Erratum: On estimating Lyα forest correlations between multiple sightlines

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An error in the sensitivity projections has been discovered in McQuinn & White (2011) since publication. This error pertains to the projections for spectroscopic galaxy surveys. While these projections were a secondary focus of this paper, this error spuriously discourages the application of Lyα forest surveys to galaxies on sensitivity grounds. In what follows, we discuss how this error affects the calculations in McQuinn & White (2011). In addition, we use this error to note a couple more minor errors that have been noticed since publication. All of these errors have been corrected in the newest version of this paper on the arXiv (\url{http://arxiv.org/abs/1102.1752}).

The calculations in McQuinn & White (2011) accidentally omitted the ‘K-correction’ needed to convert from the absolute magnitude units of the published galaxy luminosity functions to apparent magnitudes. The correct formula for this conversion is

\[ m_{\text{AB}} = M_{\text{AB}} + 5 \log_{10} \left( \frac{D_L}{10 \text{ pc}} \right) - 2.5 \log (1 + z), \]

where we have specialized to the application in the paper in which there is no spectrum-dependent K-correction and that holds for Lyman-break galaxies (LBGs) across the rest-frame optical (Reddy et al. 2008). The last term in the above is the ‘K-correction’ that was omitted in the calculations of McQuinn & White (2011), and physically is the correction needed so that the specific flux, \( f_e \), redshifts appropriately as \( \propto (1 + z)D_L(z)^{-2} \). Correcting this emission results in a shift to lower magnitudes of the galaxy \( n_{\text{eff}} \) curves in fig. 5 in McQuinn & White (2011) by 1.2, 1.5 and 1.7 for \( z = 2 \), 3 and 4, respectively. The corrected version of this figure is shown in our Fig. 1. We note that this brings us in qualitative agreement with a similar plot shown in Lee et al. (2014).

This correction also affects the black dashed curves in figs 6 and 7 in McQuinn & White (2011). The corrected versions of these two figures are Figs 2 and 3, where only the black dashed curves have changed. These figures show the S/N of the power spectrum can be detected in the specified band powers as a function of survey area and limiting survey magnitude, assuming fixed observing duration.

There is one small inconsistency in these calculations that was mentioned in McQuinn & White (2011), but that is of more relevance in the corrected results. Thus, we reiterate it here: our Fig. 1 shows \( n_{\text{eff}} \) as a function of the limiting magnitude of the survey, where the limiting magnitude is both the largest magnitude that the survey observes in band X and also the magnitude in band X for which the instrument also achieves S/N = 1 on the continuum in a 1 Å pixel in the Lyα forest band. (We comment on the generalization in McQuinn & White 2011.) However, we use different bands X to calculate this for galaxies and quasars. For the solid quasar curves, we use the g band, whereas for the dashed galaxy curves we use a band centred at 1600 Å in the galaxy frame. Because LBGs have a flat spectrum in \( f_e \) (Shapley et al. 2003), the galaxy luminosity function in the g band should be similar (identical to the extent \( f_e \sim v^{\beta} \)). However, the flux in the Lyα forest for galaxies and quasars may be different because of the spectral dependence of the two populations’ emissions and so the same g-band magnitude does not correspond to the same flux in the Lyα forest. The evolution in the intrinsic \( f_e \) in LBGs’ stacked continuum show \( f_e \sim v^{\beta} \) over much of the observer-frame optical, but then some evidence for a 50% decrease bluewards of galaxy frame 1300 Å into the Lyα forest band, whereas quasars have a spectrum that scales as \( v^{-0.7} \) (Telfer et al. 2002). Thus, both spectra suggested a similar decrease from the g band to the forest and so this inconsistency should result in a relatively small mismatch.

Minor errors that have come to our attention:

Section I: Equation (23) for the minimum variance quadratic estimator for the power spectrum is incorrect as written and should be

\[ \hat{f}_F^{\text{QE}} = \left[ \hat{f}_F^{\text{QE}} \right]_{\text{Last iteration}} + \sum_{nm} Q_{nm} \hat{\delta}_{F,n} \hat{\delta}_{F,m} - \text{tr} \{ Q \ C \}. \]
Corrected version of fig. 6 in McQuinn & White (2011), where only the dashed curves have changed from the original. The original caption follows: sensitivity to $P_F$ at $k = 0.1 \text{ Mpc}^{-1}$ (left-hand panel) and $k = 0.5 \text{ Mpc}^{-1}$ (right-hand panel) as a function of survey area and limiting magnitude, where we have assumed that $m_{\text{lim}}^{1/4} = m_{\text{lim}}/L \approx 500 \text{ Mpc}$, and $z = 2.5$. The black solid curves are contours of constant sensitivity for a quasar survey and the often overlapping black long-dashed curves are at the same sensitivity contours as the black curves but for a survey that also includes galaxies down to the same magnitude. The framed labels associated with each solid curve quote the S/N on $P_F$, in bins of width $\Delta k/k = 0.2$. The red circle represents the approximate specifications of the BOSS quasar survey. The red short-dashed curves are contours of constant $M \equiv \text{Survey Area}/(\text{limiting flux})^2$. For fixed duration of the observing campaign on an instrument, $M$ does not depend on the survey strategy. The red short-dashed curves correspond to $10^{-2}$, $10^{-1}$, $1$, $10$ and $100$ times the $M$ of the BOSS survey.

Corrected version of fig. 7 in McQuinn & White (2011), where only the dashed curves have changed from the original. The original caption follows: Same as fig. 6 (in McQuinn & White 2011, Fig. 2 here) but at $z = 4$ and for $k = 0.1 \text{ Mpc}^{-1}$.

where $[P_F^{\text{QE}}]_{\text{last iteration}}$ was dropped in McQuinn & White (2011). The power spectrum estimate requires iterating this estimator.

Section 4.2, on cross correlating Lyα surveys with galaxy surveys, following equation 35: In the phrase, ‘Even though the S/N in the cross-correlation is then a factor of $\approx 10$ below the S/N in the Lyα forest auto correlation’, the instances of ‘S/N’ should be replaced with ‘$(S/N)^2$’.

Bottom Panel, Fig. B1 in the appendix: The curve that represents the ‘2 DLA’ correlations for the standard model is really the thin blue dashed curve rather than the thick red dashed curve, contrary to what is specified in the figure annotations and in the caption. Conversely, the curve that represents the ‘cross’ term in the model that only includes absorbers with $N_{\text{HI}} > 10^{20} \text{ cm}^{-2}$ is really the thick red dashed curve rather than the thin blue dashed curve.

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