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Mass-energy and Momentum Extraction by Gravitational Wave Emission in the Merger of Two Colliding Black Holes: The Non-head-on Case RAFAEL ARANHA, Georgia Institute of Technology, IVANO SOARES, Centro Brasileiro de Pesquisas Fisicas, EDUARDO TONINI, CEFETES — We examine numerically the post-merger regime of two nonspining holes in non-head-on collisions in the realm of nonaxisymmetric Robinson-Trautman (RT) spacetimes. Characteristic initial data for the system are constructed and evolved via the RT equation. The numerical integration is performed using a Galerkin spectral method which is sufficiently stable to reach the final configuration of the remnant black hole, when the gravitational wave emission ceases. The initial data contains three independent parameters, the ratio mass α of the individual colliding black holes, their initial pre-merger infalling velocity γ and the incidence angle of collision ρ_0. In the same way, the remnant black hole is characterized by its final boost parameter, rest mass and scattering angle. Our analysis which is based on the Bondi-Sachs four-momentum conservation laws shows that the process of mass-energy extraction is less efficient compared to the head-on case. We also show distinct regimes of gravitational wave emission which are characterized by the analysis of the time behavior of the gravitational wave power as a function of α. Finally, we show numerically that the relation between the incidence and scattering angles closely approximates a Newtonian relation.

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