

Weak Lensing Constraints on Dark Matter-Baryon Interactions with N-Body Simulations and Machine Learning

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We investigate the elastic scattering cross section between dark matter and protons using the DES Year 3 weak lensing data. This scattering induces a dark acoustic oscillation structure in the matter power spectra. To address non-linear effects at low redshift, we utilize principal component analysis alongside a limited set of N -body simulations, improving the reliability of our matter power spectrum prediction. We further perform a robust Markov Chain Monte Carlo analysis to derive the upper bounds on the DM-proton elastic scattering cross-section, assuming different velocity dependencies. Our results, presented as the first Frequentist upper limits, are compared with the ones obtained by Bayesian approach. Compared with the upper limits derived from the Planck cosmic microwave background data, our findings from DES Year 3 data exhibit improvements of up to a factor of five. In addition, we forecast the future sensitivities of the China Space Station Telescope, the upcoming capabilities of this telescope could improve the current limits by approximately one order of magnitude.

Paper info

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