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Dark Energy Survey: A 2.1% measurement of the angular Baryonic Acoustic Oscillation scale at redshift zeff=0.85 from the final dataset

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Abstract

We present the angular diameter distance measurement obtained with the Baryonic Acoustic Oscillation feature from galaxy clustering in the completed Dark Energy Survey, consisting of six years (Y6) of observations. We use the Y6 BAO galaxy sample, optimized for BAO science in the redshift range 0.6 < z < 1.2, with an effective redshift at zeff = 0.85 and split into six tomographic bins. The sample has nearly 16 million galaxies over 4,273 square degrees. Our consensus measurement constrains the ratio of the angular distance to sound horizon scale to DM (zeff)/rd = 19.51 ± 0.41 (at 68.3% confidence interval), resulting from comparing the BAO position in our data to that predicted by Planck ΛCDM via the BAO shift parameter α = (DM /rd)/(DM /rd)Planck. To achieve this, the BAO shift is measured with three different methods, Angular Correlation Function (ACF), Angular Power Spectrum (APS), and Projected Correlation Function (PCF) obtaining α = 0.952 ± 0.023, 0.962 ± 0.022, and 0.955 ± 0.020, respectively, which we combine to α = 0.957 ± 0.020, including systematic errors. When compared with the ΛCDM model that best fits Planck data, this measurement is found to be 4.3% and 2.1σ below the angular BAO scale predicted. To date, it represents the most precise angular BAO measurement at z > 0.75 from any survey and the most precise measurement at any redshift from photometric surveys. The analysis was performed blinded to the BAO position and it is shown to be robust against analysis choices, data removal, redshift calibrations and observational systematics.

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