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Surrogate models for eccentric binary black hole coalescences

Orbital eccentricity of coalescing compact binaries produces a strong imprint in the gravitational waves (GWs) emitted by these systems. Its presence indicates at dynamically assembled binaries in dense stellar environments like globular clusters, nuclear star clusters, etc. Hence, detecting an eccentric merger will significantly enhance our knowledge about the formation channels of these binaries. Furthermore, neglecting eccentricity will also lead us to infer the other source parameters of the binary incorrectly. However, GW detectors are yet to unambiguously detect eccentric binaries and therefore such sources are often ignored in the current GW data analyses. But the prospects will improve in the near future as current detectors reach their design sensitivities and the proposed highly-sensitive third-generation detectors join the global GW detector network. Their broader sensitive frequency band will help in not only detecting more GW events but also in observing much longer inspirals, thereby substantially improving the range and precision of eccentricity measurements.

Theoretical GW waveform models in the near future will require improvements not only in their physics content and accuracy but also in their evaluation speeds so that accurate analyses of GW events can be arrived at in pace with the increasing amounts of incoming data. Surrogate models/ reduced order models are fast and accurate approximations of waveform models created using data-driven techniques like reduced bases and empirical interpolation. However, eccentric binary black hole waveforms have much more features than their quasi-circular counterparts and hence are trickier to model efficiently. In this talk, I will discuss some strategies for building their efficient and accurate surrogate/ reduced-order models.

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