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Erratum: Baryon acoustic oscillations in the Sloan Digital Sky Survey Data Release 7 galaxy sample

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The paper 'Baryon acoustic oscillations in the Sloan Digital Sky Survey Data Release 7 galaxy sample' was published in Mon. Not. R. Astron. Soc. **401**, 2148–2168 (2010). We report here an error on the reported value of $b_\star$ in that paper and in Reid et al. (2010), and explain in more detail how the relative amplitude between the theory and observed power spectra in our public likelihood code should be interpreted. The error is only in the interpretation of the output of our likelihood code, so no other results are affected.

The Sloan Digital Sky Survey (SDSS) Seventh Data Release (DR7) luminous red galaxy (LRG) power spectrum was reported by Reid et al. (2010) and is publicly available with a stand-alone likelihood code (http://lambda.gsfc.nasa.gov/toolbox/lrgdr/) as well as part of the package COSMOMC (http://cosmologist.info/cosmomc/). The use of these routines and the likelihoods recovered from them are not affected. The error affects only the value of $b_\star$ reported in Percival et al. (2010) and Reid et al. (2010; see also Reid et al. 2011).

When calculating the overdensity field, individual galaxies are weighted by the reciprocal of the expected bias relation (Tegmark et al. 2004; Percival et al. 2007)

$$\frac{b}{b_\star} = 0.85 + 0.15\frac{L}{L_\star} + 0.04(M_\star - M_{0.1_r}). \quad (1)$$

We apply this model across the redshift range covered by the SDSS-II LRG sample. This weighting was not applied to the mean galaxy density, only to the actual galaxies, so it has a residual effect on the normalization of the recovered clustering signal: we effectively multiply the amplitude of the power spectrum by a factor

$$\frac{\sum_i \bar{n}_i^2 w_i^2}{\sum_i \bar{n}_i^2 w_i^2 \left(\frac{b}{b_\star}\right)^2} = (1.85)^{-2}, \quad (2)$$

where the sum is over galaxies, quantities are squared because we are performing pair counts, and w_i are the standard Percival, Verde & Peacock (2004) weights. For the real-space component of the recovered power spectrum, we have a normalization equivalent to that of $b_\star$ galaxies. Assuming the standard redshift-space distortion (RSD) linear model, our recovered power spectrum can be written

$$P^{\rm halo,s}(k, z_{\rm eff}) = b_\star^2(z_{\rm eff})\left[1 + \frac{2f(z_{\rm eff})}{3b_{\rm eff}(z_{\rm eff})} + \frac{f^2(z_{\rm eff})}{5b_{\rm eff}^2(z_{\rm eff})}\right] \times P^r(k, z_{\rm eff}), \quad (3)$$

where $b_{\rm eff}(z_{\rm eff}) = 1.85 b_\star(z_{\rm eff})$. Note that, while the galaxies used have this effective bias, the power spectrum is normalized to an amplitude equivalent to that for $b_\star$ galaxies for the real-space component, while the RSD terms are normalized to the matter velocity field as expected – velocities do not depend on galaxy bias.

In the LRG likelihood code, the model power spectrum is normalized to $z = 0$, so one must translate the best-fitting amplitude of the model power spectrum, $A_{\rm rel}$, to the effective redshift of the sample ($z_{\rm eff} = 0.313$), and account for the boost factor in redshift space to derive a real-space bias value from the normalization for the LRG power spectrum:

$$A_{\rm rel} = \frac{\sigma_8^2(z_{\rm eff})}{\sigma_8^2(z=0)}\left[1 + \frac{2f(z_{\rm eff})}{3b_{\rm eff}(z_{\rm eff})} + \frac{f^2(z_{\rm eff})}{5b_{\rm eff}^2(z_{\rm eff})}\right] b_\star^2(z_{\rm eff}). \quad (4)$$

For the fiducial cosmological parameters used in our mock LRG catalogues based on a flat Λ cold dark matter (ΛCDM) cosmology with $(\Omega_{\rm b}h^2, \Omega_{\rm m}, H_0, \sigma_8, n_{\rm s}) = (0.0227, 0.2792, 70.1, 0.818, 0.96)$, we find $A_{\rm rel} = 1.25$ (not allowing scale-dependent bias nuisance parameters) or $A_{\rm rel} = 1.21$ (best-fitting nuisance parameters). Solving equation (4), we find a $b_\star = 1.19$ (or $b_\star = 1.16$), which implies $b_{\rm eff} = 2.2$ (or $b_{\rm eff} = 2.15$), respectively. In Reid et al. (2010) and Percival et al. (2010) we erroneously reported the 9 per cent higher value $b_\star = 1.3$. We caution users of the revised value with the following.

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(i) While $b_{\rm eff}\sigma_8$ should remain approximately constant as a function of the cosmological model, the best-fitting value *will* depend on the other cosmological parameters (particularly H_0).

(ii) The normalization of our power spectrum is for the reconstructed halo density field; the normalization for the full sample that includes satellite galaxies will increase by $\sim$5 per cent (see comparison in Reid, Spergel & Bode 2009).

(iii) Our reported measurements of $b_{\rm eff}$ depend on the weighting applied (see equation 2), and will differ from biases inferred from clustering measurements using luminosity-independent weightings (e.g. Masjedi et al. 2006; Tegmark et al. 2006; Kazin et al. 2010).

(iv) These measurements are at $z_{\rm eff} = 0.313$ and will need normalizing to compare with measurements at different redshifts.

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