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Impact of redshift systematics and intrinsic alignment modelling on the S8-tension

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Intrinsic alignment (IA) modelling and photometric redshift estimation are two of the main sources of systematic uncertainty in weak lensing surveys. We investigate the impact of redshift errors and their interplay with different IA models. Generally, errors on the mean δ_z and on the width σ_z of the redshift bins can both lead to biases in cosmological constraints. We find that such biases can, however, only be partially resolved by marginalizing over δ_z and σ_z. For Stage-III surveys, δ_z and σ_z cannot be well constrained due to limited statistics. The resulting biases are thus sensitive to prior volume effects. For Stage-IV surveys, we observe that marginalizing over the redshift parameters has an impact and reduces the bias. We derive requirements on the uncertainty of σ_z and δ_z for both Stage-III and Stage-IV surveys. We assume that the redshift systematic errors on S_8 should be less than half of the statistical errors, and the median bias should be smaller than 0.25σ. We find that the uncertainty on δ_z has to be
$lesssim 0.025$ for the NLA IA model with a Stage-III survey. We find no requirement threshold for σ_z since the requirements are met even for our maximum prior width of 0.3. For the TATT IA model, the uncertainty on δ_z has to be
$lesssim 0.02$ and the uncertainty on σ_z has to be
$lesssim 0.2$. Current redshift precision of Stage-III surveys is therefore high enough to meet these requirements. For Stage-IV surveys, systematic effects will be more important due to the higher statistical precision. In this case, the uncertainty on δ_z has to be
$lesssim 0.005$ and the uncertainty on σ_z should be
$lesssim 0.1$, with no significant dependence on the IA model. This required high precision will be a challenge for the redshift calibration of these future surveys. Finally, we investigate whether the interplay between redshift systematics and IA modelling can explain the S_8-tension between cosmic shear results and CMB measurements. We find that this is unlikely to explain the current S_8-tension. We also discuss how noise bias for a Stage-III survey can lead to biases of up to -0.5σ on S_8.

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