Numerical Studies of binary black hole (BBH) mergers through quasi-local horizon characteristics

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Abstract

Gravitational wave signals from binary black hole merger events are now routinely computed in numerical simulations. What is somewhat less well understood is the behaviour of black hole horizons near the merger. In this work [**?**] we have studied, how and when a common horizon is formed, how does the area grow and rate of growth slows down. How much the mass and spin multipoles differ from the Kerr multipoles near the source during its dynamical and isolated phase. Based on the approach, developed to study quasi-local quantities on dynamical and Isolated horizons (for review, see [**?**]), we have carried out these studies using flux formulae and source multipole moments [**?**] as the primary tools for the analysis.

We have found that the area of the outer horizon grows monotonically and settles to a steady value. Temporal behaviour of the mass and spin source multipoles show the falloff which is steeper just after merger. At about a duration of $10M$ after the merger, the falloff rate changes to a lower rate. Eventually indicating that the final black hole settles down as Kerr limit. We also computed gravitational flux radiation and observed the behaviour which supports the conjecture that the fields at the horizon are co-related with the fields in the wave zone, through the comparison of in-falling gravitational flux radiation on the horizon with the outgoing radiation as estimated by gravitation radiation.

Analysis of inspiral and merger phase in terms of quasi-local quantities for BBH systems including unequal mass binaries with and without spin, will be discussed.

References

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