Early B-type benchmark stars for the Gaia-ESO survey

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Motivation

Defining a set of benchmark stars with well-known and, as far as possible, model-independent estimates of their fundamental parameters is essential for calibrating the results of the GES. This is done within WG10 and WG11 using the Sun, as well as a set of stars with nearly 'direct' estimates of their surface gravity and effective temperature (e.g., from asteroseismology and interferometry).

The situation is not as favourable in the case of hot stars. With this limitation in mind, one can, however, define a sample of well-studied OB stars with relatively well-established parameters in the literature. We discuss here a set of early B-type benchmark stars that can be used to anchor the results provided by WG13.

Selection criteria

The stars selected have at least two high-quality determinations of Teff and logg in the literature. Only values solely based on spectroscopic data have been retained (e.g., this excludes Teff measurements based on photometric indices). Also, only studies treating the line formation in non-LTE have been considered. The model atmospheres used may be either LTE or non-LTE (LTE being a reasonable assumption for B-type dwarfs; Przybilla et al. 2011), but a full treatment of line blanketing is required. The results of Daflon and collaborators (Daflon & Cunha 2004, and references therein) have been ignored because of unphysically high surface gravities in several cases.

The sample of benchmark stars

The table below lists the stars observable from Paranal. The figures to the right show their position in the logg-Teff plane using either the individual literature values or the average ones. There is a good agreement between the parameters in all cases (except for HD 35039, which is discarded from the sample). A priority flag **(5 for the highest priority and 1 for the lowest)** is assigned to each star based on the number of independent studies. As the stars analysed within WG13 will mostly be main-sequence stars, a higher priority was also given to dwarfs.

List of benchmark stars. The first column gives the priority flag (5 for the highest priority and 1 for the lowest). The coordinates, magnitudes, and spectral types are from SIMBAD.

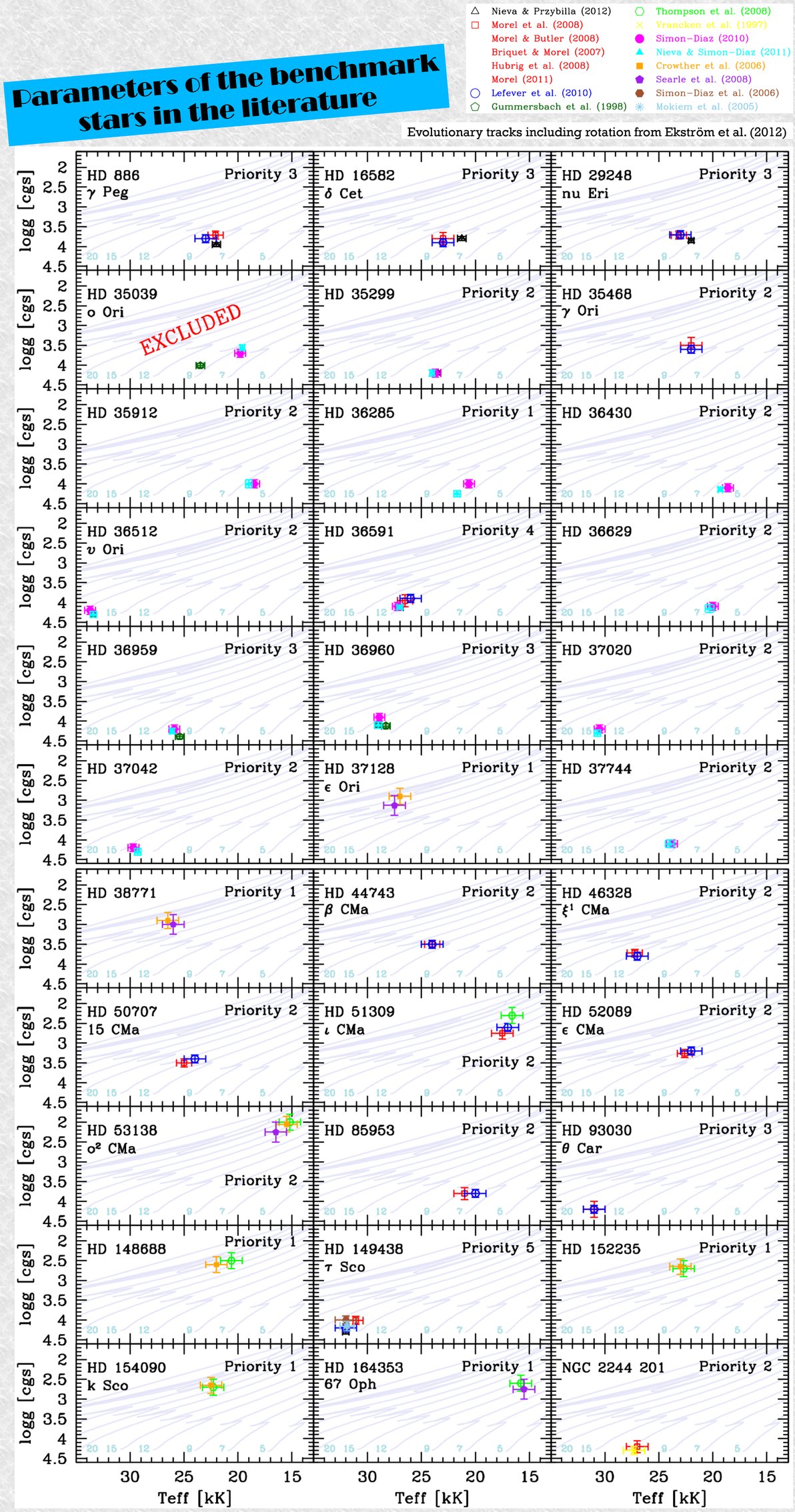
Priority	HD number	Name	Coordinates (J2000)	B	V	Spectral Type
5	149438	τ Sco	16 35 52.95 –28 12 57.7	2.61	2.81	B0.2 V
4	36591		05 32 41.35 –01 35 30.6	5.15	5.34	B1 IV
3	886	γ Peg	00 13 14.15 +15 11 00.9	2.60	2.83	B2 IV
3	16582	δ Cet	02 39 28.96 +00 19 42.6	3.85	4.07	B2 IV
3	29248	ν Eri	04 36 19.14 –03 21 08.9	3.74	3.92	B2 III
3	36959		05 35 01.01 –06 00 33.4	5.44	5.67	B1 Vv
3	36960		05 35 02.68 –06 00 07.3	4.53	4.78	B0.5 V
3	93030	θ Car	10 42 57.40 –64 23 40.0	2.54	2.78	B0 Vp
2	35299		05 23 42.31 –00 09 35.3	5.49	5.70	B1.5 V
2	35468	γ Ori	05 25 07.86 +06 20 58.9	1.42	1.64	B2 III
2	35912		05 28 01.47 +01 17 53.7	6.21	6.38	B2 V
2	36430		05 31 20.89 –06 42 30.2	6.04	6.20	B2 V
2	36512	υ Ori	05 31 55.86 –07 18 05.5	4.36	4.62	B0 V
2	36629		05 32 57.08 –04 33 59.3	7.63	7.64	B2 Vv
2	37020	V1016 Ori	05 35 15.85 –05 23 14.3	6.75	6.73	B0.5 V
2	37042		05 35 26.40 –05 25 00.7	6.05	6.02	B2-B5
2	37744		05 40 37.30 –02 49 30.9	6.01	6.20	B1.5 V
2	44743	β CMa	06 22 41.99 –17 57 21.3	1.75	2.0	B1 II/III
2	46328	ξ^1 CMa	06 31 51.37 –23 25 06.3	4.09	4.33	B0.7 IV
2	50707	15 CMa	06 53 32.91 –20 13 27.3	4.60	4.81	B1 Ib
2	51309	ι CMa	06 56 08.22 –17 03 15.3	4.31	4.38	B3 Ib
2	52089	ϵ CMa	06 58 37.55 –28 58 19.5	1.39	1.51	B2 Iab:
2	53138	o^2 CMa	07 03 01.47 –23 49 59.9	2.94	3.00	B3 Ia
2	85953	V335 Vel	09 53 50.10 –51 08 48.2	5.78	5.93	B2 III
2		NGC 2244 201	06 32 06.13 +04 52 15.3	9.90	9.73	B1 III
1	36285		05 30 20.75 –07 26 05.3	6.13	6.31	B2 IV-V
1	37128	ϵ Ori	05 36 12.81 –01 12 06.9	1.51	1.70	B0 Iab:
1	38771		05 47 45.39 –09 40 10.6	1.94	2.05	B0 Iab:
1	148688	V1058 Sco	16 31 41.77 –41 49 01.7	5.59	5.33	B1 Ia
1	152235	V900 Sco	16 53 58.85 –41 59 39.6	6.76	6.34	B0.7 Ia
1	154090	k Sco	17 04 49.35 –34 07 22.5	5.05	4.86	B1 Iae
1	164353	67 Oph	18 00 38.72 +02 55 53.6	3.97	3.97	B5 I
excluded	35039	o Ori	05 21 45.75 –00 22 56.9	4.54	4.70	B2 IV

Some words of caution

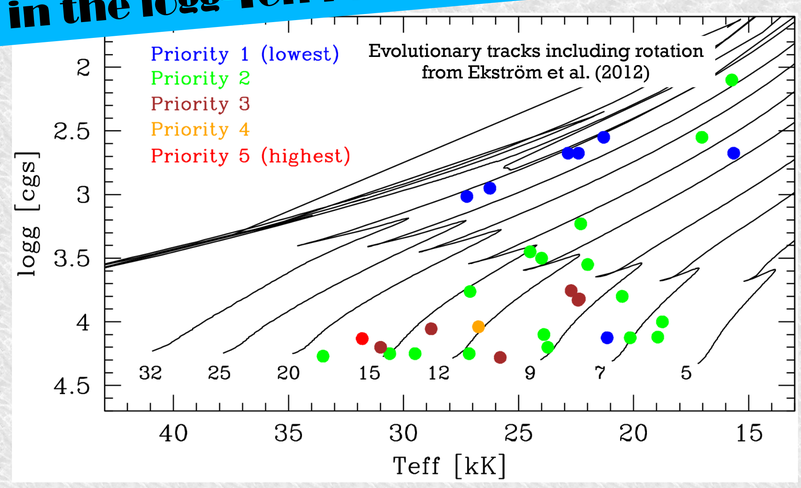
These early B-type stars may be used to assess the quality of the parameters and chemical abundances provided by WG13. However, it must be emphasised that they are not strictly speaking benchmark stars (as is, for instance, the Sun for cool stars): their parameters have been estimated in a way that is not fundamentally different from that used for the GES targets. In other words, the results are prone to be affected by the same model-dependent effects.

Most OB stars dealt with within WG13 will be fast rotators (e.g., <vsini>~160 km s^{-1} in NGC 3293), whereas the abundance studies in the literature are strongly biased against such objects. As a result, the vast majority of the benchmark stars are slow rotators (the fastest rotator is by far θ Car with vsini~110 km s^{-1}; Hubrig et al. 2008). Satisfactorily reproducing the parameters of the benchmark stars is therefore no guarantee that a similar accuracy can be achieved for the fast-rotating GES targets. This serious caveat should be kept in mind.

Parameters of the benchmark stars in the literature



Mean position of the benchmark stars in the logg-Teff plane



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