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Gravitational waveforms for neutron star binaries from binary black hole simulations KEVIN BARKETT, MARK SCHEEL, Caltech, ROLAND HAAS, Albert Einstein Institute, CHRISTIAN OTT, Caltech, SEBASTIANO BERNUZZI, University of Parma, DUNCAN BROWN, Syracuse University, BELA SZILAGYI, JEFFREY KAPLAN, JONAS LIPPUNER, Caltech, CURRAN MUHLBERGER, Cornell University, FRANCOIS FOUCART, Lawrence Berkeley National Laboratory, MATTHEW DUEZ, Washinton State University — Gravitational waves from binary neutron star (BNS) and black-hole/neutron star (BHNS) inspirals are primary sources for detection by the Advanced Laser Interferometer Gravitational-Wave Observatory. The tidal forces acting on the neutron stars induce changes in the phase evolution of the gravitational waveform, and these changes can be used to constrain the nuclear equation of state. Current methods of generating BNS and BHNS waveforms rely on either computationally challenging full 3D hydrodynamical simulations or approximate analytic solutions. We introduce a new method for computing inspiral waveforms for BNS/BHNS systems by adding the post-Newtonian (PN) tidal effects to full numerical simulations of binary black holes (BBHs), effectively replacing the non-tidal terms in the PN expansion with BBH results. Comparing a waveform generated with this method against a full hydrodynamical simulation of a BNS inspiral yields a phase difference of < 1 radian over ~ 15 orbits. The numerical phase accuracy required of BNS simulations to measure the accuracy of the method we present here is estimated as a function of the tidal deformability parameter λ.

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