

## Cross-correlation of Planck CMB lensing with DESI galaxy groups

*Friday, 10 December 2021 11:20 (20 minutes)*

We measure the cross-correlation between galaxy groups constructed from DESI Legacy Imaging Survey DR8 (Yang et al. 2021) and Planck CMB lensing, over overlapping sky area of 16876 deg<sup>2</sup>. The detections are significant and consistent with the expected signal of the large scale structure of the universe, over group samples of various redshift, mass and richness  $N_g$  and over various scale cuts. The overall S/N is 39 for a conservative sample with  $N_g \geq 5$ , and increases to 48 for the sample with  $N_g \geq 2$ . Adopting the Planck 2018 cosmology, we constrain the density bias of groups with  $N_g \geq 5$  as  $1_g = 1.31 \pm 0.10, 2.22 \pm 0.10, 3.52 \pm 0.20$  at  $0.1 < I \leq 0.33, 0.33 < I \leq 0.67, 0.67 < I \leq 1$  respectively. The value-added group catalog allows us to detect the dependence of bias on group mass with high significance. It also allows us to compare the measured bias with the theoretically predicted one using the estimated group mass. We find excellent agreement for the two high redshift bins. However, it is lower than the theory by  $\sim 3\sigma$  for the lowest redshift bin. Another interesting finding is the significant impact of the thermal Sunyaev Zel'dovich (tSZ). It contaminates the galaxy group-CMB lensing cross-correlation at  $\sim 30\%$  level, and must be deprojected first in CMB lensing reconstruction.

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**Session Classification:** Astro Session I