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Revisiting 2PN Hamiltonian mechanics of binary black holes

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Accurate modeling of binary black hole (BBH) dynamics is crucial for the detection of gravitational waves emitted by them. We focus on the so-called “orbit-averaged” spinning BBH system at the second post-Newtonian (PN) order. We discover that it is a Hamiltonian system and we present its Hamiltonian. We then establish that it is an integrable system (one that possesses action-angle variables (AAVs)) owing to the already-known constants of motion. We then construct its AAVs and hence its AAV-based solution. Using these AAVs, we locate some of its separatrices and resonances. Additionally, for the non-integrable 2PN system (without any orbit-averaging), we construct the solution for the magnitude of the position vector of the black holes in the so-called quasi-Keplerian spirit, despite the non-integrability of the system.

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