1 Numerical Methods

2 Confusion problem

Given a waveform under specetiem with non-zero deformation parameter, we need to decide which waveform under Kerr specetime is most similar to it.

If we restrict ourselves to equatorial motion, set the initial t and ϕ to 0 taking advantage of symmetry and set initial $r = r_{max}$ imposing the phase to match, orbital eccentricity e, semilatus rectum p, BH mass M and BH spin a are the parameters that determine the motion.

According to , orbits with same orbital frequency ω_r and ω_ϕ can generate most similar gravitational waveforms. Here we check this result by lookinf at overlaps between waveforms with $(\delta_1, a, M, e, p) = (0.2, 0.5, , 0.5, 6)$.

First we look at overlap distribution on a relatively large range of (e, p).

Then take a closer look at the distribution near (e,p) with same orbital frequency. Note that the same orbital frequency with respect to t can result in largest overlap while the same orbital frequency with respect to τ cannot.

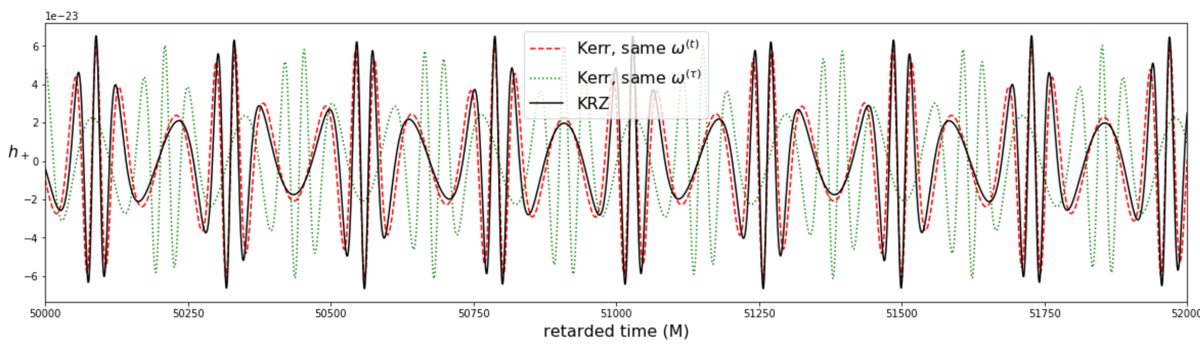

Figure 1: Comparison between waveforms of h_+ with respect to retarded time in units of central black hole mass M. The black solid line is the waveform under $\delta_1 = 0.2$, e=0.5,p=6. The red dashed line is the waveform under $\delta_1 = 0$ and e, p adapted so that the orbital frequencies with respect to t $\omega_r^{(t)}$ and $\omega_\phi^{(t)}$ are the same as that of the orbit under d1=0.2, e=0.5, p=6. The green dotted line is the waveform under $\delta_1 = 0$ and e, p adopted so that $\omega^{(\tau)}$s are the same . The spin of the central black hole is 0.5M.

Therefore we regard waveforms in Kerr spacetime with same orbital frequencies as best matches to waveforms in non-Kerr space time under KRZ parametrization.

Fig. shows the overlap distrobution...

As Fig. suggest, the confusion problem still exists in KRZ parametrization. The deformation parameter δ_1 is kind of degenerated with in Kerr spacetime. This resulted can also be found by looking at covariance matrix as discussed in next section

3 Restriction on deformation parameter by future LISA task