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Head-on collisions of binary white dwarf–neutron stars: Simulations in full general relativity VASILEIOS PASCHALIDIS, ZACHARIAH ETIENNE, YUK TUNG LIU, STUART L. SHAPIRO, University of Illinois at Urbana-Champaign — We simulate head-on collisions from rest at large separation of binary white dwarf–neutron stars (WDNSs) in full general relativity (GR). We focus on WDNSs whose total mass exceeds the maximum mass of a NS, and our goal is to determine their fate. A full GR hydrodynamic computation of realistic WDNS systems is prohibitive due to the large range of dynamical time-scales and length-scales involved. For this reason, we construct an equation of state (EOS) that mimics realistic NS EOSs while, at the same time, reduces the size of WDs. We call these scaled-down WD models "pseudo-WDs (pWDs)". Using pWDs, we can study WDNSs via a sequence of simulations where the size of the pWD gradually increases toward realistic cases. We perform simulations that study the effects of both the NS mass and the pWD compaction separately. We find that all remnant masses exceed the maximum mass of our cold EOS ($1.92M_{\odot}$), but no case leads to prompt collapse to a black hole. This outcome arises because the final configurations are hot. All cases settle into spherical, quasiequilibrium configurations consisting of a cold NS core surrounded by a hot mantle, resembling Thorne-Zytkow objects. Our study indicates that the likely outcome of a head-on collision of a realistic, massive WDNS system will be a Thorne-Zytkow-like object.

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