SWEET-Cat: A catalogue of parameters for Stars With ExoplanETs*

I. New atmospheric parameters and masses for 48 stars with planets

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ABSTRACT

Context. Due to the importance that the star-planet relation has to our understanding of the planet formation process, the precise determination of stellar parameters for the ever increasing number of discovered extra-solar planets is of great relevance. Furthermore, precise stellar parameters are needed to fully characterize the planet properties. It is thus important to continue the efforts to determine, in the most uniform way possible, the parameters for stars with planets as new discoveries are announced.

Aims. In this paper we present new precise atmospheric parameters for a sample of 48 stars with planets. We then take the opportunity to present a new catalogue of stellar parameters for FGK and M stars with planets detected by radial velocity, transit, and astrometry programs.

Methods. Stellar atmospheric parameters and masses for the 48 stars were derived assuming LTE and using high resolution and high signal-to-noise spectra. The methodology used is based on the measurement of equivalent widths for a list of iron lines and making use of iron ionization and excitation equilibrium principles. For the catalog, and whenever possible, we used parameters derived in previous works published by our team, using well defined methodologies for the derivation of stellar atmospheric parameters. This set of parameters amounts to over 65% of all planet host stars known, including more than 90% of all stars with planets discovered through radial velocity surveys. For the remaining targets, stellar parameters were collected from the literature.

Results. The stellar parameters for the 48 stars are presented and compared with previously determined literature values. For the catalog, we compile values for the effective temperature, surface gravity, metallicity, and stellar mass for (almost) all the planet host stars listed in the Extra-solar Planets Encyclopaedia. This data will be updated on a continuous basis. The compiled catalogue is available online. The data can be used for statistical studies of the star-planet correlation, as well as for the derivation of consistent properties for known planets.

Key words. planetary systems – Stars: solar-type – Stars: abundances – Catalogs

1. Introduction

The study of extrasolar planetary systems is steadily becoming a mature field of research. To date, over 850 extra-solar planets have been discovered around solar-type stars¹. Most of these were found thanks to the incredible precision achieved by today’s radial velocity and photometric transit techniques. On top of the dozens of giant planets detected, these efforts are adding to the lists the first planets that may be rocky in nature like our Earth (e.g. Léger et al. 2009; Batalha et al. 2011; Dumusque et al. 2012). To these we should add a plethora of additional candidates announced as part of space based transit surveys like Kepler (Batalha et al. 2013). Overall, these discoveries are showing that planets are ubiquitous around solar-type stars (e.g. Mayor et al. 2011; Howard et al. 2012).

The strong increase in the number of known planetary systems is allowing astronomers to analyze in a statistically significant way the properties of the newfound worlds (see e.g. Udry & Santos 2007). In addition, a combination of different techniques and methods is also giving the possibility to explore the planetary properties, including the study of their atmospheres and internal structure (e.g. Valencia et al. 2010; Cowan & Agol 2011; Demory et al. 2012).

A key aspect in all this progress is the characterization of the planet host stars. Several reasons exist for that. For instance, precise (or if possible, accurate) stellar radii are critical if we want to measure precise values for the radius of a transiting planet (see e.g. Torres et al. 2012). The determination of stellar radii depends, on its hand, on the quality of the derived stellar parameters such as the effective temperature.

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¹ For an updated table we point to http://www.exoplanet.eu
The chemical composition of a planet, both its interior and atmosphere, is also likely to be related to the chemical composition of the proto-stellar cloud, reflected on the composition of the stellar atmosphere (Guillot et al. 2006; Fortney et al. 2007; Bond et al. 2010). The precise derivation of stellar chemical abundances thus gives us important clues to understand the planets and their observed properties.

Further to this, a number of studies have pointed towards the existence of a strong relation between the properties and frequency of the newfound planets and those of their host stars. In this respect, the well known correlation between the stellar metallicity and the frequency of giant planets is a good example. Large spectroscopic studies (e.g. Santos et al. 2001, 2004b; Fischer & Valenti 2005; Sousa et al. 2011b; Mayor et al. 2011; Mortier et al. 2013a) confirmed the initial suspicions (González 1997; Santos et al. 2000a) of a positive correlation between the probability of finding a giant planet and the metal content of the stars. This strong correlation even prompted new planet search surveys based on metal-rich samples (e.g. Tinney et al. 2003; Fischer et al. 2004; Da Silva et al. 2006). Although positively increasing the planet detection rate, these surveys biased the samples towards metal-rich stars, a bias that has to be taken into account when studying the metallicity-planet correlation.

Curiously, this strong metallicity-giant planet correlation was not found for the lowest mass planets (Sousa et al. 2011b; Mayor et al. 2011; Buchhave et al. 2012). Both results, however, are in full agreement with the expectations from the most recent models of planet formation based on the core-accretion paradigm (e.g. Mordasini et al. 2012, and discussion therein).

Although the general metallicity-giant planet correlation is reasonably well established, many details are still missing that may hold the clue to new and important details concerning planet formation. For example, the exact shape of the metallicity-planet correlation is still debated (Santos et al. 2004b; Johnson et al. 2010; Mortier et al. 2013a). The understanding of this issue may be critical to point out the mechanisms responsible for the formation of giant planets across the whole metallicity range (e.g. Matsumoto et al. 2007), or to the understanding of the frequency of planets in the Milky Way. The role of the abundances of other elements is also being discussed (e.g. Adibekyan et al. 2012a), with some curious trends being a strong matter of debate, concerning e.g. the abundances of the light element lithium (Israelian et al. 2009; Baumann et al. 2010; Sousa et al. 2010; Ghezzi et al. 2010b) or specific trends including other elemental abundances (e.g. Ramírez et al. 2010; González Hernández et al. 2010).

Similar to the stellar metallicity, stellar mass has also been pointed out to play a role in the formation of giant planets. It is now widely accepted that the frequency of giant planets orbiting (lower mass) M-dwarfs is considerably lower than the one found for FGK dwarfs (Bonfils et al. 2005b, 2011; Endl et al. 2006), at least regarding the short period domain (Neves et al. 2013). Higher mass stars, on the other hand, seem to have a higher frequency of orbiting giant planets (Lovis & Mayor 2007; Johnson et al. 2007a). This result is expected from the models of planetary formation following the core-accretion paradigm (Laughlin et al. 2004; Ida & Lin 2005; Kennedy & Kenyon 2008) – see however Korhonen et al. (2005); Boss (2006). Note that this correlation may be related to the different trend in stellar metallicity that has been suggested to exist for intermediate mass giant stars with planets (Pasquini et al. 2007; Ghezzi et al. 2010a; Hekker & Meléndez 2007).

Finally, it is important to note that the role of stellar properties (metallicity, temperature) on the formation of different architectures of planetary systems has also been addressed. Among these, suspicions have been raised concerning the metallicity-orbital period relation (e.g. Queloz et al. 2000; Sozzetti 2004; Santos et al. 2003; Beaugé & Nesvorný 2013; Dawson & Murray-Clay 2013), with hot-jupiters being often pointed out as orbiting particularly metal-rich stars (note however that this trend has not been confirmed from a statistical point of view). More recently, the temperature and age of the star was shown present a correlation with the alignment of the stellar spin-orbital plane angle (Winn et al. 2010; Triaud 2011; Albrecht et al. 2012), a result that hints at the mechanisms responsible for the migration of hot jupiters.

 Paramount to the discussion of all these issues is the correct determination of stellar parameters like the effective temperature, the stellar metallicity, and the stellar mass. Since accurate values for these are usually not possible$^2$, it is critical that at least uniform sets of stellar parameters exist. Unfortunately this is not always the case, with different teams making use of different methods (line-lists, model atmospheres, methodologies) to derive the atmospheric properties of the host stars. In many cases, comparisons have shown that the differences are residual (see e.g. Sousa et al. 2008), but in other cases the discrepancies have significant impact on the knowledge of the planet parameters (for a recent discussion on the possible offsets see Torres et al. 2012).

In this paper we present new atmospheric parameters and masses for a sample of 48 stars with planets. The atmospheric parameters were derived in LTE from a uniform analysis, and making use of high resolution and high S/N spectra. These values are then included in a new catalog of stellar parameters for stars with planets (that we name SWEET-Cat), also presented in this paper. The catalogue, available online, represents an effort to compile a set of data that is usually spread in the literature. The baseline parameters in the catalog are also compared with the ones listed in other compilations or catalogs. This comparison provides to the reader (in particular the exoplanet community) the possibility to understand the typical errors (including systematic) that exist in the values of parameters for stars with planets published in the literature.

In the next sections we present the sample of 48 stars discussed in this paper and their stellar parameters. We then present the content of the catalogue, the different sources of stellar parameters used, and some considerations about future improvements.

2. New parameters for 48 planet hosts

The sample of 48 stars consists of dwarfs of spectral type F, G, or K that are known to be orbited by a planet found by the radial velocity method (according to the online catalogue www.exoplanet.eu). The list of stars is presented in Table 1.

As mentioned above, the parameters were derived from the analysis of high resolution and high S/N spectra. The spectra were gathered through observations, made by our team, and by the use of the ESO archive. In total, six different spectrographs were used: FEROS (2.2m ESO/MIPI telescope, La Silla, Chile), FIES (Nordic Optical Telescope, La Palma, Spain), HARPS (3.6m ESO telescope, La Silla, Chile), SARG (TN telescope, La Palma, Spain), SOPHIE (1.93m telescope, OHP, France), and UVES (VLT Kueyen telescope, Paranal, Chile). The characteris-

$^2$ Possible but debatable exceptions for accurate effective temperature determinations may be solar-type dwarfs with accurate parallaxes and interferometric or asteroseismic radii.
The spectra were reduced and extracted using the available pipelines or IRAF\(^3\). The spectra were then corrected for radial velocity with the IRAF task DopCor. Individual exposures of multiple observed stars with the same instrument, were co-added using the task SCOMBINE in IRAF.

Note that the use of different spectrographs is not expected to introduce significant systematic differences in the derived stellar parameters, as can be seen from previous studies (e.g. Santos et al. 2004b).

\(^3\) IRAF is distributed by National Optical Astronomy Observatories, operated by the Association of Universities for Research in Astronomy, Inc., under contract with the National Science Foundation, USA.
The determination of accurate stellar atmospheric parameters is a huge matter of debate. Several methodologies have been explored, each with its own merits and drawbacks. The choice of method depends on the specific requirements of the study, such as the desired level of accuracy, the range of stellar parameters to be measured, and the availability of observational data.

The complete list of the fields in the catalogue is listed in Table 3. A more detailed description of each field is given in the following sub-sections.

3.1. Identification and basic data

At the time that this paper is being written, the Extra-Solar Planets Encyclopaedia lists 889 planets in 694 planetary systems, most of them discovered by radial velocity or transit surveys. Due to its completeness and tradition, we decided to use this database as a starting point for the catalogue.

For each planet host star listed in the Encyclopaedia as being detected by radial velocity, astrometry, or transit measurements, we compiled a series of basic information. In this first version of the catalogue we decided to exclude direct imaging planets (most of them around early type stars), planets discovered using the microlensing technique (due to the difficulty in characterizing the host stars), as well as degenerated stars (e.g. pulsars hosting planetary systems detected by timing techniques). For the remaining stars (i.e. those listed in the Encyclopaedia as radial velocity, transiting or astrometry planet hosts), we compiled the following basic information.

- Name of the star: although we adopted the Encyclopaedia name, for all cases where the star has an HD number, this is also listed;
- Coordinates: right ascensions and declinations were compiled from Simbad whenever possible. Exceptions where no V magnitudes were listed in Simbad (for some Kepler and WASP candidates mostly) were taken directly from the Encyclopaedia. The V magnitudes are meant to serve as reference, and not to be used for accurate physical calculations;
- Parallax values were compiled from Simbad whenever these exist. For cases where the parallax is not available, we computed a “spectroscopic parallax” using the estimated stellar parameters (for details on the method we point to Sousa et al. 2011a). For M-dwarfs, a few parallaxes were also taken from the literature.

3.2. Atmospheric parameters and masses

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Parameters for stars with planets should probably focus, when- of stellar parameters. As a consequence, any catalogue of stellar line sources for the stellar parameters. Note however that the accuracy.

ever possible, on uniformity, i.e. on precision rather than accu-
In the next sections we will describe the baseline methods used to derive what we will call baseline stellar parameters, including the values for the 48 stars presented above. We also present comparisons of our baseline parameters with those presented in other catalogs and the literature. These comparisons provide a reference for the typical systematic errors existing in the stellar parameters for stars with planets derived by different teams using different, or even sometimes similar methodologies.

3.2.1. FGK stars from radial velocity surveys

The most productive radial velocity planet search surveys concentrated their efforts on the search for planets around solar-type, FGK dwarfs or sub-giants (for some examples see e.g. Udry et al. 2000; Mayor et al. 2003; Marcy et al. 2005; Johnson et al. 2007b). Further to this, and due to astrophysical constraints imposed by active young stars, most of these targets are old, slow rotators (Saar & Donahue 1997; Santos et al. 2000b; Paulson et al. 2002), with thousands of well defined weak metallic lines in their spectra. This makes them ideal targets for a standard spectroscopic analysis using iron line equivalent widths and ionization and excitation equilibrium principles (we point to Santos et al. 2004b; Sousa et al. 2008; Tsantaki et al. 2013, for details on the methodology).

For more than 10 years our team has been obtaining and compiling high resolution spectra to derive uniformly stellar parameters and chemical abundances for stars with planetary mass companions discovered by radial velocity surveys (e.g. Santos et al. 2001, 2004b, 2005; Sousa et al. 2008, 2011b,a; Tsantaki et al. 2013). This lead us to use our own parameters to establish the baseline for the whole catalogue. Note that in several cases, the parameters derived by our team have not been published in "dedicated" papers, but have rather been included in the discovery papers (for recent examples see Boisse et al. 2012; Marmier et al. 2012).

The choice of this baseline methodology for the derivation of stellar parameters is anchored on the extremely good agreement with the values found by methods that are usually considered to be “standard”. For instance, the temperatures are in very good agreement with those derived using the Infra-Red Flux Method (IRFM – see e.g. Blackwell & Shallis 1977; Casagrande et al. 2010, and references therein) and interferometry, both at the low (Tsantaki et al. 2013) and high temperature (Sousa et al. 2008) regimes. This result can be seen in Fig. 4, where baseline temperature values are compared with those derived using the IRFM and interferometry. The differences between the different methods are very small, with an offset of –32 and 34 K, for the comparison with the IRFM and interferometry results, respectively (differences are in the sense “other”–“ours”). These offsets are mostly independent of the temperature, and cannot be directly attributed to any of the methods used. For more details see Tsantaki et al. (2013) and references therein.
Table 4. Coefficients, residual standard deviation, and number of stars used for the linear regressions of the form $x_{\text{other}} = a x_{\text{thispaper}} + b$ presented in the plots of Figs.1, 2, and 6.

| Quantity  | a       | b       | RMS     | N  |
|-----------|---------|---------|---------|----|
| [Fe/H] exoplanet.eu | 0.908±0.023 | 0.056±0.005 | 0.085 | 277 |
| $T_{\text{eff}}$ | 0.896±0.015 | 544±85 | 127 | 268 |
| $M_*$ | 0.997±0.064 | 0.040±0.074 | 0.308 | 278 |

| Quantity  | a       | b       | RMS     | N  |
|-----------|---------|---------|---------|----|
| [Fe/H] exoplanets.org | 0.943±0.021 | 0.006±0.004 | 0.072 | 245 |
| $T_{\text{eff}}$ | 0.909±0.010 | 498±54 | 72 | 240 |
| $\log g$ | 0.995±0.002 | 0.042±0.103 | 0.18 | 238 |
| $M_*$ | 1.000±0.056 | 0.026±0.062 | 0.22 | 245 |

| NASA Exoplanet Archive | $T_{\text{eff}}$ | 0.884±0.018 | 583±103 | 109 | 97 |
| $M_*$ | 1.073±0.041 | −0.067±0.039 | 0.14 | 96 |

| Quantity  | a       | b       | RMS     | N  |
|-----------|---------|---------|---------|----|
| [Fe/H] TEPCat | 1.033±0.130 | −0.053±0.027 | 0.13 | 39 |
| $T_{\text{eff}}$ | 0.845±0.029 | 852±168 | 106 | 39 |
| $M_*$ | 0.858±0.062 | 0.154±0.068 | 0.08 | 39 |

Fig. 3. Same as Fig.1 but for the data from the NASA Exoplanet Archive. Transiting planets and radial-velocity planets are denoted by crosses and dots, respectively.

To keep uniformity, for all FGK dwarfs with baseline atmospheric parameters, stellar masses have been derived using a uniform method. For simplicity, we computed them with the calibration of Torres et al. (2010), using as input our spectroscopic parameters. A small correction was however applied, as follows.

Fig. 4. Comparison of the effective temperatures derived using the baseline methodology in the catalogue with values derived using the IRFM and interferometry. As in Tsantaki et al. (2013).

The values derived using this calibration are in general similar to the ones obtained using the web interface based on Padova isochrones (da Silva et al. 2006) – Fig. 5. However, a general offset is present that is a function of stellar mass. This offset was already discussed in Torres et al. (2010). In order to correct for this offset, we fitted a quadratic function to the plot in Fig. 5:

$$M_{\text{iso}} = 0.791 \times M_T^2 - 0.575 \times M_T + 0.701$$

(1)

where $M_{\text{iso}}$ and $M_T$ denote the stellar masses derived using the Padova isochrones and the Torres et al. calibration, respectively. This equation was used to correct for the mass values listed in the catalogue.

Errors in the stellar mass were also computed using the “corrected” Torres et al. calibration. The values were derived by means of a Monte Carlo analysis, where in each case 10 000 random values of effective temperature, surface gravity, and stellar metallicity were drawn assuming a gaussian distribution from the derived uncertainties. The resulting mass distribution is used

8 http://stev.oapd.inaf.it/cgi-bin/param
to derive the central value (the mass) and the 1-sigma uncertainty. The intrinsic error in the Torres et al. calibration was also quadratically added to the final uncertainty.

In Figs. 1, 2, and 3 we compare our baseline parameters for stars detected in the context of radial velocity surveys with those listed in the Extrasolar Planets Encyclopaedia (Schneider et al. 2011), exoplanets.org (Wright et al. 2011), and the NASA Exoplanet Archive9. As mentioned above, green triangles denote the parameters for the 48 stars presented in this paper. The general trends show a good agreement, though some systematic effects are present. In Table 4 we present the coefficients of the linear fits to the data. These may be used to correct for the systematic trends. Due to the small number of points available, no fit was done for the comparison of metallicities with the data from the NASA Exoplanet Archive (this archive only has metallicities for a minority of the stars listed). Note also that several important outliers appear in the plots. This shows the need for a careful and uniform derivation of stellar parameters in any case-by-case analysis of stars with planets. Finally, note that in several cases the parameters listed in the former two catalogs mentioned above were taken from our own sources, a fact that contributes to the improvement of the agreement seen in the plots.

As mentioned above, for FGK dwarfs which do not have “baseline” spectroscopic parameters, stellar parameters were compiled from the literature. Whenever possible, we used sources for which the stellar parameters compare well with our own values (e.g., the SPOCS catalogue Valenti & Fischer 2005) – see Sousa et al. (2008) for a comparison.

3.2.2. FGK stars with transiting planets

For all FGK stars with transiting planets for which we could obtain a high resolution spectrum, atmospheric parameters and masses were derived using the same methodology described in the previous section. As before, most of these parameters have already been published in dedicated papers (e.g. Santos et al. 2006; Ammler-von Eiff et al. 2009, – see also Mortier et al. 2013, in prep.) or in planet discovery papers where the spectroscopic analysis was done by our team (see Santerne et al. 2012, for a recent example). This guarantees the best possible uniformity of the results.

For stars with transiting planets, surface gravities were also derived using the information coming from the transit light curves. Indeed, surface gravities are typically very difficult to determine accurately through spectroscopy. For stars with a transiting planet, however, the surface gravity can be determined more directly. Purely from transit photometry, the stellar density can be calculated from Seager & Mallén-Ornelas (2003):

$$\rho_* + k^3 \rho_p = \frac{3\pi}{G \rho_*^2} \left( \frac{a}{R_*} \right)^3$$

Since the constant coefficient $k$ is usually small, the second term on the left is negligible. All parameters on the right come directly from the transit light curve (in the present paper these were taken directly from transit analysis papers in the literature). With this stellar density, combined with the effective temperature and metallicity from the spectroscopic analysis, the surface gravity can be determined through isochrone fitting (see e.g. Sozzetti et al. 2007). As mentioned in Mortier et al. (2013, in prep.), for this step, we used the PARSEC isochrones (Bressan et al. 2012) and a $\chi^2$ minimization process for the fitting.

The temperatures and metallicities derived using the ionization and excitation equilibrium of iron lines have shown to be mostly independent of the adopted surface gravity (Torres et al. 2012). This is due to the relatively low sensitivity of FeI lines (used to constrain the temperature and metallicity) to changes in log g. For example, if we derive the effective temperature and metallicity for the Sun using the adopted methodology and line-lists but fixing log g to 3.0 (a strong ~1.5 dex difference), the derived effective temperature and metallicity values are only ~250 K and ~0.10 dex higher, respectively, than the adopted solar values. As such, the temperatures and metallicities derived with our adopted spectroscopic method can be used as reference values even if the derived spectroscopic surface gravities differ from those derived using the transit light curve (and the stellar density – Sozzetti et al. 2007). A more detailed discussion about this issue will be presented in Mortier et al. (in prep.).

As mentioned above, the effective temperatures derived by the adopted methodology are in very good agreement with those derived by the IRFM. This implies that the stellar radii that we can derive using these parameters are probably as accurate as one can guarantee.

In Fig. 6 we compare our baseline parameters for FGK stars with transiting planets with those presented in the “homogeneous table” of the TEPCat catalogue (Southworth 2012)10. On the log g plot (lower right), crosses denote a comparison with our surface gravities derived using the transit light curve, while dots denote a comparison with our purely spectroscopic values. X-axis error bars refer to the typical spectroscopic uncertainties. Due to the very good agreement, we decided not to present any fit for the log g comparison. For all parameters compared, the results show again a good agreement. There is, however, a small offset on the metallicities between the two samples, and perhaps more important, a general trend on the temperature scales. This temperature scale difference may conduct to the derivation of

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9 http://exoplanetarchive.ipac.caltech.edu/

10 http://www.astro.keele.ac.uk/jkt/tepcat
significant different values for the planetary radii (in particular for the higher temperature stars). The dispersion in the log\(g\) comparison denoted the higher errors present in the pure spectroscopic analysis.

Whenever we did not have access to a high resolution spectrum (mostly for the cases of planets detected as part of the Kepler and WASP surveys), priority was given to studies and compilations such as the TEPCat catalogue (Southworth 2012; for transiting planets). For the remaining stars, planet discovery papers were often used as the source for the stellar parameters. In some cases, the methodologies used are similar to the ones adopted for the majority of the stars in our catalogue.

### 3.2.3. Giant and evolved stars

The determination of stellar parameters for cool, giant stars is a matter of strong debate in the literature, with several authors raising doubts about the zero point of the metallicity scale in these objects (e.g. Taylor & Croxall 2005; Cohen et al. 2008; Santos et al. 2009, 2012). Although the exact reasons are still not clear, these problems may have even lead to a significant discrepancy in studies done by different authors concerning the metallicity-giant planet correlation in giants (see debate in Pasquini et al. 2007; Hekker & Meléndez 2007; Ghezzi et al. 2010a).

To guarantee the maximum homogeneity degree in the parameter scale used in the present paper, we decided to adopt as baseline the recent study by Mortier et al. (2013, in prep.) where the parameters for 71 evolved stars with planets were derived using the same iron line ionization and excitation equilibrium method used for the study of FGK dwarfs. For the remaining stars, values were compiled from the literature, both from the discovery papers or from other compilations/catalogs (e.g. Luck & Heiter 2007; Soubiran et al. 2010).

Finally, since the mass calibration presented in Torres et al. (2010) is not valid for giant stars, the masses for all stars with log\(g\) values lower than \(\sim 4.0\) were derived using the Padova isochrones (da Silva et al. 2006).

#### 3.2.4. M-dwarfs

The derivation of M-dwarf atmospheric parameters is a challenging task. Due to the difficulty in deriving precise values for the effective temperature and metallicity based on spectral fitting procedures (e.g. Valenti et al. 1998; Wolff & Wallerstein 2005; Bean et al. 2006; Onehag et al. 2012), most determinations of their values are based on calibrations using colors (Bonfils et al. 2005a; Johnson & Appes 2009; Casagrande et al. 2008; Slawson & Laughlin 2010; Neves et al. 2012) or spectroscopic indices (e.g. Terrien et al. 2012; Rojas-Ayala et al. 2012; Mann et al. 2013; Neves et al. 2013).

For consistency reasons, in this paper we used the photometric calibration of Neves et al. (2012) as our baseline to measure the metallicity. In the case where HARPS spectra were available, however, the parameters were derived using the new Neves et al. (2013) spectroscopic calibration. Both Neves et al. (2012) and Neves et al. (2013) calibrations use the same metallicity scale, assuring thus uniformity in the results. The [Fe/H] uncertainties of the two calibrations are assumed to be 0.20 and 0.10 dex, respectively. The metallicity scale used compares very well with other estimates from the literature (see e.g. Neves et al. 2012).

Effective temperatures for all the stars in this paper, except for the case of the Kepler stars (see below), were derived using the calibrations based on the V–J, V–H, and V–K colors presented in Casagrande et al. (2008). These are based on the MOITE method which is an optical extension of the IRFM (Blackwell & Shallis 1977). For the cases where HARPS spectra were available, the spectroscopic calibration of Neves et al. (2013) was used instead. This calibration used the Casagrande parameters as baseline, meaning that all values are on the same scale and have the same accuracy. The uncertainty in \(T_{\text{eff}}\) for the Casagrande et al. (2008) was computed by adding the propagation of the errors of the V and infrared photometry (Skrutskie et al. 2006) taken to calculate the calibrations with the estimated
error of the calibration (150 K). We assume an error of 150K for the Neves et al. (2013) relation.

The stellar masses were derived using the K-band empirical calibration of Delfosse et al. (2000). Mass uncertainties are estimated to be 10%. The surface gravities were derived using Newton’s law from the mass and the radius derived using the empirical relations of Boyajian et al. (2012). We estimate a 10% uncertainty for the radii measurements. The uncertainties of the surface gravity are calculated by propagating the errors of the mass and radius. As for the remaining stars, parallaxes were taken from Simbad, except when otherwise mentioned.

Given the differences in the methodologies used to derive stellar parameters for FGK stars (see above) and those used here for M-dwarfs, for M-dwarfs we cannot guarantee that the parameters derived are on the same scale as those derived for the FGK dwarfs. However, our choice gives us some confidence that the values for their parameters are homogeneous between themselves.

In Fig. 7 we compare the metallicity and effective temperature values derived using the methodology described above with those presented by other authors or derived using other calibrations. As denoted in the insets, different symbols denote different sources: Casagrande et al. (2008, C08), Rojas-Ayala et al. (2012, RA12), Boyajian et al. (2012, BOY12) concerning the effective temperatures, and Bonfils et al. (2005a, B05), Schlaufman & Laughlin (2010, SL10), Önehag et al. (2012, O12), Terrien et al. (2012, T12), and Rojas-Ayala et al. (2012, RA12) concerning metallicities. The results show that in general, and on average, the values used in this catalog are reasonably well correlated with those derived in the literature (or derived using specific calibrations). The major difference concerns the effective temperatures, for which our values agree very well with the ones derived using the Casagrande et al. (2008) IRFM calibration, but present a significant offset with respect to other literature values, specially for the lower temperature stars. The agreement with the Casagrande et al. determinations come with no surprise, since our temperature scale was calibrated using their values as reference. In Table 5 we list the average offsets between the different sets of data as well as the number of stars used for the comparison shown in Fig. 7. All values denote the differences in the sense “literature” − “this work”.

For Kepler M-stars, due to the difficulty in gathering either high resolution spectra or reliable photometry, we opted to take the parameters from the TEPCAT catalogue (Southworth 2012), directly from the discovery papers, or from updated papers from the Kepler team.

3.2.5 General comments and the online catalogue

In Fig. 8 we plot the distribution of effective temperatures, metallicities, surface gravities, and masses that are listed in our catalogue. Besides the whole distribution, we also plot the histogram for the sample of FGK stars with derived baseline stellar parameters, as well as the subsample of FGK stars with planets discovered using the radial velocity method.

The complete table with compiled stellar parameters for planet host stars is available online at https://www.astro.up.pt/resources/sweet-cat. Besides the html version, the reader can download an ascii file with all the fields. Improvements on this online table will be done on a continuous basis.

4. Conclusions

In this paper we present new spectroscopic atmospheric parameters and masses for a sample of 48 stars with planets discovered in the context of different radial velocity planet search programs.

These parameters are then included in a new catalogue of stellar parameters for FGK and M stars with planets. The stellar parameters in this catalog are compiled from literature sources.
in a way that optimizes the uniformity of the values, making them more suitable for statistical studies of stars with planets. The catalogue will be updated as new planet hosts appear in the literature. We will also continue our effort to determine on a regular basis uniform stellar parameters from high resolution and high S/N spectra. New parameter values may be added to the catalog even before a paper is published to present them.

At the time this paper is being published, the parameters listed in the catalogue come from literature sources, both published or to be published soon. Without all these studies the present compilation would not have been possible. Although we do not encourage, we understand that for simplicity the user may wish to cite only the present paper if using the catalogue in a statistical way. We strongly suggest, however, that in studies of individual stars the original source of the parameters is also cited.

In its present form, the catalogue presents, besides basic parameters, a compilation of atmospheric parameters and masses for all planet host stars known. In the future the catalogue may be expanded to add additional stellar parameters of interest, such as the projected rotational velocity ($v \sin i$), the rotational period, and the chromospheric activity level ($\log R'_{HK}$). Furthermore, we are considering to compile also chemical abundances for elements other than iron as long as uniform sources exist (e.g. Adibekyan et al. 2012b).

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Fig. 8. Histograms with the distributions of different stellar parameters in our catalogue.
\[ \text{rms} = 0.11 \text{ dex} \]
\[ \text{offset} = 0.04 \text{ dex} \]
Teff (This work)

Teff (Others)

rms = 228 K
offset = 159 K