Contribution ID: **88** Type: **not specified**

Improved Binary Black Hole Initial Data

The past decade has witnessed remarkable progress in the detection of gravitational waves, with milestones such as the direct observation of binary black hole mergers and binary neutron star coalescence. Numerical relativity stands as a crucial tool for understanding gravity, particularly in extreme scenarios where analytical solutions become impractical.

The critical aspect of constructing initial data for binary black hole simulations is addressed, recognizing the need to move beyond conventional conformally flat methods. The challenge lies in capturing realistic radiation content from the system's past history at initial time. The proposed methodology involves leveraging the Post-Newtonian formalism to construct the initial data, creating a binary black hole toy code for verification, and implementing solutions in the SpECTRE code.
These steps aim to efficiently solve the Extended Conformal Thin-Sandwich (XCTS) equations fed by arbitrary realistic initial data, offering improved initial data for more accurate evolutions.

The utilization of the SpECTRE code, renowned for its efficiency in handling complex astrophysical problems, enhances the computational capabilities required for these simulations. We ultimately seek to improve initial data of binary black hole systems, fostering more precise simulations and contributing to the ongoing exploration of gravitational waves in the universe.

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