CESAM2K

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Workshop

Numerics

- Solution of the stellar structure eqs. by collocation method based on piecewise polynomial approximations projected on their B-spline basis
- Stable and robust calculations
- Restitution of the solution not only at grid points
- Automatic mesh refinement

Numerics

- Precise restoration of the atmosphere
- Modular in design
- Evolution of the chemical composition:
  - Without diffusion: implicit Runge-Kutta scheme
  - With diffusion: solution of the diffusion eq. using the Galerkin method

Equation of state

- OPAL 2001 EoS tables used with the OPAL interpolation scheme
- Other EoS available:
  - EFF
  - CEFF
  - MHD

Opacity

- OPAL 1996 + Alexander & Ferguson 1994:
  - Houdek9 interpolation
  - Interpolation by Lagrange Polynomials for log T6 and log R, quadratic interpolation for X and Z
- Other opacities:
  - Interpolation of the tables of Livermore 1991

Energy generation rate

- NACRE compilation (other compilations available, e. g. Caughlan and Fowler 1988).
- Several networks available (PP+CNO+3 α). Examples:
  - PP+CNO chains with ^{2}H and ^{7}Be in equilibrium
  - PP+CNO without any element in equilibrium
  - PP+CNO+3α

Convection

- Böhm-Vitense MLT taking into account the optical thickness of the bubble.
  $l = \alpha H_P$
- *CM (1991) with* $l = \alpha H_P$
- *CGM (1996)*

Atmosphere

- $T(\tau)$ relation based on the grey Hopf atmospheric law. Connection with the envelope at $\tau=10$.
- Other $T(\tau)$ relations available:
  - Eddington law
  - *$T(\tau)$ for the Sun calculated with Atlas 9 of Kurucz (for Teff=5750, 5777 K)*
  - *$T(\tau)$ calculated with Atlas 12 of Kurucz (for [Fe/H=0, -0.2, -0.5, -1.0)*
  - *Single shell*

Detailed description of the code

- Code available upon request at http://www.obs-nice.fr/morel/CESAM_PROTECT/CESAM.html
- Package contains a detailed description of the code (in french), as well as a user's guide
- Description in english: Morel 1997, A&AS, 124, 597

CESAM2K V2

- Many mesh points added around the CZ/RZ limits to refine the profile of the Brunt-Väissälä frequency
- Possibility to use either the radiative or the adiabatic gradient on the overshoot zones
- Diffusion of the angular momentum