GLOBAL VERSUS LOCAL ASPECTS OF CRITICAL COLLAPSE

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CHARACTERISTIC EVOLUTION ON COMPACTIFIED SPACETIME
CRITICAL COLLAPSE SCENARIO

future SSH
$z = \infty, \tau = \infty$

accumulation point

DSS region

past SSH
$z = 1$

$\mathcal{I}^+$

$\tau = const$

$z = 0$
LOCAL DSS BEHAVIOR

\[ \tau = -\ln \frac{u^* - u}{u^*} \]

\[ \max 2n/\tau \]

MASS SCALING

\[ \ln \frac{m_{BH}}{\ln (p - p^*)} \]
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

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

\[ \frac{du_B}{d\omega_C} = e^{2H(u)} \]
Relation between Bondi and central time

nearcritical evolution using 10000 points

- $u_B(u_C)$, $du_B/du_C = \exp(2H)$
- No redshift
- $H(u_C)$
NEWS IN BONDI TIME

$N(u_B)$
DSS in the news function

\[\tau_B\]

\[N(u_B)\]
DSS in the Bondi Mass

\[ M_B \]

\[ u_B \]
DSS in the Bondi Mass

\[ M_B \]

\[ \tau_B \]

\[ u_B \]

- \( M(uB) \)
- \( M(tau_B) \)
- \( const \times exp(-uB) \)
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

![Graphs showing quasi-normal ringing behavior.](image)
QNM half periods

\[ T_0/2 = 28.43 \, m_B \]
BONDI VERSUS SSH MASS
MASS FUNCTION
 locus of AH [red] and outermost gridpoint [green] EH [blue] 
5000 gp 3+1 sssf v_max = 2 Garfinkle_MR Tue Sep 26 2006
3+1 sssf Garfinkle MR 5000 gp amp_sup=0.081174343967691 sigma = 0.1 vcenter = 1 vmax = 2
Wed Oct 4 2006
SUPER-CRITICAL EVOLUTION

3+1 sssf Garfinkle MR 5000 gp amp_sup=0.081174343967691 sigma = 0.1 vcenter = 1 vmax = 2
Wed Oct 4 2006
HORIZON FORMATION

3+1 sssf Garfinkle MR 5000 gp amp=0.081174343967691 sigma = 0.1 vcenter = 1 vmax = 2
Tue Oct 3 2006

max 2mu/r

log r