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The complete non-spinning effective-one-body metric at linear order in the mass ratio

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Using the results of related work, in which the binding energy of a circular-orbit non-spinning compact binary system is computed at leading-order beyond the test-particle approximation, the exact expression of the effective-one-body (EOB) metric component g_{tt}^{eff} is obtained through first order in the mass ratio. Combining these results with the recent gravitational self-force calculation of the periastron advance for circular orbits in the Schwarzschild geometry, the EOB metric component g_{rr}^{eff} is also determined at linear order in the mass ratio. These results assume that the mapping between the real and effective Hamiltonians at the second and third post-Newtonian (PN) orders holds at all PN orders. Our findings also confirm the advantage of resumming the PN dynamics around the test-particle limit if the goal is to obtain a flexible model that can smoothly connect the test-mass and equal-mass limits.