Theoretical Fits for Barium Stars

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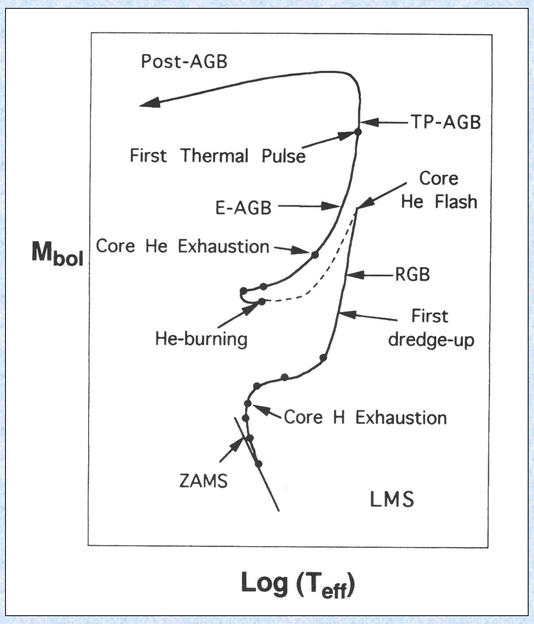
About stellar evolution

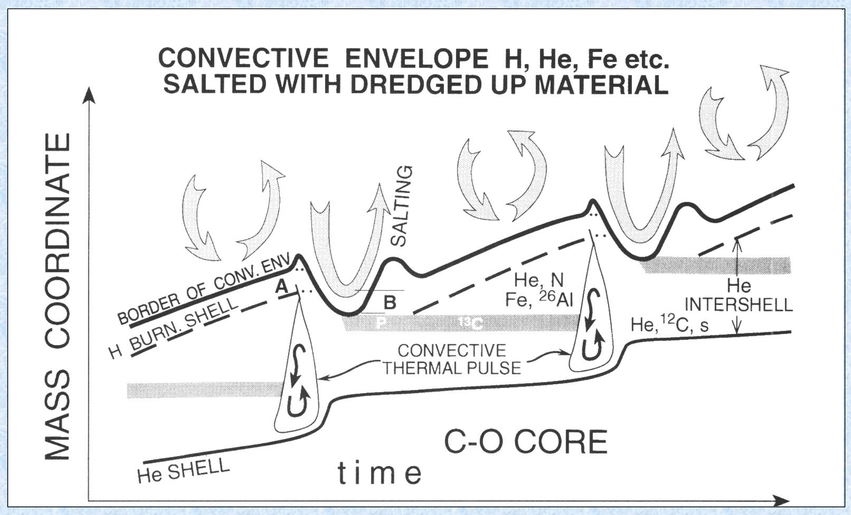


Core H burning
Core H exhaustion and contraction
H-shell ignition → core contraction + envelope expansion
First dredge-up
Core He burning
Core He exhaustion; contraction of the C-O core
Convection takes place of the radiative state in all the He-rich region
The envelope is expanded and the H-shell is cooled and extinguished
After the thermal pulse, the envelope penetrates below the H-He discontinuity (TDU)
H is reignited and the cycle continues
Envelope is eroded during the pulsating phase
The star becomes a white dwarf surrounded by a planetary nebula

Neutron sources:

radiative $^{13}C(\alpha,n)^{16}O$
convective $^{22}Ne(\alpha,n)^{25}Mg$

^{22}Ne formation: $^{14}N(\alpha,\gamma)^{18}F(\beta+,\nu)^{18}O(\alpha,\gamma)\ ^{22}Ne$
^{13}C formation: $^{12}C(p,\gamma)\ ^{13}N(\beta+,\nu)\ ^{13}C(p,\gamma)\ ^{14}N$
ST ^{13}C pocket:
5×10^{-4} M_sol ~ 1/10 of the typical mass involved in a TP
2.8×10^{-6} M_sol of ^{13}C 9×10^{-8} M_sol of ^{14}N



Barium stars

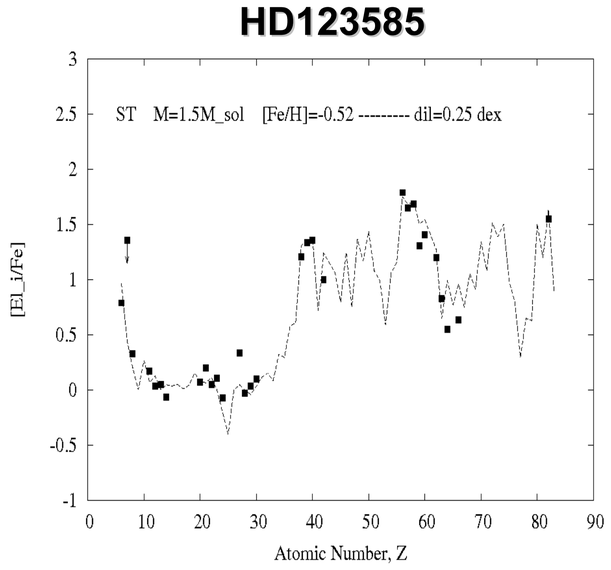
identified by Bidelman&Keenan (1951)
chemically peculiar G and K giants – enhanced lines:
BaII 4554 A resonance line
CH G band
SrII 4077A and 4215A lines
Tomkin et al. (1989) – dwarf HR 107 – barium star chemical composition
[Fe/H] ≤ 0
variations in radial velocity – white dwarf companions
s-process elements transferred from the companion during its TP-AGB phase
sample of 26 stars: Allen & Barbuy (2006)

References

- Allen,D. M. & Barbuy, B., 2006, A&A, 454, 895
- Allen,D. M. & Barbuy, B., 2006, A&A, 454, 917
- Bidelman, W. P. &Keenan, P. C., 1951, ApJ, 114, 473
- Busso, M., Gallino, R. & Wasserburg, G. J., ARA&A, 1999, 37, 239
- Gallino, R. et al., 1998, ApJ, 497, 388
- Malaney, R. A., 1987, ApJ, 321, 832
- Malaney, R. A., 1987, ApJS, 137, 251
- Tomkin, J. et al., 1989, A&A, 219, L15

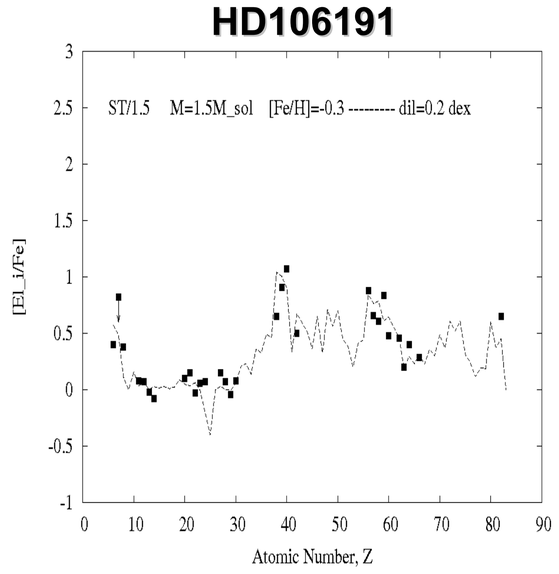
Theoretical fits

HD123585



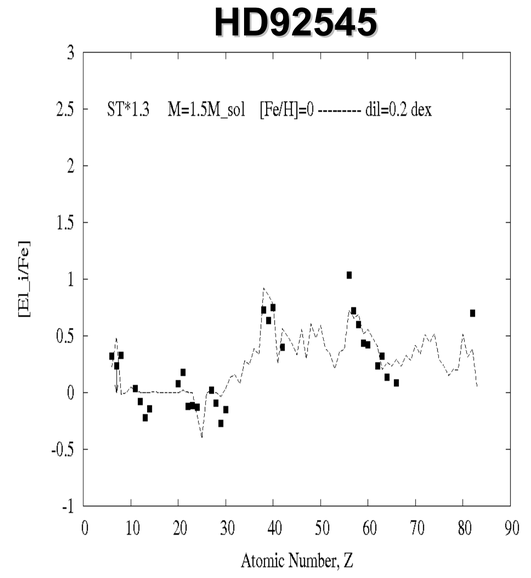
T_eff = 6350 K
log g = 4.2
[Fe/H] = -0.48
M = 1.1 M_sol
obs: good fit

HD106191



T_eff = 5890 K
log g = 4.2
[Fe/H] = -0.29
M = 1.0 M_sol
obs:
- lower Sr observed than predicted
- higher Pb observed than predicted

HD92545



T_eff = 6210 K
log g = 4.0
[Fe/H] = -0.12
M = 1.3 M_sol
obs: higher Pb and Ba observed than predicted