Contribution ID : **61** Type : **not specified**

Research on gravitational waves and dynamics of binary black holes in eccentric orbits

We begin by describing a phenomenological relationship between eccentric orbit waveforms and their circular orbit counterparts. Utilizing waveform data for eccentric binary black holes from the RIT catalog, we extend the parameter space of our study and generalize the model to include higher-harmonic gravitational wave modes. By incorporating a shift factor and modeling precession effects, we adapt the framework to both spin-aligned and precessing-spin waveforms. Next, we perform a detailed comparison between post-Newtonian and numerical relativity waveforms for eccentric binary black hole mergers. Using the (2,2) mode as a benchmark, we examine the frequencies and amplitudes of both Psi4 and h waveforms. Our results demonstrate consistent frequency agreement. We subsequently analyze the relationship between dynamical quantities—including merger time , peak luminosity, recoil velocity, remnant mass, spin parameter, and initial eccentricity for eccentric BBH mergers in the RIT catalog. We find that these dynamical quantities generally exhibit oscillations with e0, a phenomenon that only emerges in simulation series with sufficiently dense sampling of initial eccentricity. By aligning integer multiples of the orbital period with the peaks and troughs in each relationship curve, we establish that these oscillations originate from orbital transitions. Next, we find the essence of the problem from a PN perspective, namely the influence of the mean anomaly.

Presenter(s) : WANG, Hao

Session Classification : Parallel-1