PARSEC V2.0 Tracks

This database of tracks contains sets of tracks computed with a mass that ranges from 0.09 M_{sun} to 14 M_{sun}, with six metallicity values between Z=0.004 and Z=0.017, and with seven different values of initial rotation rate, from no rotation to the critical one. As described in detail in Nguyen et al. 2022, each set of tracks is composed by different type of tracks. Stellar tracks with a mass above about 0.7 M_{sun} are the new tracks and have been computed with PARSEC v2.0. Tracks with a mass below about 0.7 M_{sun} and horizontal branch tracks (files with the `.HB` extension) are tracks from the old database, computed with PARSEC V1.2s.

The following table lists the quantities contained in the new tracks, with 0.7 M_{sun} <= M <= 2 M_{sun}:

Column number	Quantity	Description
1	MODE	Model number
2	MASS	Current total mass [M_{sun}]
3	AGE	Age [yr]
4	Dtime	Time-step [yr]
5	LOG_L	$\log_{10}$ total luminosity [$\log_{10} L_{sun}$]
6	LOG_TE	effective temperature [$\log_{10}$ K]
7	RSTAR	Star radius [cm]
8	CONV	Mass of the homogeneous core (incl. overshooting) [M/M_{tot}]
9	QSCHW	Mass of the unstable core (Schwartzschild mass) [M/M_{tot}]
10	QDISC	Mass where $X - X_{surface} < 10^{-3}$ [M/M_{tot}]
11	QH_HE	Mass where $X = 0.5*(X_{max}+X_{min})$ [M/M_{tot}]
12	QHEL	Mass where X = 0 [M/M_{tot}]
13	Q_HE_CO	Mass where $Y = 0.5*(Y_{max}+Y_{min})$ [M/M_{tot}]
14	QCAROX	Mass where Y = 0 [M/M_{tot}]
15	LOG_Tc	$\log_{10}$ central temperature [$\log_{10}$ K]
16	LOG_RHc	$\log_{10}$ central density [$\log_{10}$ g cm^{-3}]
17	LOG_Pc	$\log_{10}$ central pressure [$\log_{10}$ 10^{-1} Pa]
18	PSI_C	degeneracy parameter at center

Column number	Quantity	Description
19	G1_AVG	Average Gamma 1 adiabatic index, see Marchant et al. 2019
20	G1_AVG_CO	The same as G1_AVG but the average is calculated up to QCAROX
21	XCEN	central H1 mass fraction
22	XHE3C	central He3 mass fraction
23	YCEN	central He4 mass fraction
24	XC_CEN	central C12 mass fraction
25	XN_CEN	central N14 mass fraction
26	XO_CEN	central O16 mass fraction
27	XNE_CEN	central Ne20+Ne22 mass fraction
28	XMG_CEN	central Mg24+Mg25+Mg26 mass fraction
29	XSI28_CEN	central Si28 mass fraction
30	XS32_CEN	central S32 mass fraction
31	XAR36_CEN	central Ar36 mass fraction
32	XCA40_CEN	central Ca40 mass fraction
33	XTI44_CEN	central Ti44 mass fraction
34	DM	M_{tot} variation (< 0 for mass loss > for accretion) [M_{sun}]
35	RATE	Mass loss or accretion rate [M_{sun} yr^{-1}]
36	M	Number of mesh points
37	MO1	Last saved model, from which you can restart
38	OUTALF	MLT alpha coefficient
39	Xsup	surface H1 mass fraction
40	Ysup	surface He4 mass fraction
41	XCsup	surface C12 mass fraction
42	XC13sup	surface C13 mass fraction
43	XNsup	surface N14 mass fraction
44	XOsup	surface O16 mass fraction
45	XO18sup	surface O18 mass fraction
46	XNEsup	surface Ne20 + Ne22 mass fraction
47	XMGsup	surface Mg24 + Mg25 + Mg26 mass fraction

Column number	Quantity	Description
48	MU	mean molecular weight at the center
49	POLRAD_ENV	star polar radius [cm]
50	EQRAD_ENV	star equatorial radius [cm]
51	OMG_ENV	angular rotation rate = angular velocity / angular critical velocity
52	ANG_VEL_ENV	envelope angular velocity [cm s^{-1}]
53	TANVEL_ENV	tangential linear velocity at the equator[cm s^{-1}]
54	TOT_INERTIA	Total moment of inertia of the star [g cm^2]]
55	TOT_ANGMOM	Total angular momentum [g cm^2 s^{-1}]
56	TOT_MOM_LOST	Total angular momentum lost due to stellar wind [g cm^2 s^{-1}]
57	VAR_MOMANG	Relative variation of Tot.Ang.Mom = (Tot_AngMom - Tot_Mom_0)/Tot_Mom_0
58	R_CONV	Radius at CONV [$\log_{10}$ cm]
59	R_SCHW	Radius of the unstable core [$\log_{10}$ cm]
60	R_DISC	Radius at QDISC [$\log_{10}$ cm]
61	R_H_HE	Radius at QH_HE [$\log_{10}$ cm]
62	RHEL	Radius at QHEL [$\log_{10}$ cm]
63	R_HE_CO	Radius at Q_HE_CO [$\log_{10}$ cm]
64	R_CAROX	Radius at QCAROX [$\log_{10}$ cm]
65	TMAX	maximum temperature [$\log_{10}$ K]
66	RHTMAX	Density where T = TMAX [$\log_{10}$ g cm^{-3}]
67	QTMAX	Mass coordinate where T = TMAX [M/M_{tot}]
68	LNUC	luminosity produced by nuclear burning [L/L_{tot}]
69	LX	luminosity by hydrogen burning [L/L_{tot}]
70	QH1	Mass coordinate of the bottom of Hydrogen burning zone [M/M_{tot}]
71	QH2	Mass coordinate of the top of the Hydrogen burning zone [M/M_{tot}]
72	LY	luminosity by helium burning [L/L_{tot}]

Column number	Quantity	Description
73	QHE1	Mass coordinate of the bottom of He burning zone [M/M_{tot}]
74	QHE2	Mass coordinate of the top of He burning zone [M/M_{tot}]
75	LC	luminosity by carbon burning [L/L_{tot}]
76	QC1	Mass coordinate of the bottom of C burning zone [M/M_{tot}]
77	QC2	Mass coordinate of the top of C burning zone [M/M_{tot}]
78	LNEUTR	neutrino luminosity [L/L_{tot}]
79	L_GRAV	gravitational luminosity [L/L_{tot}]
80	L_ACC	accretion luminosity [L/L_{tot}]
81	LYYY	luminosity provided by triple alpha reaction [L/L_{tot}]
82	LYC	luminosity provived by alpha capture on carbon [L/L_{tot}]
83	LYO	luminosity provided by alpha capture on oxygen [L/L_{tot}]
84	N_C	not used
85	AL_X_TOT	not used
86	EGENV_H	gravitational energy of H-rich envelope + atmosphere [$\log_{10}$ erg]
87	EGENV_HE	gravitational energy of He-rich envelope [$\log_{10}$ erg]
88	ENTAL_H	enthalpy of H-rich envelope + atmosphere [erg]
89	ENTAL_HE	enthalpy of He-rich envelope [erg]
90	E_INT_H	internal energy of H-rich envelope + atmosphere [$\log_{10}$ erg]
91	E_INT_HE	internal energy of He-rich envelope [$\log_{10}$ erg]
92	ES_TOT	total entropy [erg K^{-1}]]
93	Q_CNV	depth of convective envelope [M/M_{tot}]
94	DPTH_CNV	radial depth of convective envelope [$\log_{10}$ cm]
95	TCNV_YR	turnover timescale of convective bubble [yr]
96	PHS	Evolutionary phase. 0 = PMS, 1 = MS, 3 = SUBG, 4 = RGB, 5 = AGB (for M_{ini} <14)
97	CI1	upper border of first conv zone [M/M_{tot}]
98	CF1	bottom of first conv zone [M/M_{tot}]

Column number	Quantity	Description
99	CI2	upper border of second conv zone [M/M_{tot}]
100	CF2	bottom of second conv zone [M/M_{tot}]
101	CI3	upper border of third conv zone [M/M_{tot}]
102	CF3	bottom of third conv zone [M/M_{tot}]
103	CI4	upper border of fourth conv zone [M/M_{tot}]
104	CF4	bottom of fourth conv zone [M/M_{tot}]
105	T20L10	atmosphere temperature of the gas at tau = 20 [$\log_{10}$ K]
106	RH20L10	atmosphere density of the gas at tau = 20 [$\log_{10}$ g cm^{-3}]
107	P20L10	atmosphere pressure of the gas at tau = 20 [$\log_{10}$ 10^{-1} Pa]
108	TE20L10	"Effective temperature" (the one from boltzman-stefan law) at tau = 20 [$\log_{10}$ K]
109	R20L10	atmosphere radius at tau = 20 [$\log_{10}$ cm]
110	T2_3L10	atmosphere temperature of the gas at tau = 2/3 [$\log_{10}$ K]
111	RH2_3L10	Atmosphere density of the gas at tau = 2/3 [$\log_{10}$ g cm^{-3}]
112	P2_3L10	Atmosphere pressure of the gas at tau = 2/3 [$\log_{10}$ 10^{-1} Pa]
113	TE2_3L10	temperature from Stefan-Boltzmann law at tau = 2/3 [$\log_{10}$ K]
114	R2_3L10	Atmosphere radius at tau = 2/3 [$\log_{10}$ cm]
115	FIT_M	mass of the fitting point [M/M_{tot}]
116	COMP_TIME	Elapsed time (not CPU time) [s]

The following table lists the quantities contained in the tracks, with M <= 0.7 M_{sun} (Chen et al. 2014):

Column number	Quantity	Description
1	MODE	Model number
2	MASS	Current total mass [M_{sun}]
3	AGE	Age [yr]
4	Dtime	Time-step [yr]
5	LOG_L	$\log_{10}$ total luminosity [$\log_{10}$ L_{sun}]

Column number	Quantity	Description
6	LOG_TE	effective temperature [$\log_{10}$ K]
7	CONV	Mass of the homogeneous core (incl. overshooting) [M/M_{tot}]
8	QSCHW	Mass of the unstable core (Schwartzschild mass) [M/M_{tot}]
9	QDISC	Mass where $X - X_{surface} < 10^{-3}$ [M/M_{tot}]
10	QINTE	Mass where $X = 0.5*(X_{max}+X_{min})$ [M/M_{tot}]
11	QHEL	Mass where X = 0 [M/M_{tot}]
12	QCAROX	Mass where Y = 0 [M/M_{tot}]
13	LOG_Tc	$\log_{10}$ central temperature [$\log_{10}$ K]
14	LOG_RHc	$\log_{10}$ central density [$\log_{10}$ g cm^{-3}]
15	LOG_Pc	$\log_{10}$ central pressure [$\log_{10}$ 10^{-1} Pa]
16	QTMAX	Mass coordinate where T = TMAX [M/M_{tot}]
17	XCEN	central H1 mass fraction
18	XHE3C	central He3 mass fraction
19	YCEN	central He4 mass fraction
20	DM	M_{tot} variation (< 0 for mass loss > for accretion) [M_{sun}]
21	RATE	Mass loss or accretion rate [M_{sun} yr^{-1}]
22	M	Number of mesh points
23	MO1	Last saved model, from which you can restart
24	XC_cen	central C12 mass fraction
25	XO_cen	central O16 mass fraction
26	XN_cen	central N14 mass fraction
27	Rhtmax	Log10 Density where T = TMAX [Log g cm^{-3}]
28	Xsup	surface H1 mass fraction
29	Ysup	surface He4 mass fraction
30	XCsup	surface C12 mass fraction
31	XOsup	surface O16 mass fraction
32	XNsup	surface N14 mass fraction
33	XC13sup	surface C13 mass fraction

Column number	Quantity	Description
34	LNUC	luminosity produced by nuclear burning [L/L_{tot}]
35	LX	luminosity by hydrogen burning [L/L_{tot}]
36	QH1	Mass coordinate of the bottom of Hydrogen burning zone [M/M_{tot}]
37	QH2	Mass coordinate of the top of the Hydrogen burning zone [M/M_{tot}]
38	LY	luminosity by helium burning [L/L_{tot}]
39	QHE1	Mass coordinate of the bottom of He burning zone [M/M_{tot}]
40	QHE2	Mass coordinate of the top of He burning zone [M/M_{tot}]
41	LC	luminosity by carbon burning [L/L_{tot}]
42	QC1	Mass coordinate of the bottom of C burning zone [M/M_{tot}]
43	QC2	Mass coordinate of the top of C burning zone [M/M_{tot}]
44	LNEUTR	neutrino luminosity [L/L_{tot}]
45	L_EX_LT	**check** [L/L_{tot}]
46	lgL_SCT	**check** [L/L_{tot}]
47	lgL_AC	**check** [L/L_{tot}]
48	lgL_AC_T	**check** [L/L_{tot}]
49	L_GRAV	gravitational luminosity [L/L_{tot}]
50	Rstar	Star radius [cm]
51	r_x	**check**
52	tau_xy	**check**
53	tau_thy	**check**
54	f_th	**check**
55	n_c	**check**
56	aL_x_tot	**check**
57	MU	mean molecular weight at the center **check**
58	MU_E	mean molecular weight for electrons at the center **check**
59	CI1	upper border of first conv zone [M/M_{tot}]
60	CF1	bottom of first conv zone [M/M_{tot}]

Column number	Quantity	Description
61	CI2	upper border of second conv zone [M/M_{tot}]
62	CF2	bottom of second conv zone [M/M_{tot}]
63	CI3	upper border of third conv zone [M/M_{tot}]
64	CF3	bottom of third conv zone [M/M_{tot}]
65	CI4	upper border of fourth conv zone [M/M_{tot}]
66	CF4	bottom of fourth conv zone [M/M_{tot}]
67	CI5	upper border of fifth conv zone [M/M_{tot}]
68	CF5	bottom of fifth conv zone [M/M_{tot}]
69	MFIT	mass of the fitting point [M/M_{tot}] **check**
70	CPU_SEC	CPU time **check** [s]

The following table lists the quantities contained in the tracks, with M >= 2.0 M_{sun} (Costa et al. 2019b):

Column number	Quantity	Description
1	MODE	Model number
2	MASS	Current total mass [M_{sun}]
3	AGE	Age [yr]
4	Dtime	Time-step [yr]
5	LOG_L	$\log_{10}$ total luminosity [$\log_{10}$ L_{sun}]
6	LOG_TE	effective temperature [$\log_{10}$ K]
7	Rstar	Star radius [cm]
8	Rpol	star polar radius [cm]
9	Req	star equatorial radius [cm]
10	OMEGA	angular rotation rate = angular velocity / angular critical velocity
11	Ang_vel	envelope angular velocity [cm s^{-1}]
12	Vtan_eq	tangential linear velocity at the equator[cm s^{-1}]
13	Mom_Iner	Total moment of inertia of the star [g cm^2]]
14	Mom_ang	Total angular momentum [g cm^2 s^{-1}]

Column number	Quantity	Description
15	Mom_lost	Total angular momentum lost due to stellar wind [g cm^2 s^{-1}]
16	Var_MomAng	Relative variation of Tot.Ang.Mom = (Tot_AngMom - Tot_Mom_0)/Tot_Mom_0
17	CONV	Mass of the homogeneous core (incl. overshooting) [M/M_{tot}]
18	QSCHW	Mass of the unstable core (Schwartzschild mass) [M/M_{tot}]
19	QDISC	Mass where $X - X_{surface} < 10^{-3}$ [M/M_{tot}]
20	QH_HE	Mass where $X = 0.5*(X_{max}+X_{min})$ [M/M_{tot}]
21	QHEL	Mass where X = 0 [M/M_{tot}]
22	QHE_co	Mass where $X = 0.5*(X_{max}+X_{min})$ [M/M_{tot}]
23	QCAROX	Mass where Y = 0 [M/M_{tot}]
24	LOG_Tc	$\log_{10}$ central temperature [$\log_{10}$ K]
25	LOG_RHc	$\log_{10}$ central density [$\log_{10}$ g cm^{-3}]
26	LOG_Pc	$\log_{10}$ central pressure [$\log_{10}$ 10^{-1} Pa]
27	QTMAX	Mass coordinate where T = TMAX [M/M_{tot}]
28	XCEN	central H1 mass fraction
29	XHE3C	central He3 mass fraction
30	YCEN	central He4 mass fraction
31	DM	M_{tot} variation (< 0 for mass loss > for accretion) [M_{sun}]
32	RATE	Mass loss or accretion rate [M_{sun} yr^{-1}]
33	M	Number of mesh points
34	MO1	Last saved model, from which you can restart
35	XC_cen	central C12 mass fraction
36	XO_cen	central O16 mass fraction
37	XN_cen	central N14 mass fraction
38	Tmax	Log10 maximum temperature [Log K]
39	Xsup	surface H1 mass fraction
40	Ysup	surface He4 mass fraction

Column number	Quantity	Description
41	XCsup	surface C12 mass fraction
42	XOsup	surface O16 mass fraction
43	XNsup	surface N14 mass fraction
44	XC13sup	surface C13 mass fraction
45	LNUC	luminosity produced by nuclear burning [L/L_{tot}]
46	LX	luminosity by hydrogen burning [L/L_{tot}]
47	QH1	Mass coordinate of the bottom of Hydrogen burning zone [M/M_{tot}]
48	QH2	Mass coordinate of the top of the Hydrogen burning zone [M/M_{tot}]
49	LY	luminosity by helium burning [L/L_{tot}]
50	QHE1	Mass coordinate of the bottom of He burning zone [M/M_{tot}]
51	QHE2	Mass coordinate of the top of He burning zone [M/M_{tot}]
52	LC	luminosity by carbon burning [L/L_{tot}]
53	QC1	Mass coordinate of the bottom of C burning zone [M/M_{tot}]
54	QC2	Mass coordinate of the top of C burning zone [M/M_{tot}]
55	LNEUTR	neutrino luminosity [L/L_{tot}]
56	L_GRAV	gravitational luminosity [L/L_{tot}]
57	LYYY	luminosity provided by triple alpha reaction [L/L_{tot}]
58	LYC	luminosity provived by alpha capture on carbon [L/L_{tot}]
59	LYO	luminosity provided by alpha capture on oxygen [L/L_{tot}]
60	MLT	MLT alpha coefficient
61	n_c	**check**
62	aL_x_tot	**check**
63	XNECEN	central Ne20+Ne22 mass fraction
64	XNEsup	surface Ne20 + Ne22 mass fraction
65	XMGCEN	central Mg24+Mg25+Mg26 mass fraction
66	XMGsup	surface Mg24 + Mg25 + Mg26 mass fraction
67	MU	mean molecular weight at the center **check**

Column number	Quantity	Description
68	MU_E	mean molecular weight for electrons at the center **check**
69	R_H_HE	Radius at QH_HE [$\log_{10}$ cm]
70	RHEL	Radius at QHEL [$\log_{10}$ cm]
71	R_HE_CO	Radius at Q_HE_CO [$\log_{10}$ cm]
72	R_CAROX	Radius at QCAROX [$\log_{10}$ cm]
73	I_HE_CO	Moment of inertia within Q_HE_CO [g cm^2]]
74	AM_HE_CO	Angular momentum within Q_HE_CO [g cm^2 s^{-1}]
75	I_CAROX	Moment of inertia within Q_CAROX [g cm^2]]
76	AM_CAROX	Angular momentum within Q_CAROX [g cm^2 s^{-1}]
77	eg_envH	gravitational energy of H-rich envelope + atmosphere [$\log_{10}$ erg]
78	eg_encvHE	gravitational energy of He-rich envelope [$\log_{10}$ erg]
79	Q_CNV	depth of convective envelope [M/M_{tot}]
80	DPTH_CNV	radial depth of convective envelope [$\log_{10}$ cm]
81	INERT_CNV	Moment of iniertia of the convective envelope [g cm^2]]
82	TCNV_YR	turnover timescale of convective bubble [yr]
83	PHS	Evolutionary phase. 0 = PMS, 1 = MS, 3 = SUBG, 4 = RGB, 5 = AGB (for M_{ini} <14)
84	CI1	upper border of first conv zone [M/M_{tot}]
85	CF1	bottom of first conv zone [M/M_{tot}]
86	CI2	upper border of second conv zone [M/M_{tot}]
87	CF2	bottom of second conv zone [M/M_{tot}]
88	CI3	upper border of third conv zone [M/M_{tot}]
89	CF3	bottom of third conv zone [M/M_{tot}]
90	CI4	upper border of fourth conv zone [M/M_{tot}]
91	CF4	bottom of fourth conv zone [M/M_{tot}]
92	MFIT	mass of the fitting point [M/M_{tot}] **check**
93	CPU_SEC	CPU time **check** [s]