Primordial non-Gaussianities

SnowMass

Daan Meerburg

Primordial Non-Gaussianity basics

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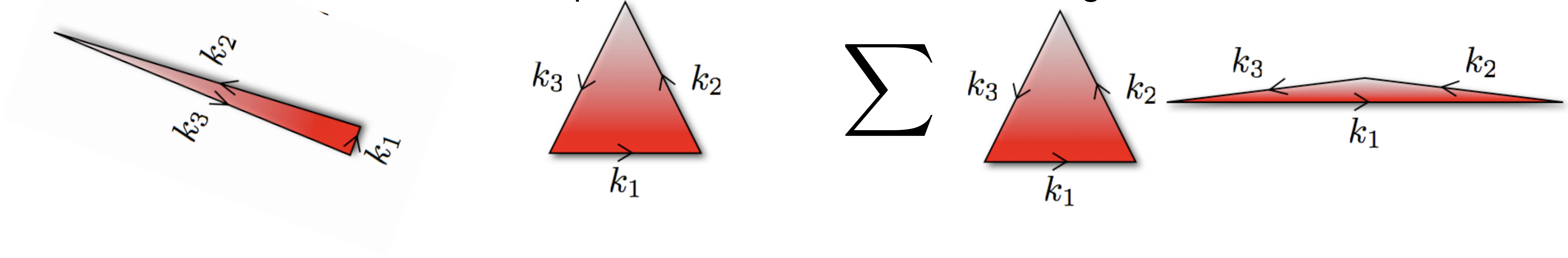
'Local' 'Equilateral' 'Orthogonal'



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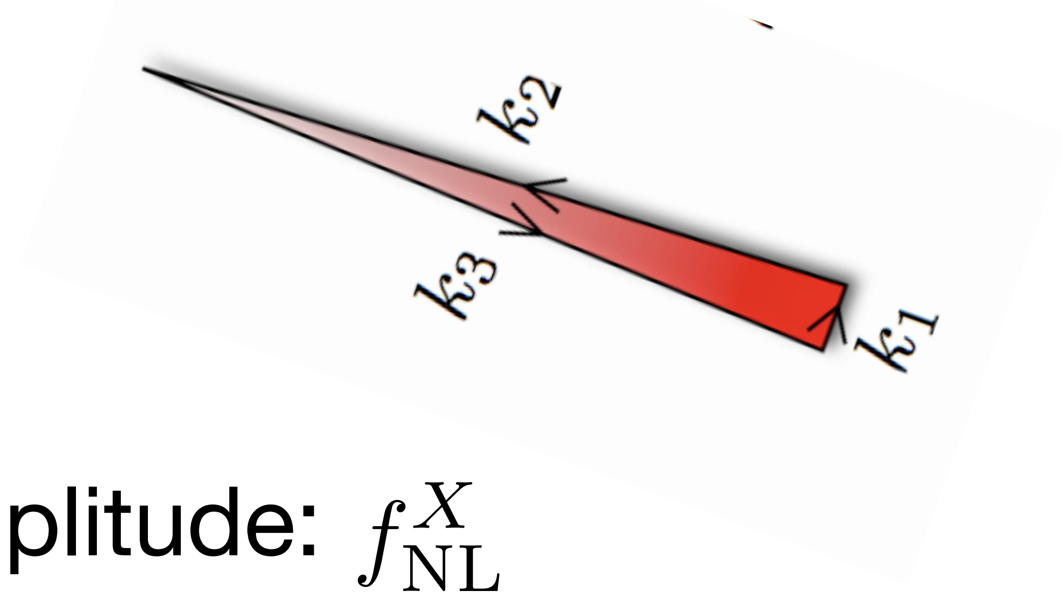
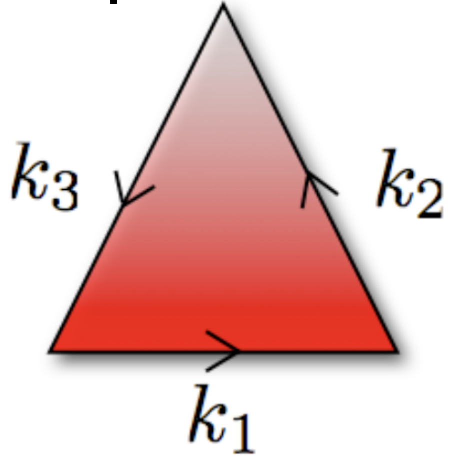
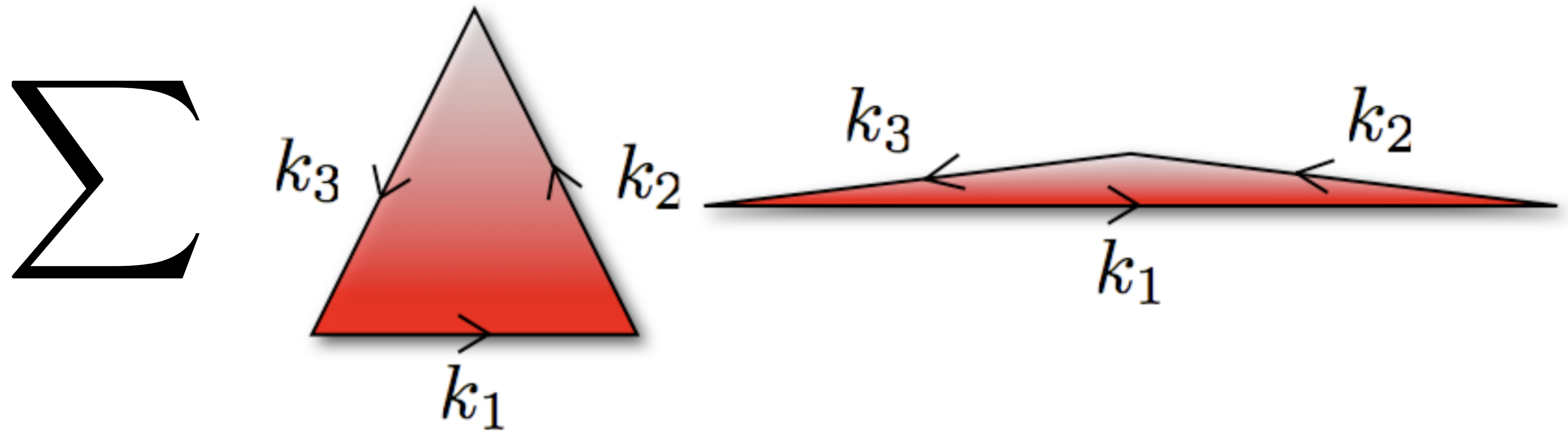


'Equilateral'



'Orthogonal'



- Amplitude: $f^X_{\rm NL}$

Alvarez et al 1412.4671

	$f^{\rm loc}_{\rm NL} \lesssim 1$	$f^{\rm loc}_{\rm NL} \gtrsim 1$
$f^{\rm eq,\,orth}_{\rm NL} \lesssim 1$	Single-field slow-roll	Multi-field
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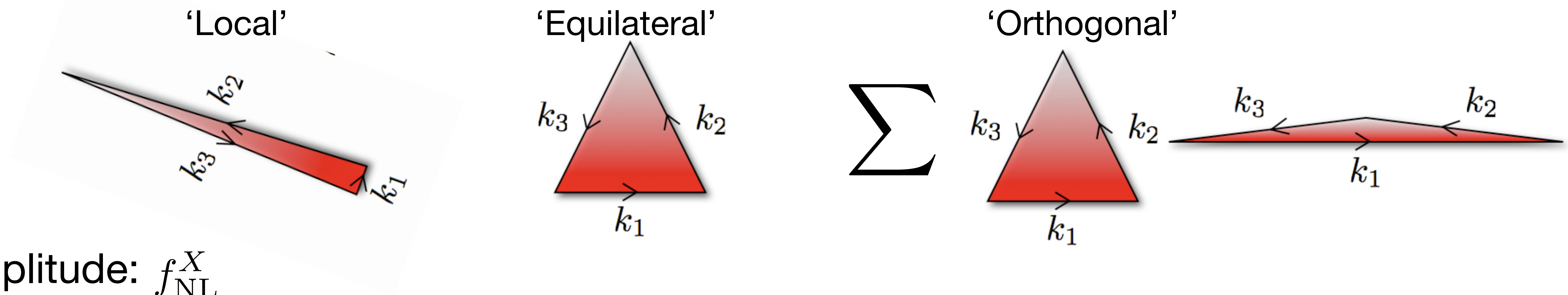

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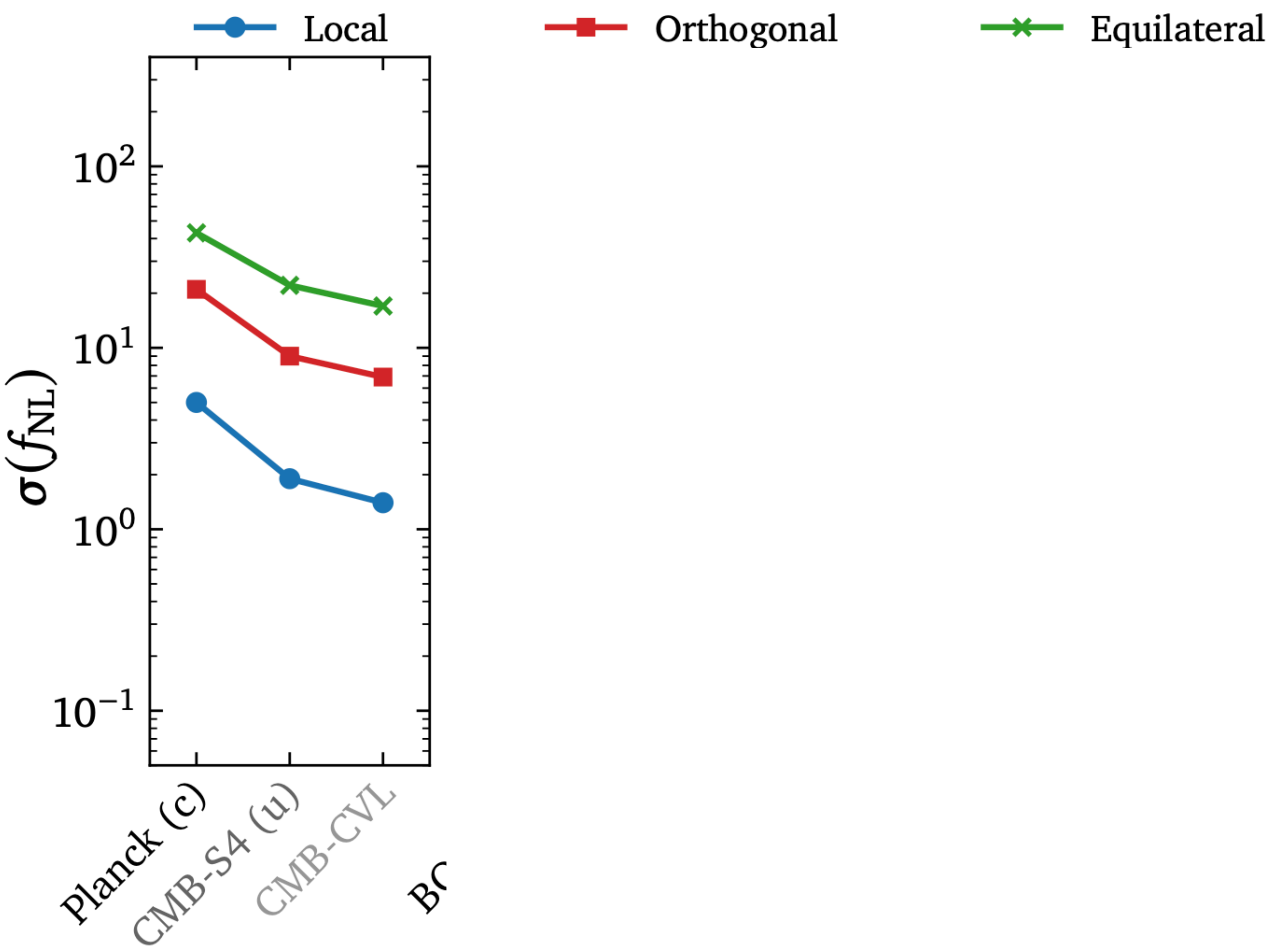
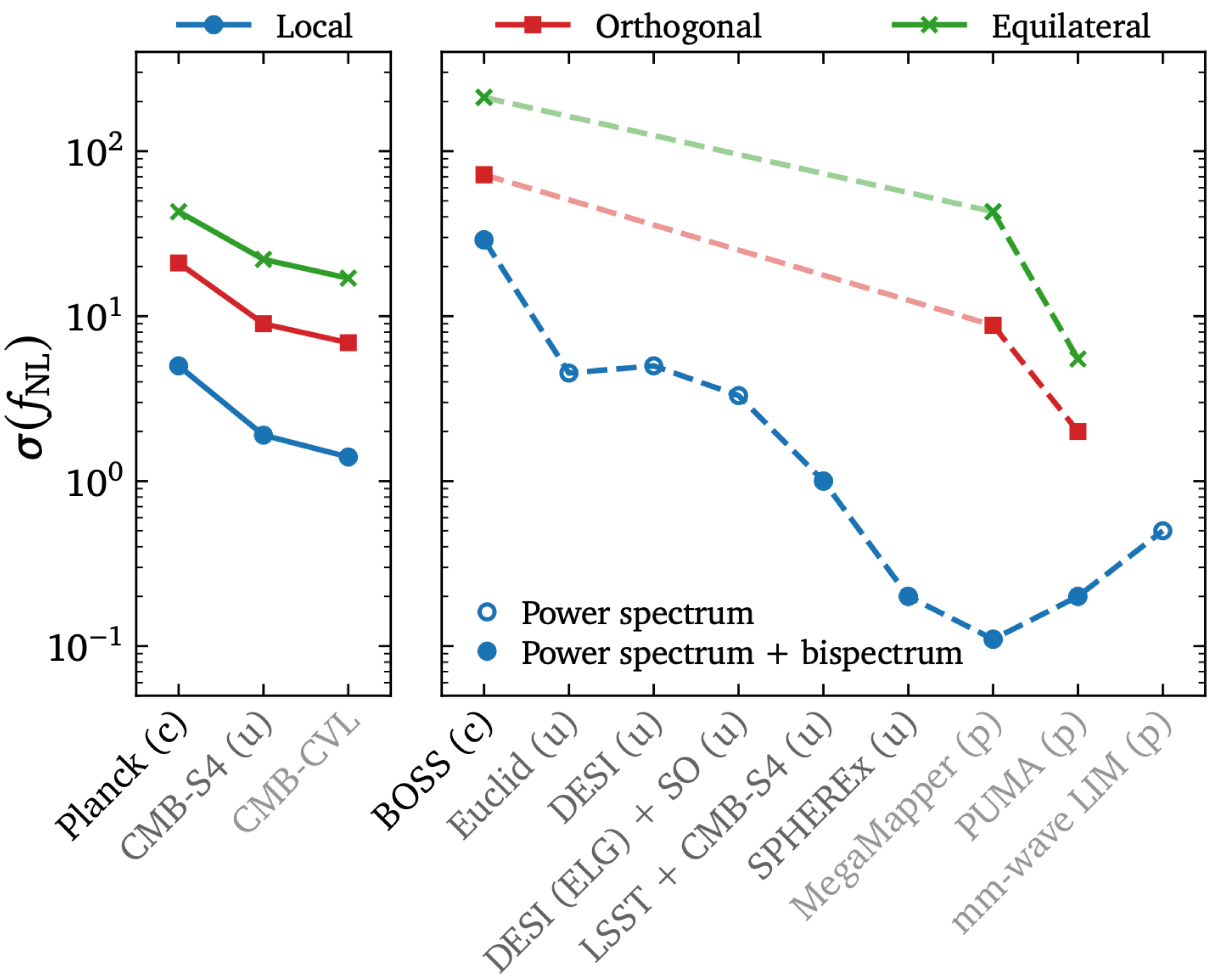
- Main take-away $f_{\rm NL} \sim \mathcal{O}(1)$ typically presents theoretically compelling threshold



c = completed
u = upcoming
p = proposed

Pimentel, Wallisch, Wu et al 2022



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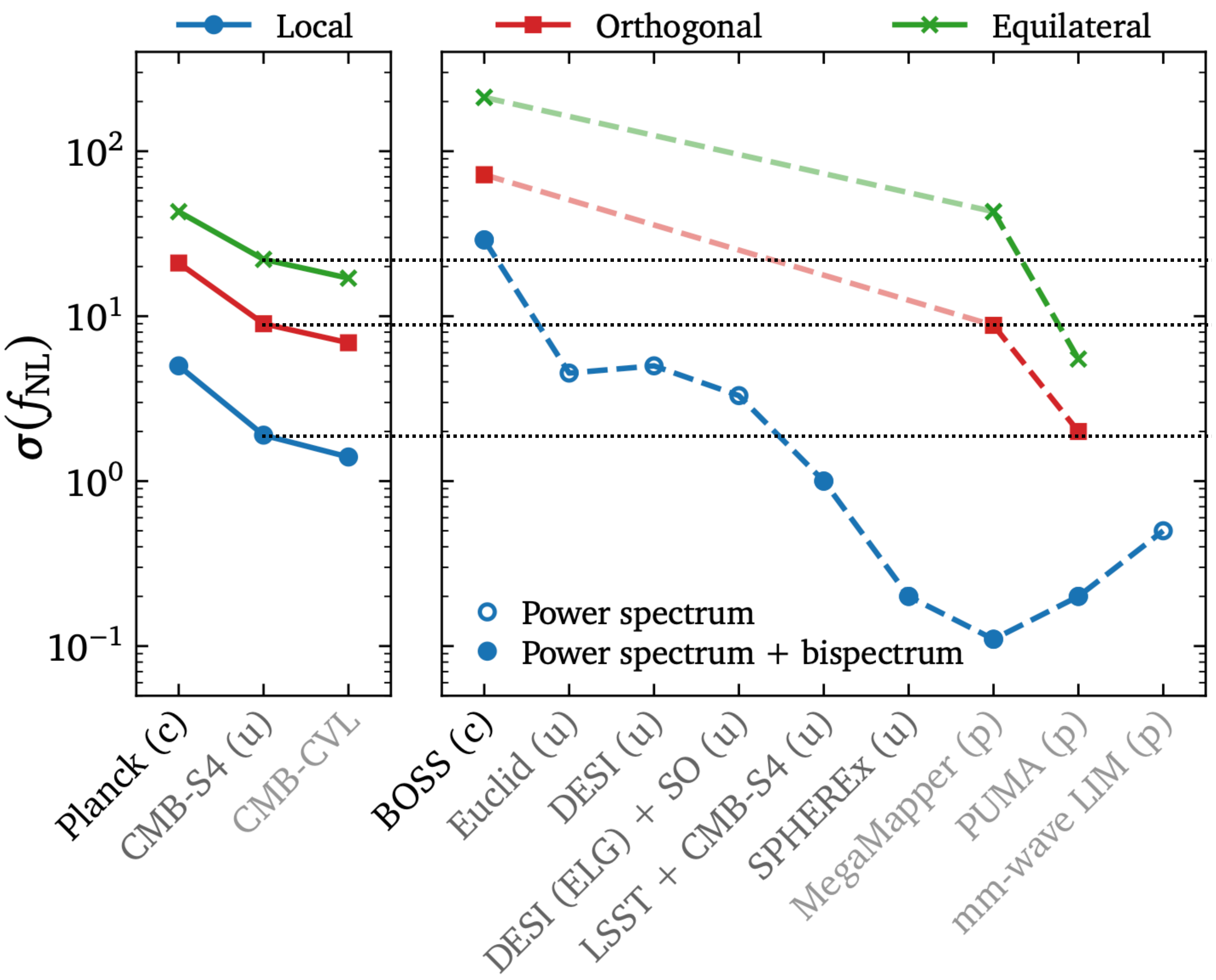

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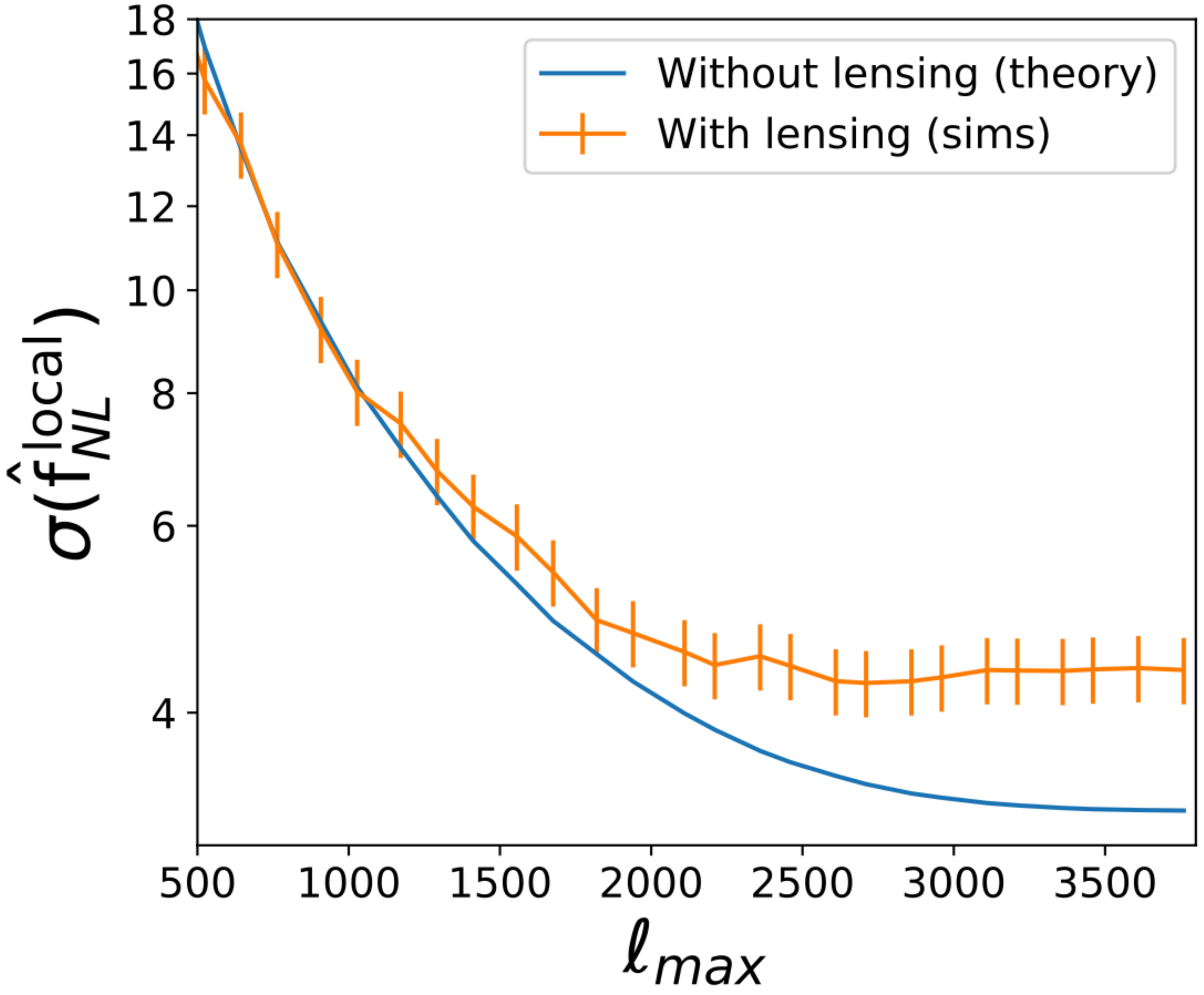
Example: Showstopper

Lensing

Coulton et al 2020



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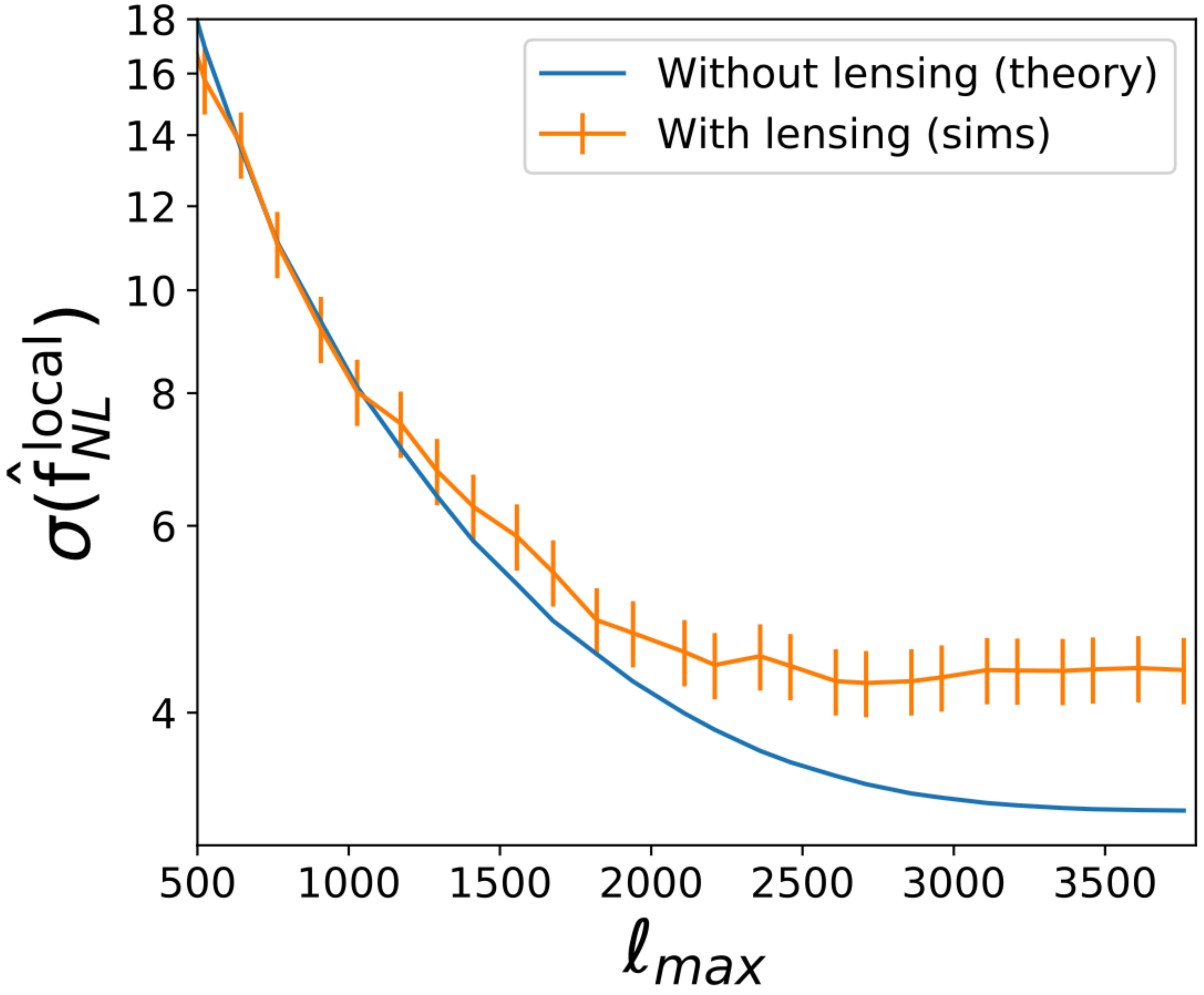
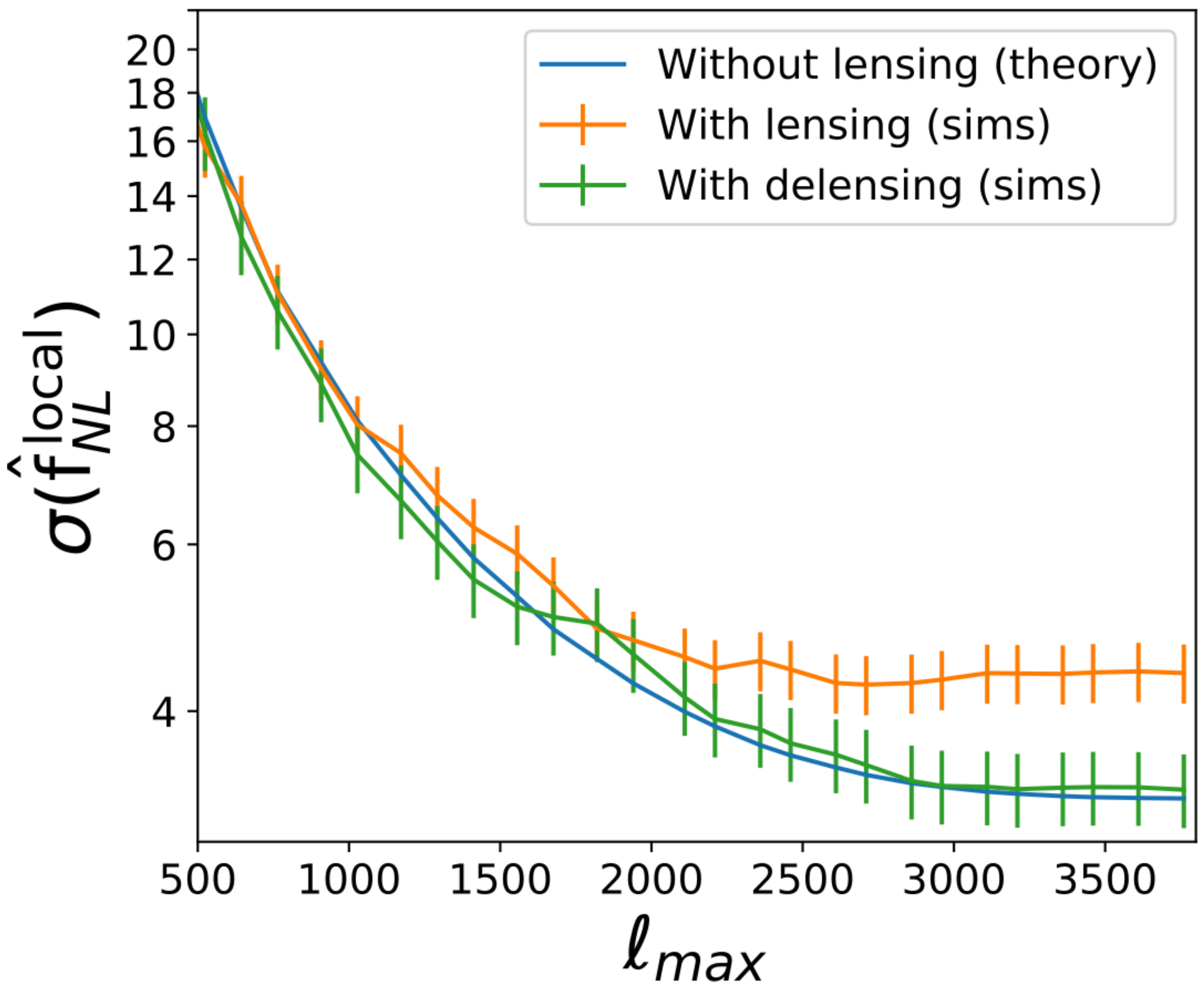


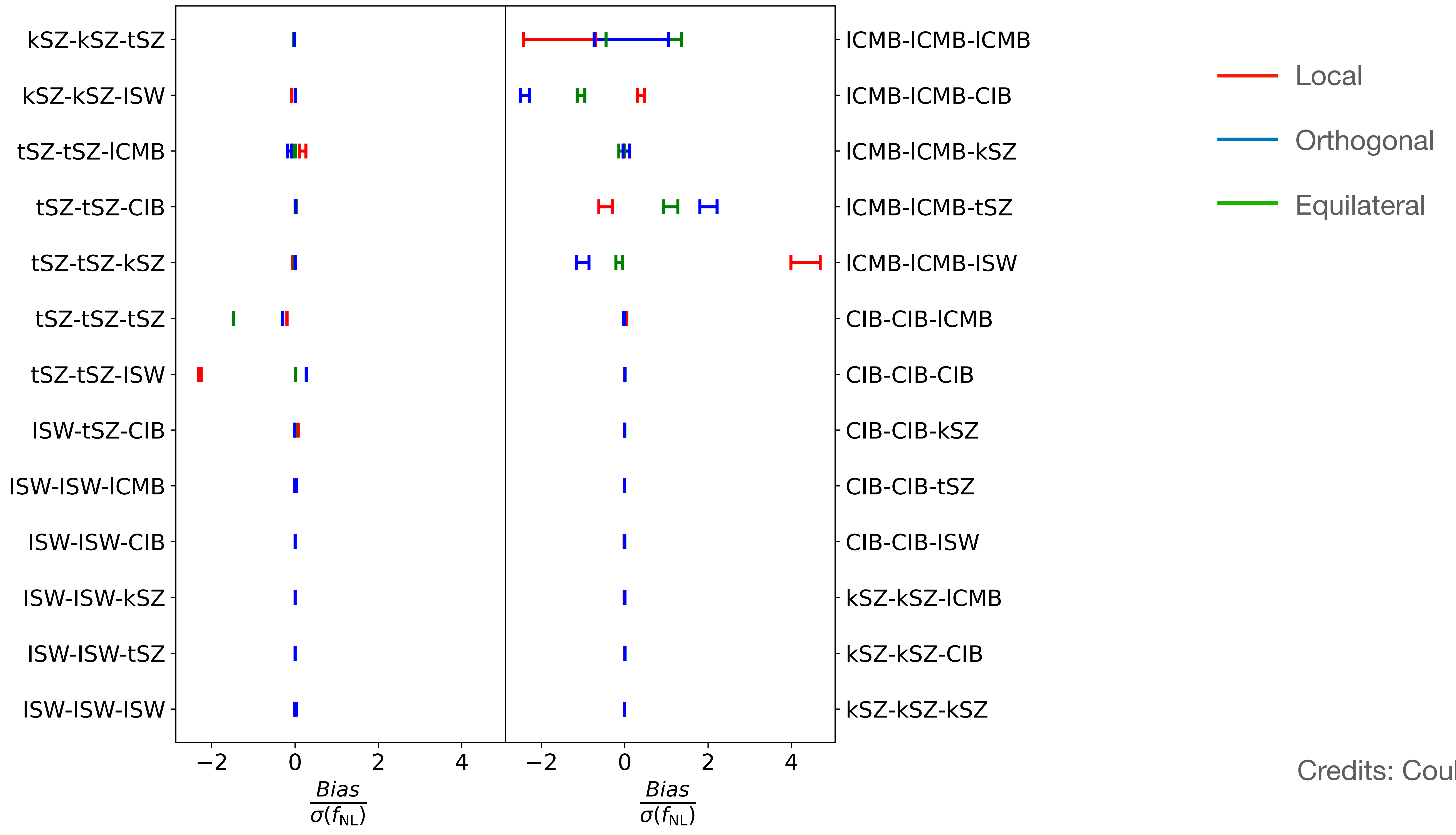


Conclusion

- Reaching $\sigma(f_{\rm NL}) \sim \mathcal{O}(1)$ is challenging, except local
- CMB will however provide the most stringent constraints (for a long time) on *i)* bispectra other than local *ii)* spectra that contain tensors
- For $f_{\rm NL}^{\rm local}$, LSS (PS + BS) and LSS + CMB (PS + BS and CV mitigating techniques) will be the way forward
- Pretty confident about the numbers for S4
  - Well studied, a lot of experience (WMAP, Planck)
  - Potential showstoppers understood (lensing + foregrounds)
- Currently analysing ACT data, which would provide foundation for next gen experiments

Showstoppers

Foregrounds (temperature only)



Credits: Coulton, Miranthis, Challinor in prep

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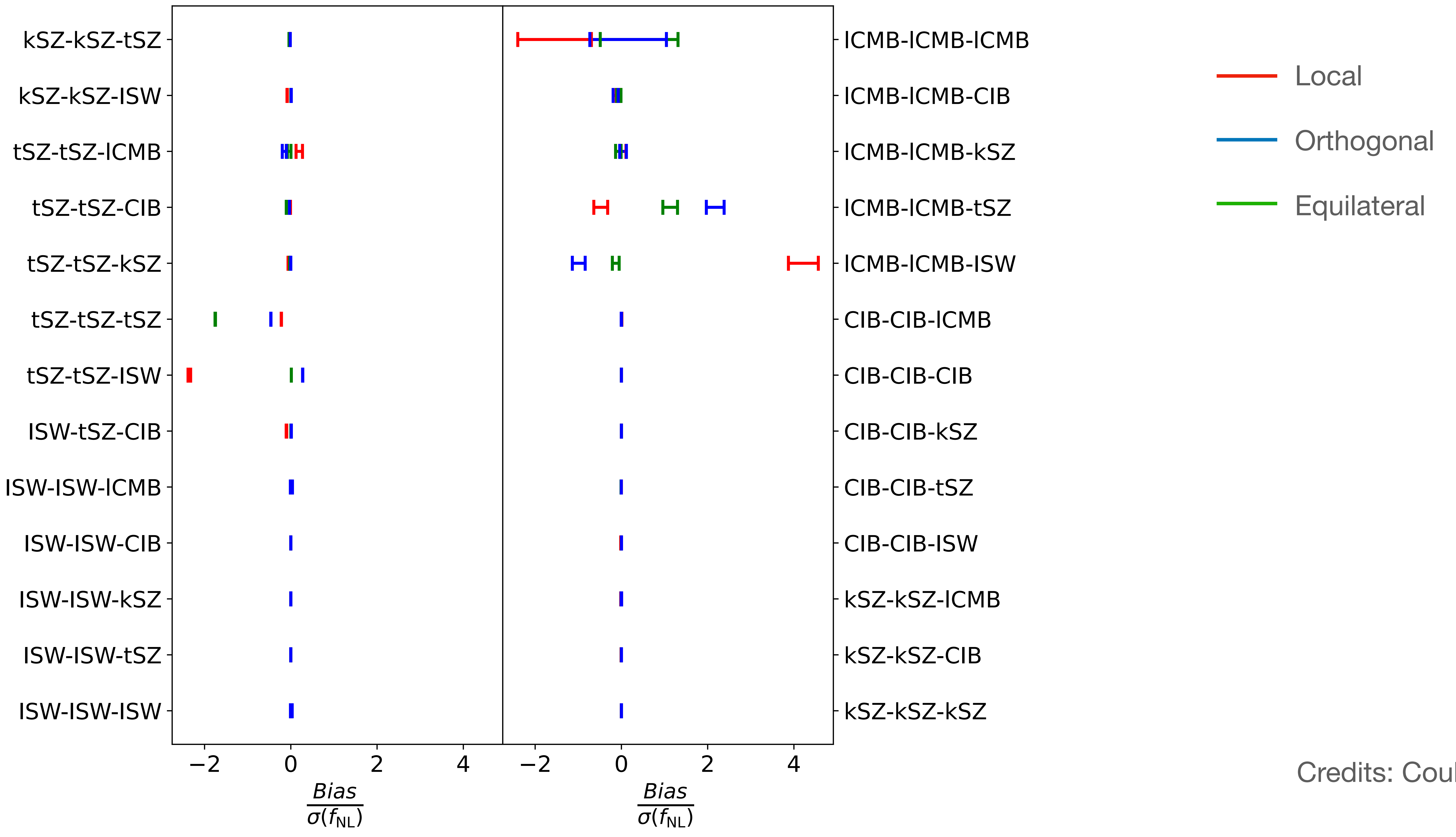

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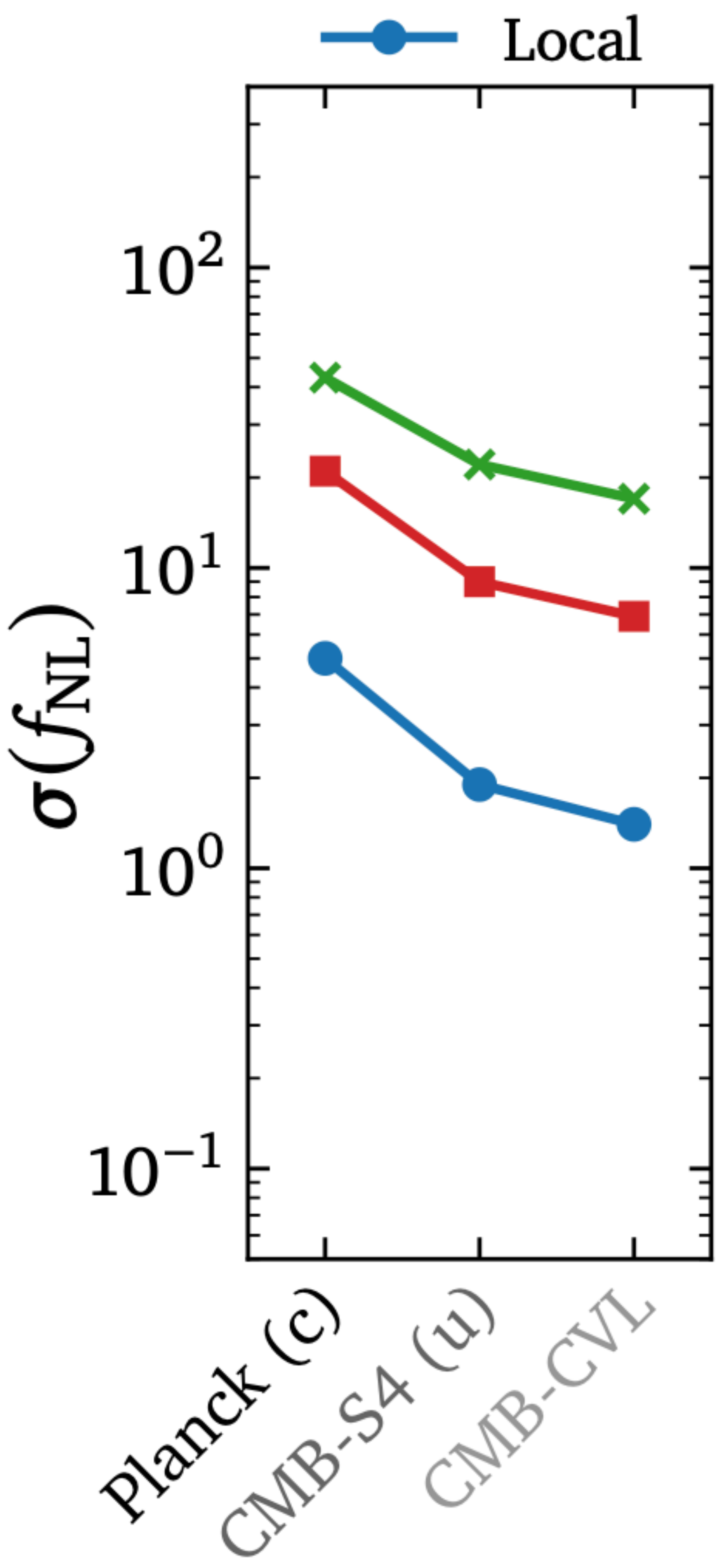
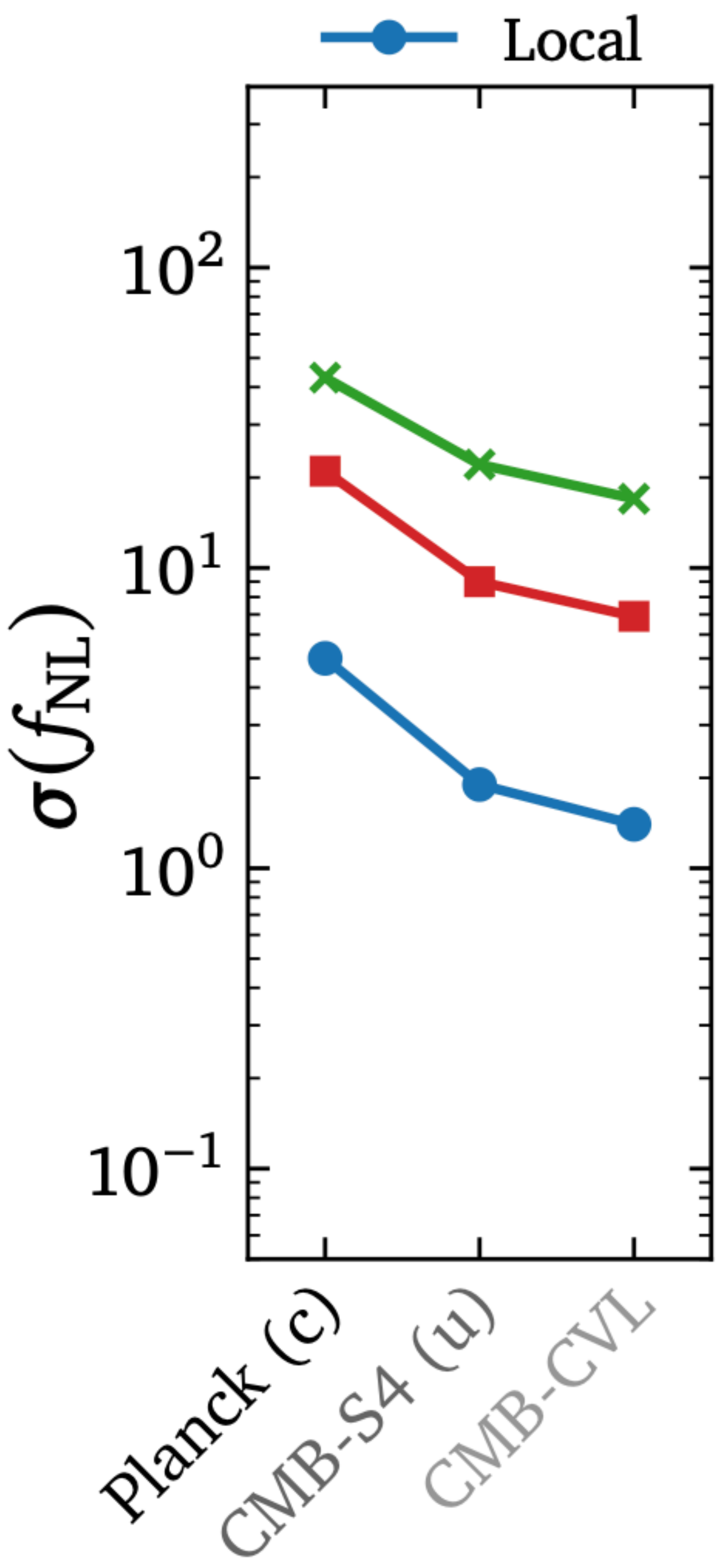


Shape: $\langle\mathcal{RRR}\rangle$ $\langle TTT\rangle,\langle TTE\rangle,\langle TEE\rangle,\langle EEE\rangle$	Current	CMB-S4 goal	Conservative	CV-limited
$f_{\rm sky}$	75%	43%	43%	100%
$\sigma(f_{\rm NL}^{\rm local})$	5	1.9 (5.3)	2.1	0.8 (7.1)
$\sigma(f_{\rm NL}^{\rm equil})$	43	22.1 (−0.4)	23.5	11.8 (−1.9)
$\sigma(f_{\rm NL}^{\rm ortho})$	21	9.0 (−5.0)	10.6	4.4 (−6.3)

Pimentel, Wallisch, Wu et al 2022, DSR 2019



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Shape: $\langle\mathcal{RR}\gamma\rangle$ $\langle BTT\rangle,\langle BTE\rangle,\langle BEE\rangle$	Current	CMB-S4 goal	Conservative	CV-limited
$f_{\rm sky}$	69%	3%	3%	100%
$\sigma(\sqrt{r}\tilde{f}_{\rm NL}^{\rm local})$	28	0.79	1.2	0.052
$\sigma(\sqrt{r}\tilde{f}_{\rm NL}^{\rm equil})$	...	16	24	1.7
$\sigma(\sqrt{r}\tilde{f}_{\rm NL}^{\rm ortho})$	...	4.4	7.4	0.41

Pimentel, Wallisch, Wu et al 2022, DSR 2019