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Effects of the second-order vector mode on weak lensing signals

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Vector mode of cosmological perturbation theory imprints characteristic signals on the weak lensing signals such as curl- and B-modes which are never imprinted by the scalar mode.
However, the vector mode is neglected in the standard first-order cosmological perturbation theory since it only has a decaying mode.
This situation changes if the cosmological perturbation theory is expanded up to second order.
The second-order vector and tensor modes are inevitably induced by the product of the first-order scalar modes.
We study the effect of the second-order vector mode on the weak lensing curl- and B-modes.
We find that the curl-mode induced by the second-order vector mode is comparable to that induced by the primordial gravitational waves with the tensor-to-scalar ratio $r = 0.1$ at $\ell \approx 200$.
In this case, the curl-mode induced by the second-order vector mode dominates at $\ell > 200$.
Furthermore, the B-mode cosmic shear induced by the second-order vector mode dominates on almost all scales.
However, we find that the observational signatures of the second-order vector and tensor modes cannot exceed the expected noise
of ongoing and upcoming weak lensing measurements.
We conclude that the curl- and B-modes induced by the second-order vector and tensor modes are unlikely to be detected in future experiments.

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