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Medium-resolution Isaac Newton Telescope library of empirical spectra – II. The stellar atmospheric parameters

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ABSTRACT

We present a homogeneous set of stellar atmospheric parameters ($T_{\rm eff}$, $\log g$, [Fe/H]) for MILES, a new spectral stellar library covering the range λλ 3525–7500 Å at 2.3 Å (FWHM) spectral resolution. The library consists of 985 stars spanning a large range in atmospheric parameters, from super-metal-rich, cool stars to hot, metal-poor stars. The spectral resolution, spectral type coverage and number of stars represent a substantial improvement over previous libraries used in population synthesis models. The atmospheric parameters that we present here are the result of a previous, extensive compilation from the literature. In order to construct a homogeneous data set of atmospheric parameters we have taken the sample of stars of Soubiran, Katz & Cayrel, which has very well determined fundamental parameters, as the standard reference system for our field stars, and have calibrated and bootstrapped the data from other papers against it. The atmospheric parameters for our cluster stars have also been revised and updated according to recent metallicity scales, colour–temperature relations and improved set of isochrones.

Key words: atlases – stars: fundamental parameters – globular clusters: general – galaxies: stellar content.

1 INTRODUCTION

This paper is the second one in a series whose ultimate goal is to provide single stellar population models in the optical spectral range on the basis of MILES (Sánchez-Blázquez et al. 2006, hereafter Paper I). MILES is a medium-resolution (2.3 Å FWHM) spectral stellar library in the region λλ3500–7500 Å consisting of 985 stars with an unprecedented coverage of stellar atmospheric parameters. The present paper is dedicated to provide a *homogenized* set of effective temperatures $T_{\rm eff}$, surface gravities $\log g$, and metallicities [Fe/H], for all the library stars, parameters necessary to make reliable stellar population model predictions. In the third paper of the series [Vazdekis et al., in preparation (hereafter Paper III)], the new stellar population models at the resolution and spectral range of MILES are going to be presented.

Stellar population models use stellar evolution theory, which predicts the fundamental stellar atmospheric parameters (such as $T_{\rm eff}$, $\log g$ and [Fe/H]) of the stars belonging to a stellar population of given age and metallicity. The relative contribution of the stars in the different evolutionary states is calculated by integrating along the mass distribution, assuming a given initial mass function. To make a high-quality stellar population model, one needs reliable stellar interior models – that include as many phases in the life of a star as possible – as well as a trustworthy conversion between the stellar parameters and the spectrum of the star.

In the past, people generally employed absorption-line strength indices when trying to constrain the stellar populations of galaxies, mostly using the Lick/IDS system (Gorgas et al. 1993, hereafter G93; Worthey et al. 1994, hereafter WOR). For each star across the isochrone, an index value was determined from its corresponding three stellar atmospheric parameters (sometimes using colours instead of $T_{\rm eff}$) using the so-called fitting functions, that is, polynomial functions relating the stellar parameters to the measured pseudo-equivalent widths (G93; WOR; Worthey & Ottaviani 1997). At present, a new generation of stellar population models goes beyond the prediction of individual features as these models synthe-

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size at once a full spectral energy distribution (SED; e.g. Vazdekis 1999; Vazdekis et al. 2003, hereafter VAZ03; Bruzual & Charlot 2003). For every set of parameters, they take the corresponding stellar spectrum from an observational or theoretical stellar library.

The price for predicting SEDs and keeping full information along the spectrum is the necessity of ensuring a much higher quality for the input ingredients for these models: the atmospheric parameters coverage, the spectral resolution and the relative flux calibration of the library stars, are essential issues to be taken into account. This is why we were motivated to perform the MILES project and obtain a new set of observed input spectra of stars of all spectral types, luminosity classes and metallicities at a spectral resolution that is high enough to ensure that the population synthesis of most galaxies – except for very low mass dwarfs – is not limited by the models but by the intrinsic broadening of the data. Although there exist other comparable stellar libraries available in the literature (see Paper I for an in-depth comparison), the better parameter coverage, the accurate flux calibration, as well as the large spectral range of MILES provide a quite significant improvement.

As regards to the atmospheric parameters, while not so critical for those models predictions based on fitting functions – in which interpolations within the parameter space are immediate – stellar libraries covering the atmospheric parameters in an ample and homogeneous way are essential to synthesize reliable, integrated spectra over a wide range of ages an metallicities. In this sense, a previous, thorough selection of stars was carried out for this project (see Paper I). Moreover, it is clear that uncertainties in the input atmospheric parameters of the library stars have important implications on the reliability and accuracy of the model predictions (e.g. Gorgas et al. 1999). In the literature, atmospheric parameters for most previous library stars are either taken from the most recent bibliographic sources at that time or assigned as average values of the existing determinations, without checking in any case whether they are on a completely homogeneous system. A common practice is to use straight means from previous parameter compilations (e.g. Cayrel de Strobel et al. 1997), even though the individual analyses do not necessarily all have the same quality or are mutually independent. We refer the reader to the work of Soubiran et al. (1998, hereafter SKC) for a thorough discussion of these and related problems. Furthermore, systematic deviations among different bibliographic sources may exist due to the different approaches for measuring atmospheric parameters.

Because of the above limitations, a special effort was started in Cenarro et al. (2001b, hereafter CEN01b) in order to construct a homogeneous atmospheric parameter system for the stars in the near-infrared (near-IR), CaT stellar library (Cenarro et al. 2001a, hereafter CEN01a). The present paper may be considered as a step forward in the work and procedure established in CEN01b. In this sense, we have derived an enlarged, homogeneous set of stellar atmospheric parameters for most stars in MILES. Section 2 presents the working procedure carried out in this paper to determine the atmospheric parameters of field stars, including data compilation and the calibration of the different bibliographic sources with respect to a standard, reference system. In Section 3, we have also recomputed the atmospheric parameters of all the cluster stars in MILES making use of colour–temperature relations and appropriate isochrones for each individual cluster, in a similar way as in G93. A brief summary of the paper is presented in Section 4 and, finally, tables containing the newly derived atmospheric parameters for the MILES stars are given in Appendix A.

2 ATMOSPHERIC PARAMETERS FOR FIELD STARS

Following the procedure carried out in CEN01b to determine a homogeneous set of atmospheric parameters for the field stars in the near-IR stellar library (CEN01a), one of the main goals of this paper is to construct a larger, homogenous set of atmospheric parameters for such stars in MILES. In the following paragraphs in this section, we explain the method used in this paper. For a more detailed explanation of the working procedure, we refer the reader to CEN01b. In short, it can be itemized in the following steps: (i) selection of a high-quality, standard reference of atmospheric parameters, (ii) bibliographic compilation of atmospheric parameters for the library stars, (iii) calibration and correction of systematic differences between the different sources and the standard reference system and (iv) determination of averaged, final atmospheric parameters for the library stars from all those references corrected on to the reference system.

2.1 The reference system

In order to establish a homogeneous system of atmospheric parameters, it is necessary to define an appropriate, initial reference system against which other sources are calibrated and corrected for systematic differences. Bearing in mind that the final purpose of this series of papers is stellar population modelling of SEDs, we are basically interested in ensuring that stars with very similar spectra have the same atmospheric parameters and the other way round. This is why, as in CEN01b, we have selected the work by SKC as our initial standard source, since it computes self-consistent atmospheric parameters for a total of 211 echelle spectra of stars with $4000 < T_{\rm eff} < 6300$ K over a wide range of log g and [Fe/H]. We refer the reader to Katz et al. (1998) for a detailed explanation of the spectroscopic method followed in SKC to derive atmospheric parameters.

2.2 Parameter compilation from bibliographic sources

Given that the stellar sample in SKC does not comprise all stars in MILES, we updated the previous, extensive compilation of atmospheric parameters in CEN01b by including data from recent publications and extending the search to all field stars in MILES. Overall, it attains 20 295 records, even though not all of them were finally employed to derive the final parameters. The catalogue of [Fe/H] determinations of F-, G- and K-type stars of Cayrel de Strobel, Soubiran & Ralite (2001) – that contains parameters for more than 3000 stars from 378 different sources up to 2000 – was our starting point. The compilation was enlarged with several additional sources to account for the most recent determinations as well as to include atmospheric parameters for early and very late spectral types which are not included in the above catalogue. It must be noted that, even for stars with data in Cayrel de Strobel et al. (2001), we checked the original data sources to exclude references that simply quoted previous determinations.

2.3 Calibration and correction of bibliographic sources

Once the compilation was finished, we carried out the iterative procedure performed in CEN01b to end up with a homogeneous system of stellar atmospheric parameters.

Most original sources giving any of the three atmospheric parameters for MILES stars were calibrated and bootstrapped against the reference system making use of all stars in common between both samples. This was done separately for each of the three atmospheric parameters (when available) by comparing the parameter values provided by a certain source (p) against those in the reference system ($p_{\rm ref}$) for the common subsample of stars. The resulting trends were quantified by fitting both a linear relationship ($p = A + B\,p_{\rm ref}$) and a constant offset ($p = A + p_{\rm ref}$). Using a t-test and a significance level of $\alpha = 0.1$, we checked the significance of the derived fits, that is, whether B – for the linear fit – and A – for the offset fit – were significantly different from 1 and 0, respectively. If only one of the two fits was significant, we adopted it to bootstrap the data from the source against the reference system. In case that both fits turned out to be significant, we preferred to keep and apply the linear correction. Obviously, when none of the fits were statistically significant, the one-to-one relationship could be assumed and the original parameters were kept.

To ensure that comparisons between any source and the reference system were statistically significant, a first iteration of the above procedure was carried out for all those sources that had, at least, 25 stars in common with the complete sample of SKC for any of the three atmospheric parameters. All the stars whose parameters were coming from references calibrated and corrected in this way constitute a new category of reference stars we refer to as RF1. They were added to the original reference system, thus enlarging the initial sample SKC and constituting a new, larger reference system (SKC & RF1). The whole above procedure was thus repeated for the rest of original sources using SKC & RF1 as reference system. Since, in general, the number of stars in the remaining, non-calibrated sources was small, the minimum number of stars in common with the reference system required to calibrate a given source was set to be only 15. This lead to a second set of final parameters which is called RF2. We did not perform further iterations since those sources that had not been calibrated yet did not possess enough stars in common with the new reference system (SKC & RF1 & RF2) to ensure reliable calibrations.

Finally, for each of the three atmospheric parameters, an estimation of the quality of the distinct calibrated sources was determined by computing the rms s.d. of the *corrected* parameter values with respect to those given in the reference system for all the stars in common. As it will be explained later, weighted according to the data quality, the various, corrected data sources for each single star were averaged to provide a final homogeneous set of atmospheric measurements.

It is important to note that, since the original reference system of the whole iterative procedure is SKC, all the above calibrations will in principle be valid for stars within the $T_{\rm eff}$ range spanned by that work, that is, from 4000 to 6300 K. In turn, we did not follow a fully automatic approach and the original parameters for every star were checked for inconsistencies or outliers, removing original references when necessary. Note also that, since the procedure is separately carried out for $T_{\rm eff}$, $\log g$ and [Fe/H], the number of stars within the subsequent reference categories (SKC & RF1 and SKC & RF1 & RF2) for each of the three parameters does not have to be necessarily the same.

In Tables 1–3 we present, respectively, the details of the calibrations on $T_{\rm eff}$, $\log g$ and [Fe/H] for all the calibrated sources, with reference codes for these sources being given in Table 4. The above tables also include a code indicating the different methods used in each original paper to derive the atmospheric parameters. Note that, although the tabulated, rms s.d. values (σ) are due to uncertainties both in the SKC parameters and in the calibrated reference, a relative comparison of the different values could in principle provide an estimate of the reliability of the different methods. Even though

Table 1. Calibrations of bibliographic sources to convert their effective temperatures on to the reference system. Column description: Code (reference code of the bibliographic source; see Table 4); M (method used to derive temperatures in that source: (a) Infrared flux method; (b) spectroscopic methods; (c) from colour relations); N (number of stars in common with the standard source); Fit (type of calibration applied to correct the original data; s: straight line; o: offset; n: none); S (standard source; 1: SKC; 2: SKC & RF1); σ (rms s.d. from the fit); A and B (independent term and slope of the applied fit; $p = A + B\,p_{\rm ref}$, with p and $p_{\rm ref}$ being generic atmospheric parameters – $T_{\rm eff}$ in this case – from the source and the reference system, respectively); $T_{\rm eff}$ (temperature validity regime of the fit). Values from JON and WOR only include original determinations, that is, parameters taken from other sources were not employed (this also holds for Tables 2 and 3).

Code	M	N	Fit	S	σ	A	B	$T_{\rm eff}$
AAM	a	67	n	1	98.0	0.0	1.0	4300, 6400
AFG	b	30	n	1	124.0	0.0	1.0	5600, 6400
BAL	c	24	o	2	107.2	47.5	1.0	5900, 6400
BLG	a	27	o	2	61.8	51.0	1.0	4200, 6250
BOV	c	18	n	2	132.1	−74	1.0	4150, 5450
BSL	c	39	s	1	66.0	396.5	0.9118	4000, 5100
CLG	c	37	o	2	54.0	126	1.0	4600, 6100
CLL	c	40	n	1	76.0	0.0	1.0	4600, 6300
CNZ	c	30	o	2	81.8	−41.5	1.0	5600, 6300
CTL	bc	17	s	2	48.0	928.5	0.8347	5200, 6350
CTS	b	18	o	2	90.5	−111.5	1.0	4500, 5050
EAG	c	36	o	1	60.0	39.9	1.0	5650, 6350
FHR	b	35	o	2	81.6	53.7	1.0	5000, 6350
FLB	b	61	n	1	114.0	0.0	1.0	4200, 6400
FRC	c	15	o	2	65.0	−61.0	1.0	3750, 5150
FUH	-	25	o	2	63.3	45.0	1.0	5200, 6400
GCC	c	65	s	1	86.0	−178.8	1.0397	4100, 6500
GGR	b	16	o	2	37.0	64.0	1.0	4300, 5100
GRJ	b	35	o	2	108.9	50.0	1.0	4300, 6300
GRO	c	15	o	2	126.3	110.0	1.0	3950, 5600
GRS	c	25	n	1	116.0	0.0	1.0	3800, 6100
GRT	c	17	s	2	101.8	424.1	0.9178	4050, 6250
GSC	c	34	o	2	92.5	129.0	1.0	4200, 6150
HEA	c	26	s	2	69.1	887.1	0.8	5000, 6300
HWA	c	17	o	2	105.0	−663.6	1.0	3750, 5200
JON	c	105	n	2	87.5	0.0	1.0	4200, 5300
KSP	b	17	o	2	81.3	64	1.0	4300, 6050
LAI	c	73	o	2	76.7	−37.0	1.0	4750, 6300
LBO	c	21	n	2	195.3	0.0	1.0	4250, 6100
LCH	c	35	o	2	61.7	−63.0	1.0	3850, 5050
LRS	b	19	o	2	85.0	242.0	1.0	3900, 5350
MAS	c	38	s	1	83.0	2852.0	0.5450	5900, 6300
MCW	c	62	n	1	86.0	0.0	1.0	3900, 5900
MEH	b	22	o	2	167.6	21.5	1.0	3900, 6100
MGN	c	18	n	2	65.0	0.0	1.0	5600, 6300
NHS	c	33	n	2	92.2	0.0	1.0	4700, 6350
OIN	b	18	n	2	118.2	0.0	1.0	3600, 5400
ONS	b	16	o	2	58.15	41.0	1.0	4000, 5650
PET	c	29	o	2	110.6	−75.0	1.0	4450, 6400
PSB	c	26	s	1	101.0	517.7	0.9042	4300, 6000
PSK	bc	32	n	2	113.3	0.0	1.0	4050, 5550
RBM	bc	32	o	2	87.0	−33.5	1.0	5200, 6200
SAH	a	16	n	2	30.0	0.0	1.0	5800, 6400
SIC	b	22	n	2	140.4	0.0	1.0	4150, 6350
TAY	abc	62	s	1	92.0	1075.9	0.8166	4800, 6200
TID	b	35	n	1	75.0	0.0	1.0	4300, 6300
TLA	b	27	o	2	110.5	66.0	1.0	4200, 5400
TLL	c	31	o	2	99.2	−40.0	1.0	4700, 6250
WOR	c	44	n	1	74.0	0.0	1.0	4100, 6100

Table 2. Calibrations of bibliographic sources to convert their surface gravities on to the reference system. Columns are the same as in Table 1. Methods employed to derive gravities: (a) spectroscopic method, (b) physical method (parallaxes), (c) physical method (luminosities from photometric indices), (d) physical method (luminosities from Ca K line), (e) photometric and (f) other.

Code	M	N	Fit	S	σ	A	B	log g
AFG	a	30	n	1	0.27	0.0	1.0	2.5, 4.8
BAL	c	30	o	2	0.13	0.095	1.0	3.8, 4.3
BSL	cd	39	n	1	0.19	0.0	1.0	1.4, 3.9
CLG	be	33	o	2	0.177	0.16	1.0	2.3, 4.9
CNZ	b	31	s	2	0.08	1.767	0.581	3.9, 4.5
CTL	bc	18	o	2	0.154	−0.085	1.0	3.5, 4.7
CTS	a	18	n	2	0.275	0.0	1.0	1.7, 3.3
EAG	f	36	o	1	0.12	0.042	1.0	3.9, 4.6
FHR	a	37	n	2	0.12	0.0	1.0	3.1, 4.7
FLB	a	61	n	1	0.25	0.0	1.0	0.5, 4.9
FRC	e	15	s	2	0.256	0.6465	0.6164	1.3, 2.9
FUH	-	23	s	2	0.11	0.961	0.760	3.5, 4.7
GCC	a	65	s	1	0.24	−0.200	1.077	0.0, 5.2
GGR	a	16	o	2	0.305	−0.365	1.0	0.9, 3.2
GRS	b	24	o	1	0.30	0.139	1.0	0.7, 4.5
GRT	a	16	s	2	0.315	0.3381	0.8076	1.0, 4.4
GSC	b	34	o	2	0.20	0.145	1.0	0.5, 5.0
HEA	b	23	n	2	0.17	0.0	1.0	3.1, 4.7
HWA	a	17	o	2	0.24	−0.23	1.0	1.7, 2.9
KNK	e	28	o	1	0.14	0.075	1.0	4.0, 4.7
KSP	a	15	o	2	0.281	0.14	1.0	0.6, 4.5
LAI	ab	72	n	2	0.25	0.0	1.0	2.1, 5.1
LBO	a	17	n	2	0.45	0.0	1.0	0.0, 3.9
LCH	ad	35	o	2	0.39	−0.420	1.0	0.2, 3.1
LRS	a	18	o	2	0.238	0.33	1.0	1.0, 4.0
MAM	b	16	n	2	0.092	0.0	1.0	3.5, 4.7
MAS	e	38	o	1	0.40	0.247	1.0	3.8, 5.0
MCW	bd	62	o	1	0.21	0.233	1.0	1.6, 4.2
MGN	a	18	o	2	0.159	−0.295	1.0	3.0, 4.4
NHS	b	33	o	2	0.17	0.14	1.0	3.1, 4.8
OIN	a	17	s	2	0.179	0.5467	0.8392	1.4, 4.7
PSK	cf	29	n	2	0.26	0.0	1.0	0.1, 3.0
SAH	e	20	s	2	0.065	1.972	0.5449	3.8, 4.5
TID	a	35	o	1	0.13	0.13	1.0	1.9, 4.8
TLA	a	23	n	2	0.29	0.0	1.0	0.5, 4.8
TLL	a	31	n	2	0.26	0.0	1.0	2.5, 5.1
WOR	f	34	n	1	0.33	0.0	1.0	1.0, 4.8

a critical analysis of these techniques is out of the scope of this paper, it must be noted that we do not find any systematic trend when comparing the uncertainties (σ) or the calibration parameters (the derived slopes and independent terms) of the different working methods.

2.4 Final atmospheric parameters for field stars

As in CEN01b, the final set of atmospheric parameters for field stars has been derived in different ways depending on the original literature sources which were available in each case. Table A1 lists the final derived atmospheric parameters for all the field stars in MILES. A synthesized recipe of the different approaches and resulting parameter categories is given in Table 5. A more detailed explanation follows below.

(i) If the star is included in the original, reference sample of SKC, the three atmospheric parameters from that paper were kept (coded SKC). This turned out to be the case for 164 stars of our sample.

Table 3. Calibrations of bibliographic sources to convert their metallicities on to the reference system. Columns are the same as in Table 1. Methods employed to compute metallicities: (a) high resolution (<0.5 Å) spectroscopy, (b) mid-resolution (>0.5 Å) spectroscopy, (c) photometry and (d) spectrophotometry.

Code	M	N	Fit	S	σ	A	B	[Fe/H]
AAM	ac	68	s	1	0.22	−0.006	1.065	−3.0, +0.4
AFG	a	30	s	1	0.13	−0.120	0.858	−2.5, −0.4
BAL	a	31	o	2	0.11	−0.060	1.000	−0.7, +0.4
BKP	b	27	s	1	0.21	−0.324	0.829	−3.1, −1.0
BSL	a	39	n	1	0.19	0.0	1.0	−0.8, +0.5
CGC	a	36	o	2	0.13	0.125	1.0	−2.6, −0.7
CLG	ac	37	o	2	0.153	0.19	1.0	−2.2, −0.1
CLL	a	41	s	1	0.10	0.029	1.070	−2.7, +0.2
CNZ	a	33	s	2	0.08	−0.096	0.798	−1.2, +0.2
CTL	a	18	n	2	0.081	0.0	1.0	−0.9, +0.4
CTS	a	18	s	2	0.116	−0.2466	0.5662	−1.0, +0.2
EAG	a	36	s	1	0.05	−0.047	0.925	−1.1, +0.2
FHR	a	35	n	2	0.09	0.0	1.0	−2.1, +0.4
FLB	a	61	o	1	0.14	0.10	1.0	−3.0, −0.3
FRA	a	19	o	2	0.119	−0.09	1.0	−2.7, +0.1
FRC	a	15	n	2	0.183	0.0	1.0	−1.1, +0.3
FUH	-	23	n	2	0.08	0.0	1.000	−2.2, +0.5
GCC	a	65	s	1	0.10	−0.002	0.947	−3.0, +0.2
GGR	a	16	o	2	0.155	0.105	1.000	−0.6, +0.3
GRO	a	19	s	2	0.138	−0.1274	0.8359	−2.8, −0.1
GRS	a	25	n	1	0.18	0.0	1.0	−2.4, +0.2
GRT	a	17	o	2	0.117	−0.12	1.0	−2.4, −0.1
GSC	a	34	o	2	0.09	0.094	1.0	−2.2, −0.8
HEA	a	23	n	2	0.18	0.0	1.0	−1.1, +0.4
HWA	a	17	o	2	0.137	−0.14	1.0	−0.8, +0.3
JON	d	98	o	2	0.12	0.075	1.0	−1.0, +0.6
KNK	c	32	s	1	0.09	−0.036	0.911	−2.1, +0.2
KSP	a	17	n	2	0.14	0.0	1.0	−3.0, −1.3
LAI	b	72	o	2	0.16	−0.082	1.0	−2.6, +0.5
LBO	a	27	o	2	0.12	0.140	1.0	−3.0, −0.5
LCH	a	33	s	2	0.16	−0.037	0.752	−0.5, +0.3
LRS	a	19	n	2	0.109	0.0	1.0	−0.6, +0.3
LUB	a	26	o	2	0.13	0.095	1.0	−3.0, −0.6
MAS	c	39	s	1	0.12	−0.040	0.630	−1.0, +0.2
MCW	a	62	o	1	0.09	−0.062	1.0	−0.7, +0.2
MGN	a	18	o	2	0.08	−0.256	1.0	−3.0, −1.1
NHS	c	33	o	2	0.15	0.070	1.0	−2.6, −1.0
OIN	d	15	n	2	0.114	0.0	1.0	−0.4, +0.4
PET	a	28	n	2	0.15	0.0	1.0	−2.7, −0.5
PSB	a	26	n	1	0.11	0.0	1.0	−3.2, −0.7
PSK	a	35	o	2	0.15	0.0	1.0	−3.0, −0.9
RBM	a	32	o	2	0.17	−0.080	1.0	−2.7, +0.4
SAH	c	19	o	2	0.082	−0.080	1.0	−0.9, +0.3
SIC	ab	20	n	2	0.15	0.0	1.0	−1.9, +0.6
THE	a	12	n	1	0.13	0.0	1.0	−2.9, +0.4
TID	a	35	o	1	0.08	0.16	1.0	−2.6, +0.0
TLA	a	27	o	2	0.13	−0.090	1.0	−2.0, +0.0
TLL	a	31	o	2	0.10	−0.129	1.0	−3.0, −1.0
WAL	b	27	o	2	0.16	0.100	1.0	−2.6, +0.4
WOR	a	182	n	2	0.18	0.0	1.0	−2.7, +0.5
ZAS	c	63	s	2	0.15	−0.071	0.604	−1.1, +0.2

(ii) When the star is not included in the sample of SKC but in N previously calibrated sources, and the original parameters are within the calibration ranges listed in Tables 1–3, the new parameters P were determined by taking the weighted average:

$$P = \frac{\sum_{i=1}^{N} p_i^* / \sigma_i^2}{\sum_{i=1}^{N} 1/\sigma_i^2}, \qquad (1)$$

Table 4. Codes for calibrated original references in Tables 1, 2 and 3.

Code	Reference	Code	Reference	Code	Reference
AAM	Alonso et al. (1996a)	GGR	Gratton et al. (1982)	MGN	Magain (1989)
AFG	Axer, Fuhrmann & Geheren (1994)	GRJ	Gray & Johanson (1991)	NHS	Nissen, Hoeg & Schuster (1997)
BAL	Balachandran (1990)	GRO	Gratton & Ortolani (1984)	OIN	Oinas (1974)
BKP	Beers et al. (1990)	GRS	Gratton & Sneden (1987)	ONS	O'Neal, Neff & Saar (1998)
BLG	Blackwell & Lynas-Gray (1994)	GRT	Gratton (1989)	PET	Peterson (1981)
BOV	Bohm-Vitense (1992)	GSC	Gratton et al. (2000)	PSB	Pilachowski, Sneden & Booth (1993)
BSL	Brown et al. (1989)	HEA	Hearnshaw (1974)	PSK	Pilachowski, Sneden & Kraft (1996)
CGC	Carretta et al. (2000)	HWA	Helfer & Wallerstein (1968)	RBM	Rebolo, Beckman & Molaro (1988)
CLG	Clementini et al. (1999)	JON	Jones (1997)	SAH	Saxner & Hammarback (1985)
CLL	Carney et al. (1994)	KNK	Kunzli et al. (1997)	SIC	Silva & Cornell (1992)
CNZ	Chen et al. (2000)	KSP	Krishnaswamy-Gilroy et al. (1988)	TAY	Taylor (1994)
CTL	Clegg, Tomkin & Lambert (1981)	LAI	Laird (1985)	THE	Thévenin (1998)
CTS	Cottrell & Sneden (1986)	LBO	Luck & Bond (1985)	TID	Thévenin & Idiart (1999)
EAG	Edvardsson et al. (1993)	LCH	Luck & Challener (1995)	TLA	Tomkin & Lambert (1999)
FHR	Fuhrmann (1998)	LRS	Lambert & Ries (1981)	TLL	Tomkin et al. (1992)
FLB	Fulbright (2000)	LUB	Luck & Bond (1983)	WAL	Wallerstein (1962)
FRA	Francois (1986)	MAM	Malagnini & Morossi (1990)	WOR	Worthey et al. (1994)
FRC	Fernández-Villacañas, Rego & Cornide (1990)	MAS	Marsakov & Shevelev (1995)	ZAS	Zakhozhaj & Shaparenko (1996)
FUH	K. Fuhrmann (private communication)	MCW	McWilliam (1990)		
GCC	Gratton, Carretta & Castelli (1996)	MEH	Meyer et al. (1998)		

Table 5. Brief explanation for the different methods to derive the atmospheric parameters.

SKC	From Soubiran et al. (1998)
RF1	From calibrated and corrected sources on to SKC
RF2	From calibrated and corrected sources on to RF1 & SKC
RF3	From non calibrated sources
RF6	From spectral type and luminosity class (Lang 1991)

where p_i^* is the corrected parameter and σ_i corresponds to the rms s.d. of the comparison with the reference system (SKC or RF1 & SKC; see Tables 1–3). It is important to note that, when the applied correction was either an offset or a linear relation with slope $\sim$1, we allowed small extrapolations of the derived fits to obtain the parameters of stars slightly out of the validity regime. Most (see below) of the atmospheric parameters of the stellar library presented here have been derived in this way (coded RF1 and RF2).

(iii) When the star is not included in any calibrated source (or, if included, the atmospheric parameters are well out of the calibration range), the final parameter is the raw mean value from all the available original sources and no previous correction to the parameter value has been applied.
Unlike CEN01b, in this paper we preferred not to make any category distinction on the basis of the $T_{\rm eff}$ of the star whose parameters were derived in this way, so this category is unique and coded RF3. Obviously, the final parameters of stars within RF3 are expected to be less reliable than those obtained from calibrated sources. Since their absolute uncertainties are known to depend on the $T_{\rm eff}$ regime (parameter determinations are in general more reliable for intermediate temperatures stars than for early and late spectral types), an estimation of relative errors for different temperature regimes is given below.

(iv) If there is no available data in the literature, both $T_{\rm eff}$ and $\log g$ are estimated from the spectral type and the luminosity class using the tabulated atmospheric data from Lang (1991). Only a few parameters (0.7 per cent of the temperature estimations and 1.8 per cent for gravities) were derived in this way, which we coded as RF6 to follow the notation in CEN01b.

With the aim of checking our results and detecting inconsistencies between stellar spectra and their assigned, final parameters, we compared the spectrum of every single star with an average one resulting from the interpolation of the rest of stars in MILES at exactly the same stellar parameters as those of the problem star. In order to do this we employed the interpolator code described in VAZ03. This allowed us to find a few stars whose spectral types were not compatible with their assigned parameters, the ones were just removed from the table if no apparent reason was found to drive the observed discrepancy.

To summarize, Fig. 1 illustrates the number of stars with final atmospheric parameters in each different category. A total of 893 temperatures, 893 gravities and 857 metallicities were derived for the 896 field stars of the stellar library. It is worth noting that most of the $T_{\rm eff}$ (72.5 per cent), $\log g$ (66.9 per cent) and [Fe/H] (75.1 per cent) values were either taken from the initial reference system (SKC) or derived from calibrated and corrected original sources (RF1 and RF2).

As far as the uncertainties of the derived parameters are concerned, we mostly reproduce the values derived in CEN01b for the distinct categories. We therefore refer the reader to Section 5 in the above paper for a detailed explanation of the error estimation. In

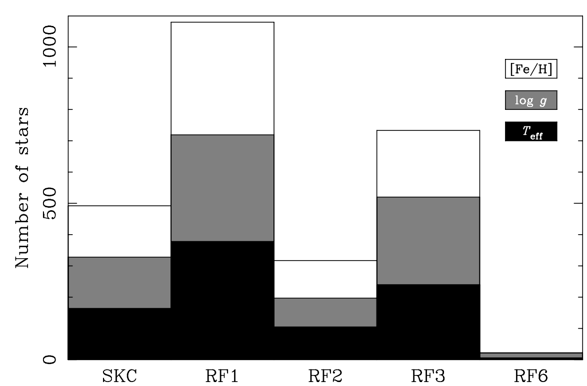

Figure 1. Histogram illustrating the total number of stars with effective temperature (black), gravity (grey) and metallicity (white) in each category.

RF1 and RF2, typical errors of ∼60 K, 0.2 and 0.1 dex are derived for $T_{\rm eff}$, log *g* and [Fe/H], respectively. Clearly the accuracy of the stellar atmospheric parameters in the RF1 and RF2 categories is much higher than those in the RF3 and RF6 categories, where calibrations have not been applied. Relative uncertainties for $T_{\rm eff}$ values of stars in RF3 have been measured to be ∼2 and ∼5 per cent for intermediate spectral types ($4000 < T_{\rm eff} < 6300$ K) and extreme spectral types ($T_{\rm eff} > 6300$ K; $T_{\rm eff} < 4000$ K), respectively. Also, the fact that our uncertainties are pretty consistent with those given in CEN01b proves that we are indeed measuring the intrinsic uncertainties among different sources and the results are not affected by small-number statistics.

Finally, we compared the parameters that we obtained with those in CEN01b. For about 200 out of the 343 stars in common there is no difference, since our parameters are based on the same literature references. For most of the other stars the differences are not large. In the case of effective temperatures, the difference is more that 200 K for only 13 stars. For nine stars log *g* is different by more than 0.3 dex, and for 12 stars [Fe/H] differs by more than 0.1 dex. The good agreement is not surprising, since in this paper we have used the same method as in CEN01b.

A detailed table containing all the original data that were used to derive the final atmospheric parameters of the stellar library is available from: http://www.ucm.es/info/Astrof/miles/miles.html.

3 ATMOSPHERIC PARAMETERS FOR CLUSTER STARS

The stellar sample presented in this series of papers constitutes an extension of both the Lick/IDS stellar library (G93, WOR) and the near-IR CaT stellar library (CEN01a), with 241 and 403 stars in common, respectively. The above two spectral libraries included a large sample of open and globular cluster stars, some of which have been retained in the present version. In this section we revise the atmospheric parameters of these cluster stars and describe the procedures carried out to derive such parameters. An updated list with recent determinations of mean metallicity [Fe/H], colour excess $E(B-V)$, apparent visual distance modulus $(m-M)_V$, and age for each cluster is presented in Table 6. Also, the final parameters adopted for each single star are presented in Table A2.

3.1 Metallicity scale

Following the criteria adopted for the CAT library, rather than using the Zinn & West (1984, hereafter ZW84) metallicity scale employed in G93, the metallicity scale of the globular clusters has been established to be the one defined by Carretta & Gratton (1997, hereafter CG97; see also Rutledge, Hesser & Stetson 1997). The difference between both scales is specially important at the intermediate metallicity regime, where the ZW84 scale underestimates the metallicities as compared to the CG97 system for up to ∼0.3 dex (e.g. M3, M5). The contrary occurs for the most metal-rich clusters, as in this case ZW84 metallicities are ∼0.1 dex larger than CG97 ones. In this sense, a very interesting case is that of M71, the globular cluster with the highest [Fe/H] of our sample. On the basis of the Ca II triplet strength, CEN01b discussed that, in general, the departure of the CaT indices of globular cluster stars from the index values predicted by the fitting functions derived in Cenarro et al. (2002, hereafter CEN02) were significantly reduced when using the CG97 scale instead of the ZW84 one. Even so, CEN02 still reported the existence of negative CaT residuals for M71 stars that could only be reasonably explained if their metallicities were lower (-0.84 ± 0.06 dex) than given by CG97 (−0.70 dex). The last result is supported by recent spectroscopic determinations of the metallicity of this cluster: -0.79 ± 0.04 dex (Sneden et al. 1994), between −0.90 and −0.75 dex (Grundahl, Stetson & Andersen 2002), -0.80 ± 0.05 dex (King, Boesgaard & Deliyannis 2005), -0.80 ± 0.06 dex (Boesgaard et al. 2005), so we decided to keep [Fe/H] = − 0.84 dex from CEN02 as a reliable value of the metallicity of M71.

Concerning the open clusters in our sample, we have adopted the metallicity scale constructed by Gratton (2000) as it also relies on the basis of high-resolution spectroscopy. In that work, making use of a compilation of open clusters with metallicities determined from different techniques, abundances derived from photometric indices and low-resolution spectroscopy are recalibrated and corrected against high dispersion, spectroscopic determinations. The final abundances are weighted averages of all the single – corrected – abundances. We refer the reader to the above paper for further details on the procedure.

3.2 Effective temperatures

Because direct determinations of $T_{\rm eff}$ for cluster stars are not usual, they have been determined following the same procedure carried out in CEN01b, that is, by using the empirical, colour–temperature relations for giant, dwarf and subdwarf stars from Alonso, Arribas & Martínez-Roger (1996b, 1999; hereafter we will refer to both references as ALO). In particular, relations involving $(B-V)$ and $(V-K)$ are the ones considered in this paper.

As demonstrated in CEN01b, temperatures derived from the above $(V-K)$–temperature relations are consistent with the ones established by reference system of this paper (SKC), whilst those resulting from the $(B-V)$ relations exhibit a minor offset of 26 K that has been applied to correct and bootstrap the predicted data against the reference system. In this way, the homogeneity and consistency of effective temperatures within the whole stellar library are guaranteed.

Final $T_{\rm eff}$ values for cluster stars were calculated as an average of the values derived from $(B-V)$ and $(V-K)$ relations. If $(B-V)$ was only available, the corrected temperature derived from this colour was kept. Since the above colour–temperature relations in turn depend on surface gravity and metallicity, a previous estimate of both parameters was necessary for each star. In this sense, input metallicities for each star were the ones established in Table 6. Input surface gravities were taken from G93 and WOR for all stars in common with the Lick/IDS library. For the rest of stars, we primarily made use of the compilation of Cayrel de Strobel et al. (1997; e.g. Clementini et al. 1994a for M4 stars). If no data for surface gravity was available in the literature, a tentative value was derived from $(B-V)$ and M_V making use of the tabulated atmospheric data from Lang (1991). Sources for input photometric data are specified in Table 6. In all cases, appropriate reddening corrections were applied using the colour excesses given in that table and assuming an $E(V-K)/E(B-V)$ value of 2.744 (Harris, Woolf & Rieke 1978).

It is important to note that, since the colour–temperature calibrations employed here are just defined for a given range of effective temperatures ($T_{\rm eff} \leqslant 8000$ K), temperatures for a few early spectral types in our star sample had to be obtained by means of extrapolations of the above relations. For HD109307, in Coma Berenices, we derive $T_{\rm eff} = 8471$ K which is in perfect agreement with the value determined by Boesgaard (1987), so the former value was kept. For the Hyades star HD27962 we obtain 9092 K, which is

Table 6. Basic data for clusters: reddening $E(B-V)$, apparent visual distance modulus $(m-M)_V$, age and metallicity [Fe/H]. Key codes of sources for the above data: BER92 (Bergbusch & Vandenberg 1992); CEN02 (Cenarro et al. 2002); CG97 (Carretta & Gratton 1997); CHA99 (Chaboyer, Green & Liebert 1999); GR00 (Gratton 2000); GRU02 (Grundahl et al. 2002); GVA98 (Grundahl, Vandenberg & Andersen 1998); HAN04 (Hansen et al. 2004); HAR03 (Catalogue of Galactic Globular Clusters by Harris 1996; revised version of 2003); KH05 (Catalogue from Kharchenko et al. 2005, and references therein); LMG94 (Loktin, Matkin & Gerasimenko 1994; $(m-M)_V$ is derived from the distance and the reddening); REY01 (Rey et al. 2001); TWA85 (Twarog & Tyson 1985); TWA97 (Twarog, Ashman & Anthony-Twarog 1997); TWA99 (Twarog, Anthony-Twarog & Bricker 1999); VAN83 (VandenBerg 1983); VAN00 (VandenBerg 2000). Key codes for sources of photometric data: A&H71 (Arp & Hartwick 1971); A&L80 (Alcaino & Liller 1980); B&S58 (Burbidge & Sandage 1958); CAR82 (Carney 1982); CLE94 (Clementini et al. 1994b); CUD85 (Cudworth 1985); FPC83 (Frogel, Persson & Cohen 1983); G93 [Gorgas et al. 1993, and references therein. V magnitudes were transformed from M_V and $(m-M)$ as given in tables 3 and 4 of that paper. $(V-K)$ data were only considered when not interpolated from $B-V$; see caption of table 3 in that paper]; MCN80 (McNamara 1980); MOR78 (Morel & Magnenat 1978); S&H77 (Stetson & Harris 1977); STE03 (Stetson, Bruntt & Grundahl 2003); WOR (Worthey et al. 1994, and references therein; table A2B in that paper); WEB-codes taken from the 'webda' data base of Open Clusters at http://www.univie.ac.at/webda/ (0014: Johnson & Knuckles 1955; 0106: McClure, Forrester & Gibson 1974; 0191: Gieren 1981; 0312: Stauffer 1982; 1091: Johnson et al. 1966).

Cluster names		Type	$E(B-V)$	$(m-M)_V$	Age (Gyr)	[Fe/H]	Photometric sources
Alpha Per	Mel 20	Open	0.09	6.67	0.04	−0.05	V and $(B-V)$ from WEB-1091
			KH05	KH05	KH05	GR00	No $(V-K)$
Coma Ber	Mel 111	Open	0.01	4.62	0.49	−0.05	V and $(B-V)$ from WEB-0014
			LMG94	LMG94	LMG94	GR00	No $(V-K)$
Hyades	Mel 25	Open	0.01	3.44	0.63	+0.13	V and $(B-V)$ from WEB-0014
			LMG94	LMG94	LMG94	GR00	$(V-K)$ from CAR82 and MOR78
Pleiades	Mel 22	Open	0.02	5.63	0.12	−0.03	V and (B-V) from WEB-0312
			KH05	KH05	KH05	GR00	No $(V-K)$
M3	NGC 5272	Globular	0.01	15.12	10.30	−1.34	V and $(B-V)$ from G93
			HAR03	HAR03	REY01	CG97	$(V-K)$ from G93
M4	NGC 6121	Globular	0.36	12.51	12.10	−1.19	V and $(B-V)$ from CLE94
			HAR03	HAN04	HAN04	CG97	No $(V-K)$
M5	NGC 5904	Globular	0.03	14.46	15.00	−1.11	V and $(B-V)$ from G93 and WOR
			HAR03	HAR03	VAN83	CG97	$(V-K)$ from G93
M13	NGC 6205	Globular	0.02	14.44	12.00	−1.39	V and $(B-V)$ from G93
			GVA98	GVA98	GVA98	CG97	$(V-K)$ from G93
M25	IC 4725	Open	0.45	10.36	0.07	+0.17	V and $(B-V)$ from WEB-0191
			KH05	KH05	KH05	GR00	No $(V-K)$
M67	NGC 2682	Open	0.06	9.98	2.57	+0.02	V and $(B-V)$ from G93
			KH05	KH05	KH05	GR00	$(V-K)$ from G93
M71	NGC 6838	Globular	0.27	13.71	12.00	−0.84	V and $(B-V)$ from G93, CUD85 and A&H71
			GRU02	GRU02	GRU02	CEN02	$(V-K)$ from G93
M79	NGC 1904	Globular	0.01	15.59	16.00	−1.37	V and $(B-V)$ from S&H77
			HAR03	HAR03	BER92	CG97	$(V-K)$ from FPC83
M92	NGC 6341	Globular	0.02	14.64	14.00	−2.16	V and $(B-V)$ from G93
			HAR03	HAR03	VAN00	CG97	$(V-K)$ from G93
NGC 288	Mel 3	Globular	0.03	14.95	11.51	−1.07	V and $(B-V)$ from A&L80
			HAR03	VAN00	VAN00	CG97	$(V-K)$ from FPC83
NGC 2420	Mel 69	Open	0.05	12.31	1.90	−0.44	V and $(B-V)$ from WEB-0106
			TWA97	TWA99	TWA99	GR00	No $(V-K)$
NGC 6791		Open	0.10	13.68	8.00	+0.40	V and $(B-V)$ from STE03
			CHA99	CHA99	CHA99	GR00	No $(V-K)$
NGC 7789	Mel 245	Open	0.31	12.30	1.50	−0.13	V and $(B-V)$ from MCN80 and B&S58
			TWA85	TWA85	TWA85	GR00	No $(V-K)$

well consistent with different determinations compiled by Cayrel de Strobel et al. (1997). Finally, as suggested in B & S58 and latter confirmed by McNamara (1980), NGC 7789 342 is a blue straggler rather than a horizontal branch star. On the basis of its $(B-V)$ colour (McNamara 1980) and corresponding luminosity class, both the spectral type (B9) and temperature ($T_{\rm eff} \sim 10\,500$ K) inferred from Lang (1991) are consistent with the temperature derived from the colour–metallicity calibration (∼10 000 K). We are therefore confident that the temperatures derived as extrapolations of the colour–temperature relations are still safe for most cases considered in this paper. In this sense, the temperature derived in this way for the horizontal branch star M5 II-53 (9441 K) was kept instead of the value given in WOR (10 460 K).

3.3 Surface gravities

Surface gravities for cluster stars were estimated by matching the location of each star in a M_V –$T_{\rm eff}$ diagram to evolutionary tracks, which is basically the same procedure carried out by G93 for the Lick/IDS cluster stars. In this paper, however, we use the improved set of isochrones from Girardi et al. (2000) after being transformed to the observational plane (colours and magnitudes) on the basis of the empirical relations given in ALO (see details in VAZ03). It is worth noting that the above isochrone set is the same as employed by our group for stellar population synthesis modelling (e.g. VAZ03), so the surface gravities derived in this way will be fully consistent with the values demanded by the spectral synthesis procedure (Paper III).

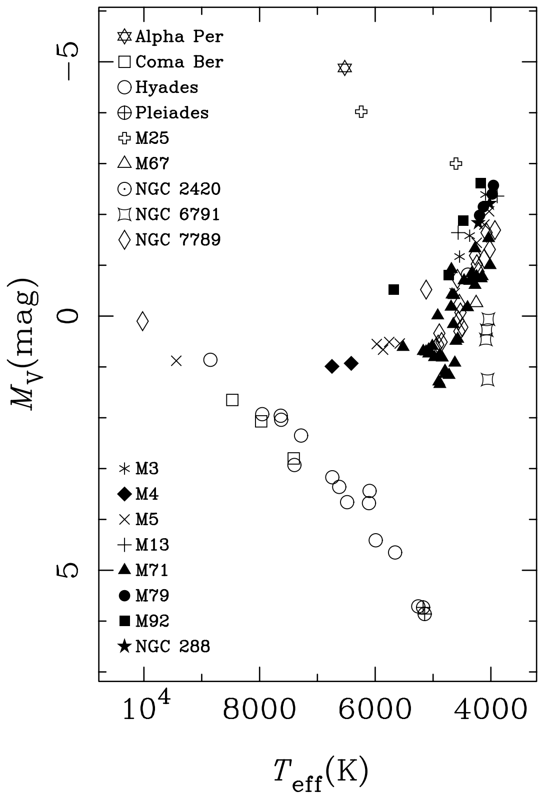

Figure 2. Pseudo-HR diagram of cluster stars for which atmospheric parameters have been computed. Different symbols correspond to stars in different open (open symbols) and globular (filled and line symbols) clusters as shown in the top and bottom keys, respectively. Absolute magnitudes are derived from the photometric data, reddenings and distance moduli given in Table 6. Effective temperatures are computed from colour–temperature calibrations as explained in Section 3.2.

Effective temperatures are the ones derived in Section 3.2. Reddening-corrected values of M_V were computed assuming a Galactic extinction law with $R_V = 3.1$ and deriving the V-band extinction A_V. Sources of photometric data, as well as the adopted age, metallicity [Fe/H], reddening $E(B - V)$, and apparent distance modulus in the V band $(m - M)_V$ for each cluster are summarized in Table 6.

In Fig. 2, a pseudo-Hertzsprung–Russell (pseudo-HR) diagram (M_V –$T_{\rm eff}$) for the whole set of cluster stars is presented. Several additional cluster stars – not finally included in MILES – have been considered in the sample. This allows us to determine their atmospheric parameters in a consistent manner together with the MILES stars, what may be useful for future work on this topic.

The procedure to determine surface gravities is described below. For each cluster, taking into account both the age and metallicity values listed in Table 6, we selected from Girardi et al. (2000) those two isochrones having the most similar age to that of the cluster and metallicities enclosing the corresponding value of the cluster. For each one of the two isochrones, and in order to avoid uncertainties arising from the colour–temperature relations, a surface gravity value for each star was estimated by comparing to the predicted M_V, that is, by ignoring any mismatch in $T_{\rm eff}$. This is a reasonable assumption since relative errors in absolute magnitudes are expected to be smaller than $T_{\rm eff}$ uncertainties. Final log g values were computed as weighted means of the single values derived from the two different metallicity isochrones, with weights accounting for the distance between the adopted cluster metallicity and the isochrone values.

Fig. 3 illustrates qualitatively the above procedure. The two isochrones employed for each cluster (with solid and dashed lines indicating, respectively, those having the higher and lower weight in the final value of log g) are overplotted together with the location of the cluster stars in a pseudo-HR diagram (M_V −$T_{\rm eff}$). Overall, the agreement between the isochrones and stars is reasonably good.

4 SUMMARY

The uncertainties in the input atmospheric parameters of library stars are one of the main sources of potential errors when computing the predictions of evolutionary synthesis models. In this paper we have derived a reliable, and highly homogeneous, set of atmospheric parameters ($2748 < T_{\rm eff} < 36\,000$ K; $0.00 < \log g < 5.50$ dex; $-2.93 <$ [Fe/H] $< +1.65$ dex) for the 985 stars in MILES, a new stellar library in the optical spectral range (Paper I). For the subsample of 896 field stars, systematic deviations between parameters from different sources have been calibrated and corrected by bootstrapping them on to a reference system, following the procedure stated in CEN01b. Also, the atmospheric parameters of 89 Galactic cluster stars (from nine open clusters and eight globular clusters) have been computed in a homogeneous way: effective temperatures have been derived from colour–temperature relations in Alonso, Arribas & Martínez-Roger (1996b, 1999), and surface gravities have been computed by fitting the location of each star in a pseudo-HR diagram using appropriate isochrones from Girardi et al. (2000). Fig. 4 shows the complete stellar library in the parameter space of $T_{\rm eff}$ and log g for various metallicity ranges. In Paper III of this series we will make use of the stellar spectra in Paper I and the atmospheric parameters here presented to predict the integrated SEDs of stellar populations all over the spectral range of MILES. Moreover, the usefulness of the new set of improved parameters goes beyond the objectives of this series. In particular, it should represent a basic ingredient for the new generation of spectral synthesis work as well as to improve the existing empirical calibrations of other relevant spectral features.

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REFERENCES

Alcaino G., Liller W., 1980, AJ, 85, 1592 (A&L80)
Alonso A., Arribas S., Martínez-Roger C., 1996a, A&A, 117, 227 (AAM)
Alonso A., Arribas S., Martínez-Roger C., 1996b, A&A, 313, 873 (ALO)

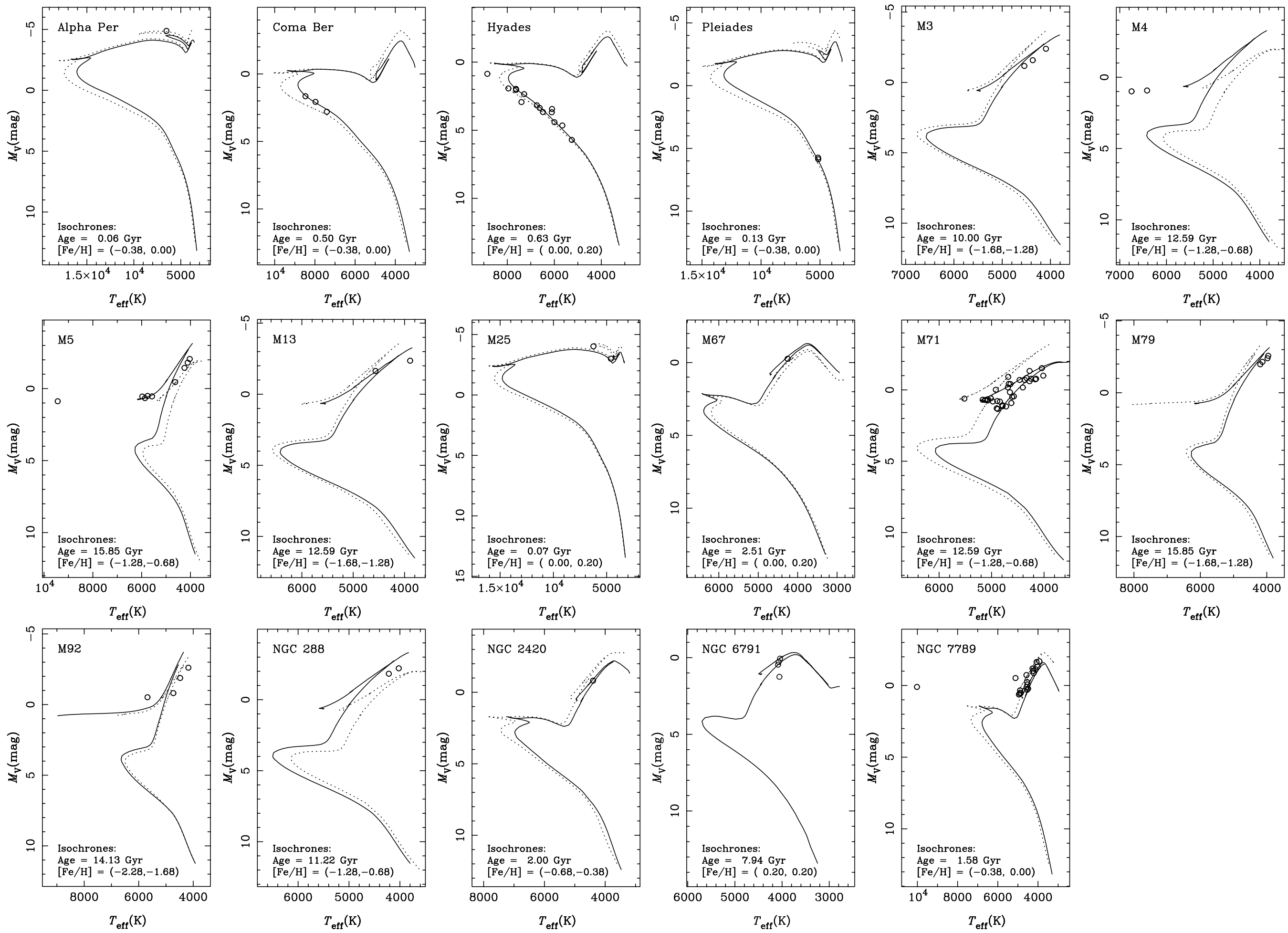

Figure 3. Pseudo-HR diagrams for the cluster stars are presented together with adequate isochrones (Girardi et al. 2000) for each individual cluster. Open circles are used for individual stars in the clusters. Solid and dashed lines illustrate isochrones having a similar age to that of the cluster and two metallicity values enclosing the one of the cluster (as shown in the labels). Adopted ages and metallicities for the clusters are given in Table 6. In all cases, the solid line is employed to indicate the isochrone whose metallicity is closer to that of the cluster. Since the metallicity adopted for NGC 6791 (+0.40 dex) is out of the metallicity regime of Girardi's isochrones, the most metal-rich one (+0.20 dex) is only displayed. Surface gravity for each star was estimated by comparing to the predicted M_V as explained in Section 3.3.

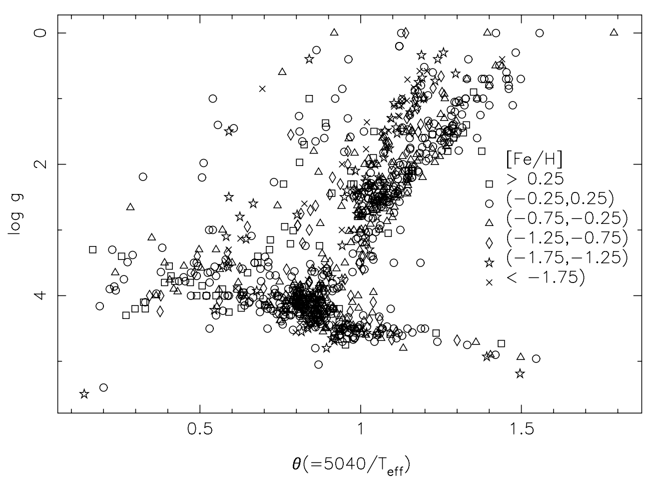

Figure 4. Surface gravity versus effective temperature diagram for all the library stars. Different symbols are used for stars within distinct metallicity regimes as indicated in the key.

Alonso A., Arribas S., Martínez-Roger C., 1999, A&AS, 140, 261 (ALO)
Andrillat Y., Jaschek C., Jaschek M., 1995, A&AS, 112, 475
Arp H. C., Hartwick F. D. A., 1971, ApJ, 167, 499 (A&H71)
Axer M., Fuhrmann K., Geheren T., 1994, A&A, 291, 895 (AFG)
Balachandran S., 1990, ApJ, 354, 310 (BAL)
Beers T. C., Kage J. A., Preston G. W., Shectman S. A., 1990, AJ, 100, 849 (BKP)
Bergbusch P. A., Vandenberg D. A., 1992, ApJS, 81, 163 (BER92)
Blackwell D. E., Lynas-Gray A. E., 1994, A&A, 282, 899 (BLG)
Boesgaard A. M., 1987, ApJ, 321, 967
Boesgaard A. M., King J. R., Cody A. M., Stephens A., Deliyannis C. P., 2005, ApJ, 629, 832
Bohm-Vitense E., 1992, AJ 103, 608 (BOV)
Brown A. J., Sneden C., Lambert D. L., Dutchover E., 1989, ApJS, 71, 293 (BSL)
Bruzual G., Charlot S., 2003, MNRAS, 344, 1000
Burbidge E. M., Sandage A., 1958, ApJ, 128, 174 (B&S58)
Carney B. W., 1982, AJ, 87, 1527 (CAR82)
Carney B. W., Latham D. W., Laird J. B., Aguilar L. A., 1994, AJ, 107, 2240 (CLL)
Carretta E., Gratton R. G., 1997, A&AS, 121, 95 (CG97)
Carretta E., Gratton R. G., Clementini G., Fusi Pecci F., 2000, ApJ, 533, 215 (CGC)

Cayrel de Strobel G., Soubiran C., Friel E. D., Ralite N., François P., 1997, A&AS, 124, 299
Cayrel de Strobel G., Soubiran C., Ralite N., 2001, A&A, 373, 159
Cenarro A. J., Cardiel N., Gorgas J., Peletier R. F., Vazdekis A., Prada F., 2001a, MNRAS, 326, 959 (CEN01a)
Cenarro A. J., Gorgas J., Cardiel N., Pedraz S., Peletier R. F., Vazdekis A., 2001b, MNRAS, 326, 981 (CEN01b)
Cenarro A. J., Gorgas J., Cardiel N., Vazdekis A., Peletier R. F., 2002, MNRAS, 329, 863 (CEN02)
Chaboyer B., Green E. M., Liebert J., 1999, AJ, 117, 1360 (CHA99)
Chen Y. Q., Nissen P. E., Zhao G., Zhang H. W., Benoni T., 2000, A&AS, 141, 491 (CNZ)
Clegg R. E. S., Tomkin J., Lambert D. L., 1981, ApJ, 250, 262 (CTL)
Clementini G., Merighi R., Gratton R., Carretta E., 1994a, MNRAS, 267, 43
Clementini G., Merighi R., Pasquini L., Cacciari C., Gouiffes C., 1994b, MNRAS, 267, 83 (CLE94)
Clementini G., Gratton R. G., Carretta E., Sneden C., 1999, MNRAS, 302, 22 (CLG)
Cottrell P. L., Sneden C., 1986, A&A, 161, 314 (CTS)
Cudworth K. M., 1985, AJ, 90, 65 (CUD85)
Edvardsson B., Andersen J., Gustafsson B., Lambert D. L., Nissen P. E., Tomkin J., 1993, A&A, 275, 101 (EAG)
Fernández-Villacañas J. L., Rego M., Cornide M., 1990, AJ, 99, 1961 (FRC)
Francois P., 1986, A&A, 160, 264 (FRA)
Frogel J. A., Persson S. E., Cohen J. G., 1983, ApJS, 53, 713 (FPC83)
Fuhrmann K., 1998, A&A, 338, 161 (FHR)
Fulbright J. P., 2000, AJ, 120, 1841 (FLB)
Gieren W., 1981, ApJS, 47, 315
Girardi L., Bressan A., Bertelli G., Chiosi C., 2000, A&AS, 141, 371
Gorgas J., Faber S. M., Burstein D., González J. J., Courteau S., Prosser C., 1993, ApJS, 86, 153 (G93)
Gorgas J., Cardiel N., Pedraz S., González J. J., 1999, A&AS, 139, 29
Gratton L., Gaudenzi S., Rossi C., Gratton R. G., 1982, MNRAS, 201, 807 (GGR)
Gratton R., 2000, in Pallavicini R., Micela G., Sciortino S., eds, ASP Conf. Proc., Vol. 198, Stellar Clusters and Associations: Convection, Rotation, and Dynamos. Astron. Soc. Pac., San Francisco, p. 225, ISBN: 1-58381-025-0
Gratton R. G., 1989, A&A, 208, 171 (GRT)
Gratton R. G., Ortolani S., 1984, A&A, 137, 6 (GRO)
Gratton R. G., Sneden C., 1987, A&A, 178, 179 (GRS)
Gratton R. G., Carretta E., Castelli F., 1996, A&A, 314, 191 (GCC)
Gratton R. G., Sneden C., Carretta E., Bragaglia A., 2000, A&A, 354, 169 (GSC)
Gray D. F., Johanson H. L., 1991, PASP, 103, 439 (GRJ)
Grundahl F., Vandenberg D. A., Andersen M. I., 1998, ApJ, 500, L179G (GVA98)
Grundahl F., Stetson P. B., Andersen M. I., 2002, A&A, 395, 481 (GRU02)
Hansen B. M. S. et al., 2004, ApJS, 155, 551 (HAN04)
Harris D. H., Woolf N. J., Rieke G. H., 1978, ApJ, 226, 829
Harris W. E., 1996, AJ, 112, 1487 (HAR03)
Hearnshaw J. B., 1974, A&A, 34, 263 (HEA)
Helfer H. L., Wallerstein G., 1968, ApJS, 16, 1 (HWA)
Hoffleit D., Jaschek C., 1982, Bright Star Catalogue, 4th revised edn. Yale Univ. Observatory, Yale (BSC)
Johnson H. L., Knuckles C. F., 1955, ApJ, 122, 209
Johnson H. L., Mitchell R. I., Iriarte B., Wisniewski W. Z., 1966, Commun. Lunar Planet Lab., 4, 99
Jones L. A., 1997, PhD thesis, Univ. North Carolina, Chapel Hill JON
Katz D., Soubiran C., Cayrel R., Adda M., Cautain R., 1998, A&A, 338, 151
Kharchenko N. V., Piskunov A. E., Röser S., Schilbach E., Scholz R.-D., 2005, A&A, 440, 403 (KH05)
King J. R., Boesgaard A. M., Deliyannis C. P., 2005, Nucl. Phys. A, 758, 300
Krishnaswamy-Gilroy K., Sneden C., Pilachowski C., Cowan J., 1988, ApJ, 327, 298 (KSP)
Kunzli M., North P., Kurucz R. L., Nicolet B., 1997, A&AS, 122, 51 (KNK)
Laird J. B., 1985, ApJS, 57, 389 (LAI)
Lambert D. L., Ries L. M., 1981, ApJ, 248, 228 (LRS)
Lang K. R., 1991, Astrophysical Data: Planets and Stars. Springer-Verlag, New York
Le Borgne J.-F. et al., 2003, A&A, 402, 433
Loktin A. V., Matkin N. V., Gerasimenko T. P., 1994, A&AT, 4, 153 (LMG94)
Luck R. E., Bond H. E., 1983, ApJ, 271, L75 (LUB)
Luck R. E., Bond H. E., 1985, ApJ, 292, 559 (LBO)
Luck R. E., Challener S. L., 1995, AJ, 110, 2968 (LCH)
Magain P., 1989, A&A, 209, 211 (MGN)
Malagnini M. L., Morossi C., 1990, A&AS, 85, 1015 (MAM)
Marsakov V. A., Shevelev Yu. G., 1995, Bull. Inf. Centre Donees Stelaires, 47, 13 (MAS)
McClure R. D., Forrester W. T., Gibson J., 1974, ApJ, 189, 409
McNamara B. J., 1980, PASP, 92, 682 (MCN80)
McWilliam A., 1990, ApJS, 74, 1075 (MCW)
Meyer M. R., Edwards S., Hinkle K. H., Strom S. E., 1998, ApJ, 508, 397 (MEH)
Morel M., Magnenat P., 1978, A&AS, 34, 477 (MOR78)
Nissen P. E., Hoeg E., Schuster W. J., 1997, in Perryman M. A. C., Bernacca P. L., eds, Proc. ESA Symp., Hipparcos – Venice '97, ESA SP-402. ESA Publications Division, Noordwijk, p. 225 (NHS)
Oinas V., 1974, ApJS, 27, 405 (OIN)
O'Neal D., Neff J. E., Saar S. H., 1998, ApJ, 507, 919 (ONS)
Peterson R. C., 1981, ApJ, 244, 989 (PET)
Pilachowski C. A., Sneden C., Booth J., 1993, ApJ, 407, 699 (PSB)
Pilachowski C. A., Sneden C., Kraft R. P., 1996, AJ, 111, 1689 (PSK)
Prugniel P., Soubiran C., 2004, preprint (astro-ph/0409214)
Rebolo R., Beckman J. E., Molaro P., 1988, A&A, 192, 192 (RBM)
Rey S., Yoon S., Lee Y., Chaboyer B., Sarajedini A., 2001, AJ, 122, 3219 (REY01)
Rutledge G. A., Hesser J. E., Stetson P. B., 1997, PASP, 109, 907
Sánchez-Blázquez P. et al., 2006, MNRAS, 371, 703 (Paper I)
Saxner M., Hammarback G., 1985, A&A, 151, 372 (SAH)
Silva D. R., Cornell M. E., 1992, ApJS, 81, 865 (SIC)
Sneden C., Kraft R. P., Langer G. E., Prosser C. F., Shetrone M. D., 1994, AJ, 107, 1773
Stauffer J. R., 1982, AJ, 87, 1507
Stetson P. B., Harris W. E., 1977, AJ, 82, 954 (S&H77)
Stetson P. B., Bruntt H., Grundahl F., 2003, PASP, 115, 413 (STE03)
Soubiran C., Katz D., Cayrel R., 1998, A&AS, 133, 221 (SKC)
Taylor B. J., 1994, PASP, 106, 452 (TAY)
Thévenin F., 1998, Bull. Inf. Centre Donees Stelaires, 49, Catalogue III/193 (THE)
Thévenin F., Idiart T. P., 1999, ApJ, 521, 753 (TID)
Tomkin J., Lambert D. L., 1999, ApJ, 523, 234 (TLA)
Tomkin J., Lemke M., Lambert D. L., Sneden C., 1992, AJ, 104, 1568 (TLL)
Twarog B. A., Tyson N., 1985, AJ, 990, 1247 (TWA85)
Twarog B. A., Ashman K. M., Anthony-Twarog B. J., 1997, AJ, 114, 2556 (TWA97)
Twarog B. A., Anthony-Twarog B. J., Bricker A. R., 1999, AJ, 117, 1816 (TWA99)
Valdes F., Gupta R., Rose J. A., Singh H. P., Bell D. J., 2004, ApJS, 152, 251
VandenBerg D. A., 1983, ApJS, 51, 29 (VAN83)
VandenBerg D. A., 2000, ApJS, 129, 315 (VAN00)
Vazdekis A., 1999, ApJ, 513, 224
Vazdekis A., Cenarro A. J., Gorgas J., Cardiel N., Peletier R. F., 2003, MNRAS, 340, 1317 (VAZ03)
Wallerstein G., 1962, ApJS, 6, 407 (WAL)
Worthey G., Ottaviani D. L., 1997, ApJS, 111, 377
Worthey G., Faber S. M., González J. J., Burstein D., 1994, ApJS, 94, 687 (WOR)
Zakhozhaj V. A., Shaparenko E. F., 1996, Kinematika Fiz. Nebesn. Tel., 12, 20 (ZAS)
Zinn R., West M. J., 1984, ApJS, 55, 45 (ZW84)

APPENDIX A: ATMOSPHERIC PARAMETERS OF MILES STARS

Tables A1 and A2 present the atmospheric parameters ($T_{\rm eff}$, log g and [Fe/H]) computed, respectively, for field and cluster stars in MILES. Identifying numbers, spectral types, reddening-corrected absolute magnitudes in V band (only for cluster stars), reference sources, as well as other stellar libraries whose stars are in common with MILES, are also provided.

Table A1. Final atmospheric parameters of field stars. MILES ordering numbers have been assigned on the basis of increasing right ascension (J2000). The corresponding ordering numbers for all stars in common with the near-IR, CaT stellar libray (CEN01a) are provided in the third column. Sources for spectral types are the Bright Star Catalogue (Hoffleit & Jaschek 1982), Andrillat, Jaschek & Jaschek (1995), Gorgas et al. (1999), the *Hipparcos* Input Catalogue and the SIMBAD data base at http://simbad.u-strasbg.fr/Simbad. References for atmospheric parameters: SKC from Soubiran et al. (1998). Numerical references *ijk* indicate that $T_{\rm eff}$ is from RF*i*, log g from RF*j* and [Fe/H] from RF*k* (see Table 5). Last column includes codes for other stellar libraries the stars are in common with: L (Lick/IDS; G93 and WOR); J (Jones 1997); S (STELIB; Le Borgne et al. 2003); I (Indo-US; Valdes et al. 2004); E (ELODIE.3; Prugniel & Soubiran 2004).

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
BD+002058A	0272		sd:F	6024	4.50	–1.49	131	
BD-010306	0081		G1V	5650	4.40	–0.90	111	
BD-011792	0266		G6V	4948	3.05	–1.05	111	
BD+012916	0505	677	KIIvw	4238	0.35	–1.47	221	I
BD-032525	0329		F3	5750	3.60	–1.90	111	
BD+044551	0777		F7Vwe	5770	3.87	–1.62	SKC	I E
BD-052678	0327		F7	5429	4.43	–2.14	111	
BD+053080	0569		K2	4832	4.00	–0.88	131	
BD+060648	0142		K0	4400	1.02	–2.10	222	
BD-060855	0144		G:?	5283	4.50	–0.70	131	
BD+062986	0537		K5	4450	4.80	–0.30	333	
BD+090352	0596		F2	5894	4.25	–2.12	212	
BD+092190	0348		A0	6270	4.11	–2.86	111	
BD+093223	0607	681	III	5350	2.00	–2.26	222	J I
BD-103166	0395			5400	4.40	0.50	333	I
BD+112998	0598		F8	5373	2.30	–1.36	222	J I
BD-114126	0594		K3V	5000	4.30	0.20	333	I
BD-122669	0318		A5	6910	4.00	–1.49	132	
BD+130013	0010		K0	5000	3.00	–1.31	131	
BD+151305	0230			5175	4.10	–0.60	111	
BD+172473	0439		G5	5299	3.75	–1.10	131	
BD-182065	0278			4700	1.90	–1.42	331	
BD+182890	0516			4957	2.20	–1.61	121	J I
BD+195116B	0884	685	M6 V	2950	5.06	0.10	113	L
BD+203603	0649		F0	6121	4.32	–2.09	SKC	E
BD+233130	0633		G0	5039	2.42	–2.55	SKC	E
BD+241676	0258		F	6201	4.38	–2.45	111	
BD+251981	0314		F0	6798	4.25	–1.26	132	J E
BD+290366	0077		F8V	5609	4.22	–1.03	SKC	E
BD+302431	0480		A2	16904	4.20	0.77	333	
BD+302611	0538	688	G8III	4311	0.94	–1.36	SKC	I E
BD+312360	0440		G8III	4600	2.00	–0.91	333	
BD+342476	0491	689	A4	6205	4.12	–2.05	111	J
BD+362165	0401		G0	6176	4.55	–1.36	SKC	E
BD+371458	0214		G0	5200	3.00	–2.10	111	J
BD+371665	0243		G5	4905	3.30	–1.38	131	
BD+384955	0866		F6	5163	3.99	–2.42	112	
BD+394926	0842		B8	7261	0.85	–2.52	333	
BD+430699	0115		K2	4608	4.52	–0.60	222	
BD+442051A	0399	692	M2 V	3544	4.85	–1.45	111	L J E
BD+450983	0159		G8:V:	5200	4.50	–0.25	111	
BD+460610	0094		F8	5841	4.11	–0.88	222	
BD+501021	0158		G8:V:	4850	4.10	–0.90	111	
BD+511696	0419		sdG0	5640	4.80	–1.37	222	
BD+592723	0876	696	F2	6112	4.17	–2.02	131	
BD+612575	0896	698	F8 Ib	6222	1.97	0.35	331	
BD+660268	0119		G0	5381	4.56	–1.98	SKC	E
BD+720094	0068		sdF2:	6056	4.46	–1.71	SKC	E
BD+800245	0293		G0	5354	3.00	–2.15	111	
CD-2415398	0723		F0	6269	2.93	–1.14	333	
CD-2610417	0520		K5V	4570	4.50	0.06	333	

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log *g*	[Fe/H]	References	Libraries
CD-2809374	0435			5000	3.40	–1.18	331	
G004-036	0095		K:	6010	4.39	–1.87	111	
G156-031	0838	705	M7e	2747	5.09	—	11	L
G171-010	0890	706	M6e	2799	5.12	—	11	L
HD000004	0004		F0	6380	3.01	0.30	333	
HD000245	0008		G2V	5348	4.50	–1.16	SKC	E
HD000249	0005	158	K1IV	4717	2.40	–0.34	232	J I
HD000319	0006		A1V	8140	3.80	–0.70	333	
HD000400	0007		F8IV	6205	4.12	–0.33	SKC	J I E
HD000448	0009		G9III	4710	2.56	0.05	111	
HD000886	0011		B2IV	21581	3.86	0.06	333	I E
HD001326B	0012	691	M6 V	3330	5.08	–1.40	111	L
HD001461	0013	160	G0V	5808	4.39	0.20	121	L
HD001918	0014	161	G9III	4865	2.01	–0.55	232	J I
HD002628	0015		A7III	7325	3.59	0.00	331	I E
HD002665	0016	162	G5IIIwe	5013	2.35	–1.96	SKC	L I E
HD002796	0017		Fw	4945	1.36	–2.31	SKC	I E
HD002857	0018	163	A2 (HB)	7450	2.60	–1.60	111	L I
HD003008	0019		K0	4331	0.84	–1.87	222	
HD003360	0021		B2IV	21170	3.92	0.12	333	I E
HD003369	0020		B5V	15276	4.10	–0.20	333	E
HD003546	0023	165	G5III	4942	2.73	–0.66	SKC	L I E
HD003567	0022	166	F5V	5917	3.96	–1.32	SKC	L E
HD003574	0024		K5III	3830	1.44	–0.01	111	
HD003651	0025	167	K0V	5396	4.61	–0.15	122	L E
HD003795	0026		G3/G5V	5355	3.88	–0.31	332	
HD003883	0027		A7m	7777	3.65	0.48	333	E
HD004307	0028	168	G0V	5727	4.07	–0.25	111	L J I E
HD004395	0029		G5	5670	3.45	–0.31	SKC	I E
HD004539	0030		A	25200	5.40	0.16	333	
HD004628	0031	170	K2V	4960	4.60	–0.29	SKC	L E
HD004656	0032	171	K5III	3912	1.45	–0.14	111	L
HD004744	0033		G8IV	4541	2.47	–0.55	232	J I
HD004906	0034		G0	5068	3.47	–0.84	121	
HD005268	0035		G5IV	4941	3.95	–0.40	132	
HD005384	0036		K5III	3950	1.66	0.00	111	
HD005395	0037	172	G8III-IV	4797	2.55	–0.70	SKC	L J I E
HD005780	0038		K5II-III	3848	1.07	–0.70	331	
HD005848	0048		K2II-III	4400	2.19	0.10	111	I
HD005916	0039		G8III-IV	4863	2.50	–0.80	SKC	I E
HD006186	0040	173	G9III	4860	2.67	–0.34	111	J I
HD006203	0041	174	K0III-IV	4496	2.47	–0.29	111	L J I
HD006229	0043		G5IIIw	5133	2.39	–1.08	222	
HD006268	0042		G:w?	4740	1.20	–2.32	222	
HD006474	0044	175	G4Ia	6222	1.50	0.25	331	
HD006497	0045		K2III. . .	4398	2.50	0.01	212	J I
HD006582	0046		G5Vp	5249	4.45	–0.75	SKC	I E
HD006755	0050	177	F8V	5102	2.40	–1.41	SKC	J E
HD006805	0047		K2III	4493	2.47	0.16	222	J I
HD006833	0051	178	G8III	4380	1.25	–0.99	SKC	J I E
HD006834	0049		F2	6473	4.22	–0.89	111	I
HD007106	0052		K0.5IIIb	4543	2.33	–0.01	111	
HD007351	0053		M2S?	3600	1.10	0.02	333	E
HD007374	0054		B8III	13324	4.00	–0.70	333	E
HD007595	0055		K2III-IV	4345	1.50	–0.80	333	
HD007672	0056		G5IIIe	5030	2.77	–0.43	111	
HD008724	0057		G5	4688	1.49	–1.69	SKC	I E
HD008829	0058		F0V	7163	4.15	0.25	331	
HD009138	0059		K4III	4103	1.85	–0.37	111	
HD009356	0060		F0	6282	2.77	–1.38	333	
HD009408	0062		K0III	4803	2.93	–0.30	212	J
HD009562	0061		G2IV	5728	3.77	0.15	111	J I E
HD009826	0063	184	F8V	6134	4.09	0.11	111	J I E
HD009919	0064		F0V	6830	3.96	–0.41	122	E

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD010307	0066	185	G2V	5838	4.28	0.03	111	L J I E
HD010380	0065	186	K3III	4057	1.43	–0.25	SKC	L E
HD010700	0067	188	G8V	5264	4.36	–0.50	SKC	L I E
HD010780	0069	189	K0V	5392	4.60	0.10	122	L J I E
HD010975	0070	190	K0III	4786	2.40	–0.32	232	J I
HD011257	0071		F2Vw	7099	4.50	–0.20	333	E
HD011397	0072		G6IV/V	6074	5.15	0.09	111	
HD011964	0073		G5	5552	4.24	0.17	333	
HD012014	0074	192	K0Ib	5196	2.30	0.45	331	
HD012438	0075		G5III	5080	2.81	–0.53	111	
HD013043	0076	195	G2V	5695	3.68	0.10	111	L
HD013267	0078	197	B5Ia	13800	2.44	—	66	E
HD013520	0080		K4III	3961	1.55	0.30	222	
HD013555	0079		F5V	6380	4.01	–0.35	111	J I E
HD013783	0082	199	G8V	5338	4.35	–0.55	SKC	L E
HD014221	0083		F4V	6295	3.91	–0.35	222	E
HD014802	0084	203	G1V	5629	3.59	–0.08	111	L E
HD014829	0085		A0	8666	3.10	–1.25	333	
HD014938	0086	204	F5	6153	4.04	–0.35	111	J I
HD015596	0087	205	G5III-IV	4755	2.50	–0.70	SKC	J I E
HD015798	0088		F5V	6401	3.74	–0.16	222	J I
HD016031	0089		G8III	6030	4.05	–1.72	111	
HD016232	0091		F4V	6346	4.54	0.03	111	E
HD016234	0090		F7V	6164	4.32	–0.31	111	
HD016673	0092		F6V	6253	4.28	0.05	111	J I
HD016784	0093		F8V	5826	3.92	–0.74	112	
HD016901	0096	207	G0Ib-II	5345	0.85	0.00	331	
HD017081	0097		B7IV	13320	3.64	0.03	333	I
HD017361	0098		K1.5III	4551	2.44	0.04	111	J I
HD017378	0102	208	A5Ia	8530	1.35	—	11	L I E
HD017382	0100		K1V	5065	4.50	–0.13	SKC	E
HD017491	0099	209	M4III	3560	0.60	—	11	L
HD017548	0101	210	F8	5958	4.28	–0.60	111	J I
HD018191	0103	212	M6IIIvar	3250	0.30	—	11	L S E
HD018391	0104	213	G0Ia	5500	0.00	–0.28	111	L
HD018907	0105		G5IV	5009	3.60	–0.75	111	
HD019373	0108	214	G0V	5991	4.02	0.17	121	L E
HD019445	0106	215	A4p	5918	4.35	–2.05	SKC	L J E
HD019510	0107		F0.5	6109	2.60	–2.50	333	I
HD019994	0109		F8V	6016	3.99	0.12	111	J I E
HD020041	0110	217	A0Ia	9560	2.13	—	11	L
HD020512	0111		G5	5024	3.40	–0.65	111	E
HD020619	0112		G0	5652	4.48	–0.28	222	
HD020630	0113	218	G5Vvar	5591	4.40	0.03	121	L E
HD020893	0114	219	K3III	4340	2.04	0.08	111	L
HD021017	0116		K4III	4405	2.22	0.05	111	
HD021197	0117		K5V	4616	4.59	0.30	333	
HD021581	0118		G0	4825	2.00	–1.70	111	S
HD021910	0122		G8III-IV	4694	1.75	–0.62	222	
HD022049	0120	220	K2V	5052	4.57	–0.15	SKC	I E
HD022484	0121	221	F8V	5993	4.03	–0.10	111	L J I E
HD022879	0123	222	F9V	5814	4.29	–0.83	111	L J E
HD023194	0126		A5V	8542	4.00	–0.20	333	
HD023249	0124	223	K0IV	4884	3.40	–0.11	111	L J I
HD023261	0125		G5	5132	4.64	0.10	333	
HD023439A	0127	224	K1V	4990	4.40	–1.01	111	L
HD023439B	0128	225	K2V	4755	4.37	–1.02	111	L
HD023607	0129		A7V	7875	4.00	–0.30	333	
HD023841	0130	226	K1III	4292	1.30	–0.95	231	J I
HD023924	0131		A7V	8000	4.00	–0.30	333	
HD024341	0133		G1V	5450	3.59	–0.60	222	
HD024421	0134		F5	5969	4.03	–0.65	111	I
HD024451	0135	227	K4V	4357	4.61	—	11	L
HD024616	0132		G8IV/V	4954	3.20	–0.75	111	

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log *g*	[Fe/H]	References	Libraries
HD025329	0136	228	K1Vsb	4787	4.58	–1.72	SKC	L J I E
HD025532	0137		F6IV-V	5525	2.20	–1.20	111	
HD025673	0138		K0	5150	4.50	–0.60	111	
HD026297	0139	229	G5-6IVw	4316	1.06	–1.67	SKC	J I E
HD026322	0141		F2IV-V	6943	3.57	0.11	111	
HD026965	0145	232	K1V	5073	4.19	–0.31	SKC	L I E
HD027126	0147		F5	5378	4.23	–0.56	121	
HD027295	0148	233	B9IV	11704	3.93	–0.74	333	J I
HD027371	0149	234	K0III	4956	2.71	0.07	111	L J I
HD027771	0150		G5	5143	4.50	0.07	333	
HD027819	0151		A7V	7957	4.32	—	26	
HD028305	0152	236	G9.5III	4846	2.68	0.11	111	J I
HD028946	0154		K0	5162	4.39	–0.26	222	E
HD028978	0155		A2Vs	9164	3.70	0.14	333	J I
HD029065	0156		K4III	4034	1.79	–0.30	111	
HD029139	0157		K5III	3922	1.41	–0.18	SKC	J I E
HD030504	0161		K4III	4000	1.52	–0.30	111	
HD030649	0162	239	G1V-VI	5699	4.22	–0.51	111	L J
HD030743	0160	241	F3-5V	6411	4.12	–0.34	111	J I
HD030834	0165		K3III	4115	1.73	–0.21	SKC	I E
HD030959	0164		M3Svar	3451	0.80	–0.15	333	
HD031128	0163		F3/F5Vw	5825	4.30	–1.50	111	
HD031295	0166		A0V	8990	4.08	–0.89	333	J I
HD031767	0167		K2II	4120	1.55	0.26	111	
HD032147	0168		K3V	4658	4.47	0.02	SKC	J I E
HD032655	0169		F2IIp?	6900	2.26	0.10	333	
HD033256	0170		F2V	6359	4.12	–0.33	222	J I E
HD033276	0171		F2IV	6909	3.30	0.25	231	I
HD033608	0173		F5V	6542	4.06	0.31	111	J I E
HD034411	0176	243	G0V	5835	4.17	0.06	SKC	L J S I E
HD034538	0174		G8IV	4891	2.91	–0.33	111	
HD035155	0177		S?	3600	0.80	–0.72	333	
HD035179	0178		G8IV	4720	1.60	–0.67	333	
HD035296	0180		F8V	6091	4.25	0.04	111	J I
HD035369	0179	244	G8III	4863	2.50	–0.26	SKC	J I E
HD035620	0181	246	K4IIIp	4367	1.75	–0.03	SKC	L I E
HD036003	0182	247	K5V	4465	4.61	0.09	113	L
HD036395	0183		M1V	3737	4.90	–1.50	131	E
HD037160	0184	250	G8III-IV	4668	2.46	–0.50	SKC	L J I E
HD037394	0188		K1V	5294	4.33	0.03	132	J S I
HD037536	0186		M2Iabs	3789	0.70	–0.15	333	
HD037792	0185		F2IV/V	6564	4.22	–0.44	111	
HD037828	0187		K0	4296	1.14	–1.38	SKC	S I E
HD037984	0189		K1III	4397	2.49	–0.55	211	J I
HD038007	0192		G0	5665	4.04	–0.33	111	
HD038392	0190		K2V	4727	4.50	0.02	133	
HD038393	0191	251	F6V	6331	4.27	–0.05	111	L
HD038545	0193		A3Vn	8970	3.60	–0.30	333	
HD038656	0195	252	G8III	4928	2.52	–0.22	111	J I
HD038751	0194	253	G8IIIvar	4751	2.27	0.04	111	L
HD039364	0196		G8III/IV	4569	2.46	–0.90	111	
HD039801	0199	255	M2Iab	3550	0.00	0.03	233	I
HD039833	0198		G0III	5761	3.85	0.29	111	I E
HD039853	0197		K5III	3994	1.00	–0.40	SKC	J I E
HD039970	0200	256	A0Ia	9400	1.43	—	31	L
HD040657	0201		K1.5III	4370	2.19	–0.52	111	
HD041117	0204	257	B2Iave	17463	2.70	—	11	L I
HD041312	0203		K3II/IIICNv	4000	0.93	–0.55	331	
HD041597	0209	258	G8III	4700	2.38	–0.54	SKC	J I E
HD041636	0207	259	G9III	4709	2.50	–0.20	111	L J S I
HD041692	0206	260	B5IV	14400	3.12	–0.40	333	J I
HD042182	0208		G0	5117	4.54	0.11	333	
HD042474	0210		M2Iabpe. . .	3789	0.70	–0.36	333	
HD042543	0211		M1Ia-ab	3614	0.00	–0.42	333	J S I

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD043042	0212		F6V	6569	4.22	0.08	111	J I
HD043318	0213	262	F6V	6224	3.93	–0.15	111	L J I E
HD043378	0217		A2Vs	9120	4.17	–0.32	333	
HD043380	0215		K2III	4577	2.34	0.08	232	J I
HD043947	0218		F8V	5912	4.23	–0.31	111	J I E
HD044007	0216	263	G5IVw	4969	2.26	–1.47	SKC	J I E
HD044030	0219		K4III	4198	1.00	–0.50	231	
HD044691A	0221		A3Vm	7950	3.95	0.35	333	
HD044889	0220		K0	3775	0.40	–0.20	333	
HD045282	0222	264	G0	5348	3.24	–1.44	SKC	J I E
HD045829	0223		K0Iab	4500	0.20	0.00	331	E
HD046341	0224		G0	5750	4.10	–0.80	111	
HD046703	0226	266	F7IVw	6000	0.40	–1.62	333	J I
HD047205	0225	267	K1IV	4751	2.93	0.05	111	L J I
HD047914	0227	268	K5III	3975	1.50	0.05	111	L
HD048329	0228		G8Ib	4302	0.87	–0.02	231	J S I
HD048433	0229	269	K1III	4460	1.88	–0.25	SKC	L J I E
HD048565	0231		F8	5929	3.59	–0.70	111	
HD048682	0232	270	G0V	5989	4.06	0.05	111	L I
HD049161	0233	271	K4III	4176	1.69	0.08	111	L
HD049331	0234		M1II	3600	0.70	–0.03	333	
HD049933	0235		F2V	6598	4.08	–0.29	122	S E
HD050420	0237		A9III	7412	3.40	0.30	333	J S I
HD050778	0236	273	K4III	4009	1.60	–0.27	111	L
HD051440	0238	274	K2III	4405	2.28	–0.35	111	L J I
HD052005	0239	275	K4Iab	4117	0.20	–0.20	111	S
HD052973	0240	276	G0Ibvar	5659	1.37	0.34	333	S
HD053927	0241		G5	4811	4.50	–0.74	222	
HD054605	0242		F8Ia	6268	0.97	0.10	331	
HD054719	0245	279	K2III	4368	1.77	0.08	111	L J S I
HD054810	0244	280	K0III	4697	2.35	–0.30	112	L I
HD055496	0246		GII:wp. . .	4800	2.80	–1.55	333	
HD055575	0248	281	G0V	5857	4.39	–0.28	111	L J I E
HD055693	0247		G1V	5845	0.26	0.02	333	
HD056274	0249		G5V	5707	4.59	–0.65	222	
HD056577	0250		K4III	4372	1.25	–0.20	331	
HD057060	0251	282	07Ia	35950	3.20	—	36	
HD057061	0252	283	09Ib	32300	3.00	—	36	
HD057264	0253	285	G8III	4620	2.72	–0.33	111	J I
HD058207	0254	286	K0III	4788	2.55	–0.12	111	L J I E
HD058551	0255	287	F6V	6165	4.18	–0.55	111	J S I
HD059374	0257		F8V	5800	4.40	–0.90	111	
HD059612	0256	289	A5Ib	8330	1.45	0.08	333	
HD059881	0260		F0III	7636	3.09	0.20	331	J S I
HD059984	0259		F5V	6000	4.31	–0.68	111	I E
HD060179	0262	290	A1V	10286	4.00	0.48	333	J I
HD060219	0261		F3IV	5900	1.83	–0.49	333	
HD060522	0264	291	M0III-IIIb	3884	1.20	0.12	111	L
HD061064	0265		F6III	6495	3.20	0.40	131	J S I
HD061603	0269	292	K5III	3870	1.50	0.24	111	
HD061606	0267		K2V	4833	4.70	–0.15	332	E
HD061772	0268		K3III	3996	1.47	–0.11	111	
HD061913	0271	293	M3II-III	3530	0.70	—	66	
HD061935	0270	294	K0III	4779	2.50	–0.06	111	L I E
HD062301	0274		F8V	5888	4.18	–0.71	222	I
HD062345	0273	295	G8IIIa	5017	2.63	–0.08	111	E
HD062721	0275	296	K5III	3961	1.52	–0.22	111	L
HD063302	0276	297	K3Iab	4500	0.20	0.12	331	J I
HD063352	0277	298	K0III	4226	2.20	–0.31	111	I
HD063791	0281		G0	4629	1.76	–1.63	SKC	J I E
HD064090	0280		sdG2	5446	4.45	–1.76	SKC	J S E
HD064332	0279		S?	3500	0.50	–0.34	333	
HD064488	0283		A2	8616	3.35	–0.75	333	
HD064606	0282	300	G8V	5210	4.24	–0.97	SKC	L J E

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD065228	0284		F7/F8II	6115	1.70	0.52	333	
HD065583	0285	301	G8V	5268	4.44	–0.56	121	J S I E
HD065714	0286	302	G8III	4840	1.50	0.27	111	J I
HD065900	0288		A1V	9692	4.00	0.24	333	J I
HD065953	0287		K4III	3960	1.68	–0.36	111	
HD066141	0289	303	K2III	4258	1.90	–0.30	111	L
HD066573	0290		G0	5733	4.38	–0.56	111	E
HD067228	0292		G1IV	5745	4.08	0.10	111	J I
HD067523	0291		F2mp?	7010	3.15	0.34	333	
HD068284	0294		F8	5860	3.98	–0.57	111	E
HD069267	0295	304	K4III	4039	1.51	–0.12	111	L
HD069611	0296		F8	5793	4.32	–0.56	111	
HD069830	0297		K0V	5484	4.64	–0.13	332	I
HD069897	0299	305	F6V	6306	4.27	–0.25	111	L J S I
HD070272	0300	306	K5III	3895	1.27	0.04	111	L S
HD071030	0301		F6V	6516	4.03	–0.25	122	
HD072184	0302	307	K2III	4624	2.61	0.12	111	L S I
HD072324	0303	308	G9III	4887	2.13	0.16	111	L S I
HD072660	0304		A1V	9692	4.00	0.34	333	J I
HD072905	0306	309	G1.5Vb	5864	4.48	–0.04	111	E
HD073394	0309	310	G5IIIw	4500	1.10	–1.38	221	I
HD073471	0305	311	K2III	4489	2.01	0.11	111	L
HD073593	0311	312	G8IV	4717	2.25	–0.12	112	L
HD073665	0308	313	K0III	4965	2.35	0.16	112	L
HD073898	0307		G4III	5030	2.80	–0.43	111	
HD074000	0310	315	F6VI	6166	4.19	–2.02	111	
HD074011	0312		F8	5727	4.29	–0.62	111	E
HD074377	0316	316	K3V	4913	4.63	–0.07	113	L
HD074395	0313	317	G2Iab	5250	1.30	–0.05	331	J I
HD074442	0315	318	K0III	4657	2.51	–0.06	111	L
HD074462	0319	319	G5IV	4527	1.53	–1.41	111	I
HD074721	0317		A0V	8560	3.57	–1.42	333	J I
HD075318	0320		G5	5422	4.50	–0.04	SKC	E
HD075691	0321		K3III	4270	2.12	–0.05	111	
HD075732	0322	320	G8V	5079	4.48	0.16	SKC	L J S I E
HD076151	0323		G2V	5692	4.28	0.08	111	J S I E
HD076292	0324		F3III	6840	3.61	0.41	111	
HD076780	0326		G5	5869	4.80	0.21	333	I E
HD076813	0330		G9III	6072	4.20	–0.82	333	J I
HD076910	0328		F5	6275	4.10	–0.50	111	
HD076932	0325	321	F7-8IV-V	5866	3.96	–0.93	SKC	J I E
HD077236	0332		K0III	4557	1.97	–0.42	231	
HD077338	0331		K0IV	5290	4.75	0.26	333	
HD078209	0336		Am	7099	4.20	0.24	333	J I
HD078234	0334		F2V	6775	3.78	–0.26	122	
HD078541	0333		K4/K5III	3890	1.55	–0.29	111	
HD078558	0335		G3V	5718	4.25	–0.38	111	J I
HD078732	0338		G8II	4900	2.00	0.24	333	
HD078737	0337		F3V	6350	3.80	–0.60	111	
HD079211	0339	323	M0V	3769	4.71	–0.40	113	L
HD079452	0340		G6III	4829	2.43	–0.49	222	J S I
HD079633	0342		A3	7099	4.15	–0.52	111	
HD079765	0341		A3	7000	4.15	–0.25	111	
HD080390	0343		M4IIIa	3430	1.02	—	66	
HD081009	0344		A5spe..	9164	4.00	0.31	333	
HD081029	0345		F0	6700	4.44	–0.01	111	
HD081192	0346		G7III	4705	2.50	–0.62	SKC	J I E
HD081797	0347	324	K3II-III	4120	1.54	–0.06	111	J I
HD081817	0355		K3IIIa	4030	1.64	0.15	111	
HD082074	0349		G6IV	5055	3.30	–0.48	333	
HD082210	0352	325	G4III-IV	5198	3.19	–0.28	111	J S I
HD082590	0350		F6:w?	6150	3.20	–1.29	222	J I
HD082734	0351		K0III	4709	2.65	0.30	233	
HD082885	0353	327	G8IV-V	5488	4.61	0.00	122	E

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD083212	0354		G8:IIIw. . .	4600	1.30	–1.40	111	J
HD083425	0356		K3III	4120	1.77	–0.29	111	
HD083506	0360		K0III	4710	2.54	0.08	111	J I
HD083618	0357	328	K3III	4231	1.74	–0.08	111	L J I
HD083632	0358		K2III	4198	1.00	–1.00	231	S
HD084441	0361	329	G1II	5310	1.81	–0.13	111	J I
HD084737	0362	330	G2V	5874	4.07	0.08	SKC	J I E
HD084937	0363	331	F5VI	6228	4.01	–2.17	SKC	L J S E
HD085235	0364		A3IV	11200	3.55	–0.40	333	J I E
HD085503	0366	332	K0III	4472	2.33	0.23	SKC	L J I E
HD085773	0367		G:w?	4463	0.97	–2.19	222	
HD086986	0368		A1V	7832	3.14	–1.40	331	J I E
HD087140	0370	334	K0	5099	2.76	–1.70	SKC	J I E
HD087141	0369		F5V	6319	3.94	0.08	111	J S I E
HD087737	0371	335	A0Ib	9730	1.97	–0.04	233	J S I E
HD087822	0372		F4V	6533	4.18	0.10	111	J S I
HD088230	0373	336	K7V	3861	4.68	–0.93	111	L J E
HD088446	0374		F8	5883	4.43	–0.45	111	
HD088609	0376	338	G5IIIwe	4513	1.26	–2.64	SKC	S I E
HD088725	0375		G1V	5634	4.50	–0.65	SKC	E
HD088737	0377		F9V	5994	3.92	0.17	111	J I
HD088986	0378		G0V	5800	4.07	0.01	SKC	J I E
HD089010	0379	339	G1.5IV-V	5698	3.92	0.01	111	L J I E
HD089254	0380		F2III	7304	3.78	0.25	331	J S I
HD089449	0381	341	F6IV	6493	4.06	0.21	111	L J I
HD089484	0382		K1IIIb	4470	2.12	–0.38	111	I
HD089707	0383		G1V	5957	4.37	–0.41	111	J I
HD089744	0384		F7V	6219	3.95	0.23	111	J I E
HD089822B	0386		A0sp?	5538	2.44	0.51	333	
HD089995	0385		F6V	6233	3.95	–0.34	222	
HD090508	0387	342	G1V	5787	4.40	–0.21	SKC	L J S I E
HD091347	0389		F8	5889	4.21	–0.47	111	J E
HD091889	0390		F7V	6067	4.15	–0.23	111	J I
HD092523	0391		K3III	4045	1.88	–0.27	111	
HD093329	0392		A0	8075	2.80	–1.48	333	
HD093487	0393	343	F8	5250	1.80	–1.05	221	J I
HD094028	0394	344	F4V	5941	4.21	–1.49	SKC	J S E
HD095128	0396	347	G0V	5813	4.34	0.04	111	J I E
HD095578	0397		M0III	3700	1.22	–0.23	222	
HD095735	0398		M2V	3828	4.90	–0.20	131	S E
HD096360	0400		M?	3550	0.50	–0.58	333	
HD097560	0402		G0	5250	2.00	–1.10	111	
HD097633	0403		A2V	9509	3.45	0.28	222	S I E
HD097855	0406		F6V+?	6260	4.05	–1.03	112	
HD097907	0404	349	K3III	4351	2.07	–0.10	111	L J I
HD097916	0405		F5V	6238	4.03	–0.99	111	S E
HD098468	0407		K0	—	—	—		
HD098553	0408		G2/G3V	5890	4.37	–0.41	111	J I
HD099109	0409		K0	5400	4.20	0.45	333	
HD099648	0411		G8II-III	4850	1.90	0.36	333	
HD099747	0412		F5Vawva	6604	4.06	–0.51	111	J S
HD099998	0413		K4III	3939	1.80	–0.31	111	J I
HD100906	0414		G8/K0w+. . .	4980	2.00	–1.02	331	
HD101227	0415		G0	5421	4.68	–0.40	SKC	E
HD101501	0416	351	G8Vvar	5401	4.60	–0.13	111	L J S I E
HD101606	0417		F4V	6320	4.12	–0.75	111	S
HD102224	0418	352	K0 III	4383	2.02	–0.46	SKC	J S I E
HD102328	0420	353	K3 III	4390	2.09	0.35	111	L J I
HD102634	0421	354	F7 V	6344	4.12	0.27	111	J S
HD102870	0422	355	F9V	6109	4.20	0.17	SKC	L J S I E
HD103095	0423	356	G8 Vp	5025	4.56	–1.36	SKC	L J E
HD103578	0424		A3V	8692	3.45	0.18	333	
HD103877	0425	359	Am	7341	4.00	0.40	331	

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log *g*	[Fe/H]	References	Libraries
HD103932	0426		K5V	4510	4.57	0.16	333	
HD104304	0428		K0IV	5478	4.15	0.18	232	J
HD104307	0427		K2III	4451	2.00	–0.01	333	
HD104833	0429		F0	7727	4.11	0.20	331	
HD105262	0430		B9	8542	1.50	–1.37	333	J I
HD105452	0431		F0IV/V	7003	4.10	–0.60	131	
HD105546	0432	361	G2 IIIw	5125	2.10	–1.50	111	S I E
HD105740	0433		G5	4700	2.50	–0.51	333	
HD106038	0434		F6V-VI	5940	4.32	–1.43	222	S
HD106516	0436	362	F5V	6199	4.36	–0.73	111	L J I E
HD107113	0437		F4V	6399	4.07	–0.51	111	J I
HD107213	0438	363	F8 Vs	6298	4.01	0.29	111	J S I E
HD108177	0441	367	F5 VI	6065	4.26	–1.68	111	L S
HD108564	0442		K2V	4594	4.67	–1.09	222	
HD108915	0443		K0	—	—	—		
HD109443	0444		F0V	6632	4.20	–0.65	111	
HD109871	0445		K2	—	—	—		
HD109995	0446	369	A0 V (HB)	8300	3.50	–1.99	112	L J S
HD110014	0447		K2III	4379	1.37	0.11	222	J
HD110379	0448		F0V+?	6875	4.46	–0.09	111	
HD110885	0450		G0	5253	2.40	–1.53	222	
HD110897	0449	372	G0V	5830	4.23	–0.48	SKC	L J S I E
HD111631	0452		M0.5V	3748	4.75	0.10	131	
HD111786	0453		A0III	7450	3.93	–1.60	333	
HD111980	0454		F7V	5600	3.70	–1.20	111	
HD112028	0451	375	A1 III	9480	3.30	—	66	
HD112127	0455		K2IIICN+?	4576	2.07	0.13	222	I
HD112413	0456	377	A0 spe	9944	3.85	0.31	333	E
HD113022	0458		F6Vs	6478	4.20	0.24	133	J S
HD113092	0457	379	K2 III	4283	1.95	–0.37	111	J
HD113285	0459	382	M8 III	2924	0.00	—	31	L
HD114038	0460		K1III	4518	2.22	0.00	111	J I
HD114330	0461		A1V	9509	3.80	–0.01	333	S I
HD114606	0462		G1V	5523	4.12	–0.69	121	
HD114642	0464		F6V	6249	3.90	–0.18	222	J I
HD114710	0463	384	F9.5V	5975	4.40	0.09	SKC	L J I E
HD114946	0465	386	G6 V	5171	3.64	0.13	111	L J
HD115383	0466		G0Vs	5921	4.04	0.13	111	J S I E
HD115589	0467		G8IV	5400	4.54	0.40	333	
HD115617	0468	391	G5V	5531	4.32	–0.01	111	L J I
HD115659	0469		G8III	5087	3.02	–0.06	222	J
HD116114	0470	392	Ap	8020	4.18	0.48	331	
HD116316	0471		F5V	6428	4.18	–0.64	111	
HD116544	0472		K5	4400	4.50	–0.20	333	
HD117176	0474	394	G5 V	5525	3.80	–0.09	122	L J S I E
HD117200	0473		F0	6726	4.06	–0.02	111	
HD117635	0475		G9V	5080	3.94	–0.67	121	E
HD117876	0476		G8III	4782	2.25	–0.50	SKC	J I E
HD118055	0477	395	K0 IIIw	4202	0.71	–1.91	111	J I
HD118100	0478		K7V	4179	4.50	–0.07	131	J I
HD118244	0479		F5V	6404	4.18	–0.56	111	
HD119228	0481		M2III	3661	1.55	0.30	222	
HD119288	0482		F3Vp	6594	4.03	–0.46	122	
HD119291	0483		K7V	4475	4.56	0.10	363	E
HD119667	0484		K5	3700	1.00	–0.35	333	
HD120136	0485	396	F7 V	6438	4.15	0.25	111	L J S I E
HD120933	0487	398	K5III	3820	1.52	0.50	111	J
HD121130	0486		M3III	3672	1.25	–0.24	333	
HD121258	0490		G5	6570	4.00	–0.92	663	
HD121299	0489		K2III	4696	2.29	0.04	111	J
HD121370	0488	400	G0 IV	5981	3.62	0.25	111	L J I
HD122106	0492		F8V	6330	3.63	0.14	111	
HD122563	0493	402	F8 IV	4566	1.12	–2.63	SKC	L J S I E
HD122742	0494		G8V	5492	4.56	–0.01	222	

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD122956	0496	403	G6 IV-Vw	4635	1.49	–1.75	SKC	E
HD123299	0495	404	A0 III	10100	3.30	–0.56	233	S I
HD123657	0497	405	M4 III	3484	0.85	0.00	232	J I
HD123821	0498		G8IIIp	4963	3.02	0.10	222	
HD124186	0499	406	K4 III	4347	2.10	0.24	111	J
HD124292	0500		G0	5391	4.50	–0.19	SKC	E
HD124850	0502	408	F7 IV	6116	3.83	–0.11	111	J S I E
HD124897	0501	409	K2 IIIp	4361	1.93	–0.53	SKC	L J I E
HD125184	0503		F9V	5536	3.92	0.15	111	J E
HD125451	0504		F5IV	6669	4.44	0.05	111	J I
HD126053	0507		G1V	5662	4.50	–0.45	SKC	E
HD126141	0506		F5V	6748	4.48	0.04	111	J S I
HD126218	0509		K0III	4921	2.81	0.09	111	
HD126327	0508	412	M7.5 III	3000	0.00	–0.58	112	L J
HD126614	0511		K0	5500	4.20	0.55	333	
HD126660	0510	413	F7 V	6202	3.84	–0.27	111	S
HD126681	0513	414	G3 V	5536	4.65	–1.25	111	
HD126778	0512		K0III	4847	2.34	–0.61	232	J
HD127243	0514	415	G3 IV	4978	3.20	–0.59	SKC	J E
HD127334	0515		G5V	5537	3.89	0.12	111	J I
HD128167	0517	418	F2 V	6722	4.38	–0.39	111	J S E
HD128429	0518		F5V	6266	4.12	–0.13	222	
HD128801	0519		B9	10250	3.40	–1.20	333	
HD128959	0521		F7V	5763	3.50	–0.97	131	
HD129174	0522		B9p+...	12416	3.76	–0.28	333	
HD130095	0523		B9V	8656	3.47	–1.65	331	
HD130322	0524		K0III	5349	4.72	0.04	222	E
HD130694	0527	421	K4III	4040	1.62	–0.28	111	J
HD130705	0526	422	K4 II-III	4336	2.10	0.41	111	J
HD130817	0525		F2V	6585	4.08	–0.46	222	
HD131430	0528		K2/K3III	4190	1.95	0.10	111	
HD131918	0530	423	K4 III	3970	1.49	0.22	111	J
HD131976	0531	424	M1 V	3506	4.73	—	11	L J
HD131977	0532	425	K4 V	4501	4.70	0.02	111	L J E
HD132142	0529	426	K1 V	5108	4.50	–0.55	SKC	L J S E
HD132345	0533	427	K3 III-IVp	4374	1.60	0.25	112	L J I
HD132475	0534	428	F6 V	5545	3.72	–1.60	111	
HD132933	0535	429	M0.5 IIb	3660	0.70	0.00	262	
HD133124	0536		K4III	3955	1.48	0.05	111	
HD134063	0539	430	G5 III	4885	2.34	–0.68	232	J
HD134083	0540	431	F5 V	6556	4.32	0.02	111	L J S I E
HD134169	0541	432	G1 Vw	5798	3.87	–0.91	SKC	J S E
HD134439	0543	433	K0/K1V	4950	4.57	–1.49	111	L
HD134440	0542	434	K0V:	4740	4.50	–1.48	111	
HD134987	0544		G5V	5695	4.33	0.25	222	
HD135482	0546		K0III	4615	2.57	0.13	111	
HD135485	0548		B3V	18667	4.30	1.65	333	
HD135722	0547	436	G8 III	4847	2.56	–0.44	SKC	L J S E
HD136064	0545		F9IV	6080	3.95	–0.04	222	J I
HD136202	0550	438	F8 III-IV	6083	3.85	–0.08	122	L I E
HD136726	0549	440	K4III	4159	1.91	0.13	111	J I
HD136834	0552		K3V	4765	4.32	0.20	333	
HD137071	0551		K4III	3952	1.13	–0.21	111	
HD137391	0553	441	F0 V	7190	4.14	0.28	122	L
HD137471	0555	442	M1 III	3810	1.10	0.07	113	L
HD137510	0556		G0IV-V	5836	3.37	0.10	111	
HD137704	0557		K4III	4109	1.97	–0.37	111	
HD137759	0554	443	K2 III	4498	2.38	0.05	111	L J S E
HD137909	0558		F0p	8541	4.25	0.82	333	E
HD138290	0559		F4Vw	6872	4.59	–0.05	111	S
HD138481	0560	445	K5III	3915	1.46	0.25	111	J
HD138764	0563		B6IV	13827	3.97	–0.13	333	
HD138776	0562		K0	5700	4.20	0.48	333	
HD139195	0564		K0p	4856	2.82	–0.04	SKC	I E

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	T_{eff}	log g	[Fe/H]	References	Libraries
HD139446	0566		G8III/IV	5080	2.70	–0.26	111	J I
HD139641	0565		G7.5IIIb	5030	2.99	–0.49	111	J S I
HD139669	0561	446	K5 III	3895	1.41	–0.01	111	L J S
HD140160	0567		A0p. . .	9164	3.30	–0.25	333	
HD140283	0568	447	F3 VI	5687	3.55	–2.53	SKC	L J E
HD141004	0570	449	G0 Vvar	5915	4.10	–0.01	SKC	J S I E
HD141714	0571	452	G3.5 III	5275	3.02	–0.29	111	J S I
HD141851	0572		A3Vn	8246	3.89	–2.00	331	
HD142373	0573	454	F9 V	5821	4.13	–0.41	SKC	L J S I E
HD142575	0574		F0V	6550	3.60	–1.00	111	
HD142703	0577		A2Ib/II	7220	3.89	–1.02	331	
HD142860	0576	455	F6 V	6272	4.17	–0.16	111	L J E
HD142908	0575		F0IV	6848	3.95	0.04	122	
HD143459	0578		A0Vs	8842	3.55	–1.26	333	
HD143761	0579	458	G2 V	5762	4.23	–0.20	SKC	L J I E
HD143807	0581		A0p. . .	11224	3.72	0.00	333	
HD144172	0582		F8	6302	4.02	–0.46	111	J
HD144585	0584	459	G5 V	5669	3.95	0.29	111	J
HD144608	0585		G6/G8III	5200	2.10	0.27	333	
HD144872	0583	460	K3 V	4739	4.65	–0.30	112	L
HD145148	0586	461	K0 IV	4849	3.45	0.09	112	L
HD145250	0588		K3III	4540	2.51	–0.30	111	
HD145675	0587	463	K0 V	5264	4.66	0.34	SKC	L J S E
HD145976	0589		F3V	6751	4.13	0.03	111	S
HD146051	0590	464	M0.5 III	3793	1.40	0.32	333	
HD146624	0592		A0V:	9509	4.50	0.01	333	
HD147379B	0591	466	M3 V	3247	4.84	—	11	L J
HD147923	0593		M. . .	3600	0.80	–0.19	333	
HD148112	0595		B9p. . .	9333	3.00	0.00	333	
HD148513	0597	468	K4 IIIp	3989	1.67	0.11	111	L J S
HD148786	0602		G8/K0III	5141	2.64	0.00	212	J I
HD148816	0599	471	F9 V	5830	4.21	–0.73	111	L J
HD148897	0600		G8p	4284	1.15	–0.50	331	
HD148898	0604		Ap	8400	3.50	–0.47	333	
HD149009	0603	472	K5 III	3910	1.60	0.30	111	
HD149121	0605		B9.5III	11100	3.78	0.12	333	S
HD149161	0606	473	K4 III	3927	1.39	–0.17	111	L J I
HD149382	0608		B5	36000	5.50	–1.30	333	
HD149661	0609	475	K0 V	5168	4.70	0.04	122	L J S I E
HD150012	0610		F5III-IV	6569	4.00	0.16	111	J I
HD150177	0611	476	F3 V	6019	3.99	–0.57	SKC	J E
HD150275	0601	477	K1 III	4703	2.50	–0.50	222	J S
HD150281	0612		K0	4863	4.26	–0.29	121	
HD150453	0613		F3V	6449	3.84	–0.35	111	J I
HD151203	0614	478	M3 IIIab	3640	0.70	–0.10	113	L
HD151217	0615	479	K5 III	3987	1.52	–0.03	111	S
HD152601	0616		K2III	4664	2.55	0.05	111	J
HD152781	0617		K0/K1III/IV	4982	3.60	0.00	333	
HD153286	0618		Am	7522	3.50	0.17	333	
HD153882	0619		B9p. . .	8842	3.00	–0.25	333	
HD154733	0620		K3III	4200	2.09	0.00	212	S
HD155078	0623		F5IV	6396	3.71	–0.10	111	
HD155358	0622	484	G0	5828	4.13	–0.67	111	J
HD155763	0621		B6III	13397	4.24	–0.95	323	I E
HD156026	0625		K5V	4541	4.54	–0.37	111	
HD156283	0624		K3IIvar	4163	1.42	–0.07	111	
HD157089	0628	486	F9 V	5785	4.12	–0.56	SKC	L J E
HD157214	0627	487	G0 V	5682	4.25	–0.39	SKC	L J S E
HD157373	0626		F4V	6422	4.07	–0.60	111	
HD157856	0631		F3V	6330	3.91	–0.14	222	
HD157881	0630	488	K7 V	4065	4.57	0.38	131	J E
HD157910	0629	489	G5 III	5631	1.83	–0.32	111	J I
HD157919	0632		F3III	6926	3.89	0.04	222	
HD159307	0635	491	F8	6198	3.90	–0.73	111	J E

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	T_{eff}	log g	[Fe/H]	References	Libraries
HD159332	0634	492	F6 V	6164	3.84	–0.21	111	J I
HD159482	0636		G0V	5615	3.92	–1.08	SKC	E
HD160693	0639	495	G0 V	5768	4.14	–0.61	SKC	L J E
HD160762	0638		B3IV	19000	3.75	0.10	233	
HD160933	0637		F9V	5684	3.90	–0.32	SKC	I E
HD161074	0640		K4III	3980	1.73	–0.27	SKC	E
HD161096	0642		K2III	4550	2.55	0.09	222	J E
HD161149	0641		F5II	6600	2.95	0.55	333	
HD161227	0644		Fm	7522	3.50	0.00	331	
HD161695	0645		A0Ib	9950	2.20	–0.03	333	
HD161796	0643		F3Ib	6666	0.60	–0.30	331	
HD161797	0646	496	G5 IV	5411	3.87	0.16	SKC	L J E
HD161817	0647	497	A2 VI (HB)	7636	2.93	–0.95	211	L S
HD162211	0648	498	K2III	4514	2.45	0.05	111	E
HD163990	0651		M6Svar	3365	0.70	0.01	333	
HD163993	0652	502	G8 III	5028	2.70	0.03	111	J S E
HD164058	0650	503	K5 III	3902	1.32	–0.05	111	E
HD164136	0653	504	F2 II	6799	2.63	–0.30	333	S I
HD164349	0654	506	K0.5 IIb	4446	1.50	0.39	111	S
HD164353	0655	507	B5 Ib	13493	2.40	—	36	S I E
HD164432	0656		B2IV	21311	3.65	–0.33	333	
HD164975	0658		G0Ib/II	6632	2.30	0.28	333	
HD165195	0657	508	K3p	4471	1.11	–2.15	SKC	L J I E
HD165341	0659		K0V	5158	4.67	0.03	SKC	I E
HD165438	0660		K1IV	4862	3.40	0.02	333	
HD165634	0663		K0IIICNpvar	4820	2.76	–0.14	111	
HD165908	0661	511	F7 V	5928	4.24	–0.53	SKC	L J I E
HD166161	0665	512	G5	4905	2.31	–1.25	SKC	I E
HD166208	0662		G8III...	4919	2.52	0.08	SKC	I E
HD166285	0666		F5V	6348	4.13	–0.16	111	E
HD166460	0667		K2III	4424	2.10	0.00	111	
HD166620	0664	515	K2 V	4944	4.47	–0.23	SKC	L J E
HD167006	0669	516	M3 III	3640	0.70	0.00	112	L I E
HD167105	0668		A0	8550	3.30	–1.84	333	
HD167665	0673		F8V	6080	4.21	–0.21	222	
HD167768	0670	518	G3 III	5235	1.61	–0.67	232	J I
HD168322	0672	519	G8.5 IIIb	4792	2.00	–0.40	222	J I
HD168608	0676		F8II	5475	1.00	0.02	333	
HD168720	0674	521	M1 III	3810	1.10	0.00	113	L I E
HD168723	0675		K0III-IV	4859	3.13	–0.19	SKC	J I E
HD169027	0671		A0	11588	3.78	–0.17	333	
HD169985	0678		G0III+...	5780	3.24	0.27	111	E
HD170693	0677	526	K1.5 III	4394	2.32	–0.38	111	J I
HD170737	0679		G8III-IV	5150	3.00	–0.67	333	
HD171391	0681		G8III	5027	2.90	–0.16	212	J I
HD171443	0682	527	K3 III	4189	1.84	–0.08	111	
HD171496	0683		G8IV	4700	1.60	–0.91	222	
HD171999	0684		G5	5031	4.65	–0.10	131	
HD172103	0686		F1IV-V	6418	3.68	–0.22	111	
HD172365	0687	529	F8 Ib-II	5800	2.12	–0.36	333	I E
HD172380	0685	530	M4-5 II	3349	0.55	—	26	
HD172816	0691	531	M5.2 III	3270	0.50	—	36	I
HD172958	0688	532	B8 V	11300	3.75	—	11	L I
HD173093	0692		F7V	6268	4.09	–0.18	222	E
HD173524	0689		B9.5p...	11944	3.78	0.28	333	
HD173648	0693		Am	8190	3.90	0.39	333	
HD173650	0694		B9p...	9540	3.00	0.12	333	
HD173667	0695		F6V	6280	3.97	0.05	222	J I E
HD173740	0690	704	M5 V	3365	4.93	–0.54	333	
HD173819	0697		K0Ibpvar	4421	0.00	–0.88	333	S E
HD174567	0698		A0Vs	10200	3.55	0.15	333	
HD174704	0702	535	F1 Vp	7412	3.50	0.60	331	E
HD174912	0699	536	F8	5746	4.32	–0.48	SKC	J E
HD174959	0701		B6IV	14681	4.00	–0.80	333	I

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD175225	0700		G9IVa	5148	3.36	0.01	111	E
HD175305	0696	539	G5 III	4899	2.30	–1.43	SKC	E
HD175535	0703	541	G7 IIIa	5066	2.55	–0.09	111	J I
HD175588	0704	543	M4 II	3550	0.60	—	26	I E
HD175640	0706		B9III	12050	3.90	–0.43	333	I
HD175865	0705	547	M5 III	3420	0.50	0.14	113	L
HD175892	0708		A1V	8816	4.22	0.00	331	
HD176232	0710		A4p(EuCrSr)	7701	4.09	0.06	333	E
HD176301	0709	548	B7 III-IV	13100	3.50	—	11	L I
HD176437	0711		B9III	10282	3.50	0.20	331	I E
HD177463	0712		K1III	4560	2.65	–0.25	SKC	E
HD178089	0707		F2V	6641	4.23	–0.08	111	
HD179761	0714		B8II-III	13175	3.27	–0.14	333	I E
HD180163	0715		B2.5IV	17360	3.38	–0.01	333	I E
HD180711	0713	551	G9 III	4800	2.67	–0.12	SKC	J I E
HD180928	0717	552	K4 III	3969	1.30	–0.35	112	L J I
HD181096	0716		F6IV:	6276	4.09	–0.26	SKC	J I E
HD181470	0718		A0III	10012	3.58	–0.46	333	
HD182293	0719	555	K3 IVp	4486	3.00	0.18	232	J I
HD182572	0721	556	G8 IVvar	5570	4.19	0.31	SKC	L I E
HD183324	0722		A0V	9260	4.22	–1.50	333	I
HD184406	0728	559	K3 III	4520	2.41	0.01	SKC	L J I E
HD184499	0726	561	G0 V	5738	4.02	–0.66	SKC	J I E
HD184786	0727		M4.5III	3467	0.60	–0.04	333	E
HD185144	0724	563	K0 V	5260	4.55	–0.24	SKC	L E
HD185351	0729		K0III	4918	3.03	–0.07	SKC	J I E
HD185657	0730		G6V	4710	3.00	–0.45	133	I E
HD185859	0732	565	B0.5 Iae	21860	2.80	—	11	L I
HD186408	0733	566	G2 V	5815	4.30	0.09	SKC	L I E
HD186427	0734	567	G5 V	5762	4.43	0.07	SKC	L E
HD187111	0736		G8III/IVw	4259	0.58	–1.83	SKC	I E
HD187216	0720		R. . .	3500	0.40	–2.48	333	
HD187691	0738	572	F8 V	6107	4.30	0.11	SKC	L J I E
HD187879	0737		B1III	19676	3.40	1.25	333	
HD187921	0739		K0var	6000	1.00	0.28	333	
HD188041	0740		A5pvar	8000	4.00	0.11	333	
HD188119	0735		G8III	4915	2.61	–0.32	SKC	I E
HD188510	0742	576	G5 Vwe	5490	4.69	–1.59	SKC	J E
HD188512	0743	577	G8 IVvar	5041	3.04	–0.04	SKC	L E
HD188650	0741		Fp	5764	2.90	–0.40	333	
HD188727	0744	578	G5 Ib var	5685	1.60	0.00	112	L
HD188947	0745		K0IIIvar	4829	2.53	0.01	SKC	J I E
HD189005	0746		G8II/III	5060	2.78	–0.38	111	
HD189558	0747		G0/G1V	5786	3.85	–1.19	SKC	I E
HD189849	0748		A4III	7972	3.59	0.08	331	
HD190178	0752		F3V	5993	3.00	–1.00	131	
HD190360	0749	579	G6 IV + M6 V	5441	3.89	0.25	111	L E
HD190390	0753		F1III	6440	1.55	–1.05	331	I
HD190404	0750		K1V	5051	4.45	–0.17	SKC	E
HD190603	0751	581	B1.5 Iae	18800	2.41	—	11	L
HD191026	0754		K0IV	5050	3.49	–0.10	SKC	J I E
HD191046	0755	583	K0 III	4317	2.01	–0.65	232	J I
HD192577	0758		K2II+. . .	4030	1.39	–0.31	111	
HD192640	0759		A2V	8030	3.96	–1.19	333	
HD192907	0756		B9III	10675	3.65	–0.05	333	
HD192909	0760		K3Ib-II+?	3880	1.34	–0.43	111	
HD193281	0761		A5/A6V	8080	3.58	–1.00	333	
HD194598	0762	589	F7 V-VI	5887	4.27	–1.22	SKC	J E
HD194943	0763		F3V	6741	4.25	–0.16	122	
HD195633	0765	593	G0 Vw	6000	3.78	–0.77	SKC	L I E
HD195838	0766		G0V	6012	4.03	–0.33	222	
HD196502	0764		A0p. . .	8842	3.90	0.28	333	
HD196544	0767		A2V	9164	4.30	0.17	333	
HD196755	0768		G5IV+. . .	5611	3.65	–0.02	SKC	E

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	T_{eff}	log *g*	[Fe/H]	References	Libraries
HD197177	0769		G8IIb	5150	2.30	0.64	333	
HD197461	0771		A7IIIp. . .	7176	3.41	–0.30	331	
HD197572	0770		G8Ib	5239	0.40	0.15	333	
HD197964	0774		K1IV	4813	3.03	0.17	SKC	I E
HD197989	0773		K0III	4798	2.56	–0.10	SKC	E
HD198001	0776		A1V	9470	3.64	0.07	333	I
HD198149	0772	598	K0 IV	5013	3.19	–0.19	SKC	L J I E
HD198183	0775	599	B5 V	14315	4.00	—	36	I
HD198478	0778	600	B3 Iae	14900	2.19	–0.23	113	L
HD199191	0779	601	K0 III	4767	2.25	–0.64	222	J I E
HD199478	0780	602	B8 Iae	11200	1.90	—	11	L I
HD199799	0781		M1	3400	0.30	–0.24	333	
HD200527	0782		M3Ib-II:	3451	0.70	–0.04	333	I
HD200580	0783	605	F9 V	5774	4.28	–0.65	111	L E
HD200779	0785	606	K6 V	4252	4.63	—	11	L
HD200790	0786	607	F8 V	5928	4.13	–0.12	SKC	J I E
HD200905	0784		K5Ib. . .	3899	0.91	–0.20	211	E
HD201078	0787		F7.5II	6157	1.65	0.13	333	
HD201091	0788		K5V	4342	4.56	–0.05	SKC	E
HD201601	0789		F0p	7657	3.92	0.07	333	
HD201889	0791		G1V	5618	4.08	–0.95	SKC	I E
HD201891	0790	611	F8 V-VI	5854	4.45	–1.11	SKC	L J I E
HD202109	0792		G8II. . .	4914	2.42	–0.04	SKC	E
HD202447	0793		G0III+. . .	5980	3.24	0.09	111	
HD202671	0794		B5II/III	15273	4.20	1.20	333	
HD203638	0795		K0III	4500	2.72	0.02	111	
HD204041	0796		A1IV	8100	4.03	–0.98	333	
HD204075	0797		G4Ibp. . .	5220	1.55	–0.45	111	
HD204155	0798		G5	5608	4.24	–0.90	SKC	E
HD204381	0801		K0III	5060	3.01	–0.28	111	
HD204543	0803		G0	4617	1.31	–1.76	SKC	I E
HD204587	0804	613	M0 V	4035	4.67	—	11	L
HD204613	0799		G0IIIwsp	5727	3.84	–0.51	SKC	I E
HD204754	0802		B8III	12923	3.50	–0.28	333	
HD205021	0800		B2IIIvar	26740	4.16	–0.23	333	I
HD205153	0806	615	G0 IV	5947	3.70	–0.02	222	L
HD205435	0805	616	G8 III	5071	2.74	–0.16	SKC	J I E
HD205512	0807	617	K1 III	4634	2.57	0.03	SKC	J I E
HD206078	0808	619	G8 III	4658	2.87	–0.48	232	J I
HD206165	0809	620	B2 Ib	17760	2.65	–0.33	333	I E
HD206453	0811		G8III	5092	3.12	–0.50	212	J I
HD206778	0814		K2Ibvar	4461	1.20	0.04	222	E
HD206826	0813		F6V	6300	4.32	–0.22	111	
HD206952	0810		K0III	4664	2.33	0.14	222	J I
HD207076	0816	621	M7 III	2750	0.00	—	11	L
HD207130	0812		K0III	4733	2.64	–0.05	SKC	J I E
HD207222	0818		A0	8542	3.50	–1.15	333	
HD207260	0815	623	A2 Ia	9450	2.09	—	11	L
HD207330	0817		B3III	18351	3.49	–0.10	333	I
HD207673	0819	624	A2 Ib	9071	1.39	–0.08	333	
HD208501	0820	626	B8 Ib	12200	2.20	—	66	I
HD208906	0821	627	F8 V-VI	5965	4.20	–0.74	SKC	L I E
HD209369	0822		F5V	6288	3.90	–0.28	111	
HD209459	0823		B9.5V	10475	3.50	–0.15	333	E
HD209975	0824	630	08 Ib	30274	3.30	0.30	333	E
HD210295	0825	632	G8	4769	2.20	–1.39	111	I
HD210424	0826		B5III	13860	4.00	–0.26	333	
HD210595	0828		F7Vwe	6270	2.93	–0.72	221	
HD210705	0829		F0V	6806	3.99	–0.21	122	
HD210745	0827	633	K1.5 Ib	4274	–0.20	0.22	213	
HD211075	0830		K2	4350	1.50	–0.54	333	
HD212454	0831		B8III-IV	15512	4.10	0.70	333	E
HD212943	0832	638	K0 III	4586	2.81	–0.34	SKC	J I E
HD213042	0835		K5V	4760	4.58	0.25	333	

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD213119	0833		K5III	3910	1.59	–0.21	111	
HD213307	0834		A0	5864	1.65	0.07	333	E
HD213470	0836	639	A3 Ia	8800	1.38	—	31	L E
HD214080	0837		B1/B2Ib	22186	3.30	–0.20	333	
HD214567	0839		G8II	5038	2.50	0.03	SKC	I E
HD214714	0840		G3Ib-IICNe	5360	2.64	–0.38	333	
HD214994	0841		A1IV	9608	3.65	0.08	333	E
HD215648	0843	643	F7 V	6167	4.04	–0.32	111	L J I E
HD216131	0846	644	G8 III	5018	2.78	–0.09	SKC	J I E
HD216143	0847	645	G5	4496	1.27	–2.15	SKC	I E
HD216174	0845	646	K1 III	4390	2.23	–0.53	SKC	J I E
HD216219	0848		G0IIp	5727	3.36	–0.39	SKC	I E
HD216228	0844	647	K0 III	4768	2.49	0.01	SKC	I E
HD216385	0849	648	F7 IV	6179	3.98	–0.35	SKC	L J I E
HD216640	0851		K1III	4568	2.74	0.22	212	J I
HD216831	0852		B7III	12923	3.80	0.40	333	E
HD216916	0853		B2IV	22989	3.90	–0.23	333	E
HD217014	0854		G5V	5729	4.12	0.11	SKC	J I E
HD217107	0855		G8IV	5548	4.28	0.31	333	E
HD217382	0850		K4III	4070	1.78	–0.11	111	
HD217754	0856		F2IV	7074	3.56	0.10	331	E
HD218031	0857	652	K0 IIIb	4646	2.52	–0.14	111	J I
HD218235	0858		F6Vs	6490	4.08	0.16	111	
HD218329	0859	653	M1 IIIab	3810	1.10	—	11	L E
HD218502	0860	655	F3w	6030	3.76	–1.84	SKC	I E
HD218640	0861		A3IV:	5640	3.62	0.27	111	
HD218804	0862		F5IV	6261	4.05	–0.23	222	E
HD218857	0863	657	G6w	5082	2.41	–1.93	SKC	I E
HD219116	0865		G8IIIp	5300	3.50	–0.34	333	
HD219134	0864	658	K3 Vvar	4717	4.50	0.05	SKC	L I E
HD219449	0867	659	K0 III	4578	2.39	–0.09	SKC	L J I E
HD219615	0870	660	G9 III	4830	2.57	–0.42	SKC	J I E
HD219617	0869	661	F8w	5878	4.04	–1.39	SKC	L E
HD219623	0868	662	F7 V	6155	4.17	–0.04	SKC	J E
HD219734	0871	663	M2 III	3730	0.90	0.27	113	L E
HD219916	0872		K0III	5110	3.14	–0.07	SKC	E
HD219978	0873	666	K4.5 Ib	4242	0.80	–0.15	331	
HD220009	0874	667	K2 III	4418	2.25	–0.56	111	J I
HD220575	0875		B8III	12293	3.70	0.50	333	I E
HD220825	0877		A0p. . .	10286	3.70	–0.18	333	I E
HD220933	0878		A0mnp. . .	10723	3.80	0.80	333	E
HD220954	0879		K1III	4664	2.37	–0.10	SKC	J I E
HD221148	0881	669	K3 IIIvar	4643	3.05	0.30	112	L J I
HD221170	0880		G2IV	4465	1.04	–2.10	SKC	I E
HD221345	0882		K0III	4731	2.63	–0.31	SKC	J I E
HD221377	0883		F7Vm	5998	3.80	–1.12	SKC	E
HD221756	0885		A1III	9020	3.91	–0.50	333	E
HD221830	0886	670	F9 V	5688	4.16	–0.44	SKC	J I E
HD222368	0888	672	F7 V	6170	4.09	–0.15	111	L J I E
HD222404	0887		K1IV	4769	2.98	–0.01	SKC	I E
HD222451	0889		F1V	6630	4.16	0.00	111	E
HD223047	0891		G5Ib	4990	1.50	0.17	333	I E
HD223385	0892		A3Ia+. . .	9333	1.00	0.00	333	I E
HD223524	0893		K0IV	4609	4.20	0.07	333	
HD223640	0894		B9p(SiCrSr)	12462	3.55	0.31	333	
HD224458	0895		G8III	4722	2.20	–0.49	232	J I
HD224930	0001	673	G3 V	5305	4.49	–0.75	SKC	L I E
HD225212	0002		K3Ibvar	4166	0.95	0.02	333	I
HD225239	0003		G2V	5775	4.00	–0.45	SKC	I E
HD232078	0731	675	K4-5 III-II	3983	0.30	–1.73	121	L I E
HD233511	0298		sdF6	5900	4.20	–1.70	111	
HD233666	0359		G2we	5295	2.50	–1.51	222	
HD233832	0410		K0V	4904	4.37	–0.74	222	
HD234677	0680		K7Vvar	4200	4.50	0.05	333	

Table A1 – *continued*

HD/other	MILES Num	CaT Num	SpT	$T_{\rm eff}$	log g	[Fe/H]	References	Libraries
HD237846	0365	695	F8	4957	1.79	–2.59	121	I
HD237903	0388	694	K7 V	4070	4.70	–0.18	113	L J I
HD250792	0202		G0V	5440	4.29	–1.21	222	
HD251611	0205		F8	5353	3.75	–1.70	131	
HD281679	0140		B8	8542	2.50	–1.43	333	
HD284248	0143		F2	6025	4.20	–1.60	111	
HD285690	0146		K0	4790	4.60	0.13	333	
HD285773	0153		G5	5208	4.46	–0.05	331	
HD293857	0172		G8V	5450	4.50	0.00	333	
HD338529	0725	686	B5	6165	4.06	–2.25	SKC	I E
HD345957	0757		G0Vwe	5702	3.87	–1.51	SKC	E
LHS1930	0263		G5	5350	4.50	–1.24	333	
MS0515.4-0710	0175		K2e	4570	3.50	0.16	333	
MS1558.4-2232	0580		K3e	4250	3.50	0.10	333	

Table A2. Final atmospheric parameters ($T_{\rm eff}$, log g and [Fe/H]) and absolute magnitudes in V band (M_V^0) of cluster stars. References for effective temperatures: (1) derived from $B-V$ versus $T_{\rm eff}$ relations in ALO (Alonso et al. 1996b, 1999); (2) mean value from $B-V$ and $V-K$ versus $T_{\rm eff}$ relations in ALO. Surface gravities were derived by interpolating the location of each individual star in a $M_V - T_{\rm eff}$ diagram, using appropriate isochrones taken from Girardi et al. (2000); see Section 3.3. Metallicity sources are provided in Table 6. Spectral types are presented for stars in Alpha Per, Coma Ber, Hyades, Pleiades, M25 and NGC 6791. For the rest of the clusters, we list positions in the HR diagram (SGB: subgiant branch; GB: giant branch; HB: horizontal branch; AGB: asymptotic giant branch). Stars labelled with an asterisk were not finally included in the MILES spectral data base. Those stars being in common with the Lick/IDS sample are coded as 'L' in the last column.

Cluster name	Star ID	MILES Num	CaT Num	SpT	M_V^0	$T_{\rm eff}$	log g	[Fe/H]	Ref($T_{\rm eff}$)	Library
Alpha Per	HD020902	0898		F5 Ib	−4.88	6527	0.26	−0.05	1	
Coma Ber	HD107276	0920	006	A6 IV-V	2.07	7972	4.21	−0.05	1	L
	HD107513	0921	007	A9 V	2.80	7409	4.25	−0.05	1	L
	HD109307	0922		A4 V	1.65	8471	4.16	−0.05	1	
Hyades	HD025825	0901	016	G0 V	4.41	5992	4.41	+0.13	1	L
	HD026736	0902	017	G3 V	4.65	5657	4.45	+0.13	2	L
	HD027383	0904		F7 V+?	3.44	6098	4.28	+0.13	2	
	HD027524	0905	023	F5 V	3.36	6622	4.28	+0.13	1	L
	HD027561	0906	025	F5 V	3.17	6742	4.24	+0.13	2	L
	HD027962	0907		A2IV	0.86	8850	3.80	+0.13	2	
	HD028483	0908	029	F6 V	3.66	6486	4.30	+0.13	1	L
	HD028546	0909		Am	2.04	7626	4.11	+0.13	1	
	HD029375	0910	032	F0 V	2.35	7283	4.17	+0.13	1	L
	HD030034	0911	034	F0 V	1.96	7634	4.11	+0.13	1	L
	HD030210	0912	035	Am	1.93	7954	4.11	+0.13	1	L
	HD030676	0913		F8	3.68	6108	4.30	+0.13	1	
	HD031236	0914	036	F3 IV	2.93	7397	4.21	+0.13	1	L
	HD284253	0903	020	K0 V	5.71	5256	4.55	+0.13	1	L
Pleiades	Mel 22 0296	0899		G8V	5.73	5173	4.57	−0.03	1	
	Mel 22 2462	0900			5.86	5145	4.61	−0.03	1	
M3	M3 398	0925	043	GB	−1.17	4541	1.51	−1.34	1	L
	M3 III 28	0924	044	GB	−2.39	4093	0.75	−1.34	2	L
	M3 IV 25	0923	045	GB	−1.58	4367	1.27	−1.34	2	L
M4	M4 LEE 1409	(∗)			0.93	6415	2.51	−1.19	1	
	M4 LEE 2303	0933			0.99	6748	2.51	−1.19	1	
M5	M5 I 45	(∗)	046	HB	0.51	5758	2.40	−1.11	1	L
	M5 II 51	0927	047	GB	−0.45	4627	1.74	−1.11	2	L
	M5 II 53	0929	048	HB	0.88	9441	2.43	−1.11	1	L
	M5 II 76	0928	049	HB	0.55	5974	2.44	−1.11	1	L
	M5 III 03	0926	050	GB	−2.06	4031	0.65	−1.11	2	L
	M5 IV 19	0930	051	GB	−1.80	4113	0.87	−1.11	2	L
	M5 IV 59	(∗)	052	GB	−1.44	4245	1.15	−1.11	2	L
	M5 IV 86	0931	053	HB	0.54	5576	2.44	−1.11	2	L
	M5 IV 87	0932	054	HB	0.66	5864	2.56	−1.11	1	L
M13	M13 A 171	0934	040	AGB	−1.64	4566	1.21	−1.39	1	L
	M13 B 786	0935	041	GB	−2.36	3891	0.73	−1.39	1	L

Table A2. – *continued*

Cluster name	Star ID	MILES Num	CaT Num	SpT	M_V^0	$T_{\rm eff}$	log g	[Fe/H]	Ref($T_{\rm eff}$)	Library
M25	HD170764	0938		G1 Ib	−4.02	6242	1.60	+0.17	1	
	HD170820	0939		K0 III	−3.00	4604	1.62	+0.17	1	
M67	M67 F 108	0919	058	GB	−0.26	4255	1.84	−0.09	2	L
M71	M71 1-09	0961	075	AGB	−0.42	4672	1.72	−0.84	1	L
	M71 1-21	0958	076	GB	−0.69	4364	1.53	−0.84	2	L
	M71 1-31	(∗)	077		0.61	5518	2.42	−0.84	1	L
	M71 1-34	0963	078	HB	0.74	5075	2.43	−0.84	1	L
	M71 1-36	(∗)	079		−0.92	4682	1.42	−0.84	1	L
	M71 1-37	0959	080	GB	0.45	4574	2.20	−0.84	1	L
	M71 1-39	0962	081	HB	0.81	4976	2.45	−0.84	1	L
	M71 1-41	0960	082	HB	0.70	5123	2.41	−0.84	1	L
	M71 1-53	0964	083	GB	−0.74	4167	1.51	−0.84	1	L
	M71 1-59	(∗)	084	GB	0.92	4623	2.42	−0.84	1	L
	M71 1-63	0957	085	AGB	−0.18	4689	1.87	−0.84	1	L
	M71 1-64	0956	086	GB	−0.61	4275	1.59	−0.84	1	L
	M71 1-65	0955	087	GB	0.49	4606	2.20	−0.84	1	L
	M71 1-66	0954	088	AGB	−0.70	4465	1.55	−0.84	1	L
	M71 1-71	0951	089	GB	−0.17	4404	1.84	−0.84	1	L
	M71 1-73	0949	090	GB	1.08	4793	2.50	−0.84	1	L
	M71 1-75	0948	091		1.14	4790	2.52	−0.84	2	L
	M71 1-77	0967			−1.00	4014	1.32	−0.84	1	
	M71 1-78	0968			−0.84	4332	1.45	−0.84	1	
	M71 1-87	0953	092		0.66	5075	2.40	−0.84	1	L
	M71 1-95	0946	093	AGB	−0.41	4639	1.73	−0.84	1	L
	M71 1-107	0947	094	AGB	−0.01	4919	1.99	−0.84	1	L
	M71 1-109	0945	095	GB	1.16	4723	2.55	−0.84	1	L
	M71 A2	0966	097	HB	0.82	4840	2.35	−0.84	2	L
	M71 A4	(∗)	098	AGB	−1.53	4040	0.94	−0.84	2	L
	M71 A9	0944	101	GB	−0.78	4151	1.45	−0.84	2	L
	M71 C	(∗)	102	HB	0.78	4892	2.36	−0.84	2	L
	M71 S	0969	104	GB	−0.78	4247	1.45	−0.84	2	L
	M71 X	0970	105	HB	0.69	5170	2.41	−0.84	2	L
	M71 I	0971			−1.33	4275	1.10	−0.84	1	
	M71 Y	(∗)			0.16	4649	2.04	−0.84	1	
	M71 KC-147	0950	108		1.29	4901	2.61	−0.84	1	L
	M71 KC-169	0965	109		0.59	5014	2.36	−0.84	1	L
	M71 KC-263	0952	110		1.34	4883	2.61	−0.84	1	L
M79	M79 131	(∗)			−1.98	4196	0.93	−1.37	2	
	M79 153	0915			−2.15	4130	0.79	−1.37	2	
	M79 160	0916			−2.57	3956	0.52	−1.37	2	
	M79 223	0917			−2.40	3977	0.64	−1.37	2	
M92	M92 III 13	0937	114	GB	−2.61	4178	0.77	−2.16	2	L
	M92 IV 114	0936	115	GB	−0.81	4728	1.70	−2.16	2	L
	M92 IX 12	(∗)	117	AGB	−0.52	5677	1.87	−2.16	1	L
	M92 XII 8	(∗)	118	GB	−1.88	4477	1.18	−2.16	2	L
NGC 288	NGC 288 77	0897			−1.83	4218	0.89	−1.07	2	
	NGC 288 96	(∗)			−2.21	4023	0.65	−1.07	2	
NGC 2420	NGC 2420 140	0918			−0.82	4397	1.73	−0.44	1	
NGC 6791	NGC 6791 R4	0940			0.28	4072	1.71	+0.40	1	
	NGC 6791 R5	0941			1.25	4057	2.32	+0.40	1	
	NGC 6791 R16	0942		K4III	0.06	4043	1.59	+0.40	1	
	NGC 6791 R19	0943			0.46	4086	1.86	+0.40	1	
NGC 7789	NGC 7789 329(491)	0972			−0.07	4527	2.14	−0.13	1	
	NGC 7789 338(499)	(∗)	145		−0.52	5120	1.90	−0.13	1	L
	NGC 7789 342(502)	0974			0.10	10 023	2.25	−0.13	1	
	NGC 7789 353(509)	0975			0.22	4494	2.31	−0.13	1	
	NGC 7789 415(550)	0976	146	GB	−1.64	4074	1.10	−0.13	1	L
	NGC 7789 461(583)	0977			−1.02	4243	1.56	−0.13	1	
	NGC 7789 468(589)	0973	147	GB	−1.19	4273	1.39	−0.13	1	L
	NGC 7789 494(604)	(∗)			−1.69	3930	1.04	−0.13	1	
	NGC 7789 501(614)	0978	149	GB	−1.13	4115	1.48	−0.13	1	L
	NGC 7789 575(671)	0979	150	GB	−0.24	4544	2.06	−0.13	1	L
	NGC 7789 637(723)	0980			0.09	4561	2.24	−0.13	1	
	NGC 7789 669(732)	(∗)			−0.87	4214	1.65	−0.13	1	L

Table A2. – *continued*

Cluster name	Star ID	MILES Num	CaT Num	SpT	M_V^0	$T_{\rm eff}$	log g	[Fe/H]	Ref($T_{\rm eff}$)	Library
	NGC 7789 732(784)	(∗)			0.34	4892	2.44	−0.13	1	
	NGC 7789 765(804)	0981			−0.73	4578	1.76	−0.13	1	
	NGC 7789 859(853)	0982	153	GB	0.30	4544	2.34	−0.13	1	L
	NGC 7789 866(864)	(∗)			0.51	4853	2.51	−0.13	1	
	NGC 7789 875(873)	0983	154	HB	0.63	4952	2.62	−0.13	1	L
	NGC 7789 897(881)	0984	155	HB	0.56	4912	2.58	−0.13	1	L
	NGC 7789 971(946)	0985	156	GB	−1.31	4020	1.32	−0.13	1	L

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