Modeling He-rich subdwarfs through the Hot-Flasher scenario

First Results

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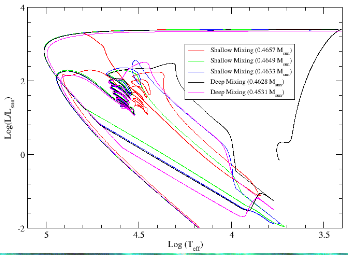
Introduction/Description: We present first results from evolutionary simulations aimed at exploring the "Hot Flasher" scenario (Castellani & Castellani 1993, D'Cruz et al. 1996, Sweigart 1997) for the formation of He-enriched subdwarf stars both in the galactic field (He-SdB, He-SdO; Stroeer et al. 2007) and in clusters (blue hook stars; Brown et al. 2001). The two types of late hot flashers that lead to He-enriched surfaces, namely "shallow" (SM) and "deep" (DM) mixing (Lanz et al. 2004) are investigated. For the later, the violent hydrogen burning event that follows the ingestion of the H-rich envelope during the helium core flash is followed within the framework of diffusive convective mixing as it was done by Cassisi et al (2003). This allows us to present a homogeneous set of surface abundances for different metallicities and for both types of late hot flashers. Preliminary results presented here are mainly based on simulations for Z=0.03 and Z=0.001. The present set of evolutionary sequences will help to understand better the formation of He-rich subdwarf stars.

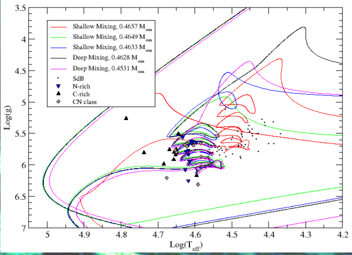
Characteristics of the simulations

Mass at ZAMS [M_{sun}]	X/Y/Z	Age at helium core flash [Myr]
0.88	0.769/0.230/0.001	12404
0.98	0.736/0.254/0.010	12617
1.04	0.668/0.302/0.030	12863

Z=0.03

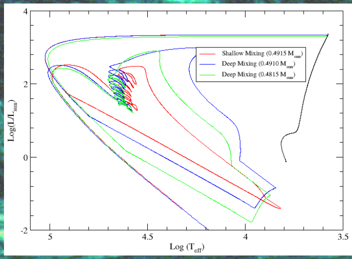
Final Mass	H	He	^{12}C	^{13}C	N	O
0.4657 (SM)	0.512	0.457	0.00297	0.00012	0.00698	0.0103
0.4649 (SM)	0.026	0.905	0.0362	$1.3\ 10^{-5}$	0.00622	0.00189
0.4633 (SM)	0.00195	0.927	0.0371	0.00344	0.00694	0.00158
0.4628 (DM)	$1.29\ 10^{-5}$	0.933	0.0424	0.00155	0.00705	0.00154
0.4531 (DM)	$4.53\ 10^{-6}$	0.939	0.031	0.00474	0.01205	0.00198

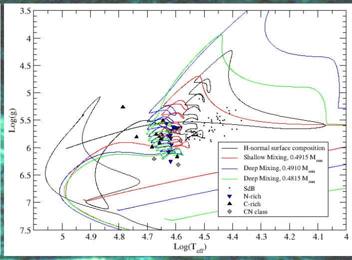


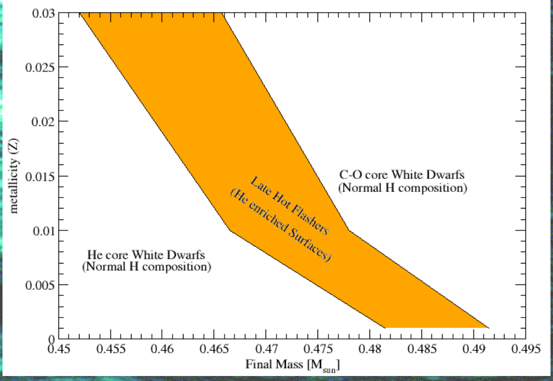


Z=0.001

Final Mass	H	He	^{12}C	^{13}C	N	O
0.4915 (SM)	0.21	0.323	0.038	$1.5\ 10^{-6}$	0.0001	0.0014
0.4910 (DM)	$1.4\ 10^{-5}$	0.955	0.0284	0.00764	0.0086	$7.\ 10^{-5}$
0.4815 (DM)	$1.18\ 10^{-6}$	0.965	0.0139	0.00471	0.0163	$4.\ 10^{-5}$







"Preliminary" Conlusions:

- All our sequences with significant He-enrichment display C/N>1 (by mass), and thus should be considered "carbon rich" contrary to what is inferred from He-SdO stars, which present both C/N>1 and C/N<1 surface abundaces (Stroeer et al. 2007). The lower C/N ratios in our sequences correspond to the deep mixing at lower metallicity and remnant masses.
- The range of final masses for which *late* hot flashes (i.e. shallow or deep mixing cases) are obtained is slightly dependent on metallicity, being $\Delta M=0.010\ M_{sun}$ for Z=0.001 and $\Delta M=0.010\ M_{sun}$ for Z=0.03. A stronger dependence shows the proportion of shallow mixing cases (as already noted by Lanz et al. 2004) which changes from <5% at Z=0.001 to ~17% at Z=0.03.
- He-SdO temperatures (as inferred by Stroeer et al 2007) are too high to fit within the Hot Flasher scenario, unless strong systematics are present in the determinations. On the other hand both the surface abundances and temperatures derived by Lanz et al. for He-SdB stars are consistent with our results.

References:

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