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On incorporating post-Newtonian effects in N-body dynamics[1]
CLIFFORD M. WILL, Univ of Florida - Gainesville — We show that the Newtonian energy of a test body orbiting a central body with a quadrupole moment is conserved over the relativistic pericenter precession timescale, if and only if relativistic, post-Newtonian cross terms between the mass monopole potential and the quadrupole potential are properly included in the equations of motion. We then argue that, for calculating the evolution of N-body systems with a central massive black hole over timescales comparable to the relativistic pericenter advance timescale, it is essential to include analogous "cross terms" in the equations of motion. These are post-Newtonian terms in the motion of a given body that represent a coupling between the potential of the central black hole and the potential due to other stars in the system. We display the post-Newtonian N-body equations of motion including a central black hole in a truncated form that includes all the relevant cross terms, in a format ready to use for numerical implementation. We do the same for hierarchical triple systems, and illustrate explicitly the effects of cross terms on the orbit-averaged equations of evolution for the orbit elements of the inner binary for the special case where the third body is on a circular orbit.

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