Using calibration from 3D simulations in stellar evolution calculations

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Significance of convection treatment

- Defines behaviour of superadiabatic gradient in top of convection zone
- **Given atmospheric properties** defines specific entropy (adiabat) in nearly adiabatic part of convection zone
- Hence needs consistency between atmosphere and mixing-length calibration

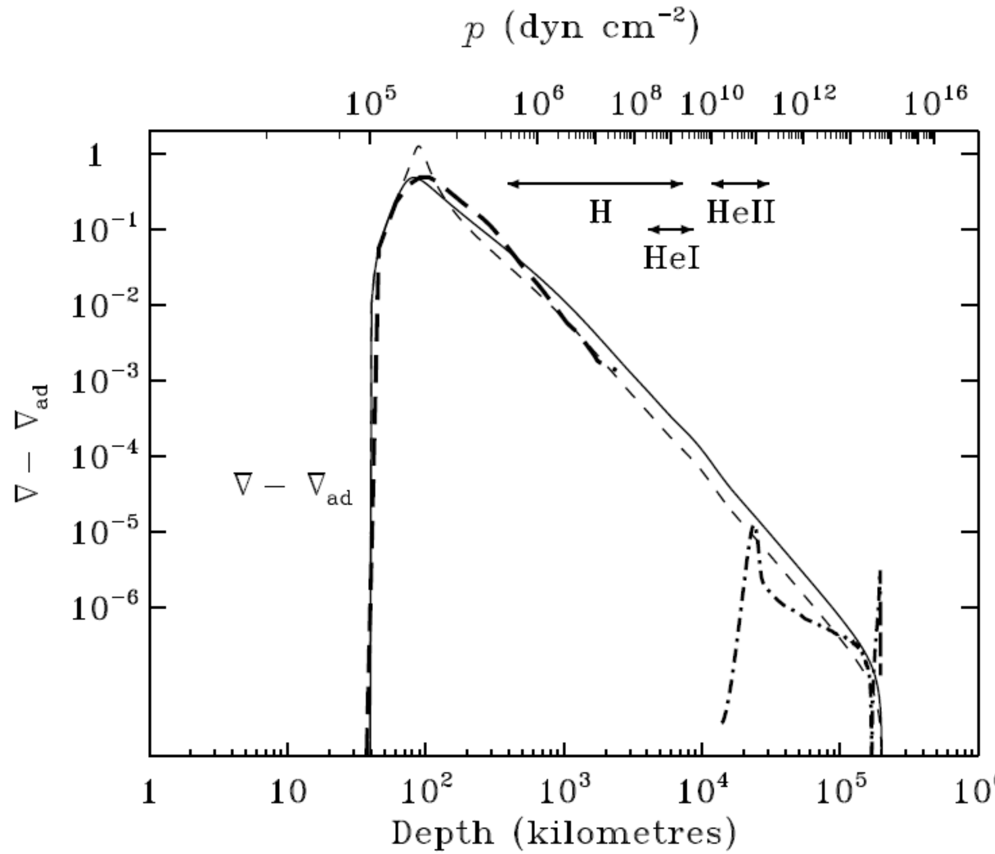
Significance of convection treatment

- Defines behaviour of superadiabatic gradient in top of convection zone
- **Given atmospher** entropy (adiabat) convection zone

Böhm-Vitense

Canuto & Mazzitelli

Averaged simulation

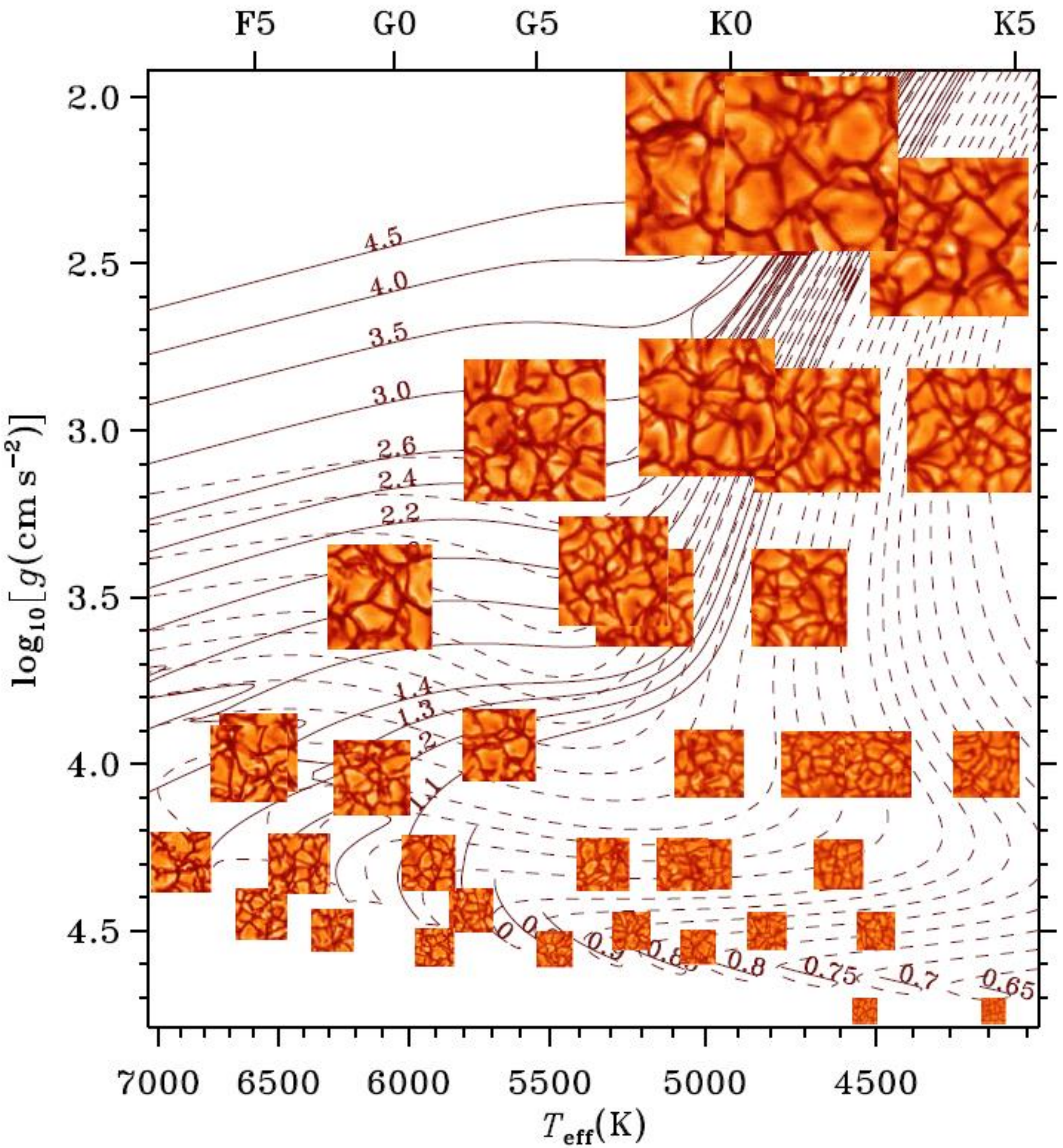


Calibration from 3D simulation

- Define atmospheric properties in terms of T(τ)
- Determine α such that structure in 1D envelope model matches deep (nearly adiabatic) part of the average simulation
- Interpolate to model T_{eff} and log g in grid of simulations

Simulations

Solar composition:
X = 0.737, Z = 0.018

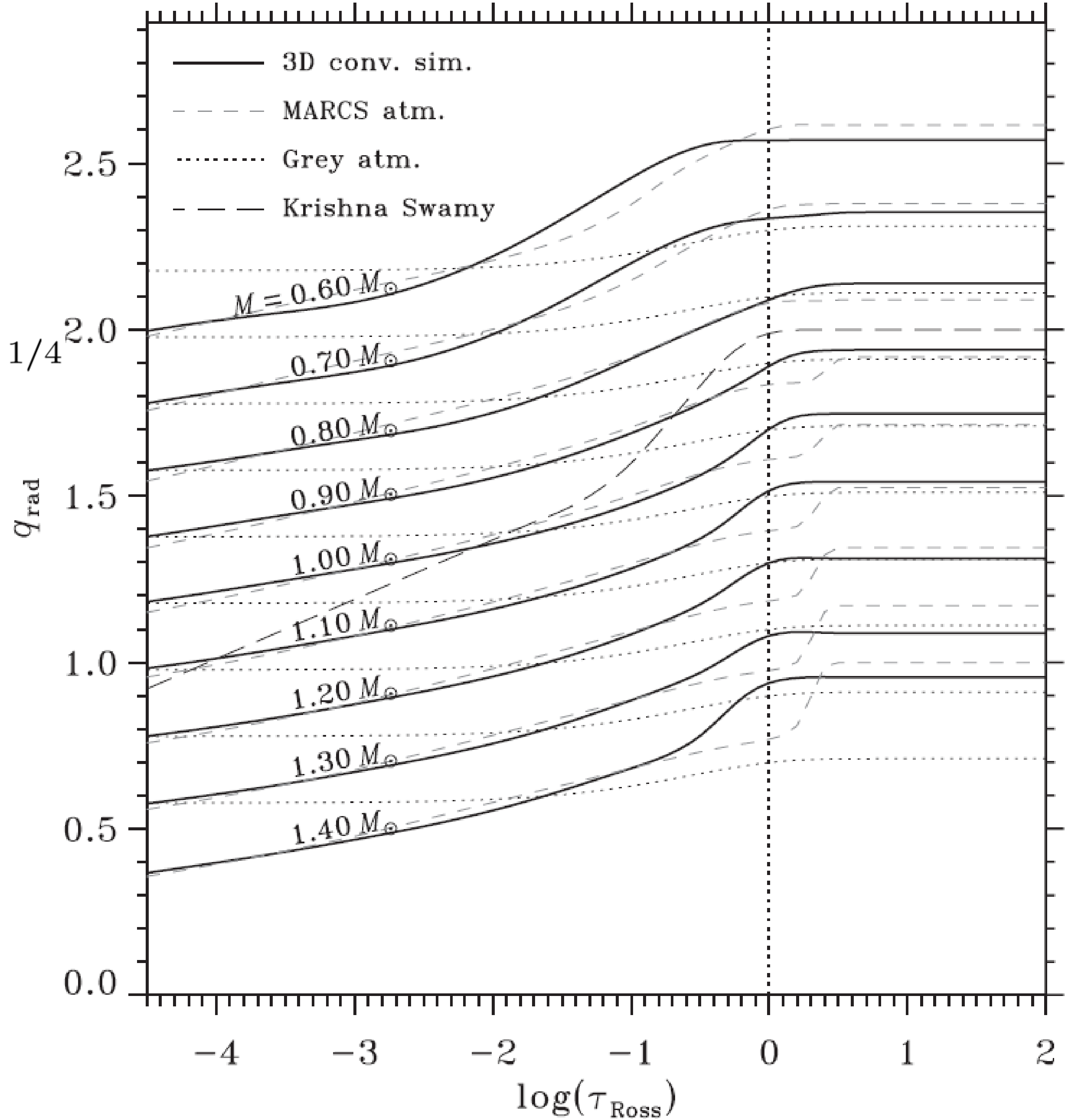


Trampedach et al. (2014;
MNRAS 445, 4366)

T(τ)

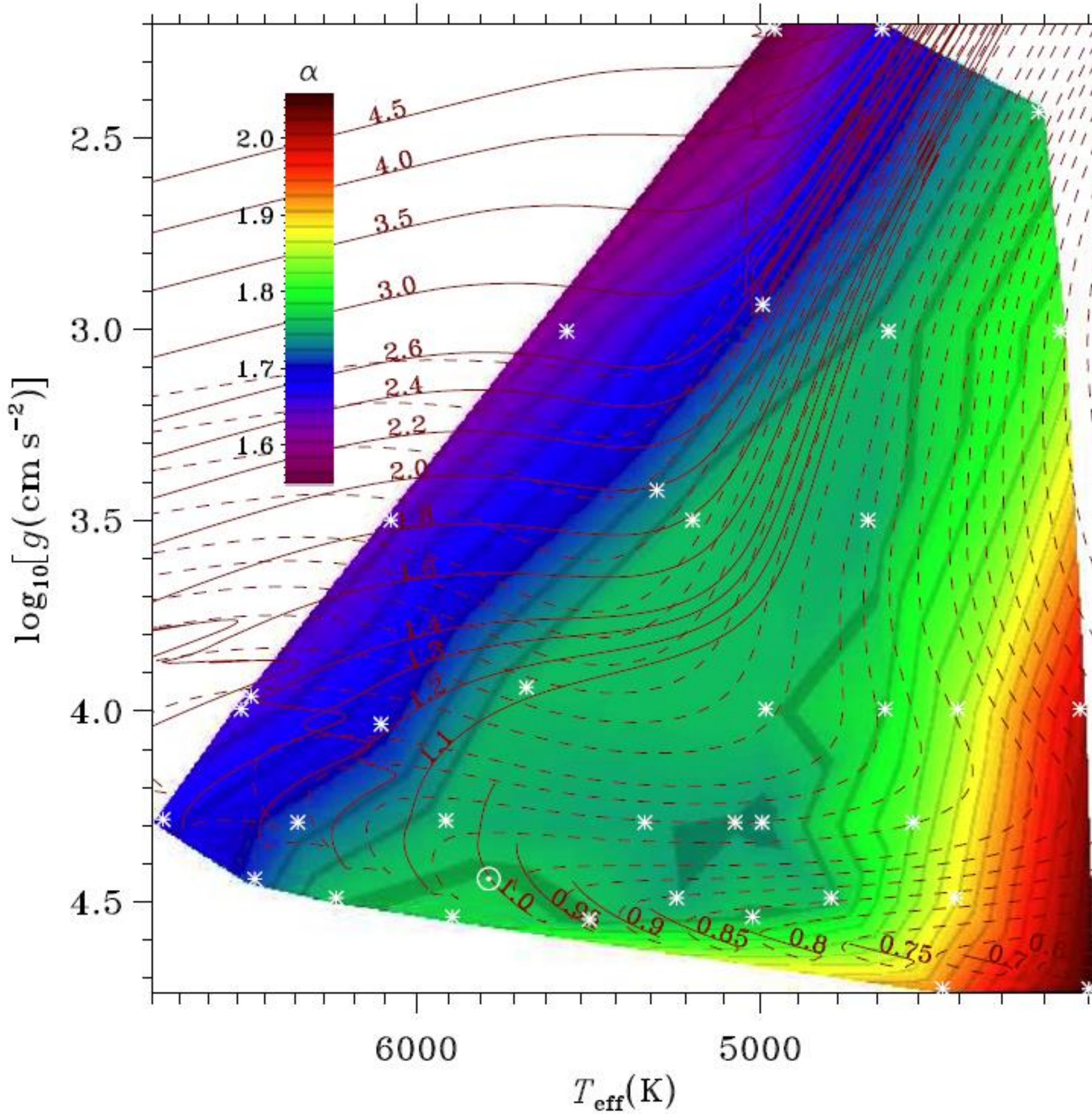
Characterize by

$$T(\tau) = T_{\rm eff}\left[\frac{3}{4}(q(\tau)+\tau)\right]^{1/4}$$



Trampedach et al. (2014;
MNRAS 442, 805)

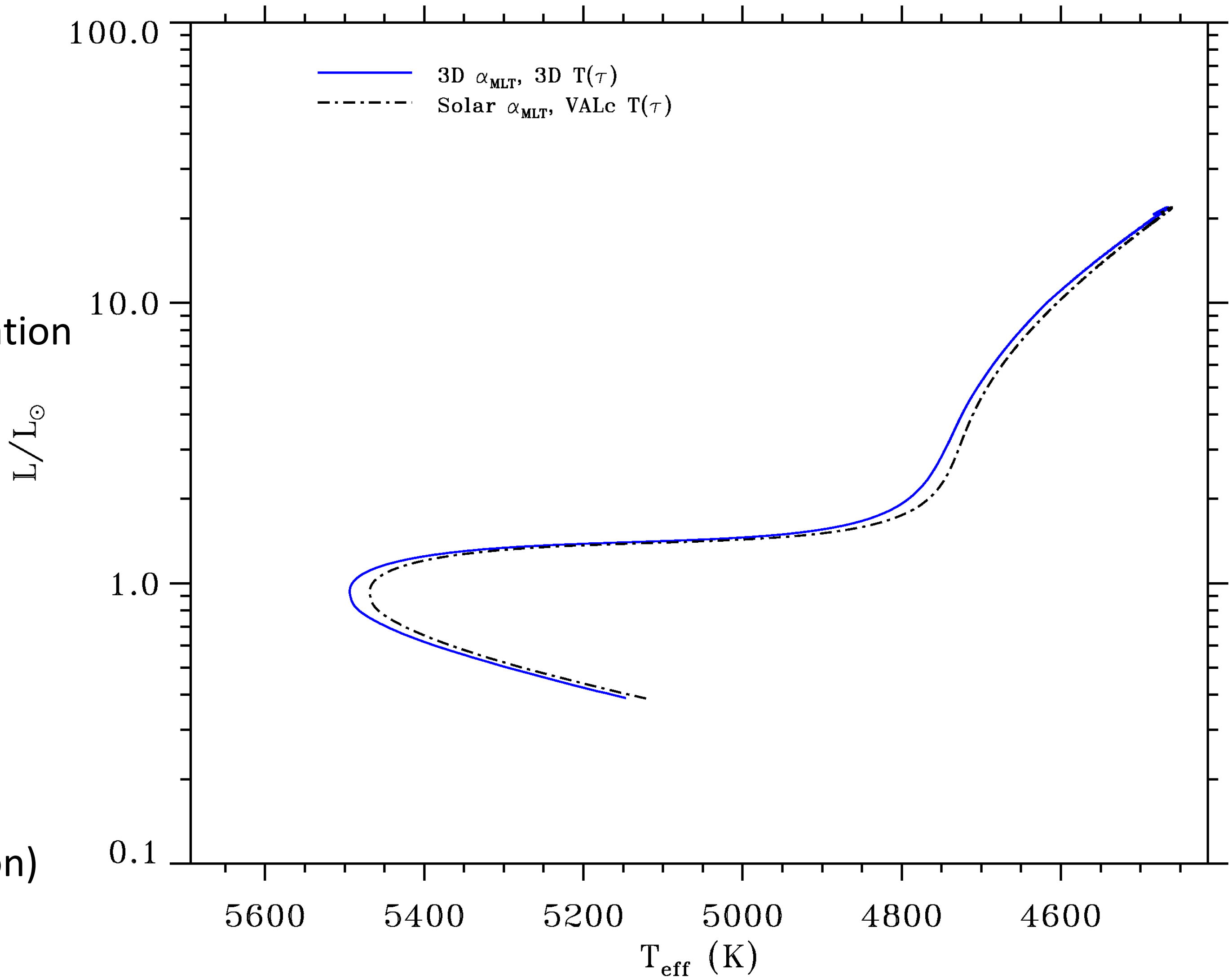
Calibrated α



Trampedach et al. (2014; MNRAS 445, 4366)

0.9 $M_\odot$

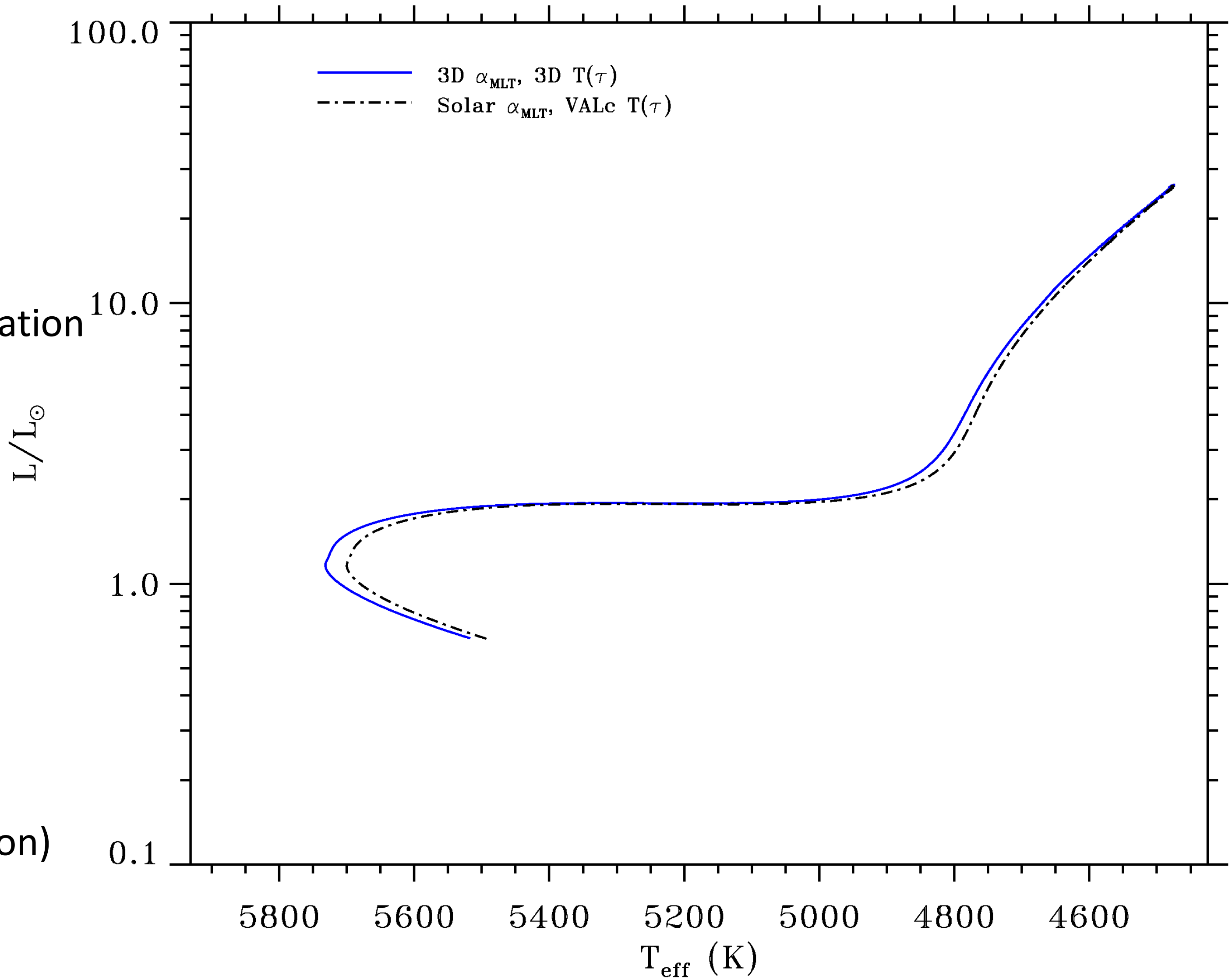
ASTEC implementation



Aarslev et al.
(in preparation)

1.0 $M_\odot$

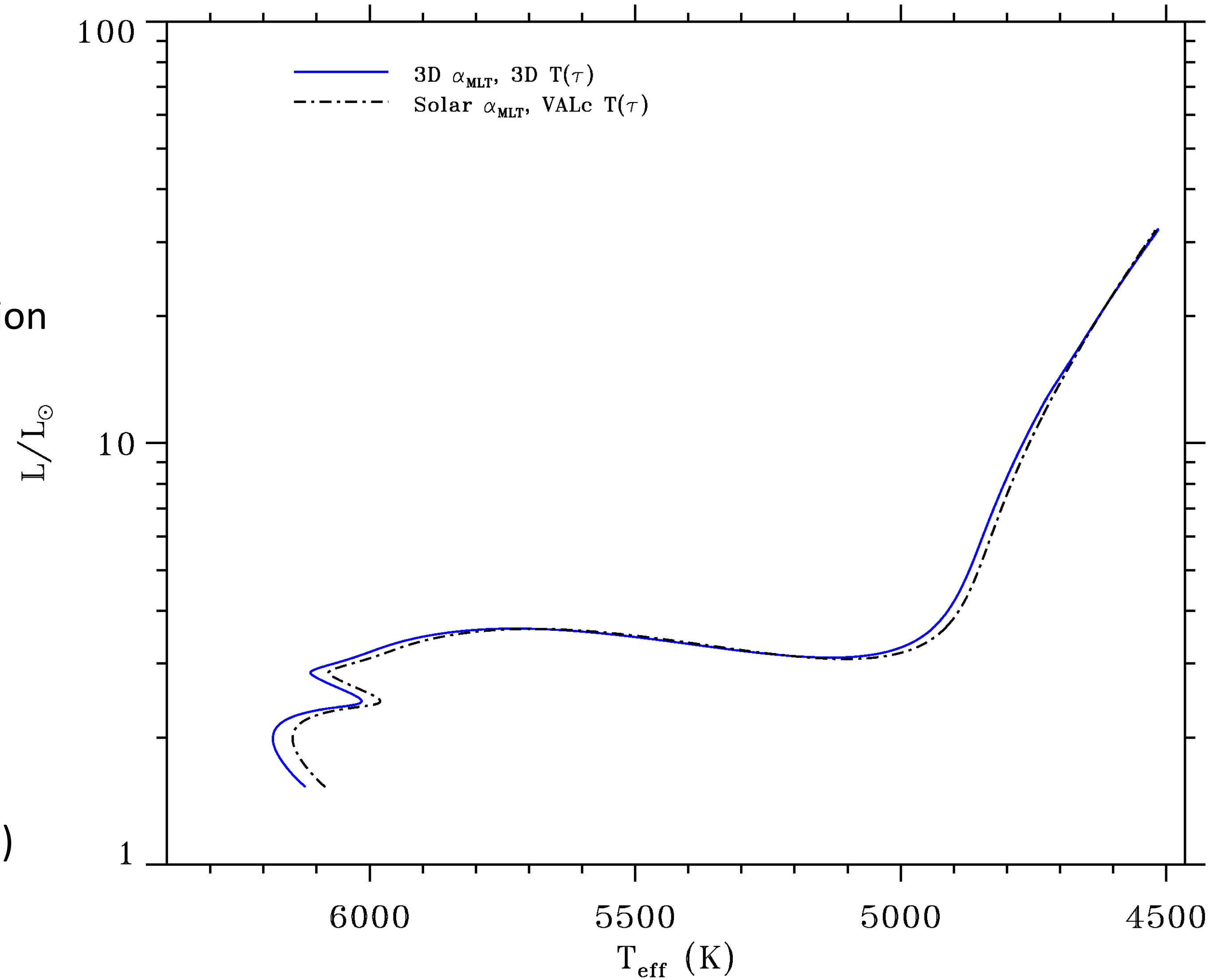
ASTEC implementation



Aarslev et al.
(in preparation)

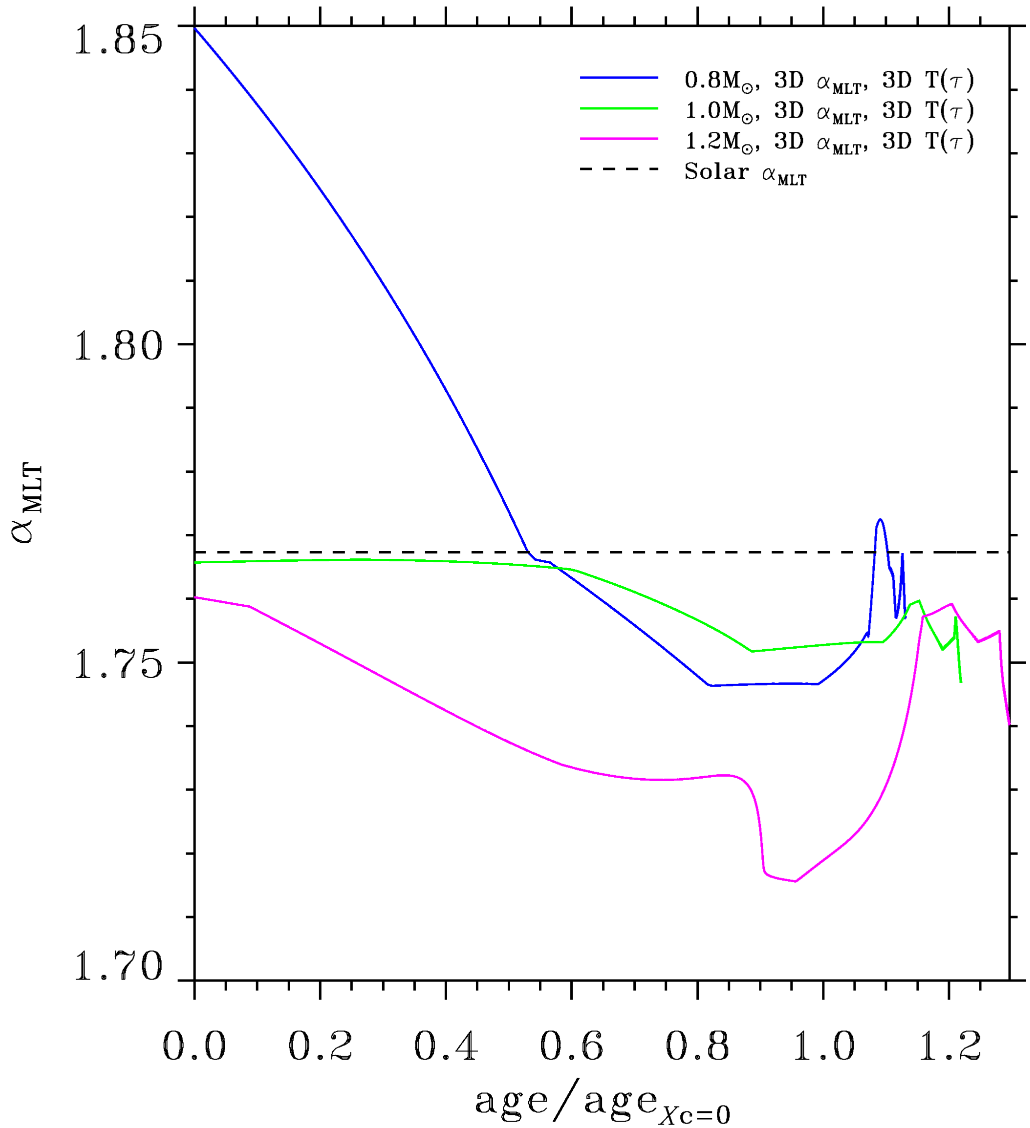
1.2 $M_\odot$

ASTEC implementation



Aarslev et al.
(in preparation)

Variation of α



Things to come

- Independent application with GARSTEC models (Jakob Mosumgaard et al.)
- Use of existing Stagger grid (Magic et al.)
- Extension of Trampedach grid to a range of compositions
- Implementation of calibrated turbulent pressure
- Direct fit to interpolated simulations