DL11349/Kumar – Response to the report of the Referee

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We would like to thank the referee for their careful reading of the manuscript, and their suggestions. All of their remarks have been incorporated in the manuscript, and were helpful in clarifying the information presented in the article.

Report of the Referee – DL11349/Kumar

The authors study the feasibility of searching for gravitational waves from the inspiral and merger of binary black hole systems using template banks constructed from numerical relativity waveforms, and hybrid post-Newtonian/numerical relativity waveforms. This approach potentially avoids the need for model waveforms which must be tuned against numerical relativity, and could therefore streamline the process by which new simulations are employed in searches.

The authors conclude that, despite the discreetness in mass ratio imposed by the nature and computation expense of NR simulations, a fairly small set of existing simulations is sufficient to construct an effectual bank over a significant range of masses and mass ratios. This result is interesting and important to the gravitational wave science community. The authors then extend their work to consider the length and accuracy requirements on future numerical simulations in order to ensure coverage down to 12 solar masses, at which point pure post-Newtonian waveforms have been found to be effectual. This extension will be of interest to both those searching for gravitational waves and numerical relativists. I recommend this manuscript be published in PRD.

I have only a few minor remarks:

Comments:

1. *"We find that the EOBNRv2 manifold is a reasonable approximation for the hybrid manifold." I would suggest alluding to this result earlier, as while reading the methods I had wondered if the use of EOBNRv2 to model signals would introduce any uncertainty into the results.*

This was mentioned in Sec.III, where we describe the method for quantification of template bank effectualness (above Eq. 18). I have added the following text in the Introduction to clarify this point earlier:

"The bank placement algorithm uses the EOB model from Ref. [53] (EOBNRv2). As this model was cal- ibrated against NR for most of these mass-ratios, we expect the manifold of EOBNRv2 to be a reasonable approxima- tion for the NR manifold. In Sec. V, we demonstrate that this approximation holds well for NR-PN hybrids as well. "

2. *"... domain pseudospectral code to solve Einsteins equations."* → *Einstein's*

This has been changed as suggested.

η	q	Length (in orbits)	Minimum total mass ($M_\odot$)
0.25	1	33	49
0.2222	2	15	76
0.1875	3	18	82
0.1600	4	15	87
0.1224	6	20	83
0.0988	8	25	83

Table 1: See text for details

3. *In Table I it would be useful to include a columns giving the lowest mass for which the waveform starts at 15Hz.*

Table I of the manuscript has been updated, adding a column with the binary masses for which the respective simulations start at 15 Hz, as shown here in Table 1

4. *"And the coverage fraction of the bank is 99%." Coverage fraction was not defined.*

The description of the termination condition for the stochastic bank construction has been rephrased as: "The process is repeated till the fraction of proposals being accepted falls below $\sim 10^{-4}$, and $\gtrsim 99\%$ of the parameter space is covered effectually."

5. *"... pushing their mass-ratios to the two neighboring mass-ratio from $\mathcal{S}_q$" I suspect it does not matter very much, but was the pushing done along lines of constant total mass or chirp mass?*

The uncovered points are pushed to the nearest allowed mass-ratio values along lines of constant chirp mass. This has been clarified in the paper as: "... pushing their mass-ratios to the two neighboring mass-ratios from $\mathcal{S}_q$ along lines of constant chirp mass"

6. *"The detectors will be relatively very sensitive to a relatively short frequency band." This reads a little awkwardly.*

This has been rephrased as: "The detectors will be most sensitive in a comparatively narrow frequency band."

7. *"The spacing between neighboring templates is given by requiring that the overlap between them be 97as the final two-dimensional bank." Again I suspect it does not matter much, but how was the first point along each q line chosen?*

The first point, i.e. the lowest total mass template, was chosen to be the one for which the hybrid mismatch is 3%. As the hybrid mismatches grow at lower masses, it is reasonable to choose the first point where the mismatches are almost at the threshold. This has been clarified as:

"The template with the lowest total mass is chosen by requiring the hybrid mismatch to be 3% at that point. The spacing between neighboring templates is given by requiring that the overlap between them be 97%. We take the union of these banks as the final two-dimensional bank."