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Action integrals of eccentric, spinning black hole binaries at three-halves post-Newtonian order SASHWAT TANAY, University of Mississippi, MS, USA, GIHYUK CHO, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany, LEO STEIN, University of Mississippi, MS, USA — Accurate and efficient modeling of the dynamics of binary black holes (BBHs) is crucial for the detection of gravitational waves (GWs) emitted by them. General BBHs will have spinning black holes and a non-zero eccentricity. In arXiv:2012.06586, we evaluated four (out of five) action integrals of the system at 1.5 post-Newtonian (PN) order and showed that the system is integrable at 2PN (integrability implies the existence of action-angle variables). In this work, we compute the fifth action integral at 1.5PN which has been elusive until now. We also argue that the BBH system is a non-degenerate one in the context of canonical perturbation theory. This opens the door to computing action-angles at 2PN in the future using non-degenerate canonical perturbation theory and later add the 2.5PN radiation-reaction effects to the conservative and integrable 2PN system by applying the method of variation of constants on the top of action-angle formalism, thus making the actions vary in time. This work can be seen as a stepping stone to obtaining closed-form solutions to the dynamics of spinning, eccentric BBHs which also shrink due to GW emission.

Sashwat Tanay
University of Mississippi

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