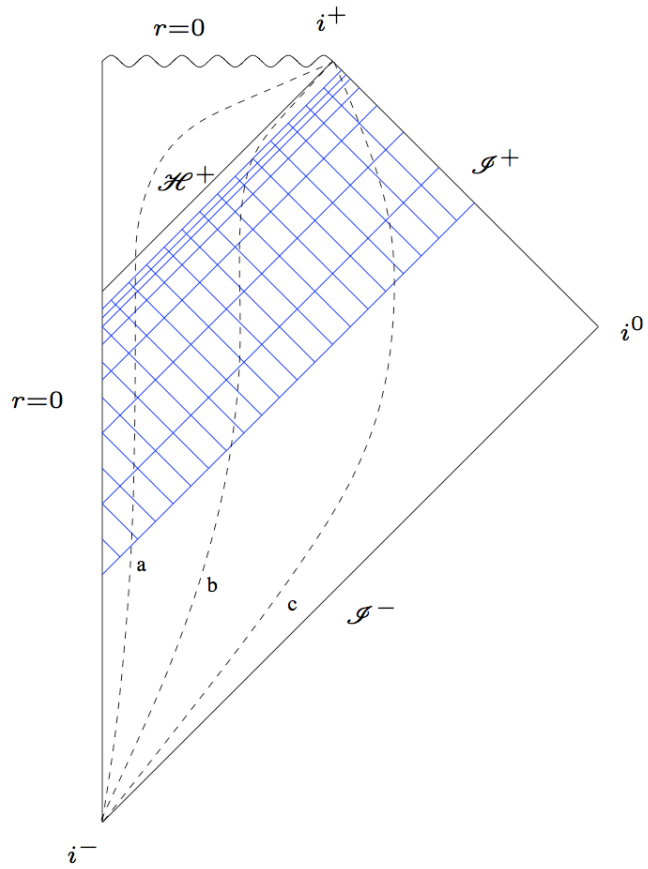
GLOBAL VERSUS LOCAL ASPECTS OF CRITICAL COLLAPSE

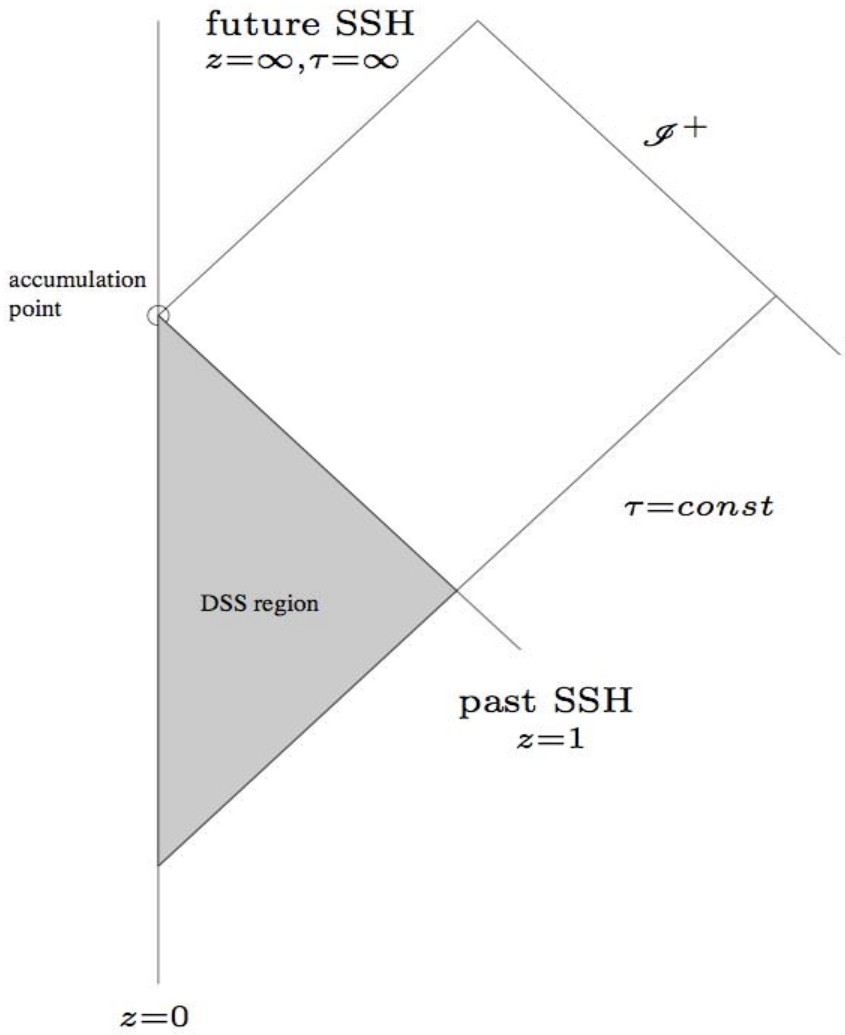
Work in collaboration with M. Puerrer and S. Husa

Paris, Nov. 2006

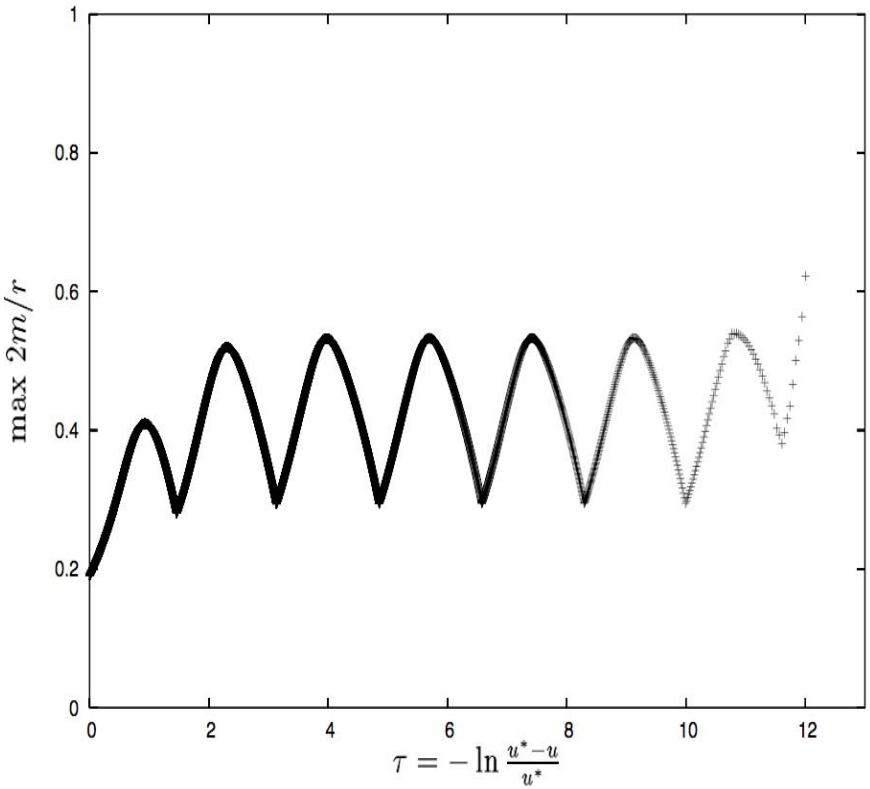
CHARACTERISTIC EVOLUTION ON COMPACTIFIED SPACETIME



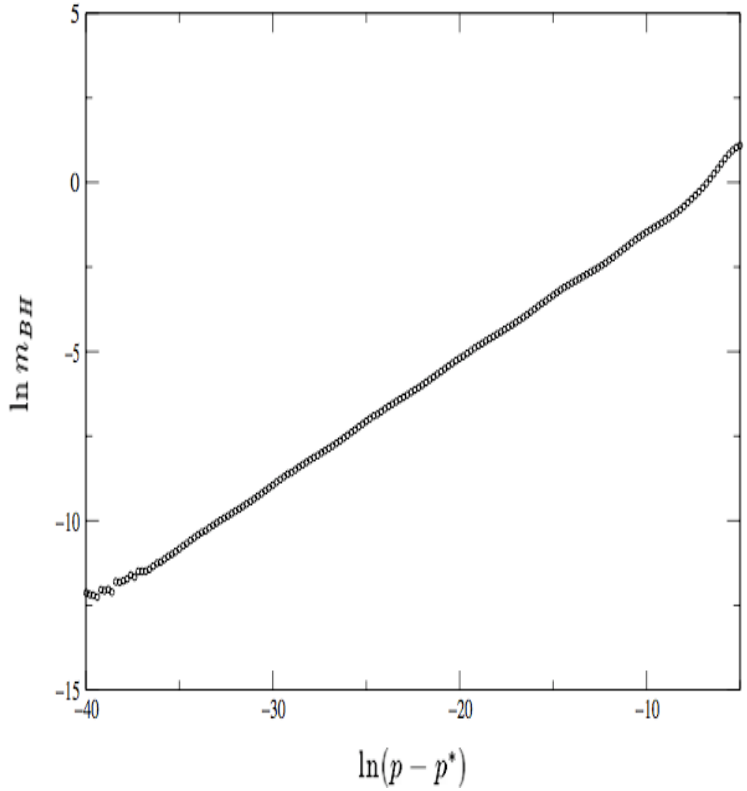
CRITICAL COLLAPSE SCENARIO



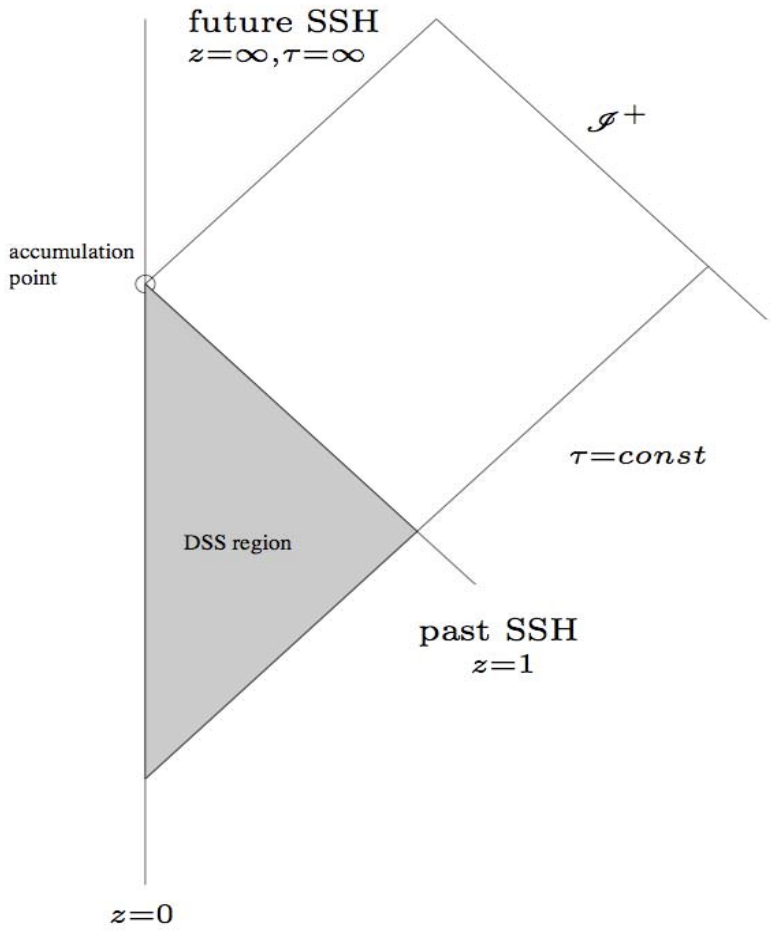
LOCAL DSS BEHAVIOR



MASS SCALING



EXPONENTIAL DECAY OF MASS FUNCTION



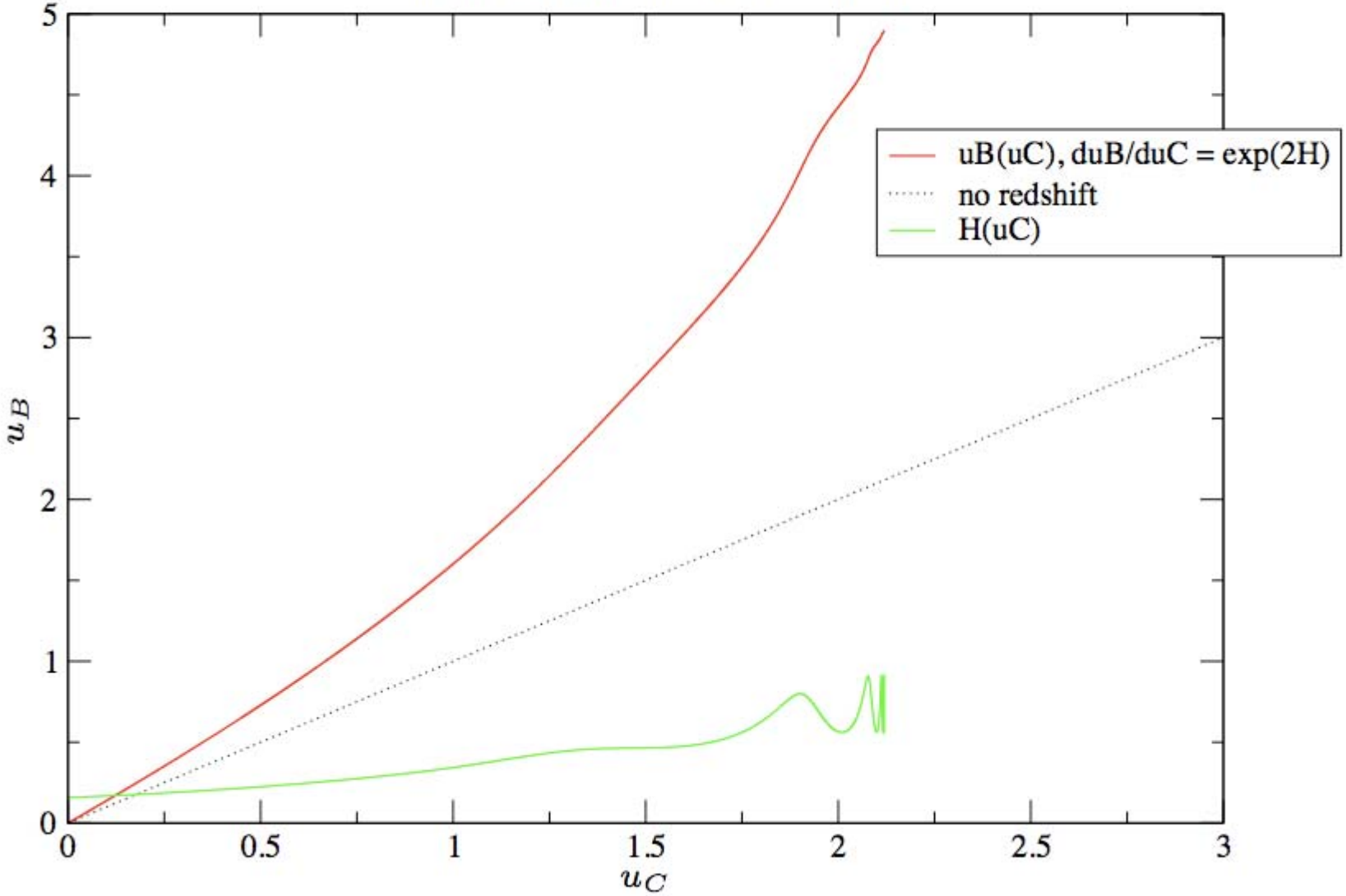
BONDI COORDINATES

$$ds^2 = -e^{2\beta(u,r)}du\left(\frac{V(u,r)}{r}du + 2dr\right) + r^2(d\theta^2 + \sin^2\theta d\varphi^2)$$

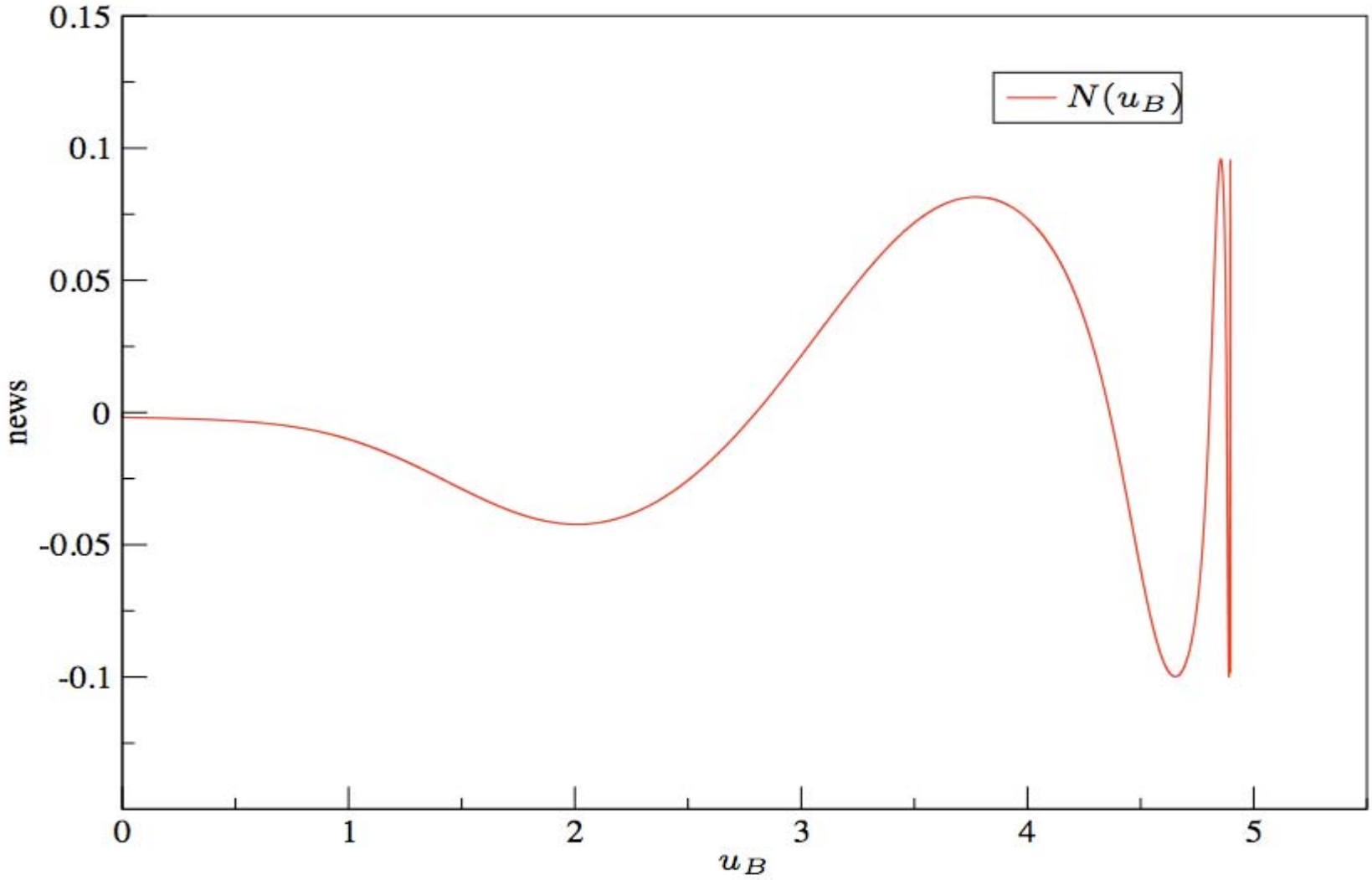
Relation between Bondi and central retarded time

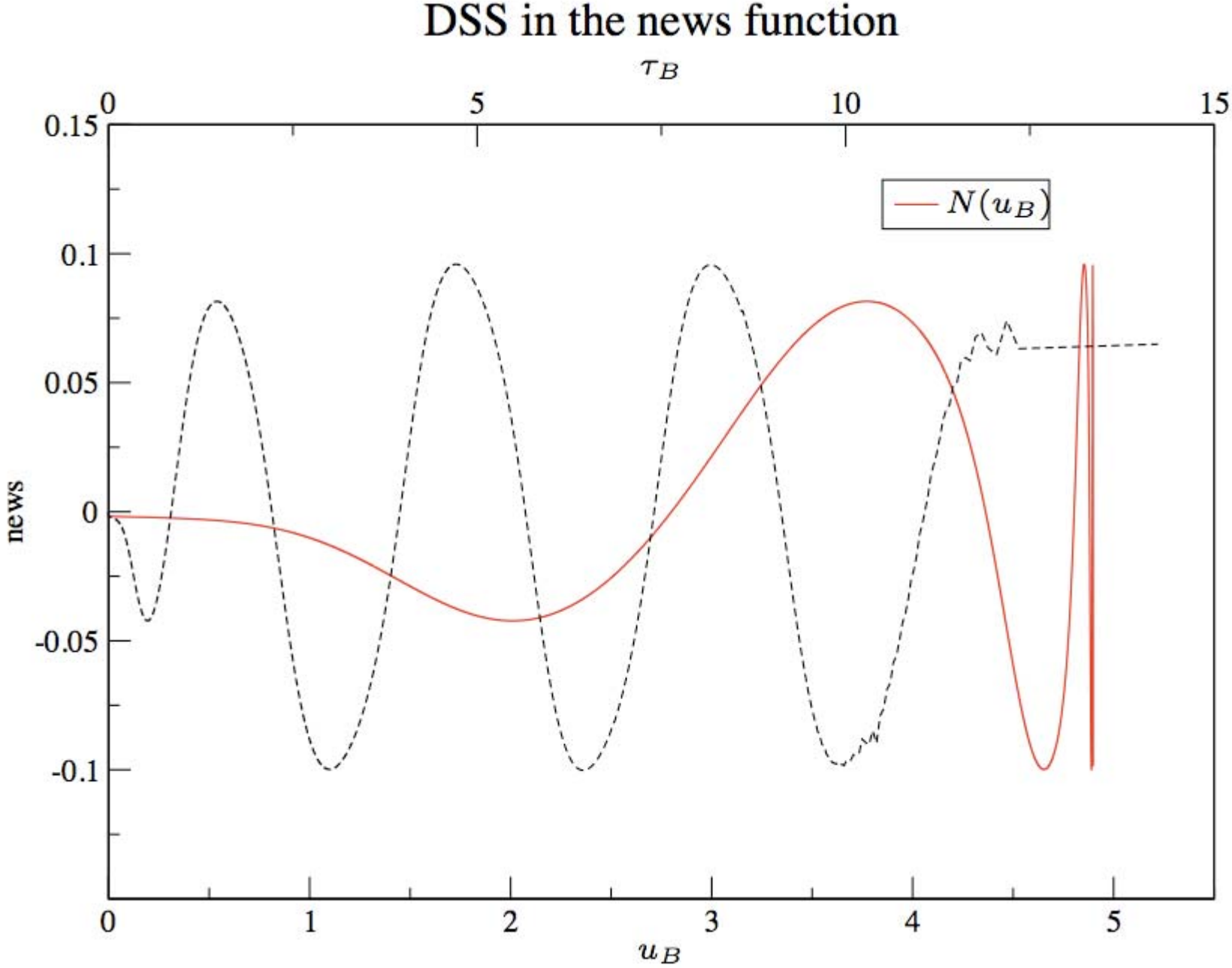
$$\beta(u,r) = H(u) - \frac{\pi c^2(u)}{r^2} + O(r^{-3})$$

$$\frac{du_B}{du_C} = e^{2H(u)}$$

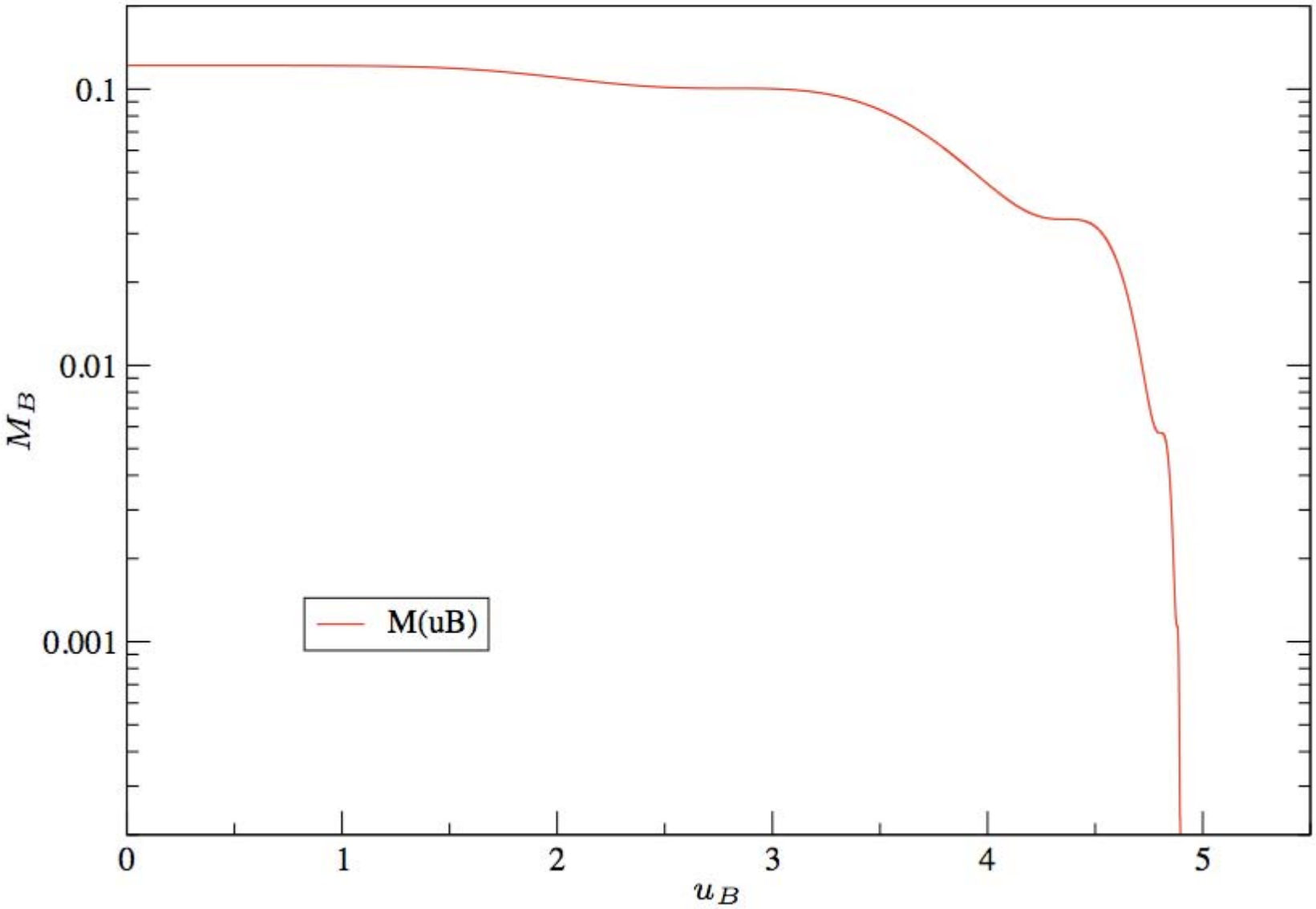

Relation between Bondi and central time
nearcritical evolution using 10000 points
uB(uC), duB/duC = exp(2H)
no redshift
H(uC)
u_B
u_C
0
1
2
3
4
5
0
0.5
1
1.5
2
2.5
3

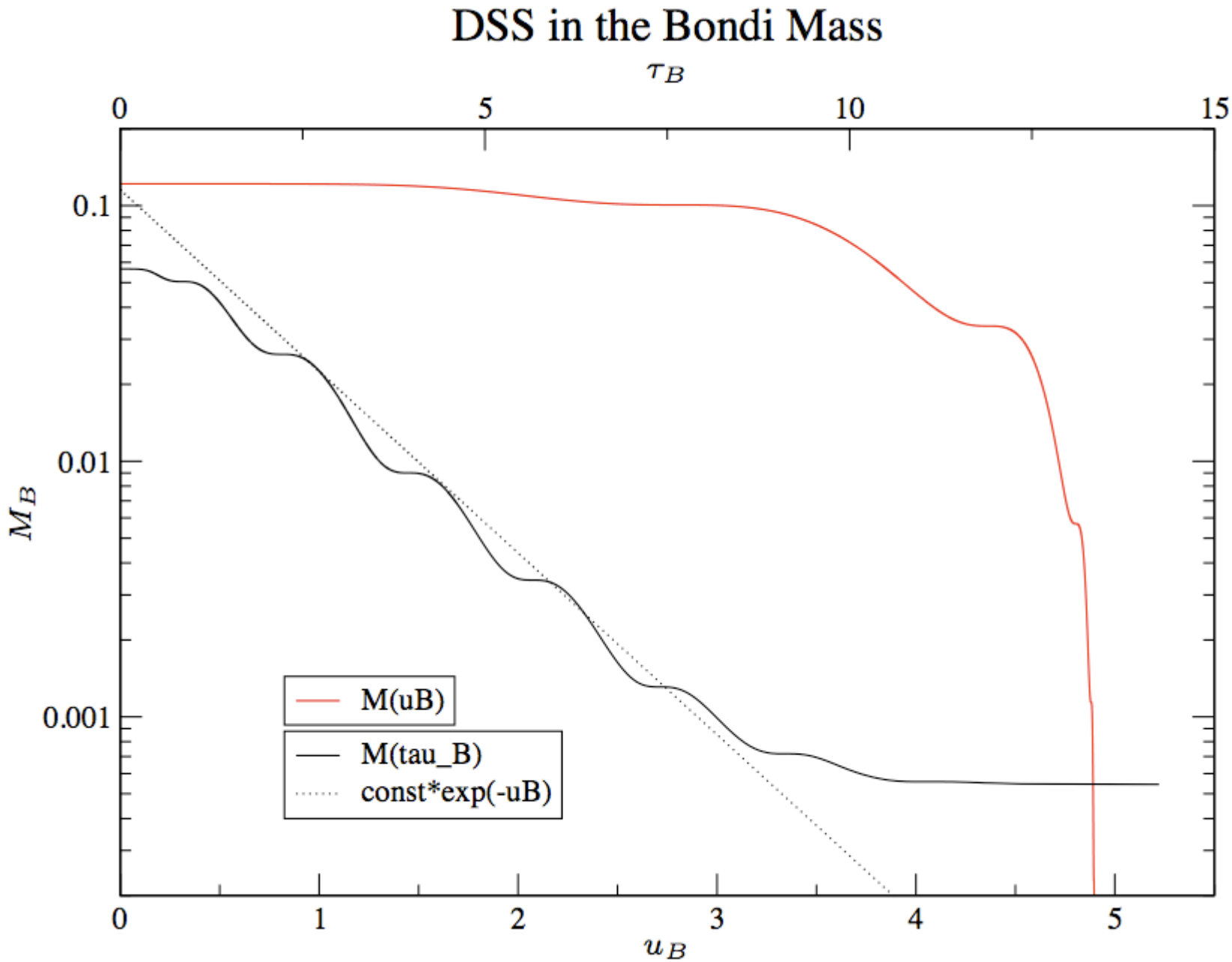
NEWS IN BONDI TIME




DSS in the news function
τ_B
0
5
10
15
0.15
0.1
0.05
0
-0.05
-0.1
news
$N(u_B)$
0
1
2
3
4
5
u_B

DSS in the Bondi Mass

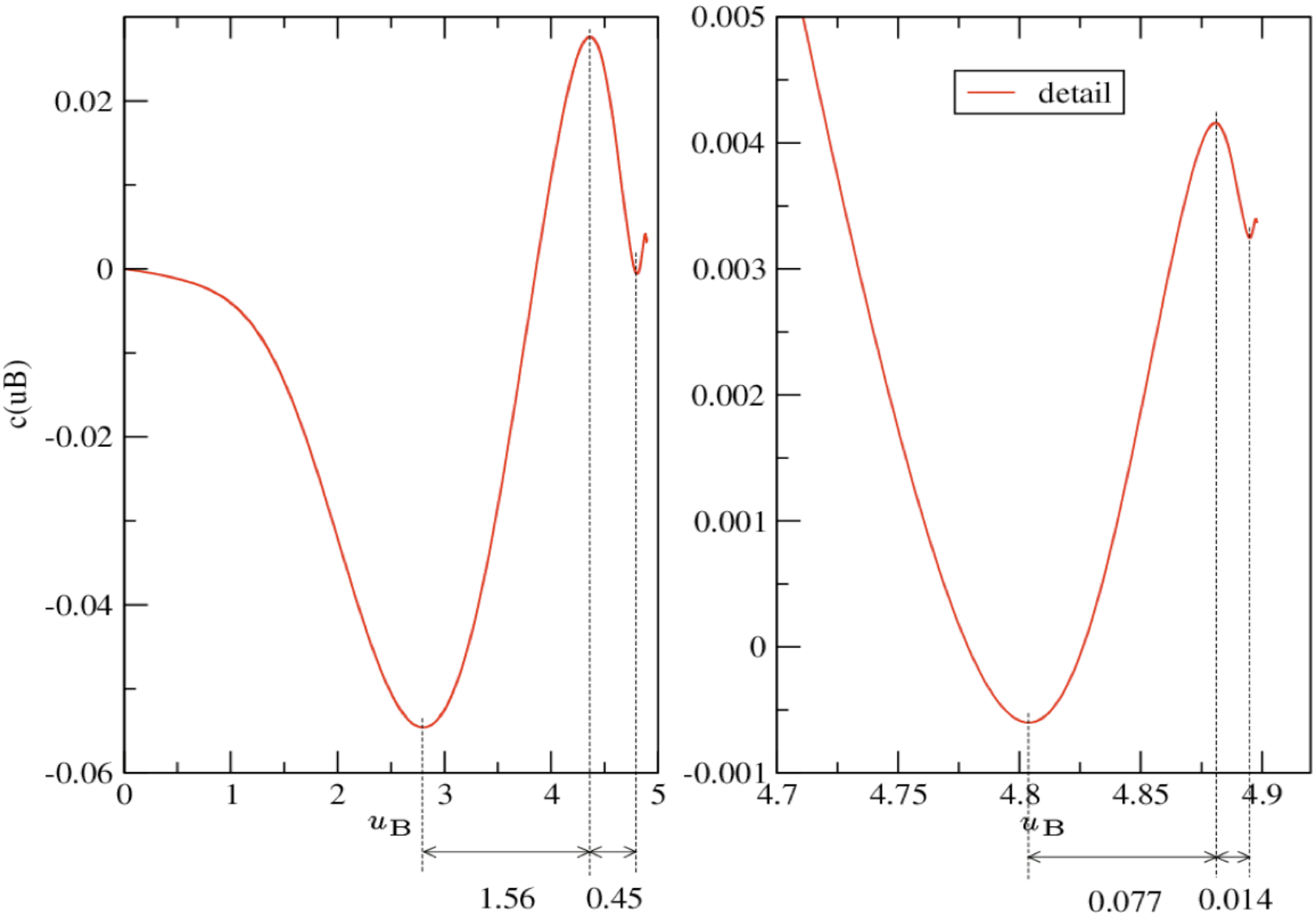



DSS in the Bondi Mass
τ_B
0
5
10
15
0.1
0.01
0.001
M_B
M(uB)
M(tau_B)
const*exp(-uB)
0
1
2
3
4
5
u_B

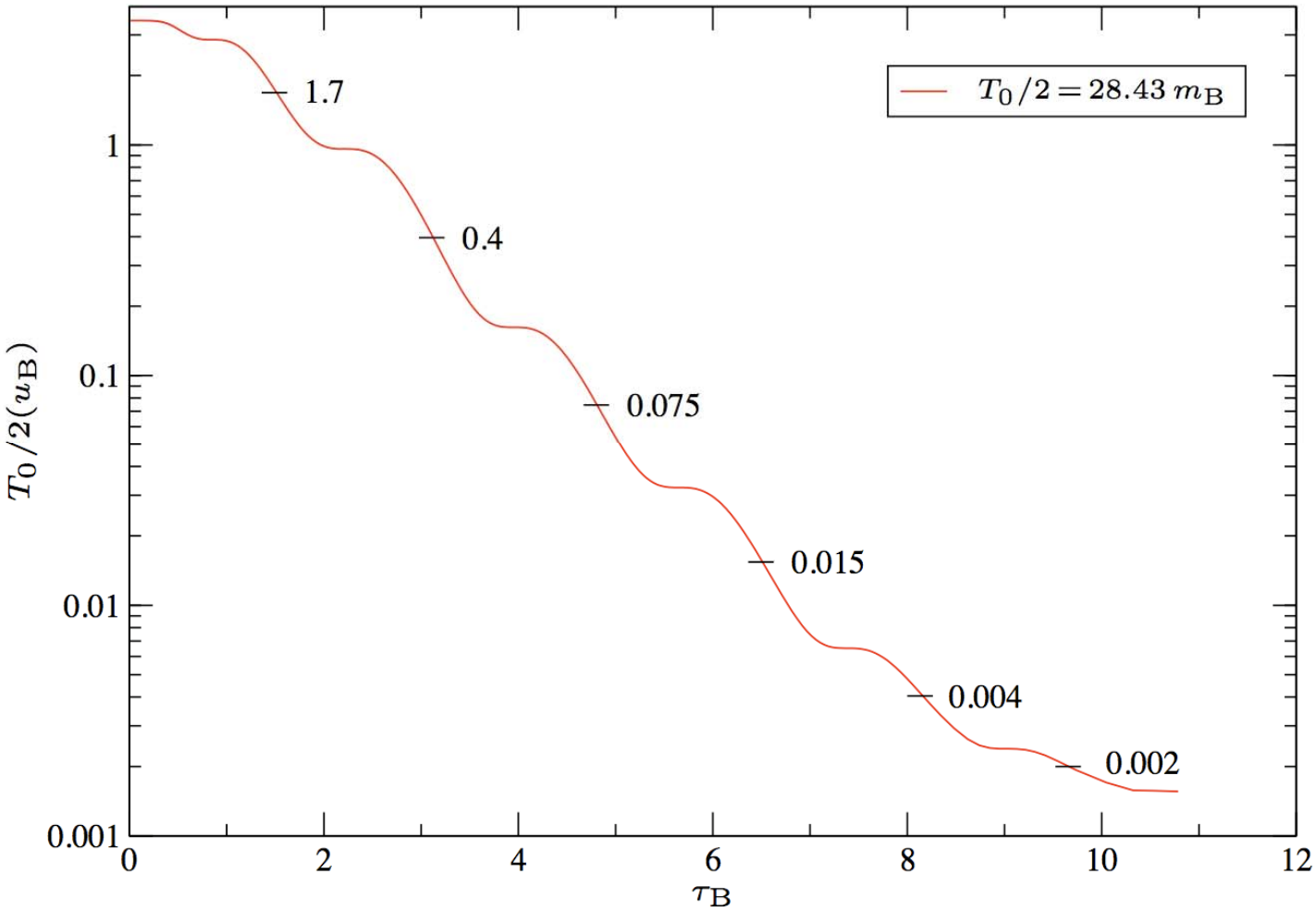
QUASINORMAL MODES

- Excitations of black holes or compact objects; radiation boundary conditions
- Linear perturbation on fixed background
- Damped oscillations
- In our case: l = 0, n = 0 mode for scalar perturbations on a Schwarzschild black hole
- Period depends linearly on the background mass

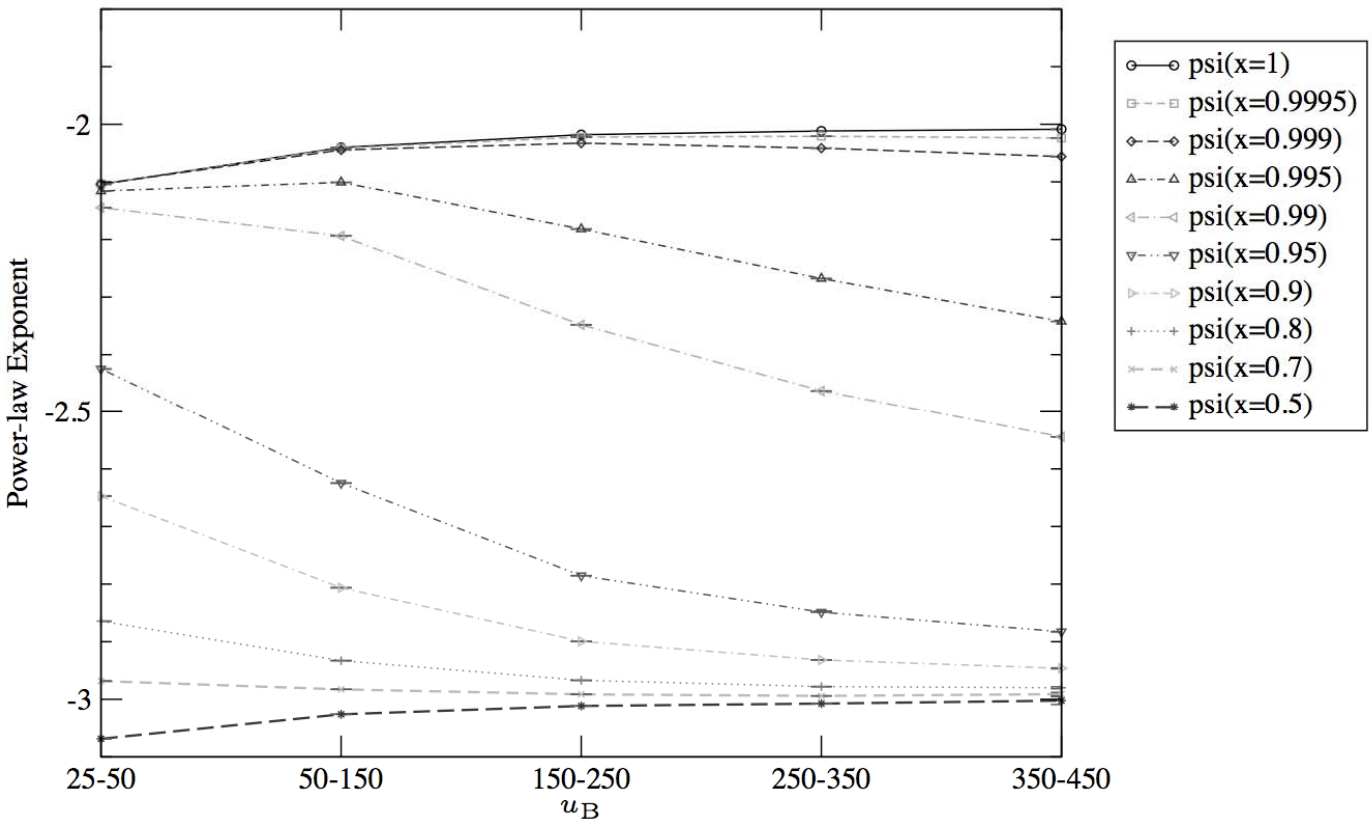
QUASI NORMAL RINGING



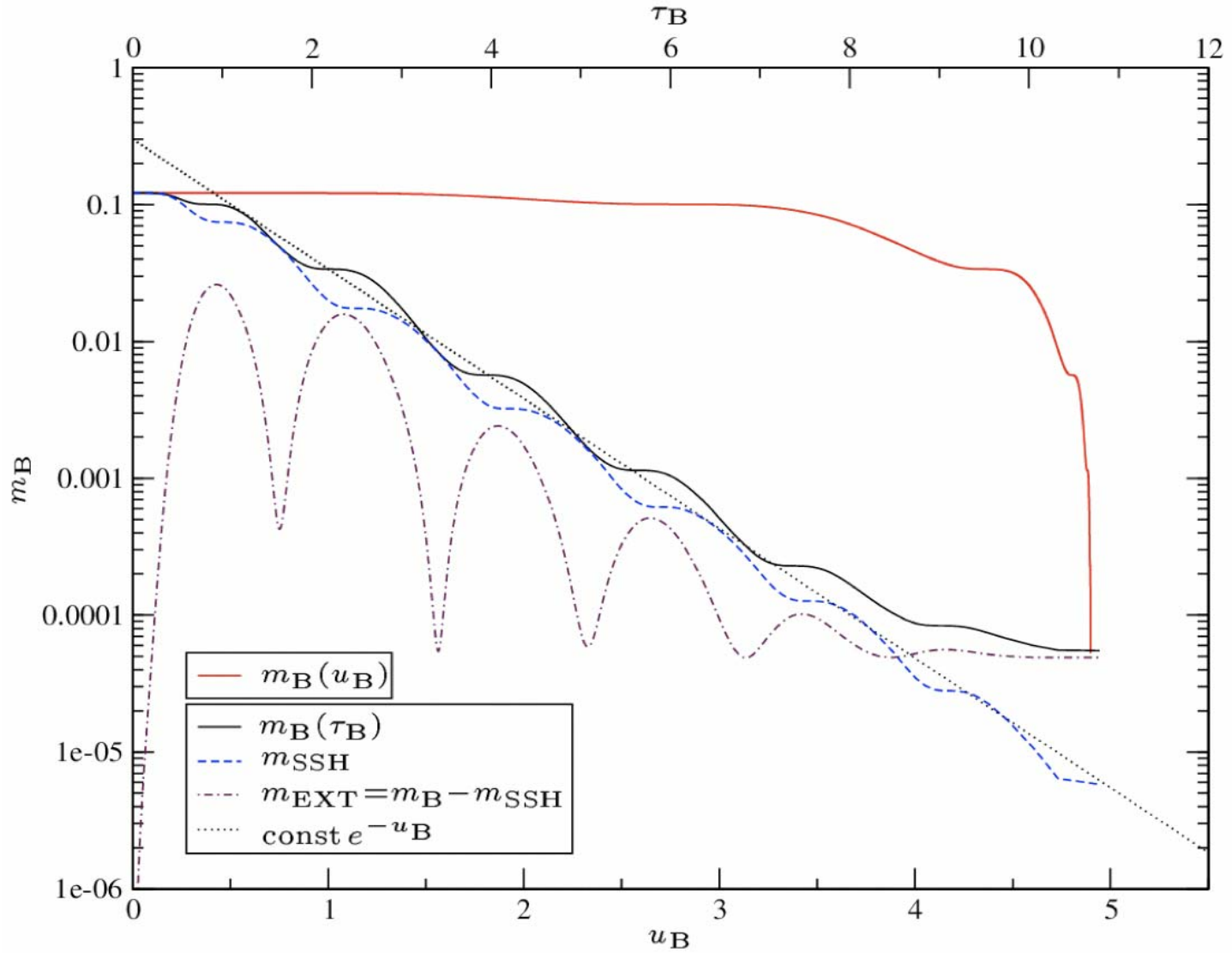
QNM half periods



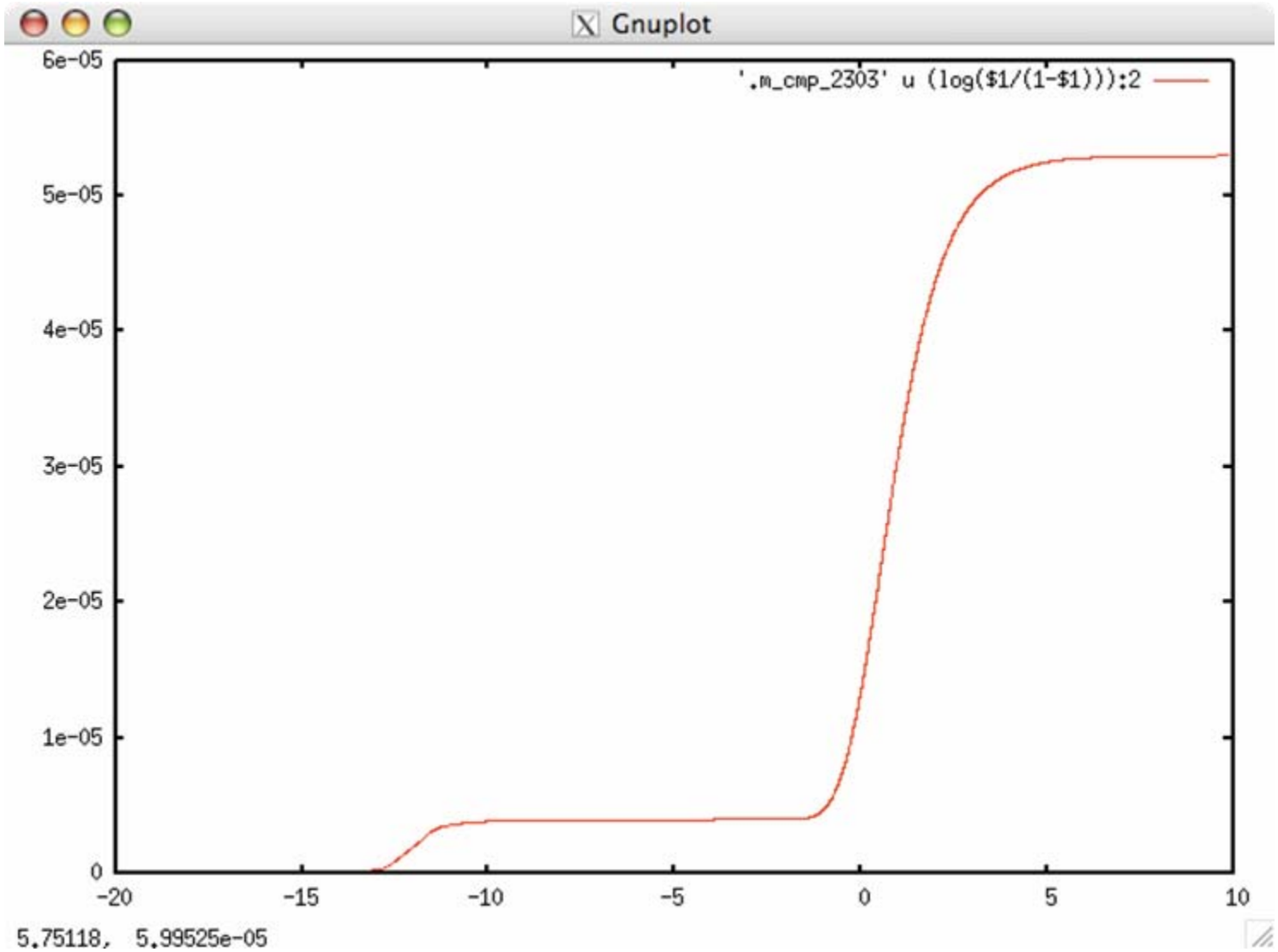
TAILS


Power-law Exponent
-2
-2.5
-3
25-50
50-150
150-250
250-350
350-450
u_B
psi(x=1)
psi(x=0.9995)
psi(x=0.999)
psi(x=0.995)
psi(x=0.99)
psi(x=0.95)
psi(x=0.9)
psi(x=0.8)
psi(x=0.7)
psi(x=0.5)

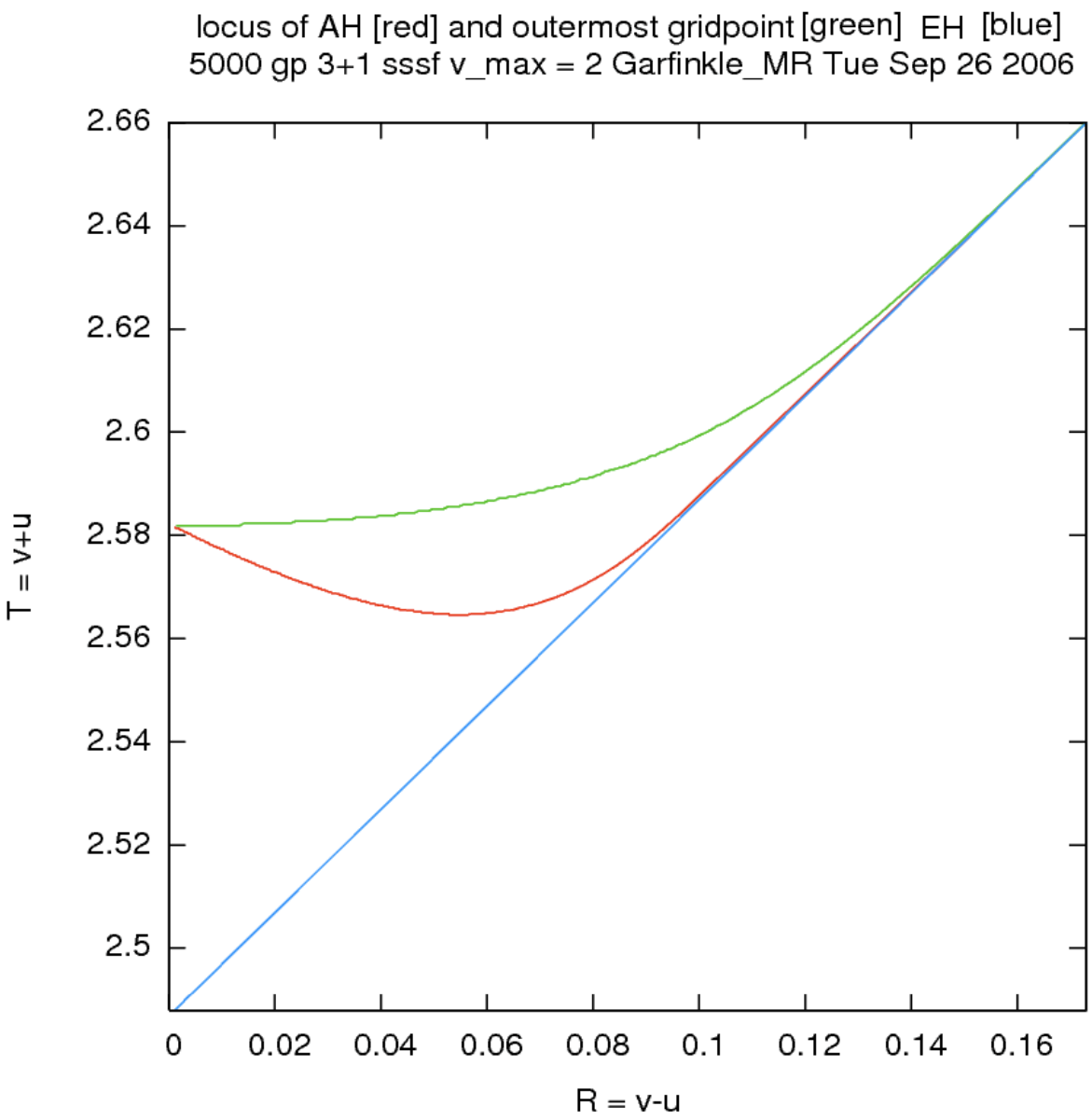
BONDI VERSUS SSH MASS



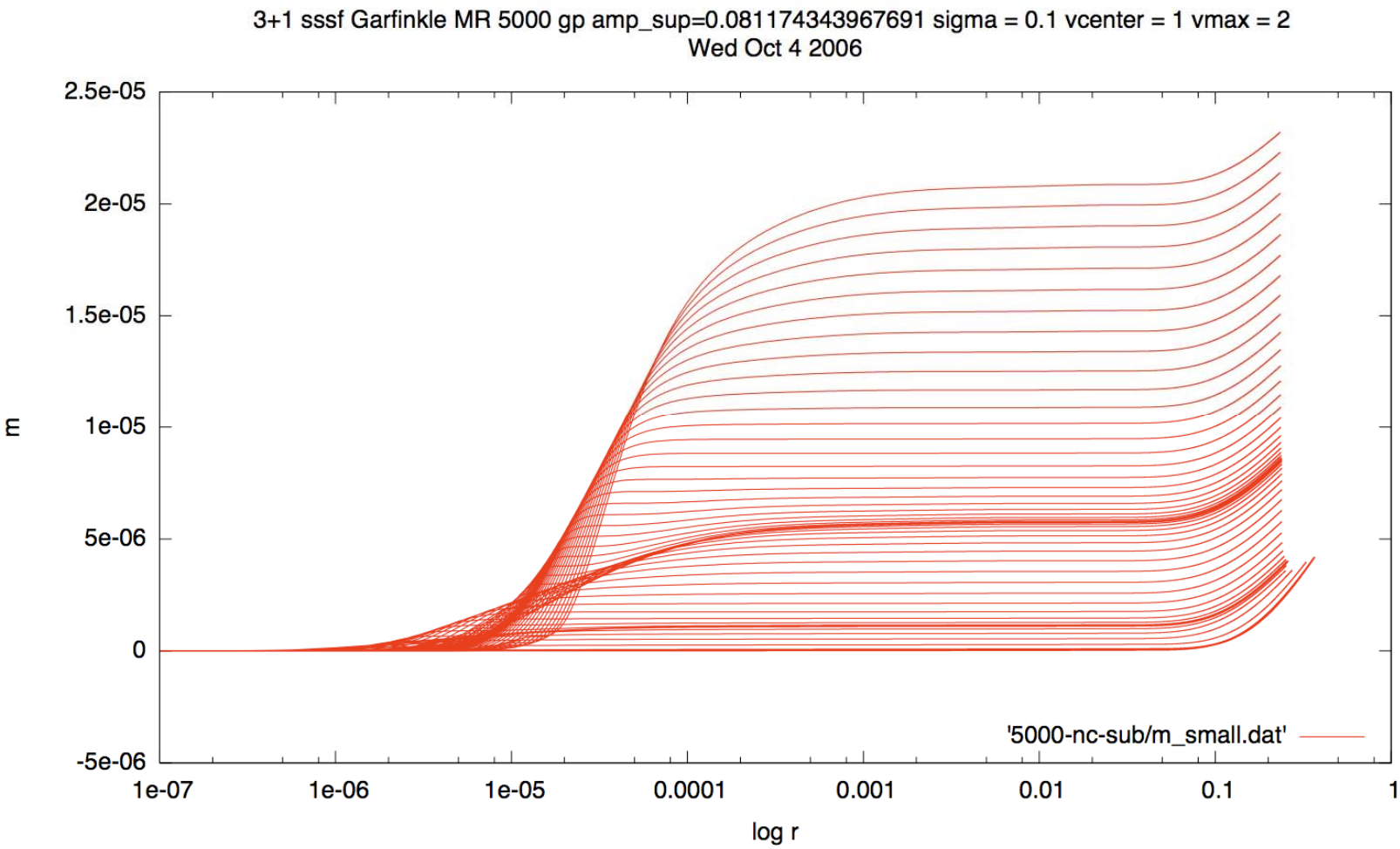
MASS FUNCTION



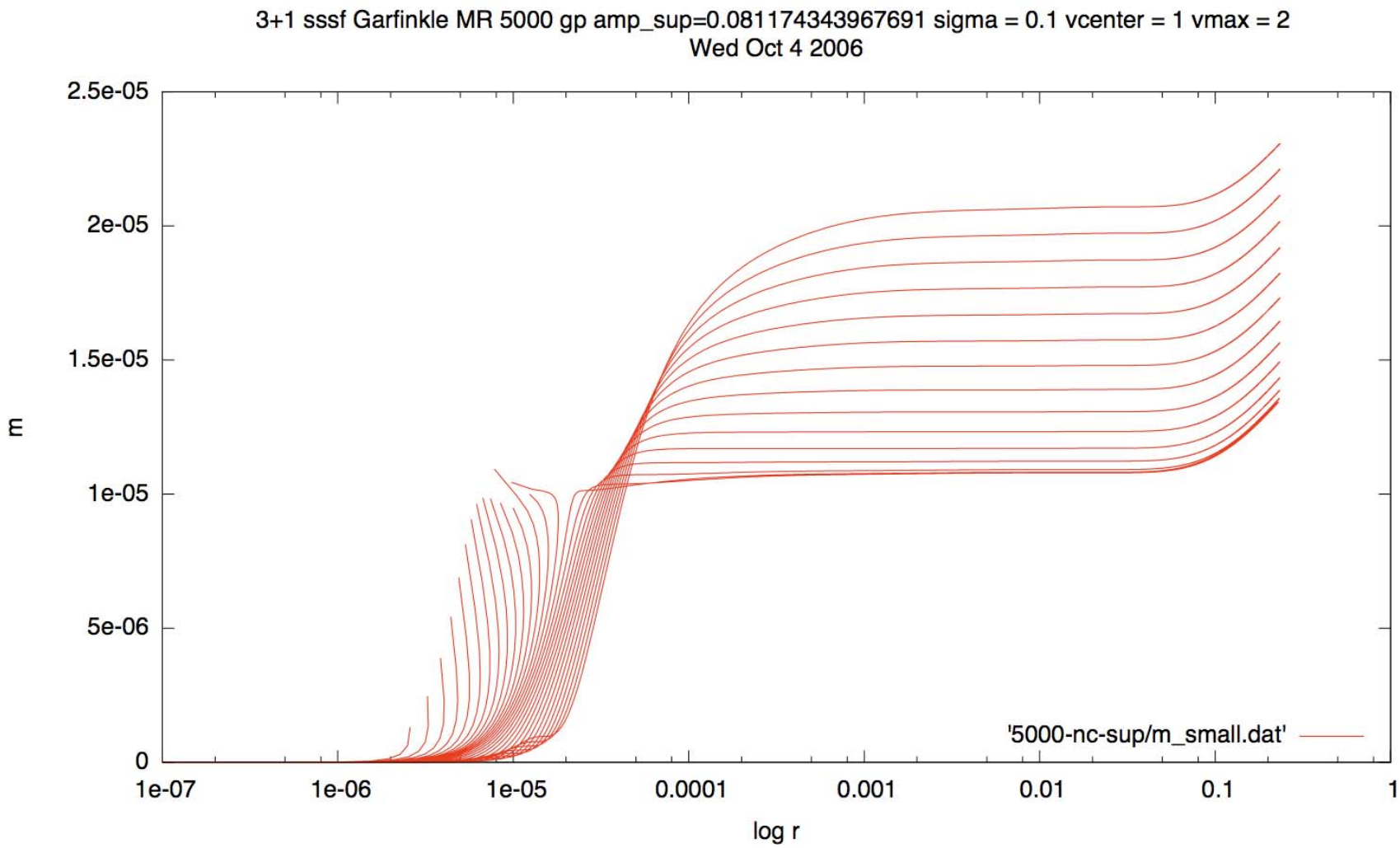
HORIZON PENETRATING CODE



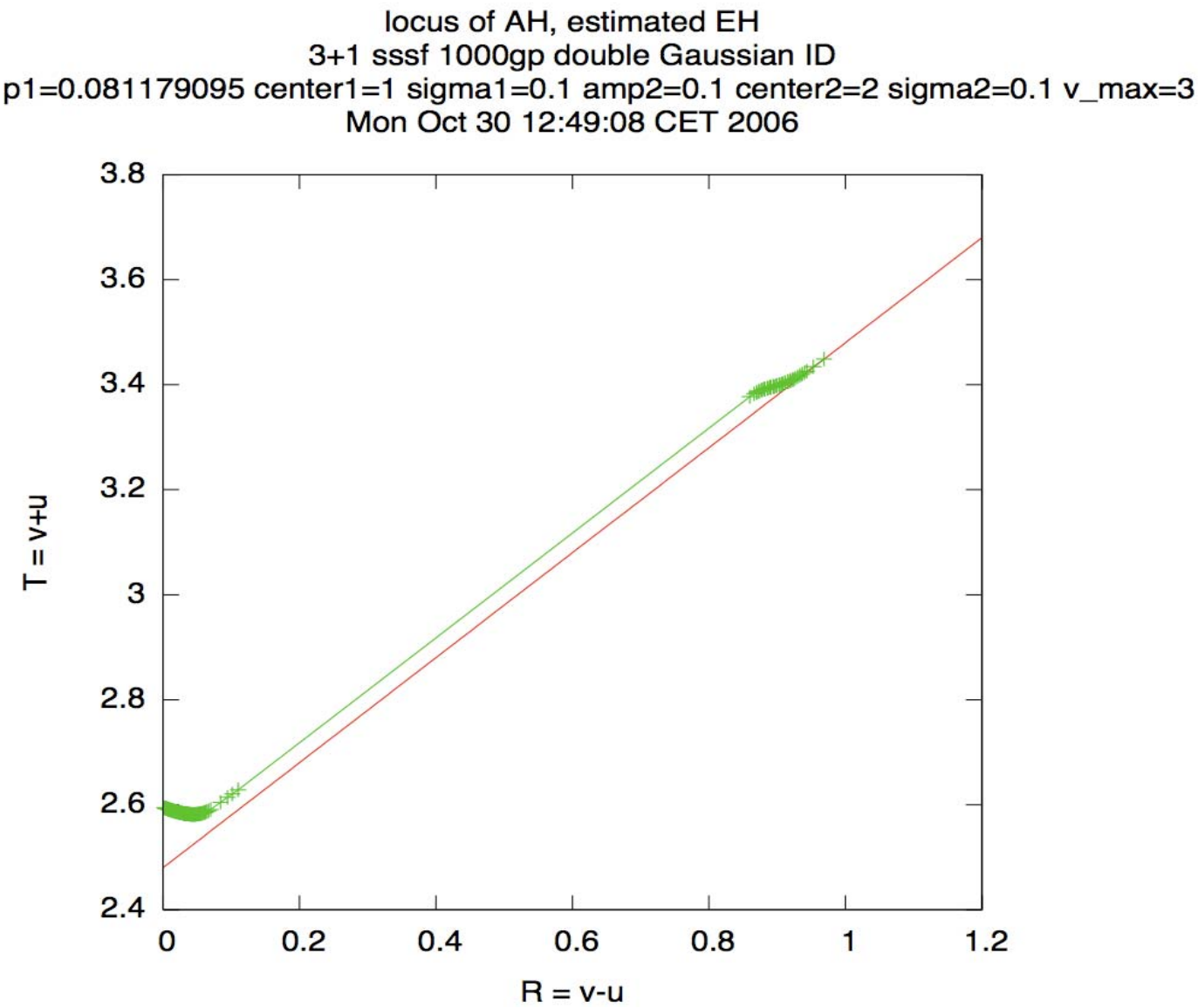
SUB-CRITICAL EVOLUTION



SUPER-CRITICAL EVOLUTION



LATE TIME COLLAPSE



HORIZON FORMATION