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Erratum: "Searches for Gravitational Waves from Known Pulsars at Two Harmonics in 2015–2017 LIGO Data" (2019, ApJ, 879, 10)

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Supporting material: machine-readable table

Two analysis errors have been identified that affect the results for a handful of the high-value pulsars given in Table 1 of Abbott et al. (2019). One affects the *Bayesian* analysis for the five pulsars that glitched during the analysis period, and the other affects the 5*n-vector* analysis for J0711–6830. Updated results after correcting the errors are shown in Table 1, which now supersedes the results given for those pulsars in Table 1 of Abbott et al. (2019). Updated versions of figures can be seen in Figures 1–4.

Bayesian analysis.—For the glitching pulsars, the signal phase evolution caused by the glitch was wrongly applied twice and was therefore not consistent with our expected model of the pulsar phase. This error did not affect the $\mathcal{F}/\mathcal{G}$-statistic or 5*n-vector* analysis.

Analyses of the five pulsars PSR J0205+6449, PSR J0534+2200, PSR J0835–4510, PSR J1028–5819, and PSR J1718–3825 have been repeated after correcting for the error. There are small quantitative differences in the results, but the changes do not affect the main conclusions of the paper. The largest differences are for PSR J0835–4510 (the Vela pulsar), for which the updated upper limits from the *Bayesian* method are found to be between 1.1 and 2 times larger than those obtained when the error was present. This appears primarily to be due to the error leading to the decohering of a strong spectral line in the LIGO Livingston detector and thus lowering the amplitude limit.

5*n-vector analysis.*—An error was also identified in the settings of the 5*n-vector* analysis, which affected the upper limit computation at the rotation frequency for $C_{21}^{95\%}$ of J0711–6830. Specifically, we found an incorrect choice for the range of amplitudes used to inject simulated signals in the O2 data. The updated upper limit is about 2.5 times worse than that obtained when the error was present. This error did not affect the *Bayesian* or $\mathcal{F}/\mathcal{G}$*-statistic* results.

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[191] Deceased, 2018 February.
[192] Deceased, 2017 November.
[193] Deceased, 2018 July.

Table 1

Limits on Gravitational-wave Amplitude and Other Derived Quantities for Five High-value Pulsars from the Three Analysis Methods

Pulsar Name (J2000)	$f_{\rm rot}$ (Hz)	$\dot{P}_{\rm rot}$ (s s^{-1})	Distance (kpc)	$h_0^{\rm sd}$	Analysis Method	$C_{21}^{95\%}$	$C_{22}^{95\%}$	$h_0^{95\%}$	$Q_{22}^{95\%}$ (kg m^2)	$\varepsilon^{95\%}$	$h_0^{95\%}/h_0^{\rm sd}$	Statistic[a] $l=2,m=1,2$	Statistic[b] $l=2,m=2$
J0205+6449[c]	15.2	1.9×10^{-13}	2.00 (c)	6.9×10^{-25}	Bayesian	$2.2(1.6) \times 10^{-24}$	$2.2(2.9) \times 10^{-26}$	$4.5(5.7) \times 10^{-26}$	$7.2(9.0) \times 10^{33}$	$0.9(1.2) \times 10^{-4}$	0.065(0.082)	−4.8(−4.7)	−2.8(−2.6)
					$\mathcal{F}$-statistic	2.2×10^{-24}	4.5×10^{-26}	8.8×10^{-26}	1.4×10^{34}	1.8×10^{-4}	0.13	0.71	0.26
					5*n*-vector	…	…	$2.9(4.5) \times 10^{-26}$	$4.6(7.1) \times 10^{33}$	$5.9(9.2) \times 10^{-5}$	0.042(0.065)	…	0.41
J0534+2200[c]	29.7	4.2×10^{-13}	2.00	1.4×10^{-24}	Bayesian	$8.1(5.9) \times 10^{-26}$	$8.9(7.6) \times 10^{-27}$	$1.9(1.5) \times 10^{-26}$	$7.8(6.3) \times 10^{32}$	$1.0(0.8) \times 10^{-5}$	0.013(0.011)	−5.2(−5.3)	−2.6(−2.6)
					$\mathcal{F}$-statistic	$1.6(1.1) \times 10^{-25}$	$1.1(1.1) \times 10^{-26}$	$2.2(1.3) \times 10^{-26}$	$9.1(5.4) \times 10^{32}$	$1.2(0.7) \times 10^{-5}$	0.015(0.0091)	0.32(0.18)	0.65(0.87)
					5*n*-vector	$1.7(1.3) \times 10^{-25}$	…	$2.9(2.9) \times 10^{-26}$	$1.2(1.2) \times 10^{33}$	$1.6(1.6) \times 10^{-5}$	0.02(0.02)	0.70	0.45
J0711–6830[c]	182.1	1.4×10^{-20}	0.11 (b)	1.2×10^{-26}	Bayesian	2.6×10^{-26}	7.0×10^{-27}	1.5×10^{-26}	9.3×10^{29}	1.2×10^{-8}	1.3	−3.1	−1.9
					$\mathcal{F}$-statistic	…	…	…	…	…	…	…	…
					5*n*-vector	3.0×10^{-26}	…	1.5×10^{-26}	9.1×10^{29}	1.2×10^{-8}	1.3	0.79	0.39
J0835–4510[c]	11.2	1.2×10^{-13}	0.29 (j)	3.3×10^{-24}	Bayesian	$1.5(1.4) \times 10^{-23}$	$1.3(1.0) \times 10^{-25}$	$2.4(2.1) \times 10^{-25}$	$1.0(0.9) \times 10^{34}$	$1.3(1.1) \times 10^{-4}$	0.073(0.062)	−3.3(−3.1)	−1.8(−2.1)
					$\mathcal{F}$-statistic	$1.3(1.1) \times 10^{-23}$	$1.1(0.9) \times 10^{-25}$	$2.6(2.0) \times 10^{-25}$	$1.1(0.8) \times 10^{34}$	$1.4(1.1) \times 10^{-4}$	0.078(0.06)	0.75(0.75)	0.75(0.75)
					5*n*-vector	…	…	$2.3(2.4) \times 10^{-25}$	$9.7(9.9) \times 10^{33}$	$1.3(1.3) \times 10^{-4}$	0.07(0.071)	…	0.41
J1028–5819	10.9	1.6×10^{-14}	1.42 (b)	2.4×10^{-25}	Bayesian	2.0×10^{-23}	1.0×10^{-25}	2.4×10^{-25}	5.2×10^{34}	6.7×10^{-4}	1	−3.8	−2.2
					$\mathcal{F}$-statistic	…	…	…	…	…	…	…	…
					5*n*-vector	…	…	1.9×10^{-25}	4.1×10^{34}	5.3×10^{-4}	0.8	…	0.40
J1718–3825	13.4	1.3×10^{-14}	3.49 (b)	9.7×10^{-26}	Bayesian	3.2×10^{-24}	3.7×10^{-26}	7.8×10^{-26}	2.8×10^{34}	3.6×10^{-4}	0.8	−5.7	−2.5
					$\mathcal{F}$-statistic	…	…	…	…	…	…	…	…
					5*n*-vector	…	…	6.5×10^{-26}	2.3×10^{34}	3.0×10^{-4}	0.67	…	0.67

Notes. For references and other notes see Table 2 in Abbott et al. (2019). Values in parentheses are those produced using the restricted orientation priors described in Section 2.2.4 of Abbott et al. (2019).

[a] For the *Bayesian* method this column shows the base-10 logarithm of the Bayesian odds, $\mathcal{O}$, comparing a coherent signal model at both the $l = 2$, $m = 1, 2$ modes to incoherent signal models. For the $\mathcal{F} - /\mathcal{G}$*-statistic* method this column shows the false-alarm probability for a signal just at the $l = 2$, $m = 1$ mode, assuming that the $2\mathcal{F}$ value has a χ^2 distribution with 4 degrees of freedom and the $2\mathcal{G}$ value has a χ^2 distribution with 2 degrees of freedom. For the 5*n-vector* method this column shows the *p*-value for a search for a signal at just the $l = 2$, $m = 1$ mode, where the null hypothesis being tested is that the data are consistent with pure Gaussian noise.

[b] This is the same as in footnote a, but for all the methods the assumed signal model is from the $l = m = 2$ mode.

[c] The observed $\dot{P}$ has been corrected to account for the relative motion between the pulsar and observer.

(This table is available in its entirety in machine-readable form.)

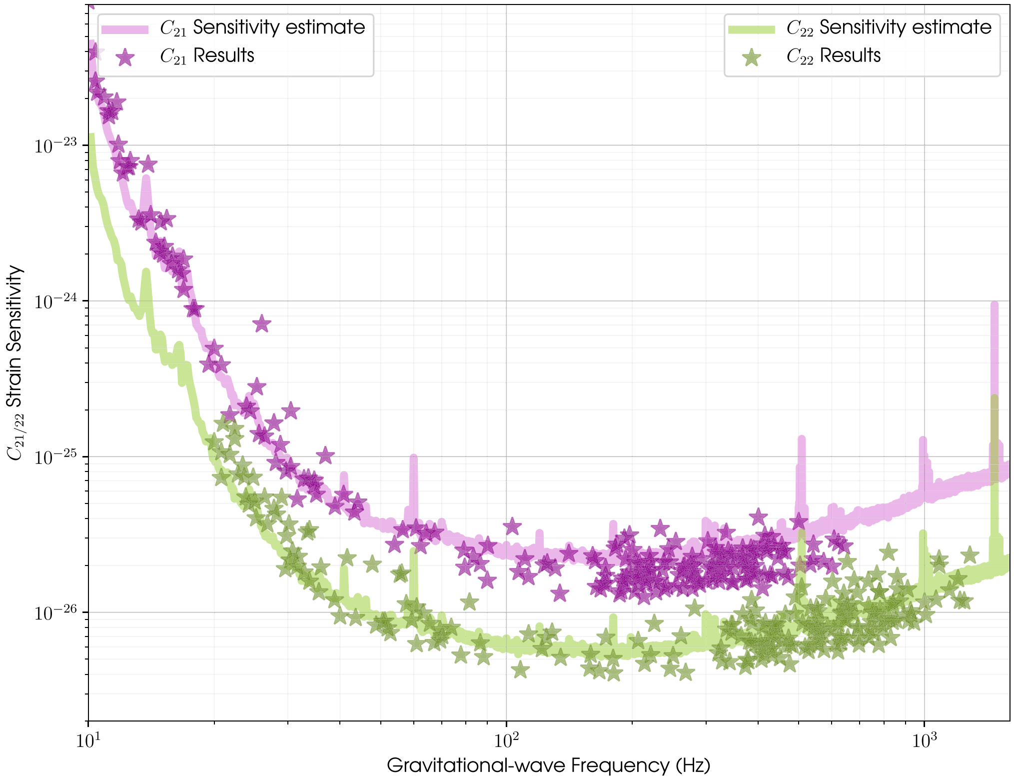

Figure 1. Upper limits on C_{21} and C_{22} for 221 pulsars. The stars show the observed 95% credible upper limits on observed amplitudes for each pulsar. The solid lines show an estimate of the expected sensitivity of the searches.

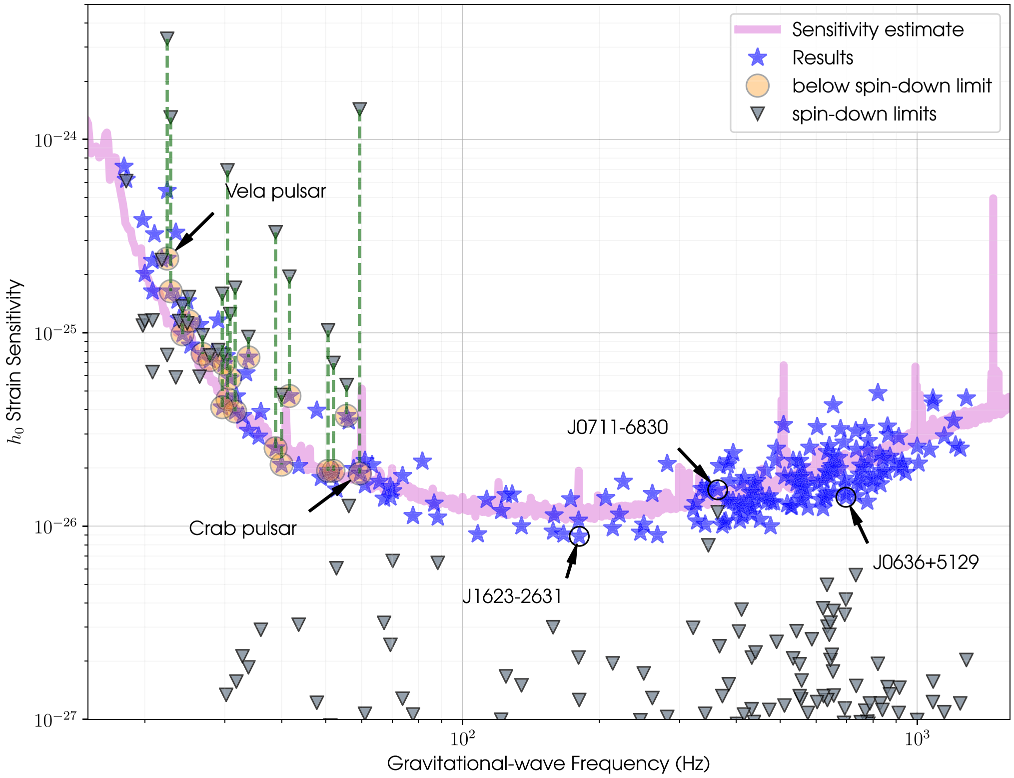

Figure 2. Upper limits on h_0 for 221 pulsars. The stars show the observed 95% credible upper limits on observed amplitude for each pulsar. The solid line shows an estimate of the expected sensitivity of the search. Triangles show the limits on gravitational-wave amplitude derived from each pulsar's observed spin-down.

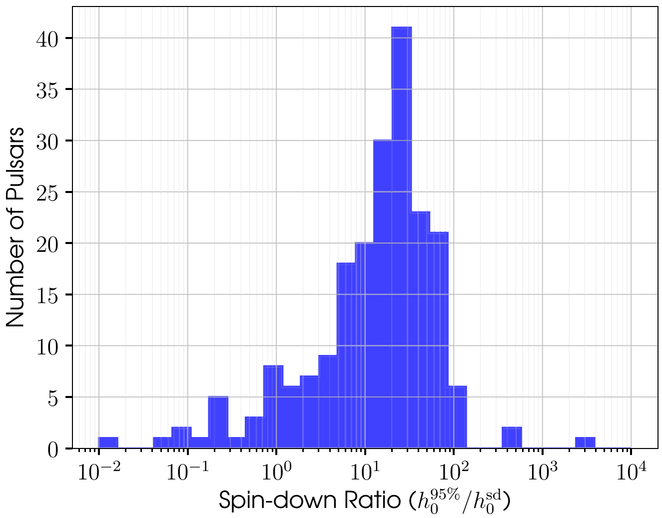

Figure 3. Histogram of ratios of upper limits on h_0 compared to the spin-down limit.

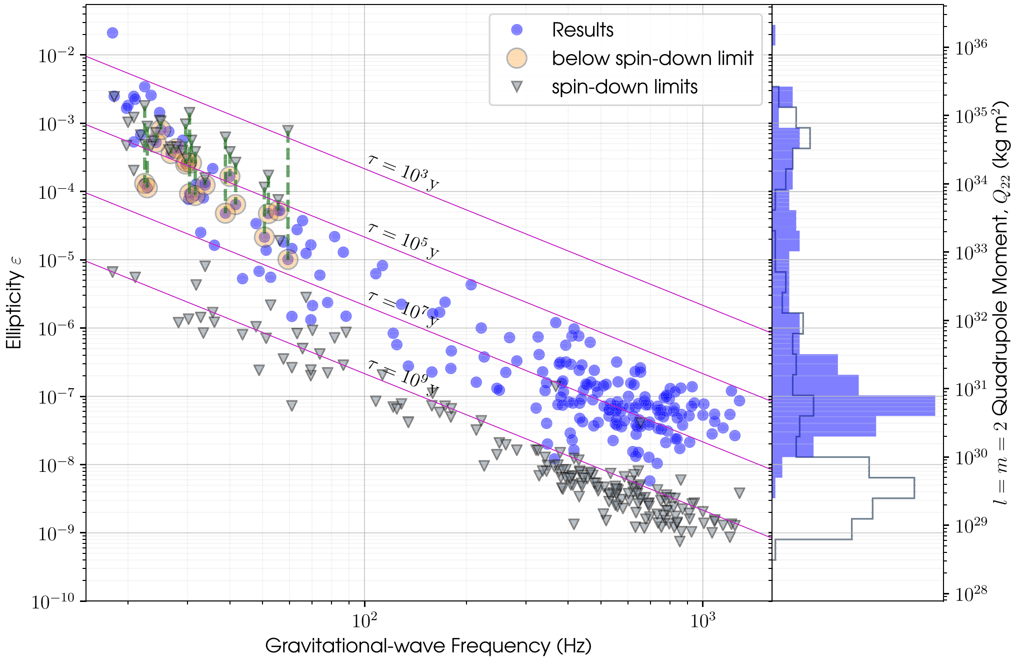

Figure 4. Upper limits on mass quadrupole Q_{22} and fiducial ellipticity ε for 221 pulsars. The filled circles show the limits as derived from the observed upper limits on the gravitational-wave amplitude h_0 assuming the canonical moment of inertia and distances. Triangles show the limits derived from each pulsar's observed spin-down. The diagonal lines show contours of equal characteristic age τ assuming that braking is entirely through gravitational-wave emission. The distributions of these limits are also show in histogram form to the right of the figure, with the filled and open histograms showing our observed limits and the spin-down limits, respectively.

Reference

Abbott, B. P., Abbot, R., Abbott, T. D., et al. 2019, ApJ, 879, 10