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Kinematic Lensing with the Dark Energy Spectroscopic Instrument - Probing S8 Tension at Very Low Redshift

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We explore the science prospects of a 14,000 deg^2 Kinematic Lensing (KL) survey with the Dark Energy Spectroscopic Instrument (DESI) and overlapping imaging surveys. KL infers the cosmic shear signal by jointly forward modeling the observed photometric image and velocity field of a disk galaxy. The latter can be constrained by placing multiple DESI fibers along the galaxy major and minor axis, a concept similar to the DESI Peculiar Velocity Survey. We study multiple subsets of the DESI Legacy Survey Data Release 9 galaxy sample and quantify the residual shape noise, σ_ϵ, of each sample as a function of cuts in r-band magnitude. We conduct simulated likelihood analyses for these galaxy samples and find that a DESI-KL program can place highly interesting constraints on structure formation at very low redshifts, i.e. $\sigma_8(z < 0.15)$. We conclude that if the S_8 tension consolidates as a phenomenon, a KL survey can provide unique insights into this phenomenon in the very late universe. Further, we note that DESI-KL benefits multiple additional science cases, e.g. studies of modified gravity models when combined with peculiar velocity surveys, and dark matter studies that are based on galaxy-galaxy lensing of dwarf galaxies.

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