	.006	
223855	-.011	.006	6.295	.003	.157	.006	1.024	.005	3	2.902	.005	3	.006	.007	-.006	.010	-.006
Mean		.001		.003		.003		.004			.003		-.001	.002	.001	.001	.000
s.d.		.001		.003		.002		.003			.003		.003	.006	.006	.006	.009