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Gravitational-wave background from extragalactic double white dwarfs for *LISA* *(Corrigendum)*

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1. Introduction

We identified a numerical implementation error in Boileau et al. (2025) for the calculation of the stochastic gravitational-wave background (SGWB) from extragalactic double white dwarfs (DWDs) when using the star formation rate density (SFRD) model of Strolger et al. (2004). We report here an updated figure for the frequency evolution and tabulated values of the signal-to-noise ratios (S/Ns) and best-fit parameters for each COSMIC model of binary evolution explored in that study.

2. Updated results

2.1. Predictions for the SGWB from extragalactic DWDs

We find that population synthesis modeling dominates the uncertainties in the background amplitude and, in particular, the treatment of common envelope evolution. Across all three SFRD models, we consistently find a factor of ∼3–5 between the default COSMIC model and the $\alpha 4$ model in the $[10^{-3}, 10^{-2}]$ Hz frequency band. On the other hand, uncertainties in the high-redshift ($z > 2$) part of the SFRD exhibit more moderate impact, with a variation by a factor of ∼1–2 in the global amplitude of the predicted backgrounds. These differences highlight the sensitivity of the SGWB from extragalactic DWDs predictions to the physical processes involved in the interactions inside stellar binaries.

Our SGWB from extragalactic DWDs predictions lie very close to the *LISA* sensitivity curve (black curve) in the $[2 \times 10^{-3}, 8 \times 10^{-3}]$ Hz frequency band, and even slightly above it for the most optimistic COSMIC $\alpha 4$ model combined with the SFRD model of Strolger et al. (2004). This suggests that the *LISA* mission may allow us to put some strong observational constraints on the amplitude of this astrophysical background in that specific frequency range.

We list in Table 1 the computed S/Ns for each combination of COSMIC simulation and SFRD model explored in this study. We find a factor of ∼5 between the strongest background (computed for $\alpha 4$ with Strolger et al. (2004)) and the most conservative one (default with Madau & Fragos (2017)). We note that all scenarios involving the commonly used SFRD from Madau & Dickinson (2014) yield S/N values well above unity, ranging from $\gtrsim$100 to $\lesssim$400 for a 4-year mission and up to $\gtrsim$600 for a 10-year mission.

We present in Appendix A numerical fits for the frequency evolution of each background across all the SFRD and stellar population synthesis models. In particular, the best-fit parameters for the same smoothly broken power-law model used in Boileau et al. (2025) are given in Table A.1.

Table 1. S/Ns for the different combinations of SFRD models and COSMIC populations.

	S/N	T = 4 yr	T = 10 yr
	Strolger et al. (2004)		
COSMIC Model	Default	189	299
	fb1	261	412
	Multidim	280	442
	$\alpha 4$	565	894
	Madau & Dickinson (2014)		
COSMIC Model	Default	155	244
	fb1	212	335
	Multidim	233	369
	$\alpha 4$	386	610
	Madau & Fragos (2017)		
COSMIC Model	Default	111	176
	fb1	152	241
	Multidim	167	264
	$\alpha 4$	279	441

Notes. The integration follows Smith & Caldwell (2019). Updated Table 2 in Boileau et al. (2025).

3. Updated conclusions

The updated findings resulting from the corrections made to our implementation of the SFRD model of Strolger et al. (2004) can be summarized as follows:

– The signal is detectable by *LISA* across all scenarios explored after only 4 years, with S/Ns ranging from ∼100

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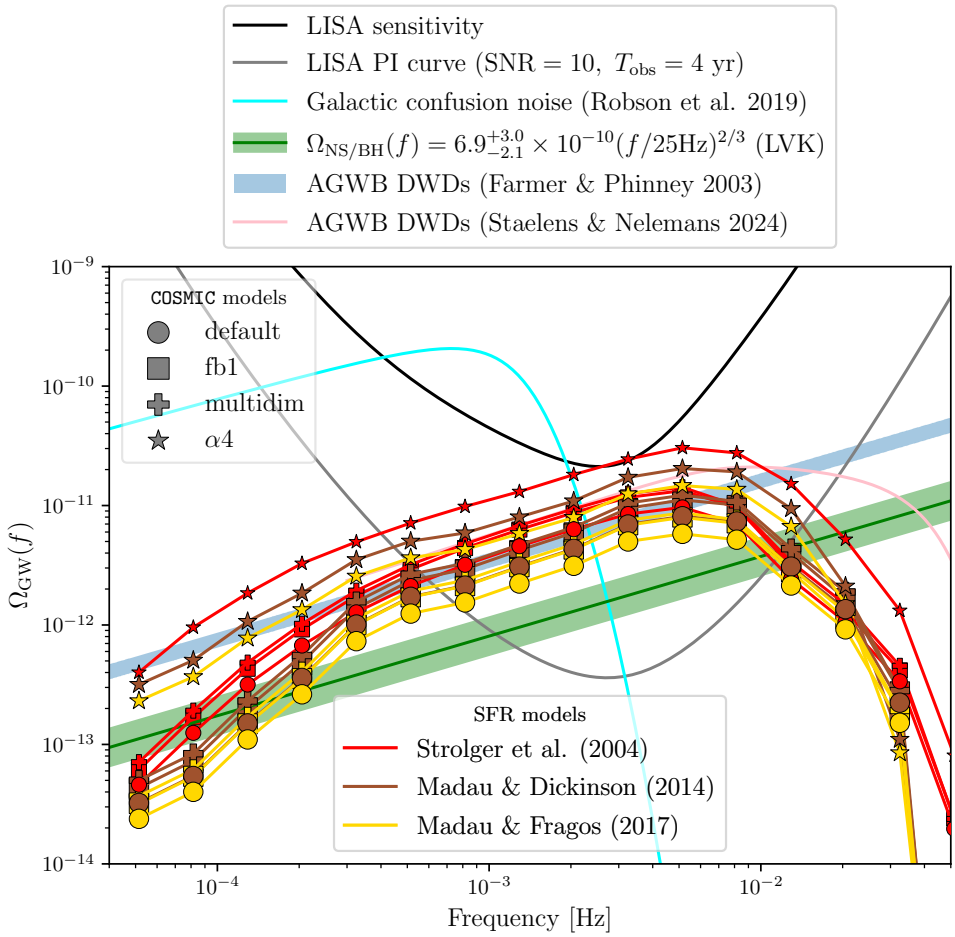

Fig. 1. Updated Fig. 1 in Boileau et al. (2025), showing the spectral energy density of the SGWB from extragalactic DWDs for the various population synthesis and SFRD models considered in that study. The red, brown, and gold lines represent the SFRD models from Strolger et al. (2004), Madau & Dickinson (2014), and Madau & Fragos (2017), respectively. The black line represents the *LISA* sensitivity curve (Colpi et al. 2024), while the gray line shows the power-law integrated curve (Thrane & Romano 2013) for four years of observation time and S/N=10. The light blue curve represents the confusion noise from the Galactic DWDs (Robson et al. 2019), and the green band represents the 90% credible interval of the SGWB from all compact object binaries estimated from gravitational wave observations (Abbott et al. 2023). As a comparison, the shaded blue band shows the SGWB from extragalactic DWDs estimated in (Farmer & Phinney 2003), and the pink curve indicates the best-fit model obtained in (Staelens & Nelemans 2024).

to ∼550. For a 10-year mission, the S/N can reach up to ≲900, indicating that the SGWB from extragalactic DWDs will be robustly observed by *LISA* under all astrophysical assumptions considered here.

– The dominant uncertainty on Ω_{GW} arises from the uncertainties in binary interactions and, in particular, the treatment of common envelope evolution (by a factor of ∼3–5), with additional variations arising from the uncertainties on the SFRD at high redshifts (by a factor of ∼1–2).

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Appendix A: Estimating the SGWB using a smoothly broken power law fit

Upon identifying uncertainties in the convergence of the method previously used in Boileau et al. (2025), we fit each computed background using the `curve_fit` method from `Scipy` (Virtanen et al. 2020). We report the updated best-fit parameters for the same smoothly broken power-law model in Table A.1 and show in Fig. A.1 an example of the best-fit result for our default `COSMIC` population coupled with the SFRD model of Madau & Dickinson (2014).

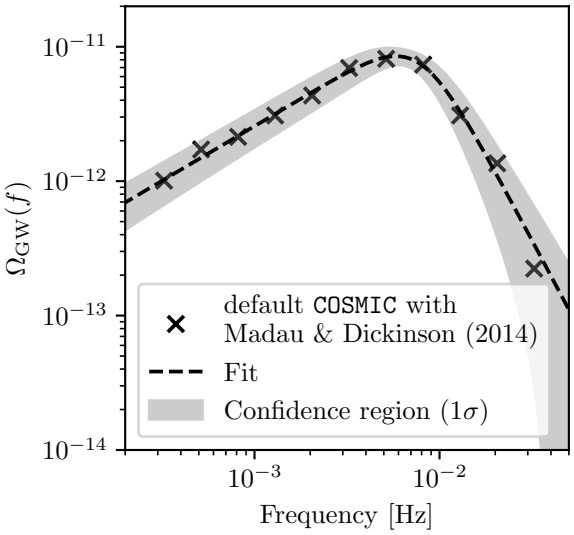

Fig. A.1: Updated Fig. B.1. in Boileau et al. (2025), with SGWB from extragalactic DWDs computed using our default `COSMIC` simulation and the SFRD model of Madau & Dickinson (2014). The solid line represents the best-fit model, and the shaded area indicates the 1σ uncertainty region.

Table A.1: Best-fit parameters for the different combinations of SFRD models and `COSMIC` populations.

	Parameters	A	f_b [Hz]	α_1	α_2	Δ
		Strolger et al. (2004)				
COSMIC Model	default	$8.6 \pm 0.4 \times 10^{-12}$	0.007 ± 0.001	-0.75 ± 0.04	2.70 ± 0.27	0.25 ± 0.03
	α4	$24.8 \pm 1.4 \times 10^{-12}$	0.009 ± 0.001	-0.71 ± 0.02	2.88 ± 0.26	0.31 ± 0.03
	fb1	$11.5 \pm 0.7 \times 10^{-12}$	0.007 ± 0.001	-0.75 ± 0.03	2.97 ± 0.34	0.25 ± 0.03
	multidim	$12.7 \pm 0.6 \times 10^{-12}$	0.007 ± 0.001	-0.75 ± 0.03	2.70 ± 0.25	0.24 ± 0.03
		Madau & Dickinson (2014)				
COSMIC Model	default	$7.5 \pm 0.9 \times 10^{-12}$	0.008 ± 0.001	-0.81 ± 0.07	2.59 ± 0.65	0.25 ± 0.08
	α4	$13.4 \pm 6.1 \times 10^{-12}$	0.011 ± 0.003	-0.74 ± 0.06	4.36 ± 2.00	0.32 ± 0.09
	fb1	$10.1 \pm 1.4 \times 10^{-12}$	0.008 ± 0.001	-0.81 ± 0.07	2.77 ± 0.74	0.25 ± 0.08
	multidim	$11.1 \pm 1.5 \times 10^{-12}$	0.008 ± 0.001	-0.80 ± 0.07	2.68 ± 0.71	0.25 ± 0.08
		Madau & Fragos (2017)				
COSMIC Model	default	$5.3 \pm 0.7 \times 10^{-12}$	0.008 ± 0.001	-0.82 ± 0.08	2.67 ± 0.71	0.26 ± 0.08
	α4	$9.7 \pm 4.5 \times 10^{-12}$	0.011 ± 0.003	-0.74 ± 0.07	4.32 ± 2.02	0.32 ± 0.09
	fb1	$7.1 \pm 1.1 \times 10^{-12}$	0.008 ± 0.001	-0.81 ± 0.07	2.87 ± 0.81	0.26 ± 0.08
	multidim	$7.8 \pm 1.1 \times 10^{-12}$	0.008 ± 0.001	-0.80 ± 0.08	2.76 ± 0.77	0.26 ± 0.09

Notes. The reported uncertainties correspond to 1σ errors. Updated Table B.1. in Boileau et al. (2025).