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Accurate time–domain gravitational waveforms for extreme-mass-ratio binaries GAURAV KHANNA, University of Massachusetts at Dartmouth, LIOR M. BURKO, University of Alabama in Huntsville — The accuracy of time-domain solutions of the inhomogeneous Teukolsky equation is improved significantly. Comparing energy fluxes in gravitational waves with highly accurate frequency-domain results for circular equatorial orbits in Schwarzschild and Kerr, we find agreement to within 1% or better, which may be even further improved. This improvement is with respect to previously reported deviations of 10–20% in the energy flux. We apply our method to orbits for which frequency-domain calculations have a relative disadvantage (namely, summation over very many modes would be required), specifically high-eccentricity (elliptical and parabolic) "zoom–whirl" orbits, and find the energy fluxes, waveforms, and characteristic strain in gravitational waves. Our calculations maintain the desired accuracy also for orbits in the strong field regime. This proof-of-concept work demonstrates that time-domain generation of waveforms can be accurate and computationally efficient, and can complement frequency-domain calculations where the latter have relative disadvantages, in addition to providing an independent check on them. Further improvements in particle modeling, non-uniform grids (including adaptive mesh refinement), and parallel computation, in addition to grid refinement and enlargement of the computational domain, may improve the accuracy even further.

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