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Evolutionary stellar models with core overshooting and mass loss: apsidal motion constants

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Abstract. — A new grid of evolutionary stellar models with core overshooting and mass loss is presented. In addition to these two physical mechanisms, new opacity Tables from Los Alamos Opacity Library were used, the chemical composition was adopted to be $(X, Z) = (0.70, 0.02)$ and the mixing-length parameter was fixed to 2.0. The computed evolutionary tracks cover the mass range from 1.12 up to 25 $m_{\odot}$. Models with about 300 layers inside the stellar configuration were calculated from the zero-age main sequence until the ignition of helium in the core. The first three harmonics of the stellar internal structure (k_2, k_3 and k_4) needed for apsidal motion studies in close binaries are given for the first time in this kind of models. The new physical mechanisms introduced are found to be responsible for structures significantly more centrally concentrated in mass than previous models. Differences are estimated in around 0.10, in log k_2, for a typical case.

Key words: evolutionary stellar models – core overshooting — mass loss — apsidal motion.

1. Introduction.

Core overshooting and mass loss are nowadays being introduced in several evolutionary stellar codes in order to improve the comparison between theoretical predictions and observational data. Maeder and Meynet (1989), on the basis of several observational studies, adopted 0.25 as a representative value of the distance that convective elements penetrate beyond the classical core in terms of pressure height scale. Unfortunately, this grid did not include computations of the internal structure constants and in the present paper we give the corresponding values of these important parameters for the same amount of overshooting.

It is known that some eclipsing binaries with well determined absolute dimensions, are found to be at very unlikely positions in the HR diagram, or its equivalent, the log g - log $T_{\rm eff}$ plane. This is the case when classical evolutionary tracks are adopted, but the increase of the duration of the main sequence due to core overshooting is expected to remove, at least partially, the problem by means of displacing these binary system to a more likely position and age.

On the other hand, results from a detailed comparison between standard stellar models with observations of apsidal motion constants (Claret and Giménez, 1991) strongly suggest that, although the main external characteristics (log g and log $T_{\rm eff}$) can be well fitted by those standard models, a non-standard physics is needed to explain the still present discrepancies concerning the internal structure. In fact, if the convective nucleus is greater than that defined by the Schwarzchild criterion there will be a corresponding decrease of the respective internal density constants as well as the radius of gyration in the sense required by observational data. Furthermore, Figure 1c by Claret and Giménez (1989) indicates that mass loss should also leads to more concentrated models. Since the mass interval where core overshooting and mass loss is expected to be more important coincides with that where apsidal motion effects are more easily detected, the present study is certainly needed in order to perform a systematic comparison between observational results and theoretical predictions for well-detached double-lined eclipsing binaries.

2. The input physics and the tables.

The present models were computed until the ignition of Helium in the core and about 300 layers inside the stellar configuration were calculated. Special care was taken to determine the size of the "new" core and more layers were introduced in some critical situations. The total number of models computed for each mass was around 150 though we present only approximately 50 for practical reasons. The complete grid, further details and material can be provided to interested readers on request.

In order to make core overshooting computations we adopted the formalism described by Maeder and Meynet (1989). The distance excess was calculated in terms of the value of the pressure-scale height at the edge of the classical nucleus $d = \alpha$ H_p. As a representative value of moderate overshooting, we take $\alpha = 0.25$. Only in the case of the lower mass evolutionary track ($m = 1.12$ $m_\odot$) we have performed calculations with two possible values of α, namely, 0.125 and 0.25.

On the other hand, we have adopted the rates of mass loss given by De Jager *et al.* (1986) and Reimers (1975) while the mixing-length parameter was fixed to 2.0. The Ross-Aller mixture$(X, Z) = (0.70, 0.02)$ was used throughout together with opacities based in the latest calculations from Los Alamos (Huebner *et al.*, 1977).

Table 1 gives the most relevant parameters for the models calculated with $\alpha = 0.125$ for a mass of 1.12 $m_\odot$ as commented above. The remaining Tables 2 to 17 show the models computed with logarithmic initial mass varying from 0.05 up to 1.4 in steps of 0.1 except in the region where the dominant source of nuclear energy changes to the CNO cycle. For this region, the step in mass logarithm was taken to be 0.05. All calculations were performed with $\alpha = 0.25$ (except those in Tab. 1).In these Tables all variables have their usual meaning and M denotes the mass as a function of time.

In Figure 1, we represent the HR diagram for the present grid of models. Figure 2 shows the models by Maeder and Meynet (1989) for 2.5, 5 and 25 $m_\odot$ (with core overshooting and mass loss) compared with our corresponding calculations. From this Figure, we can conclude that both models are very similar as expected according to the adopted physics. Our grid nevertheless includes the computation of log k_j ($j = 2, 3, 4$) and provides a larger number of individual models during the main sequence. Finally, in Figure 3, the evolutionary behaviour of the second order harmonic (k_2) of the internal structures is shown for some selected models. The results from standard models (Claret and Giménez, 1989) are shown for comparison. It should be stressed that the differences in log k_2 for the two cases increase with evolution, mainly after the main sequence.

The global effect of core overshooting, mass loss and new opacity Tables as shown in this paper on log k_2 is an average decrease of 0.10 in comparison with older models (Hejlesen, 1987) at typical evolutionary stages. This means that the present models are more centrally concentrated in mass by this amount while models calculated on the same conditions but without overshooting or mass loss (Claret and Giménez, 1989) lead to a decrease in log k_2 of 0.05, as an average.

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TABLE 1. *Log M = 0.0492.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	0.1509	4.4179	3.7838	1.120	-1.957	-2.448	-2.763
1.00000D+08	0.1547	4.4149	3.7840	1.120	-1.962	-2.452	-2.767
1.17023D+09	0.1986	4.3792	3.7860	1.120	-2.014	-2.500	-2.815
2.64423D+09	0.2622	4.3189	3.7869	1.120	-2.077	-2.555	-2.867
3.44449D+09	0.2967	4.2786	3.7854	1.120	-2.098	-2.566	-2.874
4.37249D+09	0.3322	4.2226	3.7803	1.120	-2.090	-2.538	-2.837
4.75834D+09	0.3436	4.1962	3.7765	1.120	-2.069	-2.505	-2.799
5.12973D+09	0.3539	4.1687	3.7722	1.120	-2.039	-2.464	-2.751
5.30767D+09	0.3644	4.1532	3.7710	1.120	-2.038	-2.458	-2.744
5.40173D+09	0.3788	4.1434	3.7721	1.120	-2.059	-2.480	-2.767
5.46448D+09	0.4088	4.1296	3.7762	1.120	-2.119	-2.547	-2.838
5.47999D+09	0.4363	4.1164	3.7798	1.120	-2.174	-2.610	-2.905
5.48923D+09	0.4505	4.1053	3.7805	1.120	-2.193	-2.629	-2.926
5.50304D+09	0.4584	4.0905	3.7788	1.120	-2.185	-2.615	-2.909
5.57491D+09	0.4611	4.0811	3.7771	1.120	-2.171	-2.597	-2.889
5.79051D+09	0.4773	4.0497	3.7733	1.120	-2.149	-2.564	-2.850
6.14986D+09	0.5065	3.9856	3.7646	1.120	-2.084	-2.478	-2.755
6.58418D+09	0.4869	3.8615	3.7287	1.120	-1.699	-2.059	-2.322
6.79096D+09	0.4496	3.7559	3.6930	1.120	-1.342	-1.711	-1.982
6.88475D+09	0.4959	3.6738	3.6840	1.120	-1.262	-1.640	-1.914
6.95414D+09	0.5515	3.6031	3.6802	1.120	-1.232	-1.613	-1.890
6.98871D+09	0.5845	3.5646	3.6789	1.120	-1.222	-1.605	-1.883
7.02686D+09	0.6246	3.5198	3.6777	1.120	-1.214	-1.599	-1.878
7.04421D+09	0.6443	3.4981	3.6772	1.120	-1.211	-1.597	-1.876
7.07457D+09	0.6809	3.4580	3.6763	1.120	-1.208	-1.595	-1.875
7.10099D+09	0.7157	3.4200	3.6755	1.119	-1.205	-1.593	-1.874
7.11892D+09	0.7405	3.3930	3.6750	1.119	-1.204	-1.593	-1.874
7.13561D+09	0.7654	3.3659	3.6744	1.119	-1.204	-1.594	-1.875
7.15504D+09	0.7961	3.3330	3.6739	1.119	-1.204	-1.594	-1.876
7.17256D+09	0.8260	3.3012	3.6734	1.119	-1.204	-1.596	-1.879

TABLE 4. *Log M = 0.1492.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	0.6000	4.3130	3.8448	1.410	-2.344	-2.986	-3.431
7.59929D+08	0.6521	4.2523	3.8427	1.410	-2.398	-3.030	-3.472
1.49169D+09	0.7051	4.1707	3.8355	1.410	-2.444	-3.057	-3.488
2.01876D+09	0.7435	4.0905	3.8251	1.410	-2.458	-3.046	-3.460
2.40680D+09	0.7679	4.0171	3.8128	1.410	-2.438	-2.994	-3.383
2.69437D+09	0.7818	3.9541	3.8005	1.410	-2.383	-2.900	-3.259
2.96062D+09	0.7866	3.8927	3.7864	1.410	-2.279	-2.749	-3.072
3.13146D+09	0.7870	3.8540	3.7768	1.410	-2.191	-2.630	-2.933
3.22530D+09	0.7961	3.8317	3.7735	1.410	-2.168	-2.596	-2.893
3.26823D+09	0.8205	3.8194	3.7765	1.410	-2.220	-2.658	-2.961
3.27973D+09	0.8474	3.8104	3.7810	1.410	-2.291	-2.744	-3.057
3.28515D+09	0.8751	3.8065	3.7870	1.410	-2.374	-2.848	-3.177
3.28752D+09	0.9056	3.7992	3.7928	1.410	-2.454	-2.949	-3.295
3.28856D+09	0.9322	3.7906	3.7973	1.410	-2.515	-3.026	-3.387
3.28897D+09	0.9494	3.7839	3.7999	1.410	-2.550	-3.070	-3.440
3.28943D+09	0.9361	3.7920	3.7986	1.410	-2.528	-3.044	-3.409
3.29312D+09	0.9137	3.7207	3.7752	1.410	-2.297	-2.733	-3.037
3.30971D+09	0.8810	3.6546	3.7505	1.410	-1.979	-2.356	-2.627
3.33183D+09	0.7670	3.6274	3.7152	1.410	-1.483	-1.847	-2.114
3.34658D+09	0.7737	3.5494	3.6974	1.410	-1.284	-1.660	-1.934
3.36133D+09	0.8664	3.4206	3.6883	1.410	-1.209	-1.595	-1.873
3.37607D+09	0.9851	3.2800	3.6828	1.410	-1.182	-1.574	-1.856
3.38713D+09	1.0811	3.1711	3.6796	1.410	-1.174	-1.569	-1.853
3.39635D+09	1.1588	3.0816	3.6767	1.410	-1.173	-1.571	-1.857
3.40188D+09	1.2043	3.0294	3.6750	1.410	-1.174	-1.573	-1.860
3.40833D+09	1.2582	2.9667	3.6728	1.410	-1.176	-1.576	-1.865
3.41570D+09	1.3168	2.8987	3.6704	1.409	-1.180	-1.582	-1.871
3.41845D+09	1.3413	2.8701	3.6694	1.409	-1.182	-1.584	-1.874

TABLE 2. *Log M = 0.0492.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	0.1505	4.4182	3.7838	1.120	-1.956	-2.447	-2.762
3.00000D+08	0.1612	4.4097	3.7843	1.120	-1.969	-2.458	-2.773
1.69389D+09	0.2199	4.3605	3.7867	1.120	-2.037	-2.522	-2.837
3.19212D+09	0.2840	4.2945	3.7862	1.120	-2.092	-2.564	-2.875
4.34942D+09	0.3307	4.2283	3.7813	1.120	-2.097	-2.548	-2.848
5.19875D+09	0.3579	4.1694	3.7734	1.120	-2.052	-2.479	-2.767
5.61309D+09	0.3665	4.1365	3.7673	1.120	-2.007	-2.419	-2.701
5.91576D+09	0.3710	4.1119	3.7623	1.120	-1.964	-2.366	-2.643
6.11704D+09	0.3775	4.0945	3.7596	1.120	-1.943	-2.339	-2.614
6.22820D+09	0.3892	4.0825	3.7595	1.120	-1.950	-2.345	-2.619
6.29397D+09	0.4100	4.0721	3.7621	1.120	-1.990	-2.387	-2.663
6.32705D+09	0.4649	4.0503	3.7704	1.120	-2.110	-2.519	-2.802
6.33330D+09	0.4968	4.0348	3.7745	1.120	-2.176	-2.592	-2.880
6.33775D+09	0.5018	4.0243	3.7731	1.120	-2.167	-2.579	-2.865
6.36546D+09	0.5164	3.9590	3.7604	1.120	-2.048	-2.434	-2.707
6.40457D+09	0.5164	3.9444	3.7568	1.120	-2.009	-2.389	-2.660
6.69573D+09	0.4540	3.8546	3.7187	1.120	-1.588	-1.948	-2.212
6.81217D+09	0.4311	3.8091	3.7016	1.120	-1.421	-1.786	-2.053
6.89586D+09	0.4388	3.7617	3.6917	1.120	-1.329	-1.700	-1.971
7.04656D+09	0.5113	3.6489	3.6816	1.120	-1.241	-1.621	-1.896
7.09897D+09	0.5501	3.6022	3.6797	1.120	-1.226	-1.608	-1.885
7.14372D+09	0.5882	3.5585	3.6782	1.120	-1.216	-1.600	-1.878
7.18072D+09	0.6234	3.5194	3.6773	1.120	-1.210	-1.595	-1.874
7.21351D+09	0.6579	3.4817	3.6765	1.120	-1.207	-1.593	-1.873
7.24274D+09	0.6916	3.4450	3.6757	1.119	-1.204	-1.592	-1.872
7.26818D+09	0.7231	3.4107	3.6750	1.119	-1.203	-1.591	-1.872
7.29062D+09	0.7535	3.3782	3.6745	1.119	-1.203	-1.592	-1.874

TABLE 5. *Log M = 0.1989.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	0.8032	4.3231	3.8858	1.580	-2.351	-3.013	-3.476
5.00000D+08	0.8506	4.2609	3.8821	1.580	-2.403	-3.055	-3.514
1.02679D+09	0.9023	4.1673	3.8716	1.580	-2.465	-3.103	-3.558
1.41444D+09	0.9417	4.0683	3.8567	1.580	-2.515	-3.141	-3.591
1.70113D+09	0.9684	3.9717	3.8392	1.580	-2.541	-3.151	-3.592
1.91432D+09	0.9842	3.8879	3.8222	1.580	-2.529	-3.114	-3.536
2.07023D+09	0.9913	3.8219	3.8075	1.580	-2.481	-3.032	-3.424
2.18424D+09	0.9933	3.7734	3.7959	1.580	-2.416	-2.933	-3.296
2.30144D+09	0.9991	3.7271	3.7858	1.580	-2.345	-2.828	-3.165
2.33236D+09	1.0094	3.7161	3.7856	1.580	-2.353	-2.836	-3.173
2.35182D+09	1.0305	3.7089	3.7890	1.580	-2.404	-2.900	-3.247
2.35835D+09	1.0500	3.7080	3.7937	1.580	-2.460	-2.972	-3.335
2.36183D+09	1.0711	3.7091	3.7993	1.580	-2.517	-3.048	-3.427
2.36444D+09	1.1075	3.7105	3.8087	1.580	-2.602	-3.160	-3.565
2.36524D+09	1.1352	3.7092	3.8153	1.580	-2.651	-3.223	-3.642
2.36556D+09	1.1549	3.7060	3.8194	1.580	-2.682	-3.262	-3.689
2.36579D+09	1.1573	3.7077	3.8205	1.580	-2.686	-3.268	-3.697
2.36671D+09	1.1064	3.6836	3.8017	1.580	-2.567	-3.107	-3.495
2.37038D+09	1.1109	3.5704	3.7746	1.580	-2.355	-2.807	-3.123
2.38505D+09	0.9620	3.5149	3.7234	1.580	-1.592	-1.954	-2.219
2.39239D+09	0.9430	3.4557	3.7039	1.580	-1.335	-1.707	-1.979
2.40201D+09	1.0700	3.2730	3.6899	1.580	-1.216	-1.602	-1.882
2.41226D+09	1.2617	3.0441	3.6807	1.580	-1.188	-1.582	-1.867
2.41962D+09	1.4084	2.8706	3.6740	1.580	-1.186	-1.585	-1.874
2.42360D+09	1.4881	2.7756	3.6701	1.580	-1.189	-1.590	-1.881
2.42679D+09	1.5559	2.6945	3.6668	1.580	-1.192	-1.595	-1.887
2.42954D+09	1.6177	2.6200	3.6636	1.579	-1.196	-1.601	-1.895

TABLE 3. *Log M = 0.0969.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	0.3695	4.3551	3.8108	1.250	-2.174	-2.736	-3.106
5.00000D+08	0.3970	4.3305	3.8115	1.250	-2.208	-2.769	-3.141
1.54014D+09	0.4531	4.2717	3.8109	1.250	-2.265	-2.817	-3.187
2.37311D+09	0.4976	4.2100	3.8065	1.250	-2.290	-2.823	-3.182
3.10949D+09	0.5363	4.1404	3.7988	1.250	-2.282	-2.787	-3.127
3.59970D+09	0.5565	4.0853	3.7901	1.250	-2.237	-2.711	-3.031
3.96167D+09	0.5661	4.0396	3.7811	1.250	-2.172	-2.617	-2.919
4.22158D+09	0.5688	4.0053	3.7732	1.250	-2.101	-2.524	-2.814
4.40977D+09	0.5702	3.9806	3.7674	1.250	-2.045	-2.454	-2.737
4.53551D+09	0.5757	3.9633	3.7644	1.250	-2.020	-2.422	-2.701
4.59858D+09	0.5870	3.9525	3.7645	1.250	-2.030	-2.432	-2.711
4.63096D+09	0.6026	3.9448	3.7665	1.250	-2.063	-2.468	-2.749
4.64741D+09	0.6171	3.9394	3.7688	1.250	-2.097	-2.506	-2.790
4.65461D+09	0.6450	3.9287	3.7731	1.250	-2.166	-2.585	-2.875
4.65907D+09	0.6651	3.9237	3.7769	1.250	-2.220	-2.649	-2.945
4.66157D+09	0.6876	3.9150	3.7803	1.250	-2.275	-2.714	-3.017
4.66293D+09	0.7072	3.9067	3.7831	1.250	-2.322	-2.770	-3.079
4.66373D+09	0.7235	3.8989	3.7853	1.250	-2.357	-2.811	-3.126
4.66406D+09	0.7313	3.8950	3.7862	1.250	-2.373	-2.831	-3.147
4.66605D+09	0.6964	3.8966	3.7779	1.250	-2.260	-2.690	-2.988
4.67850D+09	0.7082	3.8214	3.7620	1.250	-2.100	-2.491	-2.768
4.73384D+09	0.6431	3.7660	3.7319	1.250	-1.716	-2.076	-2.340
4.83346D+09	0.6199	3.6164	3.6887	1.250	-1.245	-1.624	-1.899
4.87220D+09	0.6805	3.5387	3.6845	1.250	-1.210	-1.595	-1.872
4.89433D+09	0.7099	3.5052	3.6834	1.250	-1.204	-1.590	-1.868
4.93859D+09	0.7858	3.4181	3.6806	1.250	-1.192	-1.580	-1.861
4.97191D+09	0.8517	3.3451	3.6789	1.250	-1.186	-1.577	-1.859

TABLE 6. *Log M = 0.2889.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	1.1993	4.3474	3.9658	1.990	-2.282	-2.949	-3.414
6.30000D+06	1.2002	4.3460	3.9657	1.990	-2.283	-2.950	-3.415
2.55000D+07	1.2034	4.3414	3.9654	1.990	-2.287	-2.953	-3.418
2.04700D+08	1.2356	4.2934	3.9614	1.990	-2.325	-2.983	-3.445
5.05187D+08	1.2936	4.1881	3.9496	1.990	-2.396	-3.039	-3.496
7.21697D+08	1.3412	4.0783	3.9341	1.990	-2.457	-3.087	-3.541
8.75912D+08	1.3741	3.9687	3.9149	1.990	-2.506	-3.127	-3.578
1.01895D+09	1.4011	3.8278	3.8864	1.990	-2.555	-3.166	-3.615
1.11201D+09	1.4137	3.7034	3.8584	1.990	-2.586	-3.190	-3.638
1.17209D+09	1.4207	3.6106	3.8370	1.990	-2.605	-3.204	-3.649
1.20473D+09	1.4312	3.5701	3.8295	1.990	-2.615	-3.212	-3.654
1.21868D+09	1.4483	3.5689	3.8335	1.990	-2.628	-3.225	-3.669
1.22394D+09	1.4651	3.5849	3.8417	1.990	-2.637	-3.235	-3.680
1.22641D+09	1.4837	3.6063	3.8517	1.990	-2.645	-3.245	-3.692
1.22772D+09	1.5039	3.6271	3.8619	1.990	-2.654	-3.254	-3.702
1.22838D+09	1.5251	3.6448	3.8717	1.990	-2.663	-3.264	-3.712
1.22875D+09	1.5454	3.6599	3.8805	1.990	-2.673	-3.274	-3.722
1.22898D+09	1.5681	3.6705	3.8888	1.990	-2.684	-3.285	-3.733
1.22907D+09	1.5792	3.6737	3.8924	1.990	-2.691	-3.292	-3.740
1.22924D+09	1.5562	3.6739	3.8867	1.990	-2.677	-3.278	-3.726
1.22995D+09	1.5301	3.5193	3.8415	1.990	-2.687	-3.283	-3.728
1.23076D+09	1.5323	3.3929	3.8105	1.990	-2.684	-3.266	-3.699
1.23318D+09	1.4774	3.2542	3.7621	1.990	-2.333	-2.784	-3.101
1.23561D+09	1.3427	3.2383	3.7244	1.990	-1.675	-2.041	-2.308
1.23722D+09	1.3208	3.1905	3.7070	1.990	-1.399	-1.769	-2.040
1.24215D+09	1.5866	2.8233	3.6816	1.990	-1.222	-1.613	-1.897
1.24616D+09	1.8647	2.4798	3.6653	1.990	-1.211	-1.613	-1.905

TABLE 7. *Log M = 0.3998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	1.5878	4.3525	4.0389	2.510	-2.212	-2.880	-3.346
1.50000D+06	1.5876	4.3513	4.0387	2.510	-2.213	-2.880	-3.346
2.55000D+07	1.5941	4.3402	4.0375	2.510	-2.222	-2.888	-3.353
2.17100D+08	1.6674	4.2264	4.0274	2.510	-2.306	-2.956	-3.415
3.79116D+08	1.7396	4.0782	4.0084	2.510	-2.396	-3.029	-3.483
4.81726D+08	1.7894	3.9307	3.9840	2.510	-2.465	-3.086	-3.538
5.47886D+08	1.8217	3.7913	3.9572	2.510	-2.517	-3.129	-3.579
5.80897D+08	1.8345	3.7002	3.9376	2.510	-2.544	-3.152	-3.602
6.04280D+08	1.8445	3.6262	3.9217	2.510	-2.565	-3.170	-3.620
6.20404D+08	1.8539	3.5797	3.9124	2.510	-2.579	-3.183	-3.633
6.29122D+08	1.8648	3.5632	3.9109	2.510	-2.589	-3.193	-3.642
6.33756D+08	1.8781	3.5674	3.9153	2.510	-2.596	-3.199	-3.649
6.36134D+08	1.8927	3.5846	3.9233	2.510	-2.602	-3.205	-3.655
6.37412D+08	1.9085	3.6071	3.9329	2.510	-2.607	-3.210	-3.660
6.38089D+08	1.9257	3.6292	3.9427	2.510	-2.613	-3.216	-3.666
6.38437D+08	1.9474	3.6482	3.9529	2.510	-2.622	-3.226	-3.676
6.38627D+08	1.9629	3.6645	3.9608	2.510	-2.628	-3.232	-3.682
6.38726D+08	1.9811	3.6733	3.9676	2.510	-2.638	-3.241	-3.691
6.38775D+08	1.9935	3.6781	3.9719	2.510	-2.643	-3.247	-3.697
6.38800D+08	2.0010	3.6800	3.9742	2.510	-2.648	-3.252	-3.702
6.38942D+08	1.9505	3.6610	3.9569	2.510	-2.622	-3.225	-3.675
6.39282D+08	1.9575	3.4909	3.9161	2.510	-2.658	-3.258	-3.708
6.39623D+08	1.9631	3.3623	3.8853	2.510	-2.684	-3.282	-3.731
6.40984D+08	1.8830	2.9819	3.7702	2.510	-2.559	-3.092	-3.474
6.42119D+08	1.7129	2.8976	3.7066	2.510	-1.514	-1.882	-2.153
6.43253D+08	1.8914	2.6194	3.6817	2.510	-1.273	-1.660	-1.942
6.44580D+08	2.1381	2.3007	3.6637	2.510	-1.242	-1.639	-1.929

TABLE 8. *Log M = 0.4998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	1.9641	4.3485	4.1071	3.160	-2.142	-2.810	-3.276
3.10000D+06	1.9660	4.3460	4.1070	3.160	-2.144	-2.812	-3.278
2.55000D+07	1.9850	4.3246	4.1064	3.160	-2.163	-2.828	-3.293
1.14247D+08	2.0509	4.2274	4.0985	3.160	-2.239	-2.891	-3.350
1.85064D+08	2.1143	4.1148	4.0862	3.160	-2.314	-2.952	-3.408
2.33028D+08	2.1637	4.0047	4.0711	3.160	-2.376	-3.004	-3.457
2.67396D+08	2.2022	3.8976	4.0539	3.160	-2.427	-3.047	-3.498
2.91612D+08	2.2298	3.7989	4.0362	3.160	-2.468	-3.081	-3.532
3.09032D+08	2.2509	3.7069	4.0184	3.160	-2.502	-3.112	-3.563
3.21659D+08	2.2647	3.6322	4.0032	3.160	-2.526	-3.134	-3.585
3.30490D+08	2.2788	3.5807	3.9938	3.160	-2.546	-3.152	-3.603
3.35271D+08	2.2903	3.5636	3.9924	3.160	-2.556	-3.161	-3.613
3.37742D+08	2.3025	3.5671	3.9964	3.160	-2.563	-3.168	-3.620
3.39027D+08	2.3154	3.5840	4.0038	3.160	-2.567	-3.172	-3.624
3.39701D+08	2.3293	3.6074	4.0131	3.160	-2.571	-3.176	-3.627
3.40066D+08	2.3433	3.6286	4.0219	3.160	-2.576	-3.181	-3.631
3.40258D+08	2.3613	3.6488	4.0315	3.160	-2.582	-3.187	-3.638
3.40360D+08	2.3773	3.6654	4.0396	3.160	-2.588	-3.193	-3.644
3.40413D+08	2.3929	3.6754	4.0460	3.160	-2.596	-3.201	-3.651
3.40442D+08	2.4079	3.6804	4.0510	3.160	-2.604	-3.208	-3.658
3.40454D+08	2.4137	3.6837	4.0533	3.160	-2.607	-3.211	-3.661
3.40511D+08	2.3797	3.6768	4.0431	3.160	-2.588	-3.192	-3.643
3.40609D+08	2.3679	3.5763	4.0150	3.160	-2.602	-3.205	-3.656
3.40804D+08	2.3932	3.3906	3.9749	3.160	-2.654	-3.255	-3.708
3.41456D+08	2.3317	2.8684	3.8290	3.160	-2.700	-3.294	-3.737
3.42043D+08	2.1878	2.4346	3.6846	3.160	-1.432	-1.806	-2.082
3.42695D+08	2.5499	1.9337	3.6499	3.160	-1.276	-1.674	-1.965

TABLE 9. *Log M = 0.5998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	2.3423	4.3383	4.1741	3.980	-2.080	-2.747	-3.213
1.50000D+06	2.3440	4.3360	4.1739	3.980	-2.082	-2.749	-3.215
1.27000D+07	2.3583	4.3177	4.1729	3.980	-2.097	-2.763	-3.228
6.05482D+07	2.4267	4.2260	4.1671	3.980	-2.172	-2.825	-3.285
8.80953D+07	2.4729	4.1531	4.1604	3.980	-2.225	-2.869	-3.326
1.17683D+08	2.5317	4.0451	4.1481	3.980	-2.294	-2.927	-3.380
1.38516D+08	2.5789	3.9381	4.1332	3.980	-2.354	-2.978	-3.429
1.53068D+08	2.6147	3.8364	4.1167	3.980	-2.402	-3.019	-3.469
1.63671D+08	2.6412	3.7426	4.0999	3.980	-2.441	-3.053	-3.503
1.69030D+08	2.6560	3.6869	4.0896	3.980	-2.464	-3.073	-3.524
1.74966D+08	2.6730	3.6206	4.0773	3.980	-2.489	-3.097	-3.548
1.78894D+08	2.6868	3.5828	4.0713	3.980	-2.506	-3.113	-3.564
1.80926D+08	2.6994	3.5726	4.0719	3.980	-2.516	-3.122	-3.573
1.81975D+08	2.7104	3.5835	4.0774	3.980	-2.521	-3.127	-3.578
1.82759D+08	2.7295	3.6186	4.0909	3.980	-2.526	-3.131	-3.582
1.82994D+08	2.7482	3.6508	4.1037	3.980	-2.531	-3.136	-3.586
1.83080D+08	2.7612	3.6707	4.1119	3.980	-2.536	-3.141	-3.591
1.83125D+08	2.7757	3.6852	4.1191	3.980	-2.542	-3.147	-3.597
1.83149D+08	2.7889	3.6946	4.1248	3.980	-2.548	-3.153	-3.602
1.83160D+08	2.7989	3.6991	4.1284	3.980	-2.554	-3.159	-3.609
1.83164D+08	2.8041	3.7004	4.1300	3.980	-2.557	-3.162	-3.612
1.83192D+08	2.7766	3.6957	4.1220	3.980	-2.540	-3.145	-3.595
1.83257D+08	2.7671	3.5686	4.0878	3.980	-2.562	-3.164	-3.615
1.83419D+08	2.7997	3.2798	4.0238	3.980	-2.642	-3.244	-3.699
1.83614D+08	2.7719	2.9441	3.9329	3.980	-2.688	-3.292	-3.746
1.83808D+08	2.6409	2.3704	3.7567	3.980	-2.642	-3.205	-3.609
1.83857D+08	2.5729	2.2595	3.7120	3.980	-2.214	-2.640	-2.935

TABLE 10. *Log M = 0.6998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	2.7072	4.3297	4.2381	5.010	-2.016	-2.683	-3.150
1.50000D+06	2.7103	4.3257	4.2379	5.010	-2.020	-2.686	-3.152
2.34176D+07	2.7690	4.2572	4.2355	5.010	-2.082	-2.740	-3.202
5.51175D+07	2.8668	4.1144	4.2242	5.010	-2.192	-2.834	-3.290
6.60253D+07	2.9079	4.0423	4.2165	5.010	-2.241	-2.875	-3.329
7.79647D+07	2.9598	3.9355	4.2027	5.010	-2.305	-2.930	-3.382
8.63964D+07	3.0012	3.8321	4.1873	5.010	-2.359	-2.977	-3.427
9.05523D+07	3.0229	3.7682	4.1767	5.010	-2.390	-3.004	-3.454
9.65796D+07	3.0562	3.6540	4.1565	5.010	-2.439	-3.048	-3.498
9.95682D+07	3.0756	3.5942	4.1464	5.010	-2.465	-3.072	-3.523
1.01428D+08	3.0897	3.5642	4.1424	5.010	-2.481	-3.087	-3.538
1.02380D+08	3.1012	3.5611	4.1445	5.010	-2.490	-3.096	-3.546
1.02886D+08	3.1110	3.5748	4.1504	5.010	-2.494	-3.100	-3.550
1.03158D+08	3.1202	3.5941	4.1575	5.010	-2.497	-3.102	-3.552
1.03302D+08	3.1316	3.6201	4.1668	5.010	-2.499	-3.105	-3.554
1.03381D+08	3.1423	3.6441	4.1755	5.010	-2.501	-3.107	-3.556
1.03411D+08	3.1520	3.6548	4.1806	5.010	-2.505	-3.111	-3.560
1.03437D+08	3.1646	3.6704	4.1877	5.010	-2.512	-3.117	-3.567
1.03448D+08	3.1722	3.6778	4.1914	5.010	-2.516	-3.121	-3.570
1.03457D+08	3.1819	3.6846	4.1955	5.010	-2.521	-3.126	-3.575
1.03462D+08	3.1926	3.6885	4.1992	5.010	-2.528	-3.133	-3.582
1.03485D+08	3.1590	3.6600	4.1837	5.010	-2.512	-3.116	-3.565
1.03578D+08	3.1950	3.2698	4.0951	5.010	-2.617	-3.219	-3.674
1.03632D+08	3.1934	3.0493	4.0396	5.010	-2.662	-3.267	-3.725
1.03711D+08	3.1426	2.6044	3.9157	5.010	-2.715	-3.322	-3.775
1.03751D+08	3.0806	2.2537	3.8125	5.010	-2.717	-3.304	-3.730
1.03778D+08	3.0132	1.9231	3.7130	5.010	-2.531	-3.014	-3.344

TABLE 11. *Log M = 0.7998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	3.0633	4.3172	4.2992	6.300	-1.958	-2.625	-3.091
1.50000D+06	3.0701	4.3097	4.2990	6.300	-1.967	-2.632	-3.098
2.36969D+07	3.1792	4.1790	4.2936	6.300	-2.084	-2.735	-3.194
3.20230D+07	3.2291	4.1064	4.2879	6.300	-2.143	-2.785	-3.242
4.32875D+07	3.3091	3.9647	4.2725	6.300	-2.241	-2.870	-3.323
5.03903D+07	3.3714	3.8247	4.2531	6.300	-2.323	-2.941	-3.392
5.48290D+07	3.4155	3.6995	4.2328	6.300	-2.385	-2.997	-3.447
5.76634D+07	3.4478	3.5998	4.2159	6.300	-2.432	-3.041	-3.491
5.93056D+07	3.4694	3.5477	4.2083	6.300	-2.460	-3.067	-3.518
6.00131D+07	3.4831	3.5466	4.2115	6.300	-2.471	-3.077	-3.528
6.03187D+07	3.4952	3.5670	4.2196	6.300	-2.477	-3.083	-3.533
6.04514D+07	3.5070	3.5989	4.2305	6.300	-2.479	-3.085	-3.535
6.04992D+07	3.5164	3.6229	4.2389	6.300	-2.481	-3.087	-3.537
6.05253D+07	3.5261	3.6422	4.2461	6.300	-2.485	-3.091	-3.541
6.05393D+07	3.5375	3.6560	4.2524	6.300	-2.491	-3.097	-3.547
6.05468D+07	3.5468	3.6655	4.2571	6.300	-2.496	-3.101	-3.551
6.05505D+07	3.5582	3.6711	4.2614	6.300	-2.504	-3.109	-3.559
6.05538D+07	3.5626	3.6747	4.2634	6.300	-2.507	-3.112	-3.561
6.05667D+07	3.5328	3.6342	4.2458	6.300	-2.494	-3.098	-3.547
6.05924D+07	3.5509	3.4214	4.1971	6.300	-2.553	-3.154	-3.606
6.06268D+07	3.5755	3.1182	4.1275	6.300	-2.635	-3.239	-3.697
6.06612D+07	3.5639	2.7535	4.0334	6.300	-2.706	-3.318	-3.780
6.06784D+07	3.5405	2.5147	3.9679	6.300	-2.742	-3.356	-3.815
6.06956D+07	3.4990	2.1692	3.8711	6.300	-2.771	-3.370	-3.808
6.07042D+07	3.4694	1.9308	3.8041	6.300	-2.769	-3.341	-3.752
6.07106D+07	3.4388	1.6916	3.7366	6.300	-2.731	-3.260	-3.628
6.07149D+07	3.4103	1.5369	3.6908	6.300	-2.542	-2.985	-3.283

TABLE 12. *Log M = 0.8998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	3.4101	4.3038	4.3574	7.940	-1.905	-2.569	-3.036
7.00000D+05	3.4147	4.2989	4.3573	7.940	-1.910	-2.574	-3.040
6.30000D+06	3.4590	4.2511	4.3565	7.940	-1.958	-2.617	-3.081
1.59952D+07	3.5419	4.1451	4.3507	7.940	-2.054	-2.702	-3.161
2.06320D+07	3.5905	4.0739	4.3450	7.940	-2.113	-2.754	-3.211
2.58032D+07	3.6520	3.9669	4.3336	7.940	-2.192	-2.823	-3.277
3.03740D+07	3.7175	3.8247	4.3145	7.940	-2.284	-2.904	-3.355
3.32247D+07	3.7662	3.6965	4.2946	7.939	-2.354	-2.968	-3.418
3.46518D+07	3.7930	3.6155	4.2810	7.939	-2.395	-3.005	-3.456
3.59191D+07	3.8195	3.5408	4.2690	7.939	-2.435	-3.042	-3.494
3.64021D+07	3.8314	3.5248	4.2680	7.939	-2.449	-3.056	-3.507
3.66599D+07	3.8405	3.5288	4.2713	7.939	-2.456	-3.063	-3.514
3.68050D+07	3.8483	3.5445	4.2771	7.939	-2.461	-3.067	-3.518
3.68580D+07	3.8537	3.5586	4.2820	7.939	-2.461	-3.068	-3.519
3.69051D+07	3.8615	3.5826	4.2899	7.939	-2.463	-3.070	-3.521
3.69310D+07	3.8695	3.6056	4.2977	7.939	-2.466	-3.072	-3.522
3.69449D+07	3.8779	3.6226	4.3041	7.939	-2.470	-3.076	-3.526
3.69526D+07	3.8878	3.6357	4.3098	7.939	-2.476	-3.082	-3.532
3.69565D+07	3.8953	3.6438	4.3137	7.939	-2.481	-3.087	-3.537
3.69582D+07	3.9040	3.6485	4.3170	7.939	-2.488	-3.094	-3.544
3.69613D+07	3.9105	3.6541	4.3201	7.939	-2.493	-3.098	-3.548
3.69753D+07	3.8817	3.5311	4.2821	7.939	-2.495	-3.098	-3.549
3.69964D+07	3.9171	3.1692	4.2005	7.939	-2.602	-3.207	-3.665
3.70175D+07	3.9169	2.7128	4.0864	7.939	-2.706	-3.321	-3.786
3.70315D+07	3.8844	2.2421	3.9606	7.939	-2.795	-3.413	-3.870
3.70403D+07	3.8386	1.7365	3.8227	7.938	-2.823	-3.394	-3.800
3.70438D+07	3.8054	1.4116	3.7332	7.938	-2.766	-3.271	-3.617

TABLE 13. *Log M = 1.0000.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	3.7411	4.2904	4.4118	10.000	-1.856	-2.518	-2.984
7.00000D+05	3.7485	4.2826	4.4117	10.000	-1.864	-2.525	-2.991
5.66371D+06	3.8098	4.2164	4.4104	10.000	-1.934	-2.589	-3.052
1.14489D+07	3.8927	4.1092	4.4044	9.999	-2.036	-2.681	-3.140
1.53657D+07	3.9610	4.0012	4.3944	9.999	-2.128	-2.763	-3.218
1.81028D+07	4.0180	3.8927	4.3816	9.998	-2.208	-2.834	-3.286
2.00442D+07	4.0653	3.7853	4.3665	9.997	-2.280	-2.899	-3.351
2.14448D+07	4.1026	3.6847	4.3507	9.995	-2.340	-2.954	-3.405
2.24294D+07	4.1316	3.5962	4.3358	9.994	-2.389	-2.999	-3.451
2.31357D+07	4.1542	3.5268	4.3241	9.992	-2.426	-3.034	-3.487
2.35748D+07	4.1691	3.4893	4.3185	9.991	-2.451	-3.058	-3.511
2.38086D+07	4.1794	3.4825	4.3193	9.990	-2.462	-3.069	-3.522
2.39327D+07	4.1872	3.4890	4.3229	9.990	-2.470	-3.076	-3.529
2.40049D+07	4.1939	3.5084	4.3295	9.990	-2.471	-3.078	-3.531
2.40401D+07	4.2003	3.5319	4.3369	9.990	-2.474	-3.081	-3.533
2.40596D+07	4.2069	3.5551	4.3444	9.990	-2.475	-3.082	-3.534
2.40702D+07	4.2139	3.5731	4.3506	9.990	-2.478	-3.084	-3.536
2.40762D+07	4.2221	3.5880	4.3564	9.990	-2.483	-3.090	-3.541
2.40795D+07	4.2294	3.5991	4.3610	9.990	-2.489	-3.095	-3.547
2.40806D+07	4.2362	3.6045	4.3641	9.990	-2.496	-3.101	-3.553
2.40814D+07	4.2424	3.6086	4.3666	9.990	-2.501	-3.106	-3.557
2.40864D+07	4.2355	3.5977	4.3622	9.990	-2.498	-3.102	-3.554
2.41009D+07	4.2435	3.2309	4.2725	9.989	-2.587	-3.191	-3.650
2.41153D+07	4.2561	2.6195	4.1228	9.989	-2.748	-3.369	-3.840
2.41225D+07	4.2328	2.1118	3.9900	9.989	-2.864	-3.487	-3.948
2.41261D+07	4.2061	1.7029	3.8811	9.989	-2.921	-3.514	-3.940
2.41283D+07	4.1765	1.3374	3.7824	9.989	-2.881	-3.404	-3.765

TABLE 14. *Log M = 1.0997.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	4.0513	4.2792	4.4616	12.580	-1.809	-2.468	-2.934
1.50000D+06	4.0779	4.2518	4.4614	12.580	-1.840	-2.497	-2.962
6.00329D+06	4.1656	4.1485	4.4575	12.577	-1.952	-2.600	-3.061
9.18847D+06	4.2399	4.0407	4.4491	12.574	-2.055	-2.693	-3.150
1.13992D+07	4.3018	3.9308	4.4371	12.570	-2.148	-2.777	-3.232
1.29728D+07	4.3522	3.8214	4.4224	12.564	-2.230	-2.852	-3.306
1.42602D+07	4.3995	3.6974	4.4032	12.556	-2.314	-2.930	-3.384
1.50353D+07	4.4315	3.5977	4.3863	12.548	-2.374	-2.987	-3.440
1.57333D+07	4.4619	3.4962	4.3685	12.539	-2.433	-3.043	-3.497
1.60500D+07	4.4774	3.4516	4.3612	12.533	-2.465	-3.073	-3.528
1.62528D+07	4.4890	3.4423	4.3618	12.529	-2.481	-3.090	-3.545
1.63262D+07	4.4950	3.4538	4.3662	12.528	-2.485	-3.093	-3.548
1.63748D+07	4.5028	3.4766	4.3738	12.527	-2.491	-3.099	-3.554
1.63927D+07	4.5082	3.4992	4.3808	12.526	-2.492	-3.100	-3.555
1.64027D+07	4.5141	3.5204	4.3876	12.526	-2.494	-3.101	-3.556
1.64068D+07	4.5181	3.5325	4.3916	12.526	-2.497	-3.104	-3.558
1.64106D+07	4.5246	3.5479	4.3971	12.526	-2.502	-3.108	-3.563
1.64128D+07	4.5310	3.5592	4.4015	12.526	-2.508	-3.116	-3.570
1.64137D+07	4.5400	3.5674	4.4058	12.526	-2.518	-3.124	-3.579
1.64155D+07	4.5515	3.5803	4.4119	12.526	-2.529	-3.135	-3.589
1.64238D+07	4.5367	3.3690	4.3554	12.526	-2.560	-3.165	-3.623
1.64280D+07	4.5490	3.1540	4.3047	12.525	-2.625	-3.233	-3.697
1.64322D+07	4.5569	2.8835	4.2391	12.525	-2.702	-3.319	-3.790
1.64363D+07	4.5521	2.5208	4.1472	12.525	-2.796	-3.425	-3.903
1.64405D+07	4.5271	1.9407	3.9959	12.525	-2.941	-3.569	-4.029
1.64426D+07	4.4942	1.4204	3.8576	12.525	-2.997	-3.567	-3.968
1.64433D+07	4.4672	1.1280	3.7778	12.524	-2.923	-3.421	-3.758

TABLE 15. *Log M = 1.1998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	4.3484	4.2672	4.5078	15.840	-1.771	-2.426	-2.891
1.50000D+05	4.3518	4.2637	4.5078	15.840	-1.775	-2.430	-2.895
2.50988D+06	4.4095	4.2004	4.5064	15.833	-1.851	-2.502	-2.965
6.03841D+06	4.5157	4.0562	4.4969	15.814	-2.008	-2.648	-3.107
8.22543D+06	4.5977	3.9069	4.4801	15.786	-2.147	-2.776	-3.232
9.62059D+06	4.6603	3.7546	4.4577	15.753	-2.268	-2.887	-3.342
1.05315D+07	4.7062	3.6105	4.4331	15.716	-2.367	-2.981	-3.437
1.11339D+07	4.7395	3.4861	4.4103	15.680	-2.448	-3.059	-3.517
1.14317D+07	4.7559	3.4224	4.3985	15.657	-2.489	-3.100	-3.558
1.15936D+07	4.7678	3.3910	4.3937	15.643	-2.514	-3.125	-3.585
1.16809D+07	4.7746	3.3888	4.3948	15.635	-2.526	-3.137	-3.596
1.17294D+07	4.7793	3.3981	4.3983	15.630	-2.533	-3.143	-3.602
1.17564D+07	4.7843	3.4165	4.4041	15.628	-2.536	-3.146	-3.605
1.17714D+07	4.7889	3.4367	4.4103	15.626	-2.538	-3.149	-3.608
1.17797D+07	4.7937	3.4574	4.4167	15.626	-2.541	-3.151	-3.610
1.17844D+07	4.7987	3.4747	4.4223	15.625	-2.544	-3.154	-3.613
1.17870D+07	4.8041	3.4869	4.4267	15.625	-2.550	-3.159	-3.618
1.17884D+07	4.8095	3.4968	4.4305	15.625	-2.556	-3.166	-3.624
1.17890D+07	4.8177	3.5056	4.4348	15.625	-2.567	-3.176	-3.635
1.17903D+07	4.8309	3.5220	4.4422	15.625	-2.584	-3.192	-3.651
1.17946D+07	4.8214	3.4224	4.4149	15.624	-2.594	-3.202	-3.662
1.17975D+07	4.8292	3.2619	4.3767	15.624	-2.644	-3.255	-3.719
1.18004D+07	4.8377	3.0330	4.3216	15.623	-2.717	-3.334	-3.805
1.18033D+07	4.8428	2.7334	4.2480	15.623	-2.809	-3.438	-3.919
1.18062D+07	4.8370	2.3063	4.1398	15.622	-2.937	-3.581	-4.065
1.18073D+07	4.8307	2.0981	4.0861	15.622	-3.000	-3.644	-4.122
1.18087D+07	4.8117	1.7193	3.9867	15.622	-3.095	-3.723	-4.175

TABLE 16. *Log M = 1.2999.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	4.6255	4.2578	4.5496	19.950	-1.735	-2.386	-2.849
1.10000D+05	4.6266	4.2561	4.5496	19.949	-1.736	-2.387	-2.850
1.31000D+06	4.6657	4.2127	4.5485	19.931	-1.794	-2.443	-2.905
4.17518D+06	4.7730	4.0683	4.5392	19.861	-1.969	-2.610	-3.070
5.95640D+06	4.8538	3.9164	4.5215	19.770	-2.128	-2.758	-3.215
6.86216D+06	4.9024	3.7960	4.5035	19.693	-2.237	-2.860	-3.317
7.61307D+06	4.9453	3.6604	4.4803	19.597	-2.343	-2.962	-3.420
8.06605D+06	4.9751	3.5405	4.4578	19.517	-2.432	-3.047	-3.507
8.49468D+06	5.0038	3.4065	4.4315	19.418	-2.524	-3.138	-3.601
8.73772D+06	5.0205	3.3316	4.4169	19.347	-2.580	-3.196	-3.661
8.84744D+06	5.0302	3.3098	4.4139	19.312	-2.607	-3.223	-3.689
8.88861D+06	5.0348	3.3150	4.4164	19.298	-2.616	-3.231	-3.697
8.91705D+06	5.0400	3.3357	4.4228	19.289	-2.621	-3.236	-3.702
8.93036D+06	5.0451	3.3622	4.4307	19.284	-2.623	-3.238	-3.703
8.93651D+06	5.0506	3.3834	4.4374	19.282	-2.629	-3.243	-3.708
8.93933D+06	5.0567	3.3988	4.4428	19.281	-2.638	-3.251	-3.717
8.94035D+06	5.0611	3.4084	4.4463	19.281	-2.644	-3.257	-3.722
8.94084D+06	5.0700	3.4209	4.4516	19.281	-2.657	-3.270	-3.735
8.94223D+06	5.0832	3.4439	4.4607	19.280	-2.678	-3.291	-3.756
8.94618D+06	5.0883	3.2928	4.4242	19.279	-2.728	-3.343	-3.813
8.94776D+06	5.1024	3.1748	4.3982	19.278	-2.788	-3.408	-3.882
8.95092D+06	5.1124	2.8398	4.3169	19.277	-2.908	-3.542	-4.030
8.95329D+06	5.1146	2.4778	4.2270	19.275	-3.041	-3.693	-4.189
8.95487D+06	5.1102	2.1440	4.1425	19.274	-3.164	-3.824	-4.315
8.95606D+06	5.1050	1.8226	4.0608	19.273	-3.278	-3.928	-4.397
8.95665D+06	5.1003	1.6326	4.0121	19.273	-3.338	-3.971	-4.421
8.95724D+06	5.0938	1.4105	3.9550	19.272	-3.391	-3.997	-4.419

TABLE 17. *Log M =1.3998.*

AGE	LOG L	LOG G	LOG TEFF	M	LOG K2	LOG K3	LOG K4
0.00000D+00	4.8812	4.2501	4.5868	25.110	-1.703	-2.350	-2.813
2.15332D+06	4.9688	4.1415	4.5815	24.965	-1.855	-2.500	-2.961
3.93596D+06	5.0566	3.9916	4.5660	24.750	-2.041	-2.678	-3.137
5.07819D+06	5.1213	3.8317	4.5422	24.508	-2.211	-2.838	-3.297
5.60366D+06	5.1566	3.7164	4.5222	24.342	-2.318	-2.941	-3.401
6.12517D+06	5.1904	3.5723	4.4946	24.120	-2.440	-3.058	-3.521
6.31840D+06	5.2059	3.4944	4.4790	24.014	-2.499	-3.117	-3.581
6.63520D+06	5.2294	3.3549	4.4500	23.811	-2.603	-3.223	-3.692
6.85471D+06	5.2451	3.2575	4.4296	23.641	-2.679	-3.300	-3.774
6.93296D+06	5.2545	3.2043	4.4186	23.574	-2.725	-3.347	-3.822
7.01198D+06	5.2660	3.2049	4.4216	23.502	-2.756	-3.380	-3.857
7.02190D+06	5.2692	3.2214	4.4266	23.492	-2.759	-3.382	-3.858
7.02884D+06	5.2736	3.2444	4.4334	23.486	-2.764	-3.387	-3.862
7.03152D+06	5.2770	3.2600	4.4382	23.483	-2.768	-3.391	-3.866
7.03341D+06	5.2818	3.2772	4.4437	23.481	-2.775	-3.397	-3.873
7.03410D+06	5.2880	3.2912	4.4487	23.481	-2.786	-3.408	-3.884
7.03481D+06	5.2996	3.3170	4.4581	23.480	-2.808	-3.430	-3.905
7.03907D+06	5.3156	3.1686	4.4250	23.476	-2.893	-3.520	-4.002
7.04192D+06	5.3358	2.8205	4.3430	23.472	-3.064	-3.711	-4.210
7.04582D+06	5.3485	2.0352	4.1498	23.466	-3.444	-4.122	-4.618
7.04689D+06	5.3503	1.7296	4.0739	23.464	-3.587	-4.245	-4.709
7.04742D+06	5.3516	1.5602	4.0319	23.463	-3.661	-4.297	-4.737
7.04866D+06	5.3557	1.1452	3.9292	23.461	-3.786	-4.337	-4.700
7.04973D+06	5.3587	0.8116	3.8465	23.459	-3.736	-4.170	-4.449
7.05061D+06	5.3609	0.5792	3.7889	23.457	-3.532	-3.860	-4.069
7.05221D+06	5.3630	0.2258	3.7011	23.453	-3.061	-3.274	-3.412
7.05470D+06	5.3630	-0.1501	3.6072	23.448	-2.365	-2.516	-2.619

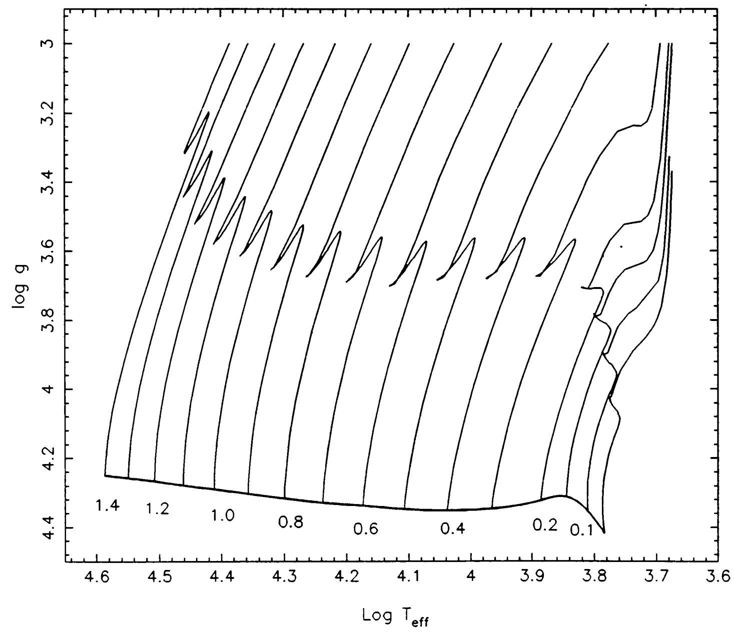

FIGURE 1. Evolutionary tracks in the log g - log $T_{\rm eff}$ plane. Labels attached denote the logarithm of mass.

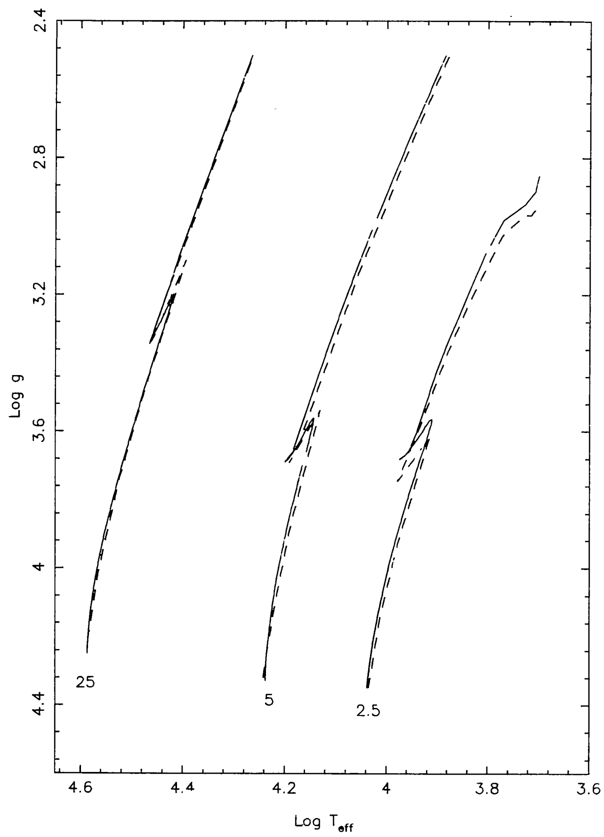

FIGURE 2. Comparative HR diagram for the present models (full lines) and those from Maeder and Meynet (1989) (dashed) for initial mass of 2.5, 5 and 25 $m_{\odot}$.

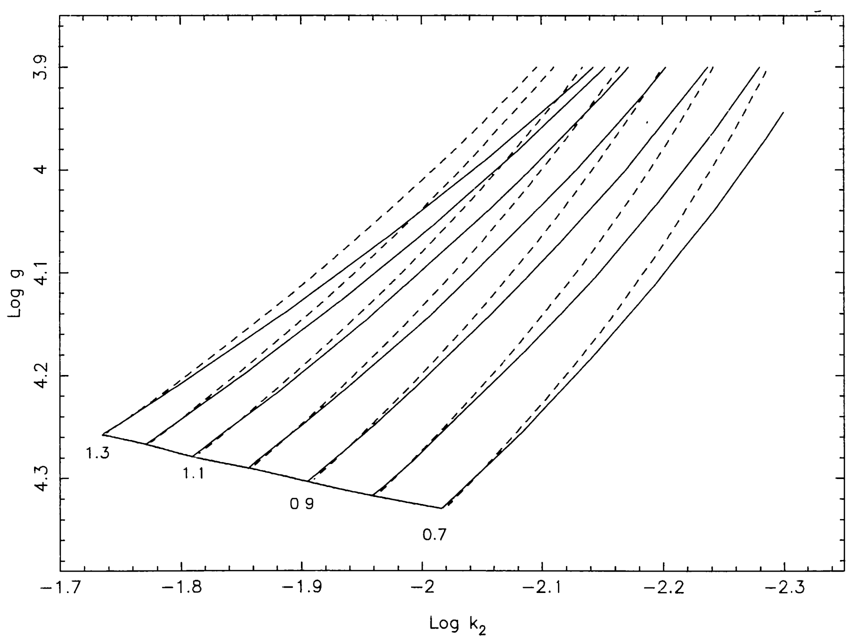

FIGURE 3. Log g - log k_2 plane for some selected models with overshooting and mass loss (full) and standard (dashed) from Claret and Giménez (1989). Labels attached denote the logarithm of mass.