Tests and future plans for the FRANEC code

(Pise and Naples groups)

1) Deeper comparison of the case 1.4

Parameters:

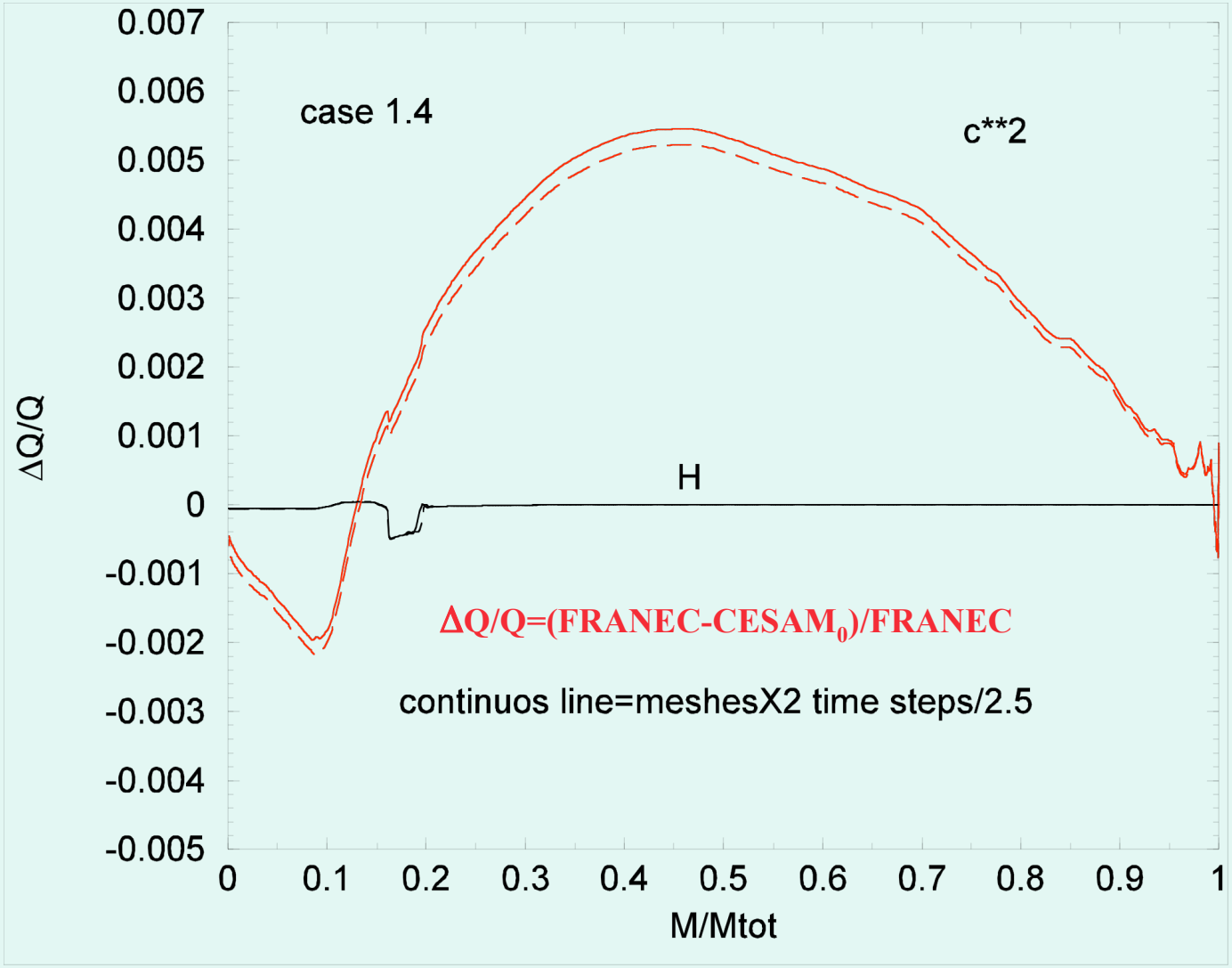
$M/M_O=2.0$ $X_0=0.70$ $Y_0=0.28$ $Z_0=0.02$ $l_{MLT}/H_p=1.6$

Target model: $T_c=1.9\cdot10^7$ K (PMS)

Global parameters case 1.4:

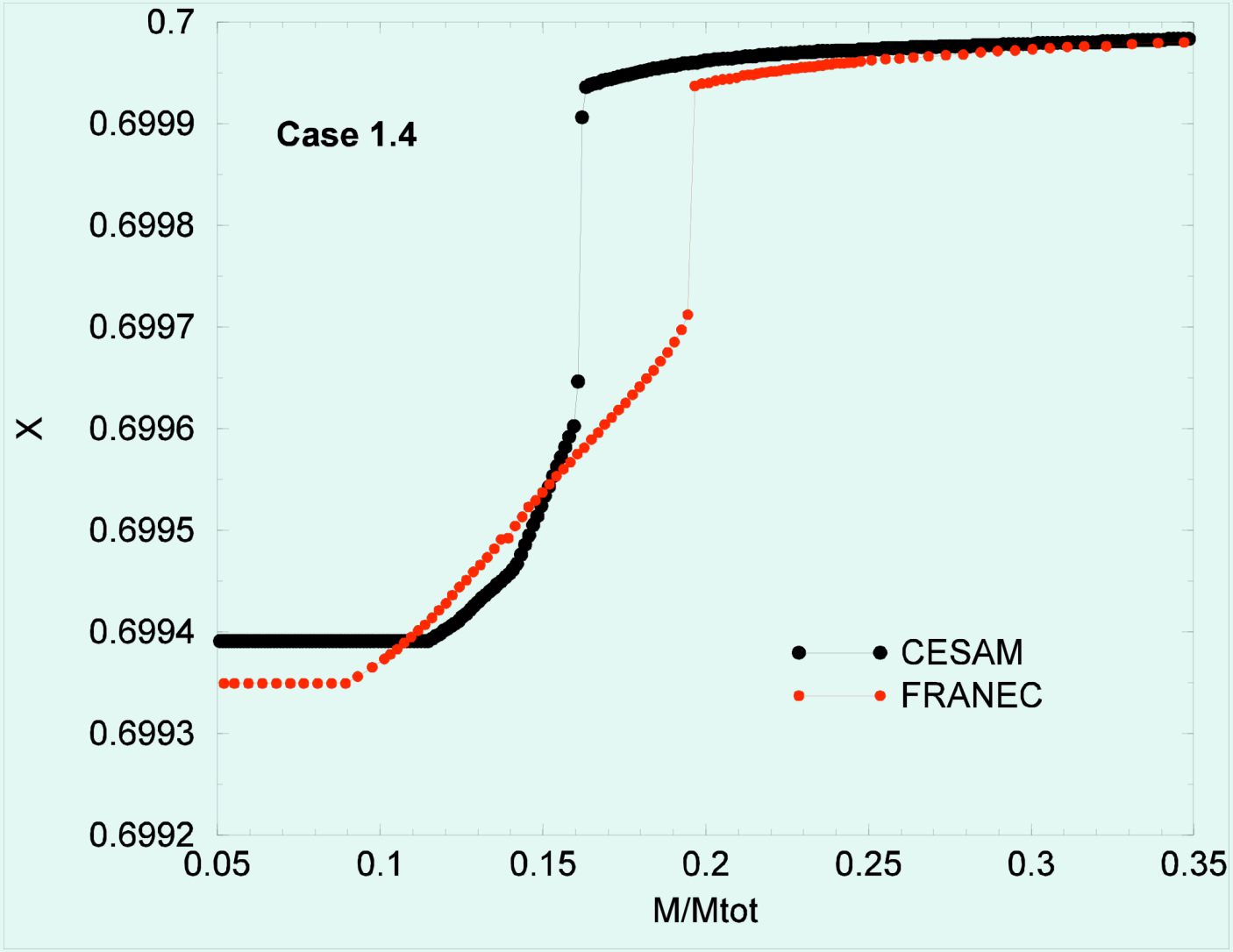
	CESAM$_0$	FRANEC	Δ
•Age [Myr]	7.043	7.764	0.10
•R/R_O	1.866	1.878	0.006
•L/L_O	15.80	16.31	0.030
•T_{eff} [K]	8431	8472	0.005
•T_c [10^7 K]	1.900	1.900	0.
• ρ_c [g/cm^3]	49.22	50.47	0.025
•X_c	0.6994	0.6993	-0.0001
•M_{cor}/M	0.1075	0.0945	-0.121
•R_{env}/R	0.9988	0.9998	0.001

Relative differences for c^2 and X abundance

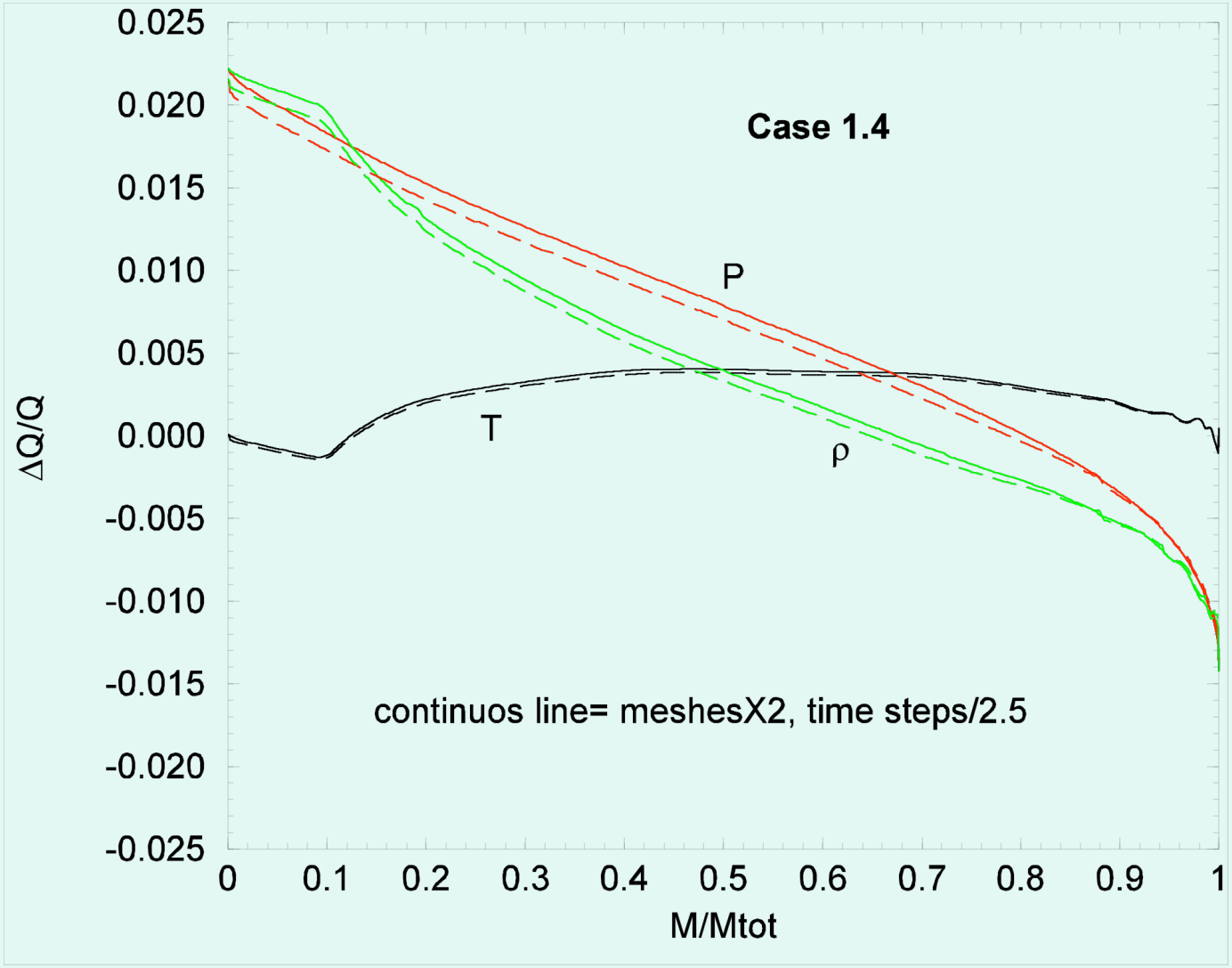


The effect of doubling the number of meshes or reducing the time step by a factor 2 is negligible

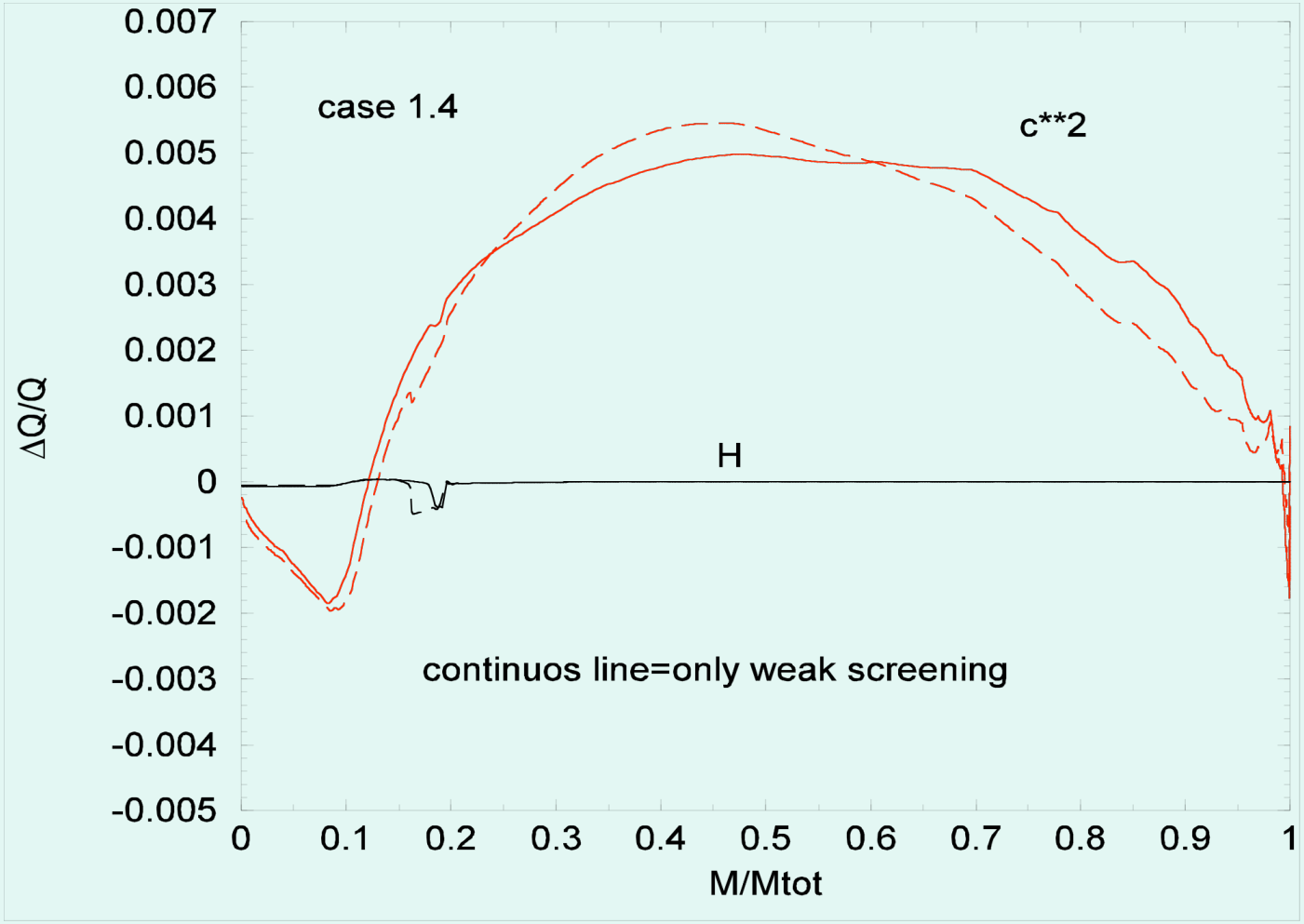
Comparison of the H profile



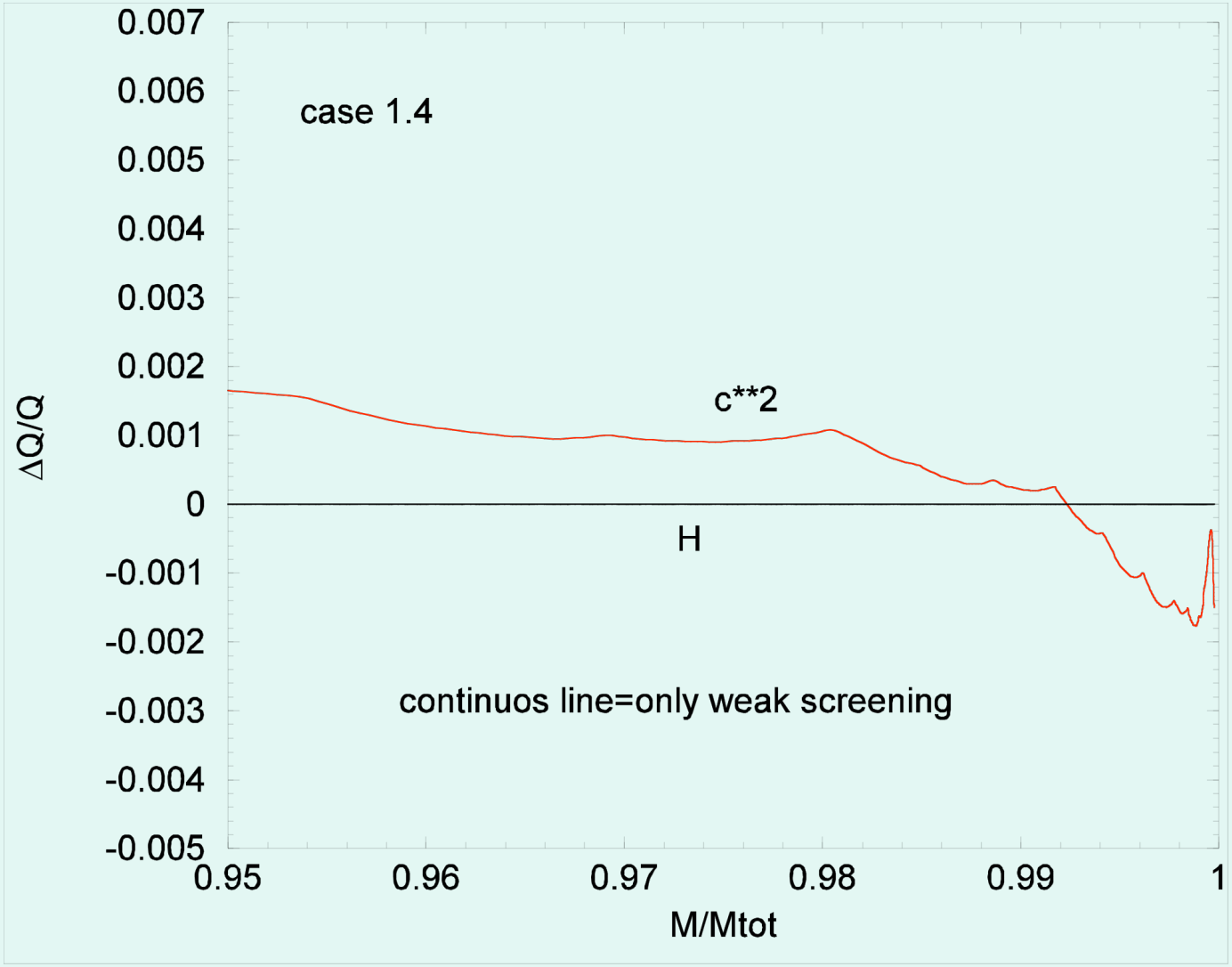
Relative differences for T, P, ρ



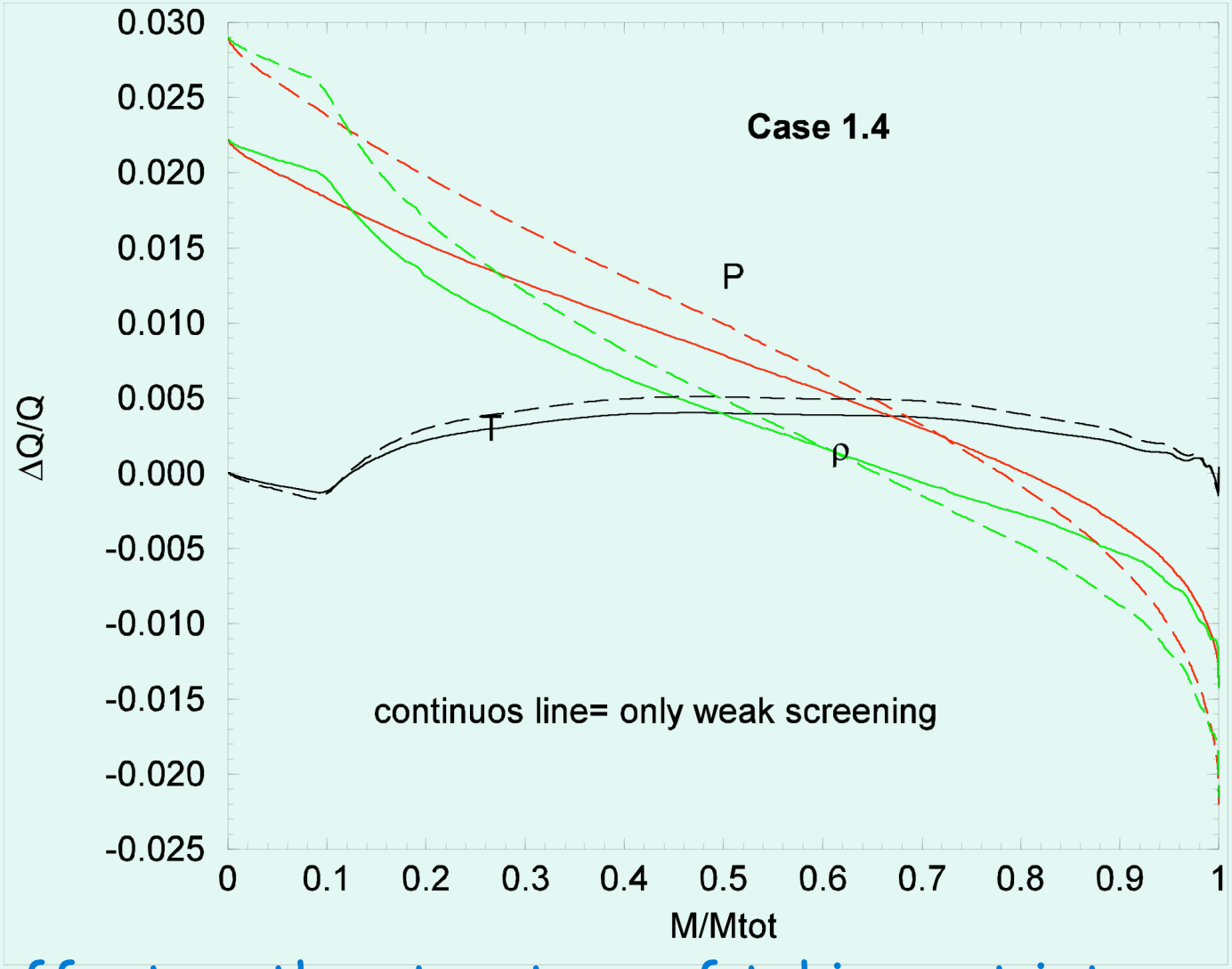
Only weak (Salpeter) screening for a better comparison with CESAM$_0$



Zoom of the more external region

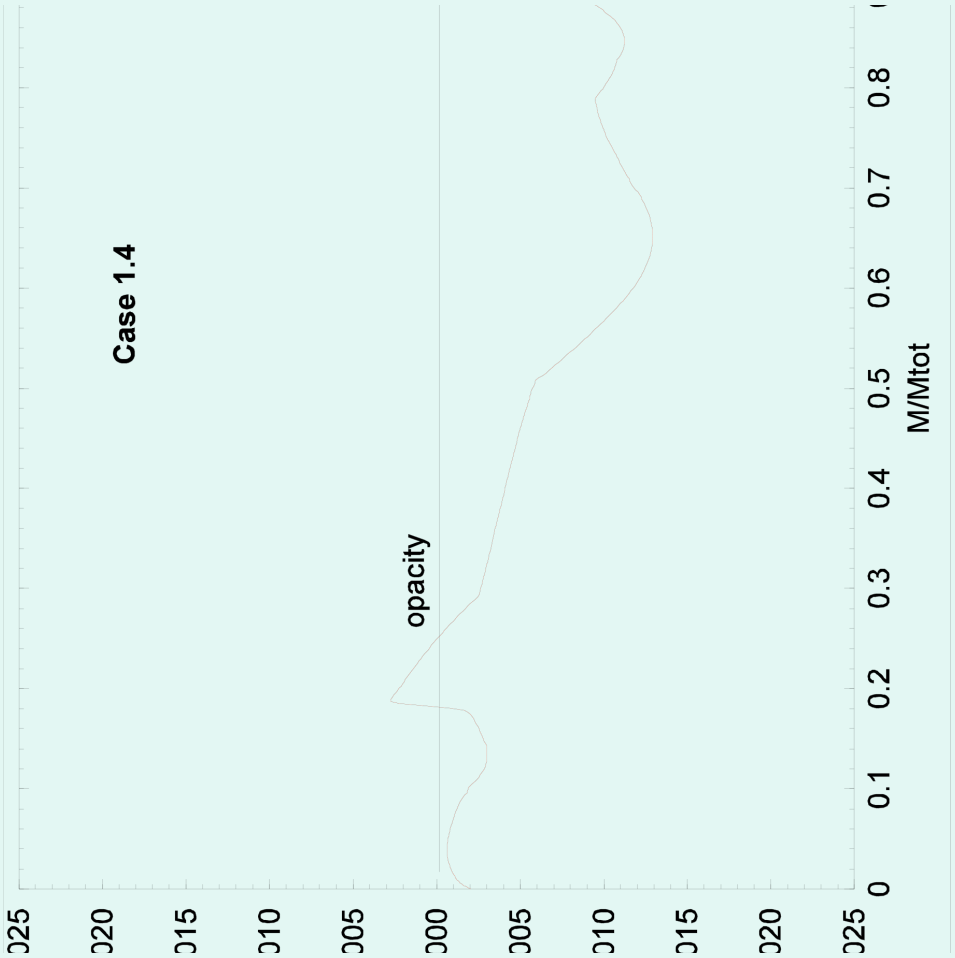


Relative differences for T, P, ρ with and without intermediate screening

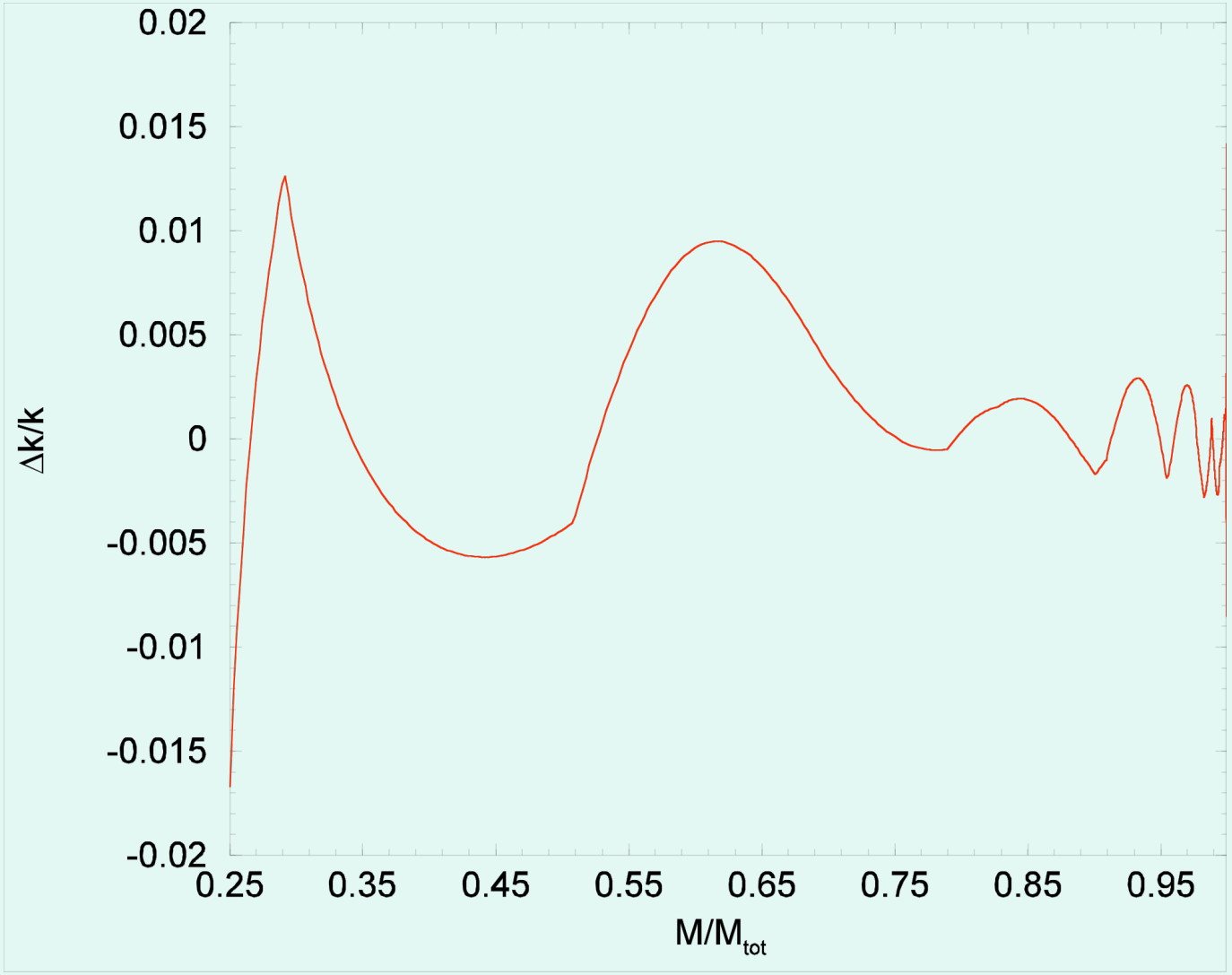


The effect on the structure of taking out intermediate screening is small

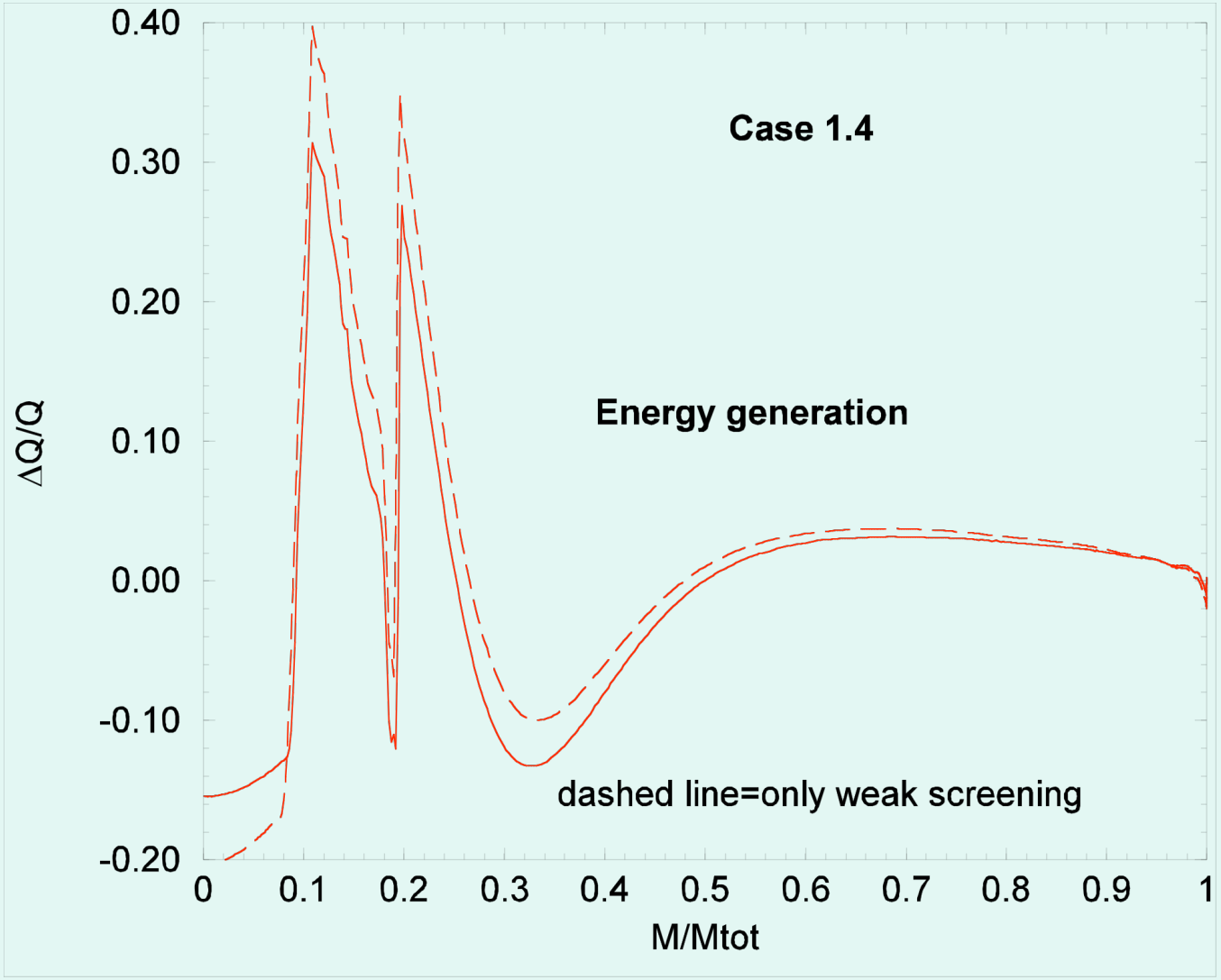
Relative difference for the opacity values



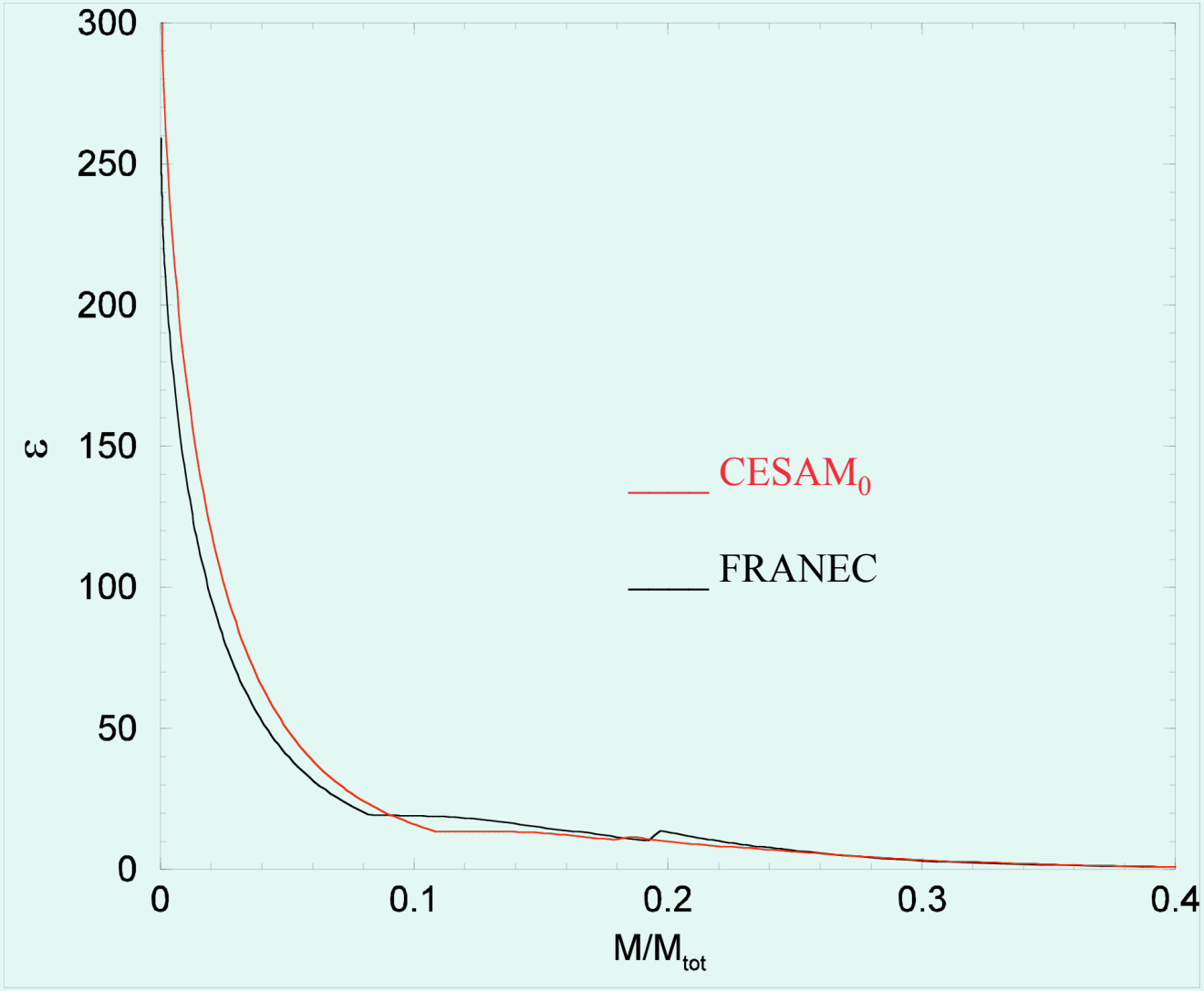
Relative difference between the CESAM$_0$ opacity and the opacity calculated with our subroutine for T, ρ, X taken from the CESAM$_0$ model

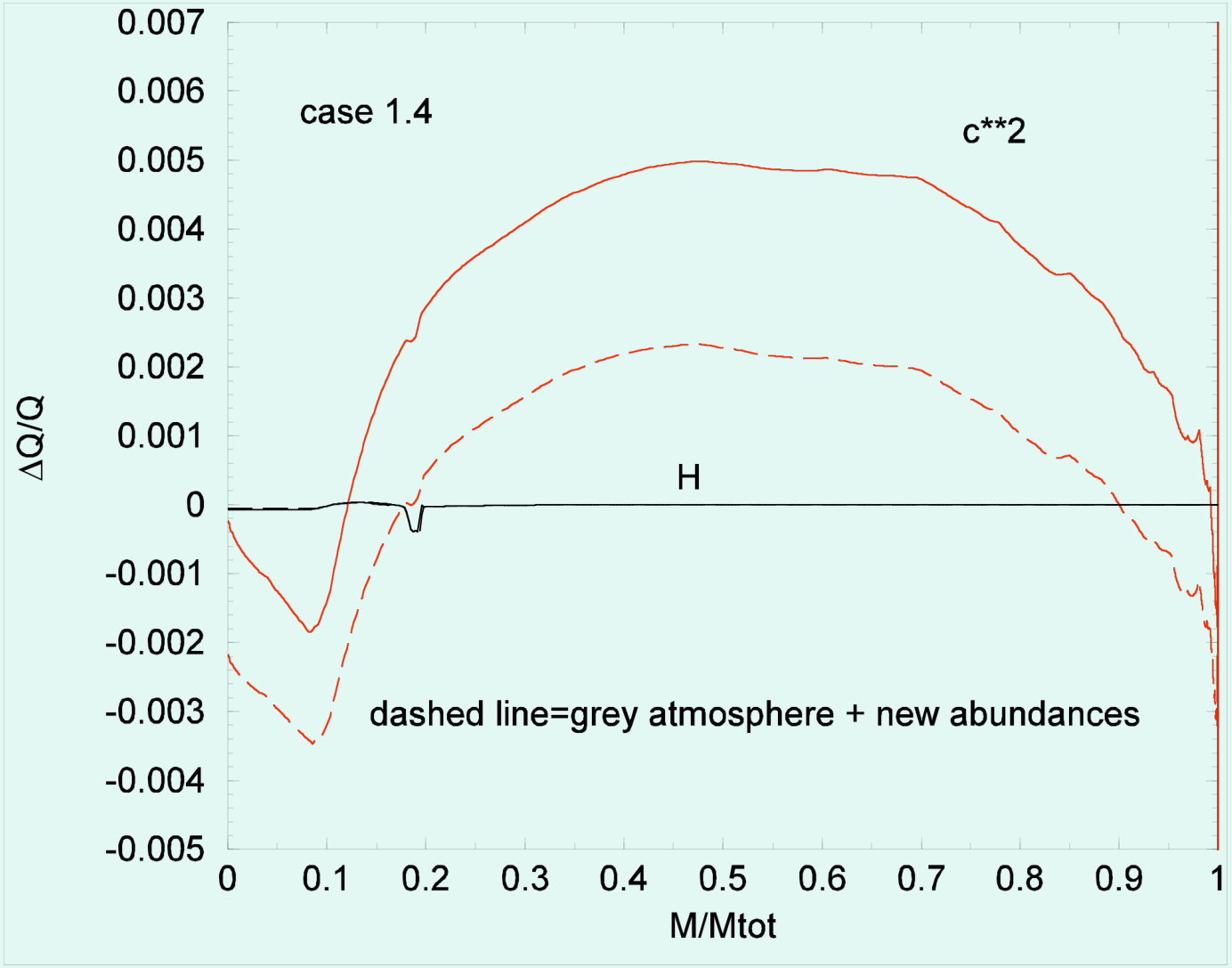


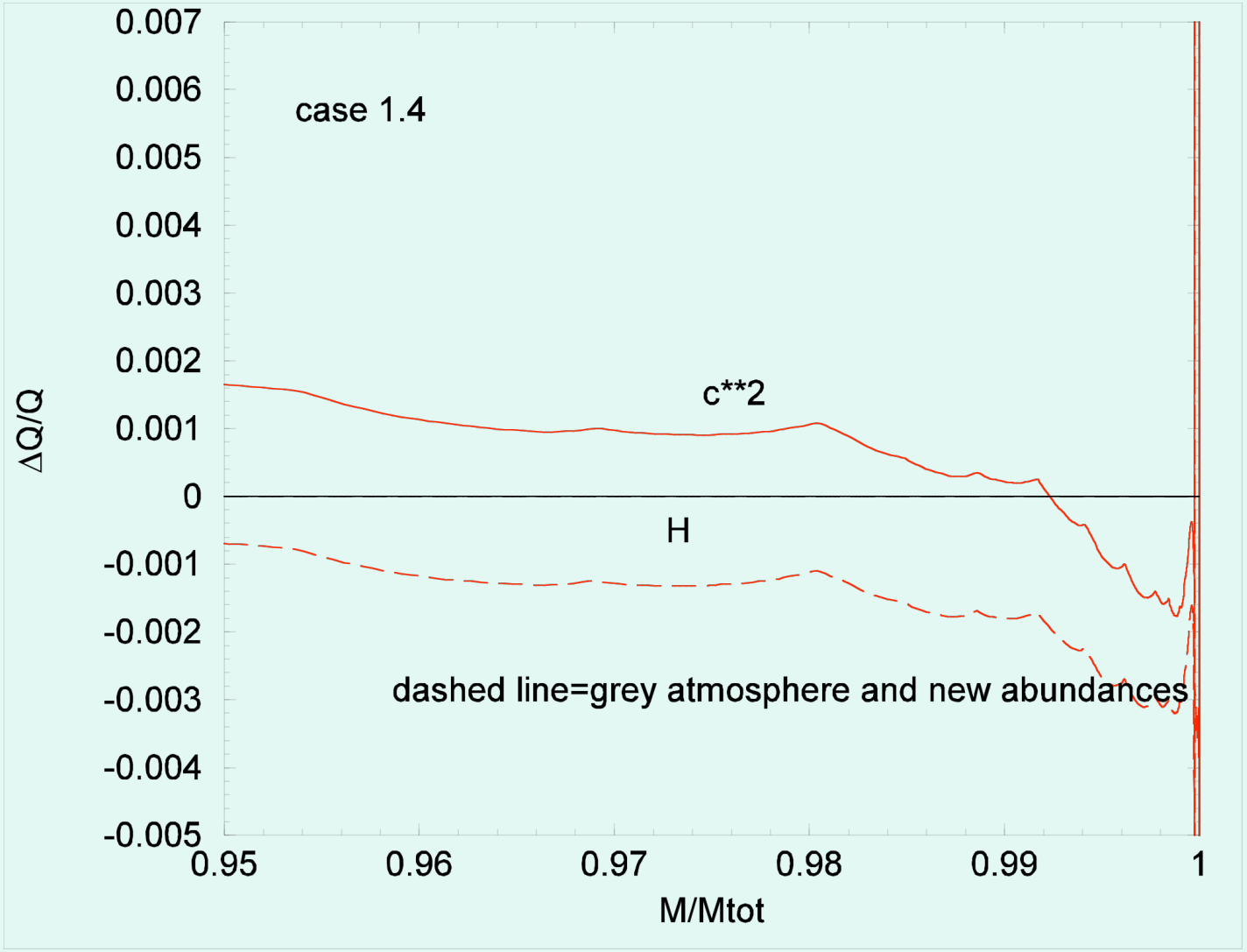
Relative difference for the energy generation

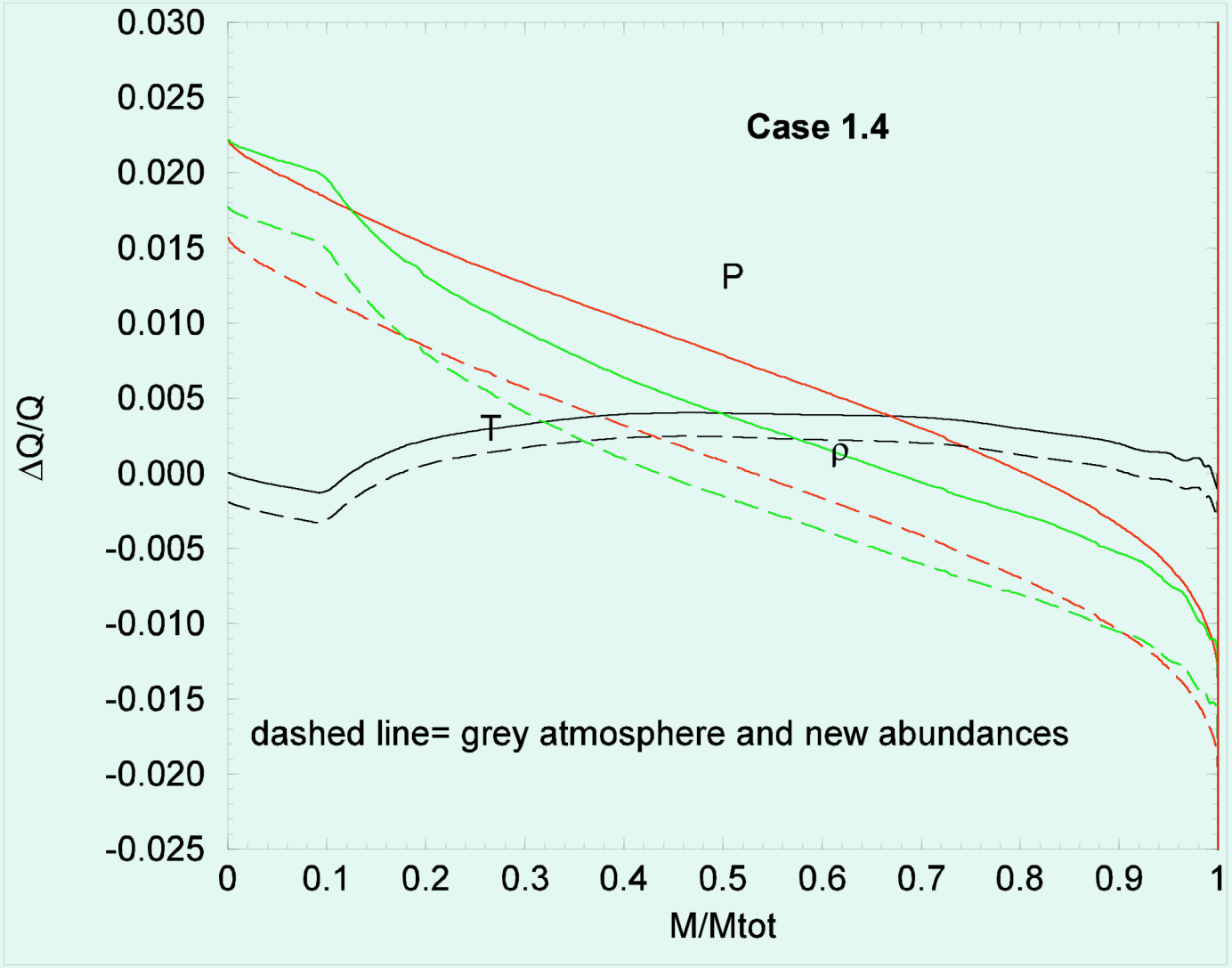


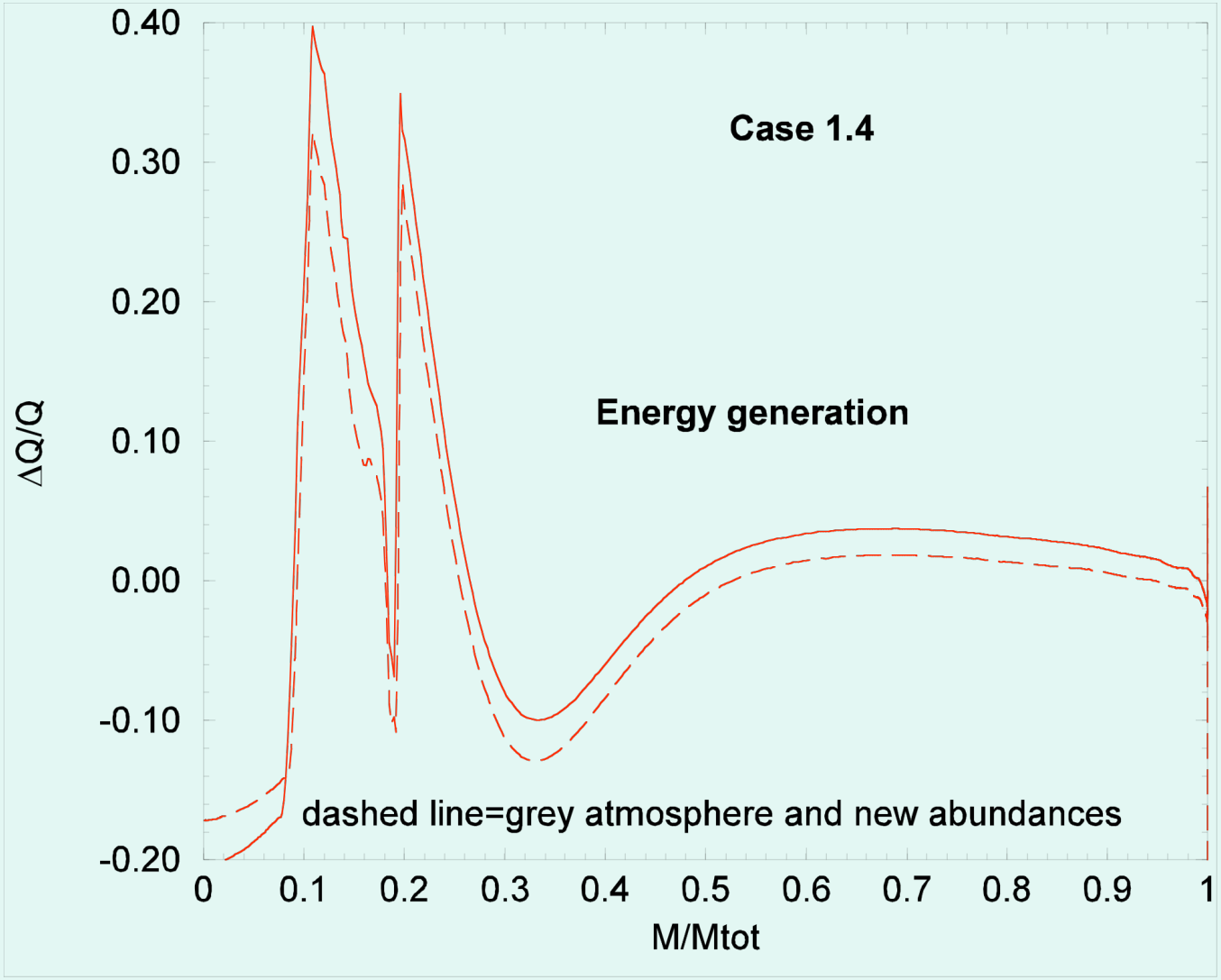
Energy generation profiles




case 1.4
c**2
H
dashed line=grey atmosphere + new abundances
ΔQ/Q
M/Mtot
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
-0.001
-0.002
-0.003
-0.004
-0.005
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


case 1.4
c**2
H
dashed line=grey atmosphere and new abundances
ΔQ/Q
M/Mtot
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
-0.001
-0.002
-0.003
-0.004
-0.005
0.95
0.96
0.97
0.98
0.99
1


Case 1.4
P
T
ρ
dashed line= grey atmosphere and new abundances
ΔQ/Q
M/Mtot
0.030
0.025
0.020
0.015
0.010
0.005
0.000
-0.005
-0.010
-0.015
-0.020
-0.025
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Case 1.4
Energy generation
dashed line=grey atmosphere and new abundances
ΔQ/Q
M/Mtot
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

2) Deeper comparison of the case 1.1

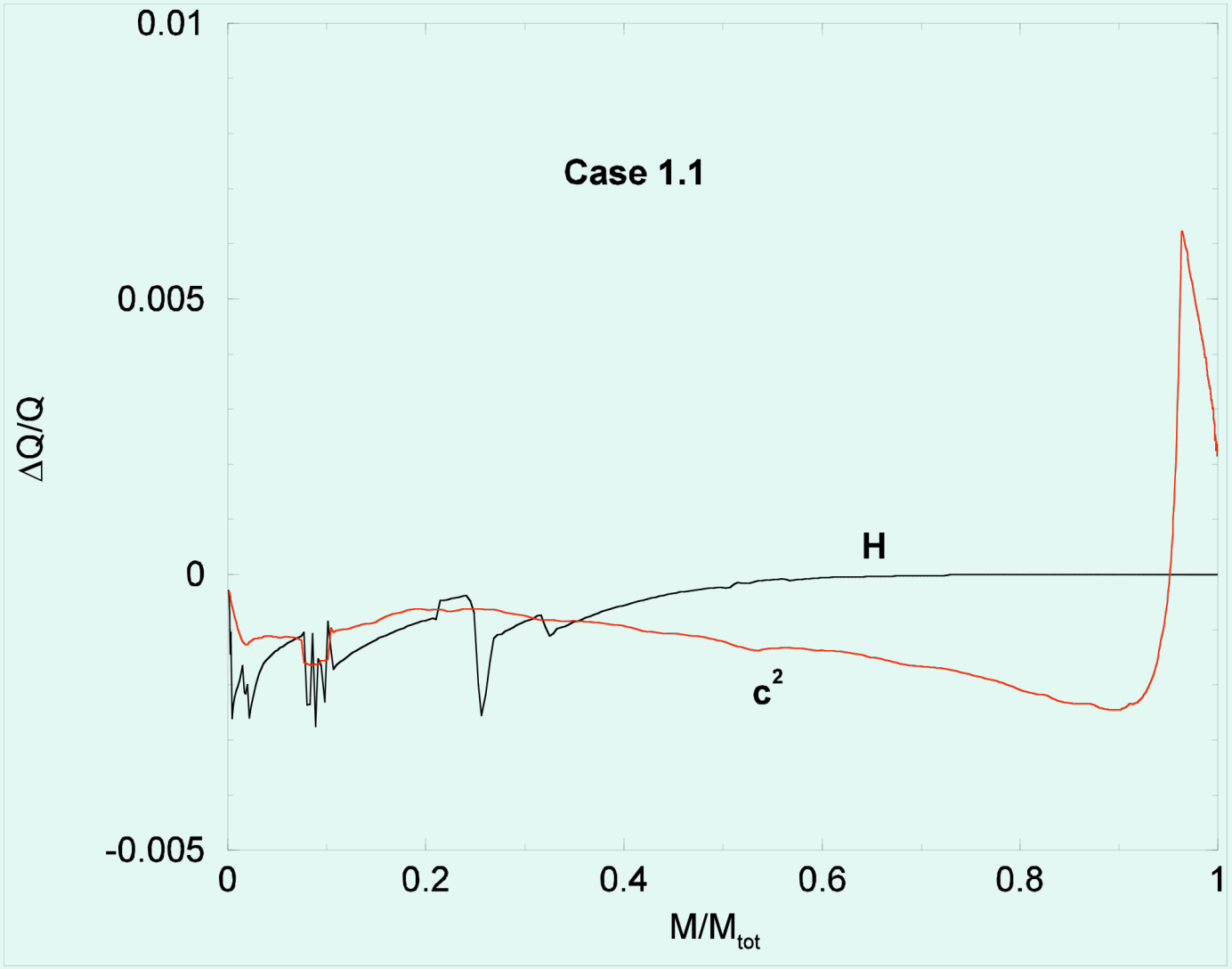
Parameters:

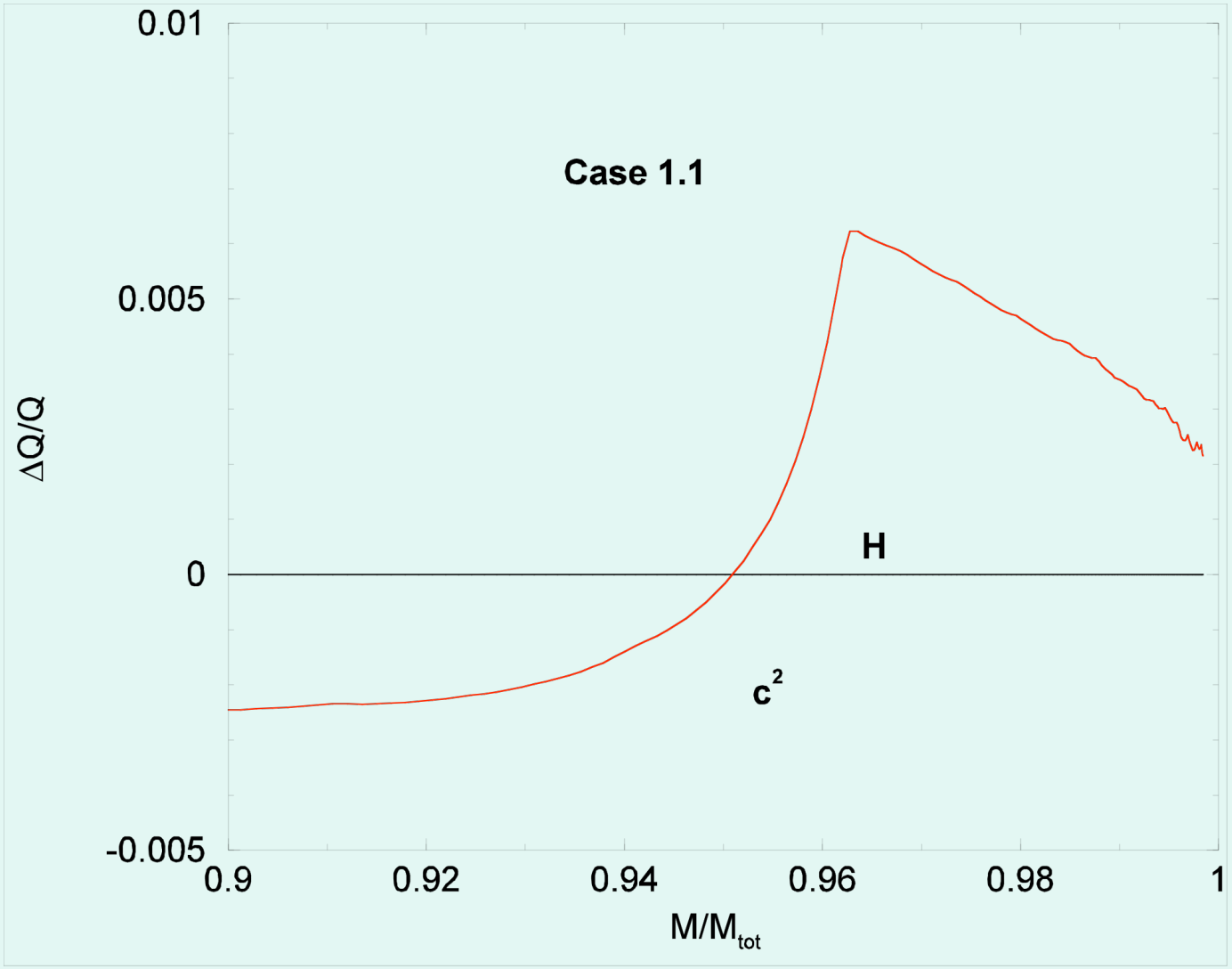
M/M_O=0.9 X_0=0.70 Y_0=0.28 Z_0=0.02 l_{MLT}/H_p=1.6

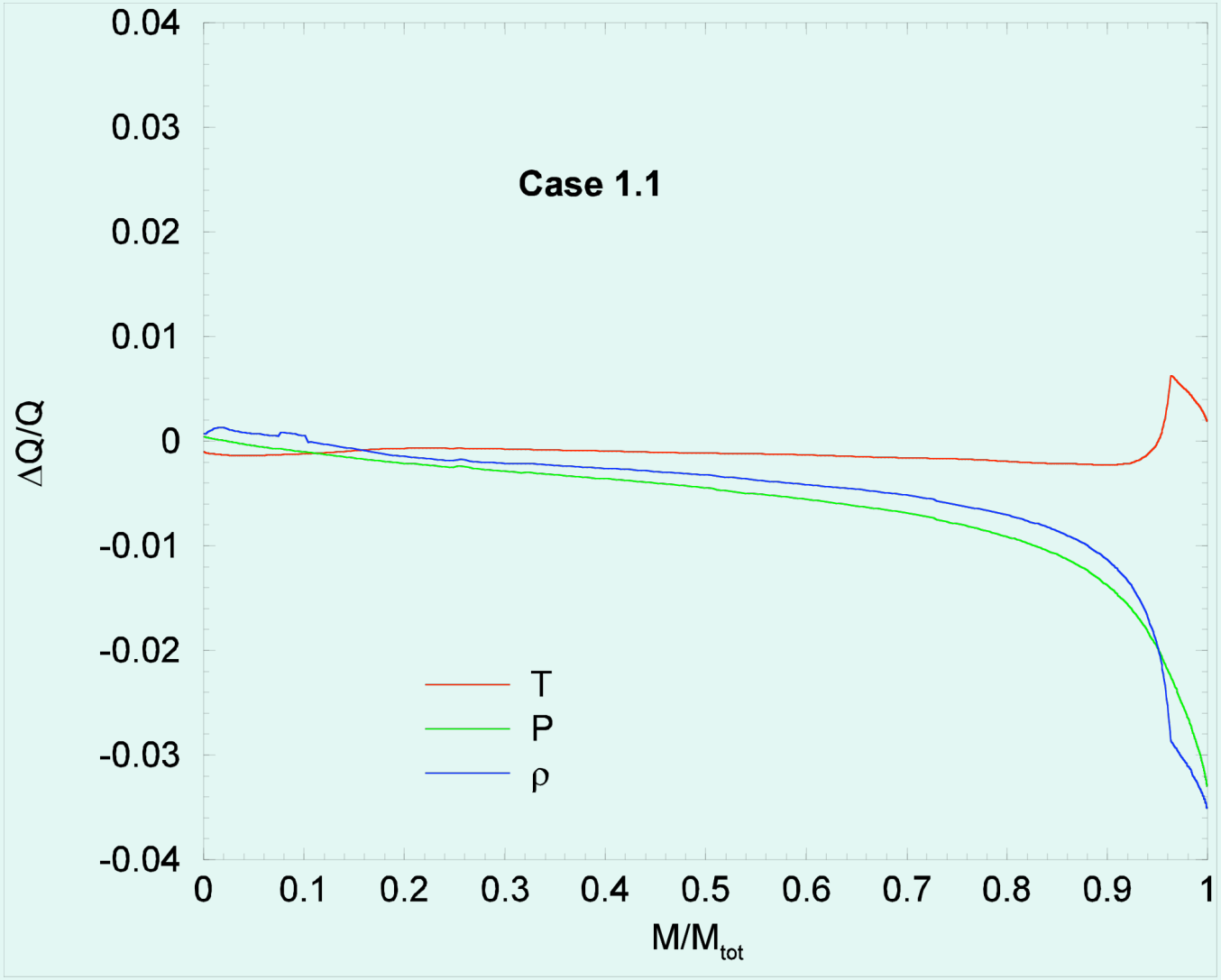
Target model: X_c=0.35 (MS)

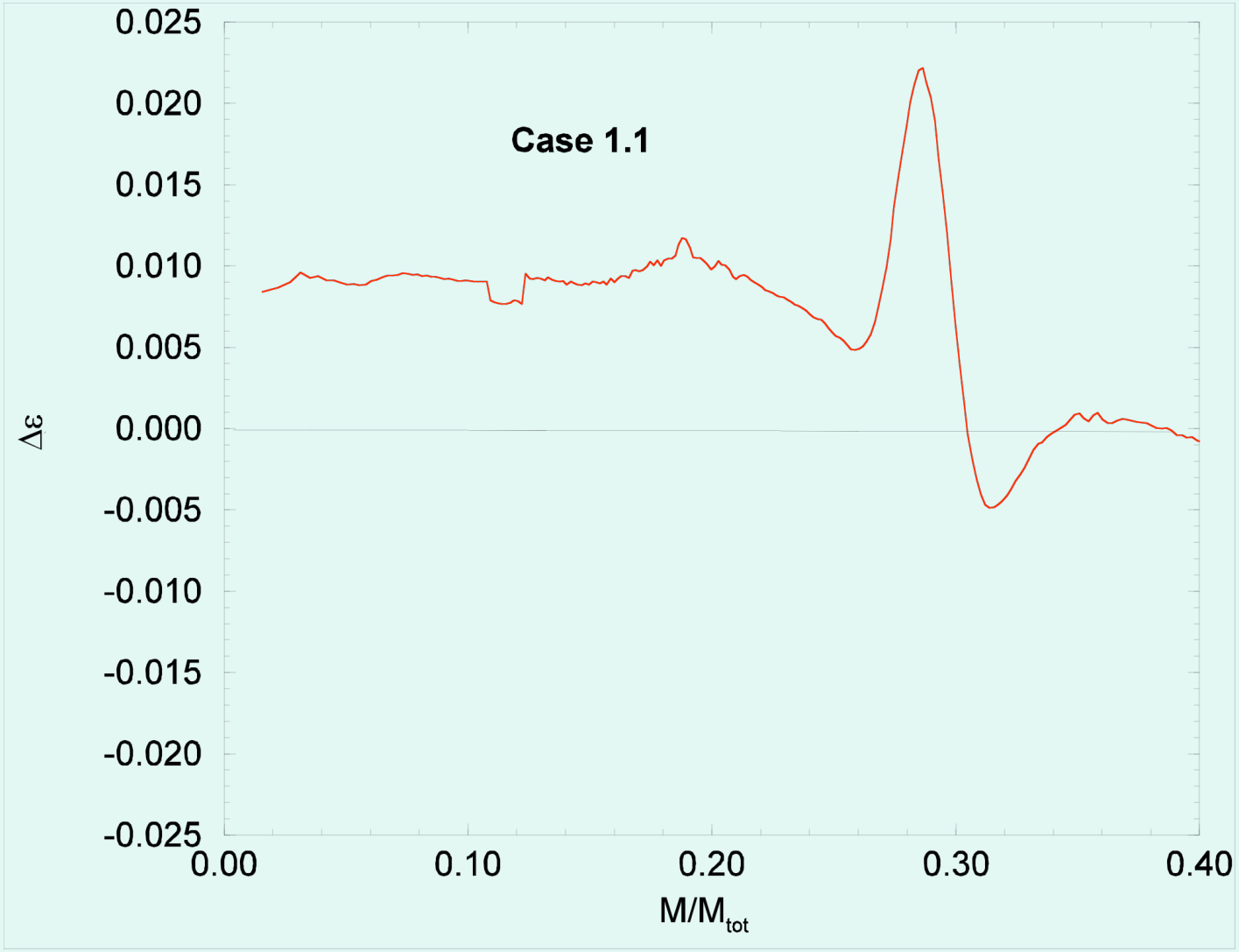
Global parameters case 1.1:

	CESAM$_0$	FRANEC	Δ
•Age [Myr]	6782	6839	0.008
•R/R_o	0.8916	0.8997	0.009
•L/L_o	0.6262	0.6273	0.002
•T_{eff} [K]	5443	5421	-0.004
•T_c [10^7 K]	1.448	1.446	-0.001
• ρ_c [g/cm^3]	150.9	151.0	0.0007
•X_c	0.3501	0.3499	-0.0006
•R_{env}/R	0.6958	0.6972	0.002


Case 1.1
0.01
0.005
0
-0.005
ΔQ/Q
0
0.2
0.4
0.6
0.8
1
M/M_tot
H
c^2


Case 1.1
0.01
0.005
0
-0.005
ΔQ/Q
H
c²
0.9
0.92
0.94
0.96
0.98
1
M/M_tot


Case 1.1
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
ΔQ/Q
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
M/M_tot
T
P
ρ


Case 1.1
0.025
0.020
0.015
0.010
0.005
0.000
-0.005
-0.010
-0.015
-0.020
-0.025
Δε
0.00
0.10
0.20
0.30
0.40
M/M_tot

Summary:

- For the case 1.4 good agreement for C^2, X, P, T, ρ but relevant discrepancies for the energy production profile, extension of the convective core, total luminosity -> more tests are needed

- For the 1.1 case good agreement of all the quantities

Future developments:

- All the others task1 models will be recalculated with weak screening, grey atmosphere, new element abundances and no conductive opacity

- The density derivative needed for the pulsation a(i) quantities will be computed analytically and the results will be compared with the ones obtained by other codes