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The multipolar post-Minkowskian iteration and tails of memory

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In traditional post-Newtonian methods, the spacetime is split into a near zone and an exterior vacuum zone. In the near zone, the metric is solved by iterating the Einstein equations in a small post-Newtonian (PN) parameter, either the relative velocity of the binary or the relative inverse separation; the power counting is done in powers of c. In the exterior vacuum zone, no assumptions are made about the binary, and one performs the weak-field post-Minkowskian (PM) expansion, counted in powers of G. Since the metric is decomposed into multipolar moments (to be matched to the near zone), this iteration is called "multi-polar post-Minkowskian" (MPM). At quadratic order in the iteration, one encounters integrals involving a static mass and a quadrupole (the tails, which enter at 1.5PN in the waveform and energy flux), as well as two quadrupoles (which give rise to the memory, which enters at 2.5PN). At cubic order: two static masses and a quadrupole give rise to tails-of-tails at 3PN; one static mass, one static angular momentum and one quadrupole moment give rise to the "spin-quadrupole tails" at 4PN; and finally, one static mass and two dynamical quadrupoles give rise at 4PN to the "tails of memory". The latter interaction is the hardest to compute due to two interacting quadrupoles: one has to deal with nested integrals and complicated kernels involving polylogarithms, which eventually simplify. In multiloop language, they would correspond to 3-loop two-point massive/massless integrals. In this talk, I will discuss the integration techniques developed to obtain these terms.

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