Erratum: Outlook for detecting the gravitational-wave displacement and spin memory effects with current and future gravitational-wave detectors [Phys. Rev. D 107, 064056 (2023)]

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In the paper, an error was found; we discovered that the code we had written to generate the results of this paper had a sign error (the corrected code is now available at [1]). The sign error in the code affected many of the results of this paper to

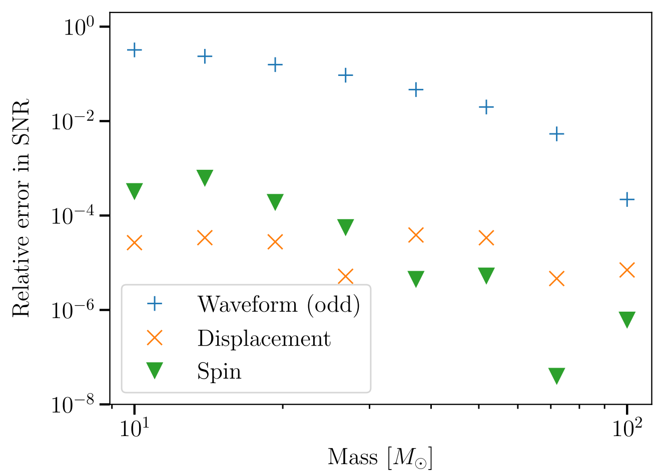

FIG. 1. A plot comparing the relative error in the SNR computed either from the full waveform or a waveform truncated in length. The specific SNRs that are computed are from the parts of the waveform that are odd under the transformation in Sec. II C, the displacement memory signal, and the spin memory signal.

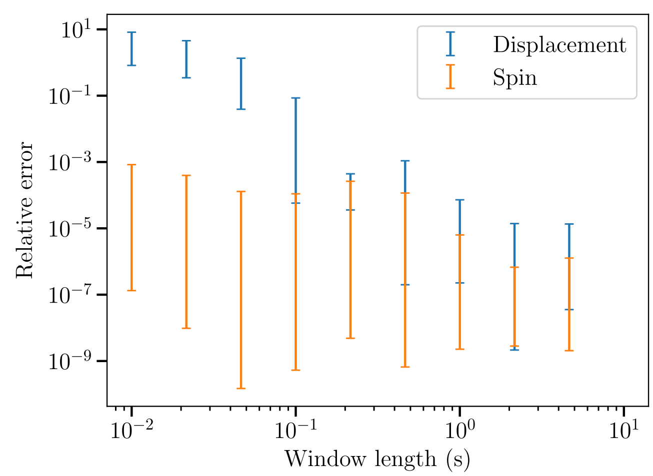

FIG. 2. The relative error in the SNR vs window length, for just the displacement and spin memory signals, using a window that pads both the beginning and end of the waveform. The error is computed by comparing against a window with a length of 10 s. The SNR is computed in the HLVKI detector at its O5 sensitivity, and for a range of masses between 10 and $10^{2.5} M_\odot$; the remaining parameters are the same as in Footnote 13.

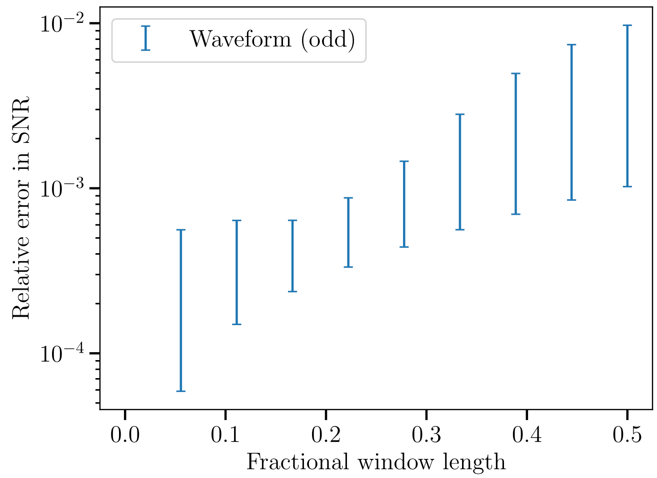

FIG. 4. The relative error in the SNR, as a function of the length of the window (as a fraction of the length of the unwindowed waveform), for the odd part of the waveform. The window is applied over both the beginning of the waveform and a padded region at the end of the waveform of the same length. The error is computed by comparing with a window length of 0. As in Fig. 2, the SNR is computed in the HLVKI detector at its O5 sensitivity, for a range of masses between 10 and $10^{2.5} M_{\odot}$; the parameters are the same as in Footnote 13.

different degrees. For the figures, the most significant change occurs in Fig. 6, which presents forecasts for the accumulated signal-to-noise ratio (SNR) for the spin memory effect. There is a smaller change in Fig. 5, which shows forecasts for the displacement memory effect. For completeness, we provide updated versions of all the paper's figures except Fig. 3 (which was not affected), although Figs. 1, 2, 4, 7, and 8 had insignificant changes. Moreover, we include the captions to these figures, although they are unchanged.

Some of the statements in the text of the Abstract, Introduction, Results, and Conclusions sections that discuss the figures and their results need to be changed accordingly. The most pertinent corrections relate to our statements about the time required to reach a given SNR for "detection" in the different detector configurations. The summary of these is as follows:

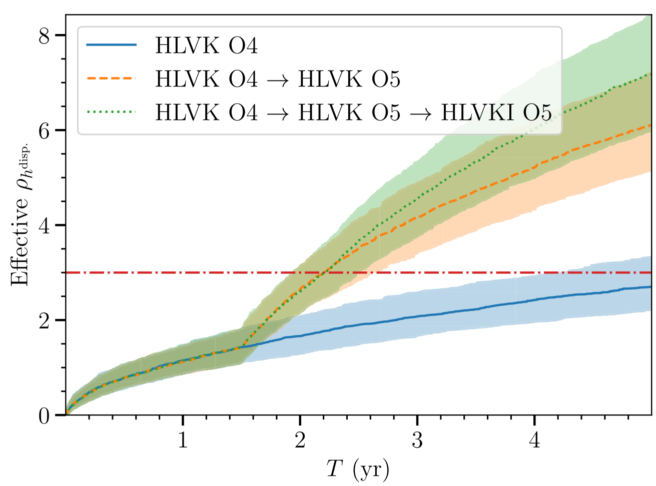

FIG. 5. The median accumulated SNR and 68% symmetric credible region for the displacement memory in second-generation detector networks as a function of run time for different realizations of binary-black-hole populations. The blue region corresponds to the O4 HLVK network at design sensitivity for all four detectors, which can be compared with the results of [47]. The orange region instead accounts for an upgrade to the O5 sensitivity of the HLVKI network after 1.5 years, as is currently planned [46], and the green region accounts for the addition of LIGO India after 2.25 years. The red dashed line is an SNR of 3, which corresponds via Eq. (2.12) to a log Bayes factor of 9, which would indicate strong evidence for the hypothesis that there is displacement memory in the population of black-hole mergers.

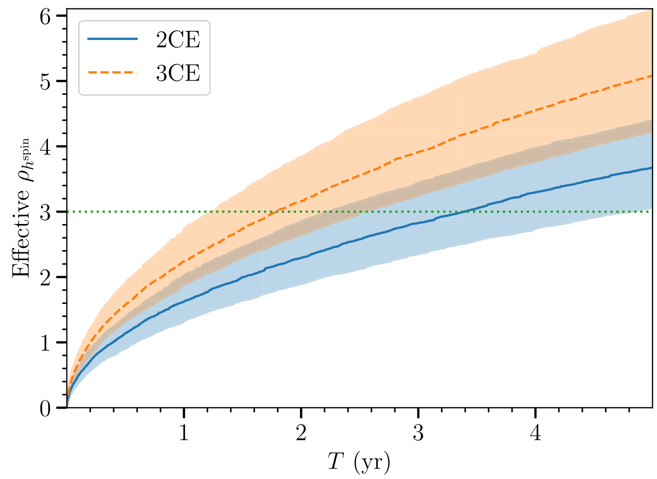

FIG. 6. The median accumulated SNR and 68% symmetric credible region for the spin memory in the third-generation Cosmic Explorer detectors as a function of run time for different realizations of binary-black-hole populations. The blue and orange regions correspond to two- and three-detector networks, respectively. The green dashed line corresponds to an accumulated SNR of 3 and is reached by the median of the populations for Cosmic Explorer for a three-detector network.

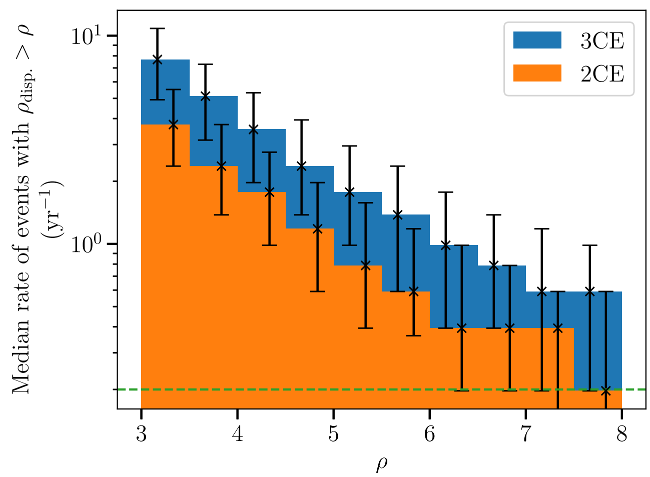

FIG. 7. The median rate of events with an SNR in the displacement memory higher than some given amount, in Cosmic Explorer with either a two- (orange) or three- (blue) detector network. Error bars correspond to the symmetric 68% confidence interval. The green line corresponds to seeing a single event over 5 years.

for the detection of the displacement memory in second-generation gravitational wave detectors, it now follows from the updated Fig. 5 that after ∼2.5 years of total run time, the displacement memory will have the lower limit of its 68% credible region reach an accumulated SNR of 3, and the median value will reach this threshold after ∼2.2 years. LIGO India now will make a minimal contribution to the time needed to reach an SNR of 3, but it will increase the median total accumulated SNR from ∼6 to ∼7 over the course of 5 years. For Cosmic Explorer, Fig. 6 shows that only two years will be necessary for the median population to reach the threshold of 3 in the accumulated SNR of the spin memory, for three Cosmic Explorer detectors. For two detectors, this threshold will be reached after 3.5 years.

Although Fig. 7 has not significantly changed, we update the prediction provided in the text of the Results section to be 7–8 events per year for a three-detector network for Cosmic Explorer; the corresponding statement in the Conclusions in Sec. V should be changed similarly (the previous number quoted, 3–4 events per year, was for a two-detector network, although this was not stated). Finally, we note that in Sec. V, the SNR threshold that was written for individual events (5) was incorrect when compared to Fig. 7; it should be changed to 3.

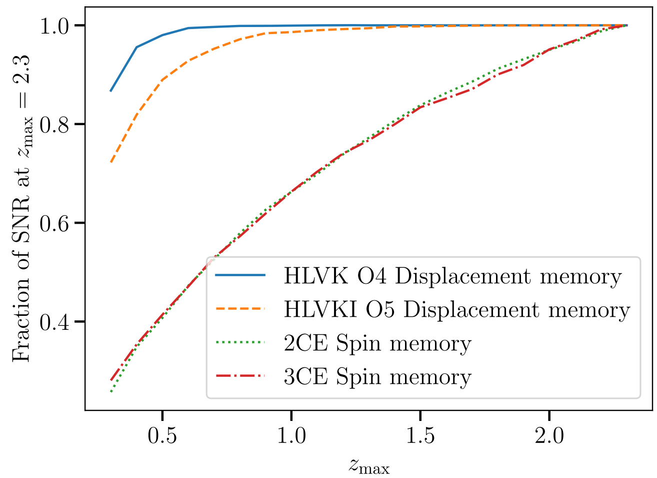

FIG. 8. A plot of the final accumulated SNR after 0.1 years for a given memory signal in a particular detector network, as a function of redshift cutoff z_{max}, as a fraction of the SNR computed using a redshift cutoff of $z_{\mathrm{max}} = 2.3$.

[1] Alexander M. Grant, GWForecasts, https://gitlab.com/alex_grant/forecasts (2023).