Configuration-space RSD measurements in Flagship

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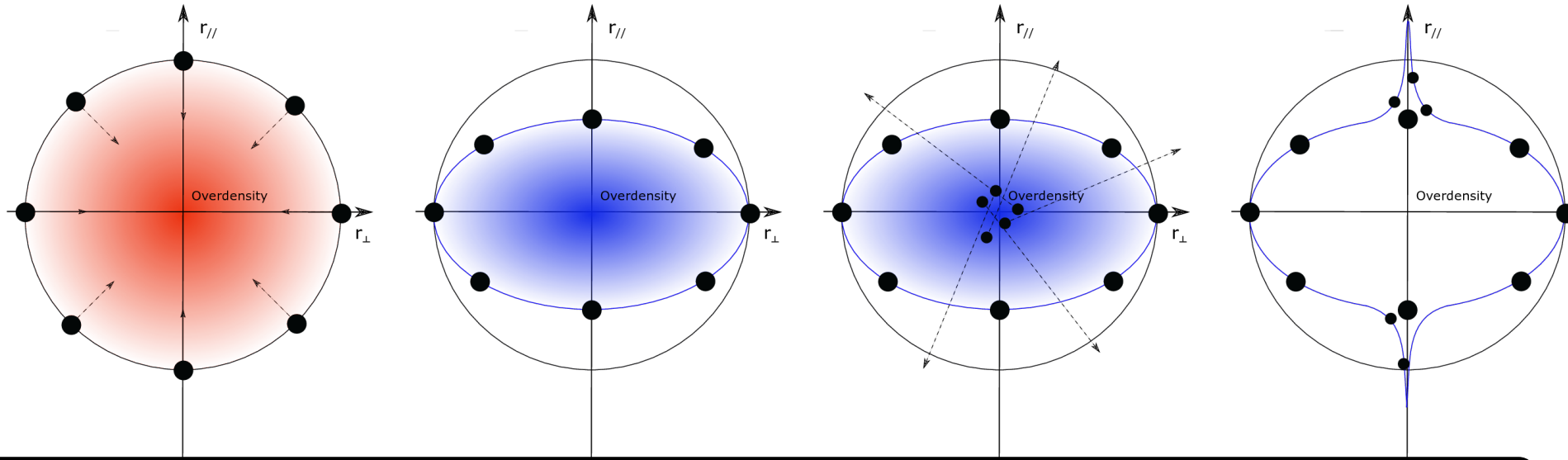
Galaxy Clustering Redshift-Space Distortions

- Observed galaxy distribution modified by peculiar velocities
- Peculiar velocities depend on the growth rate of structures f
- The growth rate is heavily sensitive to the theory of gravity



Main takeaway

Galaxy clustering RSD allow us to test General Relativity through the even multipoles of the 2PCF (and power spectrum)

RSD modelling

We use the *Convolution Lagrangian Perturbation Theory* (CLPT, Carlson+12, Wang+14) and *Gaussian Streaming Model* (Reid & White 2011)

6 parameters

- f (growth rate)
- b_1^L (1st-order Lagrangian bias)
- b_2^L (2nd-order Lagrangian bias)
- σ_v^2 (Additionnal velocity dispersion)
- $\alpha_\parallel$ (AP test)
- $\alpha_\perp$ (AP test)

code available at *https ://github.com/mianbreton/CLPT_GS*

Flagship snapshots

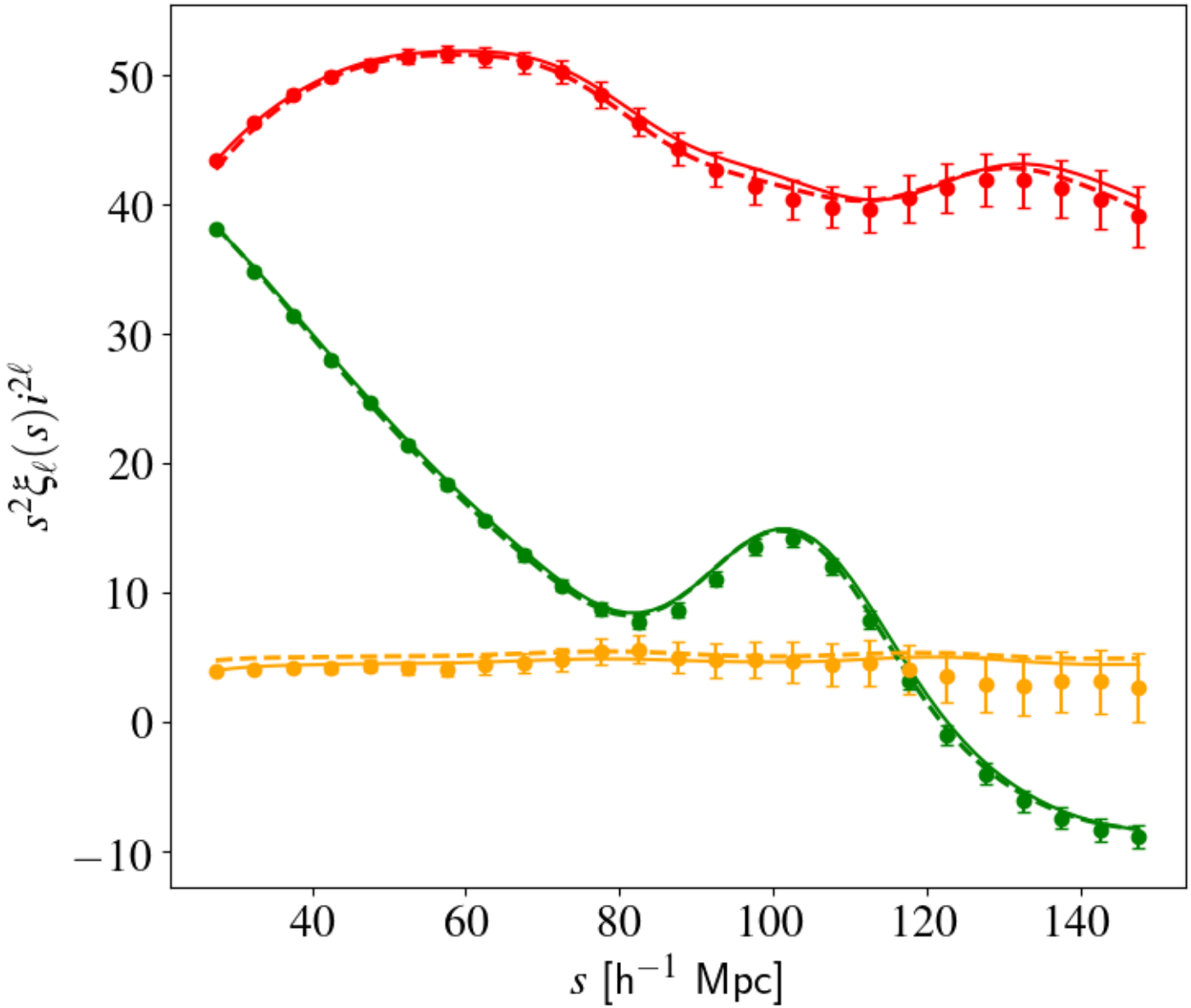
Flagship cosmology

Ω_m	Ω_b	Ω_Λ	σ_8	n_s	h
0.319	0.049	0.681	0.83	0.96	0.67

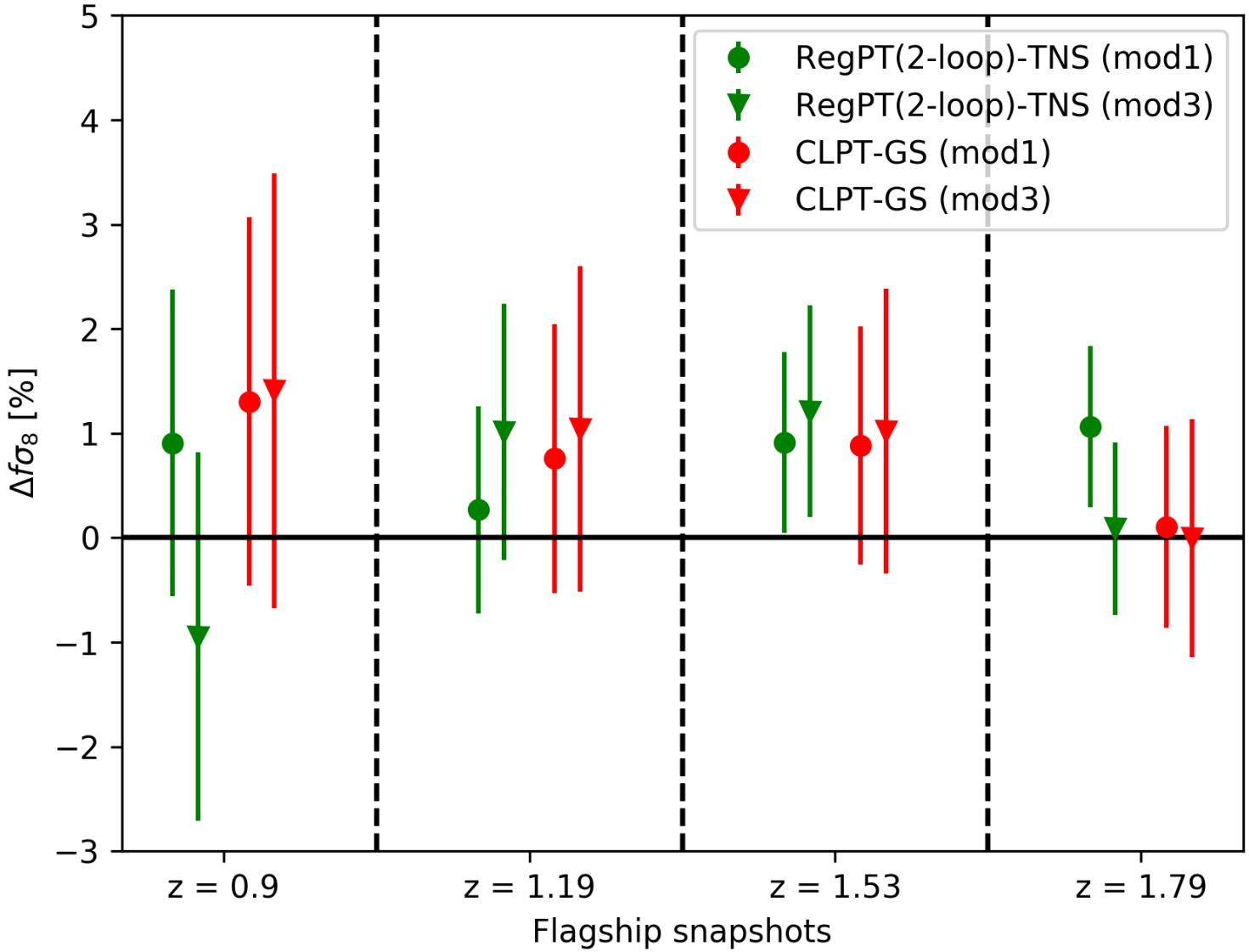
- HOD with two models (optimistic and pessimistic)

Snapshot redshifts	0.9	1.19	1.53	1.79
$N_{\rm gal}$ (Model 1) $\times 10^6$	200	110	70	25
$N_{\rm gal}$ (Model 3) $\times 10^6$	110	55	30	17

FLAGSHIP simulation snapshots ($z = 0.9$)



Flagship simulation snapshots



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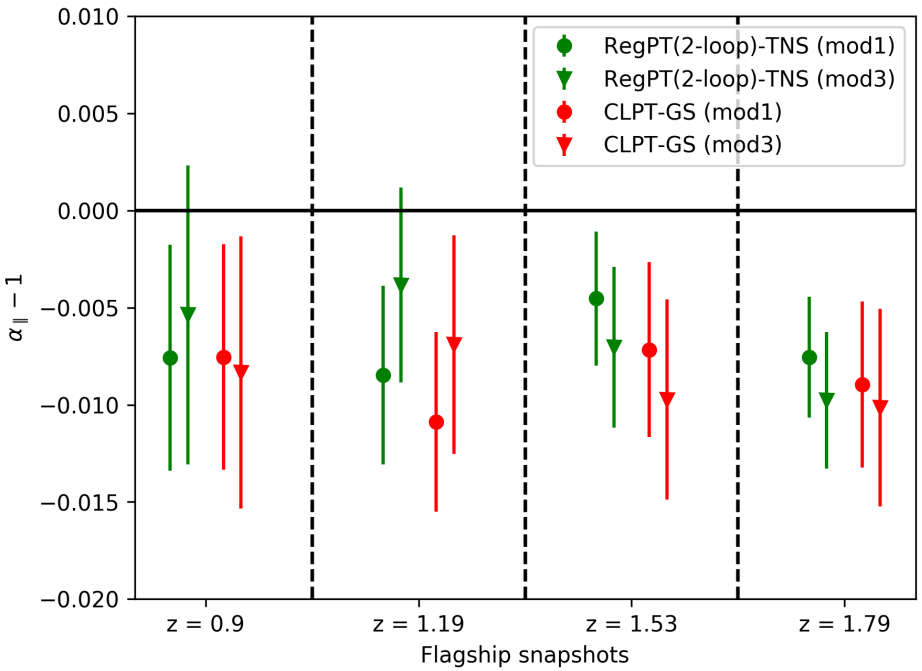

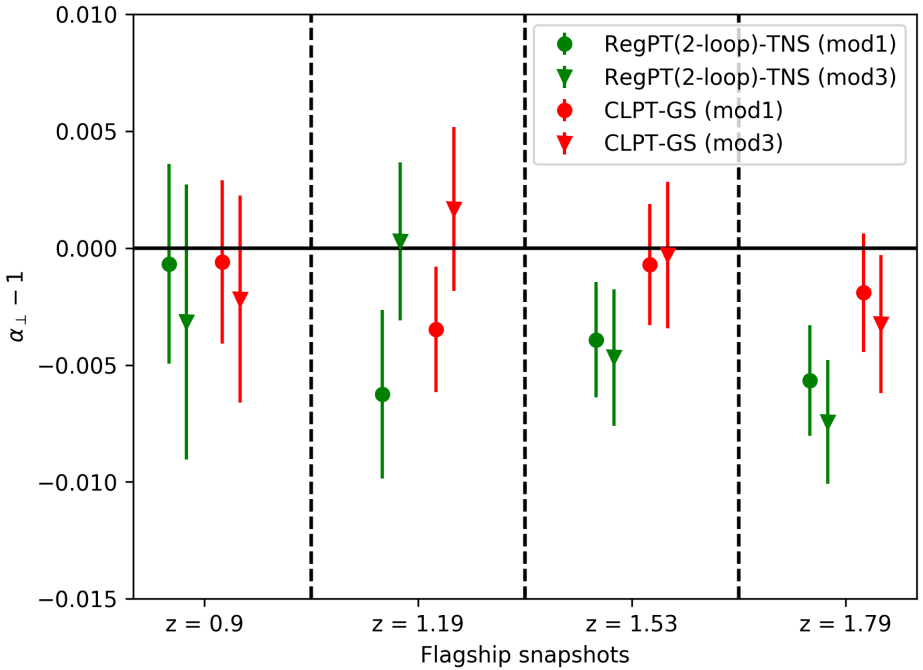

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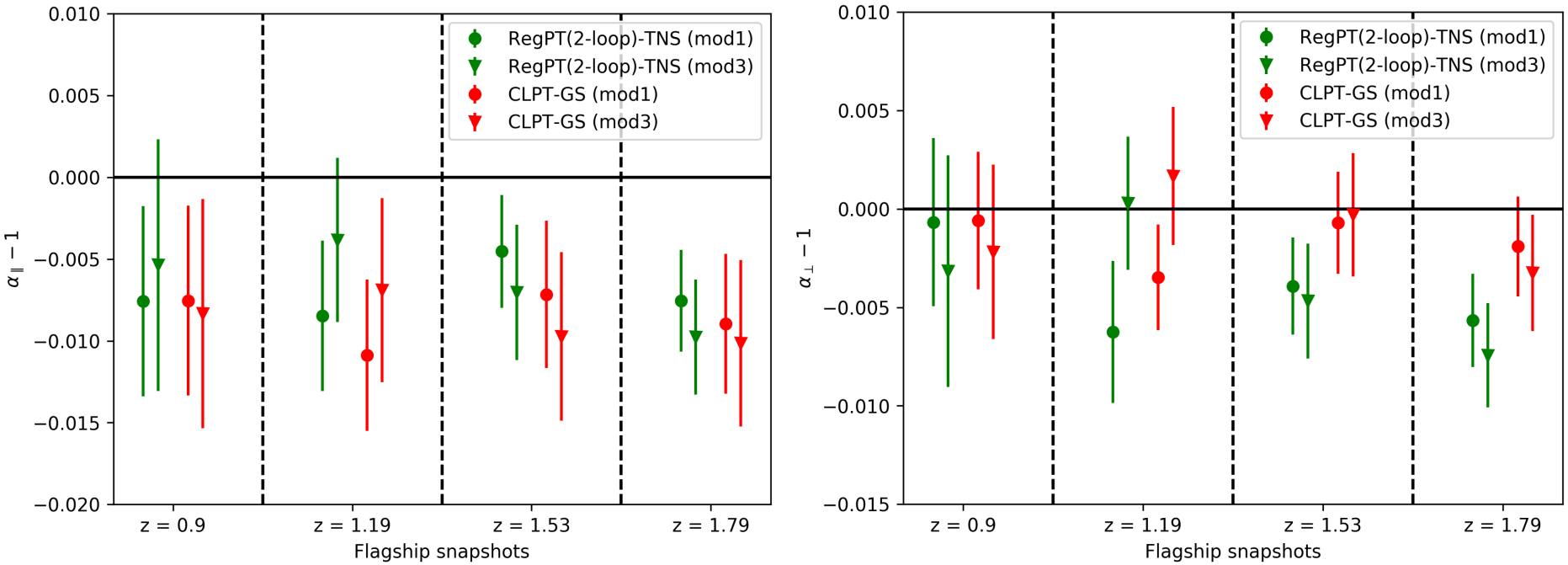
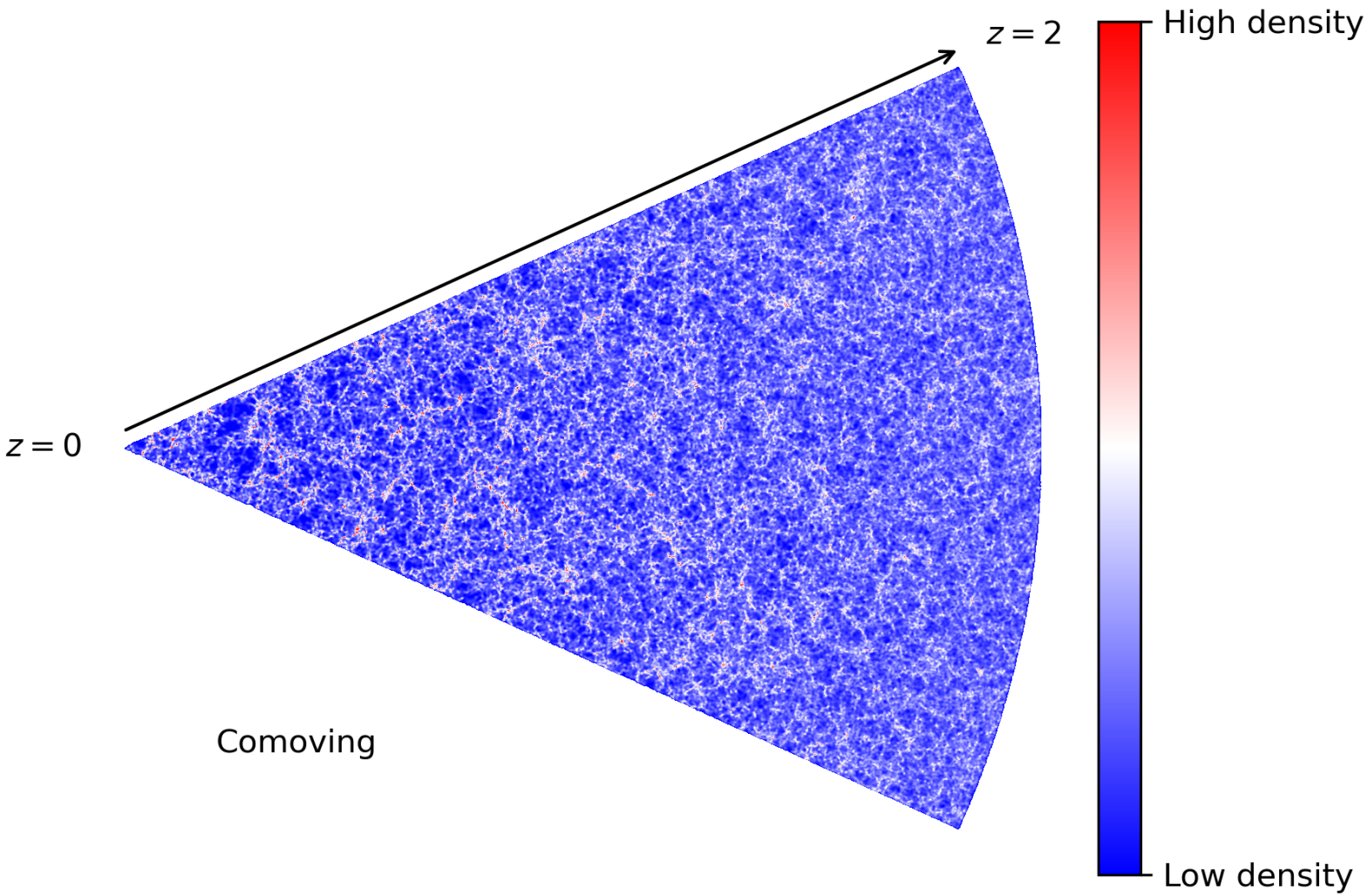


Very idealised case, what about the real light-cone ?

RayGal simulation light-cone (Breton+19, Rasera et al. in prep)



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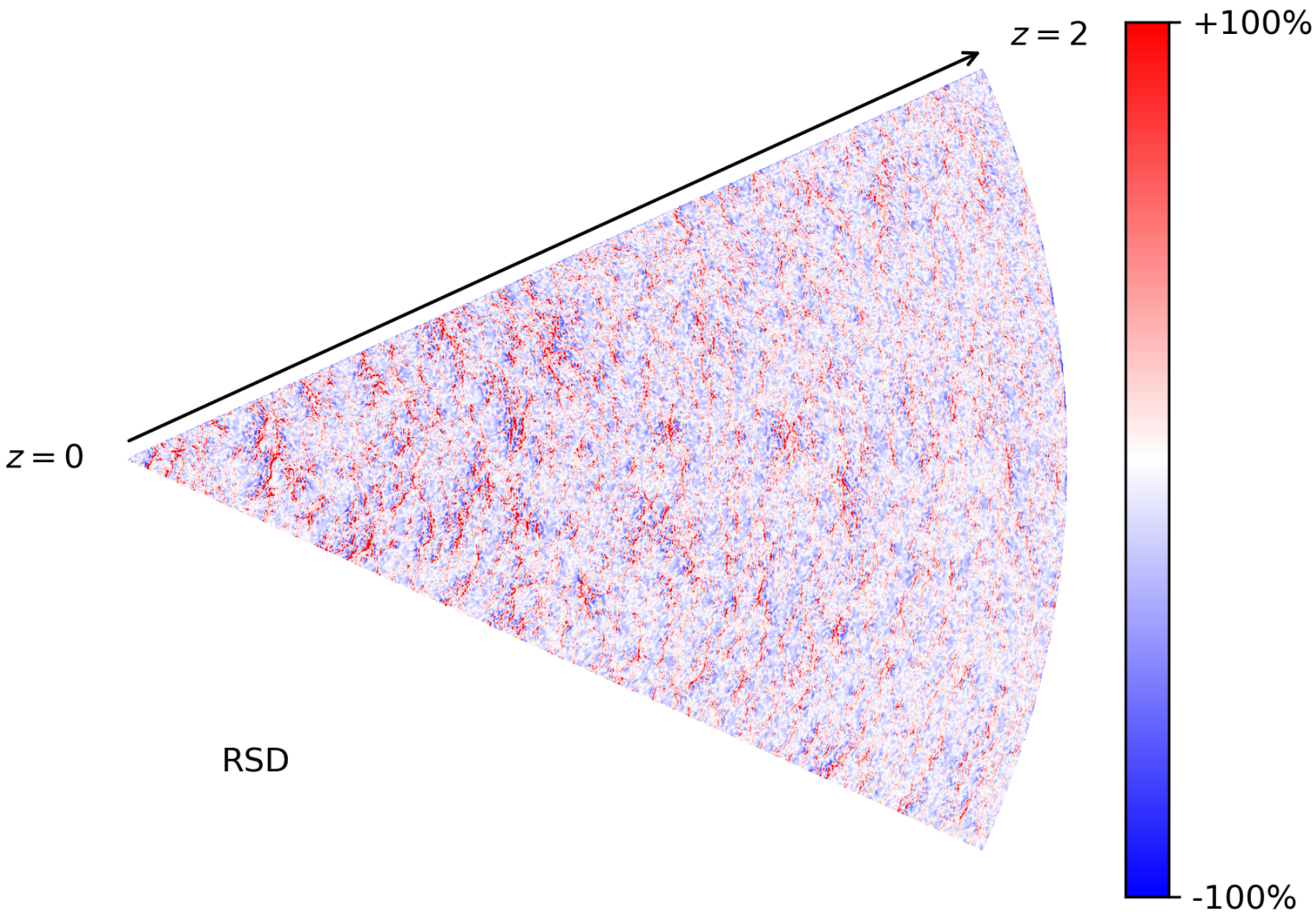

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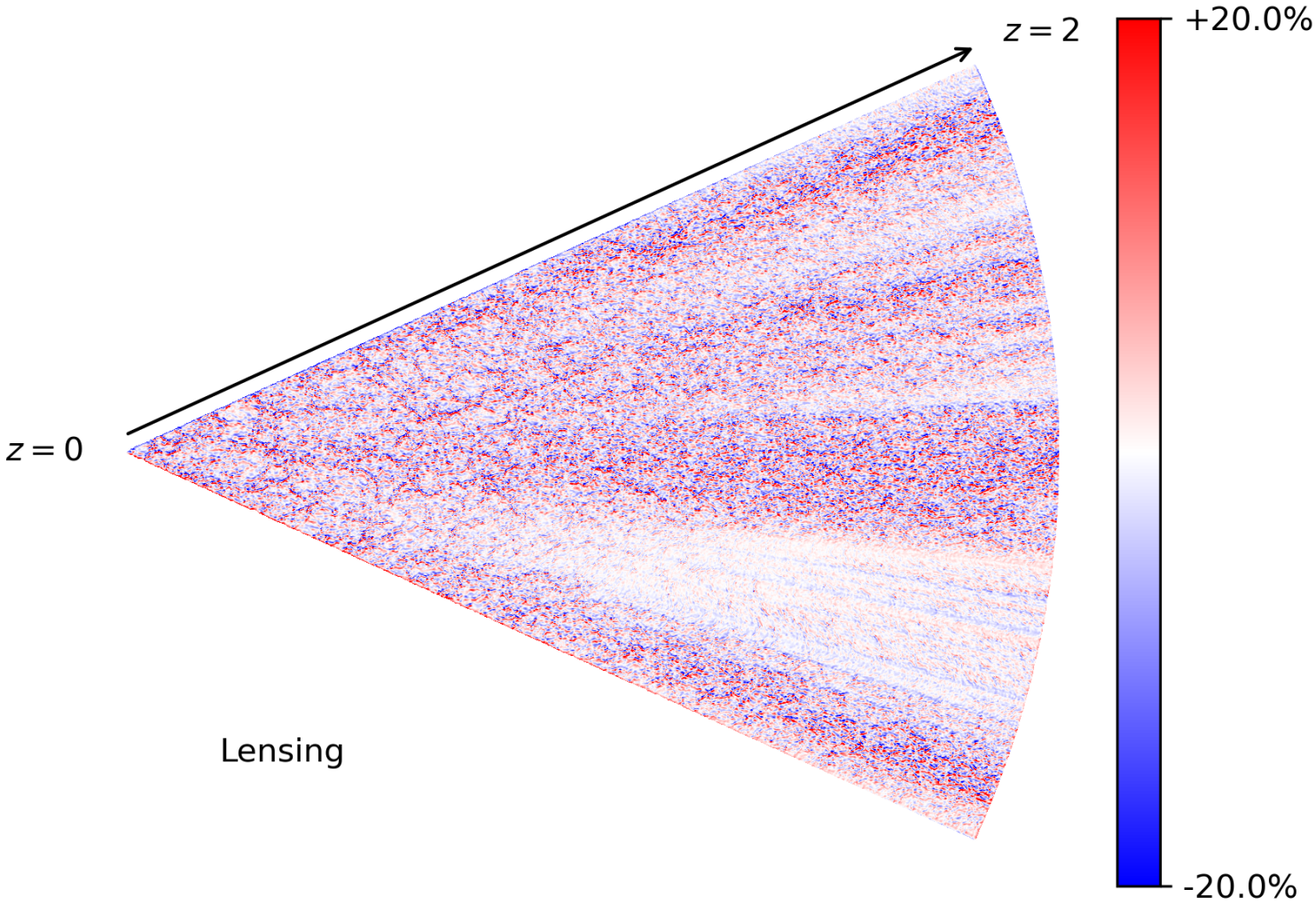

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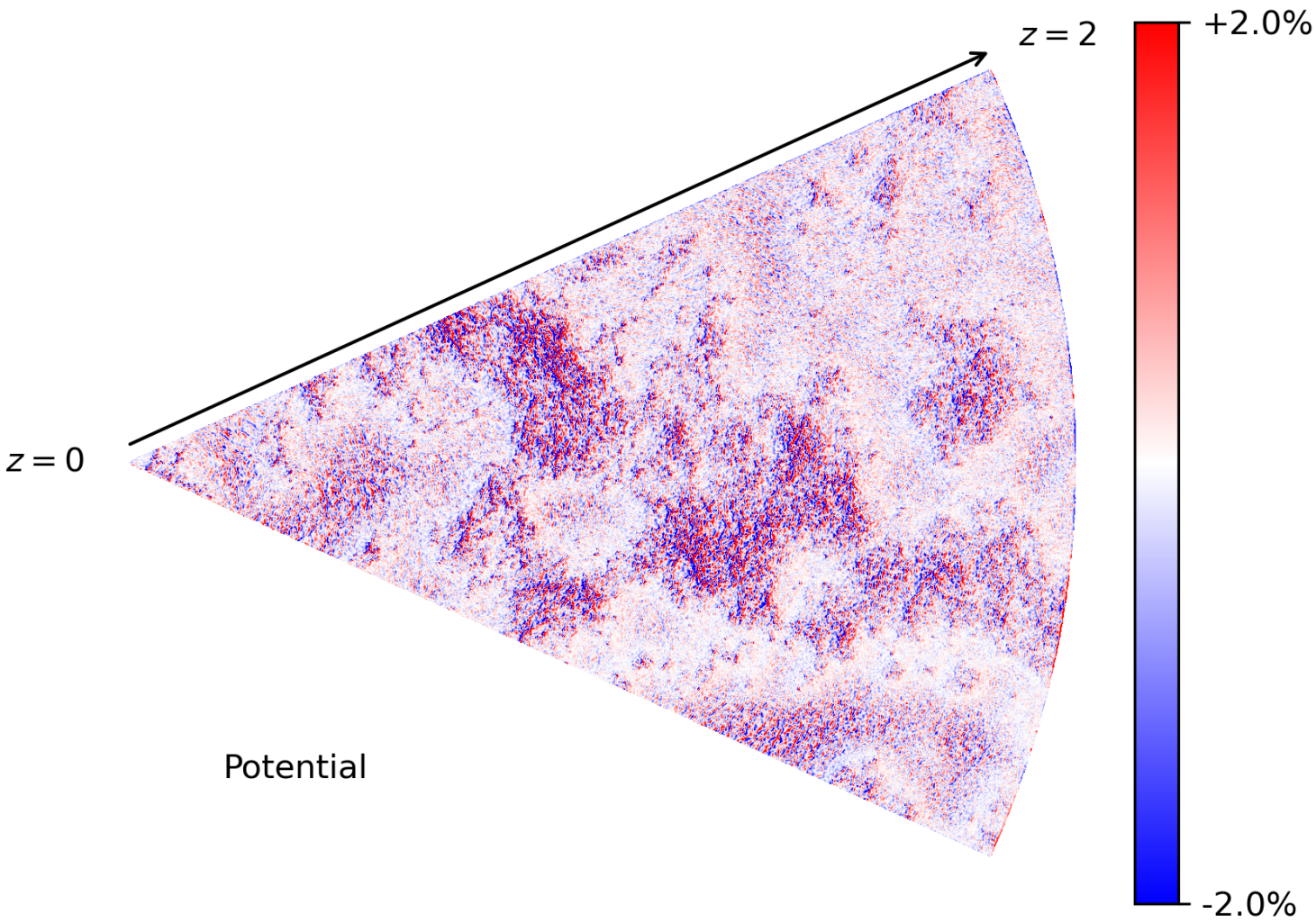

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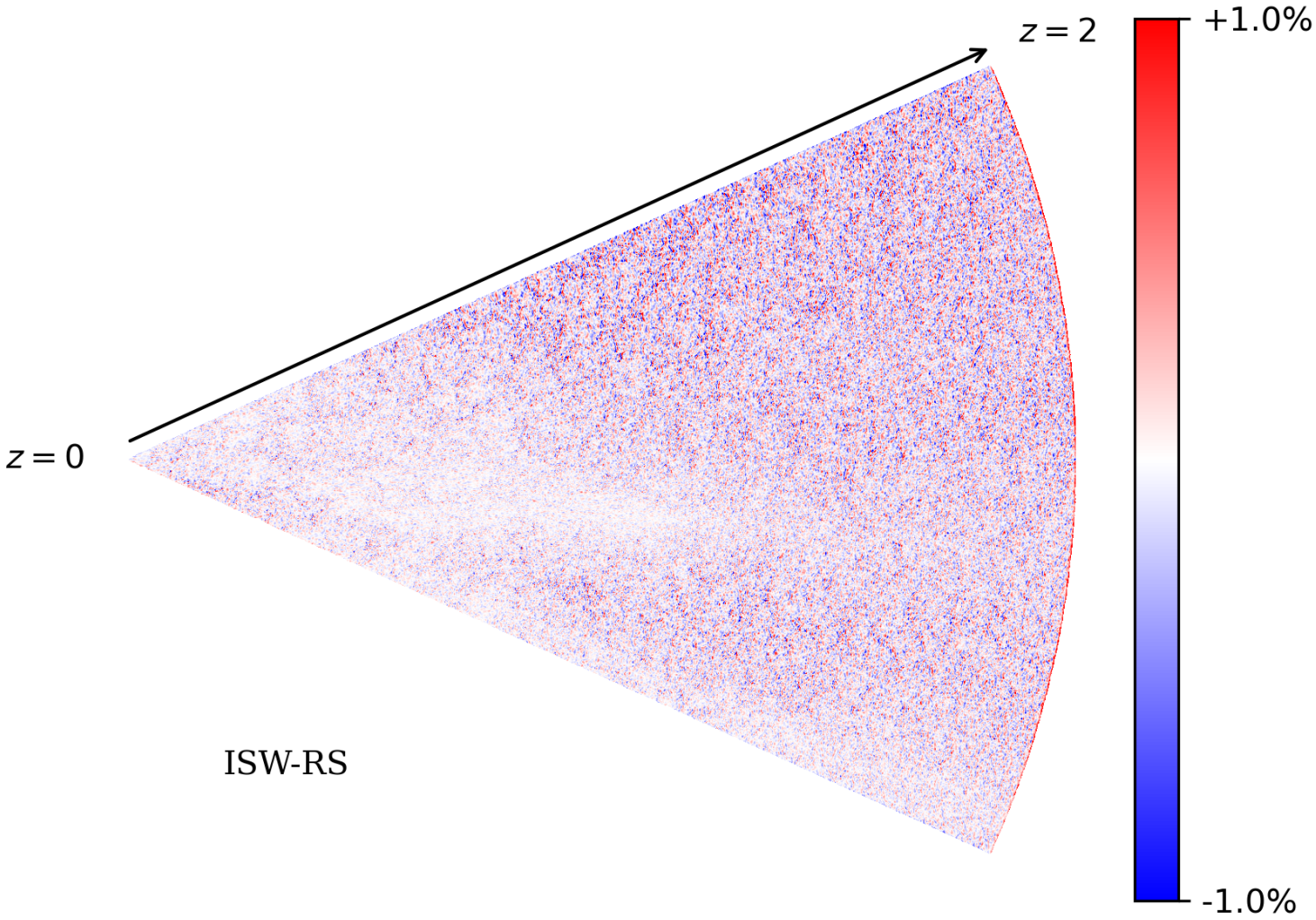

Multipoles of the 2PCF in the RayGal simulation

redshift bins : $[\mathbf{0.8-1.0}]$ and $[\mathbf{1.6-1.9}]$

ξ_ℓ	Doppler	v_o	Grav. redshift	Lensing*	T. Doppler	ISW
ξ_0	$> 20\%$	3%	$< 1\%$	$1-10\%$	$< 1\%$	$< 1\%$
ξ_2	$> 20\%$	2%	$< 1\%$	2%	$< 1\%$	$< 1\%$
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*Angular displacement only

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Number counts heavily impacted by RSD and Magnification Bias (MB)

$$\Delta = b\delta - \frac{1}{\mathcal{H}}\nabla_r(\boldsymbol{v}\cdot\boldsymbol{n}) + (5s-2)\kappa \qquad (1)$$

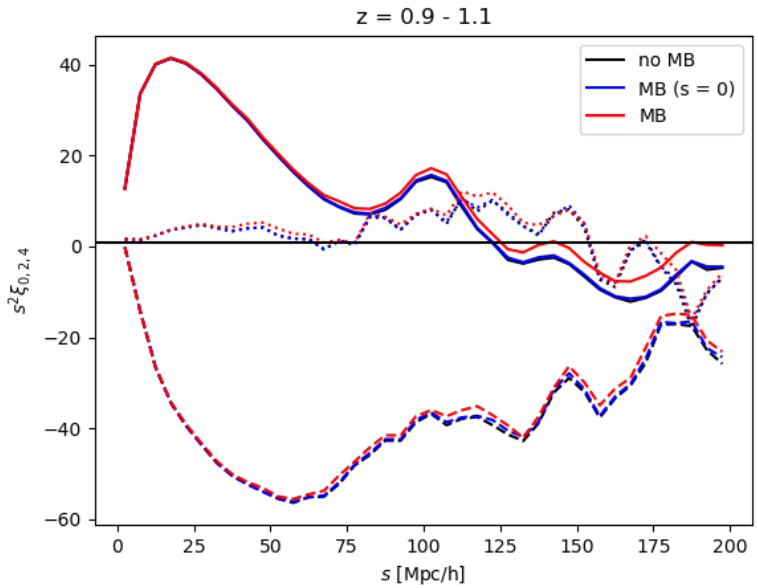
$s = \mathrm{d}\log_{10} N(<m)/\mathrm{d}m$

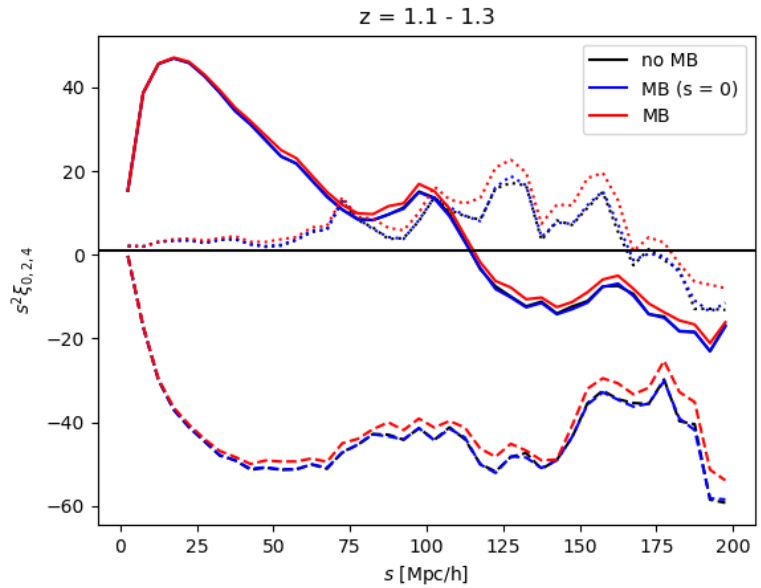
Flagship simulation light-cone

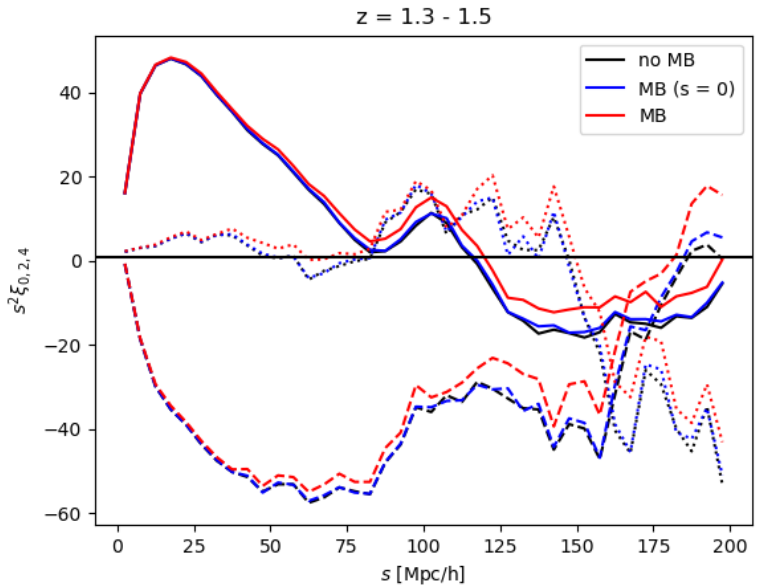
- v1.8.4, full octant (available on cosmohub)
- Spectroscopic sample :
  $z = [0.9 - 1.1], [1.1 - 1.3], [1.3 - 1.5], [1.5 - 1.8]$
  $s \sim 0.7 - 1$
- Centrals only (kind $= 0$)
- -2.5log10(euclid_nisp_h) - 48.6 $<$ 24
- logf_halpha_model3_ext $>$ -15.7

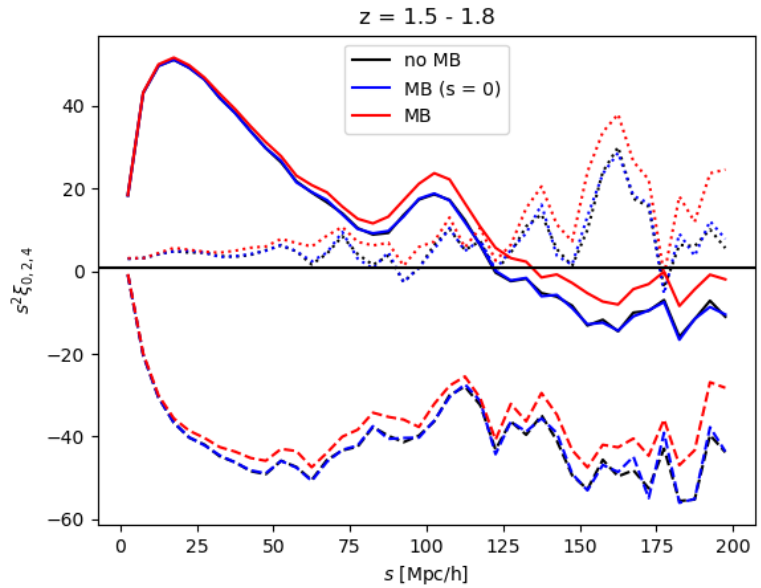
To account for MB, magnify angular positions and halpha flux

FLAGSHIP simulation light-cone









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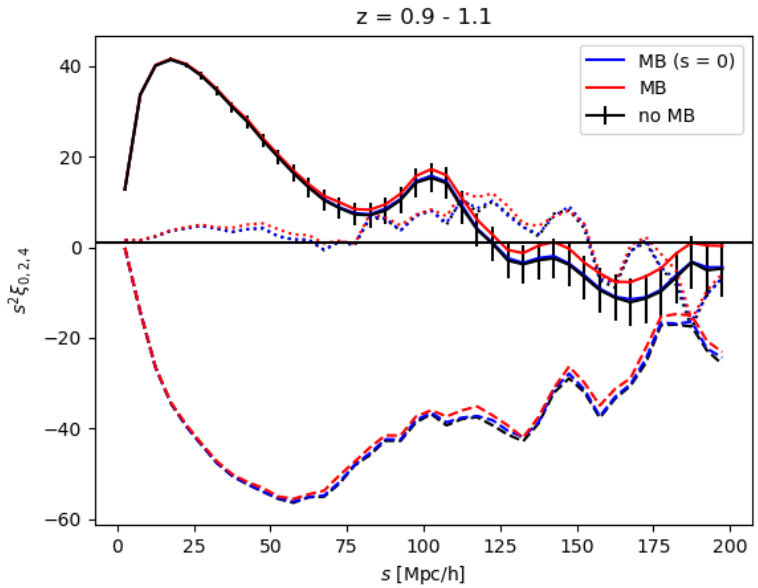
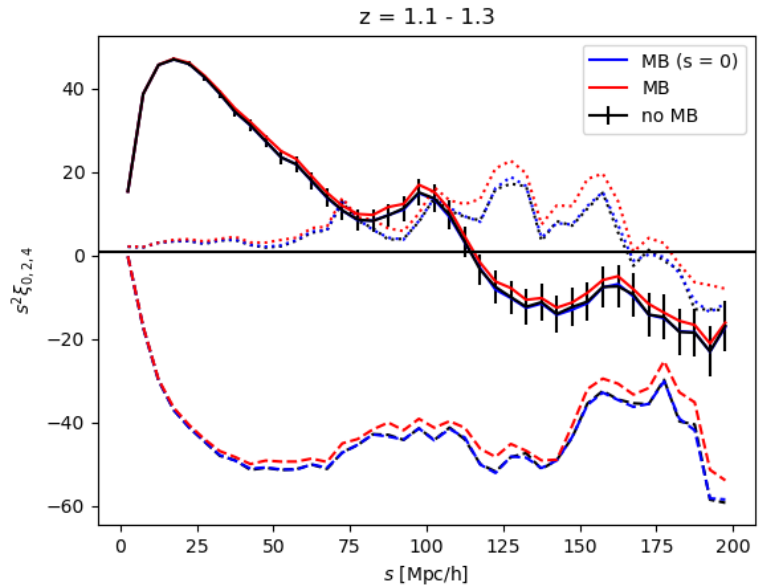
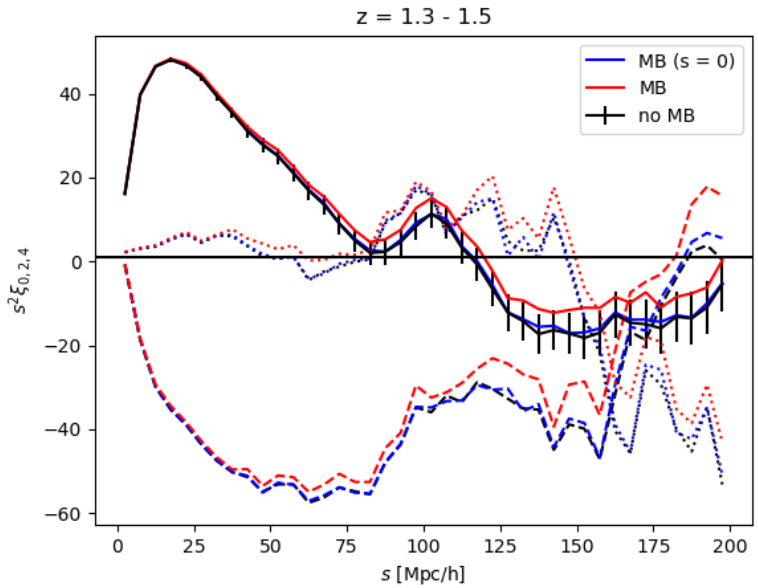
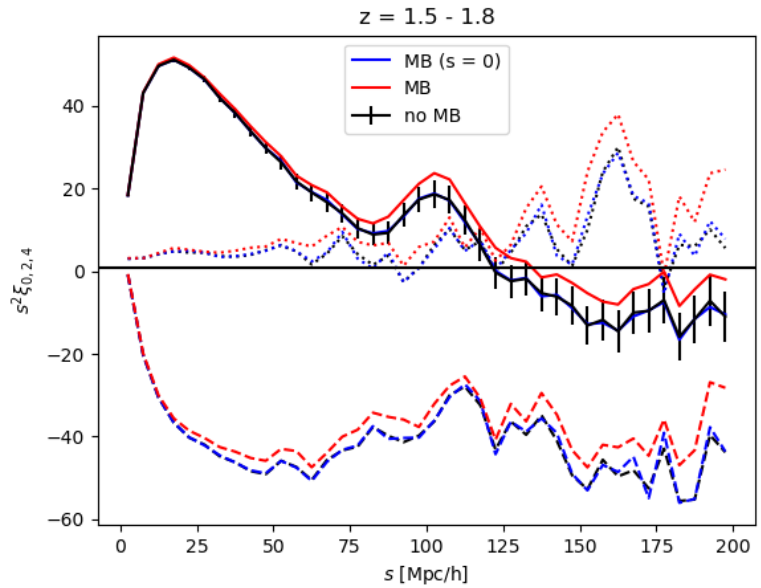
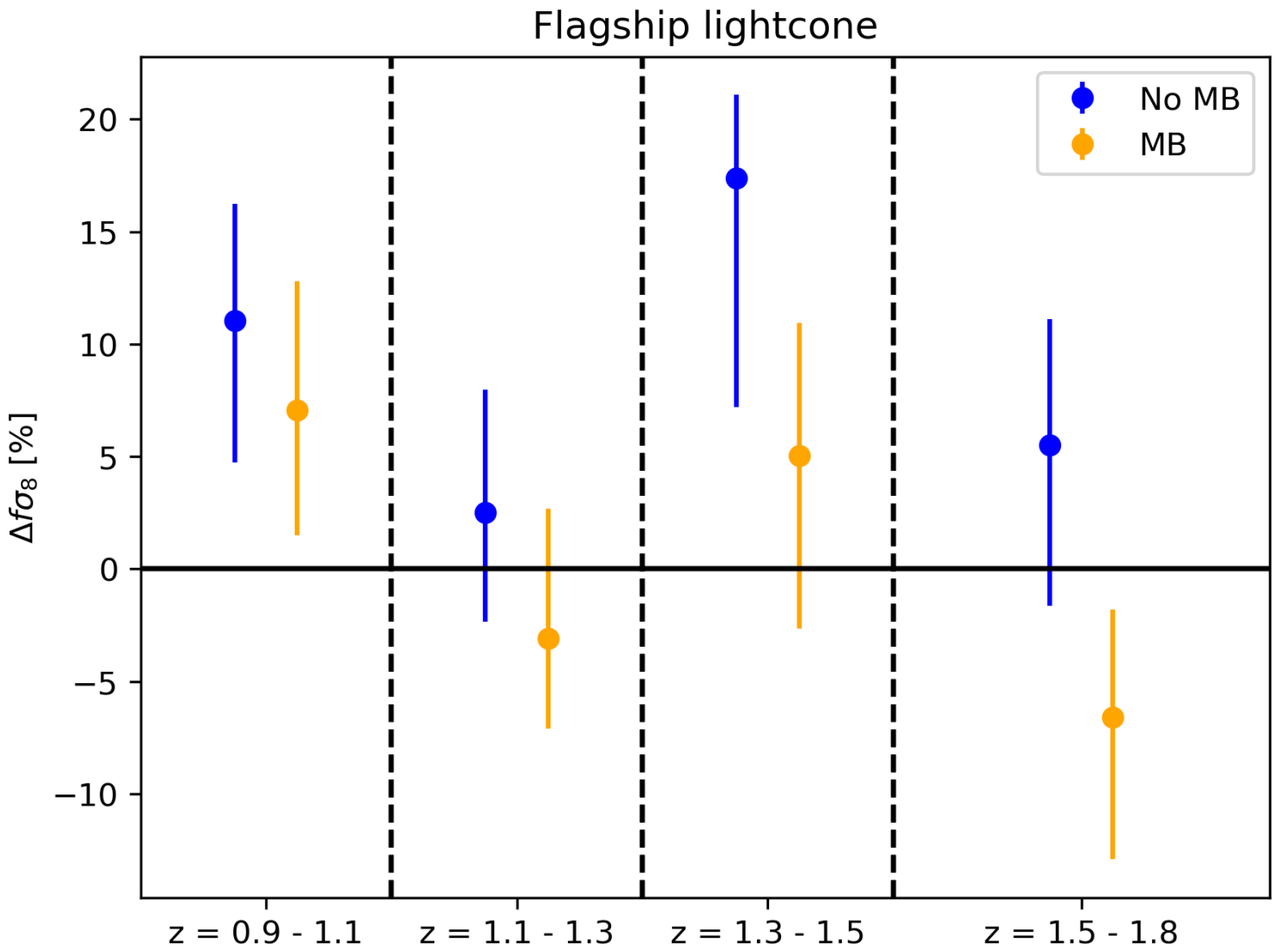








Final result



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- Large impact on $f\sigma_8$ estimation for high-z redshift bins

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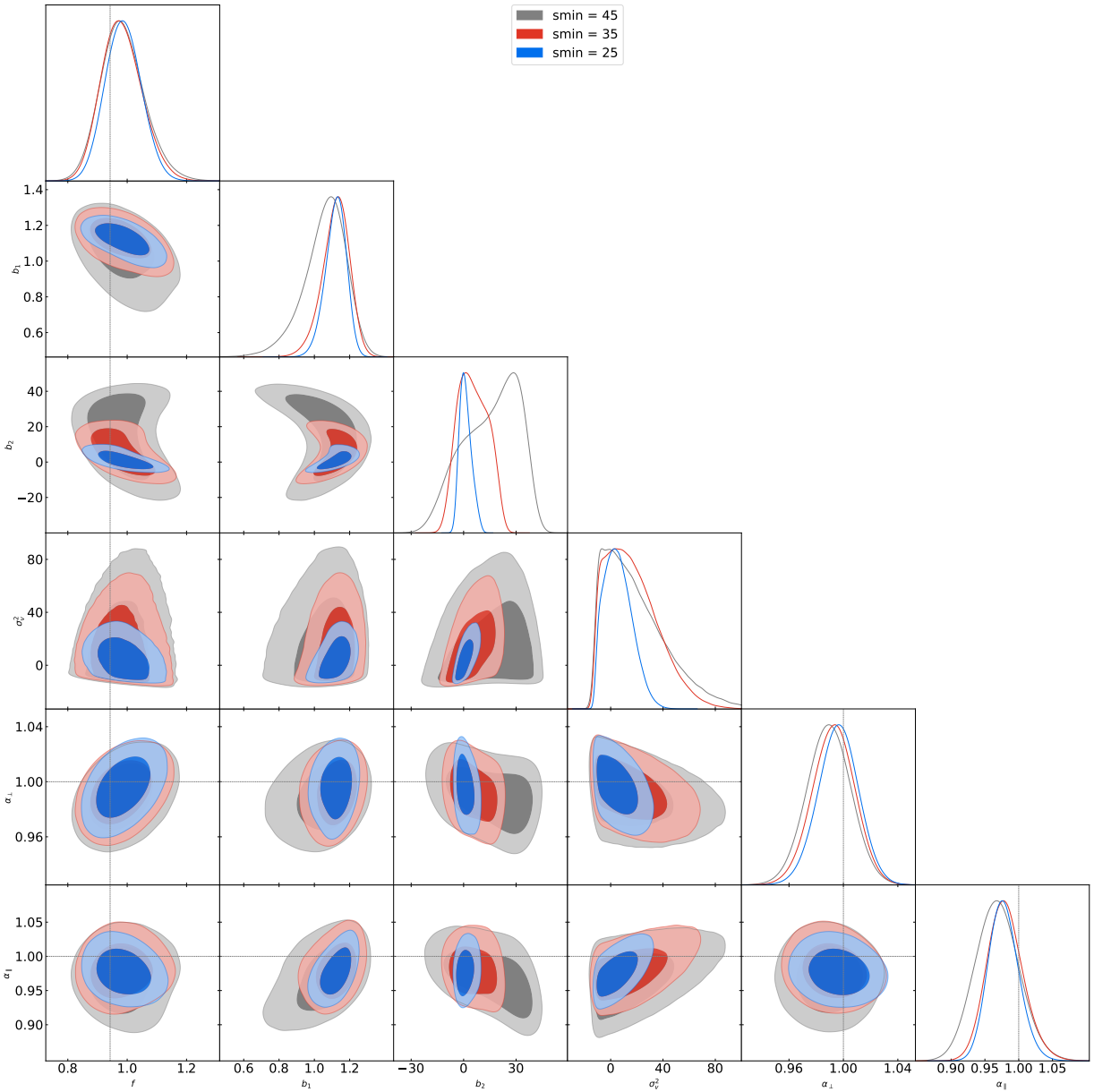
- Light-cone : need to account for magnification bias
- Number count $\Delta_{\mathrm{MB}} = (5s - \cancel{2})\kappa$ (Need to wait for Flagship 2)
- Large impact on $f\sigma_8$ estimation for high-z redshift bins
- Need to implement this correction for likelihood analysis (ongoing)

Flagship simulation light-cone ($z = 1.5$ - 1.8)



Redshift-space number count (linear) decomposition

$$\Delta^{\rm std} = b\delta - \frac{1}{\mathcal{H}}\nabla_r(\boldsymbol{v}\cdot\boldsymbol{n}), \tag{2}$$

$$\Delta^{\rm acc} = \frac{1}{\mathcal{H}c}\dot{\boldsymbol{v}}\cdot\boldsymbol{n}, \tag{3}$$

$$\Delta^{\rm q} = -\frac{\dot{\mathcal{H}}}{c\mathcal{H}^2}\boldsymbol{v}\cdot\boldsymbol{n}, \tag{4}$$

$$\Delta^{\rm div} = -\frac{2}{\mathcal{H}\chi}\boldsymbol{v}\cdot\boldsymbol{n}, \tag{5}$$

$$\Delta^{\rm pot,(1)} = \frac{1}{\mathcal{H}c}\boldsymbol{\nabla}_r\psi\cdot\boldsymbol{n}, \tag{6}$$

$$\Delta^{\rm pot,(2)} = \left(\frac{\dot{\mathcal{H}}}{\mathcal{H}^2} + \frac{2c}{\mathcal{H}\chi}\right)\psi/c^2 - \frac{1}{\mathcal{H}c^2}\dot{\psi}, \tag{7}$$

$$\Delta^{\rm shapiro} = (\phi+\psi)/c^2, \tag{8}$$

$$\Delta^{\rm lens} = -\frac{1}{c^2}\int_0^\chi \frac{(\chi-\chi')\chi'}{\chi}\nabla_\perp^2(\phi+\psi)d\chi', \tag{9}$$

$$\Delta^{\rm isw} = \frac{1}{\mathcal{H}c^2}(\dot{\phi}+\dot{\psi}), \tag{10}$$

$$\Delta^{\rm LC} = \boldsymbol{v}\cdot\boldsymbol{n}/c, \tag{11}$$

$$\Delta_{\rm neglect} = \left(\frac{\dot{\mathcal{H}}}{\mathcal{H}^2} + \frac{2c}{\mathcal{H}\chi}\right)\frac{1}{c^2}\int_\eta^{\eta_0}\frac{\partial(\phi+\psi)}{\partial\eta}d\eta' + \frac{2}{\chi c^2}\int_0^\chi(\phi+\psi)d\chi'. \tag{12}$$