Forward modelling of the gravity-mode sdB pulsator KIC 10553698A

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Outline

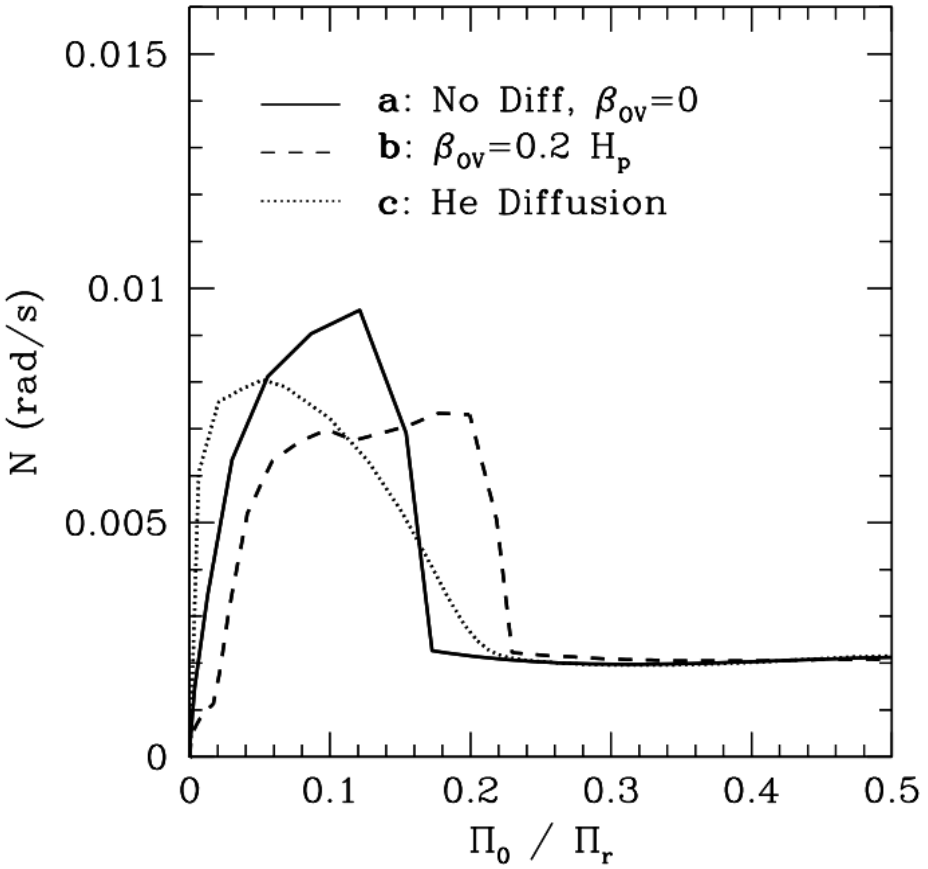
- Period Spacing and Trapped modes
- Boundary of the convective core
- Models
- KIC 10553698A
- Results
- Conclusions
- Future plan

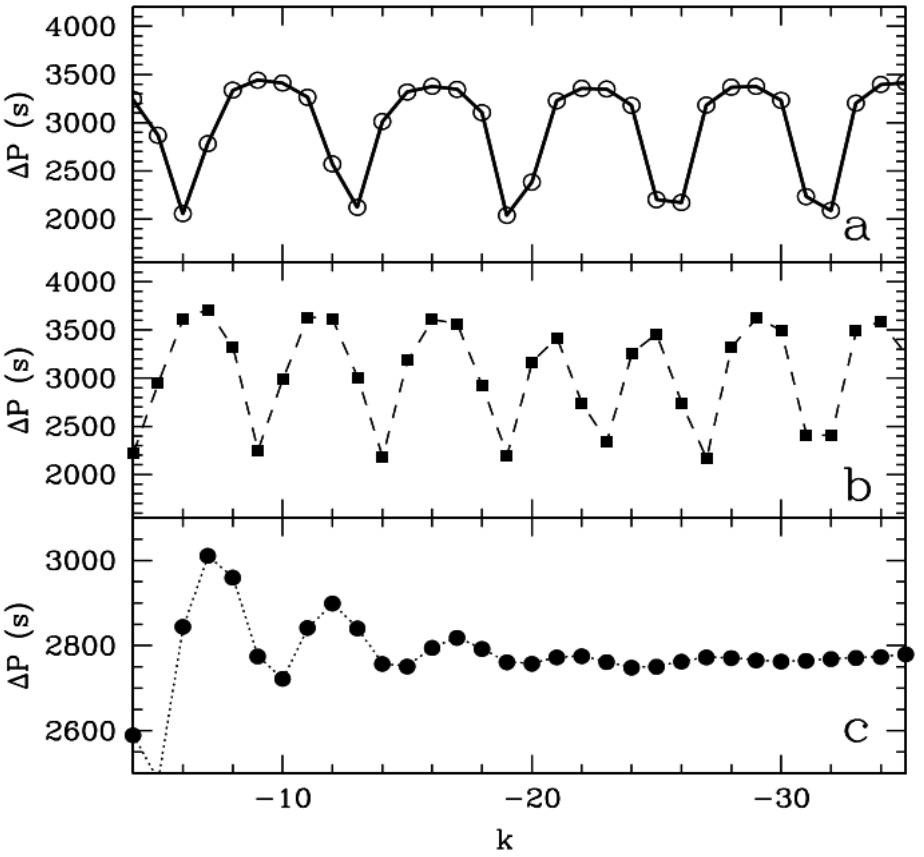
Gravity modes period spacing

- Asymptotic Period Spacing (Tassoul 1980)

$$P_k = \frac{\pi^2}{L \int_{x_0}^{1} \frac{|N|}{x} \mathrm{d}x} (2k + n_e)$$

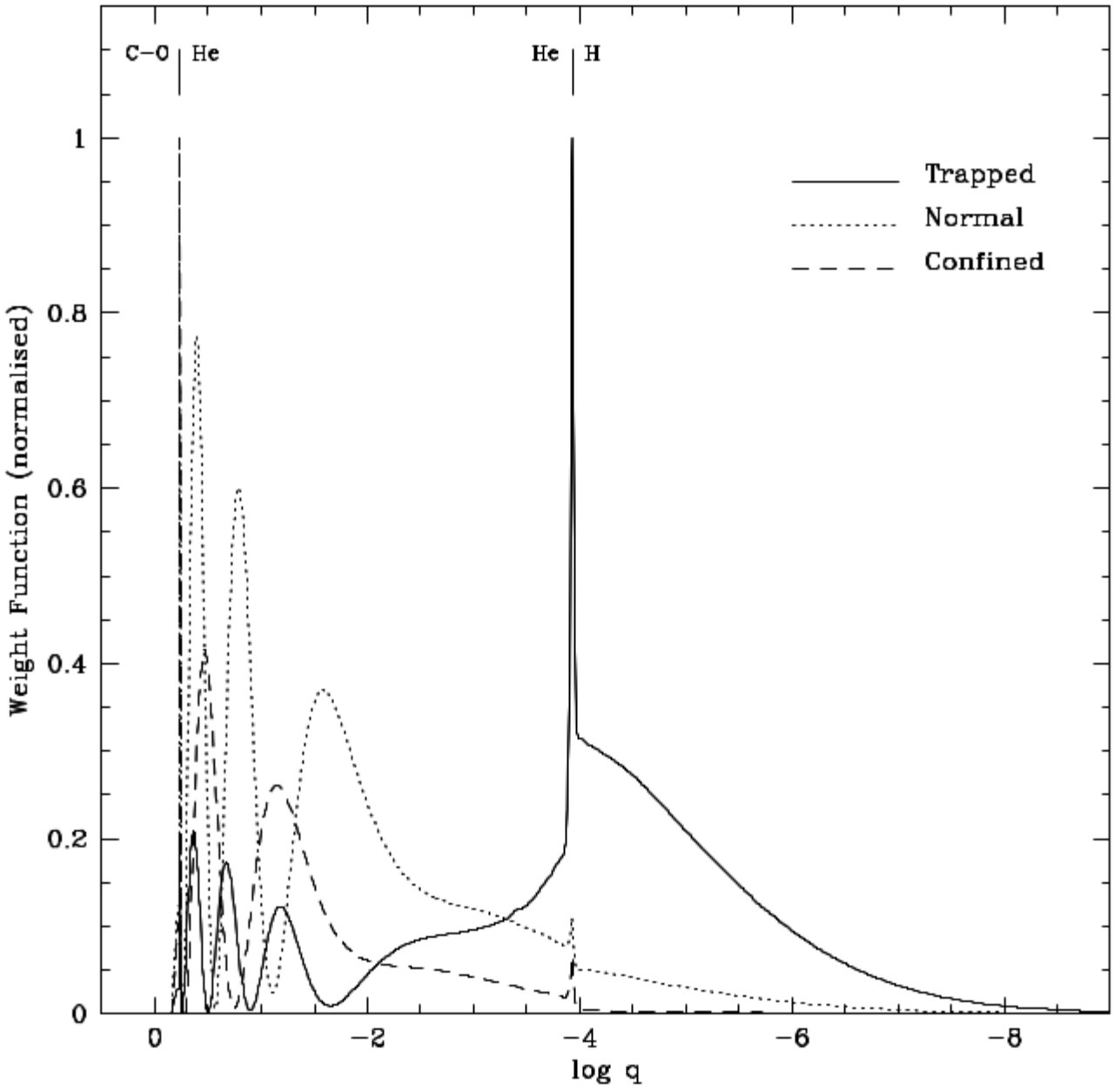
$$N^2 \simeq \frac{g^2 \rho}{p} (\nabla_{ad} - \nabla + \nabla_\mu)$$





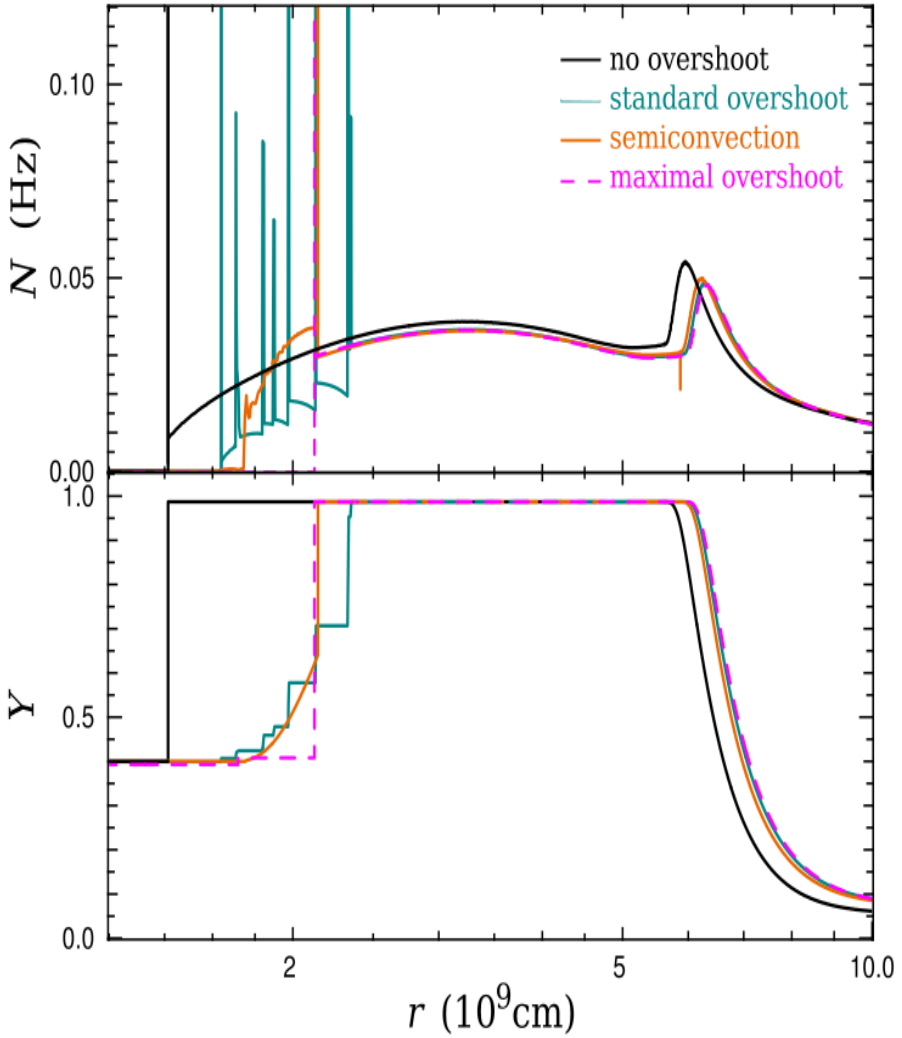
(Miglio et al. 2008)

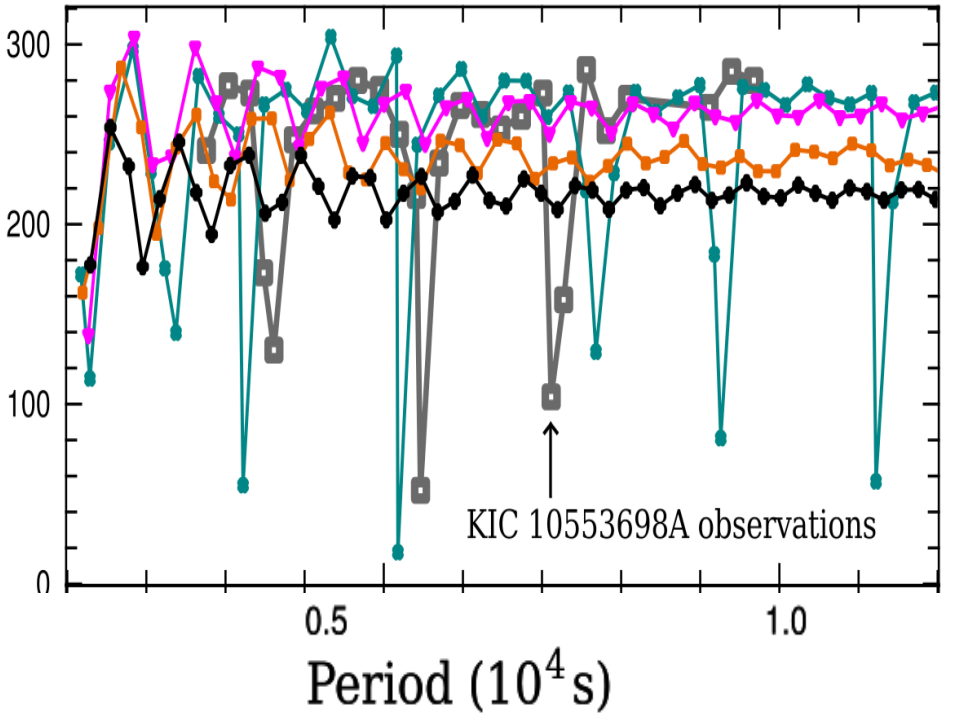
Trapped modes



(Charpinet et al., 2000)

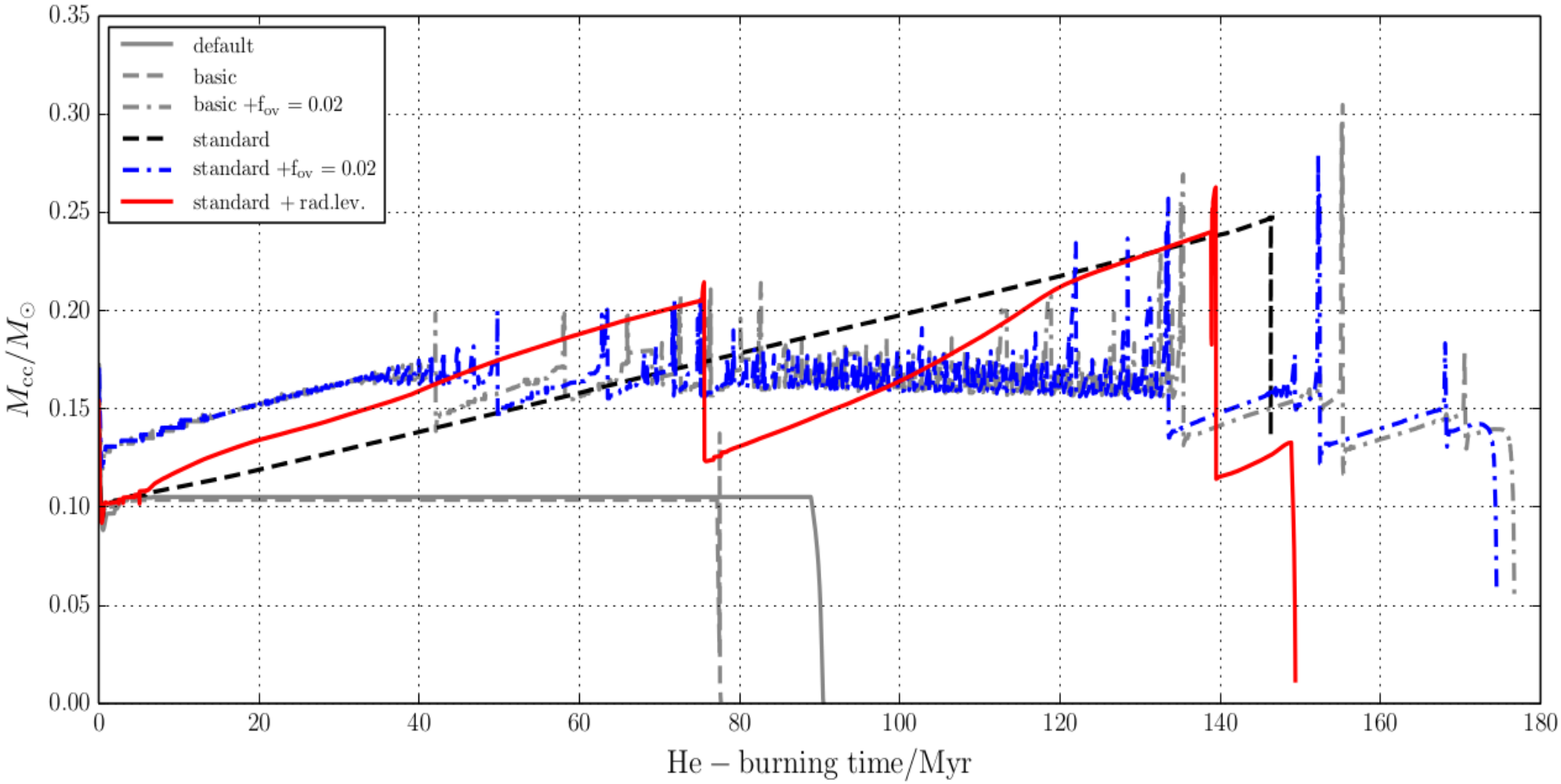
The effect of the boundary of the convective core on pulsations





(Constantino et al., 2015)

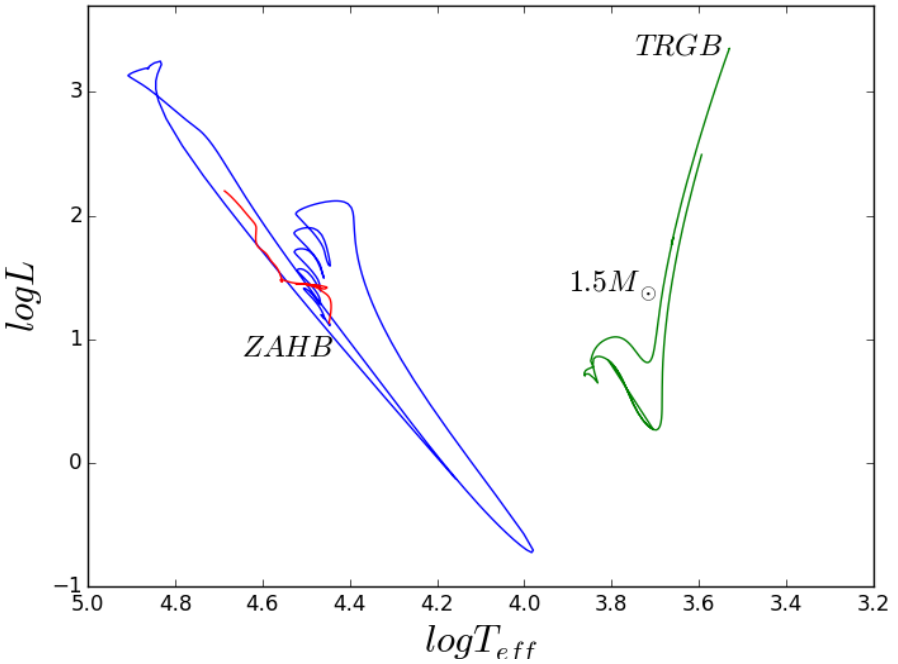
Convective core boundary



(Schindler et al., 2015)

Models

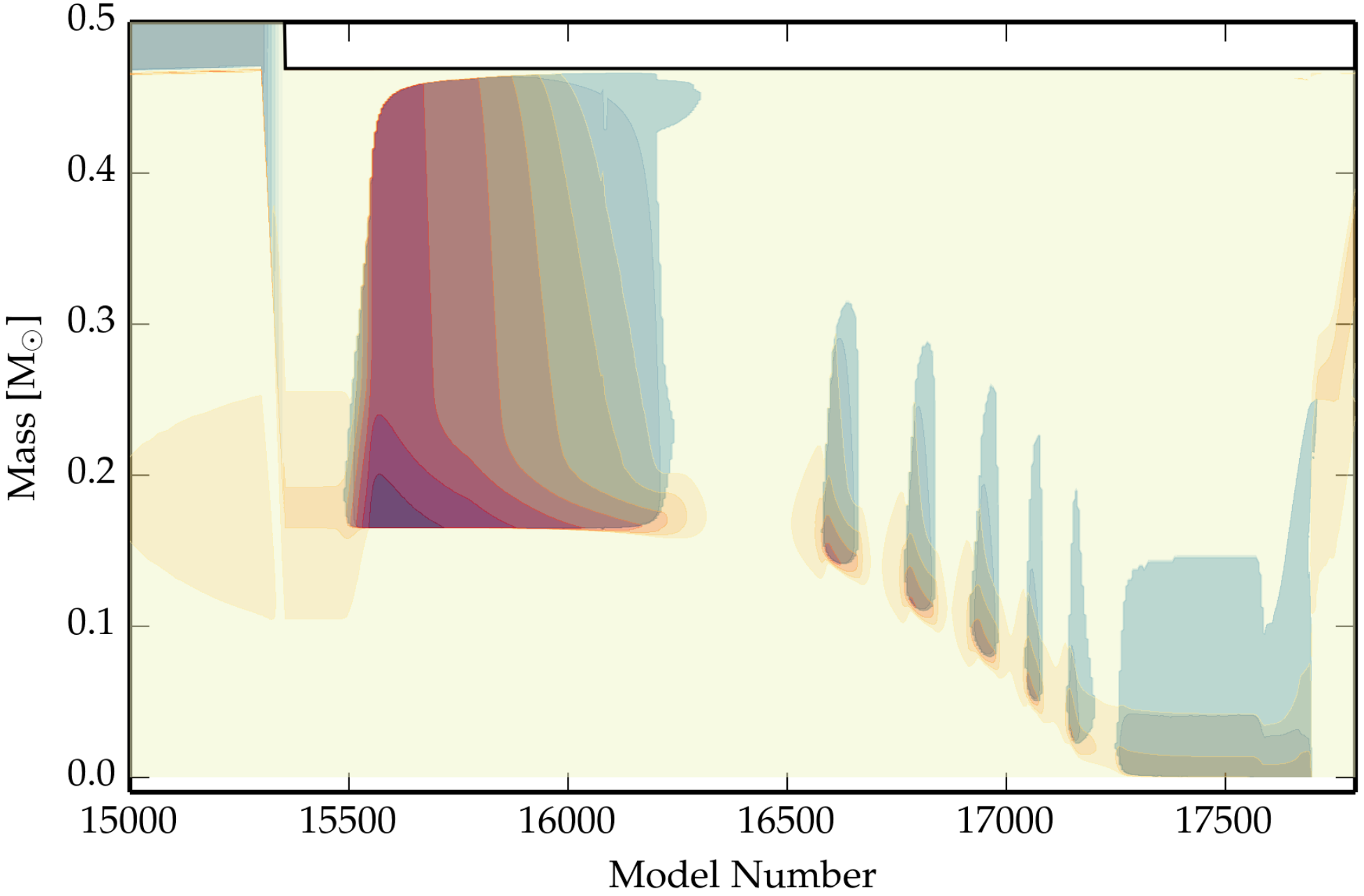
- Initial mass = 1.5 $M_{\odot}$
- Mixture : Asplund et al. 2009
- Composition: X =0.738 , Y= 0.248 , Z= 0.014
- Schwarzschild criterion
- Mixing Length alpha = 2
- Exponential diffusive overshoot (Herwing 2000, Freytag et al.1996)
- OPAL CO-enhanced (Type ll) opacities
- Envelope stripping:
- M_{total} = 0.469 $M_{\odot}$, M_{env} = 0.008 $M_{\odot}$



MESA (Paxton et al, 2011,2013,2015)

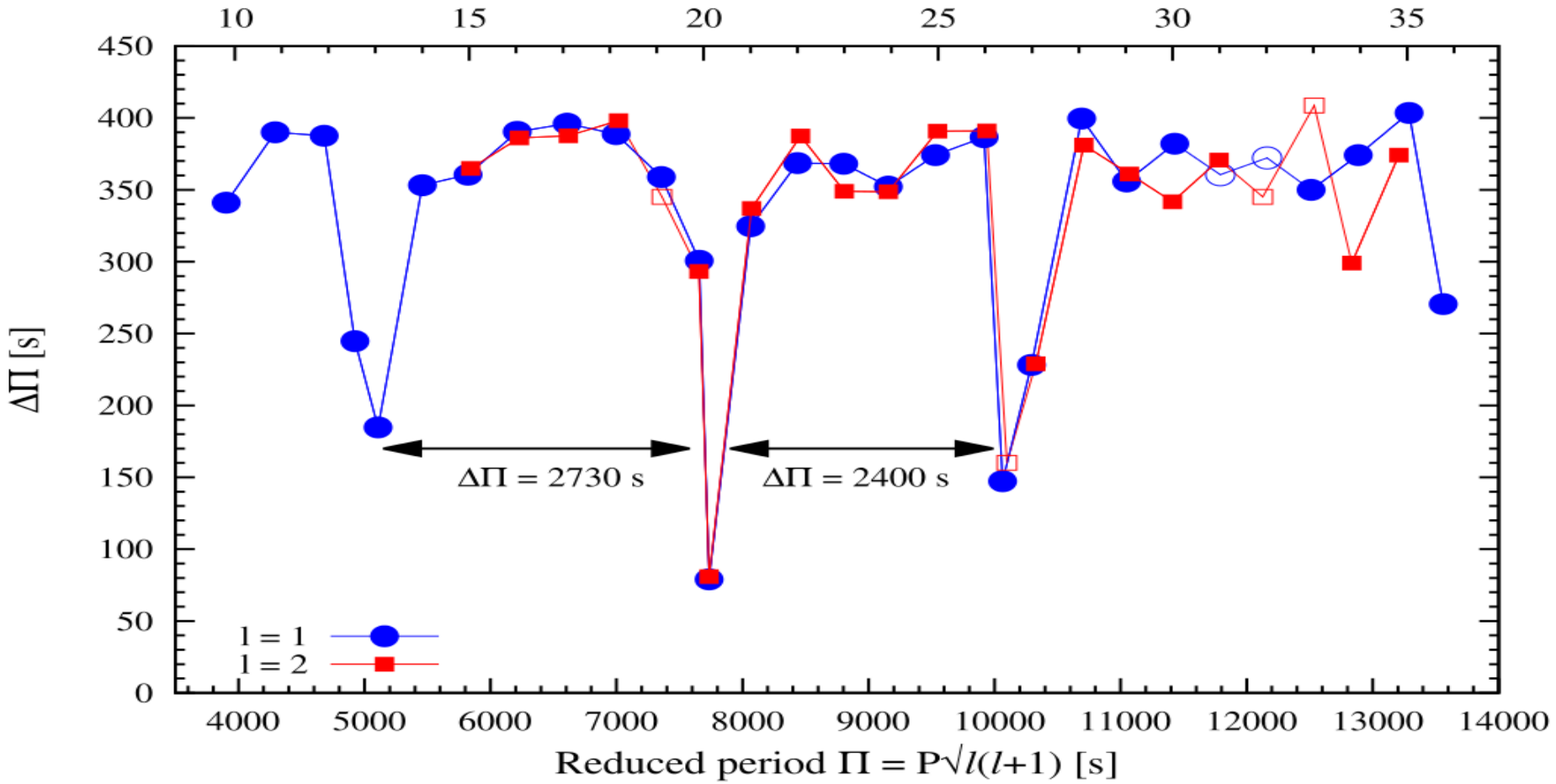
GYRE (Townsend et al., 2013)

Helium flash



KIC 10553698A

- Rich g-mode pulsator.
- White dwarf companion, KIC 10553698B, mass ~ 0.6$M_{\odot}$
- Ostensen et al. 2014, identified 156 as components of l = 1 and l = 2 multiplets.



The talk by Roy

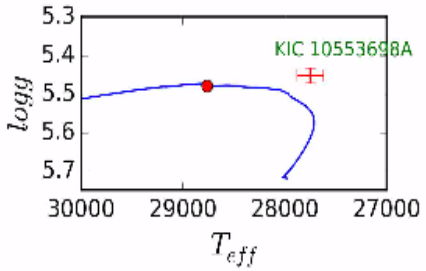
Scenarios

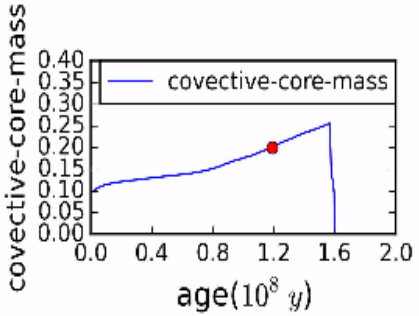
Scenarios	Covection	Semi-Convection mixing	Overshooting	Extra turbulent mixing	Element diffusion
	Ledoux / Schwarzschild	Y / N	Y / N	Y / N	Y / N
1	Schwarzschild	N	$f = 0.001\ H_p$	$D_{mix} = 10^{-2}\ (cm^2/s)$	N
2	Schwarzschild	N	$f = 0.01\ H_p$	$D_{mix} = 1\ (cm^2/s)$	Y
3	Schwarzschild	N	$f = 0.8\ H_p$	$D_{mix} = 100\ (cm^2/s)$	Y

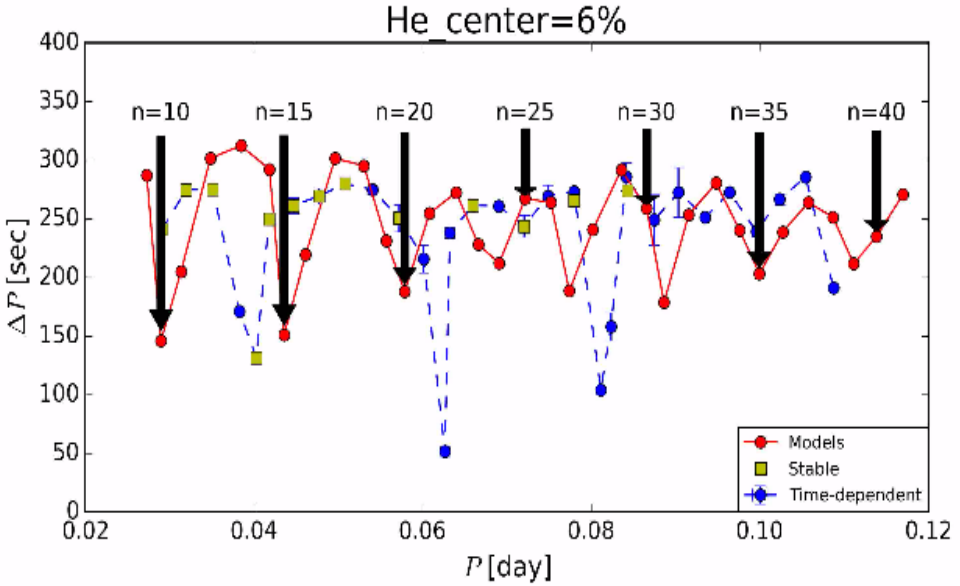
$$D_{\rm ov}(z) = D_{\rm conv}\ \exp\left(-\frac{2\,z}{f_{\rm ov}\,H_p}\right)$$

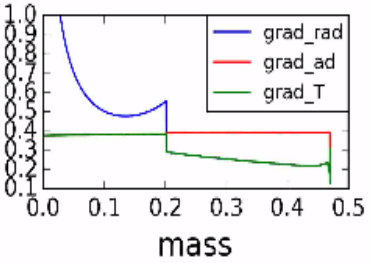
(Moravveji,2015)

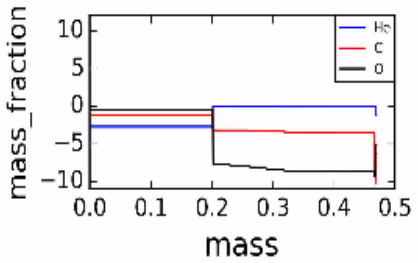
Slow mixing process

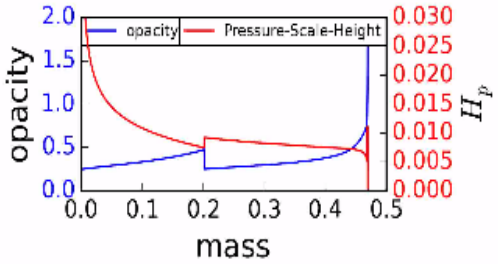


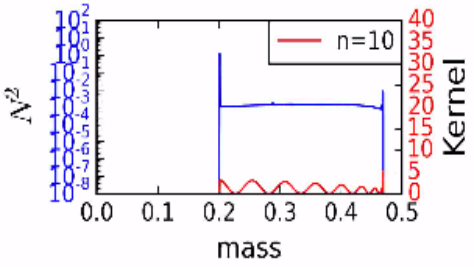


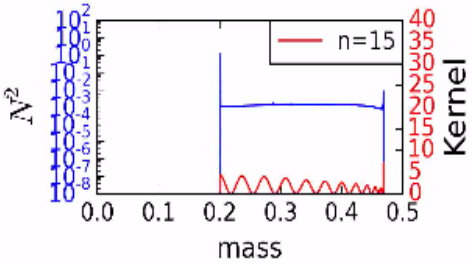


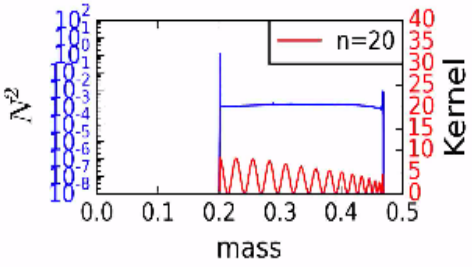


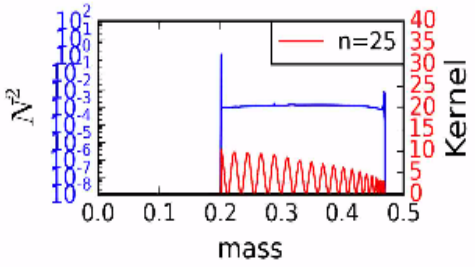


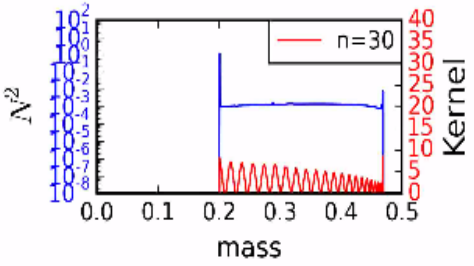


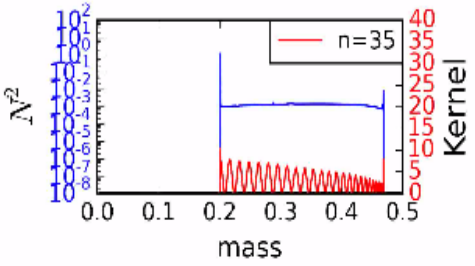


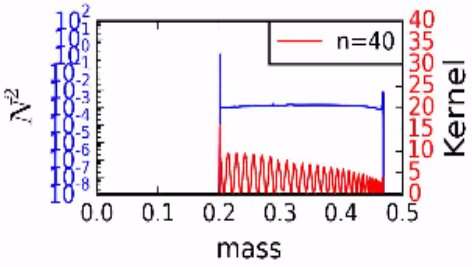




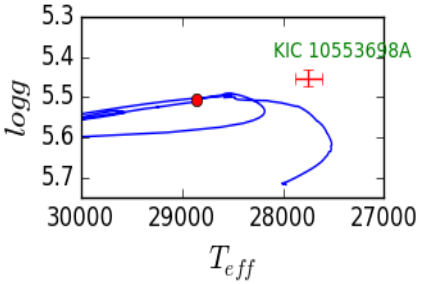


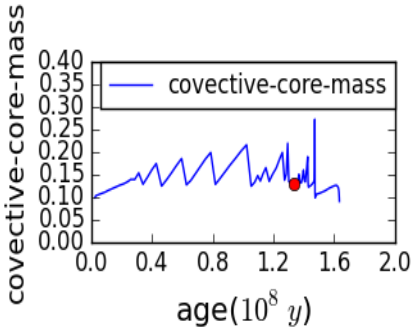


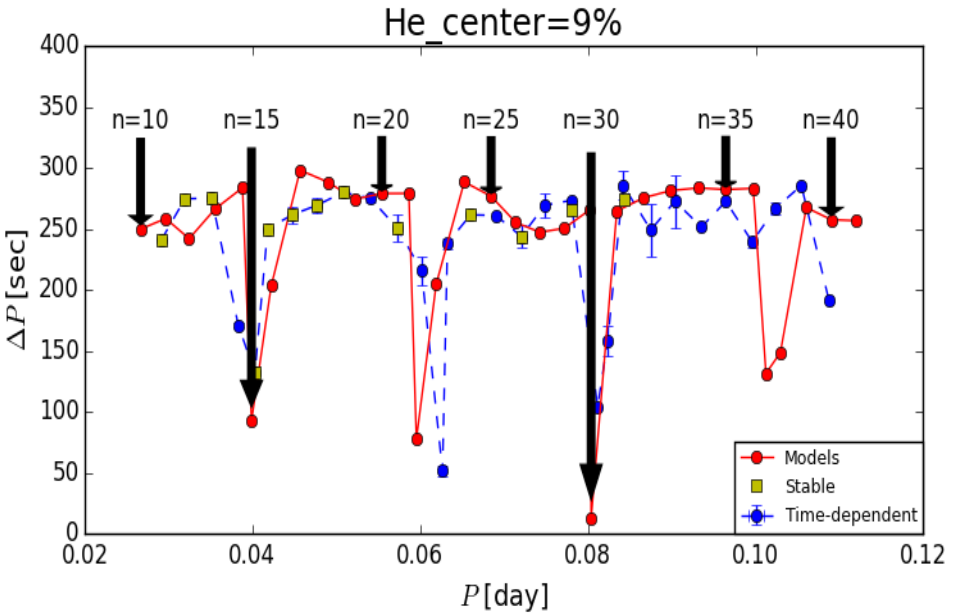


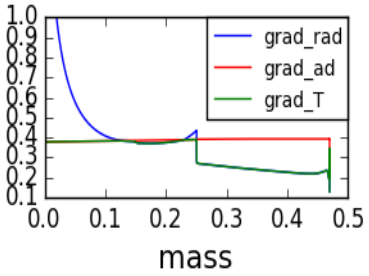


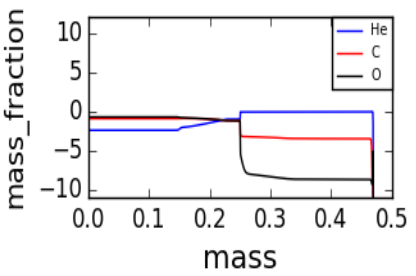
Rapid mixing process

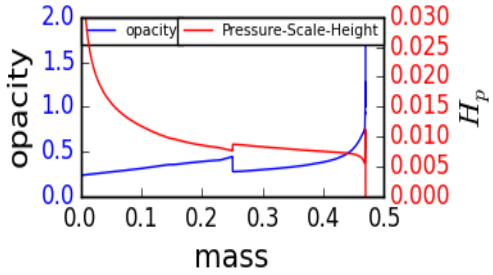


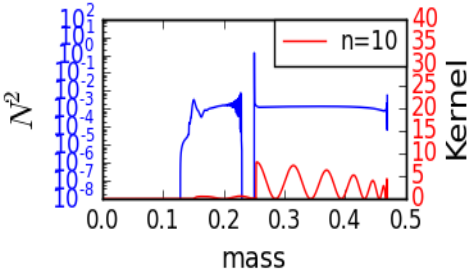


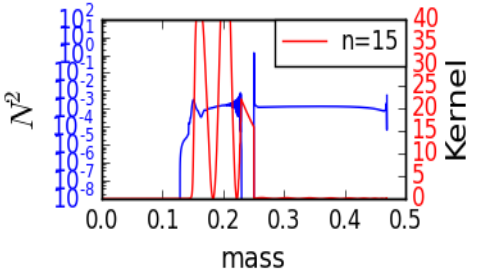


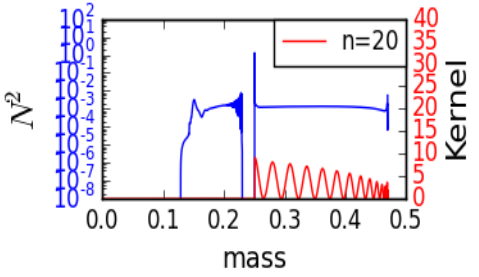


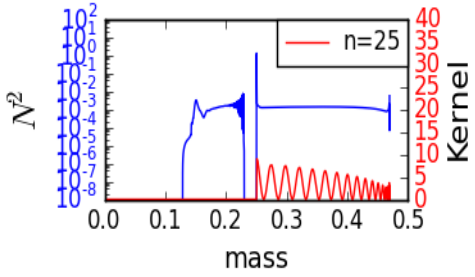


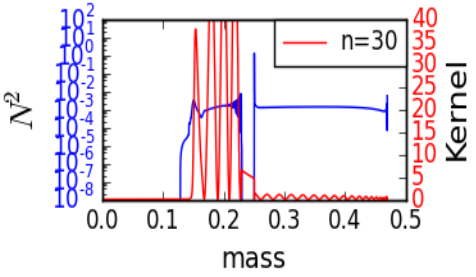


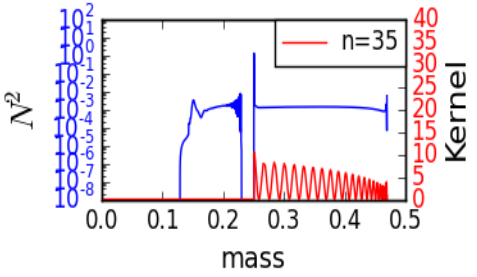


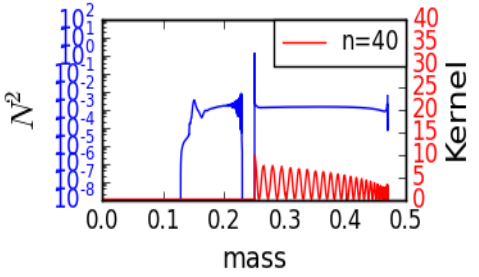




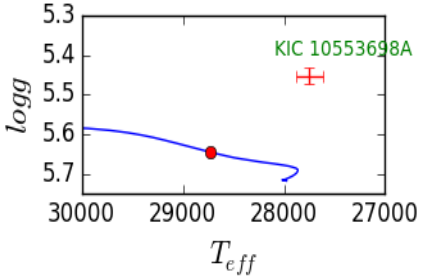


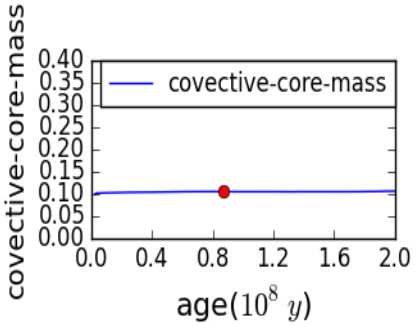


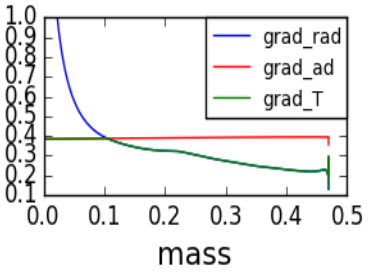


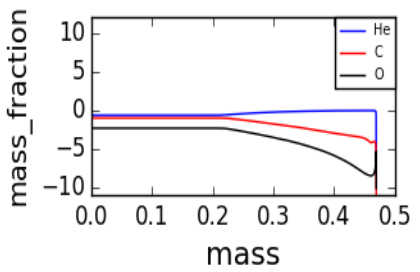


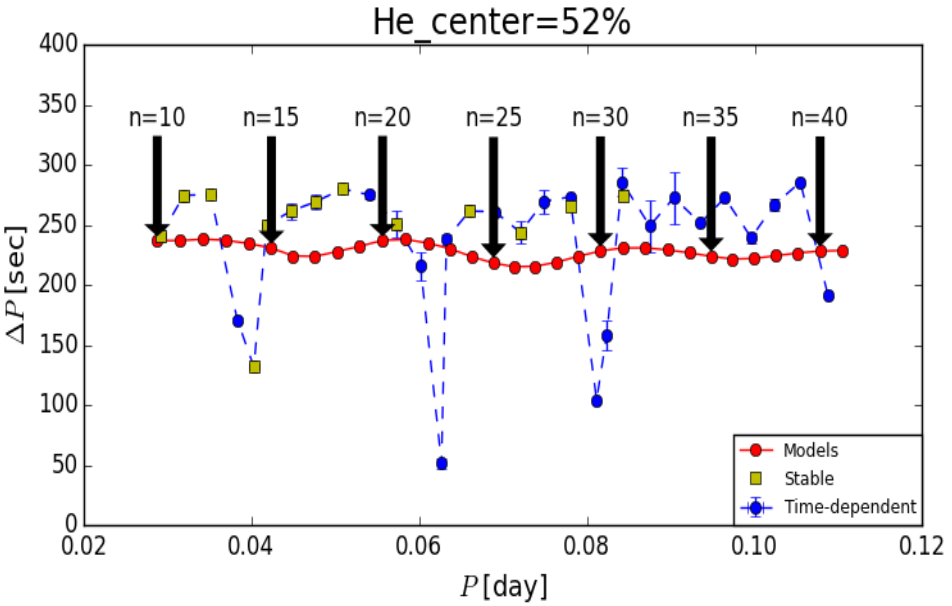
Very rapid mixing process

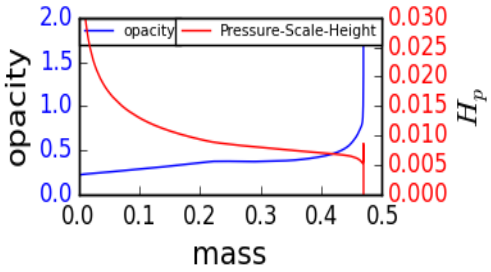


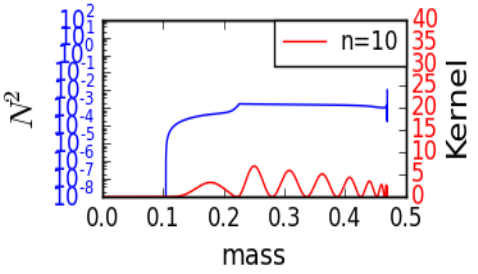


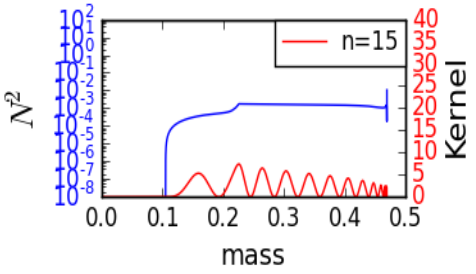


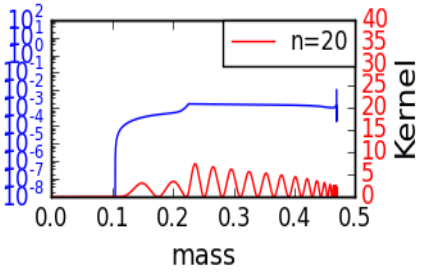


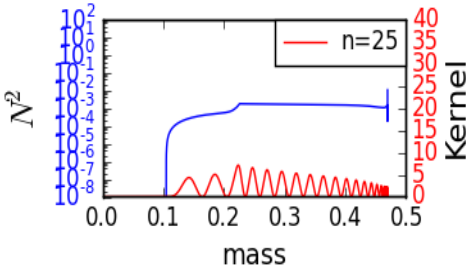


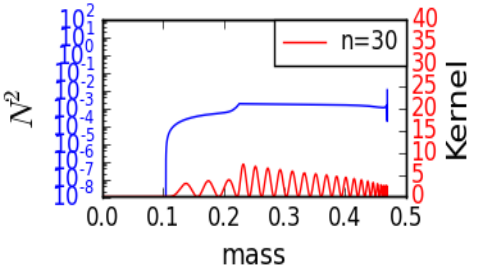


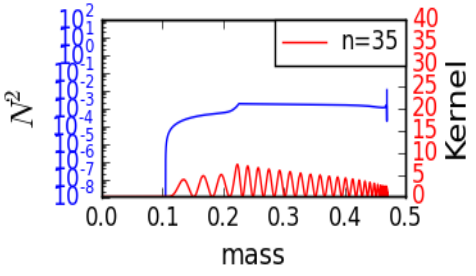


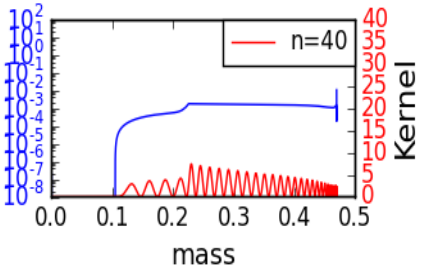






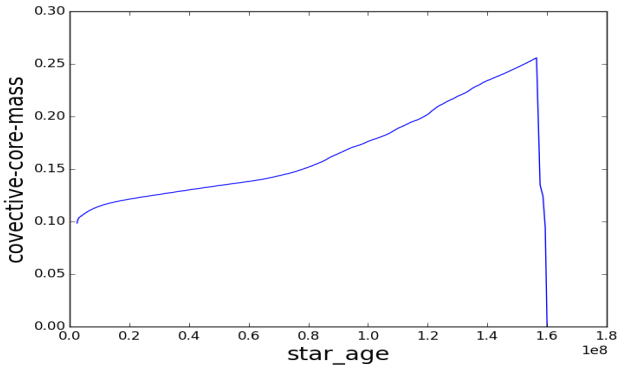


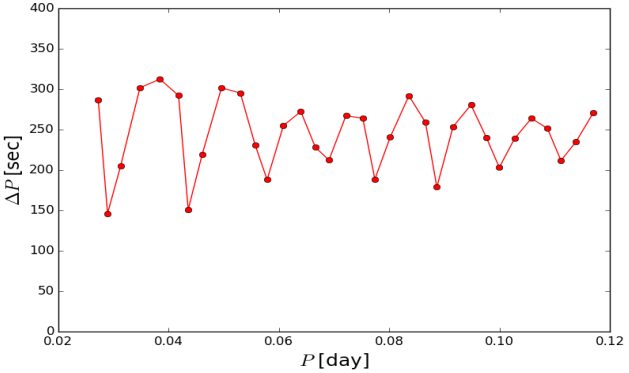




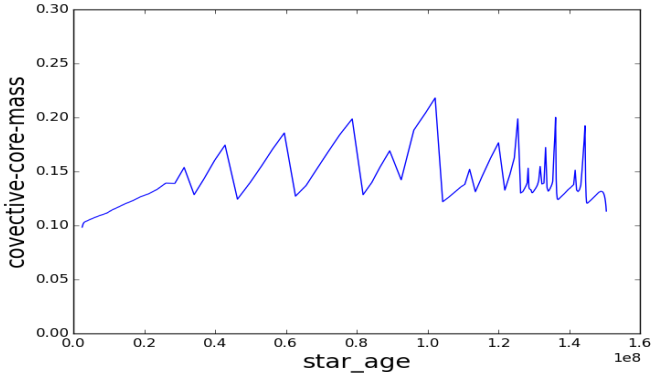
Conclusions

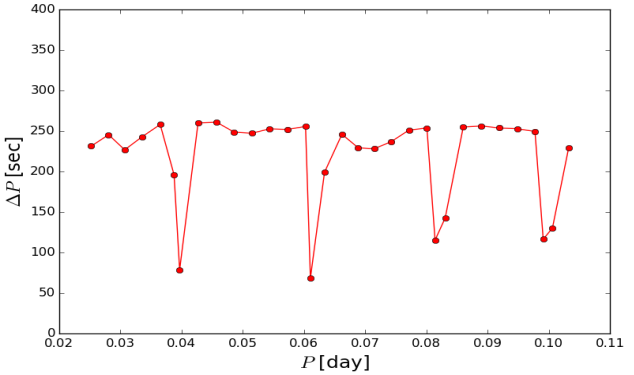
- Slow mixing processes



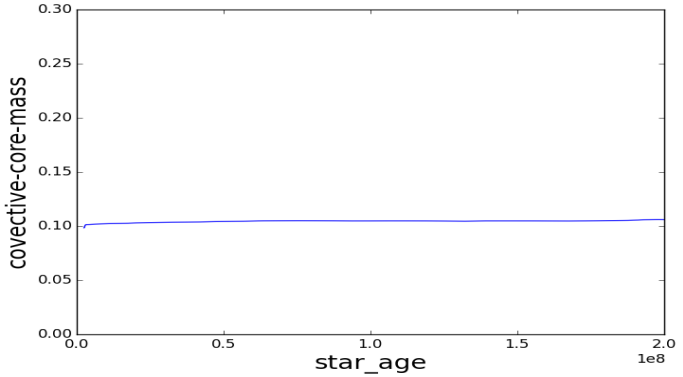


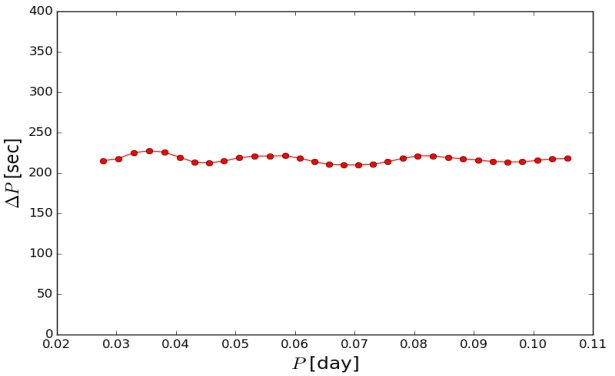
- Rapid mixing process





- Very rapid mixing process





Future plans

- More model computation.
- Other parameters: Helium core mass, Hydrogen envelope mass, Initial mass, Metallicity, etc.
- Helium core flash