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Hamiltonian normal forms for the post-Newtonian binary problem

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Since their onset, post-Newtonian schemes have been consistently effective in describing binary orbits, achieving progressively higher order expansions. Their aim is to essentially produce ‘matter-only’ equations of motion by elimination of the metric degrees of freedom. In the ADM framework, this corresponds to the computation of a matter-only Hamiltonian.
Yet despite these advancements, systematical tools for analytically solving the resulting equations often lag behind, and ad-hoc methods are frequently limited to secular or (quasi-)circular approximations. In this talk, I will describe a structural approach for solving the matter-only equations of motion of a perturbed two-body system in a canonical formalism using Lie series. This framework allows a comprehensive analytical description of the orbital evolution in coordinate-time, including both secular and oscillatory contributions, thereby complementing traditional methods. I will derive parametric generator solutions for typical Hamiltonian terms, including local conservative PN contributions and a certain class of non-gravitational perturbations. As an application, I will reproduce established 2PN results and expand on existing Hamilton-Jacobi solutions to incorporate short-term oscillations. Future research will extend this framework to include non-conservative forces and spin dynamics.

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