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Analytic Modeling of Eccentric Binary Black Holes: from Inspiral to Merger and Ringdown[1] DILLON BUSKIRK, DR. MARIA BABIUC-HAMILTON, Marshall University — Binary black hole (BBH) are primary sources of gravitational waves (GW). Their evolution is highly non-linear and numerical relativity (NR) is required to simulate this problem. However, this is computationally expensive, and it is imperative for GW modeling to create analytic formulations that produce results comparable to NR simulations. BBH dynamics are separated into three phases: inspiral, merger, and ringdown. In a recent work, we used the post-Newtonian (PN) theory for the inspiral phase, and the generic implicit rotating source (gIRS) formulation for the merger, to build complete analytical GW templates for BBH evolution. Here we expand our work to include eccentric orbits in the inspiral phase, which greatly complicates the calculations. We develop an analytic method to speed up the evaluation of the Bessel functions without loss of accuracy. For the merger and ringdown we use the Backwards-one-body (BOB) approach. This new model, introduced by S. McWilliams, provides analytic GW based on physical principles. We match the BOB model with the circularized eccentric inspiral, to obtain a complete waveform. Next, we compare our waveforms with the gIRS model and the Simulating Extreme Spacetimes (SXS) data produced using numerical relativity simulations, finding agreement.

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