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Erratum: Cosmological constraints from cosmic shear two-point correlation functions with HSC survey first-year data

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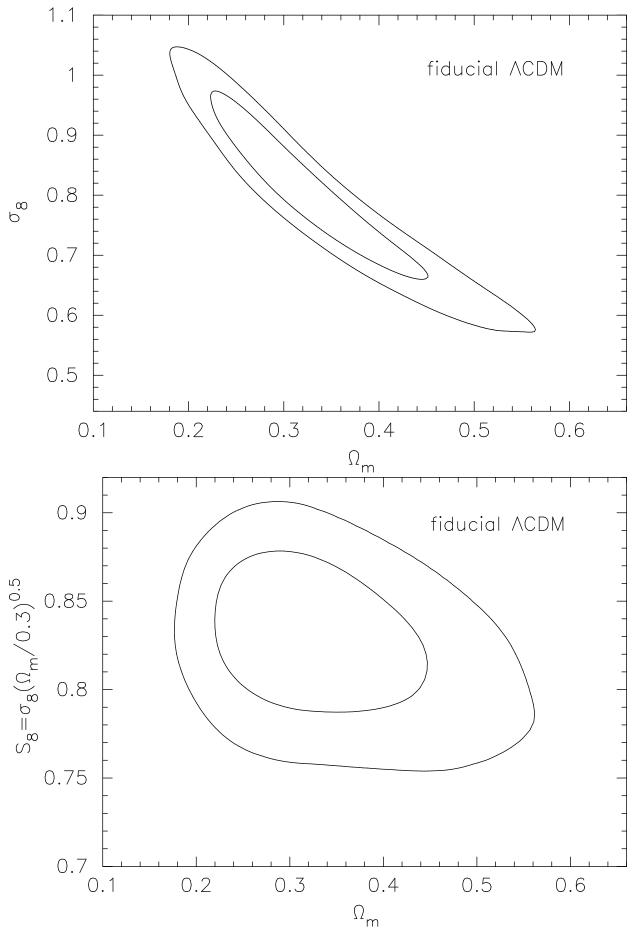

Fig. 1. Marginalized posterior contours (68% and 95% confidence levels) in the Ω_m–σ_8 plane (top panel) and in the Ω_m–S_8 plane (bottom panel), where $S_8 = \sigma_8\sqrt{\Omega_m/0.3}$ in the fiducial flat ΛCDM model.

Table 1. Summary of revised constraints (mean and 68% confidence interval) on the cosmological parameters derived from the fiducial flat ΛCDM model with the incorrect original version's results.

	Error	Correction
$S_8 = \sigma_8\sqrt{\Omega_m/0.3}$	$0.804^{+0.032}_{-0.029}$	$0.823^{+0.032}_{-0.028}$
Ω_m	$0.346^{+0.052}_{-0.100}$	$0.332^{+0.050}_{-0.096}$
σ_8	$0.766^{+0.110}_{-0.098}$	$0.799^{+0.112}_{-0.101}$

In the original publication of "Cosmological constraints from cosmic shear two-point correlation functions with HSC survey first-year data" [PASJ, 72, 16 (2020); doi: 10.1093/pasj/psz138], we discovered a couple of bugs in the software used for numerical computations. Here we present revised results obtained from corrected computations.

The first bug affects the fiducial model adopted in this study. We found that an incorrect numerical coefficient was used in the code to compute the fitting function of the nonlinear matter power spectrum, given by Takahashi et al. (2012) as an improvement to the `halofit` model of Smith et al. (2003). Owing to this bug, the nonlinear matter power spectrum at quasi-nonlinear scales was overestimated by >8%, leading to an overestimation of the cosmic shear two-point correlation function (TPCF) of approximately 6% on scales used in this study. This results in an underestimation of $S_8 = \sigma_8\sqrt{\Omega_m/0.3}$ by about 2%–3% which is the parameter of our primary interest. Figure 1 shows the marginalized posterior contours in the Ω_m–σ_8 and Ω_m–S_8 planes obtained from the corrected computation of the fiducial model. Figure 2 shows the marginalized one-dimensional posterior distributions for model parameters (three top rows) in the fiducial flat ΛCDM model, and derived parameters (bottom row). Marginalized one-dimensional constraints are (mean and 68% confidence interval) found to be $S_8 = 0.823^{+0.032}_{-0.028}$, $\Omega_m = 0.332^{+0.050}_{-0.096}$, and $\sigma_8 = 0.799^{+0.112}_{-0.101}$ (see table 1 for changes from the incorrect original version's results). We have explicitly confirmed that the rest of our conclusions remain unchanged and, especially, the fact that astrophysical modeling uncertainties and systematic ones in measurements do not have a significant impact on the cosmological constraints. This is because all the systematic tests were affected by the bug in a consistent manner.

In figure 3, our revised constraint on S_8 from the fiducial ΛCDM model is compared with other results in the literature. Since the revised result of S_8 is larger than the original version's one by about +0.02, we find that it better overlaps with the Planck 2018 CMB result (Planck Collaboration 2020, TT + TE + EE + lowE without CMB lensing) as well as the Planck 2015 CMB result. On the other hand, our revised result is located on the higher side among recent cosmic shear studies, and the KiDS + VIKING-450 (Hildebrandt et al. 2020) result is lower than our result by $\sim 2\sigma$.

In addition to the main cosmological inference described above, there is another analysis that was affected by the first bug. It is the analysis of the cross correlation between cosmological constraints obtained from this study and the cosmic shear power spectrum (PS) analysis by Hikage et al. (2019) that used the same HSC 1st year data but derived cosmological constraints overlap only mildly with our constraints as is seen in figure 3. The analysis was based on cosmological inferences on 100 realistic

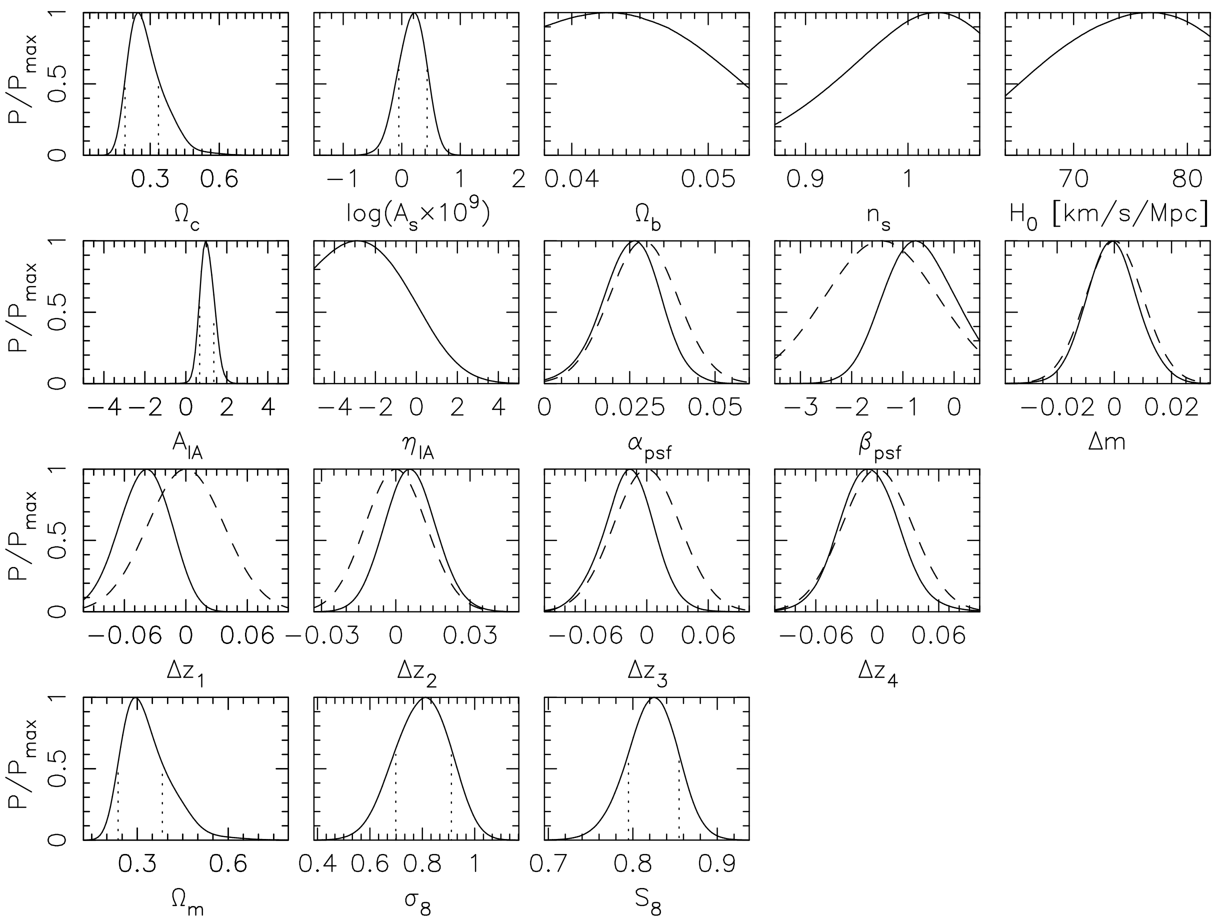

Fig. 2. The upper three rows show the marginalized one-dimensional posterior distributions of model parameters in the fiducial flat ΛCDM model; the cosmological parameters are in the top-row, and the astrophysical and systematics parameters are in two middle rows. Three panels in the bottom-row are for derived parameters. For parameters with flat prior ranges, the plotted range of the horizontal-axis indicates its prior range. For parameters with Gaussian priors, Gaussian priors are shown by the dashed curves. Dotted vertical lines represent the approximate 68% confidence intervals, which are not shown for poorly constrained parameters.

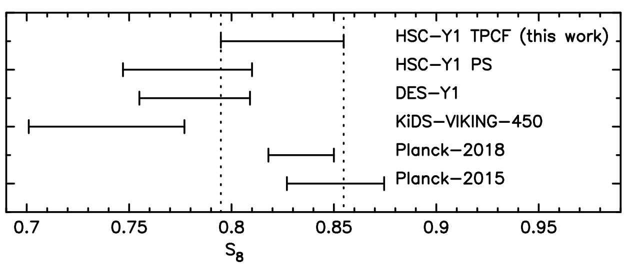

Fig. 3. 68% confidence intervals of marginalized posterior distributions of $S_8 = \sigma_8\sqrt{\Omega_m/0.3}$. Our result from the fiducial ΛCDM model is compared with other results in the literature, HSC first year cosmic shear power spectra (Hikage et al. 2019, labeled as HSC-Y1 PS), DES-Y1 cosmic shear TPCFs (Troxel et al. 2018), KiDS+VIKING-450 cosmic shear TPCFs (Hildebrandt et al. 2020), and Planck 2018 CMB (Planck Collaboration 2020, TT+TE+EE+lowE), and Planck 2015 CMB (Planck Collaboration 2016, TT + lowP without lensing). Since different studies adopt different definitions of the central values (mean, median, or peak of the posterior distribution), central values are not shown to avoid possible misunderstanding.

HSC mock catalogs using softwares of the two studies (see subsection 6.7 of the original version for details), and we have re-done the cosmological inferences using the corrected software. Figure 4 shows the revised scatter plot comparing S_8 values from these two cosmological analyses on the same mock catalogs. Comparing the original version's results, the points are moved to up by 0.005–0.022. Revised statistics are as follows: for S_8, eight cases out of one hundred have a difference $\Delta S_8 = S_8(\mathrm{PS}) - S_8(\mathrm{TPCF})$ less than the observed value of -0.042, and for Ω_m, seventeen cases out of one hundred have a difference $\Delta\Omega_m$ less than the observed difference of -0.16. If we take the two-side estimate, we find that for $S_8(\Omega_m)$, twelve (nineteen) cases out of one hundred have an absolute difference of $|\Delta S_8| > 0.042$ ($|\Delta\Omega_m| > 0.16$). These mean that these differences can be explained by a statistical fluctuation at the $\sim 1.6\sigma$ level, which is slightly larger than the original value of $\sim 1.4\sigma$. The revised correlation coefficients defined in equation (23) of the original version are $r(S_8) = 0.51$ and

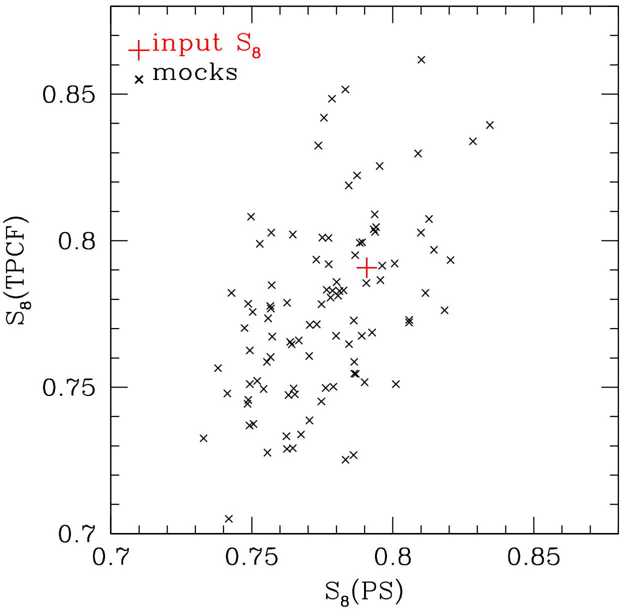

Fig. 4. Scatter plot showing median values of marginalized one-dimensional posterior distributions of S_8 derived from cosmological analyses on 100 mock catalogs. Results from the power spectrum (PS) analysis by Hikage et al. (2019) are compared with ones from the two-point correlation function (TPCF) analysis in this study. The red cross shows the value of S_8 adopted in generating the mock catalogs. (Color online)

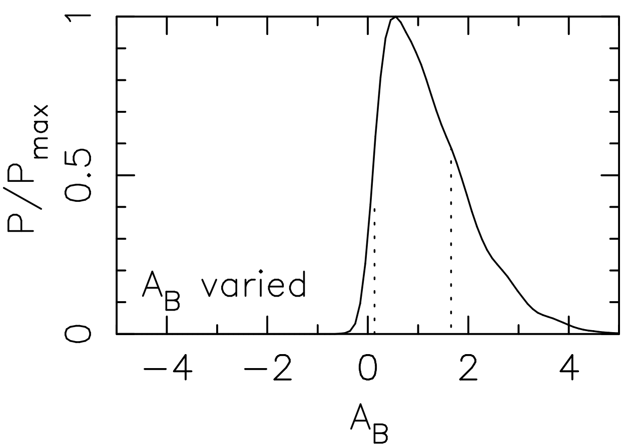

Fig. 5. Marginalized one-dimensional posterior distributions of the baryon feedback model parameter A_B derived from non-fiducial models, the "A_B varied" setup.

$r(\Omega_m) = 0.17$. Since the changes of the above correlation coefficients are not significant, the original conclusion that the correlation between derived cosmological constraints from the two analyses is weak remains unchanged.

The second bug affects one of the ancillary models tested in this study to test the effect of baryons on the matter power spectrum based on the fitting function derived by Harnois-Déraps et al. (2015) with an additional nuisance parameter (A_B) that controls the strength. In addition to the first bug mentioned above, we also incorrectly set an upper limit to the modification of the matter power spectrum by the baryon effect. As a consequence, for cases with negative A_B values which are expected to enhance the power spectrum at nonlinear scales, were not leading to an appropriate modification to the power spectrum, resulting in a smaller effect and a higher likelihood. The corrected result of the marginalized one-dimensional posterior distributions of A_B derived from the "A_B varied" setup, is shown in figure 5, where a shape cut-off at $A_B < 0$ is seen. The revised confidence interval (mean and σ) is found to be $A_B = 1.2 \pm 0.9$ (cf. the original version's result $A_B = -1.8 \pm 1.8$). Note that this does not significantly change any other results in this study, because the effect of baryons on the cosmological inference is weak. In fact, the revised confidence interval of S_8 from "A_B varied" setup is $S_8 = 0.829^{+0.032}_{-0.030}$ which agrees well with one from the fiducial case $S_8 = 0.823^{+0.032}_{-0.028}$. Therefore, the original version's conclusion that the impact of the baryon effect on cosmological constraints is not significant remains unchanged.

Finally, we comment on the impact of our re-computations on the original blinding cosmological analysis that aims to avoid confirmation bias. The bugs were originally found by a non-coauthor who inspected a source code of our software in his cross-checking work of an independent software. Then we fixed the bugs and re-did computations without changing any analysis setup. Therefore, we consider that the results of re-computations are not affected by any confirmation bias.

A modified version of the original publication, including the corrected results and figures, is available at https://arxiv.org/abs/1906.06041, or, upon request, directly from the corresponding author (TH). The revised chains are available on the HSC SSP website.[1]

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