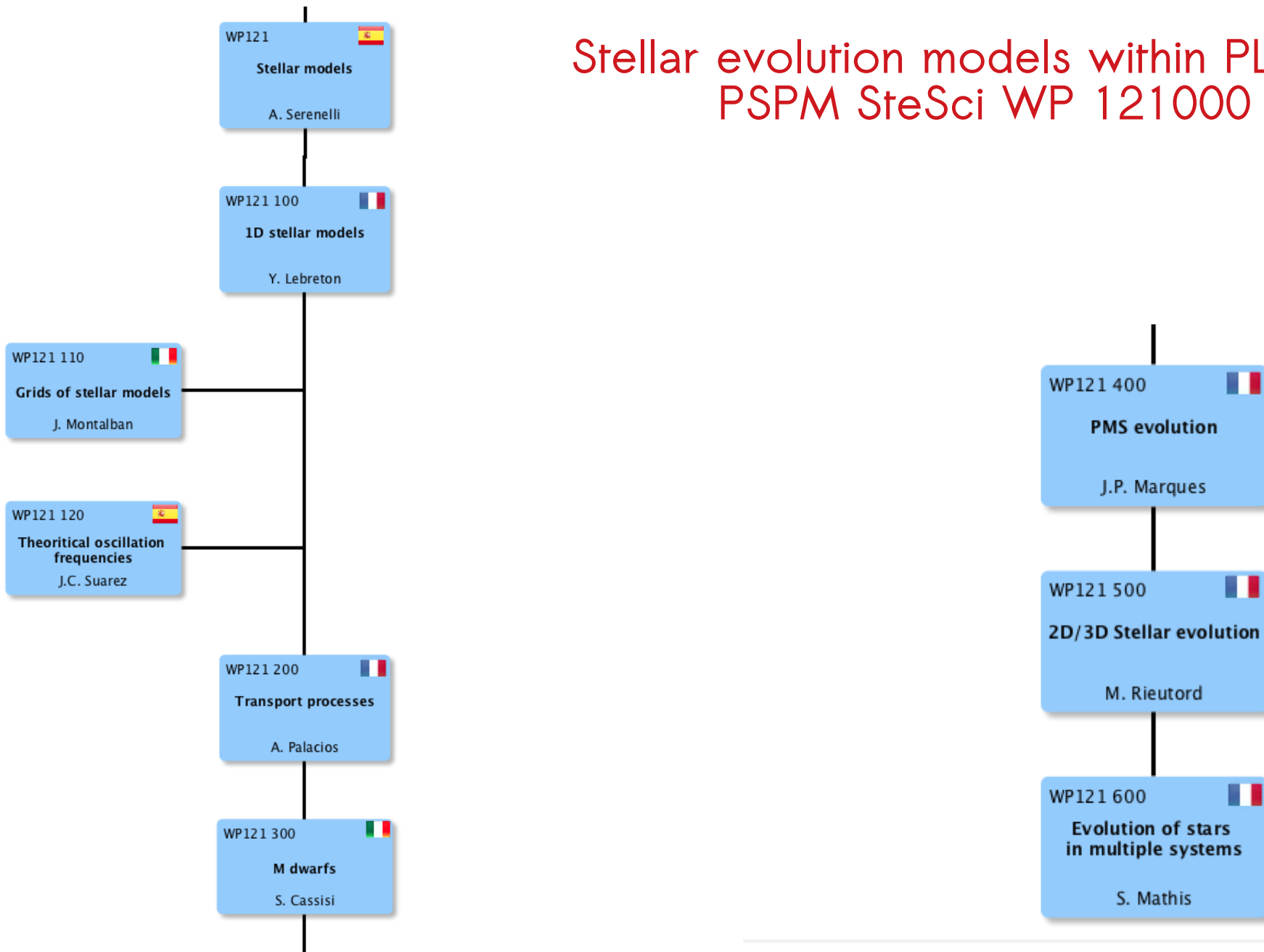


# Overview of stellar evolution modelling tools

A. Palacios

# Stellar evolution models within PLATO : PSPM SteSci WP 121000



CESAM / CESTAM / YCESAM / CESAM2k

STAR/STARS

ATON

Yale Rotation Evolution Code

ASTECC

STERN

TGEC

TWIN

Code de Montpellier-Montréal

PARSEC

LPCODE

EVOL

BINSTAR

STAROX

FRANEC

STAREVOL

Lyon Evolutionary Code

MESA

GENeva stellar Evolution Code

Dartmouth Stellar Evolution Code

MONSTAR

KEPLER

GARching Stellar Evolution Code

Code Liègeois d'Evolution Stellaire



CESAM / CESTAM / YCESAM / CESAM2k

STAR/STARS

ATON

Yale Rotation Evolution Code

ASTECC

STERN

TGEC

TWIN

Code de Montpellier-Montréal

PARS

Census : 24 stellar evolution codes, some existing in various -divergent- versions

STAREVOL

Lyon Evolutionary Code

MESA

GENeva stellar Evolution Code

Dartmouth Stellar Evolution Code

MONSTAR

KEPLER

GARching Stellar Evolution Code

Code Liègeois d'Evolution Stellaire



# Who uses what, where in the HRD ?

TOPIC	Seismic Sun	A-type stars	Massive stars	RGB/AGB	PMS stars	M,L,T,Y dwarfs	Binaries
	<u>8 codes</u>	<u>3 codes</u>	<u>8 codes</u>	<u>12 codes</u>	<u>5 codes</u>	<u>1 code</u>	<u>3 codes</u>
Codes	CESAM ASTECC STAROX MoMo YREC TGEC CLES GENEC	TGEC, MoMo, (CESTAM) MESA	FRANEC PARSEC YREC STERN MESA GENEC STAREVOL KEPLER	FRANEC PARSEC DSTC MESA STAREVOL LPCODE GARSTEC YREC MONSTAR STARS EVOL	STAREVOL Lyon Evolutionary Code CESTAM Palla &Stahler code DSTC MESA	Lyon Evolutonary code	BINSTAR TWIN STERN MESA

# Who treats rotation and associated mixing ?

Rotation and associated AM and nuclides transport

FRANEC YREC STERN MESA STAREVOL GENECE CESTAM ATON

Endal & Sofia 1978 (diffusive) formalism

Zahn 1992; Maeder & Zahn 1998 (advective/diffusive) formalism

AM transport by IGWs included in

STAREVOL

Magnetic field treatment (Tayler-Spruit dynamo formalism)

MESA YREC STERN GENECE

# Who provides model grids ?

## Grids for asteroseismology

CESAM, CLES, STAREVOL

## Massive star models

GENEC, STERN, FRANEC, PARSEC

## All masses with AGB phase included

BaSTI (code FRANEC), PARSEC, STAREVOL

## Grids with HRD to CMD conversions

BaSTI (code FRANEC), PARSEC, YREC (server Y<sup>2</sup>), GENEC (server SYCLIST)

## PMS grids

STAREVOL, Lyon Evolutionary Code, Palla & Stahler, PARSEC, Y<sup>2</sup>

## Yields

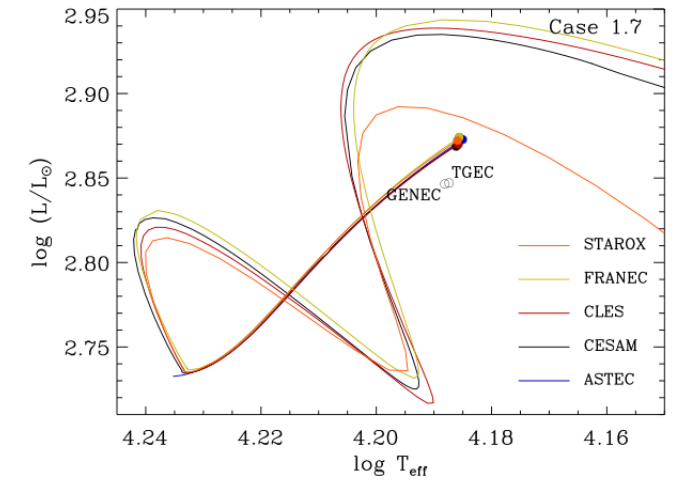
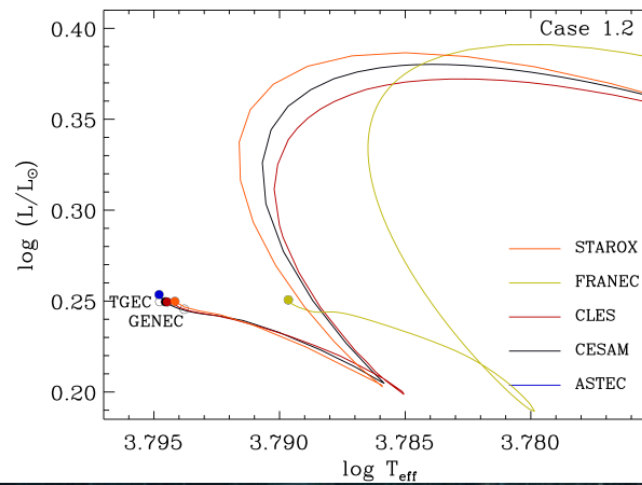
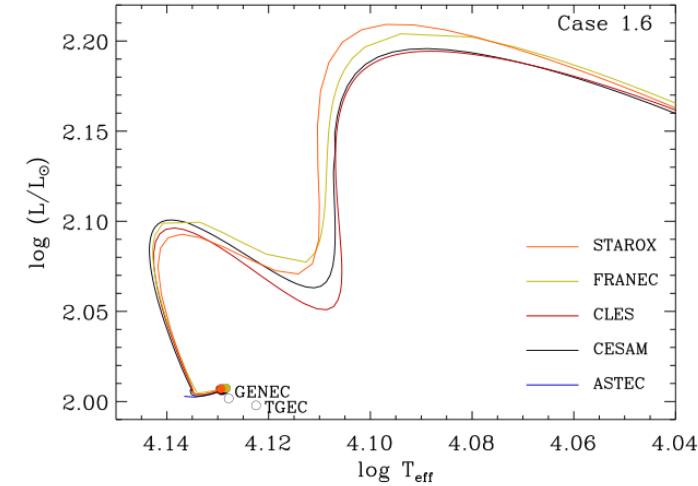
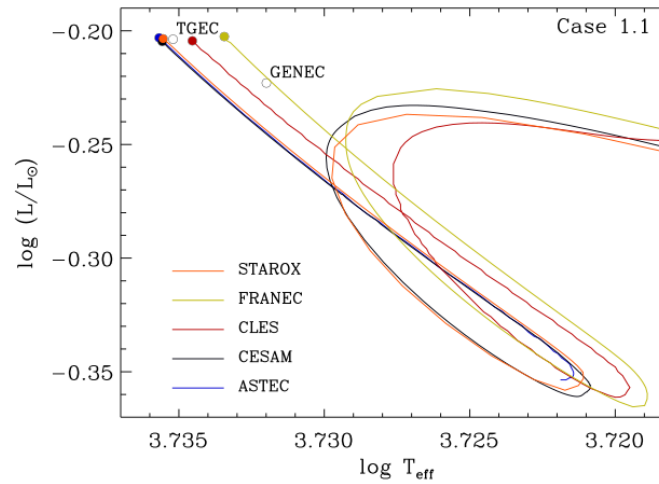
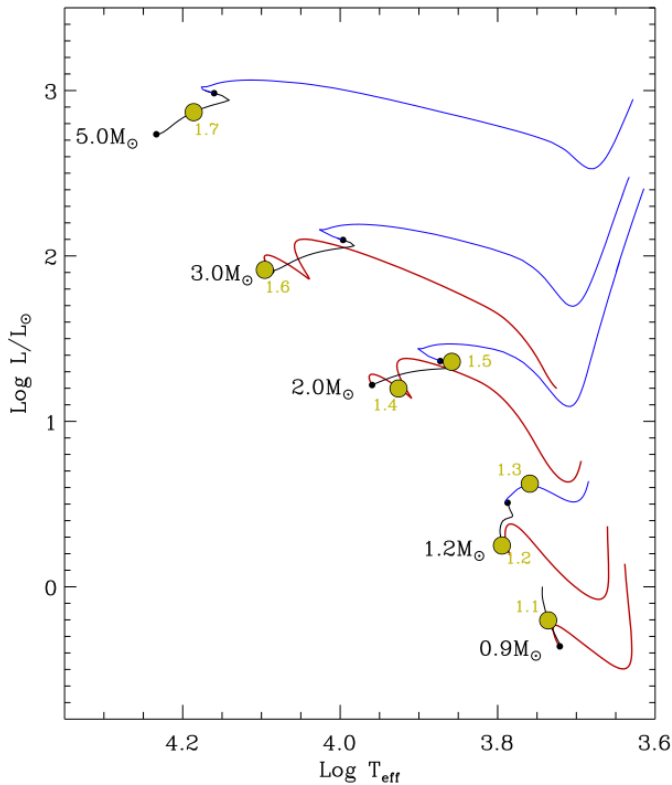
STAREVOL, FRANEC, STERN, GENEC, KEPLER

# Comparisons on the MS

CoRoT/ESTA Working group

<http://www.astro.up.pt/corot/>

Compared at fixed physical inputs\*



\* (EoS, Opacities, Atmosphere, nuclear network, initial chemical comp., convection/overshooting)

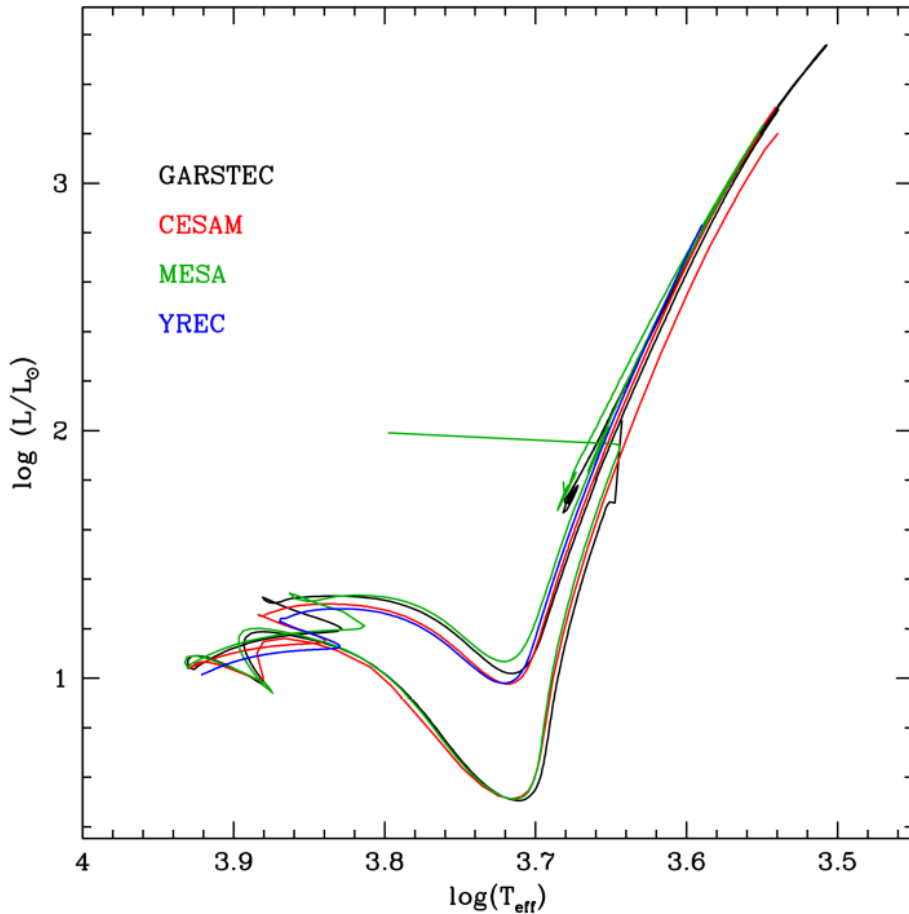


# Comparisons on the RGB

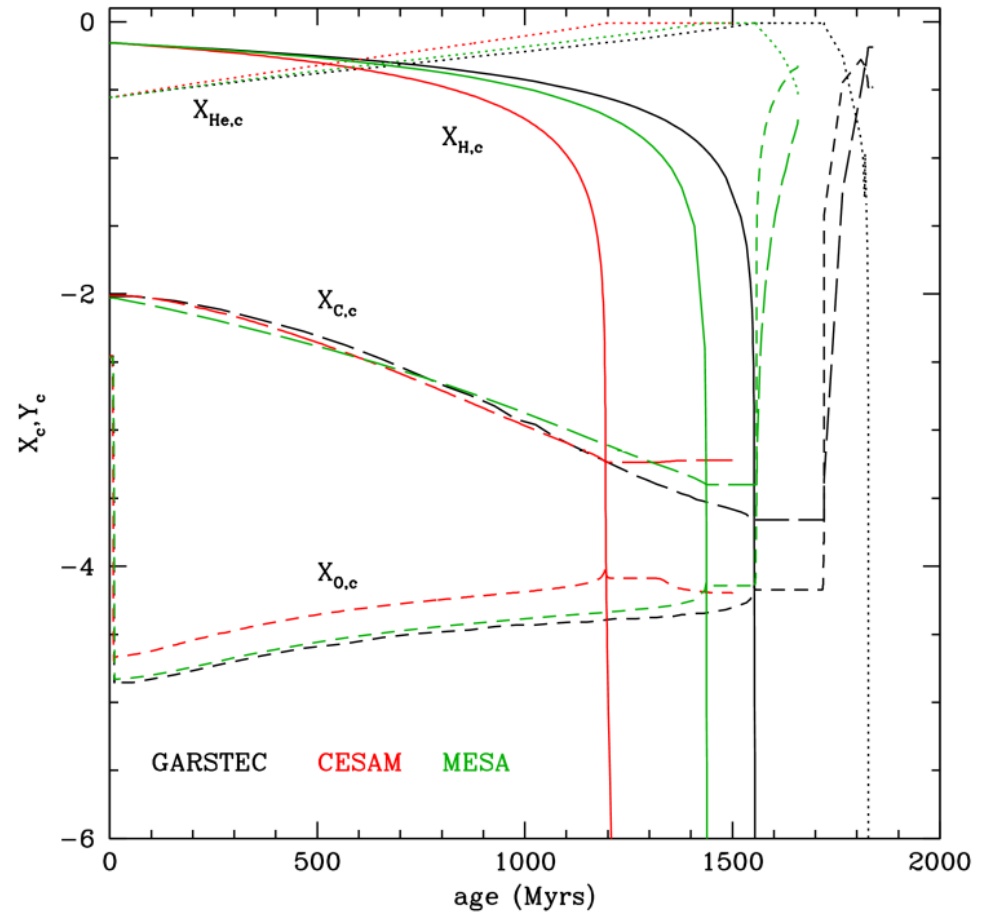
Stellar Code Calibration Project by Achim WEISS

KEPLER challenge 2009

$M = 1.8 M_{\odot}$ ,  $Y = 0.28$ ,  $Z = 0.02$ ,  $\alpha_{\text{MLT}} = 1.75$ , GN93



$M = 1.8 M_{\odot}$ ,  $Y = 0.28$ ,  $Z = 0.02$ ,  $\alpha_{\text{MLT}} = 1.75$ , GN93



<http://www.mpa-garching.mpg.de/stars/SCC/StarCode.html>

# Comparisons of massive star models

Martins & Palacios 2013

