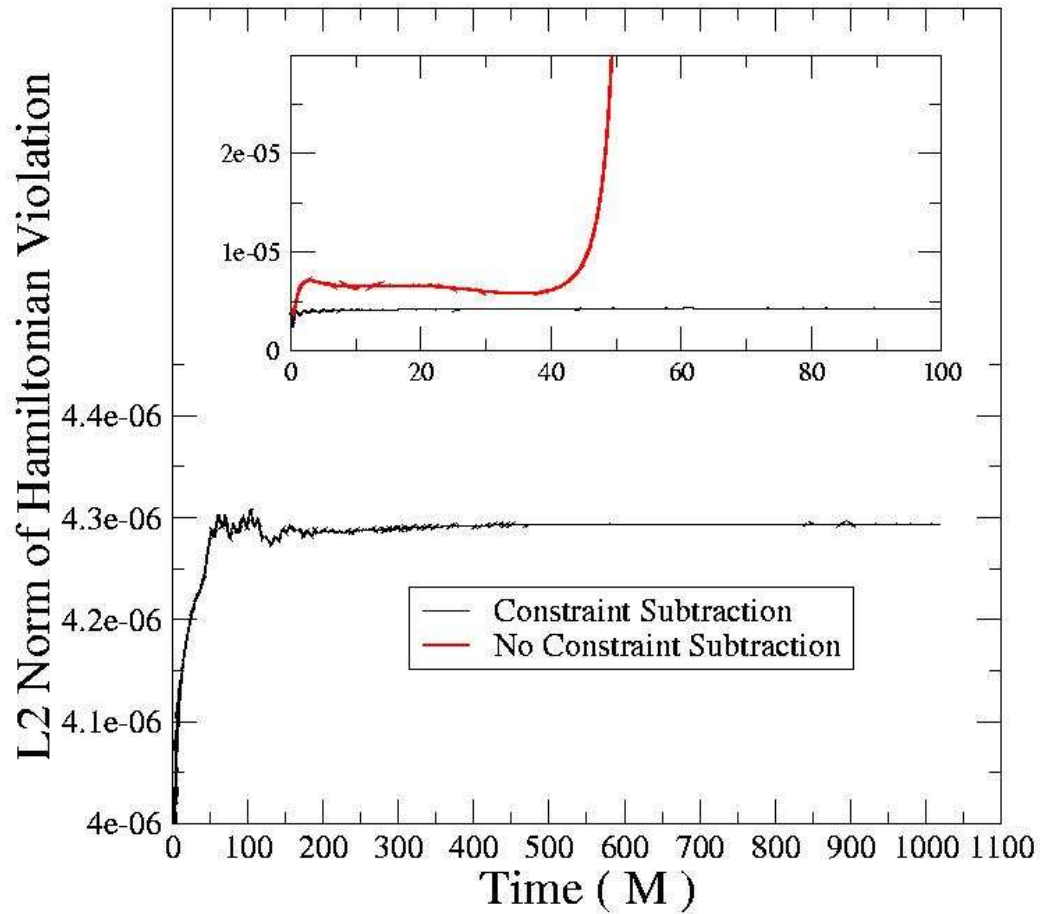


Constraint Subtraction



Isolated Schwarzschild Hole

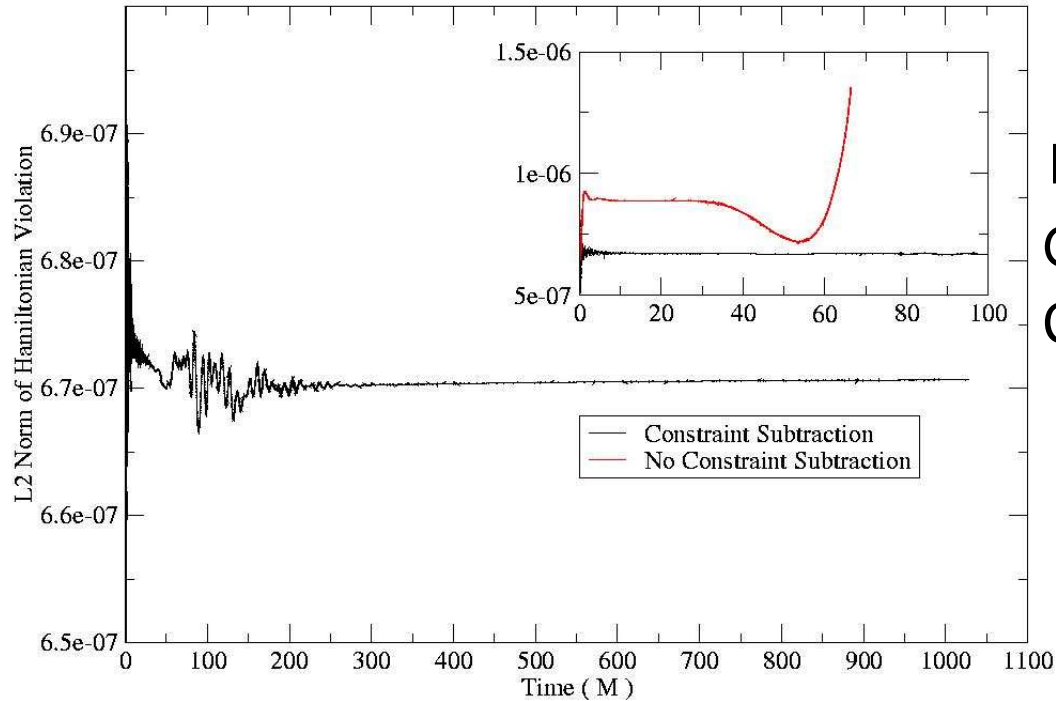
Domain: $-10M \dots 10M$

Grid: 100^3

Constraint Subtraction:

$$-0.232 \alpha g_{ij}H - 0.18 \alpha K_{ij}H$$

Constraint Subtraction



Isolated Schwarzschild Hole

Domain: $-10M \dots 10M$

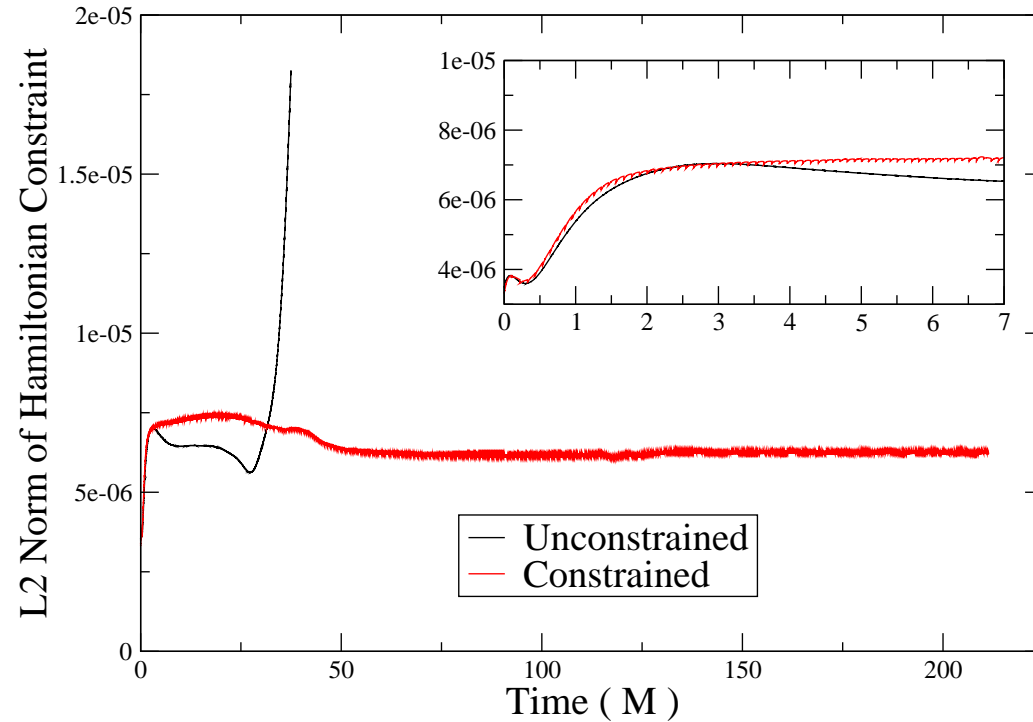
Grid: 150^3

Constraint Subtraction:

$$-0.232 \alpha g_{ij} H - 0.18 \alpha K_{ij} H$$

Constraint Solving Only

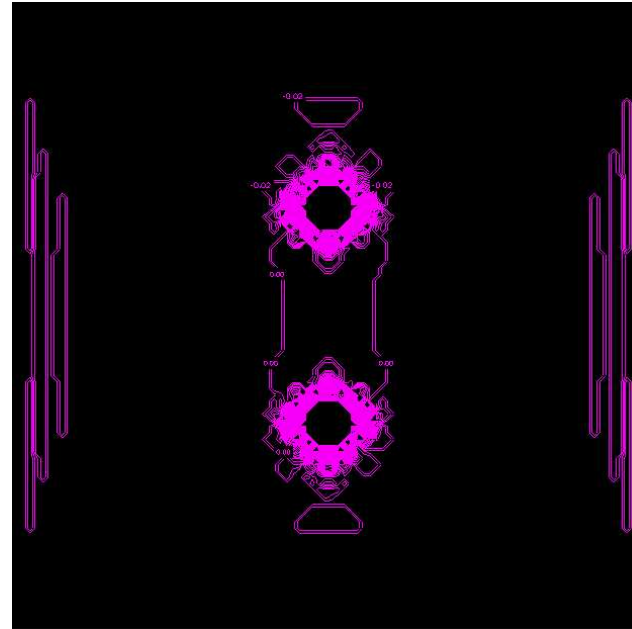
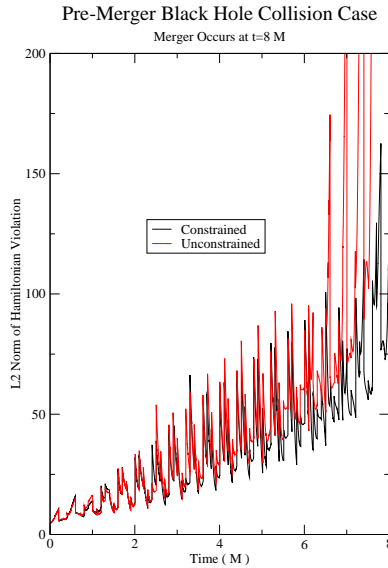
Constrained vs Unconstrained
No Constraint Subtraction



Isolated Schwarzschild Hole
Domain: $-5M \dots 5M$
Grid: 50^3
No Constraint Subtraction

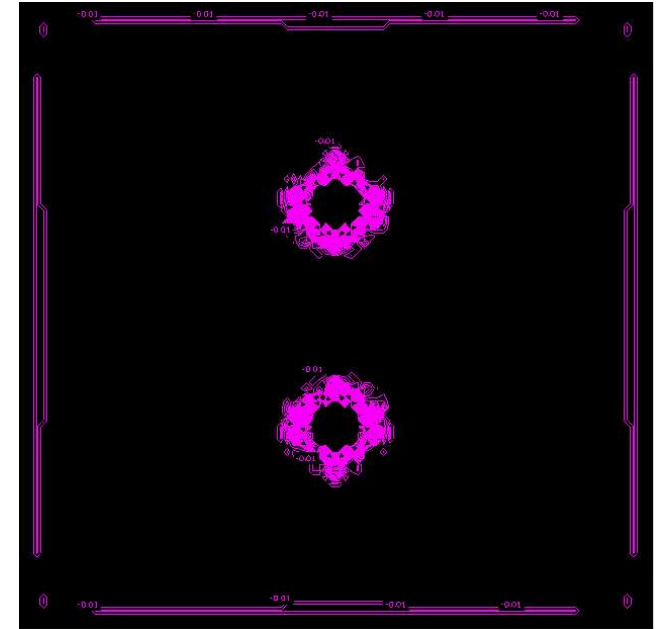
Pre-Merger Binary Black Hole

Hamiltonian Violation
Contours: 0.01 Time: 5M



Unconstrained

Max: 2.0 Min: -5.9



Constrained

Max: 1.5 Min: -4.6

Two Schwarzschild holes initially at $x = \pm 6M$ boosted $vx = \mp 0.5$

Domain: $-10M \dots 10M 100^3$

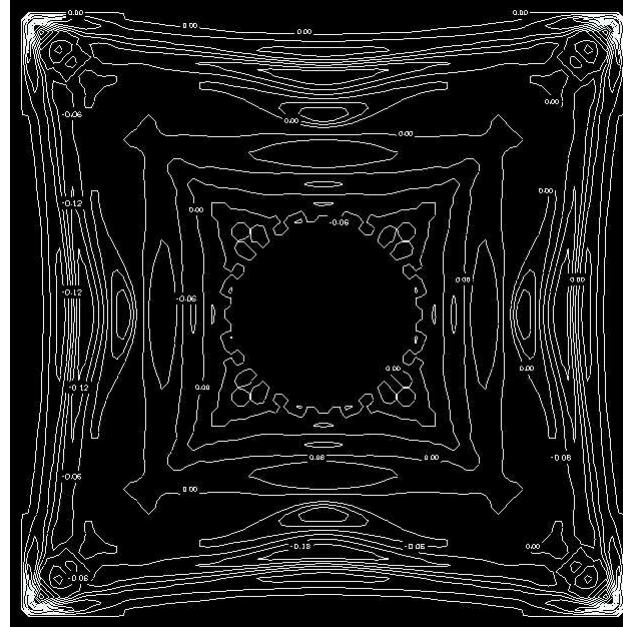
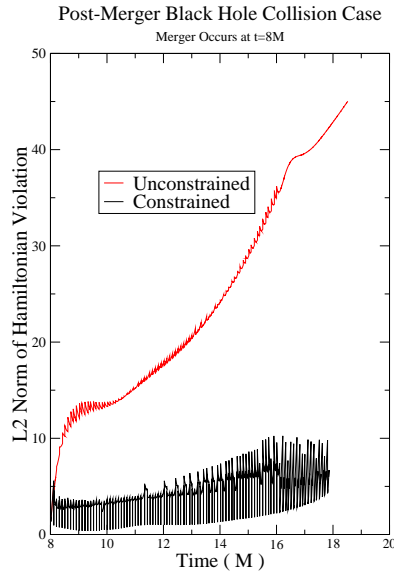
Constraint Subtraction: $-0.232 \alpha g_{ij}H - 0.18 \alpha K_{ij}H$

Merger occurs at $t = 8M$; Constraint solver solves $r = 1.65M$ and out

Post-Merger Binary Black Hole

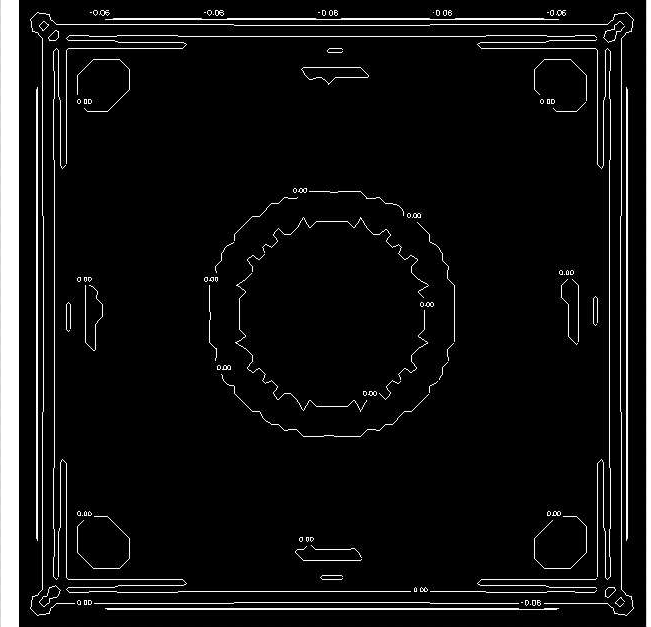
Hamiltonian Violation

Contours: 0.06 Time: 17.5M



Unconstrained

Max: 0.44 Min: -0.47



Constrained

Max: 0.30 Min: -0.27

Two Schwarzschild holes initially at $x = \pm 6M$ boosted $vx = \mp 0.5$

Domain: $-10M \dots 10M$ 100^3

Constraint Subtraction: $-0.232 \alpha g_{ij}H - 0.18 \alpha K_{ij}H$

Merger occurs at $t = 8M$; Constraint solver solves $r = 1.65M$ and out