Kepler Stellar Properties Catalog Update for Q1-Q17 Transit Search

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1. Introduction

Huber et al. (2014) presented revised stellar properties for 196,468 Kepler targets that were used for the Q1-Q16 transit search using SOC 9.1 TPS/DV (Tenenbaum et al. 2014). The catalog was based on atmospheric properties (i.e., temperature T_{eff}, surface gravity log(g), and metallicity [Fe/H]) published in the literature using a variety of methods (asteroseismology, spectroscopy, exoplanet transits, photometry), which were then homogeneously fitted to a grid of Dartmouth (DSEP) isochrones (Dotter et al. 2008).

Here we describe updates to the Q1-Q16 catalog based on the latest classifications of Kepler targets in the literature. The methodology follows Huber et al. (2014), which remains the primary reference for the Kepler stellar properties catalog hosted at the NASA Exoplanet Archive. This update to the catalog was developed to support the Q1-Q17 transit search using SOC 9.2 TPS/DV (Seader et al. 2015).

2. Catalog Updates

Table 1 summarizes the literature inputs for this catalog update. The inputs can be summarized in two groups: high-resolution spectroscopy of planet host stars (dwarfs and subgiants, log g > 3.5), and high-resolution spectroscopy, as well as Stromgren photometry of giants (log g < 3.5).

Input values were prioritized as follows: published values for confirmed systems were given highest priority, followed by the catalogs of Buchhave et al. (2014), Rowe et al. (2014) and Petigura et al. (2013) for F-mid K dwarfs and subgiants (> 4300K). For late K and M dwarf host stars (< 4300K), temperatures and metallicities by Mann et al. (2013a,b) were adopted when available, which replace the values by Muirhead et al. (2012) in the Q1-Q16 catalog. For giants, Stromgren classifications by Casagrande et al. (2014) were prioritized over APOGEE. To bring the APOGEE temperatures onto a common scale with the Stromgren survey and the remaining catalog, we adopted the photometric temperatures based on the González Hernández & Bonifacio (2009) calibration for the APOGEE sample (see Pinsonneault et al. 2014 for details). Note that Petigura et al. (2013) do not provide metallicities, and hence solar metallicity was assumed for all targets adopted from this study. Classifications of confirmed planet hosts in the Q1-Q16 catalog were not replaced in this update.

Input values were fitted to DSEP isochrones using typical uncertainties according to Table 2 of Huber et al. (2014) to derive interior properties (Figure 1). Giants in the catalogs by Casagrande et al. (2014) and Pinsonneault et al. (2014) were not fitted since the published values are based on grids which include He-core burning models. Since the lack of such models in the currently adopted DSEP grid would cause biases in masses and radii of giants (Huber et al. 2014), the published values by Casagrande et al. (2014) and Pinsonneault et al. (2014) were adopted for the catalog. We emphasize that this introduces significant inhomogeneity for giants, which should be kept in mind when using the catalog.

Figure 2 compares DSEP radii and masses to published values by Buchhave et al. (2014), Petigura et al. (2013), Rowe et al. (2014) and Mann et al. (2013a). For F-G dwarfs, DSEP values are on average smaller by 5% in mass, while for early K dwarfs both radii and masses are systematically larger. Similar trends have already been found in the Q1-Q16 catalog, and are likely due to systematic differences between Yonsei-Yale models and DSEP models. For late K and M dwarfs, radii and masses are lower by 10% compared to the values by Mann et al. (2013a). These differences are due to well-known discrepancies between interior models and empirical radii from long-baseline interferometry, which do not include a metallicity dependence (Boyajian et al. 2012). In summary, the differences in Figure 2 are indicative of potential model-dependent systematic errors for stellar radii and masses, which should be taken into account when using the catalog.

We note that the uncertainties on stellar properties for all targets used in Q1-Q16 TPS/DV were updated to be consistent with the uncertainties listed in Huber et al. (2014), which are based on the largest difference of the best-fit value to the lower or upper limit of the closest one-sigma interval around the best fit. See Section 6.2 and the final paragraph of Section 6.5 in Huber et al. (2014) for a discussion of these differences.

# of Stars	P_{Teff}	P_{logg}	$P_{[Fe/H]}$	$P_{M,R,rho}$	Reference
1784	PHO55	AST55	SPE55	MULT55	Pinsonneault et al. (2014)
969	PHO56	AST56	PHO56	MULT56	Casagrande et al. (2014)
130	SPE57	SPE57	SPE57	DSEP	Petigura et al. (2013)
143	SPE58	SPE58	SPE58	DSEP	Rowe et al. (2014)
315	SPE59	SPE59	SPE59	DSEP	Buchhave et al. (2014)
96	SPE60	SPE60	SPE60	DSEP	Mann et al. (2013a,b)
11	SPE61	SPE61	SPE61	DSEP	Marcy et al. (2014)
1	SPE62	SPE62	SPE62	DSEP	Borucki et al. (2013)
1	SPE63	SPE63	SPE63	DSEP	Sanchis-Ojeda et al. (2013)
1	SPE64	TRA64	SPE64	DSEP	Gandolfi et al. (2013)
1	SPE65	TRA65	SPE65	DSEP	Ofir et al. (2014)
1	SPE66	TRA66	SPE66	DSEP	Deleuil et al. (2014)
1	SPE67	SPE67	SPE67	DSEP	Tingley et al. (2014)

Table 1: The column header P_x gives the provenance for input parameter x, which is coupled to a number denoting the reference from which the input values were adopted. See Section 6.5 in Huber et al. (2014) for details.

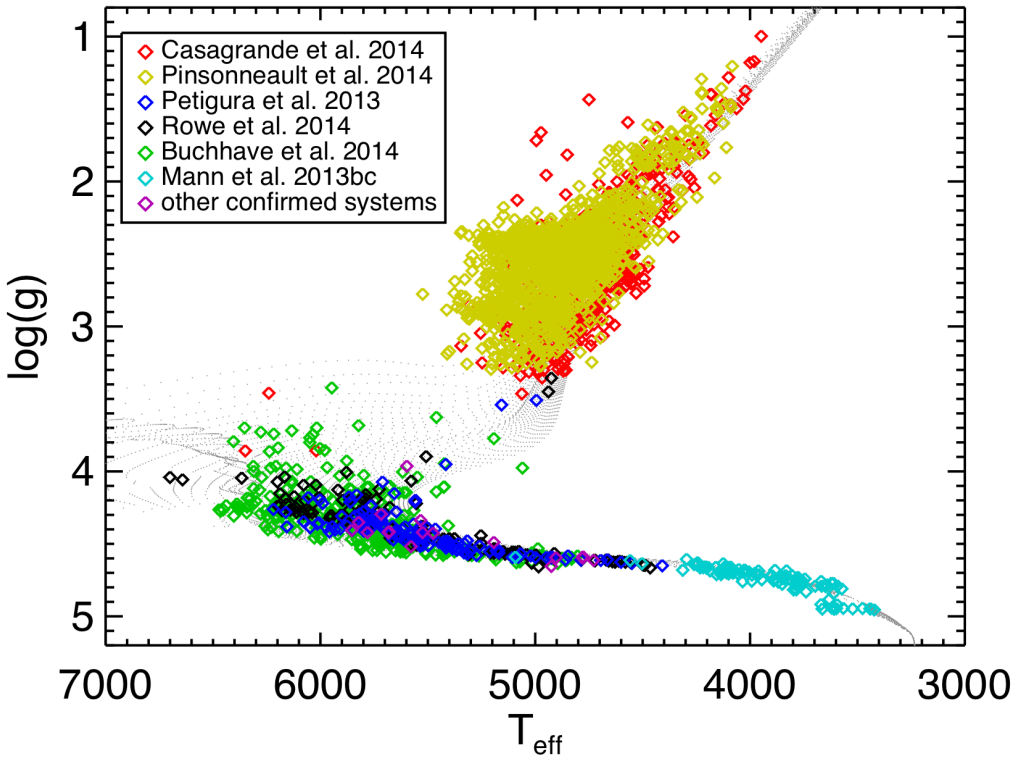

Figure 1: Surface gravity versus effective temperature for Kepler targets with updated stellar properties in the Q1-Q17 catalog. Colors denote the source for the input atmospheric properties. Plotted are the updated properties after fitting input values to Dartmouth isochrones, except for Casagrande et al. (2014) and Pinsonneault et al. (2014) for which published values were adopted (see text). Grey dots are the DSEP isochrones for the median metallicity of the sample ([Fe/H] = -0.1 dex).

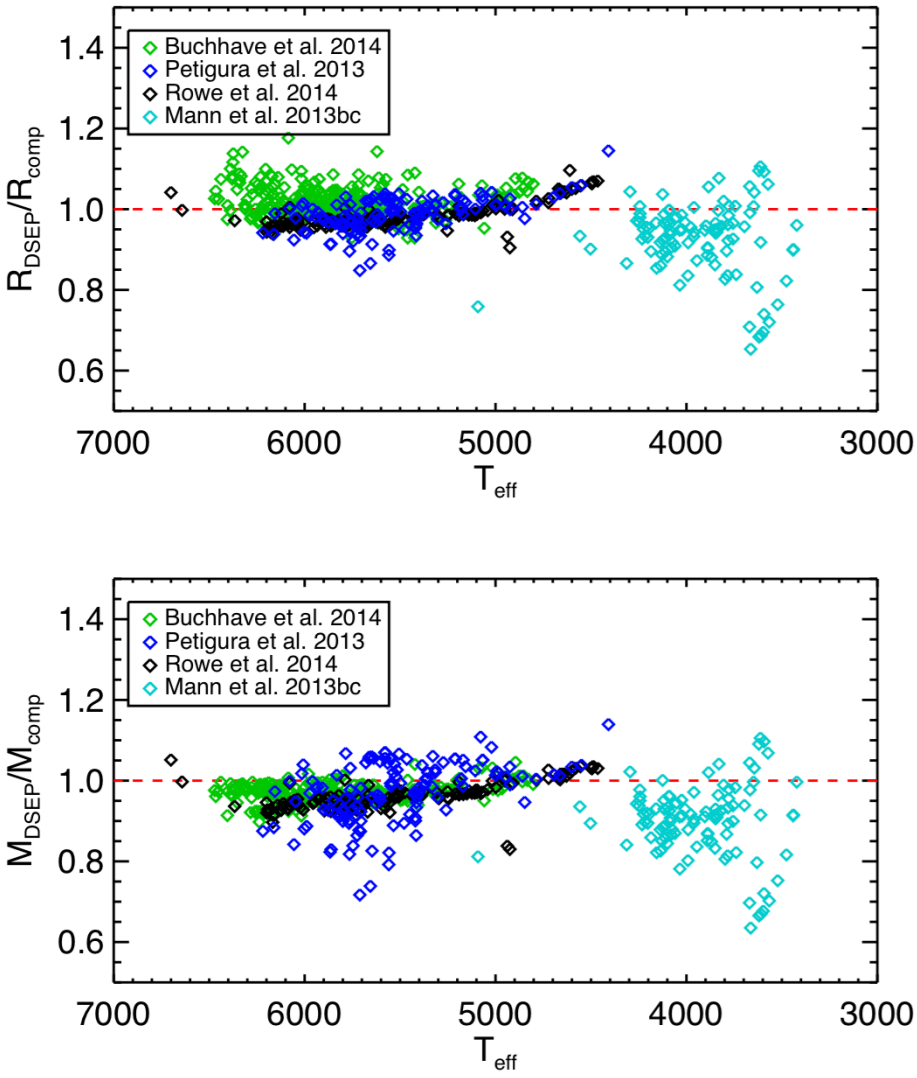

Figure 2: Comparison of radii (top panel) and masses (bottom panel) derived from fitting atmospheric properties to Dartmouth (DSEP) models with published radii and masses. The observed differences are indicative of potential model-dependent systematic errors in the catalog radii and masses.

3. *Summary*

The Q1-Q17 stellar properties catalog includes improved stellar properties for 3454 Kepler targets. The update includes one target which remained unclassified in the Q1-Q16 catalog due to a lack of reliable 2MASS colors, raising the total number of classified stars in the Kepler catalog to 196,469. The update includes 701 planet(-candidate) host stars. The Q1-Q17 stellar properties catalog was used for the Q1-Q17 transit search with SOC 9.2 TPS/DV. The resulting threshold crossing events (Seader et al. 2015) are available at the NASA Exoplanet Archive: http://exoplanetarchive.ipac.caltech.edu.

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