Abstract Submitted
for the APR14 Meeting of
The American Physical Society

Simulating extreme-mass-ratio systems in full general relativity: tidal disruption events WILLIAM EAST, KIPAC/Stanford, FRANS PRETORIUS, Princeton University — Sparked by recent and anticipated observations, there is considerable interest in understanding events where a star is tidally disrupted by a massive black hole. Motivated by this and other applications, we introduce a new method for numerically evolving the full Einstein field equations in situations where the spacetime is dominated by a known background solution. The technique leverages the knowledge of the background solution to subtract off its contribution to the truncation error, thereby more efficiently achieving a desired level of accuracy. We demonstrate how the method can be applied to systems consisting of a solar-type star and a supermassive black hole with mass ratios $\geq 10^6$. The self-gravity of the star is thus consistently modelled within the context of general relativity, and the star's interaction with the black hole computed with moderate computational cost, despite the over five orders of magnitude difference in gravitational potential (as defined by the ratio of mass to radius). We study the tidal deformation of the star during infall, as well as the gravitational wave emission, and discuss ongoing work to understand the importance of strong-field gravity effects on tidal disruption events.

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Date submitted: 09 Jan 2014 Electronic form version 1.4