List of Header Columns

I. OVERVIEW

The first table in this document lists the column headers that appear in the `.eep.track`, `.iso`, and `.iso.cmd` files, and a brief description for each. Note that not all column headers appear in each type of file. Also note that the filters in `.iso.cmd` are listed in a separate table, also found in this document. All logarithms that appear in this list are base 10. Surface and central abundances are averaged over the outer and inner $10^{-6}\%$ of the total stellar mass.

Theoretical isochrones are provided in two flavors: basic and full. The basic isochrones contain columns such as age, stellar mass, $\dot{M}$, $\log L$, $\log T_{\rm eff}$, $\log g$, and surface and central abundances of a few elements, whereas the full isochrones are much more comprehensive. Columns that appear in the basic file are marked by an asterisk (*) in the table below.

The second table in this document lists the primary equivalent evolutionary points (EEPs) and their corresponding EEP number.

The third table in this document lists the currently available filters. This is only an initial set and will expand over time. The zero points depend on the photometric system—check the file headers for details.

TABLE I: EEP Track and Isochrone Column Headers

Column Name	**Description**
Appears in `.track.eep` *Only*	
`star_age`	Age in years
Appears in `.iso.cmd` *Only*	
`Zsurf`	Surface metal mass fraction
Appears in `.iso` *and* `.iso.cmd` *Only*	
`EEP`*	Equivalent Evolutionary Point number
`initial_mass`*	Initial mass in $M_\odot$
`log10_isochrone_age_yr`*	Age of the isochrone in log years
OR	
`isochrone_age_yr`*	Age of the isochrone in years
Appears in `.track.eep`, `.iso`, *and* `.iso.cmd`	
`star_mass`*	Current mass in $M_\odot$
`star_mdot`*	Mass loss rate in $M_\odot$/year
`he_core_mass`*	Mass of the helium-rich core in $M_\odot$
`c_core_mass`*	Mass of the carbon-rich core in $M_\odot$
`o_core_mass`	Mass of the oxygen-rich core in $M_\odot$
`log_L`*	Log bolometric luminosity in $L_\odot$
`log_L_div_Ledd`	Log ratio of bolometric luminosity and Eddington luminosity, where the Eddington luminosity is a mass-weighted average over the optical depth τ between 1 and 100
`log_LH`*	Log hydrogen-burning luminosity in $L_\odot$
`log_LHe`*	Log helium-burning luminosity in $L_\odot$
`log_LZ`	Log total burning luminosity excluding H-burn, He-burn, and photodisintegrations in $L_\odot$
`log_Teff`*	Log effective temperature in K
`log_abs_Lgrav`	Log gravitational potential luminosity in $L_\odot$
`log_R`*	Log radius in $R_\odot$
`log_g`*	Log surface gravity in cm s^{-2}
`log_surf_cell_z` (*previously named* `log_surf_z`)	Log surface mass fraction in metals
`surf_avg_omega`	Surface angular rotation speed
`surf_avg_v_rot`	Surface rotation speed
`surf_num_c12_div_num_o16`	Ratio of surface number densities of ^{12}C and ^{16}O
`v_wind_Km_per_s`	Wind speed $v_{\rm w} \equiv \kappa \dot{M}/4\pi R \tau$, where $\kappa \equiv$ opacity and $\tau = 2/3$, in km/s
`surf_avg_omega_crit`	Surface (mass-averaged down to $\tau = 100$) critical angular rotation speed
`surf_avg_omega_div_omega_crit`	Ratio of surface and critical angular rotation speeds
`surf_avg_v_crit`	Surface critical/breakup rotation speed
`surf_avg_v_div_v_crit`	Ratio of surface and critical rotation speeds
`surf_avg_Lrad_div_Ledd`	Ratio of surface radiative luminosity and Eddington luminosity
`v_div_csound_surf`	Ratio of velocity and sound speed at the surface
`surf_r_equatorial_div_r`	Equatorial radius in units of “effective radius” computed following Endal & Sofia 1976
`surf_r_polar_div_r`	Polar radius in units of “effective radius”

	computed following Endal & Sofia 1976
`total_angular_momentum`	Total angular momentum in the stellar interior
`surface_h1`*	Surface mass fraction in ^{1}H
`surface_he3`*	Surface mass fraction in ^{3}He
`surface_he4`*	Surface mass fraction in ^{4}He
`surface_li7`	Surface mass fraction in ^{7}Li
`surface_be9`	Surface mass fraction in ^{9}Be
`surface_b11`	Surface mass fraction in ^{11}B
`surface_c12`*	Surface mass fraction in ^{12}C
`surface_c13`	Surface mass fraction in ^{13}C
`surface_n14`	Surface mass fraction in ^{14}N
`surface_o16`*	Surface mass fraction in ^{16}O
`surface_f19`	Surface mass fraction in ^{19}F
`surface_ne20`	Surface mass fraction in ^{20}Ne
`surface_na23`	Surface mass fraction in ^{23}Na
`surface_mg24`	Surface mass fraction in ^{24}Mg
`surface_si28`	Surface mass fraction in ^{28}Si
`surface_s32`	Surface mass fraction in ^{32}S
`surface_ca40`	Surface mass fraction in ^{40}Ca
`surface_ti48`	Surface mass fraction in ^{48}Ti
`surface_fe56`	Surface mass fraction in ^{56}Fe
`log_center_T`*	Log central temperature in K
`log_center_Rho`*	Log central density in g cm^{-3}
`center_degeneracy`	Central electron chemical potential in $k_\mathrm{b}T$, where $k_b \equiv$ Boltzmann constant and $T \equiv$ temperature
`center_omega`	Central angular rotation speed
`center_gamma`*	Central plasma interaction parameter $\bar{Z}^2 e^2/a_i k_b T$, where $\bar{Z} \equiv$ average ion charge, $e \equiv$ electron charge, and $a_i \equiv$ mean ion spacing
`mass_conv_core`	Mass of the convective core in $M_\odot$
`center_h1`*	Center mass fraction in ^{1}H
`center_he4`*	Center mass fraction in ^{4}He
`center_c12`*	Center mass fraction in ^{12}C
`center_n14`	Center mass fraction in ^{14}N
`center_o16`	Center mass fraction in ^{16}O
`center_ne20`	Center mass fraction in ^{20}Ne
`center_mg24`	Center mass fraction in ^{24}Mg
`center_si28`	Center mass fraction in ^{28}Si
`pp`	Log luminosity from pp-chain
`cno`	Log luminosity from CNO-cycle
`tri_alfa`	Log luminosity from triple α
`burn_c`	Log luminosity from carbon-burning
`burn_n`	Log luminosity from nitrogen-burning
`burn_o`	Log luminosity from oxygen-burning
`c12_c12`	Log luminosity from carbon-carbon burning
`delta_nu`	Large frequency separation for p-modes in μHz
`delta_Pg`	Period spacing for $l = 1$ g-mode in seconds
`nu_max`	Frequency of maximum power in μHz as estimated from scaling relations
`acoustic_cutoff`	Maximum frequency for p-modes at surface
`max_conv_vel_div_csound`	Maximum ratio of convective velocity and sound speed in the stellar interior
`max_gradT_div_grada`	Maximum ratio of ∇_T and ∇_ad in the stellar interior
`gradT_excess_alpha`	Denoted by α_∇ and referred to as the "Smoothing parameter for MLT$_{++}$" in Paxton et al. 2013.

	Number between 0 and 1 describing the effectiveness with which the MLT$_{++}$ prescription is used to aid the evolution calculations by reducing the superadiabaticity
`min_Pgas_div_P`	Minimum ratio of gas pressure to the total pressure in the stellar interior
`max_L_rad_div_Ledd`	Maximum ratio of radiative luminosity and Eddington luminosity in the interior
`e_thermal`	Total thermal energy in the stellar interior in ergs
`envelope_binding_energy`	Total binding energy in the envelope, defined as the H-rich region, i.e., hydrogen mass fraction is above 10^{-4}
`conv_env_top_mass`	Location of the top of the convection zone in mass
`conv_env_bot_mass`	Location of the bottom of the convection zone in mass
`conv_env_top_radius`	Location of the top of the convection zone in radius
`conv_env_bot_radius`	Location of the botoom of the convection zone in radius
`conv_env_turnover_time_l_t`	Turnover time (seconds) in the convective envelope, defined to be the mixing length ($\alpha_{\rm MLT} H_P$) divided by the $v_{\rm conv}$ evaluated one full mixing length above `conv_env_bot_radius`
`conv_env_turnover_time_l_b`	Turnover time (seconds) in the convective envelope, defined to be the mixing length ($\alpha_{\rm MLT} H_P$) divided by the $v_{\rm conv}$ evaluated one half mixing length above `conv_env_bot_radius`
`conv_env_turnover_time_g`	"Globally-averaged" turnover time (seconds) in the convective envelope, $dr/v_{\rm conv}(r)$ integrated over the entire convective envelope
`phase`*	FSPS phase type defined as follows: -1=PMS, 0=MS, 2=RGB, 3=CHeB, 4=EAGB, 5=TPAGB, 6=postAGB, 9=WR Caution: There may be overlap between MS and WR for very massive stars. Always double-check!

TABLE II: Primary EEPs

Primary EEP	EEP Number[a]	Phase
1	1	pre-main sequence (PMS)
2	202	zero age main sequence (ZAMS)
3	353	intermediate age main sequence (IAMS)
4	454	terminal age main sequence (TAMS)
5	605	tip of the red giant branch (RGBTip)
6	631	zero age core helium burning (ZACHeB)[b]
7	707	terminal age core helium burning (TACHeB)[c]
Low Mass Type		
8	808	thermally pulsating asymptotic giant branch (TPAGB)
9	1409	post asymptotic giant branch (post-AGB)
10	1710	white dwarf cooling sequence (WDCS)
High Mass Type		
8	808	carbon burning (C-burn)

[a]Also equivalent to $i + 1$ where i is the index of the array (zero-based) containing the evolutionary track.
[b]i.e., zero age horizontal branch; ZAHB for low-mass stars.
[c]terminal age horizontal branch; TAHB.

TABLE III: Currently Available Filters

Name	**Reference**
`Bessell_U`	[1]
`Bessell_B`	
`Bessell_V`	
`Bessell_R`	
`Bessell_I`	
`2MASS_J`	[2]
`2MASS_H`	
`2MASS_Ks`	
`SDSS_u`	[3]
`SDSS_g`	
`SDSS_r`	
`SDSS_i`	
`SDSS_z`	
`WFPC2_F218W`	[4]
`WFPC2_F255W`	
`WFPC2_F300W`	
`WFPC2_F336W`	
`WFPC2_F439W`	
`WFPC2_F450W`	
`WFPC2_F555W`	
`WFPC2_F606W`	
`WFPC2_F622W`	
`WFPC2_F675W`	

WFPC2_F791W	
WFPC2_F814W	
WFPC2_F850LP	
ACS_HRC_F220W	[5]
ACS_HRC_F250W	
ACS_HRC_F330W	
ACS_HRC_F344N	
ACS_HRC_F435W	
ACS_HRC_F475W	
ACS_HRC_F502N	
ACS_HRC_F550M	
ACS_HRC_F555W	
ACS_HRC_F606W	
ACS_HRC_F625W	
ACS_HRC_F658N	
ACS_HRC_F660N	
ACS_HRC_F775W	
ACS_HRC_F814W	
ACS_HRC_F850LP	
ACS_HRC_F892N	
ACS_WFC_F435W	
ACS_WFC_F475W	
ACS_WFC_F502N	
ACS_WFC_F550M	
ACS_WFC_F555W	
ACS_WFC_F606W	
ACS_WFC_F625W	
ACS_WFC_F658N	
ACS_WFC_F660N	
ACS_WFC_F775W	
ACS_WFC_F814W	
ACS_WFC_F850LP	
ACS_WFC_F892N	
WFC3_UVIS_F200LP	[6]
WFC3_UVIS_F218W	
WFC3_UVIS_F225W	
WFC3_UVIS_F275W	
WFC3_UVIS_F280N	
WFC3_UVIS_F300X	
WFC3_UVIS_F336W	
WFC3_UVIS_F343N	
WFC3_UVIS_F350LP	
WFC3_UVIS_F373N	
WFC3_UVIS_F390M	
WFC3_UVIS_F390W	
WFC3_UVIS_F395N	
WFC3_UVIS_F410M	
WFC3_UVIS_F438W	
WFC3_UVIS_F467M	
WFC3_UVIS_F469N	
WFC3_UVIS_F475W	
WFC3_UVIS_F475X	
WFC3_UVIS_F487N	
WFC3_UVIS_F502N	
WFC3_UVIS_F547M	

WFC3_UVIS_F555W	
WFC3_UVIS_F600LP	
WFC3_UVIS_F606W	
WFC3_UVIS_F621M	
WFC3_UVIS_F625W	
WFC3_UVIS_F631N	
WFC3_UVIS_F645N	
WFC3_UVIS_F656N	
WFC3_UVIS_F657N	
WFC3_UVIS_F658N	
WFC3_UVIS_F665N	
WFC3_UVIS_F673N	
WFC3_UVIS_F680N	
WFC3_UVIS_F689M	
WFC3_UVIS_F763M	
WFC3_UVIS_F775W	
WFC3_UVIS_F814W	
WFC3_UVIS_F845M	
WFC3_UVIS_F850LP	
WFC3_UVIS_F953N	
WFC3_IR_F098M	
WFC3_IR_F105W	
WFC3_IR_F110W	
WFC3_IR_F125W	
WFC3_IR_F126N	
WFC3_IR_F127M	
WFC3_IR_F128N	
WFC3_IR_F130N	
WFC3_IR_F132N	
WFC3_IR_F139M	
WFC3_IR_F140W	
WFC3_IR_F153M	
WFC3_IR_F160W	
WFC3_IR_F164N	
WFC3_IR_F167N	
IRAC_3.6	[7]
IRAC_4.5	
IRAC_5.8	
IRAC_8.0	
UKIDSS_Z	[8]
UKIDSS_Y	
UKIDSS_J	
UKIDSS_H	
UKIDSS_K	
CFHT_u	[9]
CFHT_g	
CFHT_r	
CFHT_i_new	
CFHT_i_old	
CFHT_z	
WISE_W1	[10]
WISE_W2	
WISE_W3	
WISE_W4	

Strömgren_u	[11]
Strömgren_v	
Strömgren_b	
Strömgren_y	
PS_g	[12]
PS_r	
PS_i	
PS_z	
PS_y	
PS_w	
PS_open	
GALEX_FUV	[13]
GALEX_NUV	
DECam_u	[14]
DECam_g	
DECam_r	
DECam_i	
DECam_z	
DECam_Y	
SkyMapper_u	[15]
SkyMapper_v	
SkyMapper_g	
SkyMapper_r	
SkyMapper_i	
SkyMapper_z	
Washington_C	[16]
Washington_M	
Washington_T1	
Washington_T2	
DDO51_vac	[17]
DDO51_f31	
Kepler_Kp	[18]
Kepler_D51	
LSST_u	[19]
LSST_g	
LSST_r	
LSST_i	
LSST_z	
LSST_y	
JWST_F070W	[20]
JWST_F090W	
JWST_F115W	
JWST_F140M	
JWST_F150W2	
JWST_F150W	
JWST_F162M	
JWST_F164N	
JWST_F182M	
JWST_F187N	
JWST_F200W	
JWST_F210M	
JWST_F212N	

JWST_F250M	
JWST_F277W	
JWST_F300M	
JWST_F322W2	
JWST_F323N	
JWST_F335M	
JWST_F356W	
JWST_F360M	
JWST_F405N	
JWST_F410M	
JWST_F430M	
JWST_F444W	
JWST_F460M	
JWST_F466N	
JWST_F470N	
JWST_F480M	
Swift_UVW2	[21]
Swift_UVM2	
Swift_UVW1	
Swift_U	
Swift_B	
Swift_V	
Hipparcos_Hp	[22]
Tycho_B	[23]
Tycho_V	
Gaia_G_DR2Rev	[24]
Gaia_BP_DR2Rev	
Gaia_RP_DR2Rev	
TESS	[25]

[1] Bessell & Murphy (2012); Bessell & Brett (1988)
[2] Cohen et al. (2003)
[3] classic.sdss.org/dr7/instruments/imager/index.html
[4] Holtzman et al. (1995)
[5] www.stsci.edu/hst/acs/analysis/throughputs
[6] www.stsci.edu/hst/wfc3/ins_performance/filters/
[7] Fazio et al. (2004)
[8] Hewett et al. (2006)
[9] www.cfht.hawaii.edu/Instruments/Imaging/Megacam/specsinformation.html
[10] Wright et al. (2010)
[11] Bessell (2011)
[12] Tonry et al. (2012)
[13] http://asd.gsfc.nasa.gov/archive/galex/Documents/PostLaunchResponseCurveData.html
[14] www.ctio.noao.edu/noao/sites/default/files/DECam/DECam_filters.xlsx
[15] Bessell et al. (2011)
[16] Bessell et al. (2001)
[17] www.noao.edu/kpno/mosaic/filters/
[18] keplergo.arc.nasa.gov/CalibrationResponse.shtml
[19] https://github.com/lsst/throughputs
[20] http://www.stsci.edu/jwst/instruments/nircam/instrumentdesign/filters

[21] http://swift.gsfc.nasa.gov/proposals/swift_responses.html
[22] Bessell & Murphy (2012)
[23] Bessell & Murphy (2012)
[24] https://www.cosmos.esa.int/web/gaia/iow_20180316
[25] https://heasarc.gsfc.nasa.gov/docs/tess/the-tess-space-telescope.html#bandpass