

The CARMENES search for exoplanets around M dwarfs[★]

Different roads to radii and masses of the target stars

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ABSTRACT

Aims. We determine the radii and masses of 293 nearby, bright M dwarfs of the CARMENES survey. This is the first time that such a large and homogeneous high-resolution ($R > 80,000$) spectroscopic survey has been used to derive these fundamental stellar parameters.

Methods. We derived the radii using Stefan-Boltzmann's law. We obtained the required effective temperatures T_{eff} from a spectral analysis and we obtained the required luminosities L from integrated broadband photometry together with the *Gaia* DR2 parallaxes. The mass was then determined using a mass-radius relation that we derived from eclipsing binaries known in the literature. We compared this method with three other methods: (1) We calculated the mass from the radius and the surface gravity $\log g$, which was obtained from the same spectral analysis as T_{eff} . (2) We used a widely used infrared mass-magnitude relation. (3) We used a Bayesian approach to infer stellar parameters from the comparison of the absolute magnitudes and colors of our targets with evolutionary models.

Results. Between spectral types M0 V and M7 V our radii cover the range $0.1 R_{\odot} < R < 0.6 R_{\odot}$ with an error of 2–3% and our masses cover $0.09 M_{\odot} < M < 0.6 M_{\odot}$ with an error of 3–5%. We find good agreement between the masses determined with these different methods for most of our targets. Only the masses of very young objects show discrepancies. This can be well explained with the assumptions that we used for our methods.

Key words. stars: fundamental parameters – stars: low mass – stars: late type

1. Introduction

The mass of a star is one of its most important properties. When trying to understand a star by itself and when isolating it from its environment, it is fundamental to stellar physics that the mass is

the most influential parameter that determines almost exclusively all other properties throughout a star's life. Moreover, should the star have a companion, the masses of both components determine the gravitational potential and their orbits. In particular, if the companion is a planet, the gravitational potential is dominated by the stellar mass, which is crucial to know if we want to measure the minimum mass, $M_p \sin i$, of the planet.

[★] Table B.1 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via <http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/>

The latter is the situation that the CARMENES search faces in its quest to find Earth-mass planets. CARMENES (Calar Alto high-Resolution search for M dwarfs with Exo-earths with Near-infrared and optical Échelle Spectrographs) is a double channel spectrograph built to find Earth-mass planets around M dwarfs using the radial-velocity method (Quirrenbach et al. 2014). The visual channel of this spectrograph has a resolving power of $R \approx 95\,000$ and covers the wavelength range from $0.52\,\mu\text{m}$ to $0.96\,\mu\text{m}$. Its near infrared channel has a resolving power of $R \approx 80\,000$ and covers the wavelength range from $0.96\,\mu\text{m}$ to $1.71\,\mu\text{m}$. This spectrograph is operated at the 3.5 m telescope on Calar Alto, Spain, and has been taking data since January 2016 (Quirrenbach et al. 2016, 2018; Reiners et al. 2018b). So far CARMENES has been used in the discovery of several new planets (Reiners et al. 2018a; Kaminski et al. 2018; Ribas et al. 2018; Luque et al. 2018; Nagel et al. 2019). All of these discoveries estimated the mass of the host star with the same procedure that we present in this work, even though Reiners et al. (2018a), Kaminski et al. (2018), and Ribas et al. (2018) used slightly older data than those used in this work. However, an in-depth investigation of the validity of this method is still missing.

A widely used method to determine masses of M dwarfs directly is the observation of detached double-lined eclipsing binary systems (see, e.g., Andersen 1991; Torres et al. 2010; Torres 2013, for reviews). Accurately measuring the radial-velocity amplitudes of the components of such systems allows us to derive their stellar masses independently. Another method to measure the masses of M dwarfs dynamically are observations of astrometric binaries that are also visual or spectroscopic binaries (see, e.g., Quirrenbach 2001; Benedict et al. 2016, and both their references), for which it is possible to reconstruct the orbits of the components.

For measuring stellar radii, eclipsing binaries can be used as well. The radii of their components and the inclination of the system can be determined from the eclipsing light curve (e.g., Torres & Ribas 2002; Ribas 2003; Clausen et al. 2009; Morales et al. 2009). For single stars, interferometry is used to directly measure the angular diameter (e.g., van Belle et al. 2009; Boyajian et al. 2012a,b; Ligi et al. 2016). Together with the distance, the physical radius can be inferred from the same dataset. However, it is difficult to apply this method to low-mass stars because they are small and faint, which requires high sensitivity and resolution to achieve acceptable accuracy. Some interferometric radius measurements of M dwarfs with uncertainties of 1–5% have been performed by Ségransan et al. (2003), Berger et al. (2006), Boyajian et al. (2012b), and von Braun et al. (2014).

On the other hand, because the fundamental techniques of measuring the mass and radius of isolated M dwarfs (or those with wide companions) are limited, well-calibrated empirical relationships are generally employed. This is an adequate solution if the stars are assumed to behave like statistical representatives of the sample on which these relations are based. It has the advantage that only the luminosity or magnitude in certain bands has to be measured to estimate the stellar mass. An early mass-luminosity relation for M dwarfs was provided by Henry & McCarthy (1993). Several other works (e.g., Delfosse et al. 2000; Benedict et al. 2016; Mann et al. 2019) provided up-to-date mass-magnitude relations for low-mass stars, calibrated for different parameter ranges. Additionally, relations connecting colors or other measurable quantities with the mass or radius that are not directly accessible have been established to determine missing parameters of stars in question (e.g., Mann et al. 2015). If there are, however, systematic differences between the samples used to determine any such empirical relation and the stars

to be analyzed, then there is a bias in the results, which are based on such relations. Most prominently, the level of stellar activity may cause such a bias. For example, Caballero et al. (2010), Jackson et al. (2018), and Kesseli et al. (2018) reported inflated radii for young, magnetically active, or fast rotating stars.

Therefore, to obtain the mass M of the CARMENES targets we would traditionally use, for example, a $M-M_K$ relation (e.g., Delfosse et al. 2000) and an infrared magnitude. This was actually done in the first CARMENES-based planet analysis (Trifonov et al. 2018) and in the survey overview of Reiners et al. (2018b). Our new approach, however, is to use such relations only when unavoidable. Instead, we exploit as much information from the observations as possible and use all the measurements, including our spectra and up-to-date photometry and parallaxes, already obtained. We also investigate the accuracy with which we can measure the radius and mass of a star. This includes calculating individual error bars for every analyzed object. We finally confront our method with other methods (both new and traditional) using the same homogeneous data set.

In Section 2 we present the sample used in this work. In Section 3 we describe our method. In short, we combine several purely observational data sets (high-resolution spectroscopy, photometry, and trigonometric parallaxes) with only one computational model (synthetic spectra based on a grid of model atmospheres) and one fundamental relation (a mass-radius relation) to obtain luminosities, radii, and masses. In Section 4 we compare the results from our method with results obtained from other alternative methods. In Sections 5 and 6 we finally discuss the results and draw conclusions for the future.

2. The sample

To date, the catalog of targets observed during guaranteed time observations (GTO) of the CARMENES spectrograph includes a total of 341 bright, nearby M dwarfs or M dwarf systems, for which CARMENES based results have been published, and we use 293 of these for the reasons outlined below.

In this work we based our mass and radius determinations on the spectral analysis of Passegger et al. (2016, 2018, see Section 3.2). We imposed the same requirements and only used those CARMENES spectra with a signal-to-noise ratio (S/N) of $S/N > 75$. Furthermore, as in Passegger et al. (2018, hereafter Pass18) we excluded targets with spectral line profiles that cannot be reproduced by a purely photospheric model, i.e., stars with signs of activity that significantly affect the profiles of the lines used by Pass18 for determining stellar parameters; see Tal-Or et al. (2018) and Fuhrmeister et al. (2018) for the impact of activity on CARMENES target stars. Finally, as in Pass18 we excluded fast rotators. All these criteria finally yield 293 stars.

Previously, however, different CARMENES GTO samples have been studied. Reiners et al. (2018b) presented the initial sample of 324 CARMENES targets without any presumable companion closer than 5 arcsec, while Baroch et al. (2018) added nine double-lined spectroscopic binaries discovered in the survey. Baroch et al. (2018) determined their minimum masses and radii using methods suitable for spectroscopic binaries, but we do not consider these nine binaries in this work because we are interested only in isolated M dwarfs (or those with wide companions). One of the original 324 targets was recently determined to be a close astrometric binary as well (to be discussed in a future publication) and we do not consider it in this work either. There can still be some very long-period, low-amplitude, single-lined spectroscopic binaries in our GTO sample that are yet to be discovered and did not pass our initial filters (Cortés-Contreras

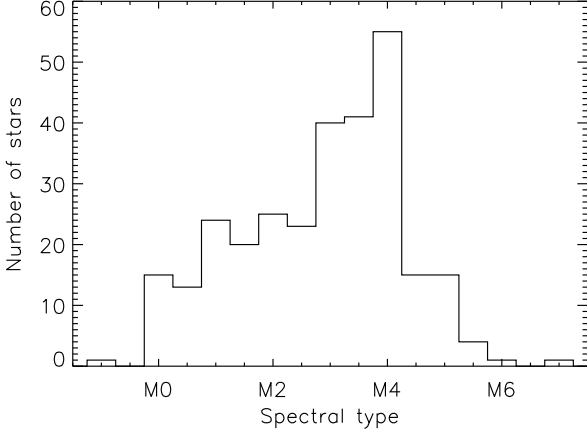


Fig. 1. Histogram of the spectral types (as determined by Alonso-Floriano et al. 2015, and references therein) of all 293 targets of our sample. The leftmost bin represents the only K7 V star in our sample.

et al. 2017; Jeffers et al. 2018; Baroch et al. 2018). Another eight objects did not have any or not sufficient observations to reach enough S/N to be tabulated by Reiners et al. (2018b). Three of these¹ were included in the sample of Díez Alonso et al. (2019), who studied the rotation periods of CARMENES targets. All of these eight objects except one² were included in the study of Schöfer et al. (2019), who investigated the activity of the CARMENES targets. We, finally, included six³ of the eight new targets.

We present our sample in Table B.1. For each of the 293 M dwarfs, we provide for identification purposes the CARMENES identifier (Caballero et al. 2016), the Gliese or Gliese & Jahreiss name when available, or the discovery name otherwise; we also give the luminosity-class V spectral type (Alonso-Floriano et al. 2015, and references therein). A histogram of the spectral types of our sample is shown in Fig. 1.

3. Our method

Our method is a multi-step process. In the first step in Section 3.1 we determine the luminosity from distance and photometry. In the second step in Section 3.2 we measure the effective temperature from the CARMENES spectra by fitting PHOENIX (Hauschildt & Baron 1999) synthetic spectra. In the third step in Section 3.3 we use Stefan-Boltzmann’s law to obtain the radius. To finally obtain the masses in Section 3.4, we introduce an empirical mass-radius relation to calculate the mass from the radius. These steps, along with those needed for the alternative methods, are sketched in Fig. 2.

3.1. Distances and luminosities

We determine the luminosities from apparent magnitudes and distances. For 285 of the 293 M dwarfs, we retrieve parallax distances from the *Gaia* DR2 catalog (Gaia Collaboration et al. 2018). For the remaining eight cases, which are not part

of *Gaia* DR2 and are listed in Table B.1 together with a corresponding note, we retrieve parallactic distances from the astrometric analyses of van Altena et al. (1995, two stars⁴), van Leeuwen (2007, three stars⁵), and Finch & Zacharias (2016, two stars⁶), and derive spectrophotometric distances after applying the *J*-band absolute magnitude-spectral type relation given by Cortés-Contreras et al. (2017, one star⁷).

For every target star in the CARMENES input catalog Carmencita (Caballero et al. 2016), we collected apparent magnitudes in broadband passbands from a number of all-sky and ultra-wide surveys from the ultraviolet, through optical and near-infrared, to the mid-infrared. The integration of the spectral energy distribution (SED) of each CARMENES target allowed us to determine the bolometric luminosity L . In our case, we performed the integration with the Virtual Observatory SED Analyzer (VOSA; Bayo et al. 2008), the distances described above, and the SEDs built with photometric data from *GALEX* (*FUV* *NUV*; Morrissey et al. 2007), SDSS (*ugriz*; York et al. 2000), UCAC4 and APASS9 (*BgVri*; Zacharias et al. 2013; Henden et al. 2015), Tycho-2 (*B_T V_T*; Høg et al. 2000), *Gaia* DR2 (*B_P G R_P*; Gaia Collaboration et al. 2018), CMC15 (*r'*; Muñíos & Evans 2014), Pan-STARRS1 (*grizy*; Tonry et al. 2012), 2MASS (*JHK_s*; Skrutskie et al. 2006), and *AllWISE* (*W1 W2 W3 W4*; Cutri et al. 2014). The VOSA software uses the latest zero-point fluxes provided by the Filter Profile Service (Rodrigo et al. 2012), which can be found on their website⁸. We used synthetic photometry based on the BT-Settl models (Allard et al. 2012) for the ultraviolet flux blueward of the Johnson *B* band and for the mid- and far-infrared redward of *WISE* *W4*. At the considered effective temperatures, M dwarfs hardly emit any flux in these two wavelength regions. Therefore, the approximation of these two contributions to the luminosity are barely dependent on the models chosen as input to VOSA. Moreover, by using synthetic photometry for the ultraviolet we do not contaminate the photospheric flux with chromospheric flux from stellar activity. The resulting luminosities are listed in Table B.1. Typical relative errors of L are between 1 and 2%. More details on the photometry compilation and luminosity derivation including their errors will be provided in a separate publication.

3.2. Effective temperatures, surface gravities, and metallicities

We measured the photospheric parameters effective temperature T_{eff} , surface gravity $\log g$, and metallicity, denoted by the relative iron abundance $[\text{Fe}/\text{H}]$ by fitting PHOENIX-ACES synthetic spectra (Husser et al. 2013) to the CARMENES spectra of the visual (VIS) channel as described in Passegger et al. (2016) and Pass18. In summary, this method has T_{eff} and $[\text{Fe}/\text{H}]$ as free parameters, but fixes $\log g$ by a $T_{\text{eff}}\text{-}\log g$ relation from theoretical 5 Gyr isochrones of Baraffe et al. (1998). To analyze all 293 members of our sample described in Section 2, we repeated the analysis of Pass18 using the latest available CARMENES co-added (Zechmeister et al. 2018) VIS spectra that fulfill the requirements of Pass18 described above (cf. Section 2).

¹ J15474-108 (GJ 3916), J18198-019 (Gl 710) and J20556-140S (Gl 810B)

² J18198-019 (Gl 710)

³ J04219+213 (K2-155), J08409-234 (Gl 317), J09143+526 (Gl 338A), J15474-108 (GJ 3916), J18198-019 (Gl 710) and J20556-140S (Gl 810B)

⁴ J22020-194 (Gl 843) and J18224+620 (GJ 1227)

⁵ J07274+052 (Gl 273), J11033+359 (Gl 411) and J11054+435 (Gl 412A)

⁶ J06574+740 (2M J06572616+7405265) and J09133+688 (G 234-057)

⁷ J06396-210 (LP 780-032)

⁸ <http://svo2.cab.inta-csic.es/theory/fps/>

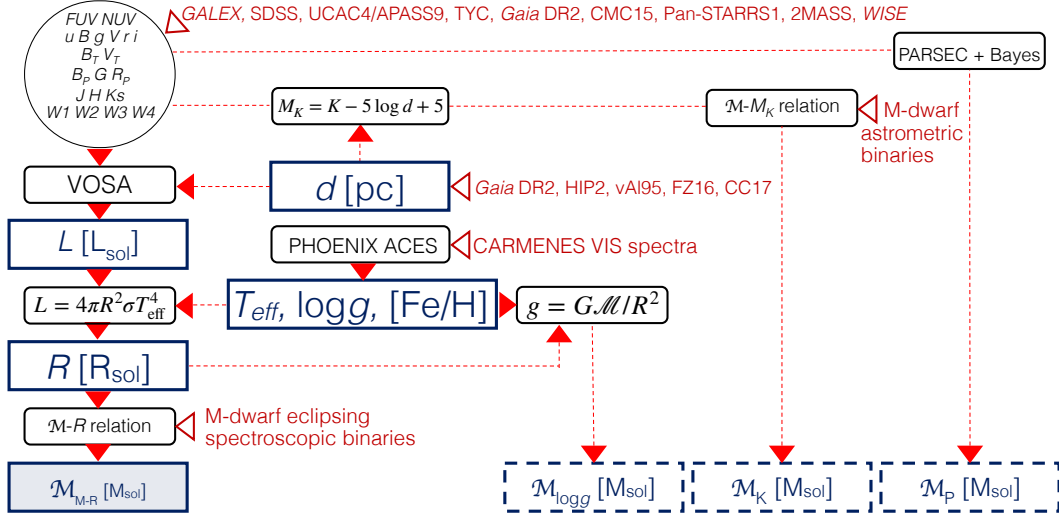


Fig. 2. Flowchart of our different roads to masses.

Pass18 presented the stellar photospheric parameters for 235 stars of our exoplanet survey. These authors used CARMENES VIS data for 234 targets and CAFE (Calar Alto Fiber-fed Echelle spectrograph) data for one star. We present in this work 59 new parameter sets derived from CARMENES spectroscopy, and update the parameters for 234 stars of Pass18 (omitting the binary mentioned in Section 2). The updated and Pass18 results agree within their fixed error bars ($\Delta T_{\text{eff}} = 51$ K, $\Delta \log g = 0.07$ dex, and $\Delta[\text{Fe}/\text{H}] = 0.16$ dex). All results are listed in Table B.1.

There exist, however, alternative model atmospheres and synthetic spectra for M dwarfs, most prominently the BT-Settl models (Allard et al. 2012). When they are used in spectral analyses, the fit quality (see, e.g., Rojas-Ayala et al. 2012) is similar to the fit quality in Pass18. However, the resulting photospheric parameters typically differ. Most recently, Rajpurohit et al. (2018) determined effective temperatures for the CARMENES GTO targets listed in Reiners et al. (2018b) using the latest BT-Settl models, which are about 100–200 K smaller than ours. Describing these differences is beyond the scope of this paper and they will be investigated in a future publication. However, in order to assess an error estimate resulting from the use of one specific set of synthetic spectra we repeated our analysis described above using the latest, publicly available grid with varying metallicities, which are the 2011 BT-Settl models. We then found effective temperatures that are about 50 K (i.e., our ΔT_{eff}) hotter for $T_{\text{eff}} \lesssim 3700$ K and up to about 200 K cooler for $T_{\text{eff}} \gtrsim 3700$ K. Owing to error propagation, this means that for $T_{\text{eff}} \lesssim 3700$ K the derived radii and masses (see below) that are based on PHOENIX-ACES models, and radii and masses that are based on BT-Settl models would agree within our error bars. However, for higher T_{eff} values, there would be a systematic offset between these derived quantities. Similarly, using the significantly and systematically differing T_{eff} results from Rajpurohit et al. (2018) would also introduce a systematic offset in radii and masses beyond our error bars.

3.3. Radii

Using the effective temperature T_{eff} and luminosity L from Section 3.1 we calculated the radius R using Stefan-Boltzmann’s law

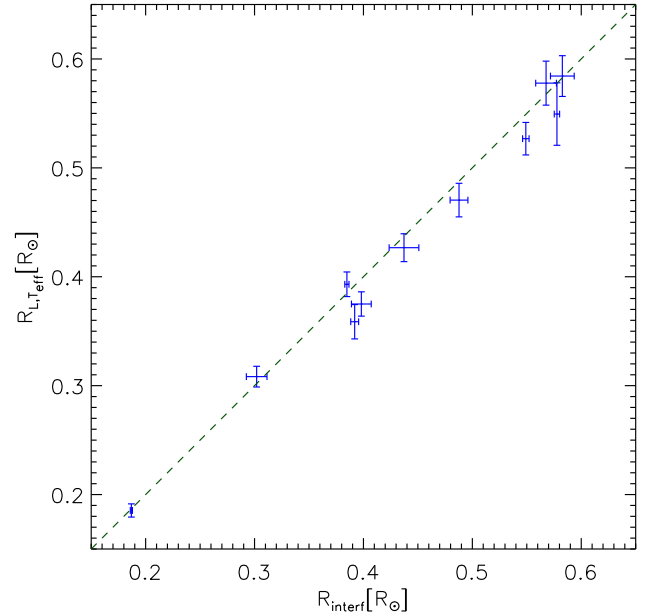


Fig. 3. Radii determined using the spectroscopic T_{eff} from Section 3.2, the bolometric luminosity from Section 3.1, and Stefan-Boltzmann’s law plotted against interferometric radii from Boyajian et al. (2012b). The two discussed outliers are GI 411 and GI 412A with R_{interf} of 0.392 and 0.398 R_{\odot} , respectively.

$$R = \left(\frac{L}{4\pi\sigma T_{\text{eff}}^4} \right)^{1/2}. \quad (1)$$

The error for R is then described by

$$\left(\frac{\Delta R}{R} \right)^2 = \left(2 \frac{\Delta T_{\text{eff}}}{T_{\text{eff}}} \right)^2 + \left(\frac{1}{2} \frac{\Delta L}{L} \right)^2. \quad (2)$$

When explicitly expressing L by the distance d and the photometrically measured flux S via $L = 4\pi d^2 \cdot S$ the radius becomes

Table 1. Radii of 11 stars of our sample with interferometric diameters measured by Boyajian et al. (2012b).

Karmn	Name	R [R_{\odot}]	R_{interf} [R_{\odot}]	Θ_{LD}^B [mas]	d [pc]
J00183+440	Gl 15A	0.393 ± 0.011	0.385 ± 0.002	1.005 ± 0.005	3.5626 ± 0.0005^G
J05314-036	Gl 205	0.549 ± 0.029	0.578 ± 0.002	0.943 ± 0.004	5.7003 ± 0.0023^G
J09143+526	Gl 338A	0.578 ± 0.020	0.568 ± 0.010	0.834 ± 0.014	6.3339 ± 0.0016^G
J09144+526	Gl 338B	0.584 ± 0.019	0.583 ± 0.011	0.856 ± 0.016	6.3335 ± 0.0016^G
J11033+359	Gl 411	0.359 ± 0.016	0.392 ± 0.004	1.432 ± 0.013	$2.5469 \pm 0.0043^{\text{HIP}}$
J11054+435	Gl 412A	0.375 ± 0.011	0.398 ± 0.009	0.764 ± 0.017	$4.8480 \pm 0.0235^{\text{HIP}}$
J11421+267	Gl 436	0.427 ± 0.013	0.437 ± 0.014	0.417 ± 0.013	9.7561 ± 0.0086^G
J13457+148	Gl 526	0.470 ± 0.015	0.488 ± 0.008	0.835 ± 0.014	5.4354 ± 0.0015^G
J15194-077	Gl 581	0.308 ± 0.010	0.302 ± 0.009	0.446 ± 0.014	6.2992 ± 0.0020^G
J17578+046	Gl 699	0.185 ± 0.006	0.187 ± 0.001	0.952 ± 0.005	1.8267 ± 0.0010^G
J22565+165	Gl 880	0.527 ± 0.015	0.549 ± 0.003	0.744 ± 0.004	6.8677 ± 0.0019^G

References. (B) Boyajian et al. (2012b); (G) Gaia Collaboration et al. (2018); (HIP) van Leeuwen (2007)

$$R = \left(\frac{S}{\sigma T_{\text{eff}}^4} \right)^{1/2} d \quad (3)$$

and thus

$$\left(\frac{\Delta R}{R} \right)^2 = \left(2 \frac{\Delta T_{\text{eff}}}{T_{\text{eff}}} \right)^2 + \left(\frac{1}{2} \frac{\Delta S}{S} \right)^2 + \left(\frac{\Delta d}{d} \right)^2. \quad (4)$$

In the era of satellite-based parallaxes, the relative error in distance $\Delta d/d$ is negligible except for the very few stars without *Gaia* DR2 or *Hipparcos* parallaxes. Therefore, the main contributions to the relative error arise from the precision of the measured effective temperature, $\Delta T_{\text{eff}}/T_{\text{eff}}$, and photometry $\Delta S/S$, which are both typically between 1 and 2%, yielding typical $\Delta R/R$ between 2 and 3%.

Our sample has 11 stars in common with the sample of stars with interferometric radii presented by Boyajian et al. (2012b). We used the interferometric angular diameter corrected for limb darkening Θ_{LD} given in Boyajian et al. (2012b), but use *Gaia* DR2 distances d when available to calculate an interferometric radius R_{interf} via

$$R_{\text{interf}} = \frac{1}{2} \Theta_{\text{LD}} d. \quad (5)$$

These R_{interf} are listed in Table 1 along with the angular diameters and distances that we used. When we compared our spectroscopic radii with R_{interf} we find good agreement for 9 of the common stars, as can be seen in Fig. 3. Six of our radii have error bars comparable to the error bars obtained from interferometry. For the remaining 5 stars, interferometry is more precise, as expected. Only the radii of the 2 targets Gl 411 (J11033+359) and Gl 412A (J11054+435), which are based on *Hipparcos* parallaxes, differ significantly beyond their respective error bars (see Section 5.2). The parallactic distances for the other 9 M dwarfs are based on *Gaia* DR2 data.

3.4. Masses (M_{M-R})

We compiled a sample of 55 detached, double-lined, double-eclipsing, main-sequence M dwarf binaries from the literature (see Table B.2 and Fig. 4). We excluded pre-main-sequence stars in very young open clusters and very old stars in globular clusters. From the published masses and radii of these eclipsing binaries, we estimated the best linear fit (following Press et al. 2007)

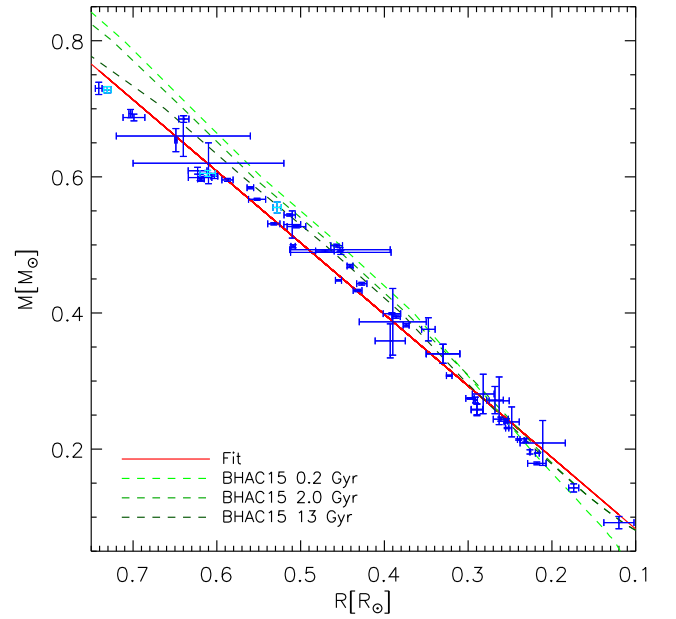


Fig. 4. Masses and radii for the eclipsing binaries of Table B.2. Blue crosses indicate field stars, while turquoise crosses indicate, from left to right, the low-metallicity globular cluster members NGC 6362 V41 B (Kaluzny et al. 2015), M4 V65 B (Kaluzny et al. 2013), and M55 V54 B (Kaluzny et al. 2014). The red solid line shows our best linear fit. The increasingly darker green dashed lines represent isochrones for 0.2, 2, and 13 Gyr from BHAC15.

of the mass-radius relation and found for the radius and mass range given by Table B.2,

$$\frac{M}{M_{\odot}} = (-0.0240 \pm 0.0076) + (1.055 \pm 0.017) \cdot \frac{R}{R_{\odot}}, \quad (6)$$

or equivalently

$$\frac{R}{R_{\odot}} = (0.0282 \pm 0.0068) + (0.935 \pm 0.015) \cdot \frac{M}{M_{\odot}}. \quad (7)$$

Both fits have a non-reduced $\chi^2 \approx 0.02$ translating into an rms ≈ 0.02 in solar units.

By excluding members of young clusters, the mass-radius relation is well defined for M dwarfs older than a few hundred

million years. This is underlined by the comparison with mass-radius relations for ages between 0.2 and 13 Gyr from evolutionary models for solar metallicity by Baraffe et al. (2015, hereafter BHAC15), also shown in Fig. 4. The explanation of the small difference between models and observations is beyond the scope of this paper. However, the small spread between the isochrones demonstrates that our linear mass-radius relation can be treated independently of age. Furthermore, our sample in Table B.2 includes all known eclipsing binaries in the field, independent of metallicity. Yet, our mass-radius relation is well defined, and, therefore, we conclude that it does not significantly depend on metallicity either. Such metallicity independence of the mass-radius relation for low-mass stars is also frequently found in evolutionary models (see, e.g., Fig. 3 of del Burgo & Allende Prieto 2018). This is underlined by including three representative low-metallicity members of the open clusters M 4, M 55, and NGC 6362 in Fig. 4 (but not in the fits for Eqs. 6 and 7), which match our mass-radius relation very well.

The reasons for the intrinsic spread in the observed mass-radius relation and the comparison to theoretical models have been and are still being investigated elsewhere (e.g., Feiden & Chaboyer 2012; Korda et al. 2017; Tognelli et al. 2018; Parsons et al. 2018). As pointed out by Parsons et al. (2018), this spread sets a lower limit on the error bars for the masses obtained with this method. In any case, for this paper, we assume that eclipsing binaries are representative of our single-star sample, and we apply our mass-radius relation to derive masses.

In Table B.1 and for the remainder of this paper we label masses determined with this method as M_{M-R} . As already mentioned in the introduction, these are the masses that we have been using for the planet discoveries of CARMENES. However, Kaminski et al. (2018) used the effective temperature from Pass18. Reiners et al. (2018a) and Ribas et al. (2018) additionally used the mass-radius relation from Casal (2014) and the distances listed in Gaia DR1 (Gaia Collaboration et al. 2016) or as measured by Hipparcos (van Leeuwen 2007) for calculating the luminosity. As a consequence, the masses we list for these three planet hosts⁹ are about 5–8% higher than in the discovery papers. The largest contribution to this change is the update of the parallax and, hence, luminosity.

4. Comparison methods

4.1. Spectroscopic masses ($M_{\log g}$)

If we use the surface gravity $\log g$ from Section 3.2, the mass is calculated via

$$M = \frac{10^{\log g} R^2}{G}, \quad (8)$$

and its error is calculated via

$$\left(\frac{\Delta M}{M}\right)^2 = (\ln 10 \Delta \log g)^2 + \left(2 \frac{\Delta R}{R}\right)^2. \quad (9)$$

In practice, the error in $\log g$ dominates the error in M . The precision of our radii $\Delta R/R$ is about 2 to 3% (cf. Section 3.3). It would require $\Delta \log g \lesssim 0.03$ dex for both contributions to Eq. 9 to become of similar size. However, our current $\Delta \log g = 0.07$ dex is about twice as large. In Table B.1 and for the remainder of this paper we label the mass determined with this method as $M_{\log g}$.

⁹ J16167+672S (Gl 617A), J17578+046 (Gl 699), J1919+051N (Gl 752A)

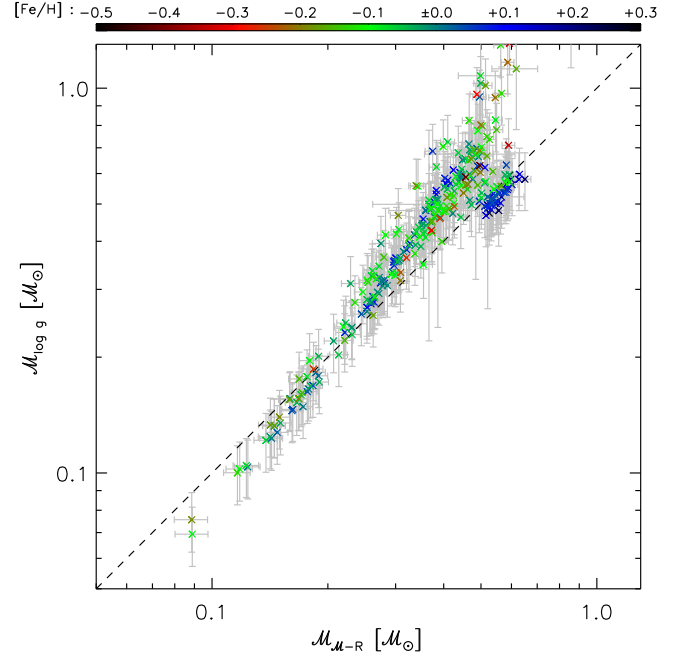


Fig. 5. Comparison of masses for all stars in Table B.1 using our two methods described in Section 4.1 on the y-axis and Section 3.4 on the x-axis. See Fig. A.1 for the same plot without error bars and linear axes.

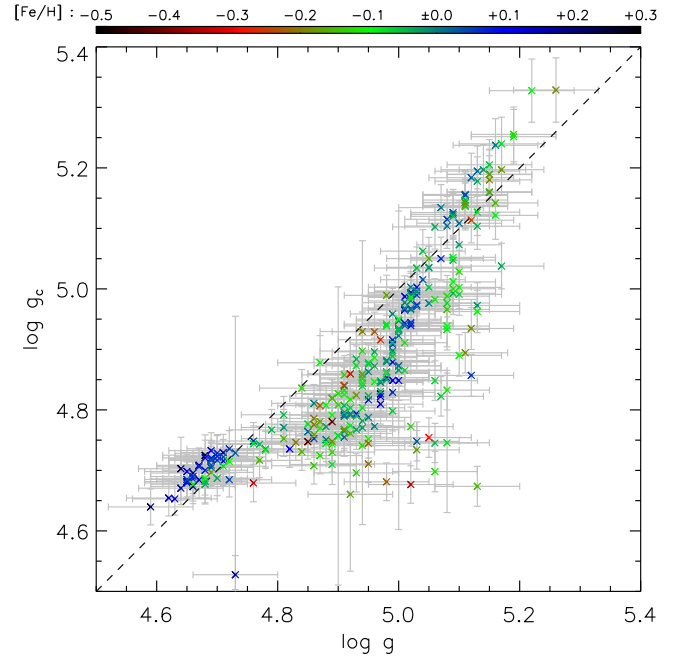


Fig. 6. Value of $\log g_c$ calculated using M_{M-R} from Section 3.4 and using R from Section 3.3 against the spectroscopic $\log g$ from Section 3.2.

We compare M_{M-R} from above with $M_{\log g}$ in Fig. 5. We find systematically lower $M_{\log g}$ values for the lowest ($M_{M-R} \lesssim 0.2 M_\odot$) and highest ($M_{M-R} \gtrsim 0.5 M_\odot$) M_{M-R} values. In between, the $M_{\log g}$ values are higher than the M_{M-R} values, and in particular for M_{M-R} between 0.4 and 0.5 M_\odot there is a large scatter without any correlation, except for the highest metallicities, which seem to form a curve with a sharp turn around 0.5 M_\odot .

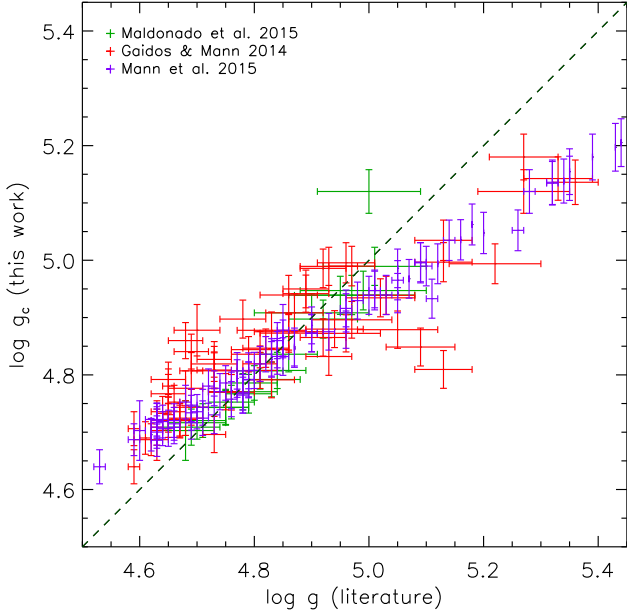


Fig. 7. Value of $\log g_c$ calculated using M_{M-R} from Section 3.4 and using R from Section 3.3 against $\log g$ from the literature.

Furthermore, we reverse the calculation and obtain the surface gravity from M_{M-R} and Stefan-Boltzmann’s radius of Section (3.3). We call this $\log g_c$ and list this value in Table B.1 as well. When we compare the spectroscopic $\log g$ from Section 3.2 to this $\log g_c$ in Fig. 6 we find, as expected, a similar behavior as above when comparing M_{M-R} with $M_{\log g}$: there is a large scatter in the mid-value regime but there are consistent results for the highest and lowest surface gravities, i.e., the least and most massive stars. And, again, the highest metallicity stars form a curve with less scatter than the other metallicities. This is a similar result as found by [Pass18](#) in their Fig. 6, where some spectroscopic $\log g$ values deviate from literature values in a similar fashion. Also similar to [Pass18](#) and as mentioned in Section 3.2, our $\log g$ is connected to T_{eff} . This metallicity dependent connection causes systematic effects due to the underlying evolutionary models. In particular, the $\log g$ values for high-metallicity results are obtained by extrapolating from solar metallicity isochrones ([Pass18](#)).

To examine whether $\log g_c$ is more reliable than $\log g$, we compare our $\log g_c$ with literature values in Fig. 7 to produce a similar plot as Fig. 6 of [Pass18](#). When comparing Fig. 6 of [Pass18](#) to our Fig. 7 we find an improvement. The values published by [Maldonado et al. \(2015\)](#) generally agree well with our $\log g_c$. The $\log g$ values derived from radii and masses published by [Mann et al. \(2015\)](#) show a linear correlation to ours, although its slope is smaller than unity. Only the $\log g$ values derived from radii and masses published by [Gaidos & Mann \(2014\)](#) show a very weak correlation to ours. Since the $\log g$ values that have recently been published by [Rajpurohit et al. \(2018\)](#) do not correlate with [Pass18](#) or other literature values, we did not include these values in Fig. 7. When we now use $\log g_c$ as an input for our spectral analysis described in Section 3.2 and keep it fixed, the resulting effective temperatures (and metallicities) do not change significantly and, therefore, neither do the radii nor the masses determined in Section 3.

Despite the large error bars inherent in calculating $M_{\log g}$, and the problems described above, this method should not be generally dismissed. With precise input data as we have here, the error bars of $M_{\log g}$ become small enough so that the correlation in Fig. 5 becomes visible. However, since the M_{M-R} masses have a much smaller error bar than the $M_{\log g}$ masses we decided to keep using M_{M-R} .

4.2. Photometric masses (M_{M-K_s})

For M dwarfs well established mass-magnitude relations exist for infrared filters determined by [Delfosse et al. \(2000\)](#), [Benedict et al. \(2016\)](#), and most recently by [Mann et al. \(2019\)](#). The latter provided two variants: the first is independent of metallicity and the second one accounts for metallicities $-0.4 < [\text{Fe}/\text{H}] < +0.3$ when using their conservative validity range for metallicity. Both are valid for $4.5 \text{ mag} < M_{K_s} < 10.5 \text{ mag}$, where M_{K_s} is the absolute magnitude in the 2MASS K_s band. Since they also compared their results extensively to the well-established ([Mann et al. 2015](#)) $M - M_K$ relations of [Delfosse et al. \(2000\)](#) and [Benedict et al. \(2016\)](#) and found good (but not perfect, see below) agreement, and since we determined metallicities (Section 3.2) within the recommended range, we employed the metallicity dependent variant of [Mann et al. \(2019\)](#) by using their recommended software¹⁰. However, the metallicity independent relation yields only marginally different numbers. We list the resulting masses, M_{M-K_s} , in Table B.1.

A comparison between our M_{M-R} masses and the photometrically determined masses M_{M-K_s} is given in Fig. 8. Except for individual outliers (which is discussed in Section 5.2), the two mass values agree very well. When we, alternatively, compare our M_{M-R} values with the masses obtained from the two relations of [Delfosse et al. \(2000\)](#) and [Benedict et al. \(2016\)](#), we find disagreement of just beyond the size of our error bars for $M_{M-R} \geq 0.3 M_{\odot}$ but agreement otherwise. This is the same result described by [Mann et al. \(2019\)](#), who found discrepancies of about 10% between their values and the values obtained from the two previous relations above $0.3 M_{\odot}$. For the remainder of this paper we use M_{M-R} since differences between M_{M-R} and M_{M-K_s} are small.

As mentioned before, [Trifonov et al. \(2018\)](#) in their planet analysis and [Reiners et al. \(2018b\)](#) in their sample overview based their stellar masses on a mass-magnitude relation, but used a combination of the [Delfosse et al. \(2000\)](#) and [Benedict et al. \(2016\)](#) relations together with *Gaia* DR1 parallaxes. Therefore, our M_{M-K_s} masses differ accordingly.

4.3. PARSEC-based masses (M_P)

Another method we used consists of a Bayesian approach applied to the PARSEC library of stellar evolution models to infer stellar parameters, as performed by [del Burgo & Allende Prieto \(2018\)](#). We applied this technique to 262 targets from Table B.1, assuming solar metallicity, and with data for the SDSS r band, the 2MASS J band, and *Gaia* DR2 parallaxes to convert the apparent magnitudes J into M_J . The input parameters to feed the method were then M_J , $r - J$, and $[\text{Fe}/\text{H}] = 0.0 \pm 0.2 \text{ dex}$. The uncertainty in the iron-to-hydrogen ratio is reasonable since it reflects the range of $[\text{Fe}/\text{H}]$ that we found in Sec. 3.2 (see also Fig. 5 of [Pass18](#)), and most of our targets belong to the thin disc ([Cortés-Contreras 2016](#)) for which this is a typical range.

¹⁰ https://github.com/awmann/M_M_K

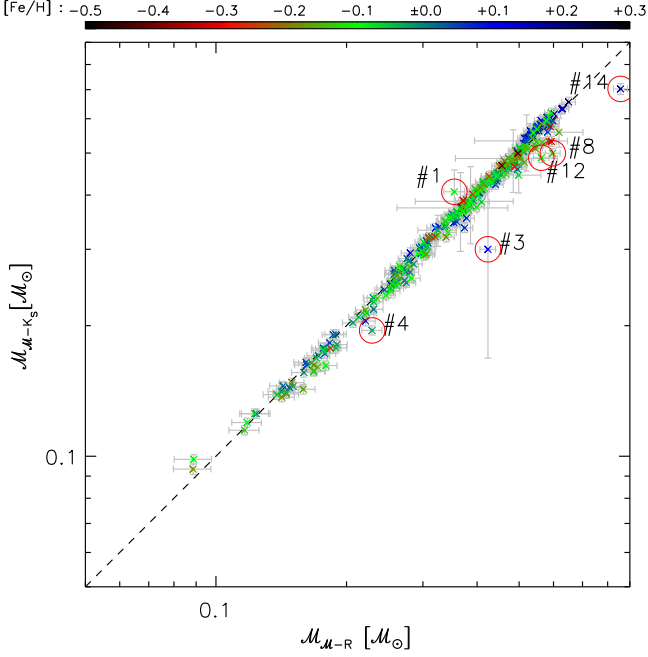


Fig. 8. Comparison of masses for all stars in Table B.1 using the method from Mann et al. (2019) as described in Section 4.2 on the y-axis and the method described in Section 3.4 on the x-axis. The metallicities are color coded as indicated. Obvious outliers, and stars discussed in reference to this figure in Section 5.2, are encircled: #1=GJ 411 (J11033+359), #3=GJ 4063 (J18346+401), #4=GJ 1235 (J19216+208), #8=IRXS J050156.7+010845 (J05019+011), #12=StKM 2-809 (J12156+526), and #14=K2-33 (J16102-193). See Fig. A.2 for a different comparison between the plotted values.

A grid of PARSEC isochrones (version 1.2S; Bressan et al. 2012; Chen et al. 2014, 2015; Tang et al. 2014) were downloaded and arranged, where $[\text{Fe}/\text{H}]$ ranges from -2.18 to 0.47 in steps of 0.05 dex, age spans from 2 Myr to 13.1 Gyr with steps of 0.1% , and the initial mass runs from $0.09 M_{\odot}$ to the highest mass established by the corresponding stellar lifetime.

This method yields mass, radius, luminosity, metallicity, age, and all derivable parameters. For this work we only use mass and radius and list these in Table B.1 as R_p and M_p . The remaining results will be presented and discussed in a separate publication.

When we compare M_{M-R} with M_p in Fig. 9 we find good correlation except for five outliers. They are the very young objects K2-33 (J16102-193), 1RXS J050156.7+010845 (J05019+011), and RX J0506.2+0439 (J05062+046), and the two stars RBS 365 (J02519+224) and GJ 15A (J00183+440). All of these targets are discussed in Section 5.2 below. However, all M_p values are systematically slightly higher than M_{M-R} . This means that the M_p values are also systematically offset to the M_{M-K_s} values in the same way.

Once again, for the remainder of this paper we use M_{M-R} since systematic differences between M_{M-R} and M_p do not change the overall picture, as described in Section 5.1.

5. Discussion

5.1. Sample properties

Having established a way to measure the masses of our targets, we investigate further statistical properties of our sample. When

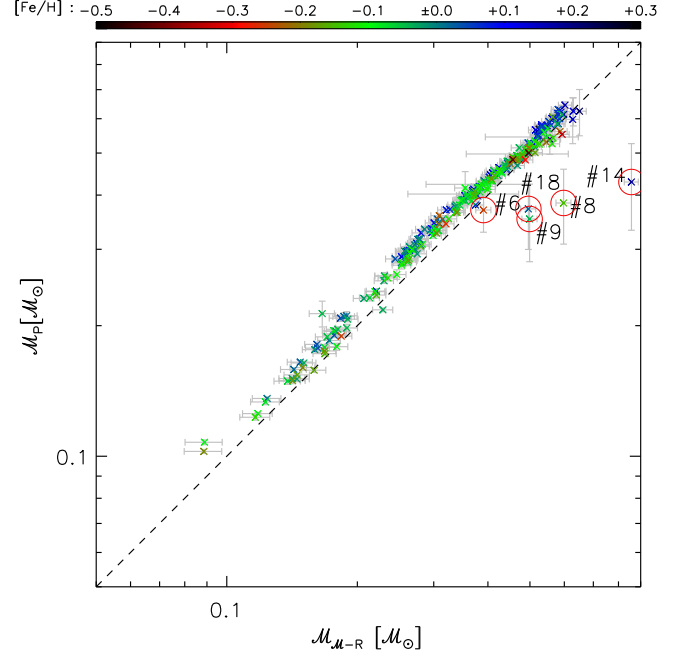


Fig. 9. Comparison of masses for all stars in Table B.1 using the method described in Section 4.3 on the y-axis and the method described in Section 3.4 on the x-axis. The metallicities are color coded as indicated. Obvious outliers, and stars discussed in reference to this figure in Section 5.2, are encircled: #6=GJ 15A (J00183+440), #8=1RXS J050156.7+010845 (J05019+011), #9=RX J0506.2+0439 (J05062+046), #14=K2-33 (J16102-193), and #18=RBS 365 (J02519+224).

we use our results and produce a Hertzsprung-Russell diagram (HRD) in Fig. 10, we find all targets on the main sequence except for a few outliers. Most of these outliers are young. This is discussed on a case-by-case basis below.

Furthermore, when we plot T_{eff} against the mass of the star we find the relation shown in Figs. 11 and Fig. 12. While there is a large spread, the distribution is well consistent with the isochrones by BHAC15. Again, we can identify outliers, most of which are young or active, and all of these cases are discussed below. While the HRD only compares our independently determined luminosities L and effective temperatures T_{eff} , Fig. 11 directly shows the results of our method described in Section 3.4.

Finally, when we plot the bolometric luminosity from Section 3.1 against the mass of the star to create a (bolometric) mass-luminosity relation we obtain Fig. 13. Again it is well consistent with the isochrones by BHAC15. When we fit a power law to these data for $0.1 M_{\odot} < M_{M-R} < 0.5 M_{\odot}$ we find a flat power law of

$$L \propto M^{2.22 \pm 0.02}, \quad (10)$$

which deviates from power laws for $L-M$ relations that average the whole main sequence yielding exponents of at least three. However, this agrees with results obtained for very low-mass stars that show a flattening of this power law at the bottom of the main sequence. This flattening can be seen already in, for example, Torres et al. (2010) or del Burgo & Allende Prieto (2018). As a recent example, Eker et al. (2018, and similarly the references therein) have derived a comparable exponent of 2.028 ± 0.135 for $0.179 M_{\odot} < M < 0.45 M_{\odot}$. For $M_{M-R} \gtrsim 0.5 M_{\odot}$ the relation in Fig. 13 clearly required a different exponent, but our high-mass range is too small to fit a reliable second power law.

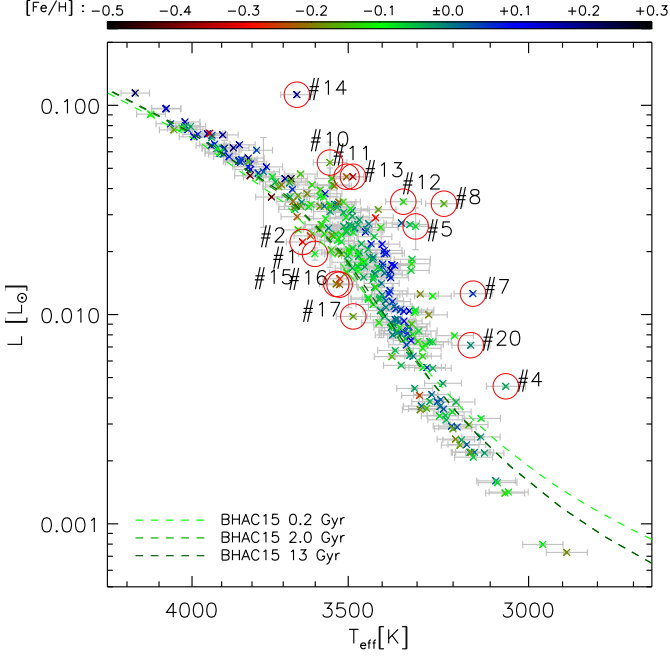


Fig. 10. Hertzsprung-Russell diagram using L from Section 3.1 and T_{eff} from Section 3.2. The metallicities are color coded as indicated. For comparison we plot isochrones for 0.2, 2, and 13 Gyr (in increasingly darker green) from BHAC15. Obvious outliers, and stars discussed in reference to this figure in Section 5.2, are encircled: #1=GJ 411 (J11033+359), #2=GJ 412A (J11054+435), #4=GJ 1235 (J19216+208), #5=2M J06572616+7405265 (J06574+740), #7=RX J0447.2+2038 (J04472+206), #8=1RXS J050156.7+010845 (J05019+011), #10=G 234-057 (J09133+688), #11=TYC 3529-1437-1 (J18174+483), #12=StKM 2-809 (J12156+526), #13=GJ 9520 (J15218+209), #14=K2-33 (J16102-193), #15=GJ 745A (J19070+208), #16=GJ 745B (J19072+208), #17=GJ 465 (J12248-182), and #20=LP 022-420 (J15499+796). Outliers #12 and #13 lie almost on top of each other. See Fig. A.3 for the same plot but using the pseudo equivalent width $\text{pEW}'_{\text{H}\alpha}$ of Schöfer et al. (2019) for the color coding. See also Fig. A.4 for a different comparison between the plotted values.

5.2. Outliers

Most of the outliers discussed in this section are young objects. They either belong to young associations or to young moving groups. Our M_{M-R} values, however, are based on the assumption that the stars are older than a few hundred million years (cf. Section 3.4). The M_{M-R} values that we list for these young objects should be treated accordingly. As Pass18 have already concluded, their effective temperatures are generally not affected by this assumption. Under the further assumption that the luminosity is not affected much either, the radii we list are not affected much by any assumptions regarding ages either. In other words, in cases in which we list or show a mass that is too high, we also derive a similarly large radius (cf. Eqs. 6 and 7), which may be expected for young objects.

Another set of the targets listed below are outliers and at the same time, some of their entries in at least one of the photometric catalogs are marked as being of bad quality. If such systematic errors were accounted for, our error bars would be increased significantly.

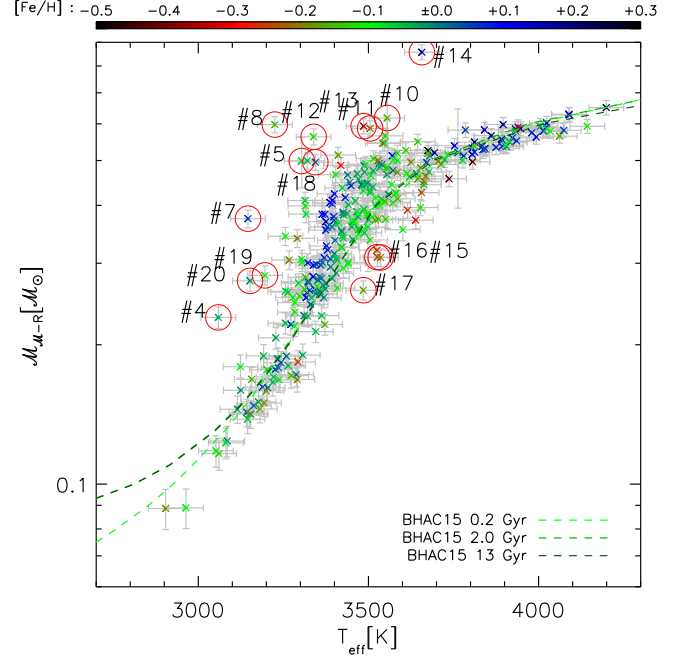


Fig. 11. Values of M_{M-R} from Section 3.4 plotted against T_{eff} from Section 3.2. The metallicities are color coded as indicated. For comparison we plot isochrones for 0.2, 2, and 13 Gyr (in increasingly darker green) from BHAC15. Obvious outliers, and stars discussed in reference to this figure in Section 5.2, are encircled: #4=GJ 1235 (J19216+208), #5=2M J06572616+7405265 (J06574+740), #7=RX J0447.2+2038 (J04472+206), #8=1RXS J050156.7+010845 (J05019+011), #10=G 234-057 (J09133+688), #11=TYC 3529-1437-1 (J18174+483), #12=StKM 2-809 (J12156+526), #13=GJ 9520 (J15218+209), #14=K2-33 (J16102-193), #15=GJ 745A (J19070+208), #16=GJ 745B (J19072+208), #17=GJ 465 (J12248-182), #18=RBS 365 (J02519+224), #19=RX J1417.3+4525 (J14173+454), and #20=LP 022-420 (J15499+796). Outliers #12 and #13 lie almost on top of each other.

5.2.1. Data-based reasons

We first eliminate all outliers from our discussion that have data-based reasons for their designation as outliers because we do not wish to misidentify physical reasons.

#1=GJ 411 (J11033+359) and #2=GJ 412A (J11054+435) For these two stars we obtain different radii than measured interferometrically (cf. Section 3.3). Both are missing in the latest *Gaia* catalog, therefore we use parallaxes from the *Hipparcos* measurements. However, when comparing Eqs. 3 and 5 it is obvious that the distance does not cause a mismatch between the two different methods of computing radii. We confirm that by using the *Gaia* distance of GJ 412B for GJ 412A since both form a common proper motion pair. The values R and R_{interf} both changed slightly, but the data point in Fig. 3 only moved parallel to the 1-1-line, as expected.

Both stars have very reliable measurements of their effective temperatures since their fits described in Section 3.2 are of high quality. Furthermore, both T_{eff} agree well with the recent measurements of Mann et al. (2015) and Rajpurohit et al. (2018). Therefore, the reason for the mismatch to the very reliable interferometric radii must lie in the photometry. As a test, we took three stars from Table 1 that are in *Gaia* DR2 (GJ 15A, GJ 880

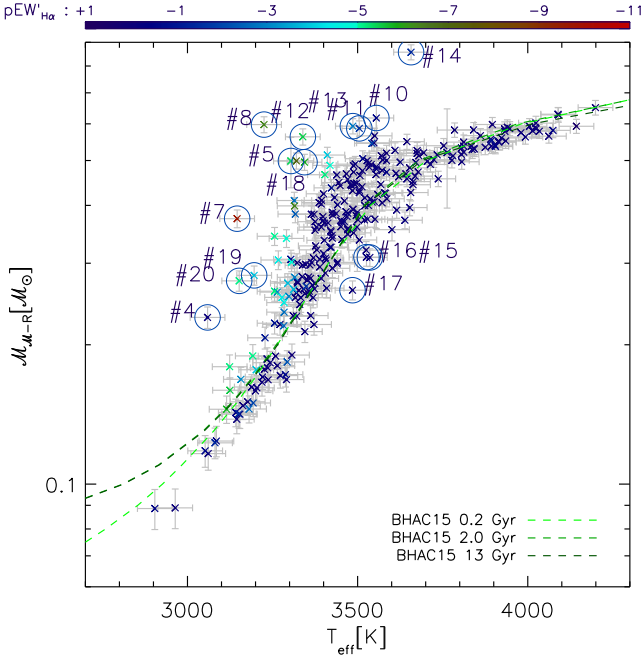


Fig. 12. Same as Fig. 11, but using the pseudo equivalent width $pEW'_{H\alpha}$ of Schöfer et al. (2019) for the color coding. Negative values of $pEW'_{H\alpha}$ denote $H\alpha$ emission.

and Gl 699) and for which we obtain good results using *Gaia* parallaxes and photometry (cf. Section 3.3). But for this test we ignored all the *Gaia* bands B_P , G , and R_P , and calculated the luminosities with the remaining photometry. Using VOSA, we obtained different luminosities and, hence, radii that no longer agreed with their interferometric counterparts. This is because the *Gaia* filters anchor the SED very reliably in the optical while 2MASS and allWISE anchor the SED in the infrared. In particular Gl 15A, which has unreliable 2MASS photometry (see below), showed the largest change in the test.

As a consequence of its uncertain luminosity, radius, and mass, Gl 411 also appears below the main sequence in the HRD in Fig. 10 and is a mild outlier in Fig. 8. In addition to not having *Gaia* magnitudes, Gl 411 has also 2MASS and allWISE magnitudes of poor quality because of its brightness. In both catalogs Gl 411 is listed to have magnitudes with low quality flags (DCD in 2MASS and UUA in allWISE). As described above, our error bars would have to be larger.

#3=GJ 4063 (J18346+401) This is an outlier when comparing M_{M-R} to the absolute K_s band magnitude (cf. Fig. A.5). It is also one of the outliers when comparing M_{M-R} with M_{M-K_s} in Fig. 8. The reason for the deviations is the poor K_s -band photometry as indicated by the 2MASS quality flags (AAU).

#4=GJ 1235 (J19216+208) This object is an outlier in the HRD (Fig. 10), when plotting mass against effective temperature in Fig. 11 and in the $L - M_{M-R}$ plot in Fig. 13. However, we cannot explain this except by pointing out that this is a relatively faint, high proper motion star located in a crowded field where photometric contamination by background sources cannot be excluded.

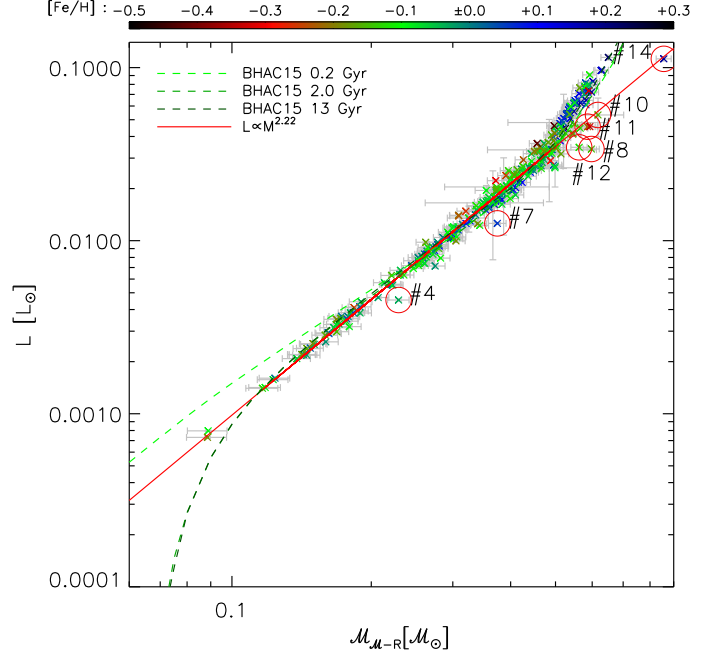


Fig. 13. Mass-luminosity relation using L from Section 3.1 and M_{M-R} from Section 3.4. The metallicities are color coded as indicated. For comparison we plot isochrones for 0.2, 2, and 13 Gyr (dashed lines in increasingly darker green) from BHAC15. The red solid line indicates the fit we obtained in Eq. 10. Obvious outliers, and stars discussed in reference to this figure in Section 5.2, are encircled: #4=GJ 1235 (J19216+208), #7=RX J0447.2+2038 (J04472+206), #8=1RXS J050156.7+010845 (J05019+011), #10=G 234-057 (J09133+688), #11=TYC 3529-1437-1 (J18174+483), #12=StKM 2-809 (J12156+526), and #14=K2-33 (J16102-193).

#5=2MASS J06572616+7405265 (J06574+740) This object does not have a space-based parallax. We use the value obtained with the United States Naval Observatory Robotic Astrometric Telescope (Finch & Zacharias 2016), which is the only published trigonometric parallax and has a large relative error of 11%. Despite its large error bar, it is an outlier in the HRD (Fig. 10), and when plotting mass against effective temperature in Fig. 11. However, as an X-ray source (Haakonsen & Rutledge 2009) this is an active star (Ansdell et al. 2015; Schöfer et al. 2019), but we attribute its deviation in the diagrams instead to a wrong parallactic distance ($d = 26 \pm 3$ pc). In the literature, there have been at least four additional distance determinations from photometry and spectroscopy (Lépine & Gaidos 2011; Lépine et al. 2013; Cortés-Contreras 2016), and they all point toward a closer distance in the range $d = 14.0$ – 19.6 pc, which would lead to a luminosity and mass consistent with its measured effective temperature. We expect the next *Gaia* release to improve the precision of its luminosity and to help clarify its nature.

#6=Gl 15A (J00183+440) When plotting mass versus the J magnitude (Fig. A.6) this object is a mild outlier. However, it is also too bright in the infrared to have reliable 2MASS magnitudes as indicated by their quality flags (DCE).

5.2.2. Young age-based reasons

#7=RX J0447.2+2038 (J04472+206) This is one of the outliers in the HRD (Fig. 10) and when comparing mass against

T_{eff} in Figs. 11 and 12. It is very active (Ishioka et al. 2014; Jeffers et al. 2018; Tal-Or et al. 2018), and Cortés-Contreras (2016) identified this object as a candidate member of the young disc population.

#8=1RXS J050156.7+010845 (J05019+011) and #9=RX J0506.2+0439 (J05062+046) The first is an outlier in all plots. It was identified by Schlieder et al. (2012b) to be a member of the β Pictoris moving group and, hence, very young. The second is a mild outlier and was identified by Schlieder et al. (2012a) as a candidate member of β Pictoris as well. These are two of the outliers in Fig. 9 comparing M_P to M_{M-R} . Their corresponding masses differ by about 30%. For the former the PARSEC-based method (cf. Section 4.3) yields for $M_P = 0.38 \pm 0.08 M_\odot$ an age of $\tau = 36 \pm 16$ Myr. For the latter the method yields for $M_P = 0.35 \pm 0.07 M_\odot$ an age of $\tau = 38 \pm 17$ Myr. Both ages are similar to the currently assumed age of β Pictoris of $\tau = 25 \pm 3$ Myr (e.g., Messina et al. 2016; Shkolnik et al. 2017).

#10=G 234-057 (J09133+688) and #11=TYC 3529-1437-1 (J18174+483) Both stars are noticeable outliers in almost all plots. However, both are young and candidate members of the AB Doradus association. The first was listed as a candidate by Schlieder et al. (2012a), and the second by Kastner et al. (2017). The second is also an active star discussed in Fuhrmeister et al. (2018).

#12=StKM 2-809 (J12156+526) This is an outlier in the $L - M_{M-R}$ plot in Fig. 13 and the HRD (Fig. 10). But again, this is an active (Stephenson 1986; Tal-Or et al. 2018), young star, which was identified as a candidate member of the Ursa Major moving group (Cortés-Contreras 2016).

#13=GJ 9520 (J15218+209) This is an outlier in almost every plot (e.g., in the HRD in Fig. 10), although not always an obvious one. It is an active (Fuhrmeister et al. 2018) and young star belonging to the Local Association (Tetzlaff et al. 2011).

#14=K2-33 (J16102-193) This is a pre-main-sequence star in the Upper Scorpius OB association. Its age is estimated to be between 5 and 20 Myr (David et al. 2016; Mann et al. 2016). It is a very obvious outlier in almost all plots. We measure unrealistic masses above $0.8 M_\odot$ with all methods except that for obtaining M_P described in Section 4.3. Therefore, it appears as one of the outliers in Fig. 9. The PARSEC-based method yields $M_P = 0.43 \pm 0.10 M_\odot$ and at the same time an age of $\tau = 8.0 \pm 3.5$ Myr. Furthermore, it is by far the most distant target, and at a distance of $d \approx 140$ pc located in Upper Scorpius, extinction can no longer be neglected.

5.2.3. Examples of possible surprising results

While the stars discussed in this section are not obvious outliers, they demonstrate certain physical effects that can result in unexpected masses or radii. Furthermore, these stars are only examples and not a comprehensive list. In particular the plots involving T_{eff} (Figs. 10, 11 and 12) show a natural spread (as already described by Pass18), and the decision on which star is an outlier in these plots would require a non-trivial definition of a criterion.

#15=Gl 745A (J19070+208) and #16=Gl 745B (J19072+208)

Both components of the wide binary system LDS 1017 are slightly below the main sequence in the HRD (Fig. 10). We also measure high effective temperatures for their derived masses when comparing these two parameters in Fig. 11. Together with very low activity they show a behavior akin to subdwarfs. Our derived $[\text{Fe}/\text{H}] = -0.20 \pm 0.16$ dex and $[\text{Fe}/\text{H}] = -0.23 \pm 0.16$ dex, respectively, also point toward low-metallicity objects. Furthermore, Mann et al. (2015) derived for Gl 745A an even lower metallicity of $[\text{Fe}/\text{H}] = -0.33 \pm 0.08$ dex, and Houdebine (2008) already classified both components as subdwarfs.

#17=Gl 465 (J12248-182) As the previous two stars, this isolated star is below the main sequence in the HRD and has a very high effective temperature for its derived mass (see Fig. 11). We measure $[\text{Fe}/\text{H}] = -0.17 \pm 0.16$ dex for this object. This metallicity is still too high to call it a subdwarf as it is still consistent with the solar. However, Maldonado et al. (2015) measured an even lower metallicity of $[\text{Fe}/\text{H}] = -0.33 \pm 0.09$ dex for this star.

#18=RBS 365 (J02519+224), #19=RX J1417.3+4525 (J14173+454) and #20=LP 022-420 (J15499+796) These three stars are mild outliers in the HRD (Fig. 10) or when plotting mass against T_{eff} (Figs. 11 and 12). These, however, are active stars that have, for instance, $\log L_{\text{H}\alpha}/L_{\text{bol}} > -4$ (Schöfer et al. 2019). The latter two are also in the CARMENES radial-velocity-loud sample discussed by Tal-Or et al. (2018).

5.3. How do the masses differ?

Overall, all methods in determining masses yield consistent results, even when using $\log g$ in order to obtain $M_{\log g}$.

The largest amount of information is used in the construction of M_{M-R} (Section 3.4) and in the construction of $M_{\log g}$ (Section 4.1). The latter does not even use any empirical relation, however, it yields the largest error bars. Both M_{M-R} and M_{M-K_s} (Section 4.2) use an empirical relation. However, the $M-R$ relation is more fundamental than the mass-magnitude relation. Mass and radius are fundamentally connected via the hydrostatics of a star, whereas a magnitude is an “arbitrary” portion of the SED. It is not fundamentally obvious that the luminosity within a restricted wavelength range uniquely relates to the mass of a star. Of course, these relations are well established and have been working very well (not to mention that they only require photometry and no spectroscopy). After all, the infrared magnitudes are representative of the luminosity of a star since similar relations between near-infrared magnitudes and luminosity are also well established, and an $M-L$ relation is similarly fundamental as an $M-R$ relation. In any case, our work can be considered an independent confirmation of the mass-magnitude relations of Mann et al. (2019), Benedict et al. (2016), or Delfosse et al. (2000).

It follows from the above discussion on the outliers that the age of a star also plays a significant role in testing the validity of any method intended for obtaining its mass and radius. All of these, except the PARSEC-based masses M_P (Section 4.3), assume an age of at least a few hundred megayears, i.e., that the stars have left the Hayashi track and reached the main sequence. Our spectral analysis (Section 3.2 and Pass18) assumes for the $\log g$ determination an age of 5 Gyr, which directly enters the spectroscopic mass $M_{\log g}$. Both the mass-radius based masses M_{M-R} and the photometric masses M_{M-K_s} use empirical rela-

tions based on samples of old stars. This is in turn an advantage of the PARSEC-based masses M_P because, for example, the GTO targets of the β Pictoris moving group and the Upper Scorpius OB association have significantly lower M_P values than all the other masses. At the same time the method for obtaining M_P yields young ages for these sources. However, a detailed investigation of the validity and consequences of the combined determination of all parameters of M dwarfs (and the CARMENES targets in particular) using this method is beyond the scope of this paper and will be discussed in a separate publication. Therefore, we do not list the ages determined with this method except for the few examples above. On the other hand, old stars such as the potential subdwarfs mentioned above do not pose a problem for our method. In particular, as described in Sec. 3.4, our mass-radius relation does not differ for different ages above a few hundred million years, nor can we infer a metallicity dependence down to metallicities of globular clusters.

Besides the age constraints inherent in the different methods, there are further biases that enter some of the methods as already indicated in the introduction. Both M_{M-R} and M_{M-K_s} use empirical relations based on binaries. However, the mass-radius relation for M_{M-R} uses close binaries, while the mass-luminosity relation for M_{M-K_s} is measured using wide binaries. The latter is certainly a better representation for isolated M dwarfs, i.e., our targets. If the former suffers from, for example, inflated radii then there is a systematic difference between M_{M-R} and M_{M-K_s} . Such inflated radii have been reported (e.g., Jackson et al. 2018 or Kesseli et al. 2018, and for eclipsing binaries by Parsons et al. 2018), but only for young, magnetically active, or fast-rotating stars. Our sample, however, mostly includes old, inactive, and slowly rotating stars (see Sec. 2). But if such a bias exists within the mass-radius relation derived in Sec. 3.4, it introduces an offset in our M_{M-R} values. As shown in Sec. 4.2 we find no offset between M_{M-R} and M_{M-K_s} , indicating no systematic difference between the mass-radius relation and the mass-magnitude relation, or the samples on which they are based.

Finally, as described in Section 3.2, the choice of a specific set of synthetic spectra in our spectral analysis may introduce another systematic offset on the order of our $\Delta T_{\text{eff}}/T_{\text{eff}}$ errors, or larger. But again, the agreement of our M_{M-R} with the M_{M-K_s} that we observe indicates that we did not introduce such a systematic offset.

6. Conclusions

We have derived radii and masses with individual error bars for 293 of the CARMENES GTO M dwarfs. In particular, for measuring the masses, we used several methods and compared them. For typical field stars that are not young, we list consistent masses with all methods. For our main method we list radii R that typically have errors of 2–3%, and masses M_{M-R} that typically have errors of 3–5% (cf. Fig. 14). Systematic uncertainties on the order of the error bars, however, cannot be fully excluded.

For young stars, M_{M-R} and M_{M-K_s} are not suitable since the applicable empirical relations are derived for old stars (and cannot easily be adapted for young stars). Therefore, M_{M-R} and M_{M-K_s} for any young star in our sample (and not only for the outliers discussed in Section 5.2) should be used with care. The identification of all young stars, or determining their membership in young moving groups, should it exist, is beyond the purpose of this paper and will be published in the future. Similarly, an age determination of any star (not only those of our sample) is challenging. For example, Veyette & Muirhead (2018) derived ages for some of the CARMENES targets. On the other hand,

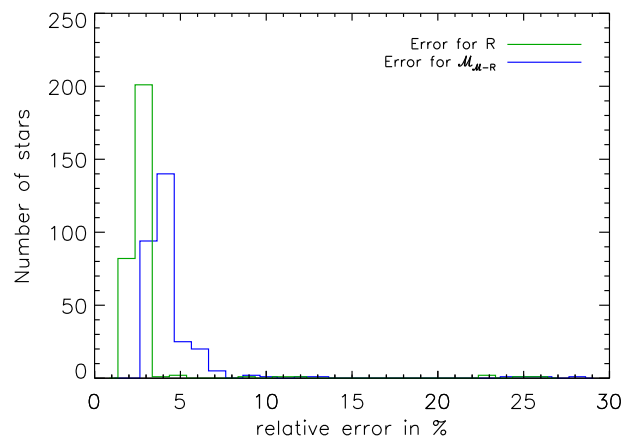


Fig. 14. Histograms of the errors of R and M_{M-R} .

M_P is not restricted to a single age, and ages along with M_P can be determined simultaneously as described in Section 4.3. Finally, when age estimates are available, our method of obtaining $\log g$ will be able to use isochrones for the appropriate age. Then our $M_{\log g}$ is also an option, at least when we will be able to reduce the error bars of $\log g$ to be smaller than the current 0.07 dex, and when systematic effects of theoretical isochrones can be reduced.

Our methods for measuring R and M_{M-R} work best for a field star of at least a few hundred million years when we can spectroscopically determine a reliable T_{eff} , when the parallax of the object is based on *Gaia* DR2, and when L is well anchored by *Gaia* and near-infrared photometry. Then, we can determine for the target with the latest spectral type in our sample, the M7 V object Teegarden’s star $R = 0.107 \pm 0.004 R_{\odot}$ and $M_{M-R} = 0.089 \pm 0.009 M_{\odot}$, while we determine for our M0.0 V targets average values $R = 0.566 \pm 0.016 R_{\odot}$ and $M_{M-R} = 0.574 \pm 0.021 M_{\odot}$.

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Appendix A: Additional plots

In this appendix, we provide supplemental material. First, we repeat Fig. 5 but we use linear axes and omit the error bars in Fig. A.1 for clarity.

Next, we resolve the confusion seen in Fig. 8 where all stars lie very close to the 1-1-line when plotting M_{M-K_s} against M_{M-R} . Instead, in Fig. A.2 we now plot the ratio M_{M-K_s} over M_{M-R} against the metallicity from Section 3.2 and also take into account the activity of the stars using the pseudo equivalent width $pEW'_{H\alpha}$ of Schöfer et al. (2019) for the color coding. We can now identify that all H α emitters have slightly higher M_{M-R} masses (and by Eqs. 6 and 7 also slightly larger radii) compared to the M_{M-K_s} masses. The H α absorbers, however, are symmetrically spread around a ratio of unity. There is a trend that the M_{M-R} masses are lower than the M_{M-K_s} masses only for the highest metallicities. A similar comparison of M_{M-R} with the other alternative masses $M_{\log g}$ and M_P , however, does neither show a trend with activity nor with metallicity in their deviation from M_{M-R} .

We also repeat the HRD of Fig. 10 but using the pseudo equivalent width $pEW'_{H\alpha}$ of Schöfer et al. (2019) for the color coding in Fig. A.3. We again magnify the spread seen in the HRDs in Figs. 10 and A.3 by plotting the ratio L over $L_{BHAC15(13\text{ Gyr})}$ against the metallicity from Section 3.2 in Fig. A.4 and again taking into account the activity of the stars using the pseudo equivalent width $pEW'_{H\alpha}$ of Schöfer et al. (2019) for the color coding. This $L_{BHAC15(13\text{ Gyr})}$ is the luminosity of a star on the 13 Gyr isochrone from BHAC15 selected by its measured T_{eff} , i.e., the x-axes of the HRD in Fig. 10. Similar to Figs. 10 and A.3 we can identify that the active stars have the largest discrepancy from a theoretical, 13 Gyr old $L - T_{\text{eff}}$ sequence, and we can also see that all stars with $[Fe/H] \geq 0.5$ dex are above the ratio of unity. The same behavior could be seen in a plot that magnifies the spread seen in Figs. 11 and 12 in an equivalent fashion but since no new information is revealed we omit such a plot.

We finally plot M_{M-R} against absolute magnitudes K_s and J in Figs. A.5 and A.6. These two plots help in identifying the outliers of Section 5.2.

Appendix B: Tables

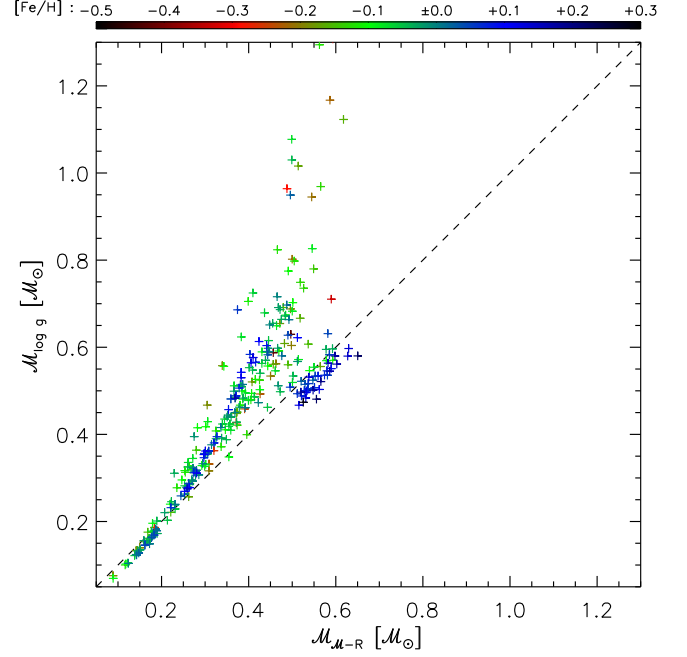


Fig. A.1. Same as Fig. 5, but without error bars for better clarity

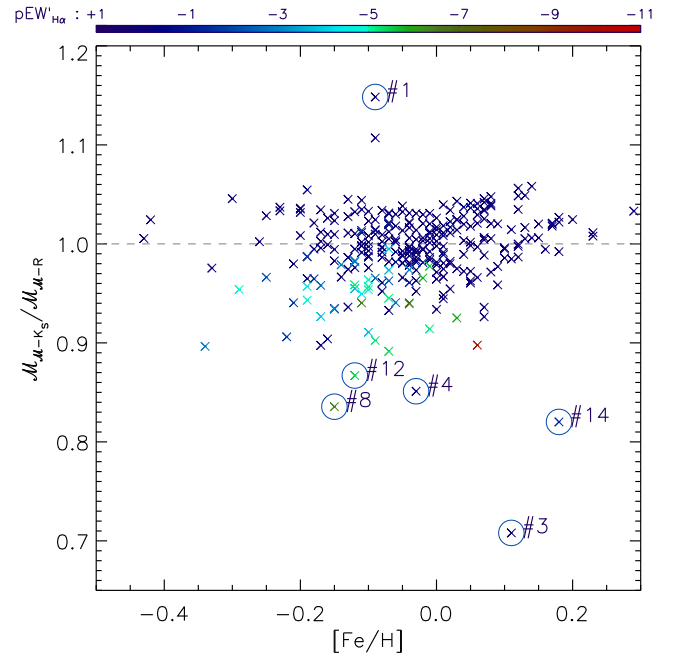


Fig. A.2. Ratio of the masses of Fig. 8 as a function of $[Fe/H]$ using the pseudo equivalent width $pEW'_{H\alpha}$ of Schöfer et al. (2019) for the color coding. Negative values of $pEW'_{H\alpha}$ denote H α emission. Error bars are omitted for clarity. See Fig. 8 for the identification of the encircled stars.

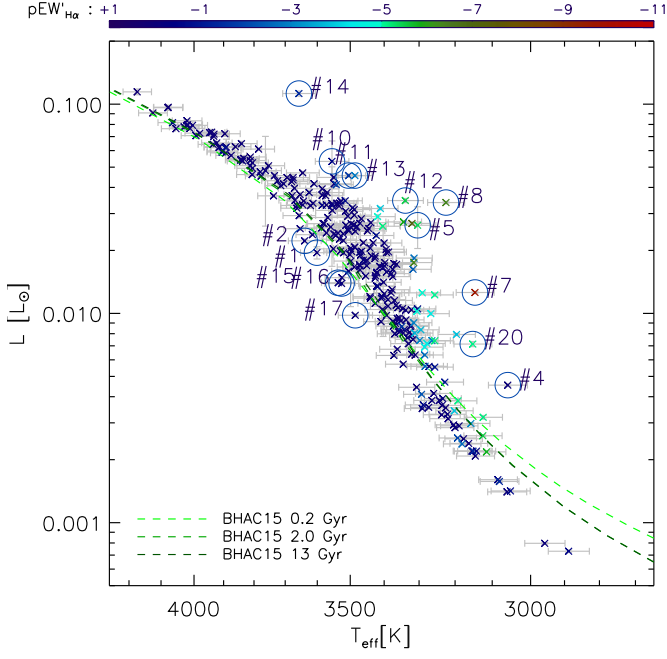


Fig. A.3. Same as Fig. 10, but using the pseudo equivalent width $pEW'_{H\alpha}$ of Schöfer et al. (2019) for the color coding. Negative values of $pEW'_{H\alpha}$ denote $H\alpha$ emission. See Fig. 10 for the identification of the encircled stars.

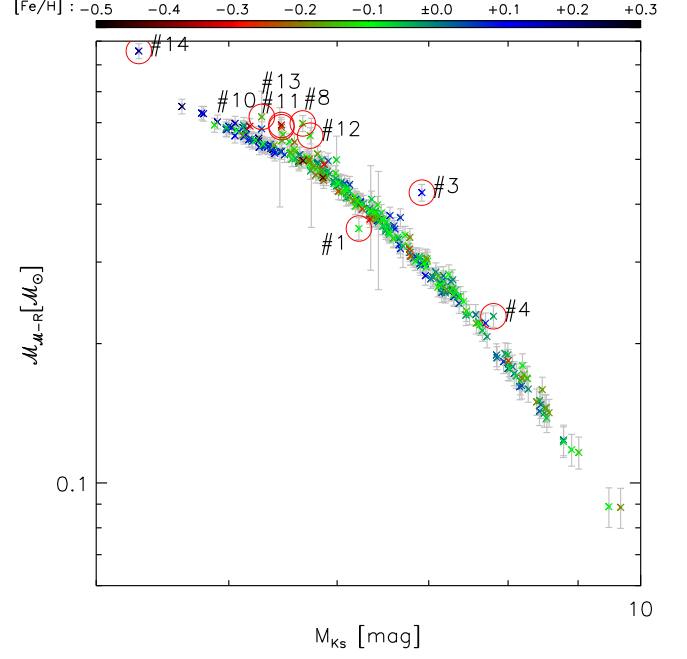


Fig. A.5. Value of M_{M-R} against absolute K_s magnitude M_{K_s} . Obvious outliers, and stars discussed in reference to this figure in Section 5.2, are encircled: #1=GJ 411 (J11033+359), #3=GJ 4063 (J18346+401), #4=GJ 1235 (J19216+208), #8=1RXS J050156.7+010845 (J05019+011), #10=G 234-057 (J09133+688), #11=TYC 3529-1437-1 (J18174+483), #12=StKM 2-809 (J12156+526), #13=GJ 9520 (J15218+209), and #14=K2-33 (J16102-193). Outliers #11 and #13 lie almost on top of each other.

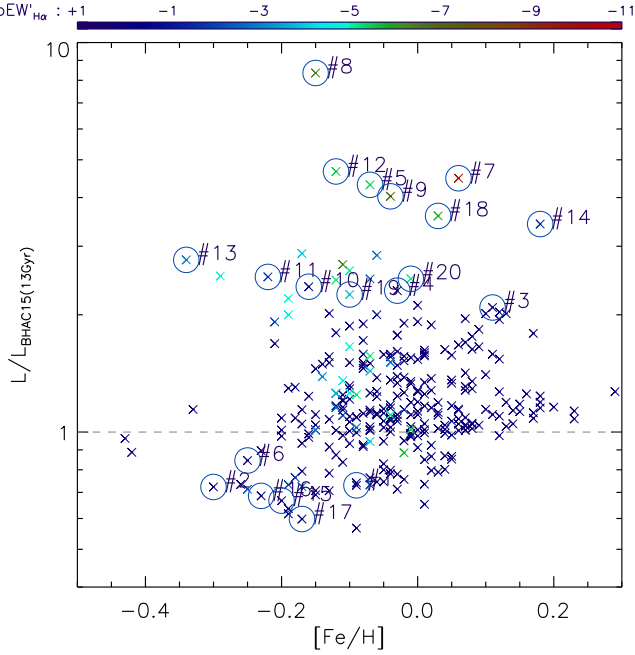


Fig. A.4. Ratio of the luminosity of the HRD in Fig. 10 and the luminosity of a 13 Gyr isochrone from BHAC15 for the measured effective temperatures as a function of $[Fe/H]$ using the pseudo equivalent width $pEW'_{H\alpha}$ of Schöfer et al. (2019) for the color coding. Negative values of $pEW'_{H\alpha}$ denote $H\alpha$ emission. Error bars are omitted for clarity. See Fig. 10 for the identification of the encircled stars.

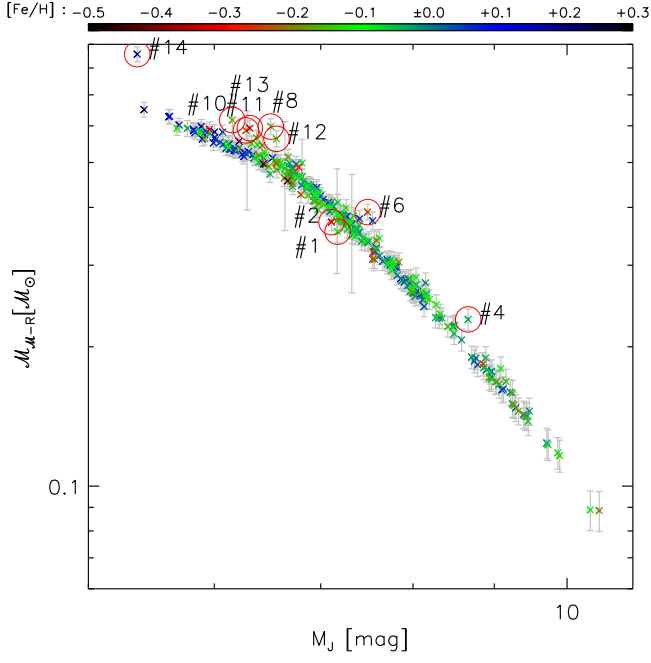


Fig. A.6. Value of M_{M-R} against absolute J magnitude M_J . Obvious outliers, and stars discussed in reference to this figure in Section 5.2, are encircled: #1=G1 411 (J11033+359), #2=G1 412A (J11054+435), #4=GJ 1235 (J19216+208), #6=G1 15A (J00183+440), #8=IRXS J050156.7+010845 (J05019+011), #10=G 234-057 (J09133+688), #11=TYC 3529-1437-1 (J18174+483), #12=StKM 2-809 (J12156+526), #13=GJ 9520 (J15218+209), and #14=K2-33 (J16102-193). Outliers #11 and #13 lie almost on top of each other.

Table B.1. Stellar parameters^a for all stars of our sample.

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J00051+457 GI 2	3675±51 dM1.0 V	4.84±0.07 4.731±0.030	-0.16±0.16	0.04341±0.00086 11.500±0.005	0.514±0.015 ...	0.518±0.020 0.667±0.114	0.518±0.013 ...
J00067-075 GJ 1002	3061±51 dM5.5 V	5.19±0.07 5.255±0.045	-0.13±0.16	0.00140±0.00002 4.849±0.003	0.133±0.005 0.152±0.002	0.116±0.009 0.100±0.018	0.115±0.003 0.123±0.002
J00162+198E GJ 1006B	3323±51 dM4.0 V	5.03±0.07 4.973±0.034	0.08±0.16	0.00877±0.00013 15.326±0.019	0.282±0.009 0.318±0.004	0.274±0.013 0.312±0.054	0.266±0.007 0.310±0.006
J00183+440 GI 15A	3615±51 dM1.0 V	4.91±0.07 4.841±0.030	-0.25±0.16	0.02379±0.00026 3.563±0.001	0.393±0.011 0.363±0.038	0.391±0.016 ^{Out} 0.458±0.078	0.402±0.010 0.369±0.041
J00184+440 GI 15B	3291±51 dM3.5 V	5.11±0.07 5.143±0.038	-0.19±0.16	0.00351±0.00003 3.561±0.001	0.182±0.006 0.199±0.003	0.168±0.010 0.156±0.027	0.162±0.004 0.175±0.003
J00286-066 GJ 1012	3398±51 dM4.0 V	4.98±0.07 4.853±0.033	0.07±0.16	0.01746±0.00032 13.374±0.018	0.381±0.012 0.409±0.003	0.378±0.016 0.506±0.088	0.354±0.008 0.399±0.003
J00389+306 GI 26	3537±51 dM2.5 V	4.89±0.07 4.819±0.031	-0.05±0.16	0.02421±0.00034 12.665±0.006	0.414±0.012 0.448±0.005	0.413±0.017 0.486±0.083	0.429±0.011 0.455±0.006
J00570+450 G 172-030	3426±51 dM3.0 V	4.99±0.07 4.894±0.033	-0.06±0.16	0.01476±0.00022 13.148±0.009	0.345±0.011 0.367±0.008	0.340±0.015 0.424±0.073	0.340±0.009 0.368±0.009
J01013+613 GI 47	3529±51 dM2.0 V	4.94±0.07 4.858±0.031	-0.16±0.16	0.01985±0.00027 10.516±0.004	0.377±0.011 0.398±0.003	0.373±0.015 0.451±0.077	0.383±0.009 0.407±0.004
J01025+716 GI 48	3488±51 dM3.0 V	4.91±0.07 4.755±0.031	0.02±0.16	0.03136±0.00052 8.236±0.002	0.485±0.015 0.496±0.006	0.487±0.019 0.697±0.120	0.465±0.011 0.499±0.007
J01026+623 GI 49	3805±51 dM1.5 V	4.69±0.07 4.733±0.029	0.13±0.16	0.04938±0.00092 9.855±0.003	0.511±0.015 0.569±0.005	0.515±0.019 0.467±0.080	0.540±0.013 0.565±0.007
J01048-181 GJ 1028	3154±51 dM5.0 V	5.14±0.07 5.197±0.041	-0.02±0.16	0.00220±0.00003 9.773±0.008	0.157±0.005 0.181±0.002	0.142±0.010 0.124±0.022	0.141±0.004 0.151±0.002
J01125-169 GI 54.1	3151±51 dM4.5 V	5.17±0.07 5.197±0.042	-0.18±0.16	0.00219±0.00004 3.713±0.001	0.157±0.005 0.177±0.003	0.142±0.010 0.133±0.023	0.137±0.003 0.149±0.002
J01339-176 LP 768-113	3349±51 dM4.0 V	5.06±0.07 4.983±0.034	-0.11±0.16	0.00866±0.00011 14.715±0.017	0.276±0.009 0.306±0.004	0.268±0.013 0.320±0.055	0.271±0.008 0.300±0.006
J01433+043 GI 70	3532±51 dM2.0 V	4.91±0.07 4.832±0.033	-0.09±0.16	0.02264±0.00056 11.320±0.006	0.402±0.013 0.409±0.009	0.400±0.017 0.478±0.083	0.404±0.010 0.418±0.008
J01518+644 GJ 3117A	3555±51 dM2.5 V	4.90±0.07 4.757±0.246	-0.08±0.16	0.03348±0.01669 17.313±0.009	0.482±0.121 0.494±0.004	0.485±0.128 0.674±0.355	0.486±0.080 0.498±0.005
J02002+130 GI 83.1	3193±51 dM3.5 V	5.15±0.07 5.180±0.040	-0.19±0.16	0.00254±0.00002 4.472±0.002	0.165±0.005 0.188±0.002	0.150±0.010 0.140±0.024	0.148±0.004 0.160±0.002
J02015+637 GJ 3126	3489±51 dM3.0 V	4.93±0.07 4.790±0.035	-0.05±0.16	0.02647±0.00090 11.901±0.008	0.445±0.015 ...	0.446±0.019 0.615±0.108	0.442±0.011 ...
J02070+496 G 173-037	3419±51 dM3.5 V	5.01±0.07 4.911±0.033	-0.12±0.16	0.01346±0.00016 14.314±0.014	0.331±0.010 0.352±0.005	0.325±0.014 0.408±0.070	0.323±0.008 0.353±0.006
J02088+494 GJ 3136	3315±51 dM3.5 V	5.08±0.07 4.833±0.033	-0.11±0.16	0.01750±0.00021 17.065±0.023	0.401±0.013 0.408±0.004	0.399±0.017 0.705±0.122	0.375±0.009 0.412±0.005
J02123+035 GI 87	3663±51 dM1.5 V	4.81±0.07 4.792±0.030	-0.05±0.16	0.03182±0.00050 10.509±0.004	0.443±0.013 0.472±0.004	0.443±0.017 0.462±0.079	0.449±0.011 0.479±0.005
J02222+478 GI 96	3935±51 dM0.5 V	4.67±0.07 4.706±0.030	0.07±0.16	0.06424±0.00156 11.936±0.010	0.545±0.016 ...	0.551±0.020 0.507±0.087	0.576±0.015 ...
J02336+249 GI 102	3283±51 dM4.0 V	5.09±0.07 5.052±0.036	-0.09±0.16	0.00560±0.00006 9.972±0.011	0.231±0.007 0.258±0.003	0.220±0.011 0.240±0.042	0.212±0.005 0.239±0.003
J02358+202 GI 104	3585±51 dM2.0 V	4.89±0.07 4.730±0.033	-0.13±0.16	0.03937±0.00115 14.053±0.014	0.514±0.016 0.523±0.005	0.518±0.021 0.749±0.130	0.511±0.013 0.524±0.006
J02362+068 GI 105B	3327±51 dM4.0 V	5.03±0.07 4.990±0.034	0.05±0.16	0.00812±0.00012 7.222±0.005	0.271±0.009 0.306±0.005	0.262±0.013 0.287±0.050	0.252±0.006 0.297±0.006
J02442+255 GI 109	3472±51 dM3.0 V	4.95±0.07 4.875±0.032	-0.06±0.16	0.01708±0.00024 7.681±0.004	0.361±0.011 0.392±0.003	0.357±0.015 0.424±0.073	0.358±0.009 0.397±0.004
J02519+224 RBS 365	3344±51 dM4.0 V	5.03±0.07 4.748±0.032	0.03±0.16	0.02737±0.00037 27.086±0.051	0.493±0.015 0.546±0.016	0.496±0.020 ^{Out} 0.949±0.164	0.459±0.011 0.372±0.072
J02530+168 Teegarden's Star	2904±51 dM7.0 V	5.26±0.07 5.329±0.053	-0.19±0.16	0.00073±0.00001 3.831±0.004	0.107±0.004 0.131±0.001	0.089±0.009 0.076±0.013	0.093±0.003 0.103±0.001
J02565+554W GI 119A	3896±51 dM1.0 V	4.66±0.07 4.673±0.028	0.18±0.16	0.07221±0.00119 20.292±0.016	0.590±0.016 0.613±0.006	0.598±0.021 0.580±0.099	0.593±0.015 0.614±0.010
J03133+047 GJ 1057	3204±51 dM5.0 V	5.11±0.07 5.156±0.040	0.04±0.16	0.00293±0.00005 8.610±0.007	0.176±0.006 0.210±0.002	0.161±0.010 0.145±0.025	0.165±0.004 0.181±0.002

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_P [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J03181+382 GI 134	3861±51 dM1.5 V	4.66±0.07 4.696±0.028	0.20±0.16	0.06261±0.00090 15.985±0.018	0.559±0.015 0.603±0.005	0.566±0.020 0.521±0.089	0.580±0.015 0.600±0.009
J03213+799 GI 133	3549±51 dM2.0 V	4.93±0.07 4.824±0.032	-0.18±0.16	0.02396±0.00042 13.935±0.008	0.409±0.012 0.427±0.006	0.408±0.017 0.520±0.090	0.416±0.010 0.436±0.006
J03217-066 GJ 3218	3555±51 dM2.0 V	4.92±0.07 4.761±0.031	-0.15±0.16	0.03280±0.00065 17.229±0.015	0.477±0.014 0.485±0.005	0.479±0.019 0.691±0.119	0.477±0.012 0.490±0.005
J03463+262 GI 154	3993±51 dM0.0 V	4.65±0.07 4.698±0.028	0.12±0.16	0.07073±0.00103 14.399±0.012	0.555±0.015 0.601±0.005	0.562±0.020 0.503±0.085	0.594±0.015 0.601±0.009
J03473-019 G 080-021	3411±51 dM3.0 V	5.03±0.07 4.734±0.032	-0.17±0.16	0.03172±0.00051 16.801±0.017	0.510±0.016 0.498±0.005	0.514±0.020 1.016±0.175	0.476±0.012 0.501±0.006
J03531+625 Ross 567	3488±51 dM3.0 V	4.93±0.07 4.884±0.032	-0.04±0.16	0.01667±0.00028 12.323±0.008	0.353±0.011 0.383±0.005	0.349±0.015 0.388±0.067	0.356±0.009 0.390±0.005
J04219+213 ^{New} K2-155	3940±51 dM0.0 V	4.76±0.07 4.679±0.031	-0.33±0.16	0.07350±0.00227 72.939±0.266	0.582±0.018 ...	0.590±0.022 0.710±0.122	0.575±0.015 ...
J04225+105 LSPM J0422+1031	3445±51 dM3.5 V	4.95±0.07 4.788±0.032	0.00±0.16	0.02543±0.00033 20.820±0.035	0.448±0.014 0.473±0.004	0.448±0.018 0.651±0.112	0.449±0.011 0.476±0.005
J04290+219 GI 169	4199±51 dM0.5 V	4.59±0.07 4.640±0.030	0.23±0.16	0.11450±0.00364 11.241±0.006	0.639±0.019 0.846±0.036	0.650±0.024 0.580±0.099	0.655±0.017 0.624±0.076
J04376-110 GI 173	3621±51 dM1.5 V	4.85±0.07 4.777±0.030	-0.07±0.16	0.03276±0.00051 11.215±0.004	0.460±0.013 0.480±0.010	0.461±0.018 0.546±0.094	0.470±0.011 0.486±0.009
J04376+528 GI 172	4034±51 dM0.0 V	4.68±0.07 4.687±0.028	-0.09±0.16	0.07779±0.00133 9.923±0.006	0.571±0.015 ...	0.578±0.020 0.569±0.097	0.592±0.015 ...
J04429+189 GI 176	3574±51 dM2.0 V	4.89±0.07 4.743±0.031	-0.10±0.16	0.03648±0.00073 9.473±0.006	0.498±0.015 0.509±0.009	0.501±0.020 0.703±0.121	0.489±0.013 0.512±0.008
J04429+214 2M J04425586+2128230	3437±51 dM3.5 V	4.97±0.07 4.847±0.032	-0.03±0.16	0.01882±0.00030 13.900±0.014	0.387±0.012 0.415±0.004	0.384±0.016 0.509±0.088	0.381±0.010 0.417±0.004
J04472+206 RX J0447.2+2038	3146±51 dM5.0 V	5.12±0.07 4.857±0.035	0.06±0.16	0.01259±0.00017 23.261±0.043	0.378±0.013 0.391±0.003	0.374±0.017 ^{Out} 0.686±0.120	0.336±0.008 0.379±0.004
J04520+064 GI 179	3393±51 dM3.5 V	5.00±0.07 4.873±0.033	0.01±0.16	0.01577±0.00030 12.361±0.009	0.363±0.011 0.400±0.005	0.359±0.016 0.481±0.083	0.366±0.009 0.400±0.005
J04538-177 GI 180	3572±51 dM2.0 V	4.90±0.07 4.827±0.031	-0.12±0.16	0.02427±0.00036 11.945±0.004	0.407±0.012 0.423±0.005	0.405±0.016 0.479±0.082	0.409±0.010 0.432±0.005
J04588+498 GI 181	4022±51 dM0.0 V	4.65±0.07 4.679±0.028	0.09±0.16	0.07975±0.00136 16.620±0.017	0.581±0.016 0.619±0.006	0.589±0.021 0.551±0.094	0.601±0.015 0.621±0.011
J05019+011 1RXS J050156.7+010845	3225±51 dM4.0 V	5.13±0.07 4.674±0.033	-0.15±0.16	0.03387±0.00047 25.284±0.051	0.589±0.019 0.610±0.017	0.598±0.024 ^{Out} 1.710±0.297	0.499±0.012 0.384±0.075
J05019-069 GJ 3323	3288±51 dM4.0 V	5.07±0.07 5.134±0.038	0.01±0.16	0.00365±0.00005 5.376±0.002	0.186±0.006 0.209±0.003	0.172±0.010 0.149±0.026	0.171±0.004 0.185±0.003
J05033-173 GJ 3325	3409±51 dM3.0 V	5.02±0.07 4.986±0.034	-0.11±0.16	0.00914±0.00012 9.231±0.004	0.274±0.008 0.298±0.003	0.265±0.013 0.287±0.049	0.274±0.007 0.294±0.005
J05062+046 RX J0506.2+0439	3320±51 dM4.0 V	5.06±0.07 4.745±0.032	-0.04±0.16	0.02692±0.00038 27.801±0.039	0.496±0.016 0.577±0.015	0.499±0.020 ^{Out} 1.030±0.178	0.469±0.012 0.352±0.072
J05127+196 GI 192	3582±51 dM2.0 V	4.90±0.07 4.808±0.032	-0.13±0.16	0.02687±0.00055 12.157±0.007	0.425±0.013 0.451±0.004	0.425±0.017 0.525±0.090	0.437±0.011 0.459±0.005
J05280+096 GI 203	3362±51 dM3.5 V	5.03±0.07 5.034±0.035	-0.05±0.16	0.00674±0.00009 10.206±0.010	0.242±0.008 0.273±0.004	0.231±0.012 0.229±0.040	0.227±0.005 0.260±0.005
J05314-036 GI 205	3891±51 dM1.5 V	4.64±0.07 4.703±0.052	0.23±0.16	0.06238±0.00564 5.700±0.002	0.549±0.029 0.537±0.044	0.556±0.033 0.481±0.092	0.562±0.042 0.538±0.042
J05337+019 GI 207.1	3419±51 dM2.5 V	5.05±0.07 4.754±0.033	-0.29±0.16	0.02901±0.00062 15.723±0.022	0.485±0.015 0.477±0.004	0.488±0.020 0.964±0.167	0.465±0.012 0.482±0.005
J05348+138 GJ 3356	3421±51 dM3.5 V	4.98±0.07 4.880±0.032	-0.01±0.16	0.01574±0.00018 11.926±0.010	0.357±0.011 0.388±0.003	0.353±0.015 0.444±0.077	0.355±0.008 0.391±0.004
J05360-076 GJ 3357	3380±51 dM4.0 V	4.99±0.07 4.916±0.033	0.08±0.16	0.01256±0.00019 15.083±0.014	0.327±0.010 0.374±0.004	0.321±0.014 0.380±0.066	0.336±0.008 0.369±0.005
J05365+113 GI 208	4074±51 dM0.0 V	4.65±0.07 4.685±0.029	0.05±0.16	0.08164±0.00198 11.436±0.008	0.573±0.016 0.630±0.005	0.581±0.021 0.536±0.091	0.605±0.015 0.630±0.008
J05366+112 2M J05363846+1117487	3315±51 dM4.0 V	5.08±0.07 4.966±0.035	-0.14±0.16	0.00902±0.00015 11.446±0.012	0.288±0.009 0.312±0.005	0.280±0.013 0.364±0.063	0.274±0.007 0.305±0.006
J05415+534 GI 212	3875±51 dM1.0 V	4.69±0.07 4.719±0.029	0.08±0.16	0.05687±0.00090 12.277±0.008	0.529±0.015 0.582±0.006	0.534±0.019 0.500±0.085	0.554±0.014 0.579±0.008

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J05421+124 GI 213	3311±51 dM4.0 V	5.05±0.07 5.035±0.035	0.01±0.16	0.00633±0.00008 5.790±0.003	0.242±0.008 0.275±0.002	0.231±0.012 0.239±0.041	0.218±0.005 0.260±0.004
J06000+027 GJ 3379	3284±51 dM4.0 V	5.10±0.07 5.028±0.035	-0.12±0.16	0.00633±0.00009 5.206±0.002	0.246±0.008 0.273±0.002	0.235±0.012 0.277±0.048	0.231±0.006 0.258±0.004
J06011+595 GJ 3378	3357±51 dM3.5 V	5.03±0.07 4.997±0.034	-0.01±0.16	0.00813±0.00010 7.724±0.005	0.267±0.008 0.305±0.003	0.257±0.012 0.278±0.048	0.262±0.006 0.297±0.004
J06024+498 GJ 3380	3145±51 dM5.0 V	5.15±0.07 5.205±0.042	-0.06±0.16	0.00208±0.00002 9.534±0.006	0.154±0.005 0.178±0.003	0.138±0.010 0.122±0.021	0.139±0.003 0.149±0.003
J06103+821 GI 226	3521±51 dM2.0 V	4.92±0.07 4.817±0.031	-0.11±0.16	0.02402±0.00037 9.462±0.003	0.416±0.012 0.436±0.005	0.415±0.017 0.526±0.090	0.414±0.010 0.443±0.005
J06105-218 GI 229A	3837±51 dM0.5 V	4.70±0.07 4.723±0.036	0.07±0.16	0.05348±0.00251 5.757±0.002	0.523±0.019 0.546±0.009	0.528±0.023 0.500±0.088	0.546±0.038 0.545±0.009
J06246+234 GI 232	3237±51 dM4.0 V	5.11±0.07 5.143±0.039	-0.07±0.16	0.00328±0.00004 8.493±0.004	0.182±0.006 0.203±0.002	0.168±0.010 0.156±0.027	0.157±0.004 0.178±0.002
J06371+175 GI 239	3737±51 dM0.0 V	4.89±0.07 4.780±0.030	-0.42±0.16	0.03647±0.00063 10.008±0.005	0.455±0.013 0.476±0.006	0.457±0.018 0.588±0.100	0.468±0.012 0.483±0.006
J06396-210 LP 780-032	3333±51 dM4.0 V	5.05±0.07 5.003±0.058	-0.05±0.16	0.00766±0.00072 11.500±0.500 ^{CC17}	0.262±0.015 ...	0.253±0.018 0.282±0.055	0.244±0.013 ...
J06421+035 GJ 3404A	3454±51 dM3.5 V	4.95±0.07 4.863±0.033	0.00±0.16	0.01776±0.00035 15.072±0.016	0.372±0.012 0.403±0.004	0.368±0.016 0.450±0.078	0.372±0.010 0.407±0.005
J06548+332 GI 251	3451±51 dM3.0 V	4.96±0.07 4.872±0.032	-0.03±0.16	0.01691±0.00028 5.582±0.002	0.364±0.011 0.389±0.004	0.360±0.015 0.440±0.076	0.356±0.009 0.393±0.005
J06574+740 2M J06572616+7405265	3304±51 dM4.0 V	5.08±0.07 4.746±0.115	-0.07±0.16	0.02638±0.00596 26.455±2.869 ^{URAT}	0.495±0.058 ...	0.499±0.062 ^{Out} 1.077±0.306	0.445±0.040 ...
J06594+193 GJ 1093	3085±51 dM5.0 V	5.16±0.07 5.237±0.044	0.01±0.16	0.00161±0.00002 7.752±0.010	0.140±0.005 0.168±0.001	0.124±0.009 0.104±0.018	0.125±0.003 0.136±0.001
J07033+346 GJ 3423	3298±51 dM4.0 V	5.09±0.07 5.000±0.035	-0.12±0.16	0.00743±0.00009 13.263±0.012	0.264±0.008 0.290±0.004	0.255±0.012 0.313±0.054	0.250±0.006 0.279±0.006
J07044+682 GI 258	3461±51 dM3.0 V	4.95±0.07 4.823±0.032	-0.04±0.16	0.02178±0.00043 16.364±0.011	0.410±0.013 0.425±0.007	0.409±0.017 0.548±0.095	0.411±0.010 0.431±0.007
J07274+052 GI 273	3365±51 dM3.5 V	5.01±0.07 4.939±0.034	0.02±0.16	0.01096±0.00022 3.803±0.020 ^{HIP}	0.308±0.010 ...	0.301±0.014 0.354±0.061	0.295±0.008 ...
J07287-032 GJ 1097	3466±51 dM3.0 V	4.94±0.07 4.844±0.032	-0.03±0.16	0.01979±0.00024 11.718±0.010	0.390±0.012 ...	0.387±0.016 0.483±0.083	0.385±0.010 ...
J07319+362N GI 277C	3314±51 dM3.5 V	5.07±0.07 4.822±0.033	-0.06±0.16	0.01838±0.00021 12.000±0.010	0.411±0.013 0.430±0.004	0.410±0.017 0.725±0.125	0.386±0.009 0.432±0.004
J07353+548 GJ 3452	3520±51 dM2.0 V	4.94±0.07 4.859±0.032	-0.16±0.16	0.01951±0.00033 12.789±0.010	0.375±0.011 0.391±0.004	0.372±0.016 0.448±0.077	0.376±0.009 0.400±0.005
J07361-031 GI 282C	3894±51 dM1.0 V	4.69±0.07 4.705±0.030	0.05±0.16	0.06195±0.00163 14.069±0.028	0.547±0.016 0.594±0.010	0.553±0.021 0.534±0.092	0.573±0.014 0.591±0.012
J07386-212 GJ 3459	3426±51 dM3.0 V	5.00±0.07 4.950±0.033	-0.10±0.16	0.01118±0.00013 10.434±0.004	0.300±0.009 ...	0.292±0.013 0.328±0.057	0.293±0.007 ...
J07393+021 GI 281	4014±51 dM0.0 V	4.66±0.07 4.686±0.028	0.07±0.16	0.07660±0.00152 15.058±0.011	0.572±0.016 0.616±0.007	0.580±0.021 0.546±0.093	0.604±0.015 0.617±0.011
J07403-174 GI 283B	2964±51 dM6.0 V	5.22±0.07 5.328±0.052	-0.09±0.16	0.00080±0.00001 9.170±0.007	0.107±0.004 0.137±0.002	0.089±0.009 0.069±0.012	0.098±0.002 0.108±0.001
J07472+503 2M J07471385+5020386	3312±51 dM4.0 V	5.08±0.07 4.988±0.034	-0.12±0.16	0.00805±0.00009 14.144±0.014	0.272±0.009 0.295±0.003	0.263±0.013 0.326±0.056	0.252±0.006 0.286±0.005
J07558+833 GJ 1101	3256±51 dM4.5 V	5.10±0.07 4.991±0.035	-0.07±0.16	0.00740±0.00007 13.098±0.007	0.270±0.009 0.292±0.004	0.261±0.013 0.335±0.058	0.247±0.006 0.280±0.005
J07582+413 GJ 1105	3367±51 dM3.5 V	5.02±0.07 4.980±0.034	-0.01±0.16	0.00894±0.00013 8.843±0.005	0.278±0.009 0.308±0.003	0.269±0.013 0.295±0.051	0.269±0.007 0.301±0.005
J08119+087 GI 299	3200±51 dM4.5 V	5.15±0.07 5.161±0.040	-0.17±0.16	0.00285±0.00005 6.874±0.027	0.173±0.006 0.183±0.002	0.159±0.010 0.155±0.027	0.143±0.004 0.158±0.002
J08126-215 GI 300	3342±51 dM4.0 V	5.01±0.07 4.987±0.034	0.11±0.16	0.00837±0.00011 8.116±0.005	0.273±0.009 0.309±0.004	0.264±0.013 0.278±0.048	0.268±0.007 0.298±0.005
J08161+013 GJ 2066	3568±51 dM2.0 V	4.89±0.07 4.791±0.031	-0.10±0.16	0.02873±0.00053 8.941±0.004	0.443±0.013 ...	0.444±0.018 0.557±0.096	0.443±0.011 ...
J08293+039 2M J08292191+0355092	3585±51 dM2.5 V	4.88±0.07 4.745±0.030	-0.08±0.16	0.03674±0.00053 18.409±0.027	0.497±0.015 0.500±0.004	0.500±0.019 0.683±0.117	0.493±0.013 0.504±0.005

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J08315+730	3356±51	5.02±0.07	0.01±0.16	0.00951±0.00011	0.288±0.009	0.280±0.013	0.266±0.007
LP 035-219	dM4.0 V	4.966±0.034		14.658±0.011	0.313±0.004	0.318±0.055	0.307±0.006
J08358+680	3461±51	4.98±0.07	-0.11±0.16	0.01797±0.00028	0.373±0.011	0.369±0.016	0.366±0.009
GJ 3506	dM2.5 V	4.862±0.032		13.012±0.007	0.390±0.004	0.484±0.083	0.397±0.005
J08402+314	3393±51	5.01±0.07	-0.01±0.16	0.00979±0.00013	0.286±0.009	0.278±0.013	0.281±0.007
LSPM J0840+3127	dM3.5 V	4.968±0.033		11.210±0.009	0.323±0.003	0.306±0.053	0.318±0.005
J08409-234 ^{New}	3432±51	4.95±0.07	0.08±0.16	0.02175±0.00034	0.417±0.013	0.416±0.017	0.424±0.010
GI 317	dM3.5 V	4.817±0.032		15.205±0.014	...	0.566±0.098	...
J08413+594	3081±51	5.17±0.07	-0.07±0.16	0.00157±0.00002	0.139±0.005	0.123±0.009	0.125±0.003
GJ 3512	dM5.5 V	5.240±0.044		9.489±0.008	0.164±0.002	0.105±0.018	0.133±0.002
J08526+283	3320±51	5.02±0.07	0.15±0.16	0.00788±0.00013	0.268±0.009	0.259±0.013	0.264±0.007
GI 324B	dM4.5 V	4.994±0.035		12.481±0.017	0.308±0.004	0.275±0.048	0.296±0.006
J09005+465	3228±51	5.10±0.07	-0.02±0.16	0.00470±0.00005	0.219±0.007	0.207±0.011	0.203±0.005
GJ 1119	dM4.5 V	5.073±0.037		10.088±0.006	0.253±0.002	0.220±0.038	0.231±0.003
J09028+680	3358±51	5.02±0.07	0.01±0.16	0.00836±0.00012	0.270±0.008	0.261±0.013	0.254±0.006
GJ 3526	dM4.0 V	4.992±0.034		12.285±0.009	0.304±0.004	0.279±0.048	0.298±0.006
J09133+688	3555±51	4.92±0.07	-0.16±0.16	0.05327±0.01345	0.608±0.079	0.618±0.084 ^{Out}	0.558±0.043
G 234-057	dM2.5 V	4.660±0.127		21.053±2.482 ^{URAT}	...	1.123±0.342	...
J09140+196	3493±51	4.95±0.07	-0.10±0.16	0.03198±0.00053	0.488±0.015	0.491±0.019	0.488±0.012
LP 427-016	dM3.0 V	4.752±0.031		22.904±0.073	0.507±0.004	0.775±0.133	0.510±0.005
J09143+526 ^{New}	4024±51	4.68±0.07	-0.05±0.16	0.07892±0.00380	0.578±0.020	0.586±0.025	0.605±0.016
GI 338A	dM0.0 V	4.682±0.035		6.334±0.002	...	0.583±0.102	...
J09144+526	4005±51	4.68±0.07	-0.03±0.16	0.07920±0.00308	0.584±0.019	0.593±0.023	0.583±0.015
GI 338B	dM0.0 V	4.677±0.033		6.334±0.002	0.611±0.026	0.596±0.103	0.613±0.030
J09161+018	3306±51	5.08±0.07	-0.10±0.16	0.01025±0.00017	0.308±0.010	0.301±0.014	0.291±0.008
RX J0916.1+0153	dM4.0 V	4.939±0.034		15.647±0.017	0.335±0.003	0.418±0.072	0.329±0.004
J09163-186	3585±51	4.91±0.07	-0.18±0.16	0.03286±0.00063	0.470±0.014	0.472±0.019	0.469±0.012
GJ 3543	dM1.5 V	4.768±0.031		13.448±0.007	0.476±0.006	0.654±0.113	0.482±0.006
J09307+003	3408±51	5.00±0.07	-0.04±0.16	0.01181±0.00017	0.312±0.010	0.305±0.014	0.304±0.008
GJ 1125	dM3.5 V	4.934±0.033		9.901±0.007	0.339±0.004	0.354±0.061	0.337±0.004
J09360-216	3505±51	4.94±0.07	-0.12±0.16	0.01591±0.00036	0.342±0.011	0.337±0.015	0.348±0.008
GI 357	dM2.5 V	4.897±0.033		9.445±0.005	0.360±0.007	0.372±0.064	0.365±0.007
J09411+132	3613±51	4.87±0.07	-0.11±0.16	0.03358±0.00064	0.468±0.014	0.469±0.018	0.475±0.012
GI 361	dM1.5 V	4.770±0.031		11.554±0.005	0.487±0.006	0.591±0.102	0.492±0.006
J09423+559	3399±51	4.98±0.07	0.08±0.16	0.01686±0.00019	0.374±0.011	0.371±0.016	0.373±0.009
GI 363	dM3.5 V	4.861±0.032		16.545±0.016	0.411±0.004	0.488±0.084	0.412±0.004
J09425+700	3515±51	4.94±0.07	-0.12±0.16	0.03455±0.00079	0.501±0.016	0.505±0.020	0.492±0.012
GI 360	dM2.0 V	4.741±0.032		11.854±0.004	0.521±0.006	0.798±0.138	0.522±0.006
J09428+700	3423±51	4.99±0.07	-0.06±0.16	0.02357±0.00052	0.436±0.014	0.436±0.018	0.428±0.010
GI 362	dM3.0 V	4.798±0.033		11.876±0.006	0.459±0.005	0.679±0.118	0.463±0.005
J09439+269	3427±51	4.98±0.07	-0.02±0.16	0.01833±0.00029	0.384±0.012	0.381±0.016	0.379±0.009
GJ 3564	dM3.5 V	4.850±0.032		14.388±0.019	0.414±0.006	0.514±0.089	0.417±0.006
J09447-182	3362±51	5.02±0.07	0.03±0.16	0.00947±0.00012	0.287±0.009	0.278±0.013	0.282±0.007
GJ 1129	dM4.0 V	4.968±0.034		11.011±0.010	0.323±0.004	0.314±0.054	0.316±0.006
J09468+760	3680±51	4.78±0.07	-0.01±0.16	0.04265±0.00056	0.508±0.014	0.512±0.019	0.504±0.012
GI 366	dM1.5 V	4.735±0.030		15.795±0.007	0.514±0.007	0.567±0.097	0.517±0.007
J09511-123	3777±51	4.76±0.07	-0.07±0.16	0.04536±0.00072	0.497±0.014	0.501±0.019	0.516±0.013
GI 369	dM0.5 V	4.744±0.029		13.118±0.009	0.526±0.004	0.519±0.089	0.527±0.006
J09561+627	3980±51	4.66±0.07	0.07±0.16	0.07270±0.00140	0.567±0.016	0.574±0.020	0.589±0.015
GI 373	dM0.0 V	4.690±0.028		10.533±0.004	0.602±0.005	0.536±0.091	0.601±0.010
J10023+480	3785±51	4.72±0.07	0.05±0.16	0.06099±0.00071	0.574±0.016	0.582±0.021	0.559±0.014
GI 378	dM1.0 V	4.685±0.029		14.961±0.007	0.586±0.005	0.631±0.108	0.584±0.008
J10122-037	3610±51	4.87±0.07	-0.13±0.16	0.04163±0.00059	0.521±0.015	0.526±0.020	0.513±0.013
GI 382	dM1.5 V	4.724±0.030		7.705±0.005	0.522±0.003	0.735±0.126	0.524±0.004
J10125+570	3406±51	5.00±0.07	-0.05±0.16	0.01201±0.00015	0.315±0.010	0.308±0.014	0.304±0.007
LP 092-048	dM3.5 V	4.931±0.033		10.059±0.010	0.334±0.004	0.361±0.062	0.332±0.005
J10167-119	3532±51	4.88±0.07	0.01±0.16	0.03362±0.00056	0.489±0.015	0.492±0.019	0.476±0.011
GI 386	dM3.0 V	4.751±0.031		13.472±0.013	0.497±0.004	0.663±0.114	0.501±0.005
J10251-102	3780±51	4.72±0.07	0.06±0.16	0.04742±0.00098	0.507±0.015	0.511±0.019	0.526±0.013
GI 390	dM1.0 V	4.736±0.030		12.821±0.016	...	0.493±0.084	...

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J10289+008 GI 393	3579±51 dM2.0 V	4.88±0.07 4.808±0.032	-0.09±0.16	0.02687±0.00054 7.033±0.002	0.426±0.013 0.446±0.007	0.426±0.017 0.503±0.087	0.432±0.011 0.453±0.007
J10350-094 LP 670-017	3469±51 dM3.0 V	4.94±0.07 4.853±0.032	-0.02±0.16	0.01900±0.00027 16.292±0.021	0.381±0.012 0.410±0.003	0.378±0.016 0.462±0.080	0.390±0.010 0.415±0.004
J10396-069 GI 399	3554±51 dM2.5 V	4.88±0.07 4.772±0.032	-0.02±0.16	0.03107±0.00068 15.579±0.022	0.465±0.014 0.489±0.005	0.466±0.019 0.598±0.103	0.468±0.011 0.493±0.006
J10416+376 GJ 1134	3272±51 dM4.5 V	5.07±0.07 5.050±0.036	0.07±0.16	0.00558±0.00006 10.055±0.007	0.233±0.007 0.259±0.003	0.221±0.012 0.232±0.040	0.205±0.005 0.240±0.003
J10504+331 GJ 3626	3393±51 dM4.0 V	4.99±0.07 4.829±0.032	0.07±0.16	0.01955±0.00025 22.609±0.056	0.405±0.012 0.438±0.004	0.403±0.017 0.584±0.101	0.405±0.010 0.440±0.006
J10508+068 GI 402	3345±51 dM4.0 V	5.03±0.07 4.996±0.035	0.01±0.16	0.00806±0.00016 6.969±0.003	0.267±0.009 0.299±0.003	0.258±0.013 0.279±0.048	0.268±0.006 0.289±0.005
J11000+228 GI 408	3499±51 dM2.5 V	4.94±0.07 4.845±0.235	-0.11±0.16	0.02044±0.00967 6.751±0.003	0.389±0.093 0.418±0.008	0.386±0.098 0.481±0.242	0.387±0.078 0.423±0.007
J11026+219 GI 410	3905±51 dM1.0 V	4.69±0.07 4.717±0.028	0.04±0.16	0.05908±0.00078 11.936±0.009	0.531±0.014 0.570±0.004	0.536±0.019 0.504±0.086	0.556±0.014 0.568±0.008
J11033+359 GI 411	3601±51 dM1.5 V	4.87±0.07 4.878±0.045	-0.09±0.16	0.01951±0.00131 2.547±0.004 ^{HIP}	0.359±0.016 0.408±0.038	0.354±0.019 ^{Out} 0.348±0.064	0.407±0.050 0.415±0.038
J11054+435 GI 412A	3639±51 dM1.0 V	4.92±0.07 4.860±0.031	-0.30±0.16	0.02223±0.00044 4.848±0.024 ^{HIP}	0.375±0.011 ...	0.372±0.015 ^{Out} 0.427±0.073	0.389±0.010 ...
J11110+304 GI 414B	3753±51 dM2.0 V	4.71±0.07 4.716±0.029	0.13±0.16	0.05079±0.00057 11.876±0.008	0.533±0.015 0.574±0.005	0.538±0.020 0.531±0.091	0.547±0.014 0.571±0.008
J11126+189 GJ 3649	3645±51 dM1.5 V	4.86±0.07 4.708±0.030	-0.14±0.16	0.04695±0.00081 16.683±0.014	0.543±0.016 ...	0.549±0.021 0.780±0.134	0.531±0.013 ...
J11201-104 LP 733-099	3542±51 dM2.0 V	4.95±0.07 4.711±0.031	-0.21±0.16	0.04123±0.00069 18.907±0.018	0.539±0.016 0.529±0.006	0.545±0.021 0.945±0.163	0.512±0.013 0.530±0.007
J11289+101 GJ 3666	3375±51 dM3.5 V	5.01±0.07 4.977±0.034	0.00±0.16	0.00918±0.00015 12.806±0.023	0.280±0.009 0.313±0.005	0.272±0.013 0.293±0.051	0.271±0.007 0.307±0.006
J11302+076 K2-18	3513±51 dM2.5 V	4.91±0.07 4.796±0.031	-0.03±0.16	0.02640±0.00042 38.066±0.072	0.438±0.013 0.463±0.005	0.439±0.018 0.570±0.098	0.445±0.011 0.468±0.006
J11306-080 LP 672-042	3422±51 dM3.5 V	4.98±0.07 4.882±0.032	-0.01±0.16	0.01560±0.00018 13.443±0.013	0.355±0.011 0.387±0.002	0.351±0.015 0.440±0.076	0.361±0.009 0.390±0.003
J11417+427 GJ 1148	3375±51 dM4.0 V	4.99±0.07 4.879±0.033	0.09±0.16	0.01499±0.00017 11.018±0.006	0.358±0.011 0.401±0.004	0.354±0.015 0.457±0.079	0.346±0.008 0.399±0.004
J11421+267 GI 436	3505±51 dM2.5 V	4.91±0.07 4.807±0.031	-0.04±0.16	0.02477±0.00036 9.756±0.009	0.427±0.013 0.452±0.004	0.426±0.017 0.540±0.093	0.423±0.010 0.458±0.004
J11467-140 GI 443	3570±51 dM3.0 V	4.82±0.07 4.735±0.030	0.11±0.16	0.03779±0.00053 19.384±0.023	0.508±0.015 0.524±0.005	0.512±0.020 0.622±0.107	0.504±0.012 0.525±0.007
J11476+002 GJ 3685A	3256±51 dM4.0 V	5.10±0.07 4.890±0.034	-0.10±0.16	0.01226±0.00021 18.801±0.025	0.348±0.011 ...	0.343±0.015 0.556±0.097	0.328±0.009 ...
J11476+786 GI 445	3369±51 dM3.5 V	5.02±0.07 5.003±0.035	0.00±0.16	0.00799±0.00015 5.256±0.001	0.262±0.008 0.288±0.003	0.253±0.012 0.263±0.046	0.244±0.006 0.279±0.005
J11477+008 GI 447	3264±51 dM4.0 V	5.09±0.07 5.120±0.038	-0.04±0.16	0.00384±0.00007 3.375±0.001	0.194±0.006 0.221±0.003	0.180±0.011 0.168±0.029	0.176±0.004 0.196±0.003
J11509+483 GJ 1151	3221±51 dM4.5 V	5.11±0.07 5.138±0.038	-0.05±0.16	0.00330±0.00004 8.038±0.008	0.184±0.006 0.214±0.003	0.170±0.010 0.160±0.028	0.168±0.004 0.189±0.003
J11511+352 GI 450	3645±51 dM1.5 V	4.87±0.07 4.781±0.030	-0.17±0.16	0.03299±0.00040 8.761±0.003	0.455±0.013 0.483±0.005	0.456±0.018 0.561±0.096	0.462±0.011 0.488±0.006
J12054+695 GJ 3704	3338±51 dM4.0 V	5.02±0.07 4.944±0.034	0.10±0.16	0.01036±0.00012 15.456±0.007	0.304±0.009 0.342±0.005	0.297±0.014 0.354±0.061	0.296±0.008 0.334±0.005
J12100-150 GJ 3707	3375±51 dM3.5 V	4.98±0.07 4.863±0.033	0.17±0.16	0.01622±0.00027 12.262±0.015	0.372±0.012 0.410±0.005	0.369±0.016 0.483±0.084	0.375±0.009 0.409±0.006
J12111-199 GJ 3708A	3471±51 dM3.0 V	4.95±0.07 4.878±0.032	-0.06±0.16	0.01684±0.00021 12.763±0.010	0.359±0.011 0.382±0.005	0.354±0.015 0.418±0.072	0.361±0.009 0.388±0.005
J12123+544S GI 458A	3933±51 dM0.0 V	4.70±0.07 4.687±0.029	-0.03±0.16	0.07019±0.00150 15.242±0.007	0.570±0.016 0.583±0.012	0.578±0.021 0.595±0.102	0.580±0.014 0.584±0.013
J12156+526 StKM 2-809	3339±51 dM4.0 V	5.06±0.07 4.698±0.033	-0.12±0.16	0.03463±0.00081 25.381±0.135	0.556±0.018 0.525±0.005	0.562±0.023 ^{Out} 1.294±0.225	0.488±0.012 0.525±0.006
J12189+111 GJ 1156	3115±51 dM5.0 V	5.15±0.07 5.190±0.041	-0.02±0.16	0.00218±0.00003 6.472±0.005	0.160±0.005 0.181±0.002	0.145±0.010 0.132±0.023	0.140±0.004 0.151±0.002

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J12230+640 GI 463	3540±51 dM3.0 V	4.86±0.07 4.753±0.031	0.05±0.16	0.03362±0.00052 18.365±0.010	0.487±0.015 0.505±0.006	0.490±0.019 0.628±0.108	0.476±0.011 0.508±0.006
J12248-182 GI 465	3485±51 dM2.0 V	4.98±0.07 4.989±0.033	-0.17±0.16	0.00980±0.00015 8.870±0.006	0.271±0.008 0.286±0.003	0.262±0.012 ^{Out} 0.257±0.044	0.261±0.007 0.283±0.006
J12312+086 GI 471	3914±51 dM0.5 V	4.71±0.07 4.707±0.032	-0.07±0.16	0.06264±0.00204 13.557±0.075	0.544±0.017 0.571±0.014	0.550±0.021 0.554±0.096	0.567±0.014 0.569±0.014
J12350+098 GI 476	3572±51 dM2.5 V	4.85±0.07 4.764±0.031	0.02±0.16	0.03297±0.00051 18.169±0.017	0.474±0.014 0.480±0.005	0.476±0.018 0.580±0.100	0.468±0.011 0.486±0.006
J12373-208 LP 795-038	3394±51 dM4.0 V	4.97±0.07 4.822±0.032	0.13±0.16	0.02025±0.00025 23.906±0.040	0.411±0.013 0.450±0.004	0.410±0.017 0.576±0.099	0.412±0.010 0.450±0.005
J12388+116 GI 480	3439±51 dM3.0 V	4.96±0.07 4.773±0.032	0.00±0.16	0.02713±0.00046 14.241±0.014	0.464±0.014 0.482±0.004	0.465±0.019 0.716±0.124	0.457±0.012 0.486±0.004
J12428+418 G 123-055	3317±51 dM4.0 V	5.06±0.07 4.848±0.033	-0.07±0.16	0.01625±0.00019 14.306±0.014	0.386±0.012 0.407±0.003	0.383±0.016 0.624±0.108	0.369±0.009 0.407±0.004
J12479+097 GI 486	3389±51 dM3.5 V	5.00±0.07 4.933±0.033	0.03±0.16	0.01164±0.00019 8.076±0.004	0.313±0.010 0.356±0.004	0.306±0.014 0.357±0.062	0.314±0.008 0.352±0.005
J13005+056 GI 493.1	3192±51 dM4.5 V	5.13±0.07 5.104±0.038	-0.04±0.16	0.00382±0.00007 8.561±0.015	0.202±0.007 0.224±0.004	0.189±0.011 0.201±0.035	0.178±0.005 0.198±0.004
J13102+477 G 177-025	3157±51 dM5.0 V	5.16±0.07 5.142±0.039	-0.15±0.16	0.00298±0.00003 12.191±0.009	0.182±0.006 0.201±0.001	0.168±0.010 0.176±0.031	0.157±0.004 0.172±0.002
J13196+333 GI 507.1	3812±51 dM1.5 V	4.67±0.07 4.708±0.029	0.18±0.16	0.05593±0.00071 16.861±0.009	0.542±0.015 0.581±0.005	0.548±0.020 0.501±0.085	0.563±0.014 0.578±0.008
J13209+342 GI 508.2	3763±51 dM1.0 V	4.73±0.07 4.729±0.226	0.03±0.16	0.04814±0.02201 16.644±0.011	0.516±0.119 0.545±0.005	0.520±0.126 0.522±0.255	0.533±0.079 0.544±0.007
J13229+244 GJ 3779	3324±51 dM4.0 V	5.05±0.07 4.976±0.034	0.00±0.16	0.00867±0.00011 13.748±0.011	0.281±0.009 0.306±0.003	0.272±0.013 0.322±0.056	0.254±0.007 0.300±0.005
J13283-023W GI 512A	3482±51 dM3.0 V	4.92±0.07 4.794±0.033	0.01±0.16	0.02577±0.00062 13.122±0.060	0.441±0.014 0.455±0.005	0.441±0.018 0.590±0.102	0.440±0.011 0.460±0.005
J13293+114 GI 513	3449±51 dM3.5 V	4.93±0.07 4.794±0.033	0.09±0.16	0.02481±0.00053 19.120±0.018	0.441±0.014 0.453±0.005	0.441±0.018 0.604±0.104	0.423±0.011 0.458±0.005
J13299+102 GI 514	3714±51 dM0.5 V	4.81±0.07 4.752±0.029	-0.15±0.16	0.04076±0.00049 7.620±0.003	0.487±0.014 0.501±0.004	0.490±0.018 0.560±0.096	0.505±0.013 0.507±0.006
J13427+332 GJ 3801	3373±51 dM3.5 V	5.02±0.07 4.987±0.034	-0.01±0.16	0.00870±0.00008 9.189±0.003	0.273±0.008 0.312±0.003	0.264±0.013 0.285±0.049	0.267±0.007 0.304±0.006
J13450+176 GI 525	3806±51 dM1.0 V	4.85±0.07 4.747±0.029	-0.43±0.16	0.04609±0.00052 12.912±0.007	0.494±0.014 0.492±0.006	0.497±0.018 0.629±0.107	0.499±0.013 0.500±0.006
J13457+148 GI 526	3678±51 dM1.5 V	4.79±0.07 4.767±0.034	-0.04±0.16	0.03651±0.00127 5.435±0.001	0.470±0.015 0.510±0.007	0.472±0.020 0.498±0.087	0.487±0.012 0.514±0.008
J13458-179 GJ 3804	3402±51 dM3.5 V	4.99±0.07 4.898±0.033	0.01±0.16	0.01408±0.00024 11.207±0.010	0.341±0.011 0.375±0.004	0.336±0.015 0.416±0.072	0.339±0.010 0.376±0.004
J13536+776 RX J1353.6+7737	3295±51 dM4.0 V	5.08±0.07 4.977±0.035	-0.07±0.16	0.00835±0.00014 13.250±0.009	0.280±0.009 ...	0.272±0.013 0.345±0.060	0.265±0.007 ...
J13582+125 GJ 3817	3372±51 dM3.0 V	5.05±0.07 5.050±0.035	-0.15±0.16	0.00630±0.00008 9.353±0.008	0.232±0.007 0.249±0.002	0.221±0.011 0.221±0.038	0.217±0.006 0.235±0.003
J13591-198 GJ 3820	3264±51 dM4.0 V	5.09±0.07 4.993±0.035	-0.04±0.16	0.00741±0.00012 10.819±0.009	0.269±0.009 0.298±0.005	0.260±0.013 0.325±0.056	0.253±0.007 0.284±0.007
J14010-026 GI 536	3724±51 dM1.0 V	4.77±0.07 4.743±0.030	-0.04±0.16	0.04309±0.00069 10.412±0.010	0.498±0.014 0.516±0.003	0.502±0.019 0.534±0.091	0.510±0.012 0.520±0.004
J14082+805 GI 540	3841±51 dM1.0 V	4.67±0.07 4.684±0.030	0.16±0.16	0.06477±0.00161 17.191±0.009	0.575±0.017 ...	0.582±0.022 0.563±0.097	0.579±0.015 ...
J14152+450 GJ 3836	3480±51 dM3.0 V	4.91±0.07 4.792±0.031	0.04±0.16	0.02598±0.00038 16.987±0.012	0.443±0.013 0.470±0.003	0.444±0.018 0.583±0.100	0.431±0.010 0.474±0.004
J14173+454 RX J1417.3+4525	3196±51 dM5.0 V	5.13±0.07 4.963±0.035	-0.10±0.16	0.00793±0.00010 19.327±0.060	0.290±0.009 0.320±0.003	0.282±0.013 ^{Out} 0.415±0.072	0.257±0.006 0.308±0.004
J14251+518 GI 549B	3521±51 dM2.5 V	4.91±0.07 4.832±0.031	-0.07±0.16	0.02231±0.00027 14.537±0.008	0.401±0.012 0.420±0.005	0.399±0.016 0.478±0.082	0.404±0.011 0.428±0.005
J14257+236E GI 548B	3947±51 dM0.5 V	4.65±0.07 4.682±0.028	0.17±0.16	0.07316±0.00100 16.340±0.013	0.578±0.015 0.625±0.004	0.586±0.021 0.545±0.093	0.598±0.015 0.627±0.010
J14257+236W GI 548A	4024±51 dM0.0 V	4.64±0.07 4.671±0.027	0.17±0.16	0.08330±0.00121 16.345±0.013	0.594±0.016 0.639±0.005	0.602±0.021 0.561±0.095	0.615±0.016 0.645±0.011

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J14294+155 GI 552	3671±51 dM2.0 V	4.76±0.07 4.749±0.031	0.06±0.16	0.03964±0.00078 14.249±0.010	0.492±0.015 0.527±0.005	0.495±0.019 0.508±0.087	0.505±0.012 0.527±0.006
J14307-086 GI 553	4089±51 dM0.5 V	4.63±0.07 4.653±0.027	0.14±0.16	0.09668±0.00137 15.783±0.010	0.619±0.016 0.741±0.025	0.629±0.021 0.597±0.101	0.633±0.016 0.624±0.046
J14310-122 GI 553.1	3400±51 dM3.5 V	5.00±0.07 4.923±0.033	0.00±0.16	0.01242±0.00017 10.861±0.012	0.321±0.010 0.354±0.003	0.315±0.014 0.376±0.065	0.320±0.008 0.352±0.004
J14342-125 GI 555	3337±51 dM4.0 V	5.01±0.07 4.965±0.034	0.12±0.16	0.00932±0.00015 6.246±0.004	0.289±0.009 0.336±0.003	0.281±0.013 0.311±0.054	0.294±0.008 0.327±0.005
J14524+123 GJ 3871	3548±51 dM2.0 V	4.89±0.07 4.710±0.033	-0.08±0.16	0.04167±0.00125 20.687±0.017	0.540±0.018 0.545±0.004	0.546±0.022 0.826±0.144	0.520±0.013 0.543±0.006
J14544+355 GJ 3873	3379±51 dM3.5 V	5.00±0.07 4.873±0.033	0.06±0.16	0.01549±0.00019 14.910±0.011	0.363±0.011 0.394±0.004	0.359±0.015 0.481±0.083	0.347±0.009 0.396±0.004
J15013+055 GJ 3885	3425±51 dM3.0 V	4.99±0.07 4.889±0.032	-0.06±0.16	0.01514±0.00018 14.995±0.013	0.349±0.011 0.376±0.003	0.344±0.015 0.435±0.075	0.355±0.009 0.379±0.004
J15095+031 GJ 3892	3492±51 dM3.0 V	4.92±0.07 4.791±0.031	-0.01±0.16	0.02640±0.00031 14.601±0.013	0.444±0.013 0.460±0.004	0.444±0.018 0.598±0.103	0.438±0.010 0.465±0.005
J15194-077 GI 581	3441±51 dM3.0 V	4.98±0.07 4.939±0.033	-0.08±0.16	0.01202±0.00020 6.299±0.002	0.308±0.010 0.337±0.004	0.301±0.014 0.331±0.057	0.311±0.008 0.335±0.005
J15218+209 GJ 9520	3486±51 dM1.5 V	5.02±0.07 4.677±0.031	-0.34±0.16	0.04557±0.00068 11.444±0.007	0.585±0.018 0.555±0.004	0.593±0.022 ^{Out} 1.308±0.225	0.532±0.014 0.552±0.007
J15369-141 GI 592	3370±51 dM4.0 V	5.00±0.07 4.931±0.033	0.07±0.16	0.01153±0.00014 13.955±0.016	0.315±0.010 0.350±0.003	0.308±0.014 0.362±0.062	0.310±0.008 0.345±0.004
J15474-108 ^{New} GJ 3916	3528±51 dM2.0 V	4.95±0.07 4.745±0.032	-0.21±0.16	0.03444±0.00067 15.995±0.072	0.497±0.015 ...	0.500±0.020 0.802±0.138	0.490±0.012 ...
J15499+796 LP 022-420	3152±51 dM5.0 V	5.13±0.07 4.973±0.038	-0.01±0.16	0.00714±0.00020 20.653±0.132	0.283±0.010 0.311±0.004	0.275±0.014 ^{Out} 0.395±0.069	0.251±0.006 0.293±0.005
J15598-082 GI 606	3625±51 dM1.0 V	4.89±0.07 4.748±0.031	-0.19±0.16	0.03781±0.00083 13.293±0.009	0.493±0.015 0.511±0.006	0.496±0.019 0.688±0.118	0.489±0.013 0.513±0.007
J16028+205 GI 609	3330±51 dM4.0 V	5.04±0.07 5.015±0.034	0.04±0.16	0.00717±0.00006 10.010±0.006	0.254±0.008 0.297±0.002	0.244±0.012 0.259±0.045	0.242±0.006 0.285±0.003
J16092+093 G 137-084	3450±51 dM3.0 V	4.98±0.07 4.861±0.032	-0.10±0.16	0.01790±0.00019 13.539±0.011	0.374±0.011 0.392±0.004	0.371±0.015 0.488±0.084	0.366±0.009 0.397±0.005
J16102-193 K2-33	3657±51 dM3.0 V	4.73±0.07 4.528±0.032	0.18±0.16	0.11240±0.00318 139.860±1.565	0.835±0.026 1.002±0.035	0.857±0.032 ^{Out} 1.366±0.236	0.703±0.020 0.429±0.097
J16167+672N GI 617B	3488±51 dM3.0 V	4.93±0.07 4.767±0.033	-0.03±0.16	0.02949±0.00069 10.764±0.005	0.470±0.015 0.485±0.006	0.472±0.019 0.686±0.119	0.460±0.011 0.490±0.006
J16167+672S GI 617A	4090±51 dM0.0 V	4.62±0.07 4.654±0.030	0.15±0.16	0.09616±0.00280 10.768±0.003	0.617±0.018 0.780±0.035	0.627±0.023 0.580±0.099	0.631±0.016 0.598±0.072
J16254+543 GI 625	3525±51 dM1.5 V	4.97±0.07 4.916±0.032	-0.26±0.16	0.01482±0.00022 6.474±0.001	0.326±0.010 0.337±0.004	0.320±0.014 0.363±0.062	0.321±0.008 0.343±0.005
J16303-126 GI 628	3389±51 dM3.5 V	5.00±0.07 4.947±0.034	0.00±0.16	0.01084±0.00019 4.306±0.001	0.302±0.009 0.337±0.003	0.294±0.014 0.333±0.058	0.302±0.008 0.332±0.004
J16327+126 GJ 1203	3487±51 dM3.0 V	4.91±0.07 4.839±0.032	0.01±0.16	0.02072±0.00028 18.501±0.051	0.394±0.012 0.425±0.003	0.392±0.016 0.461±0.079	0.389±0.010 0.431±0.004
J16462+164 GJ 3972	3506±51 dM2.5 V	4.92±0.07 4.803±0.031	-0.06±0.16	0.02526±0.00034 15.770±0.010	0.431±0.013 0.447±0.003	0.430±0.017 0.563±0.097	0.427±0.010 0.453±0.004
J16554-083N GI 643	3345±51 dM3.5 V	5.04±0.07 5.062±0.036	-0.05±0.16	0.00572±0.00009 6.497±0.005	0.225±0.007 0.249±0.003	0.213±0.011 0.203±0.035	0.209±0.005 0.232±0.004
J16570-043 GJ 1207	3284±51 dM3.5 V	5.09±0.07 5.012±0.035	-0.10±0.16	0.00690±0.00010 8.693±0.006	0.257±0.008 0.276±0.004	0.247±0.012 0.295±0.051	0.235±0.006 0.262±0.007
J16581+257 GI 649	3734±51 dM1.0 V	4.78±0.07 4.734±0.030	-0.08±0.16	0.04558±0.00100 10.383±0.003	0.510±0.015 0.532±0.005	0.514±0.020 0.572±0.098	0.519±0.013 0.533±0.007
J17033+514 GJ 3988	3243±51 dM4.5 V	5.08±0.07 5.115±0.038	0.05±0.16	0.00384±0.00005 9.914±0.004	0.196±0.006 0.233±0.003	0.183±0.011 0.169±0.029	0.183±0.005 0.208±0.004
J17052-050 GI 654	3642±51 dM1.5 V	4.81±0.07 4.771±0.030	-0.01±0.16	0.03445±0.00043 10.456±0.007	0.466±0.013 0.457±0.006	0.468±0.018 0.512±0.088	0.464±0.012 0.468±0.006
J17071+215 GI 655	3486±51 dM3.0 V	4.94±0.07 4.839±0.033	-0.07±0.16	0.02075±0.00048 14.053±0.008	0.395±0.012 0.421±0.004	0.393±0.017 0.495±0.086	0.395±0.009 0.427±0.005
J17115+384 GJ 3992	3426±51 dM3.5 V	4.97±0.07 4.845±0.032	0.01±0.16	0.01877±0.00027 12.026±0.007	0.389±0.012 0.415±0.005	0.386±0.016 0.515±0.089	0.379±0.009 0.418±0.005

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J17166+080	3543±51	4.91±0.07	-0.10±0.16	0.02366±0.00035	0.408±0.012	0.407±0.016	0.410±0.010
GJ 2128	dM2.0 V	4.825±0.031		15.119±0.009	0.424±0.004	0.494±0.085	0.432±0.005
J17198+417	3498±51	4.93±0.07	-0.07±0.16	0.01779±0.00036	0.363±0.011	0.359±0.015	0.367±0.009
Gl 671	dM2.5 V	4.873±0.033		12.231±0.006	0.394±0.004	0.409±0.071	0.401±0.005
J17303+055	3812±51	4.77±0.07	-0.15±0.16	0.05378±0.00074	0.531±0.015	0.537±0.019	0.542±0.014
Gl 678.1 A	dM0.0 V	4.717±0.029		10.116±0.004	...	0.607±0.103	...
J17355+616	3893±51	4.69±0.07	0.06±0.16	0.05850±0.00064	0.531±0.014	0.537±0.019	0.559±0.014
Gl 685	dM0.5 V	4.717±0.028		14.320±0.008	0.575±0.007	0.505±0.086	0.573±0.009
J17378+185	3656±51	4.87±0.07	-0.23±0.16	0.02934±0.00073	0.427±0.013	0.426±0.017	0.442±0.011
Gl 686	dM1.0 V	4.807±0.032		8.159±0.002	...	0.493±0.085	...
J17542+073	3322±51	5.02±0.07	0.12±0.16	0.01040±0.00015	0.308±0.010	0.301±0.014	0.297±0.008
GJ 1222	dM4.0 V	4.940±0.034		16.072±0.015	0.354±0.003	0.362±0.063	0.345±0.004
J17578+046	3273±51	5.11±0.07	-0.15±0.16	0.00356±0.00007	0.185±0.006	0.172±0.010	0.160±0.004
Gl 699	dM3.5 V	5.136±0.039		1.827±0.001	...	0.162±0.028	...
J17578+465	3441±51	4.97±0.07	-0.04±0.16	0.02053±0.00040	0.403±0.013	0.401±0.017	0.400±0.010
GJ 4040	dM2.5 V	4.831±0.033		13.990±0.008	0.430±0.005	0.553±0.096	0.434±0.005
J18022+642	3124±51	5.16±0.07	-0.09±0.16	0.00319±0.00007	0.193±0.007	0.179±0.011	0.162±0.004
LP 071-082	dM5.0 V	5.122±0.040		7.783±0.004	0.206±0.004	0.196±0.034	0.179±0.003
J18027+375	3163±51	5.12±0.07	0.03±0.16	0.00239±0.00002	0.163±0.005	0.148±0.010	0.144±0.004
GJ 1223	dM5.0 V	5.184±0.040		12.213±0.009	0.195±0.001	0.128±0.022	0.165±0.001
J18051-030	3663±51	4.86±0.07	-0.20±0.16	0.03279±0.00049	0.449±0.013	0.450±0.017	0.466±0.012
Gl 701	dM1.0 V	4.786±0.030		7.729±0.004	0.464±0.003	0.534±0.091	0.472±0.004
J18165+048	3226±51	5.09±0.07	0.04±0.16	0.00354±0.00005	0.190±0.006	0.177±0.011	0.177±0.005
G 140-051	dM5.0 V	5.126±0.038		14.674±0.024	0.217±0.002	0.163±0.028	0.190±0.002
J18174+483	3505±51	4.98±0.07	-0.22±0.16	0.04558±0.00080	0.579±0.018	0.587±0.022 ^{Out}	0.531±0.013
TYC 3529-1437-1	dM2.0 V	4.681±0.031		19.849±0.012	0.564±0.004	1.167±0.201	0.561±0.007
J18180+387E	3440±51	4.98±0.07	-0.08±0.16	0.01183±0.00008	0.306±0.009	0.299±0.013	0.296±0.007
GJ 4048A	dM3.0 V	4.942±0.032		11.357±0.004	0.323±0.003	0.327±0.056	0.323±0.005
J18189+661	3181±51	5.15±0.07	-0.17±0.16	0.00238±0.00003	0.161±0.005	0.145±0.010	0.139±0.003
GJ 4053	dM4.5 V	5.189±0.041		7.647±0.002	0.181±0.001	0.133±0.023	0.154±0.001
J18198-019 ^{New}	4143±51	4.66±0.07	-0.11±0.16	0.09080±0.00189	0.585±0.016	0.593±0.021	0.619±0.016
Gl 710	dK7 V	4.677±0.028		19.040±0.018	...	0.570±0.097	...
J18221+063	3405±51	4.99±0.07	0.00±0.16	0.01044±0.00016	0.293±0.009	0.286±0.013	0.277±0.007
Gl 712	dM4.0 V	4.959±0.033		14.795±0.013	0.341±0.003	0.307±0.053	0.334±0.005
J18224+620	3219±51	5.11±0.07	-0.04±0.16	0.00314±0.00015	0.180±0.007	0.166±0.011	0.164±0.005
GJ 1227	dM4.0 V	5.147±0.045		8.230±0.149 ^{Yale}	0.237±0.013	0.152±0.027	0.213±0.015
J18319+406	3413±51	5.01±0.07	-0.07±0.16	0.01676±0.00025	0.370±0.011	0.366±0.016	0.360±0.009
GJ 4062	dM3.5 V	4.865±0.033		13.578±0.007	0.384±0.003	0.512±0.088	0.387±0.004
J18346+401	3400±51	4.97±0.07	0.11±0.16	0.02170±0.00045	0.424±0.013	0.424±0.018 ^{Out}	0.300±0.132
GJ 4063	dM3.5 V	4.809±0.033		10.887±0.006	0.462±0.003	0.613±0.106	0.463±0.004
J18353+457	3932±51	4.68±0.07	0.06±0.16	0.07190±0.00108	0.578±0.016	0.585±0.021	0.584±0.014
Gl 720A	dM0.5 V	4.682±0.028		15.564±0.007	0.601±0.005	0.583±0.099	0.600±0.010
J18363+136	3304±51	5.08±0.07	-0.08±0.16	0.01051±0.00016	0.313±0.010	0.306±0.014	0.294±0.007
GJ 4065	dM4.0 V	4.933±0.034		12.044±0.012	0.336±0.004	0.429±0.074	0.331±0.005
J18409-133	3812±51	4.70±0.07	0.08±0.16	0.05081±0.00087	0.517±0.015	0.521±0.019	0.541±0.013
Gl 724	dM1.0 V	4.728±0.029		16.975±0.014	0.554±0.003	0.488±0.083	0.551±0.006
J18419+318	3471±51	4.96±0.07	-0.10±0.16	0.01614±0.00023	0.351±0.011	0.346±0.015	0.354±0.009
GJ 4070	dM3.0 V	4.886±0.032		10.800±0.003	0.383±0.008	0.411±0.071	0.389±0.007
J18480-145	3496±51	4.94±0.07	-0.11±0.16	0.01979±0.00026	0.383±0.011	0.380±0.016	0.380±0.010
GJ 4077	dM2.5 V	4.851±0.032		17.082±0.018	0.412±0.006	0.467±0.080	0.417±0.005
J18498-238	3293±51	5.12±0.07	-0.25±0.16	0.00411±0.00006	0.197±0.006	0.184±0.011	0.177±0.004
Gl 729	dM3.5 V	5.114±0.037		2.975±0.001	0.211±0.001	0.186±0.032	0.189±0.002
J18580+059	3923±51	4.68±0.07	0.08±0.16	0.06529±0.00103	0.553±0.015	0.559±0.020	0.582±0.015
Gl 740	dM0.5 V	4.700±0.028		11.105±0.006	0.580±0.010	0.534±0.091	0.580±0.012
J19070+208	3536±51	4.94±0.07	-0.20±0.16	0.01402±0.00022	0.315±0.009	0.309±0.014 ^{Out}	0.319±0.008
Gl 745A	dM2.0 V	4.930±0.032		8.823±0.008	0.337±0.003	0.316±0.054	0.343±0.004
J19072+208	3526±51	4.96±0.07	-0.23±0.16	0.01390±0.00023	0.316±0.010	0.309±0.014 ^{Out}	0.320±0.008
Gl 745B	dM2.0 V	4.929±0.032		8.833±0.004	0.357±0.004	0.332±0.057	0.359±0.004
J19084+322	3454±51	4.96±0.07	-0.03±0.16	0.01509±0.00015	0.343±0.010	0.338±0.014	0.348±0.008
GJ 4098	dM3.0 V	4.896±0.032		12.467±0.006	0.376±0.004	0.391±0.067	0.379±0.005

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J19098+176 GJ 1232	3259±51 dM4.5 V	5.08±0.07 5.104±0.037	0.02±0.16	0.00415±0.00004 10.262±0.017	0.202±0.006 0.235±0.004	0.189±0.011 0.179±0.031	0.191±0.005 0.211±0.005
J19169+051N GI 752A	3534±51 dM2.5 V	4.90±0.07 4.758±0.031	-0.04±0.16	0.03258±0.00039 5.912±0.002	0.481±0.014 ...	0.484±0.019 0.672±0.115	0.475±0.011 ...
J19216+208 GJ 1235	3059±51 dM4.5 V	5.17±0.07 5.038±0.038	-0.03±0.16	0.00454±0.00007 10.616±0.027	0.240±0.008 0.240±0.002	0.229±0.012 ^{Out} 0.311±0.054	0.195±0.005 0.217±0.002
J19251+283 GJ 4109	3403±51 dM3.0 V	5.00±0.07 4.866±0.263	-0.02±0.16	0.01654±0.00878 16.750±0.014	0.370±0.099 0.400±0.005	0.366±0.105 0.499±0.279	0.374±0.077 0.402±0.005
J19346+045 GI 763	4062±51 sdM0.0 V	4.69±0.07 4.697±0.027	-0.17±0.16	0.07633±0.00054 14.428±0.008	0.558±0.014 0.605±0.004	0.564±0.019 0.556±0.094	0.584±0.015 0.606±0.010
J19511+464 GJ 1243	3278±51 dM4.0 V	5.10±0.07 5.002±0.035	-0.11±0.16	0.00718±0.00011 11.979±0.006	0.263±0.008 0.288±0.005	0.253±0.013 0.317±0.055	0.240±0.006 0.276±0.006
J20260+585 GJ 1253	3189±51 dM5.0 V	5.11±0.07 5.155±0.040	0.05±0.16	0.00290±0.00005 9.586±0.005	0.176±0.006 0.206±0.004	0.162±0.010 0.146±0.026	0.162±0.004 0.177±0.004
J20305+654 GI 793	3471±51 dM2.5 V	4.96±0.07 4.847±0.033	-0.10±0.16	0.01964±0.00050 8.081±0.001	0.387±0.012 0.409±0.004	0.385±0.017 0.500±0.087	0.380±0.009 0.415±0.005
J20336+617 GJ 1254	3372±51 dM4.0 V	4.99±0.07 4.849±0.033	0.12±0.16	0.01732±0.00028 16.008±0.010	0.386±0.012 0.415±0.005	0.383±0.016 0.530±0.092	0.383±0.009 0.416±0.005
J20405+154 GJ 1256	3234±51 dM4.5 V	5.10±0.07 5.109±0.037	0.02±0.16	0.00392±0.00003 9.534±0.008	0.199±0.006 0.234±0.004	0.186±0.011 0.183±0.032	0.191±0.005 0.210±0.004
J20450+444 GI 806	3586±51 dM1.5 V	4.89±0.07 4.819±0.031	-0.15±0.16	0.02562±0.00030 12.048±0.004	0.414±0.012 0.435±0.003	0.413±0.016 0.487±0.083	0.423±0.010 0.444±0.004
J20525-169 LP 816-060	3321±51 dM4.0 V	5.05±0.07 5.036±0.035	-0.02±0.16	0.00638±0.00008 5.614±0.003	0.241±0.008 0.271±0.002	0.231±0.012 0.238±0.041	0.232±0.006 0.254±0.003
J20533+621 GI 809A	3843±51 dM1.0 V	4.71±0.07 4.722±0.029	0.04±0.16	0.05409±0.00089 7.041±0.001	0.524±0.015 0.569±0.007	0.529±0.019 0.515±0.088	0.544±0.014 0.567±0.009
J20556-140S ^{New} GI 810B	3177±51 dM5.0 V	5.13±0.07 5.178±0.040	-0.03±0.16	0.00252±0.00003 12.464±0.014	0.166±0.005 0.192±0.001	0.151±0.010 0.135±0.023	0.145±0.004 0.164±0.002
J20567-104 GI 811.1	3514±51 dM2.5 V	4.91±0.07 4.765±0.031	-0.03±0.16	0.03077±0.00051 16.098±0.018	0.473±0.014 0.487±0.005	0.475±0.019 0.664±0.114	0.469±0.011 0.491±0.005
J21019-063 GI 816	3507±51 dM2.5 V	4.92±0.07 4.774±0.032	-0.08±0.16	0.02917±0.00051 14.463±0.025	0.463±0.014 0.480±0.003	0.464±0.018 0.649±0.112	0.462±0.011 0.485±0.004
J21152+257 GJ 4184	3675±51 dM3.0 V	4.68±0.07 4.725±0.034	0.29±0.16	0.04460±0.00159 26.731±0.036	0.521±0.017 0.572±0.005	0.525±0.022 0.474±0.082	0.543±0.014 0.567±0.007
J21164+025 LSPM J2116+0234	3485±51 dM3.0 V	4.94±0.07 4.803±0.031	-0.08±0.16	0.02466±0.00032 17.640±0.019	0.431±0.013 0.444±0.005	0.430±0.017 0.589±0.101	0.429±0.011 0.450±0.006
J21221+229 TYC 2187-512-1	3705±51 dM1.0 V	4.83±0.07 4.746±0.030	-0.20±0.16	0.04161±0.00066 15.482±0.012	0.495±0.014 0.509±0.004	0.498±0.019 0.604±0.103	0.502±0.013 0.514±0.006
J21348+515 GJ 4205	3497±51 dM3.0 V	4.91±0.07 4.789±0.032	0.00±0.16	0.02681±0.00045 17.615±0.012	0.446±0.014 0.473±0.003	0.447±0.018 0.590±0.102	0.437±0.011 0.478±0.004
J21463+382 LSPM J2146+3813	3307±51 dM4.0 V	5.06±0.07 5.102±0.037	-0.03±0.16	0.00444±0.00005 7.040±0.002	0.203±0.006 0.228±0.002	0.190±0.011 0.172±0.030	0.181±0.004 0.207±0.003
J21466-001 GJ 1263A	3352±51 dM4.0 V	5.03±0.07 4.971±0.034	0.02±0.16	0.00920±0.00011 12.381±0.017	0.284±0.009 0.325±0.003	0.276±0.013 0.316±0.055	0.285±0.007 0.316±0.005
J21466+668 G 264-012	3360±51 dM4.0 V	5.01±0.07 4.944±0.033	0.07±0.16	0.01066±0.00010 16.015±0.010	0.305±0.009 0.334±0.003	0.297±0.013 0.346±0.060	0.294±0.007 0.328±0.004
J22012+283 GJ 4247	3267±51 dM4.0 V	5.12±0.07 4.935±0.035	-0.19±0.16	0.00997±0.00019 9.104±0.005	0.312±0.010 0.334±0.004	0.305±0.014 0.467±0.081	0.292±0.007 0.327±0.005
J22020-194 GI 843	3422±51 dM3.5 V	4.99±0.07 4.911±0.090	-0.04±0.16	0.01352±0.00231 12.500±1.000 ^{Yale}	0.331±0.030 ...	0.325±0.033 0.390±0.095	0.332±0.027 ...
J22021+014 GI 846	3915±51 dM0.5 V	4.69±0.07 4.709±0.032	0.03±0.16	0.06214±0.00201 10.555±0.016	0.542±0.017 0.572±0.005	0.547±0.021 0.524±0.090	0.571±0.014 0.571±0.008
J22057+656 GJ 4258	3653±51 dM1.5 V	4.86±0.07 4.759±0.032	-0.17±0.16	0.03696±0.00091 23.491±0.017	0.480±0.015 0.486±0.004	0.482±0.019 0.609±0.105	0.483±0.012 0.493±0.005
J22096-046 GI 849	3467±51 dM3.5 V	4.94±0.07 4.771±0.032	-0.02±0.16	0.02833±0.00045 8.803±0.004	0.466±0.014 0.483±0.004	0.468±0.019 0.691±0.119	0.465±0.011 0.487±0.005
J22114+409 1RXS J221124.3+410000	3125±51 dM5.5 V	5.15±0.07 5.159±0.040	-0.01±0.16	0.00260±0.00002 12.669±0.013	0.174±0.006 0.208±0.001	0.160±0.010 0.156±0.027	0.156±0.004 0.176±0.002
J22115+184 GI 851	3550±51 dM2.0 V	4.93±0.07 4.696±0.032	-0.13±0.16	0.04466±0.00100 11.725±0.005	0.558±0.017 0.543±0.007	0.565±0.022 0.969±0.167	0.529±0.013 0.542±0.008

Table B.1. Stellar parameters^a for all stars of our sample (continued).

Karmn Name	T_{eff} [K] SpT	$\log g$ $\log g_c$	[Fe/H]	L [L_{\odot}] d [pc]	R [R_{\odot}] R_p [R_{\odot}]	M_{M-R} [M_{\odot}] $M_{\log g}$ [M_{\odot}]	M_{M-K_s} [M_{\odot}] M_P [M_{\odot}]
J22125+085	3501±51	4.92±0.07	-0.04±0.16	0.01910±0.00035	0.376±0.011	0.372±0.016	0.369±0.009
GJ 9773	dM3.0 V	4.859±0.032		15.929±0.025	0.395±0.004	0.428±0.074	0.402±0.005
J22137-176	3236±51	5.09±0.07	0.01±0.16	0.00364±0.00005	0.192±0.006	0.178±0.011	0.172±0.004
GJ 1265	dM4.5 V	5.123±0.038		10.255±0.007	0.220±0.004	0.165±0.029	0.194±0.004
J22231-176	3202±51	5.13±0.07	-0.07±0.16	0.00343±0.00005	0.190±0.006	0.177±0.011	0.176±0.004
GJ 4274	dM4.5 V	5.127±0.039		7.237±0.013	0.222±0.003	0.178±0.031	0.195±0.003
J22252+594	3387±51	4.97±0.07	0.12±0.16	0.01966±0.00027	0.407±0.013	0.406±0.017	0.405±0.010
GJ 4276	dM4.0 V	4.826±0.032		21.349±0.018	0.443±0.005	0.564±0.097	0.445±0.005
J22298+414	3317±51	5.03±0.07	0.10±0.16	0.00752±0.00007	0.262±0.008	0.253±0.012	0.249±0.006
GJ 1270	dM4.0 V	5.003±0.034		14.029±0.024	0.299±0.003	0.269±0.047	0.288±0.007
J22330+093	3669±51	4.86±0.07	-0.20±0.16	0.03475±0.00076	0.461±0.014	0.463±0.018	0.479±0.012
GI 863	dM1.0 V	4.775±0.031		12.982±0.010	0.475±0.004	0.562±0.097	0.483±0.005
J22468+443	3291±51	5.11±0.07	-0.19±0.16	0.01254±0.00016	0.344±0.011	0.339±0.015	0.320±0.008
GI 873	dM3.5 V	4.894±0.033		5.050±0.001	0.369±0.005	0.558±0.097	0.365±0.005
J22503-070	3904±51	4.72±0.07	-0.10±0.16	0.05976±0.00104	0.534±0.015	0.540±0.020	0.557±0.014
GI 875	dM0.5 V	4.715±0.029		14.501±0.011	0.558±0.005	0.546±0.093	0.559±0.008
J22518+317	3404±51	5.02±0.07	-0.12±0.16	0.02610±0.00042	0.464±0.014	0.466±0.019	0.447±0.011
GI 875.1	dM3.0 V	4.772±0.032		15.056±0.016	0.481±0.004	0.824±0.142	0.485±0.005
J22532-142	3377±51	4.99±0.07	0.07±0.16	0.01298±0.00021	0.333±0.010	0.327±0.015	0.338±0.008
GI 876	dM4.0 V	4.908±0.033		4.676±0.002	0.377±0.004	0.395±0.068	0.371±0.004
J22559+178	3834±51	4.70±0.07	0.06±0.16	0.05503±0.00067	0.531±0.015	0.537±0.019	0.556±0.014
GJ 4306	dM1.0 V	4.717±0.028		16.943±0.017	0.565±0.005	0.517±0.088	0.563±0.008
J22565+165	3805±51	4.69±0.07	0.12±0.16	0.05246±0.00096	0.527±0.015	0.532±0.020	0.550±0.014
GI 880	dM1.5 V	4.720±0.029		6.868±0.002	0.585±0.004	0.496±0.085	0.581±0.008
J23216+172	3364±51	5.00±0.07	0.10±0.16	0.01716±0.00030	0.386±0.012	0.383±0.016	0.381±0.009
GJ 4333	dM4.0 V	4.849±0.033		10.565±0.010	0.418±0.005	0.542±0.094	0.418±0.006
J23245+578	3842±51	4.68±0.07	0.14±0.16	0.05440±0.00104	0.526±0.015	0.531±0.020	0.562±0.014
GI 895	dM1.0 V	4.721±0.029		13.233±0.005	0.578±0.007	0.484±0.083	0.574±0.009
J23340+001	3559±51	4.86±0.07	0.00±0.16	0.02588±0.00041	0.423±0.013	0.422±0.017	0.428±0.010
GI 899	dM2.5 V	4.811±0.031		14.011±0.010	0.435±0.005	0.473±0.081	0.444±0.005
J23351-023	3052±51	5.19±0.07	-0.09±0.16	0.00142±0.00002	0.135±0.005	0.118±0.009	0.120±0.003
GJ 1286	dM5.5 V	5.252±0.045		7.178±0.006	0.155±0.001	0.102±0.018	0.125±0.001
J23381-162	3551±51	4.91±0.07	-0.13±0.16	0.02035±0.00037	0.377±0.011	0.373±0.016	0.378±0.009
GJ 4352	dM2.0 V	4.858±0.032		13.148±0.012	0.390±0.003	0.421±0.072	0.400±0.004
J23419+441	3142±51	5.13±0.07	0.02±0.16	0.00220±0.00003	0.158±0.005	0.143±0.010	0.145±0.004
GI 905	dM5.0 V	5.195±0.042		3.155±0.001	0.191±0.001	0.123±0.021	0.159±0.001
J23431+365	3256±51	5.09±0.07	-0.04±0.16	0.00554±0.00008	0.234±0.008	0.223±0.012	0.214±0.005
GJ 1289	dM4.0 V	5.048±0.036		8.354±0.008	...	0.245±0.043	...
J23492+024	3653±51	4.84±0.07	-0.13±0.16	0.02540±0.00043	0.398±0.012	0.396±0.016	0.413±0.010
GI 908	dM1.0 V	4.836±0.031		5.905±0.002	...	0.399±0.068	...
J23505-095	3347±51	5.02±0.07	0.05±0.16	0.01055±0.00020	0.305±0.010	0.298±0.014	0.303±0.008
GJ 4367	dM4.0 V	4.943±0.034		16.958±0.035	...	0.356±0.062	...
J23556-061	3694±51	4.71±0.07	0.18±0.16	0.04459±0.00081	0.515±0.015	0.520±0.020	0.531±0.013
GI 912	dM2.5 V	4.729±0.030		17.813±0.032	0.552±0.003	0.497±0.085	0.549±0.005
J23585+076	3471±51	4.94±0.07	-0.03±0.16	0.02697±0.00073	0.454±0.015	0.455±0.019	0.447±0.011
GJ 4383	dM3.0 V	4.782±0.033		16.434±0.068	...	0.655±0.114	...

Notes. Also available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via <http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/>

^(a) T_{eff} , $\log g$, $\log g_c$, [Fe/H], L , R , R_p , M_{M-R} , $M_{\log g}$, M_{M-K_s} and M_P are determined in this work. Spectral types are from [Alonso-Floriano et al. \(2015\)](#) and references therein. Heliocentric distances are from [Gaia Collaboration et al. \(2018\)](#) except where indicated otherwise: ^(HIP) [van Leeuwen \(2007\)](#); ^(Yale) [van Altena et al. \(1995\)](#); ^(URAT) [Finch & Zacharias \(2016\)](#); ^(CC17) Following [Cortés-Contreras et al. \(2017\)](#).

^(New) New stars not tabulated by [Reiners et al. \(2018b\)](#).

^(Out) Masses of outliers discussed in Section 5.2, to be used with care.

Table B.2. Masses and radii of the eclipsing M dwarf binaries used to derive Eq. 6.

Name	RA (J2000)	Dec (J2000)	SpT ^a	\mathcal{M} [M_{\odot}]	R [R_{\odot}]	Ref.
OGLE-TR-122 B	11 06 51.89	-60 51 45.9	M	0.092±0.009	0.120±0.018	16
WTS 19g-4-02069 B	19 35 03.55	+36 31 16.5	M	0.143±0.006	0.174±0.006	20
LP 837-20 B	05 44 57.93	-24 56 09.7	M	0.179±0.002	0.218±0.011	19
LP 661-13 B	06 56 18.95	-08 35 46.5	M	0.19400±0.00034	0.2174±0.0023	18
Kepler-16 B	19 16 18.18	+51 45 26.8	M	0.1959±0.0031	0.2262±0.00056	4
OGLE-TR-125 B	10 57 51.86	-61 43 58.9	M	0.209±0.033	0.211±0.027	16
KOI-126 C	19 49 54.20	+41 06 51.4	M	0.2127±0.0026	0.2318±0.0013	7
CM Dra B	16 34 20.33	+57 09 44.4	M4.5	0.2141±0.0010	0.2396±0.0015	10
CM Dra A	16 34 20.33	+57 09 44.4	M4.5	0.2310±0.0009	0.2534±0.0019	10
SDSS-MEB-1 B	03 18 23.88	-01 00 18.4	M	0.240±0.022	0.248±0.009	5
KOI-126 B	19 49 54.20	+41 06 51.4	M	0.2413±0.003	0.2543±0.0014	7
LP 837-20 A	05 44 57.93	-24 56 09.7	M	0.244±0.003	0.261±0.009	19
1RXS J154727.5+450803 A	15 47 27.41	+45 07 51.3	M4	0.2576±0.0085	0.2895±0.0068	8
1RXS J154727.5+450803 B	15 47 27.41	+45 07 51.3	M4	0.2585±0.0080	0.2895±0.0068	8
OGLE-TR-5 B	17 51 49.34	-30 01 44.4	M	0.271±0.035	0.263±0.012	15
SDSS-MEB-1 A	03 18 23.88	-01 00 18.4	M	0.272±0.020	0.268±0.010	5
HAT-TR-318-007 B	08 50 32.96	+12 08 23.6	M5	0.2721±0.0042	0.2913±0.0024	24
LSPM J1112+7626 B	11 12 42.34	+76 26 56.4	M	0.2745±0.0012	0.2978±0.0050	1
OGLE-TR-7 B	17 52 08.66	-29 56 12.1	M	0.281±0.029	0.282±0.013	15
LP 661-13 A	06 56 18.95	-08 35 46.5	M3.5	0.30795±0.00084	0.3226±0.0033	18
LP 133-373 A	14 04 08.89	+50 20 38.7	M4	0.340±0.014	0.33±0.02	6
LP 133-373 B	14 04 08.89	+50 20 38.7	M4	0.340±0.014	0.33±0.02	6
OGLE-TR-6 B	17 51 03.07	-29 55 49.8	M	0.359±0.025	0.393±0.018	15
T-Cyg1-12664 B	19 51 39.82	+48 19 55.4	M	0.376±0.017	0.3475±0.0081	17
motess-gnat 2056316 B	23 14 38.16	+03 39 49.4	M3	0.382±0.0023	0.374±0.0035	2
OGLE-TR-18 B	17 54 16.46	-29 43 11.9	M	0.387±0.049	0.390±0.040	15
LSPM J1112+7626 A	11 12 42.34	+76 26 56.4	M4	0.3946±0.0023	0.3860±0.0050	1
CU Cnc B	08 31 37.57	+19 23 39.4	M3.5	0.399±0.0015	0.391±0.0104	12
CU Cnc A	08 31 37.57	+19 23 39.4	M3.5	0.433±0.0017	0.432±0.0052	12
MOTESS-GNAT 646680 B	10 30 55.21	+03 34 26.7	M2	0.443±0.0020	0.427±0.0061	2
HAT-TR-318-007 A	08 50 32.96	+12 08 23.6	M4	0.448±0.001	0.4548±0.0036	24
motess-gnat 2056316 A	23 14 38.16	+03 39 49.4	M2	0.469±0.0023	0.441±0.0035	2
Tres-Her0-07621 B	16 50 20.73	+46 39 01.4	M	0.489±0.003	0.452±0.06	13
MOTESS-GNAT 78457 B	03 26 20.73	+03 12 36.3	M4	0.491±0.0018	0.471±0.0111	2
Tres-Her0-07621 A	16 50 20.73	+46 39 01.4	M	0.493±0.003	0.453±0.06	13
NSVS 01031772 B	13 45 34.87	+79 23 48.3	M	0.498±0.0022	0.509±0.0026	25
MOTESS-GNAT 646680 A	10 30 55.21	+03 34 26.7	M1	0.499±0.0020	0.457±0.0070	2
MOTESS-GNAT 78457 A	03 26 20.73	+03 12 36.3	M3	0.527±0.0018	0.505±0.0111	2
WTS 19g-4-02069 A	19 35 03.55	+36 31 16.5	M3.5	0.530±0.020	0.510±0.010	20
MOTESS-GNAT 116309 B	04 48 09.63	+03 17 48.1	M0	0.531±0.0016	0.532±0.0073	2
MOTESS-GNAT 506664 B	07 43 11.57	+03 16 22.1	M2	0.544±0.0016	0.513±0.0068	2
MOTESS-GNAT 116309 A	04 48 09.63	+03 17 48.1	K8	0.567±0.0015	0.552±0.0102	2
MOTESS-GNAT 506664 A	07 43 11.57	+03 16 22.1	M1	0.584±0.0015	0.560±0.0039	2
V530 Ori B	06 04 33.8	-03 11 52	M1	0.5955±0.0022	0.5873±0.0067	22
YY Gem A	07 34 37.58	+31 52 11.1	M1	0.597±0.0034	0.619±0.0040	11
GU Boo B	15 21 54.82	+33 56 09.1	M1	0.599±0.0044	0.620±0.014	9
YY Gem B	07 34 37.58	+31 52 11.1	M1	0.601±0.0034	0.603±0.0041	11
GU Boo A	15 21 54.82	+33 56 09.1	M1	0.609±0.0050	0.623±0.0112	9
2MASSJ01542930+0053266 B	01 54 29.30	+00 53 26.7	M1	0.62±0.03	0.61±0.09	14
Kepler-16 A	19 16 18.18	+51 45 26.8	K7	0.654±0.017	0.6489±0.0013	4
2MASSJ01542930+0053266 A	01 54 29.30	+00 53 26.7	M0	0.66±0.03	0.64±0.08	14
KIC 6131659 B	19 37 06.97	+41 26 12.8	M	0.685±0.005	0.6395±0.0061	21
ASAS J082552-1622.8 B	08 25 51.61	-16 22 47.4	M0	0.6872±0.0049	0.699±0.013	23
RXJ0239.1-1028 B	02 39 08.75	-10 27 46.4	K7	0.693±0.006	0.703±0.002	3
RXJ0239.1-1028 A	02 39 08.75	-10 27 46.4	K7	0.730±0.009	0.741±0.004	3

Notes. ^(a) The spectral types are the ones listed in SIMBAD or as given in the corresponding reference otherwise.

References. (1) Irwin et al. (2011); (2) Kraus et al. (2011); (3) López-Morales & Shaw (2007); (4) Bender et al. (2012); (5) Blake et al. (2008); (6) Vaccaro et al. (2007); (7) Carter et al. (2011); (8) Hartman et al. (2011); (9) López-Morales & Ribas (2005); (10) Morales et al. (2009); (11) Torres & Ribas (2002); (12) Ribas (2003); (13) Creevey et al. (2005); (14) Becker et al. (2008); (15) Bouchy et al. (2005); (16) Pont et al. (2005); (17) Iglesias-Marzoa et al. (2017); (18) Dittmann et al. (2017); (19) Zhou et al. (2015); (20) Nefs et al. (2013); (21) Bass et al. (2012); (22) Torres et al. (2014); (23) Helminiak & Konacki (2011); (24) Hartman et al. (2018); (25) Lopez-Morales et al. (2006).