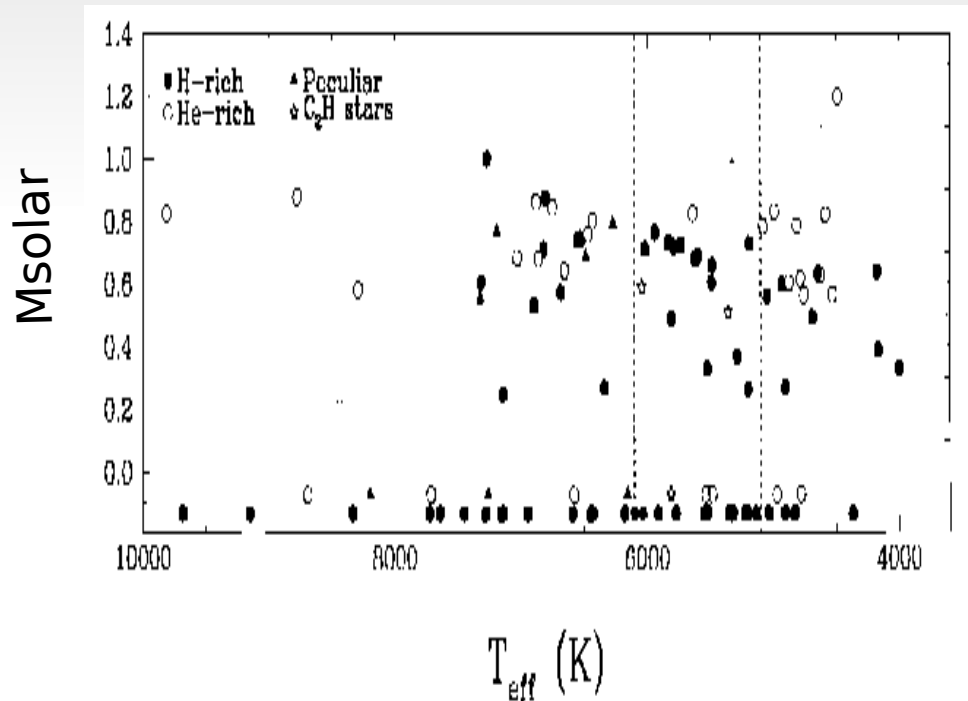


White Dwarf Spectral Evolution – The Rejuvenate Scenario

Eugene Chen, Brad Hansen

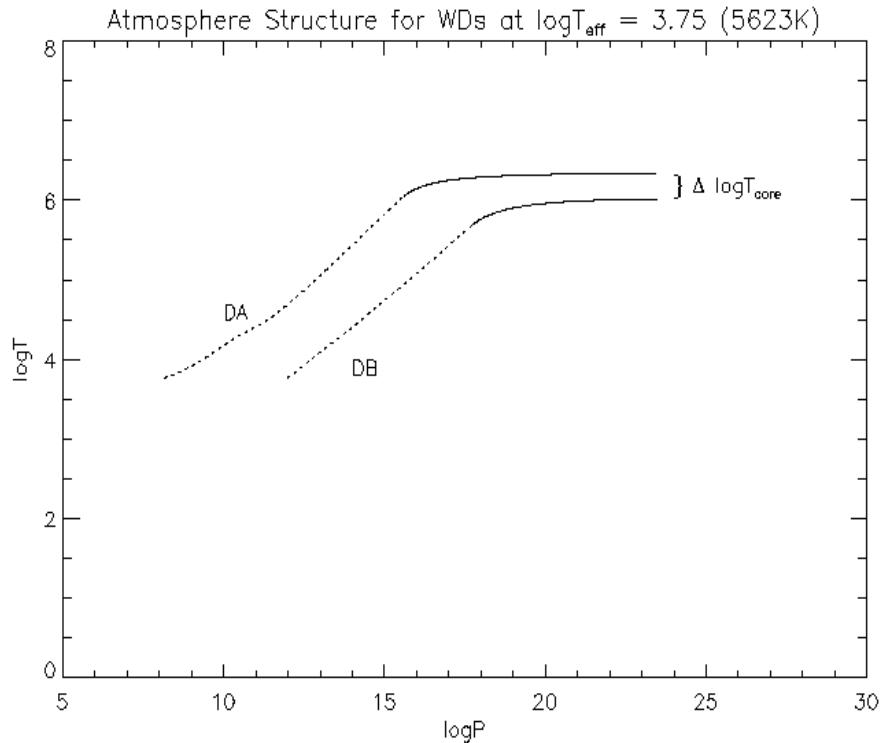
UCLA

The non-DA gap of BRL(1997)



- “It seems unavoidable that most, if not all, He-rich white dwarfs above the non-DA gap turn into H-rich stars...and some of them will become He-rich again...” (Malo, Wesemael, Bergeron, *1999ApJ*)
- Transforming from DA to DB to DA to DB.....White dwarf spectral evolution is known to be complicated !

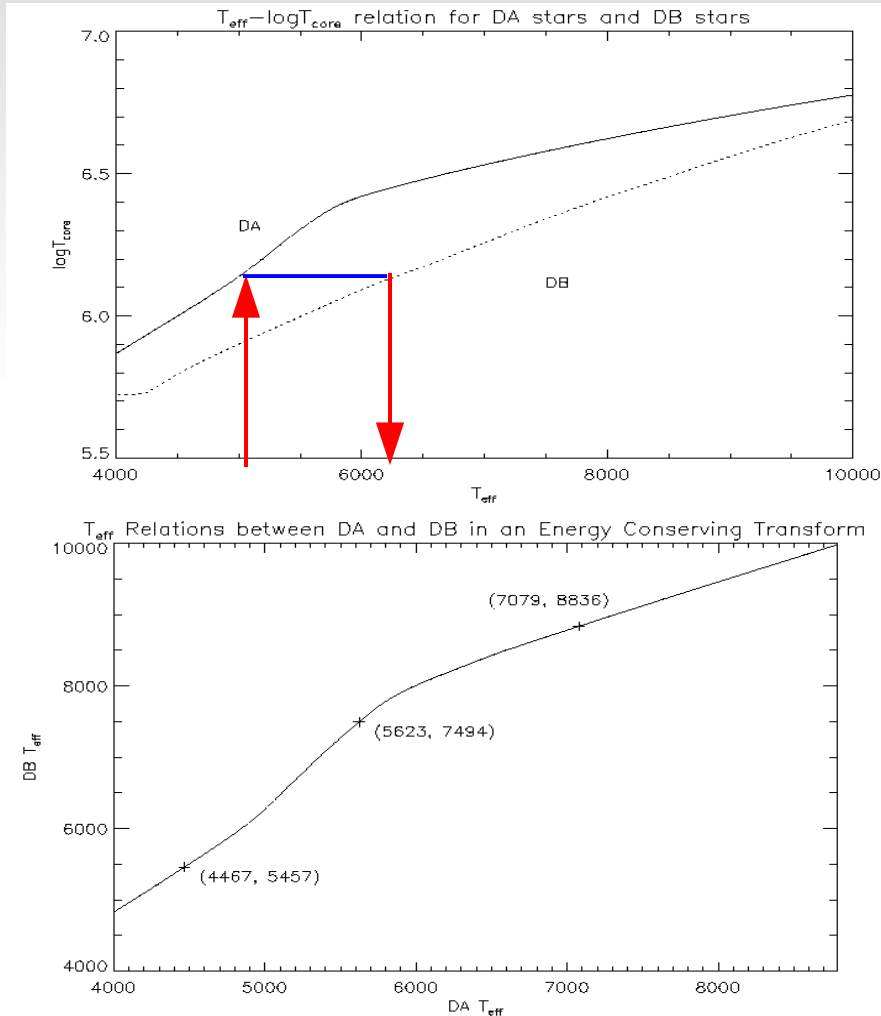
Energy Crisis hidden in the old story



$$\Delta E \approx \frac{3kM}{2Am_p} \Delta T_{\text{core}}$$

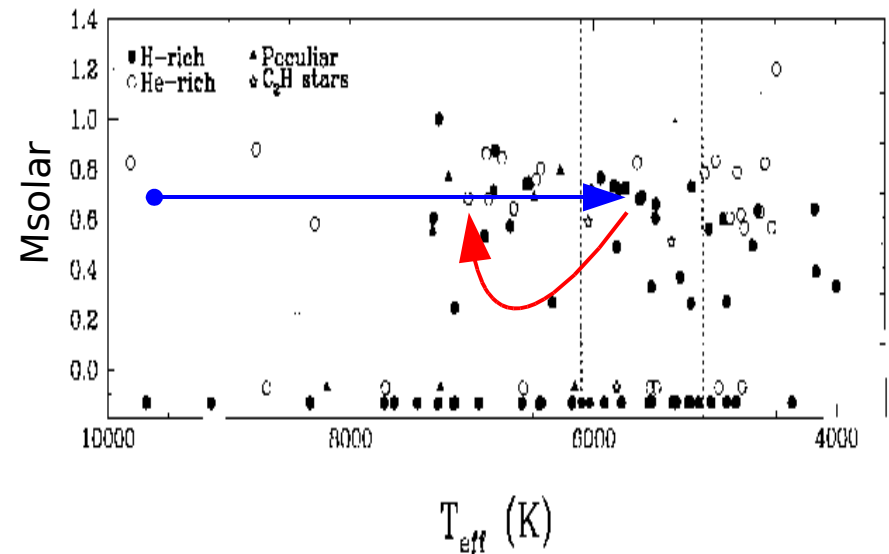
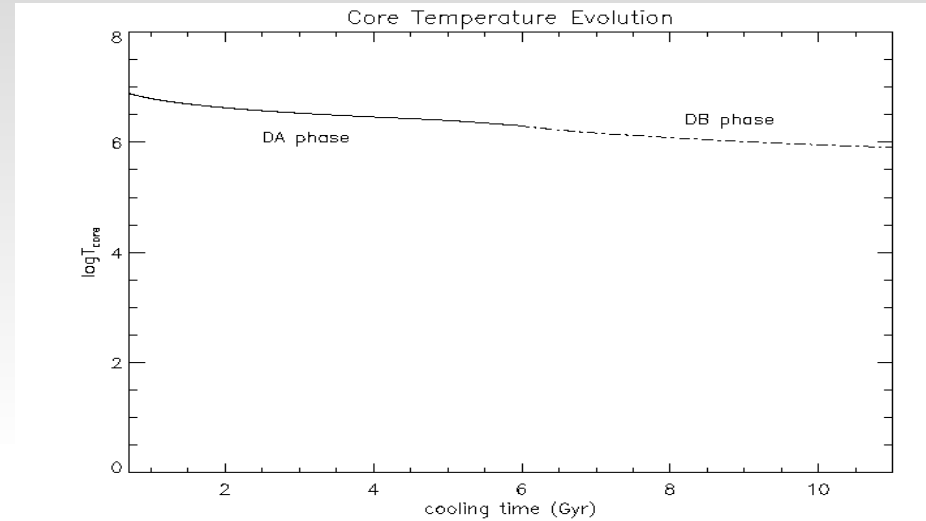
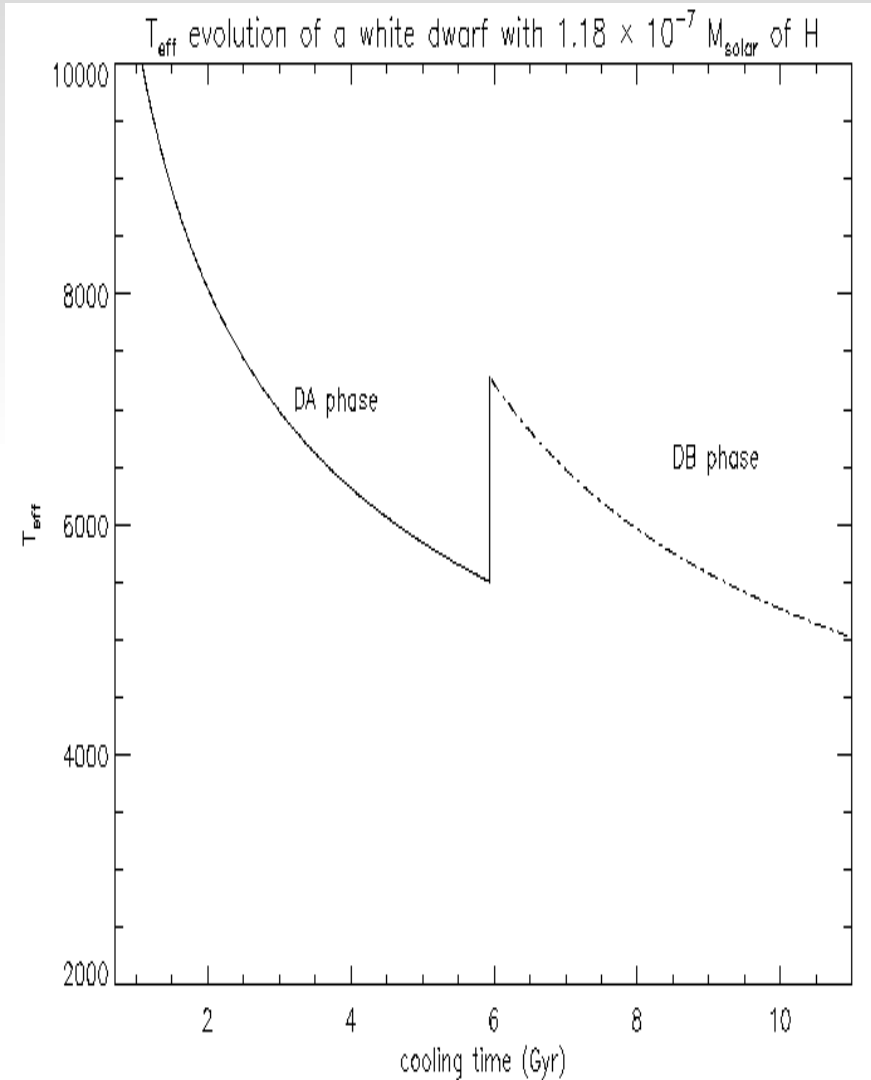
- The heat content of a DA star and a DB star is different at a given effective temperature.
- The transformation of DA to DB at constant T_{eff} must accompany the disappearance of energy up to 2.5×10^{44} ergs!

Rejuvenate to conserve energy



- We calculated the relation between T_{eff} and T_{core} for DA and DB stars, respectively.
- Transformation from DA to DB can only be taken at constant T_{core} (i. e., constant energy)
- As a result, T_{eff} will increase when a DA is transformed into a DB. The white dwarf will look “younger” in the cooling sequence.

The not so complicated (but energy conserving!) new story



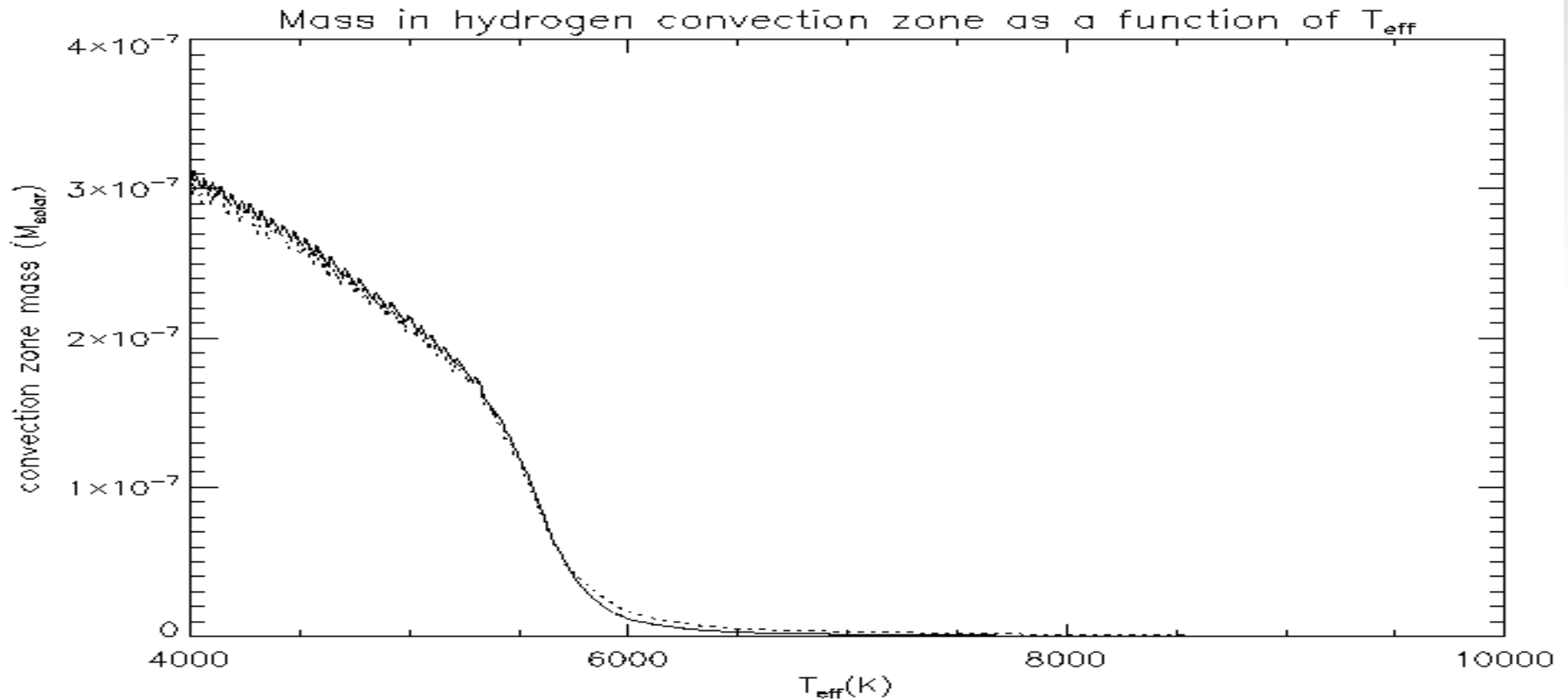
Conclusions

- An explanation to non-DA gap based on fundamental physics law (energy conservation.)
- Can be used to improve White Dwarf Cosmochronology – We can now better interpret the luminosity function.
- Will incorporate with a more realistic cooling model soon.

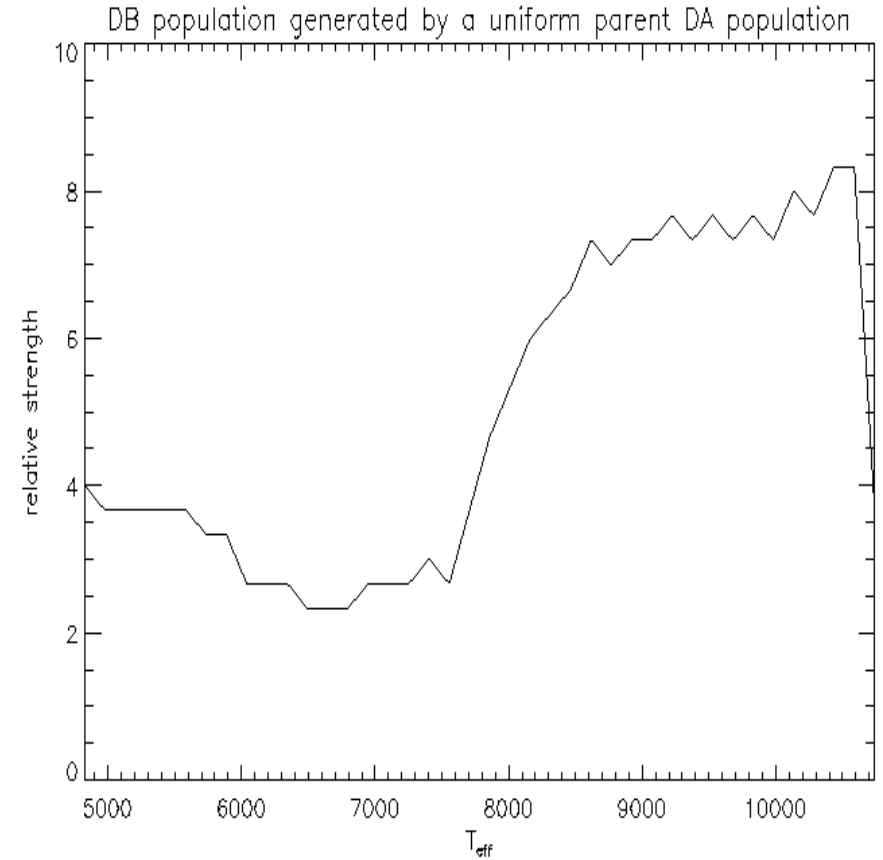
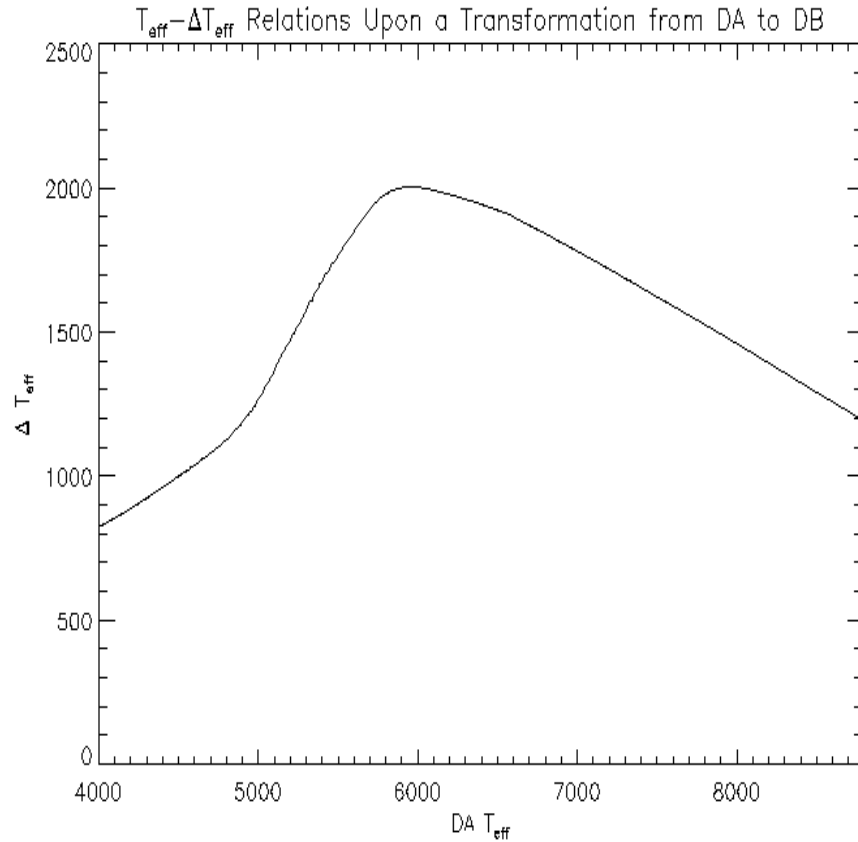


Questions?

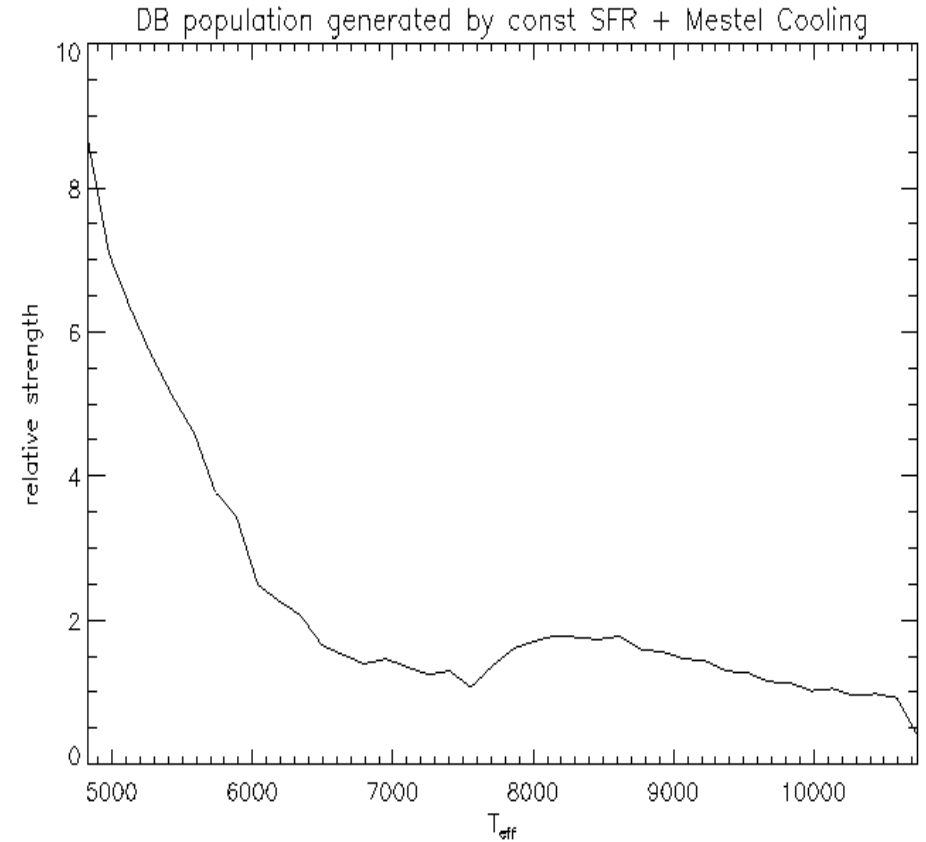
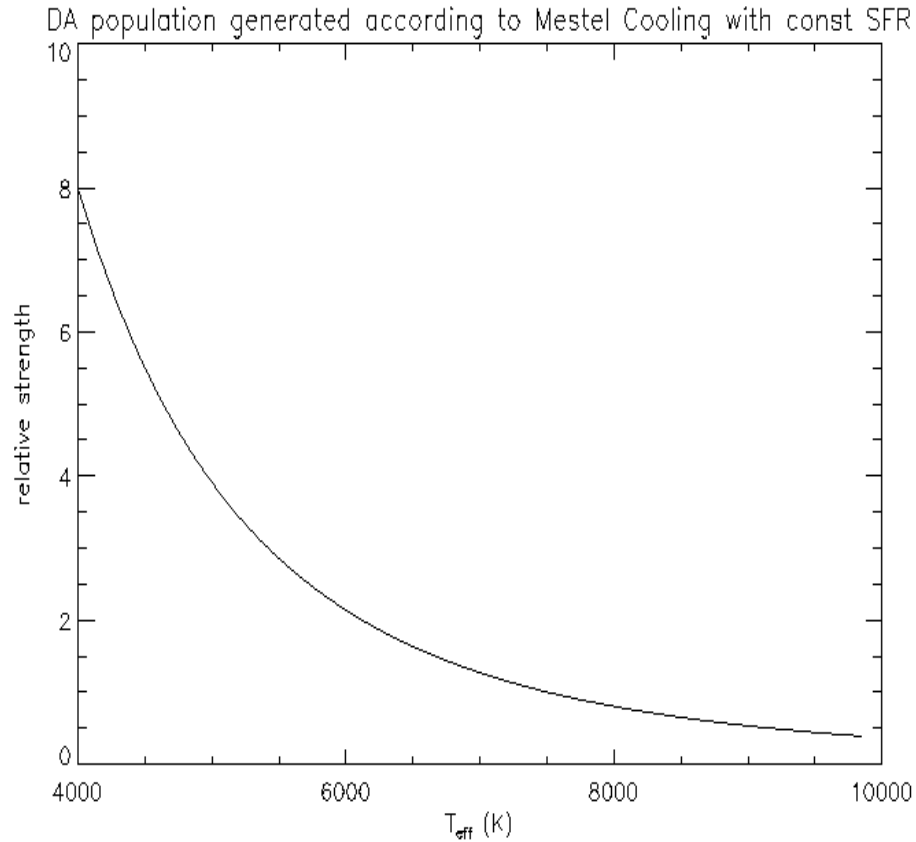
More hydrogen means a longer life as a DA



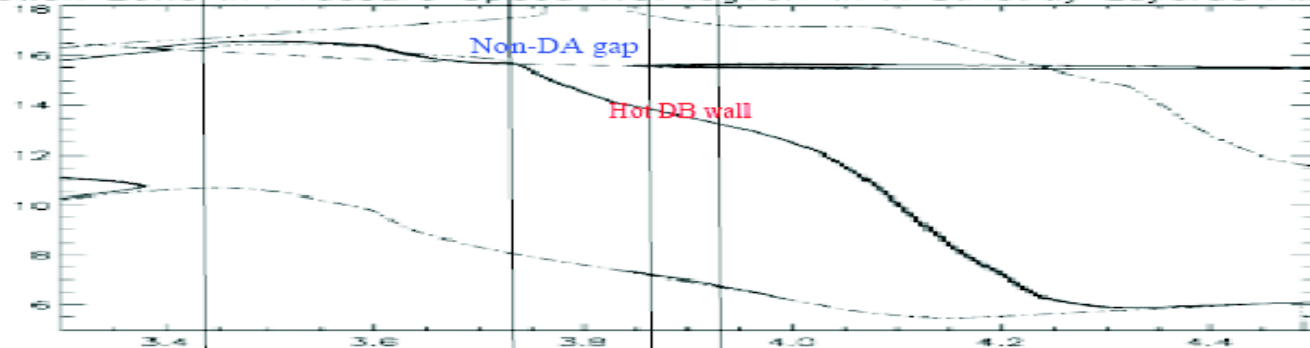
The non-DA gap as a consequence of inhomogeneous “jumping”



a non-uniform parent population

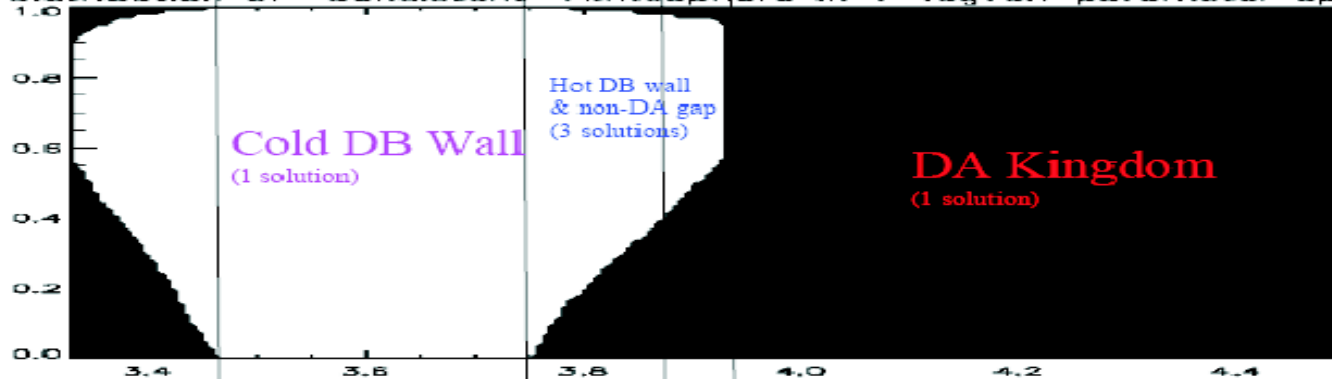


Convection Zone in Pressure Space V.S. $\log T_{\text{eff}}$ in A Strictly Layered Atmosphere



$m_{\text{Hini}} = 5.00000e-008 \text{ Msolar}$, Accretion rate = $5.00000e-018 \text{ Msolar/yr}$.

Distribution of "Consistent" Atmosphere in $Y-\log T_{\text{eff}}$ parameter space



Given Mestel Cooling Model and an Accretion rate of $5e-18 \text{ Msolar/yr}$ & $M_{\text{Hini}}=5e-8 \text{ Msolar}$