Contribution ID: **23** Type: **poster**

Factorization and resummation: A new paradigm to improve gravitational wave amplitudes. II: the higher multipolar modes.

Wednesday, 20 February 2019 18:01 (1 minute)

We improve and generalize to all multipoles the factorization and resummation approach of Nagar and Shah,designed to improve the strong-field behavior of the post-Newtonian (PN) residual waveform amplitudes $f_{\ell m}$'s entering the effective-one-body, circularized, gravitational waveform for spinning coalescing binaries. For a test-particle orbiting a Kerr black hole, each multipolar amplitude is truncate at relative 6~post Newtonian (PN) order, both for the orbital and spin factors. By taking a certain Pad\'e approximant of the orbital factor in conjuction with the inverse Taylor (iResum) representation of the spin factor, it is possible to push the analytical/numerical agreement of the energy flux at the level of 5% at the last-stable-orbit for a spinning black hole with dimensionless spin parameter $+0.99$.
When the procedure is generalized to comparable-mass binaries, each orbital factor is kept at relative 3^{+3}PN order, i.e. the globally 3PN-accurate comparable-mass terms are hybridized with higher PN test-particle terms up to 6PN relative order in each mode. The same Pad\'e resummation is used for continuity. By contrast, the spin factor is only kept at the highest comparable-mass PN-order currently available. We illustrate that the consistency between different truncations in the spin content of the waveform amplitudes is more marked in the resummed case than when using the standard Taylor-expanded form. We finally introduce a method to consistently hybridize comparable-mass and test-particle information {\it also} in the presence of spin.
The improved, factorized and resummed, multipolar waveform amplitudes presented here are expected to set a new standard for effective-one-body-based gravitational waveform models.

Summary

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Session Classification: Poster session

Track Classification: Gravitational Waves