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Canonical Hamiltonian for an extended test body in curved spacetime: To quadratic order in spin JUSTIN VINES, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), DANIELA KUNST, ZARM, University of Bremen, JAN STEINHOFF, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), TANJA HINDERER, Department of Physics, University of Maryland — We derive a Hamiltonian for an extended spinning test-body in a curved background spacetime, to quadratic order in the spin, in terms of three-dimensional position, momentum, and spin variables having canonical Poisson brackets. This requires a careful analysis of how changes of the spin supplementary condition are related to shifts of the body's representative worldline and transformations of the body's multipole moments, and we employ bitensor calculus for a precise framing of this analysis. We apply the result to the case of the Kerr spacetime and thereby compute an explicit canonical Hamiltonian for the test-body limit of the spinning two-body problem in general relativity, valid for generic orbits and spin orientations, to quadratic order in the test spin. This fully relativistic Hamiltonian is then expanded in post-Newtonian orders and in powers of the Kerr spin parameter, allowing comparisons with and extensions of the test-mass limits of available post-Newtonian results. Both the fully relativistic Hamiltonian and the results of its expansion can inform the construction of waveform models, especially effective-one-body models, for the analysis of gravitational waves from compact binaries.

Justin Vines
Max Planck Institute for Gravitational Physics (Albert Einstein Institute)

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