Constrained Evolution Successes and Problems

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Constraint Subtraction

Isolated Schwarzschild Hole Domain: $-10M \ldots 10M$

Constraint Subtraction:

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

No Constraint Subtraction

Isolated Schwarzschild Hole   Domain: $-5M \ldots 5M$

L2 Norm of Hamiltonian Violation

Apparent Horizon Area ($M^2M$)
Constraint Surface
Region Not Constrained
Isolated Schwarzschild Hole
Domain: $-10M \ldots 10M$
Grid: $100^3$
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: $-10M \ldots 10M \ 100^3$

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

Post-Merger Black Hole Collision Case
Merger Occurs at t=8M

Two Schwarzschild holes initially at \( x = \pm 6M \) boosted \( v x = \mp 0.5 \)

Domain: \(-10M \ldots 10M\) \( 100^3 \)

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