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Radiation Reaction, Gravitational Self-Force and Higher-Order Perturbation Theory in General Relativity[1] STEVEN DETWEILER, Univ of Florida - Gainesville — In General Relativity a small object of mass m moves along a geodesic. This elementary fact implies that even under the influence of "gravitational radiation reaction" while the object orbits, say, a large black hole whose metric is g_{ab}, the motion of m is geodesic—but not a geodesic of g_{ab}! The retarded metric perturbation $h^{\rm ret}_{ab}$ caused by m is determined using perturbation analysis. In a neighborhood of the small object, $h^{\rm ret}_{ab}$ may be decomposed into two parts $h^{\rm ret}_{ab} = h^S_{ab} + h^R_{ab}$ where the "singular source term" h^S_{ab} appears, in coordinates local to the object, as the part of the Schwarzschild metric of mass m which is linear in m along with some other terms linear in m that reflect the tidal distortion of the object. The "regular remainder" $h^{\rm R}_{ab}$ is also linear in m and is known to be differentiable in a neighborhood of the small object. The effect of radiation reaction and, more generally, the gravitational self-force then requires that the object move along a geodesic of $g_{ab}+h^{\rm R}_{ab}$, which is a source free solution to the Einstein equations in a neighborhood of m. This description is extendable to include higher order perturbation analysis.

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