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Erratum: Search for Gravitational Waves from Binary Black Hole Inspiral, Merger, and Ringdown (Physical Review D - Particles, Fields, Gravitation and Cosmology (2011) 83 (122005))

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Since the publication of [1] we have discovered two errors in the calculation of upper limits on binary black hole (BBH) coalescence rates inferred from the nondetection of gravitational waves. The errors caused systematic biases of opposite signs and different sizes in the 90% confidence rate limits; when errors are corrected, the resulting limits are a factor 3 to 5 smaller than those quoted in [1]. Here we give a brief description of the errors and report their impacts on the upper limit results.

First, the marginalization over volume uncertainties was handled incorrectly: the corrected formula for the marginalized likelihood is

$$p(k_i, \Omega_i, \Lambda_i|R) \propto [1 + R\Omega_i(1/k_i + \Lambda_i)][1 + R\Omega_i/k_i]^{-(k_i+1)},$$

which replaces Eq. (5.4) of [1]. Correcting this error leads to an increase of approximately 50% in the rate limits. This change will be discussed in a forthcoming corrigendum to [2].

Second, an inappropriate numerical method was used to estimate the derivative in Eq. (5.7) of [1] from discretely sampled data. A spline fit was used without allowing for statistical errors in the fitted points, leading to unphysical excursions in the fitted function and a resulting systematic overestimate of Λ_i (the measure of the significance of the loudest events). This effect compounded over the 36 separate analysis times for which Λ_i was calculated, and was the dominant systematic error. We were able to substantially reduce this bias by replacing the spline with a linear least squares

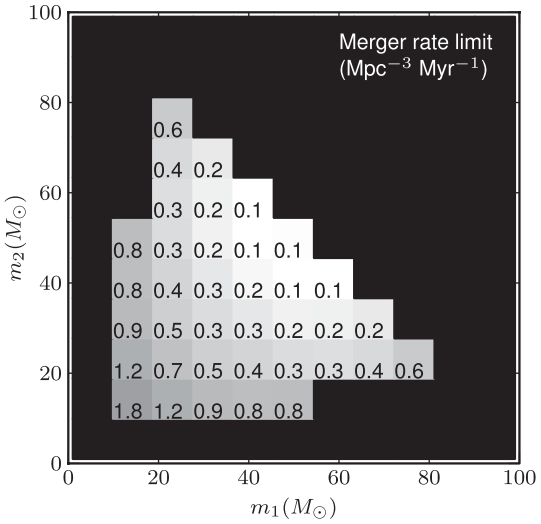

FIG. 1. The 90% confidence upper limit on the merger rate as a function of mass in units of $M_\odot$ (symmetric over m_1 and m_2). This image represents the rate limit in units of $\mathrm{Mpc}^{-3}\,\mathrm{Myr}^{-1}$. These limits can be converted to traditional units of L_{10}^{-1} Myr^{-1} by dividing by $0.0198 L_{10}$ Mpc^{-3} [3]. Only bins with mass ratios $<$4:1 have upper limits computed, due to uncertainty in the waveform models for more asymmetric systems.

fit, leading to a reduction in the 90% confidence upper limits by a factor of 5 to 7. However, we note that the resulting upper limits may still be affected by as much as 50% by our inability to estimate Λ_i with sufficient accuracy for borderline candidates given our finite estimation of the event background and simulated signal injections.

With these corrections, our search better constrains the rate of BBH mergers: the resulting 90% confidence rate upper limits are shown in Fig. 1, which replaces Fig. 2 of [1].

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