NILC results for PICO

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10 Jan 2021

To-do list

- ❑ Model 90.91:
  - $r = 0$ (10 realizations of CMB and noise)
  - $r = 0.003$ (10 realizations of CMB and noise)
- ❑ Model 90.92:
  - $r = 0$ (10 realizations of CMB and noise)
  - $r = 0.003$ (10 realizations of CMB and noise)

To-do list

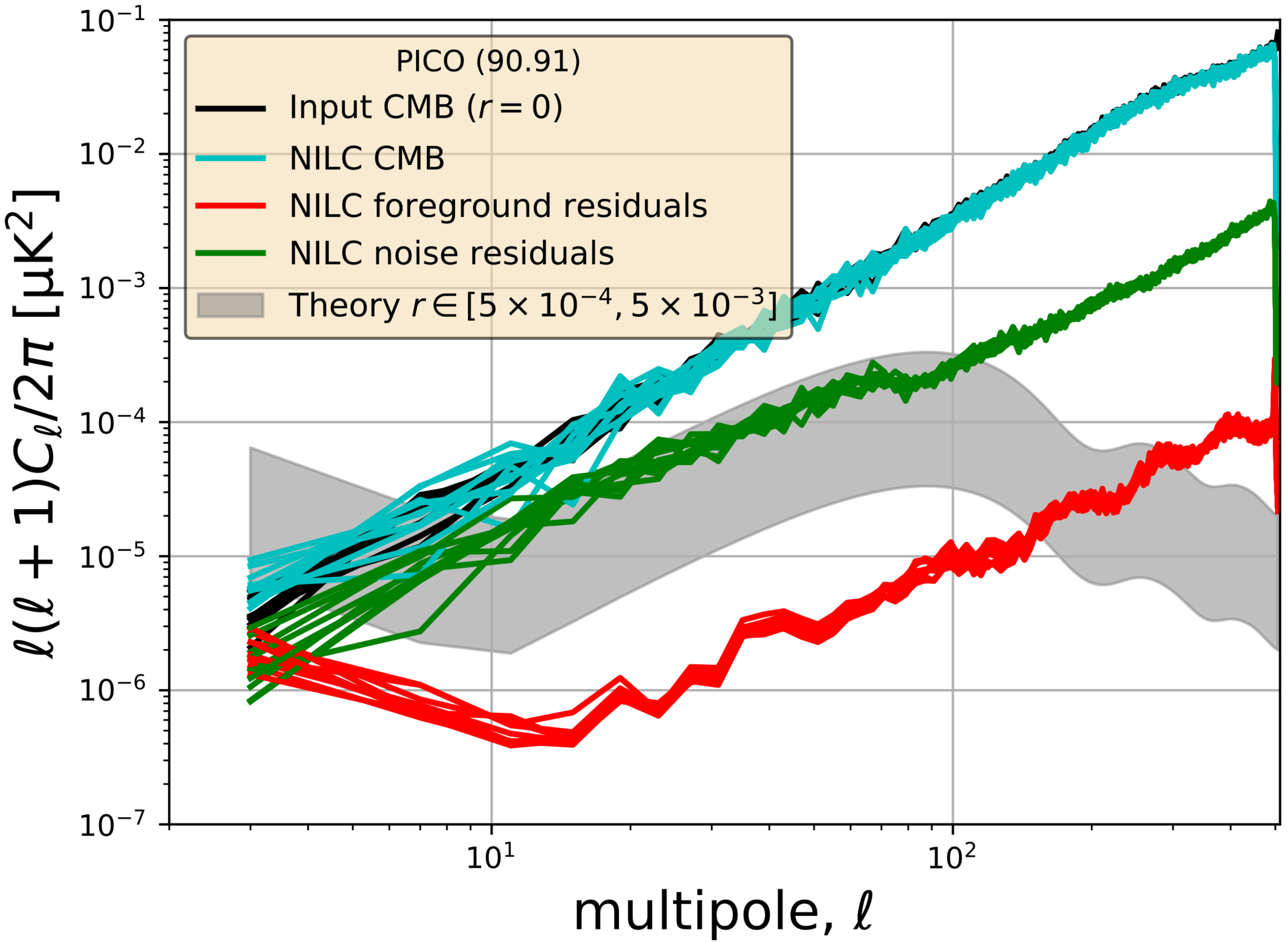
- ❑ Model 90.91:
  - ✓ done! $r = 0$ (10 realizations of CMB and noise)
  - ✓ done! $r = 0.003$ (10 realizations of CMB and noise)
- ❑ Model 90.92:
  - ✓ done! $r = 0$ (10 realizations of CMB and noise)
  - ✓ done! $r = 0.003$ (10 realizations of CMB and noise)

$$r = 0$$

90.91 & 90.92

90.91, $r = 0$

NILC



10 realizations

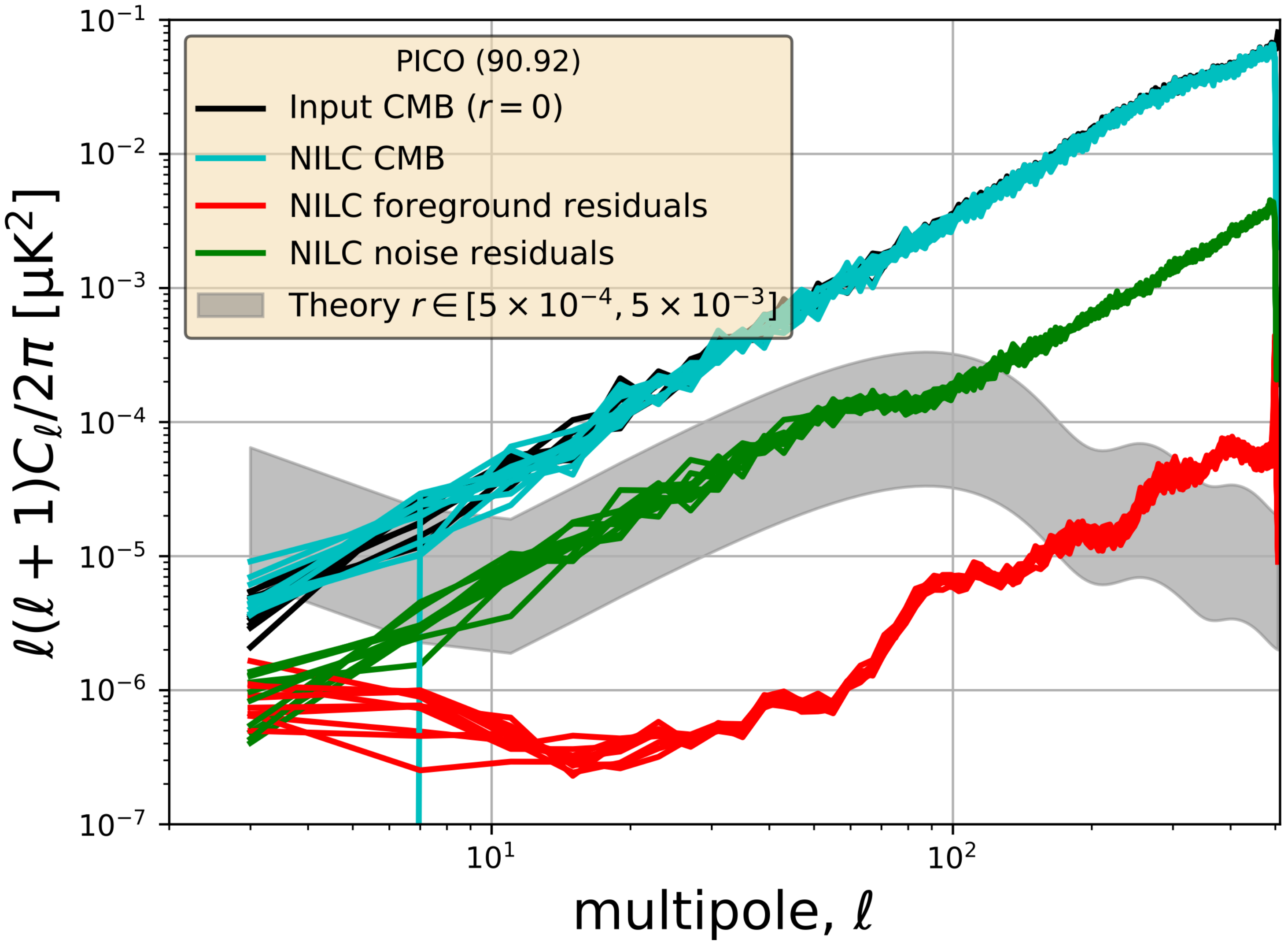
MASTER

$f_{\rm sky} = 50\%$

Binning: $\Delta\ell = 4$

90.92, $r = 0$

NILC



10 realizations

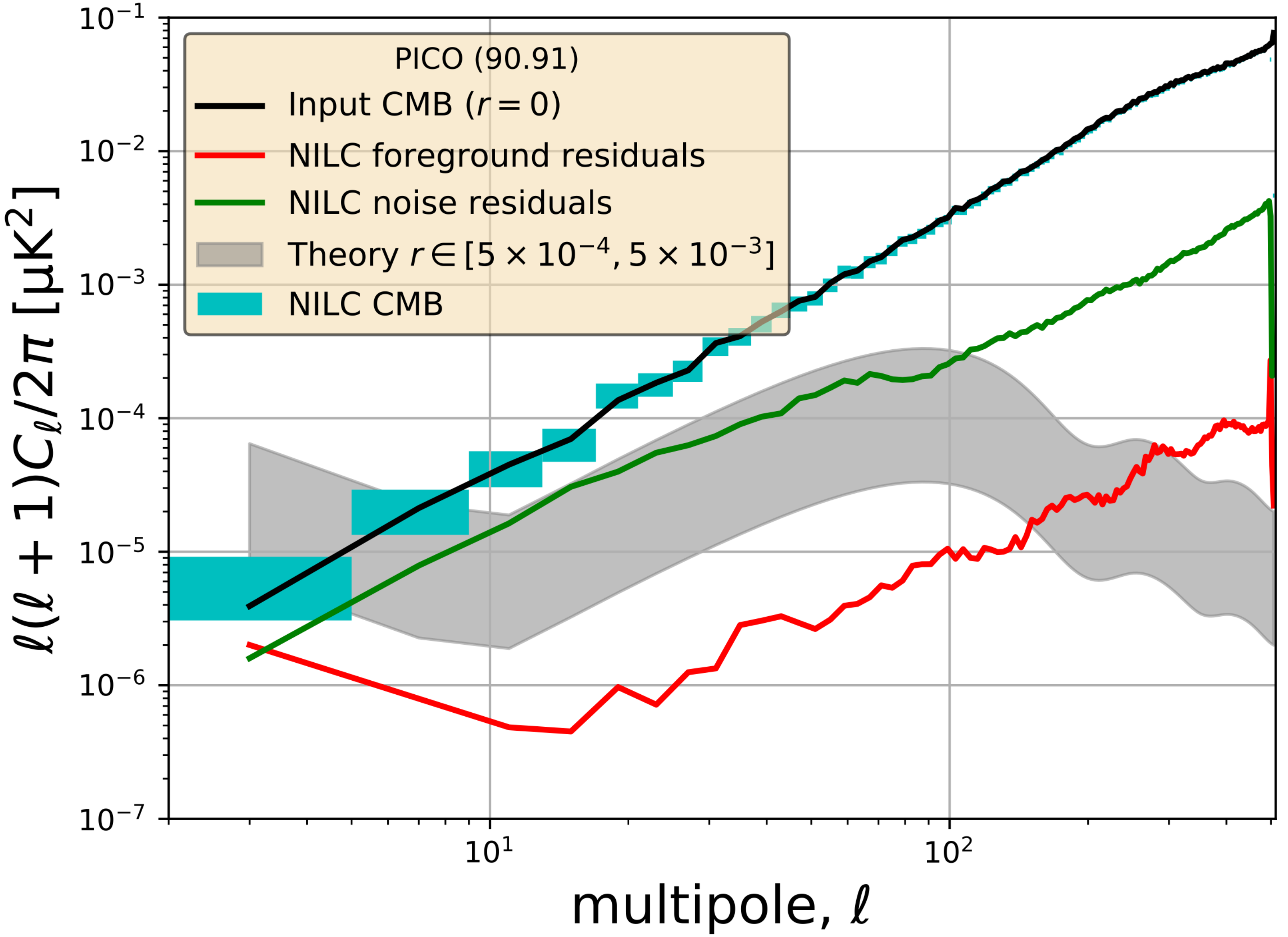
MASTER

$f_{\mathrm{sky}} = 50\%$

Binning: $\Delta\ell = 4$

90.91, $r = 0$

NILC



10 realizations

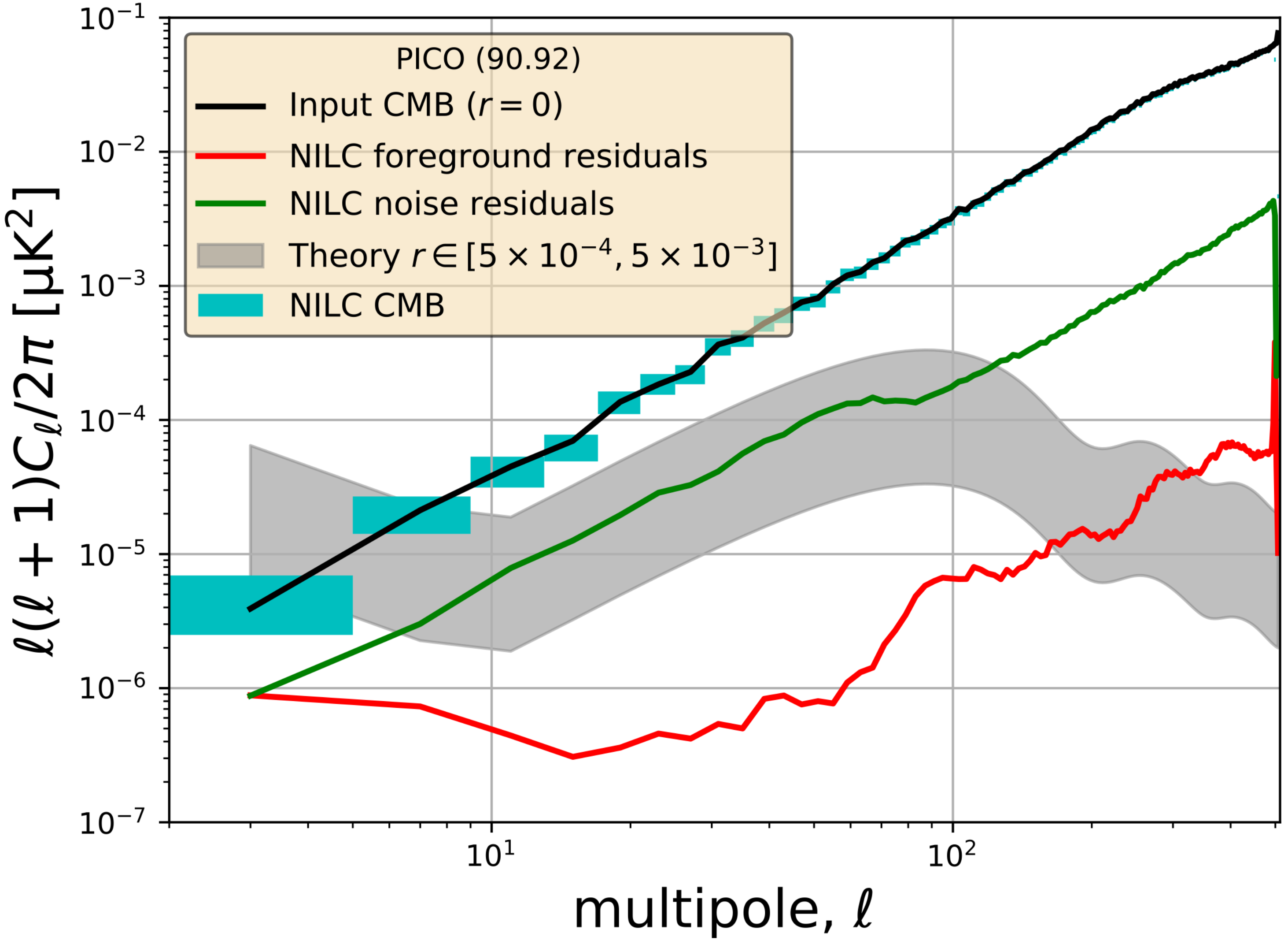
MASTER

$f_{\rm sky} = 50\%$

Binning: $\Delta\ell = 4$

90.92, $r = 0$

NILC



10 realizations

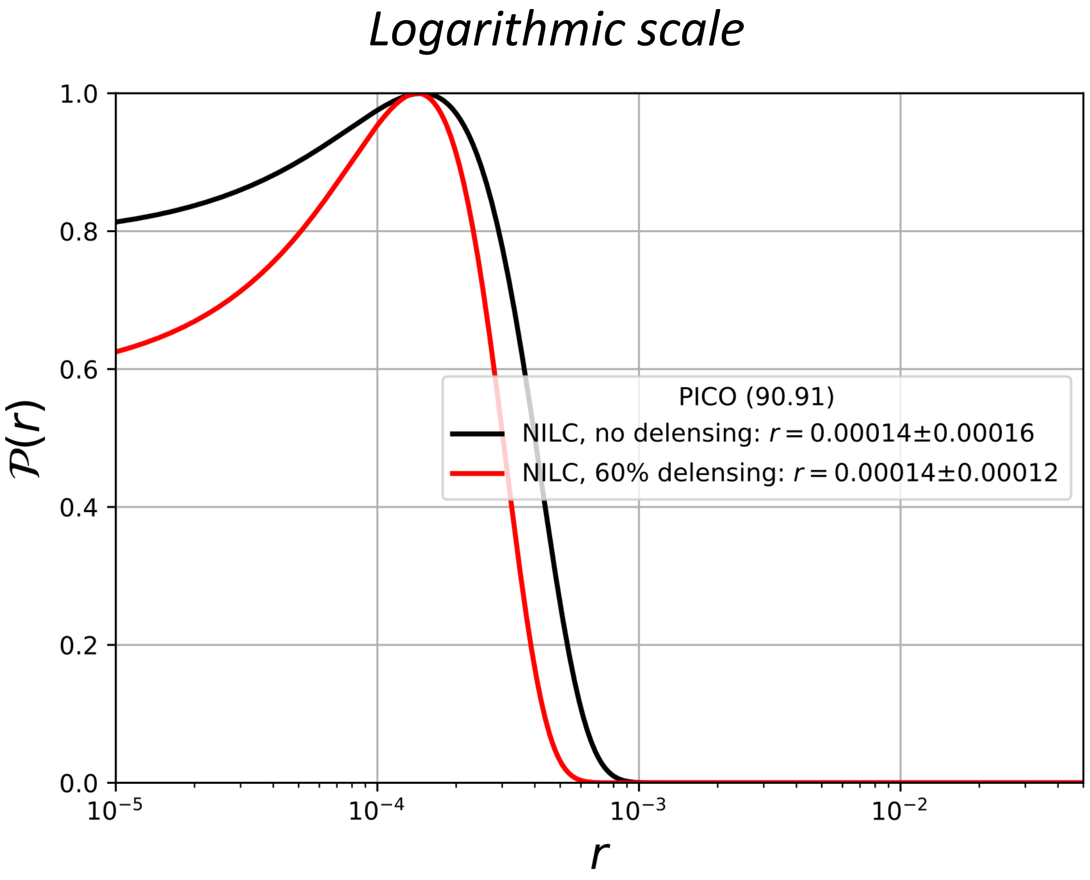
MASTER

$f_{\rm sky} = 50\%$

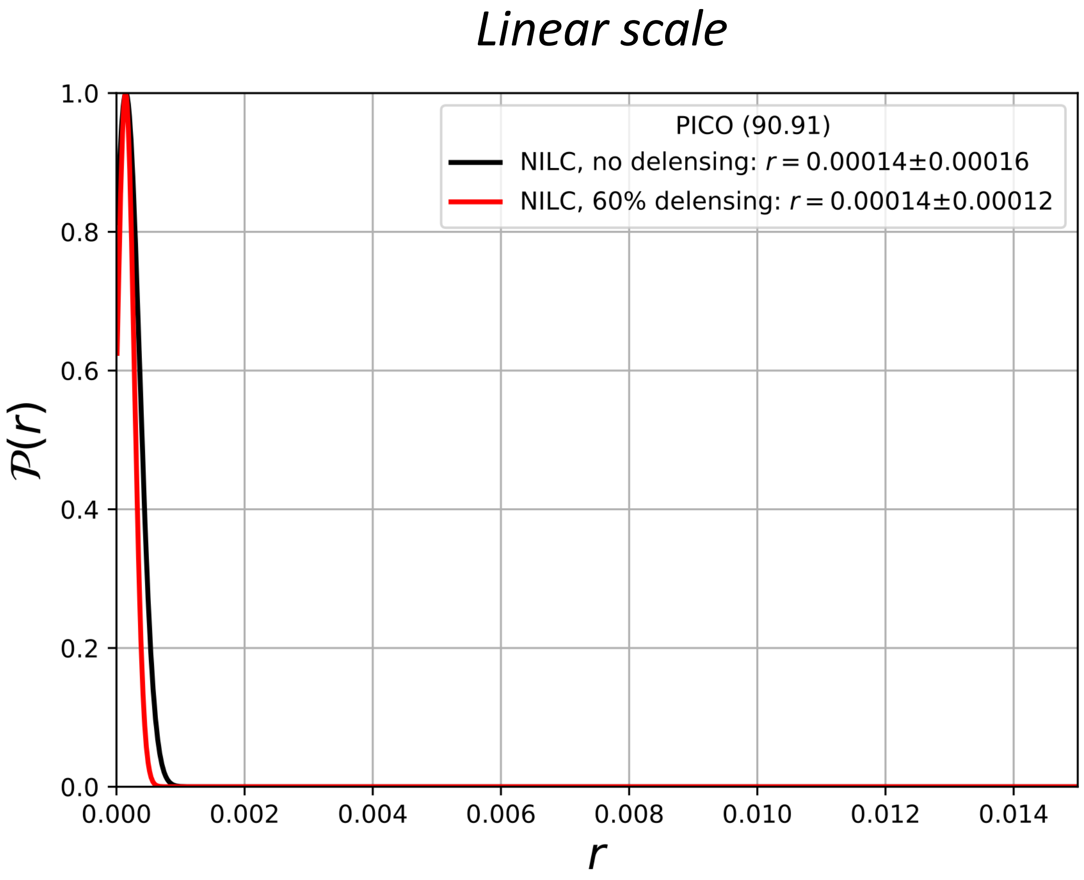
Binning: $\Delta\ell = 4$

90.91, $r = 0$

NILC



Logarithmic scale
PICO (90.91)
NILC, no delensing: r = 0.00014±0.00016
NILC, 60% delensing: r = 0.00014±0.00012
P(r)
r
1.0
0.8
0.6
0.4
0.2
0.0
10−5
10−4
10−3
10−2

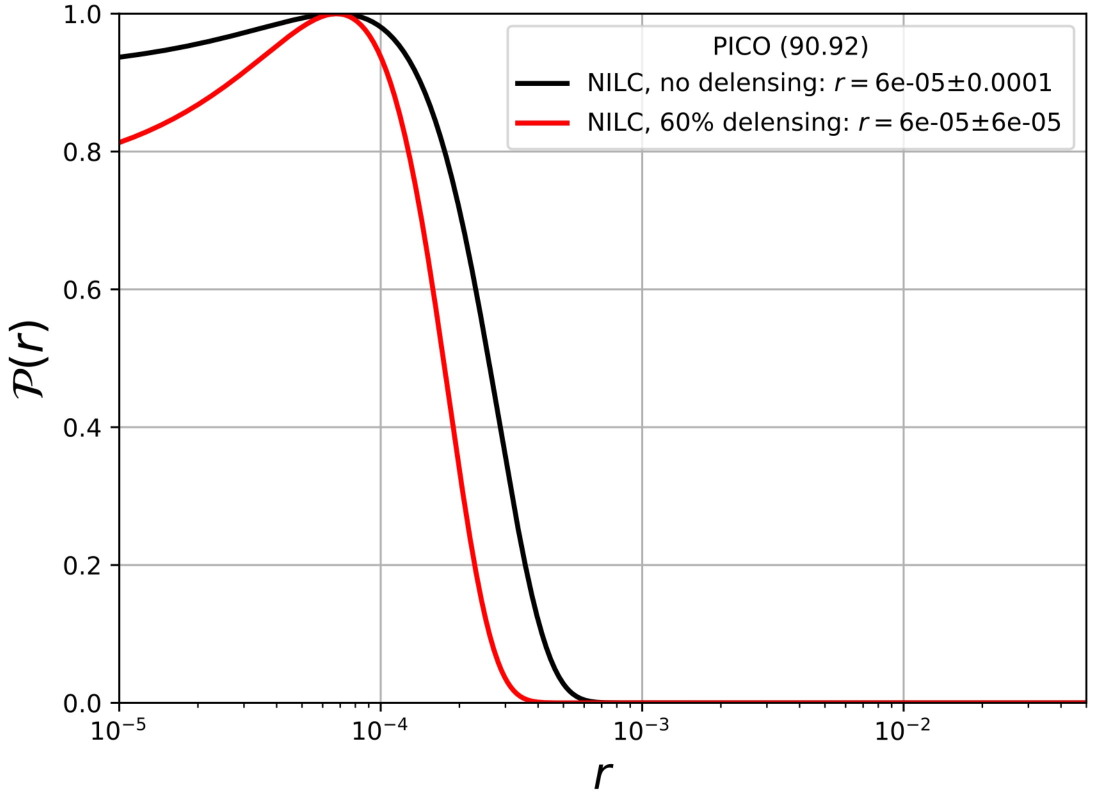


Linear scale
PICO (90.91)
NILC, no delensing: r = 0.00014±0.00016
NILC, 60% delensing: r = 0.00014±0.00012
P(r)
r
1.0
0.8
0.6
0.4
0.2
0.0
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014

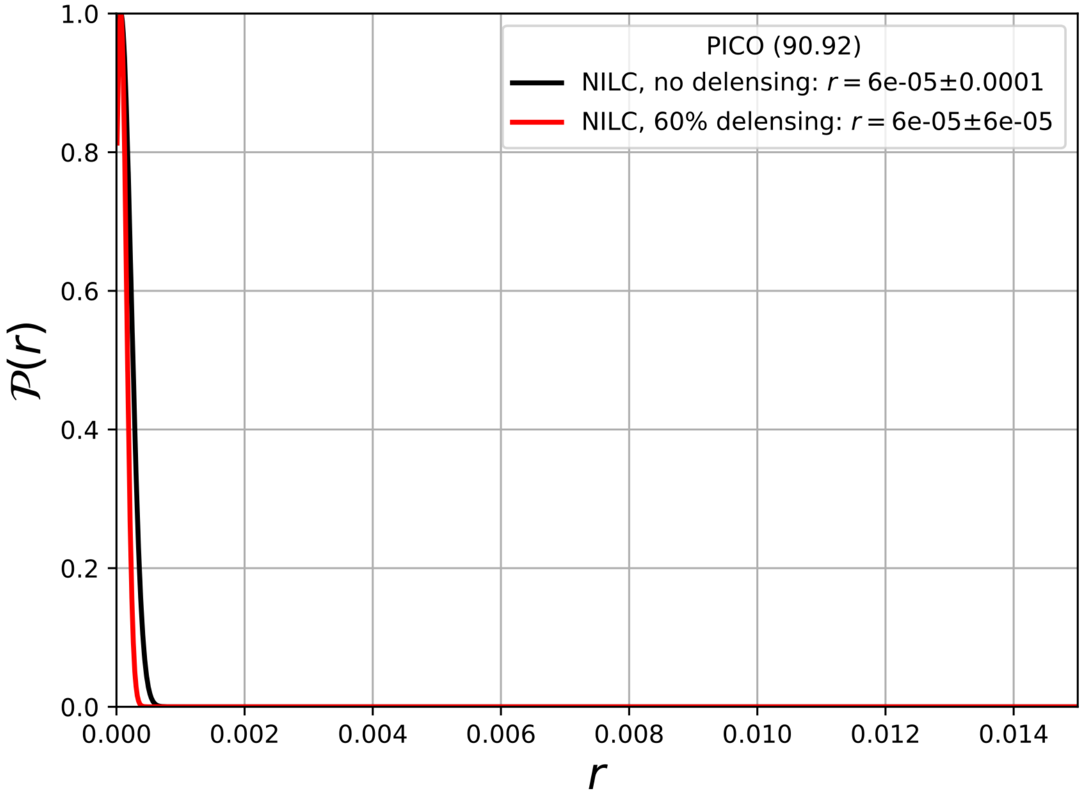
90.92, $r = 0$

NILC

Logarithmic scale



Linear scale

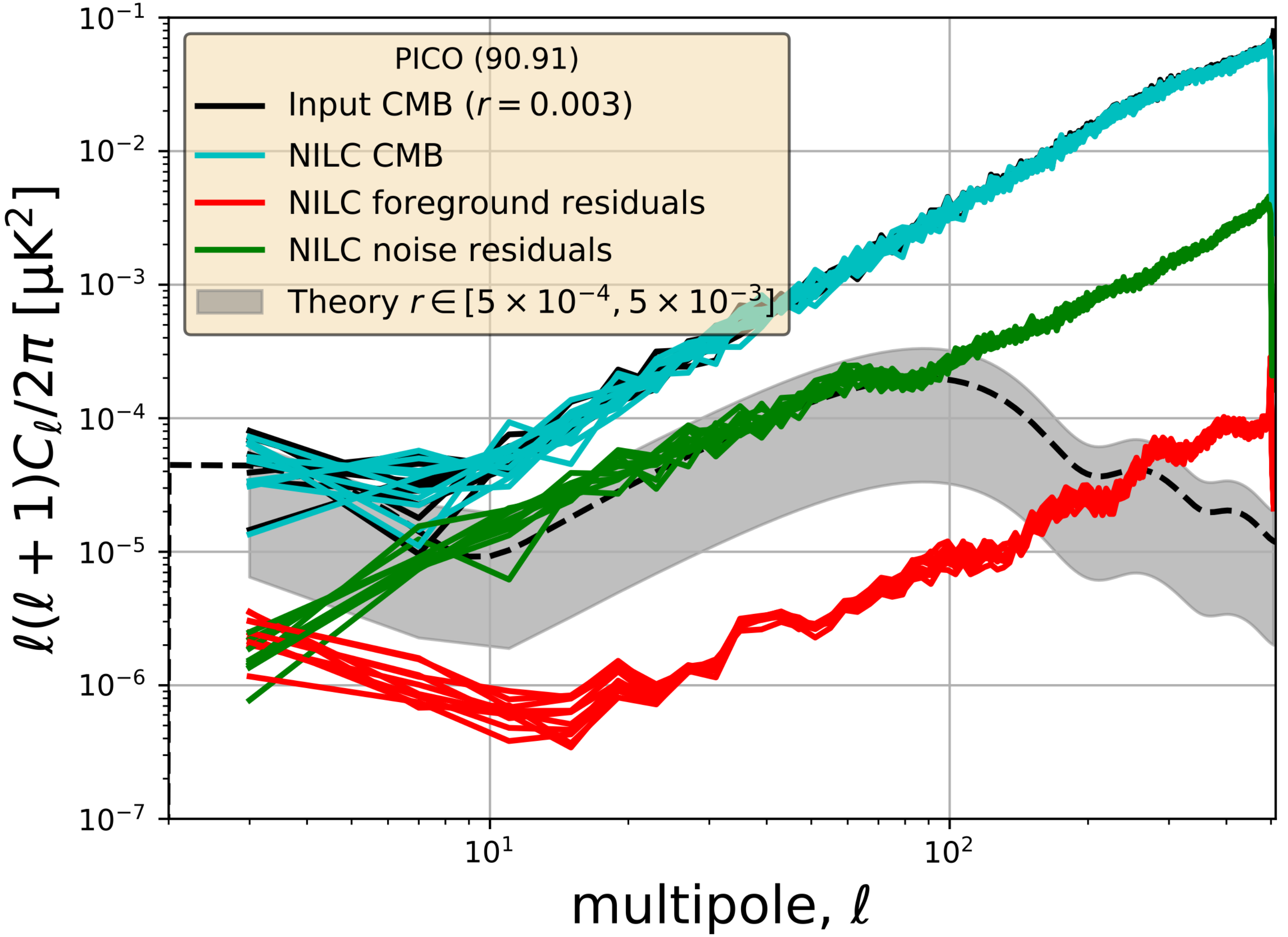


$$r = 0.003$$

90.91 & 90.92

90.91, $r = 0.003$

NILC



10 realizations

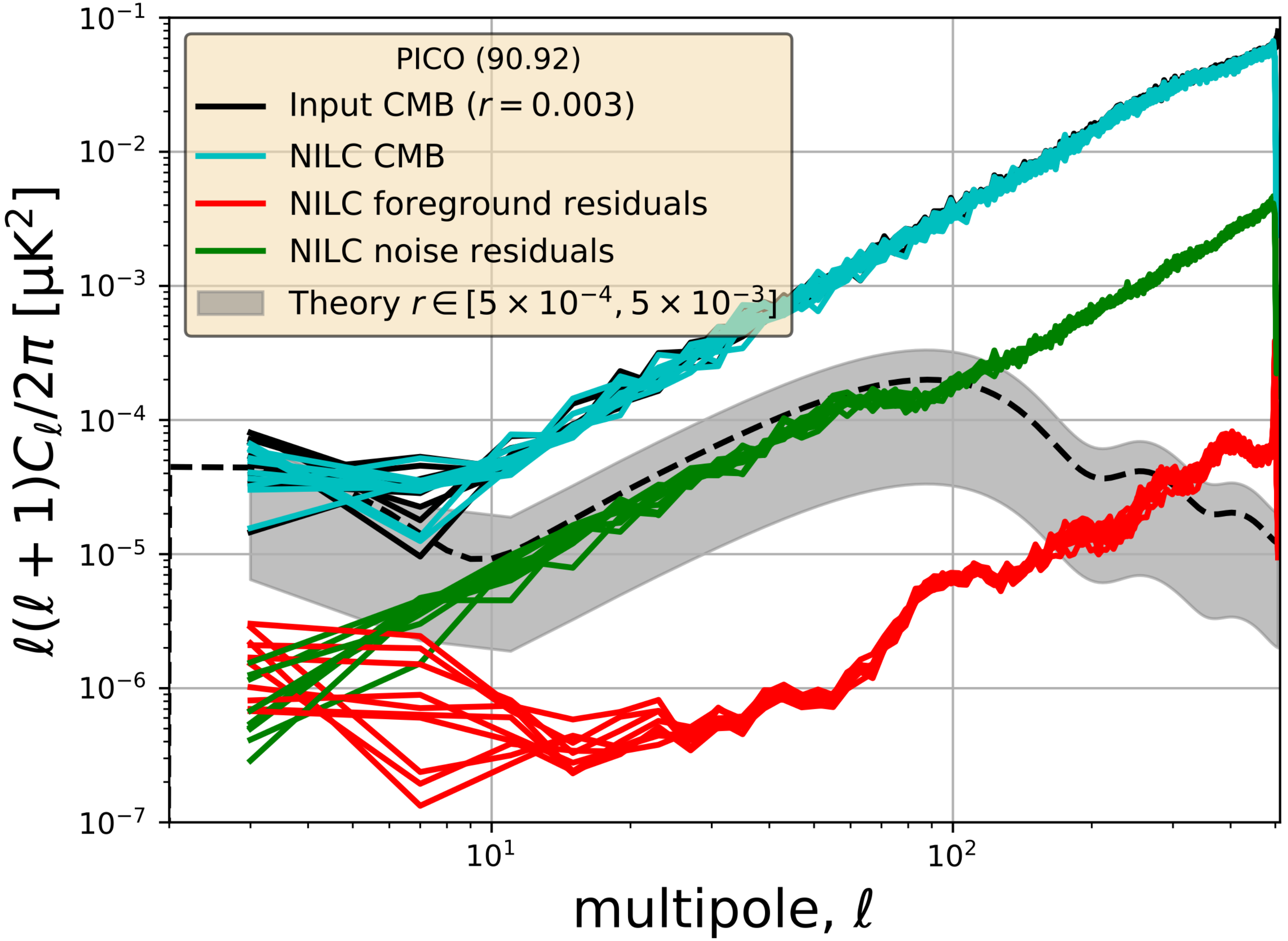
MASTER

$f_{\mathrm{sky}} = 50\%$

Binning: $\Delta\ell = 4$

90.92, $r = 0.003$

NILC



10 realizations

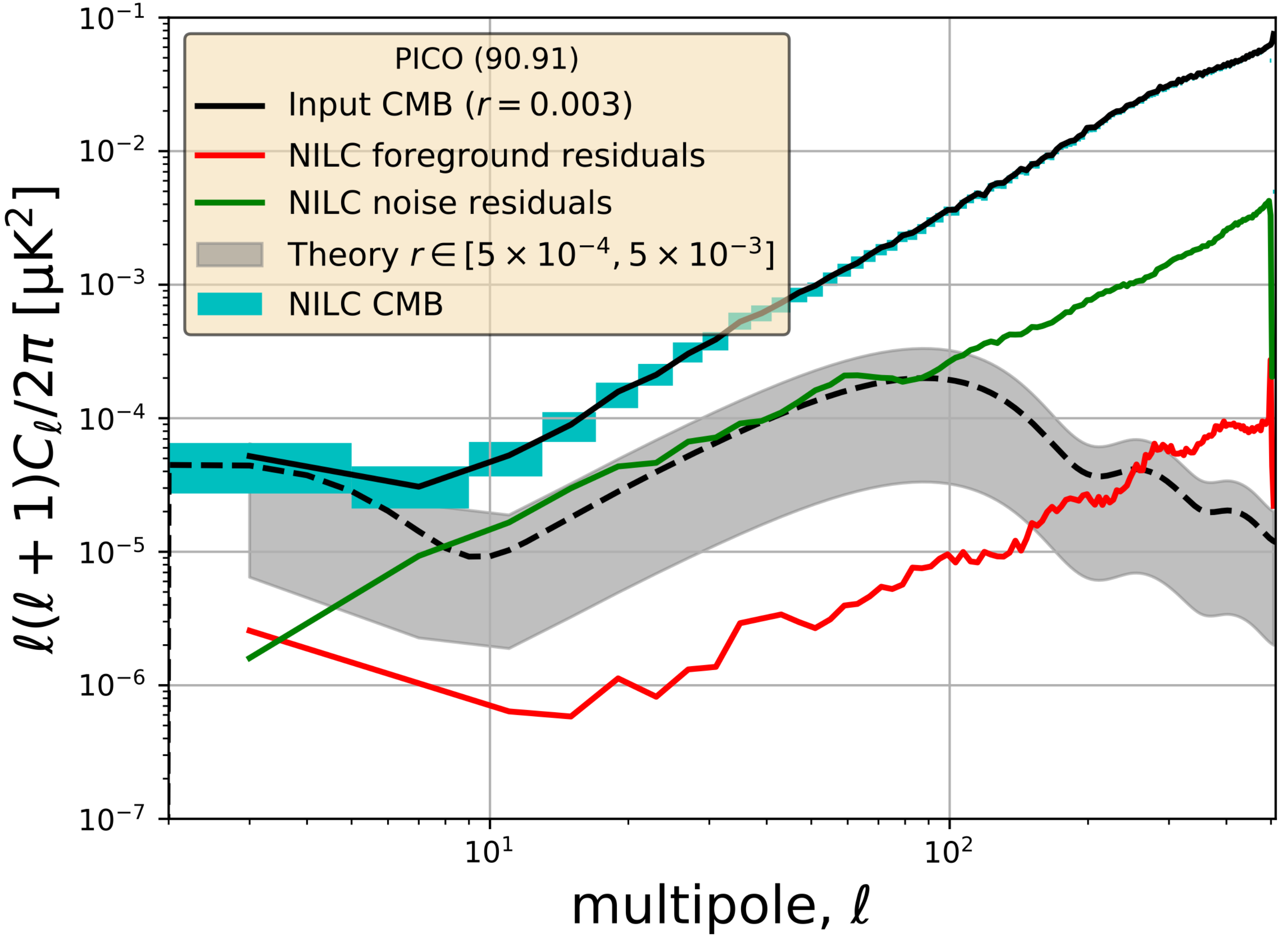
MASTER

$f_{\rm sky} = 50\%$

Binning: $\Delta\ell = 4$

90.91, $r = 0.003$

NILC



10 realizations

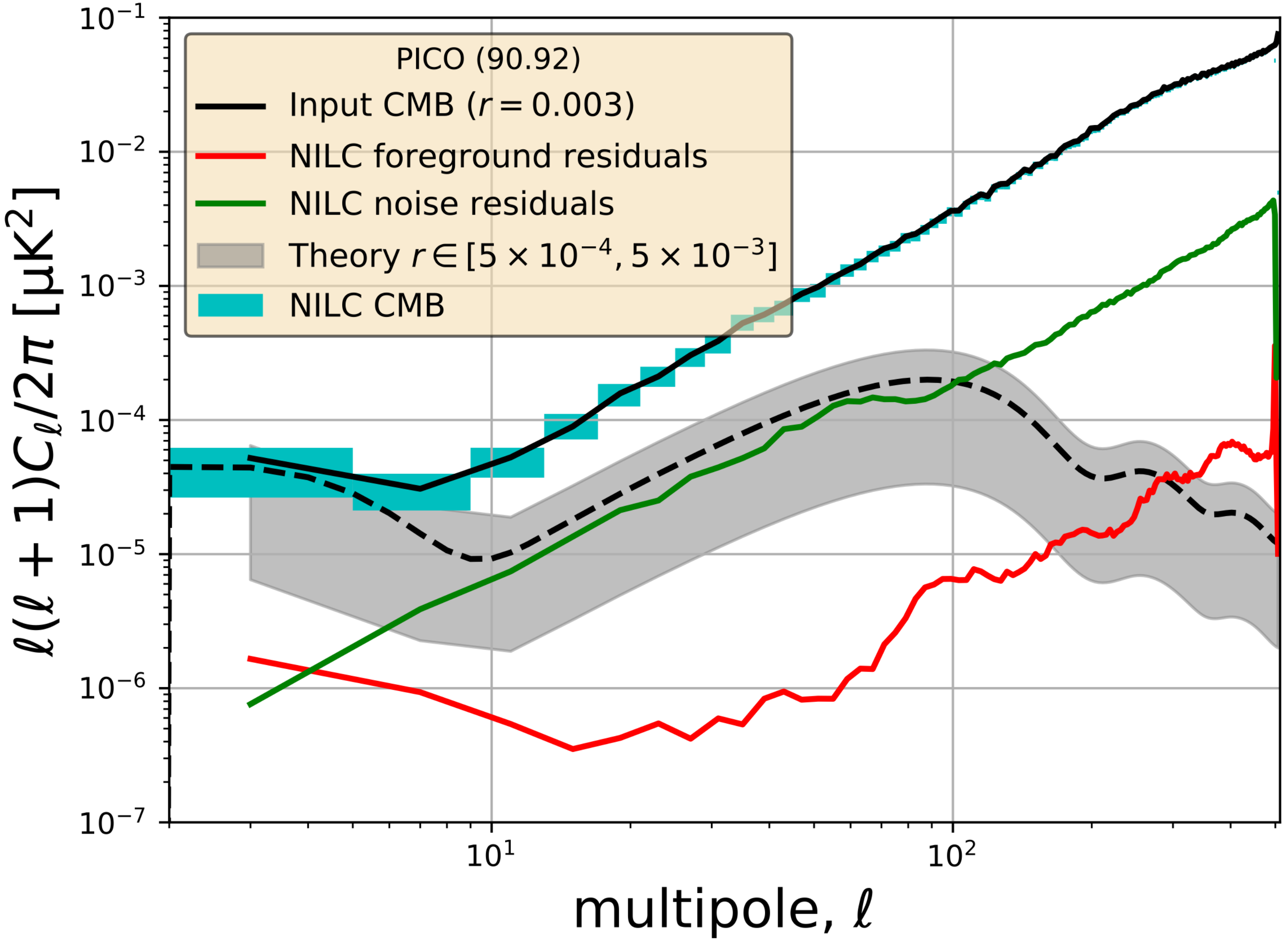
MASTER

$f_{\rm sky} = 50\%$

Binning: $\Delta\ell = 4$

90.92, $r = 0.003$

NILC



10 realizations

MASTER

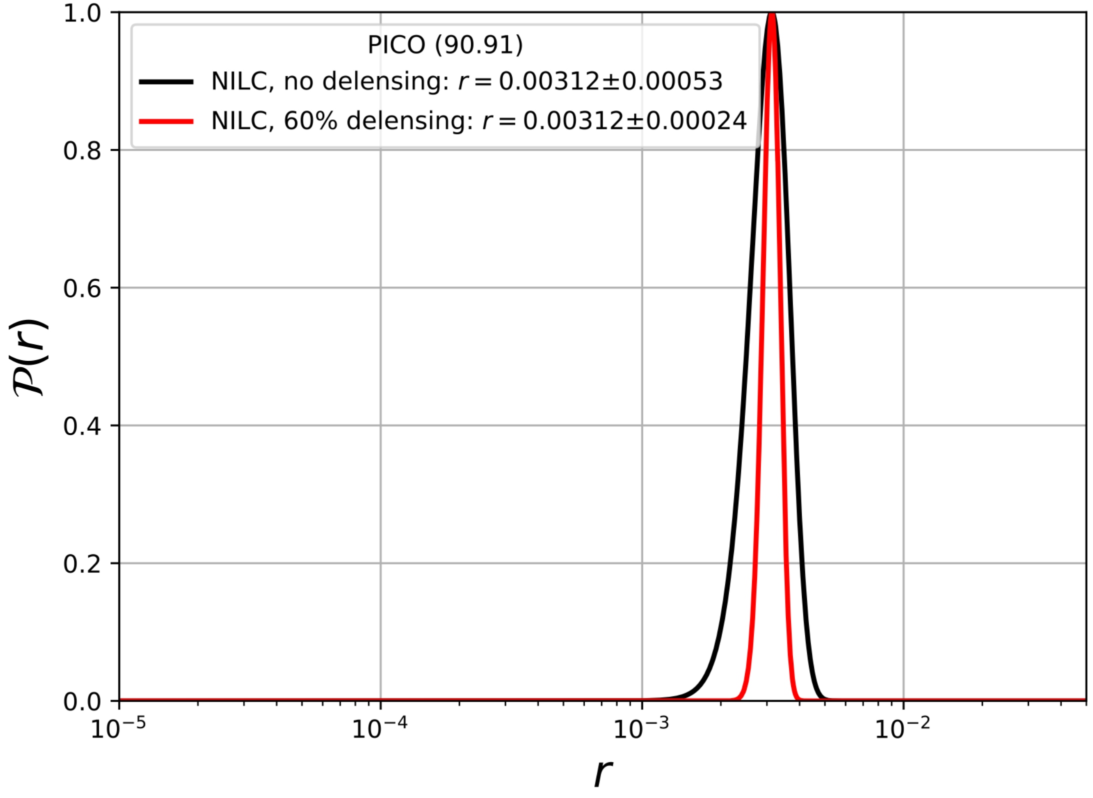
$f_{\mathrm{sky}} = 50\%$

Binning: $\Delta\ell = 4$

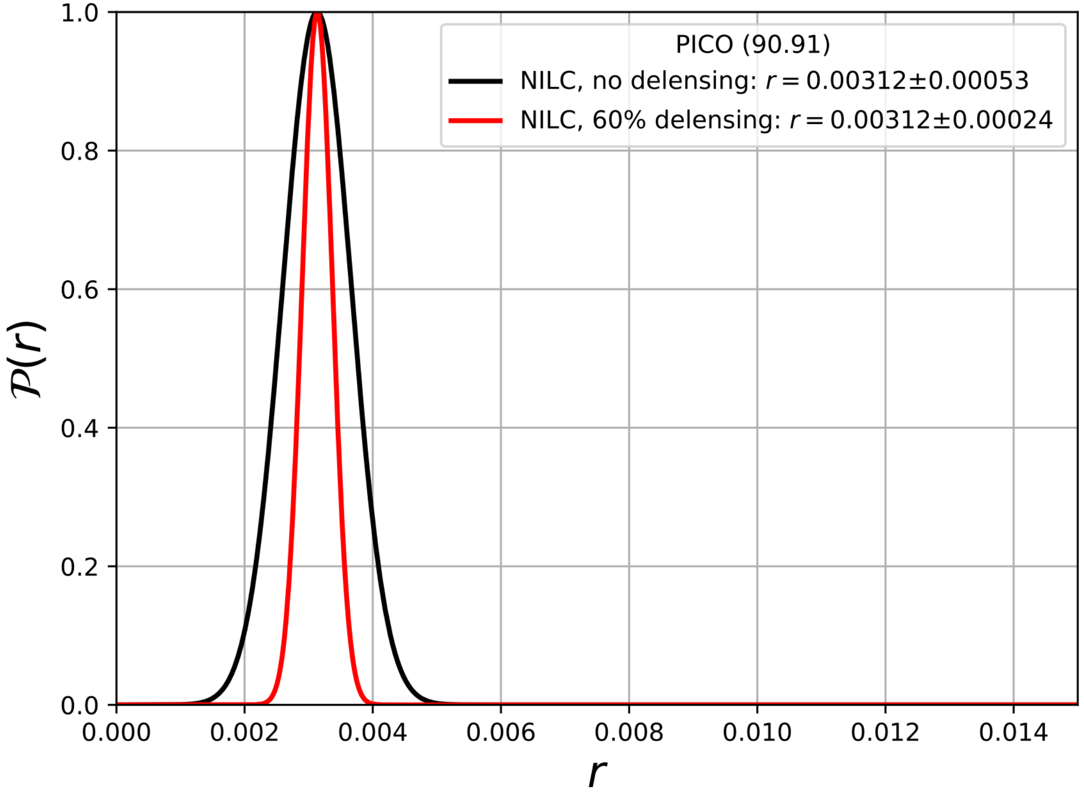
90.91, $r = 0.003$

NILC

Logarithmic scale



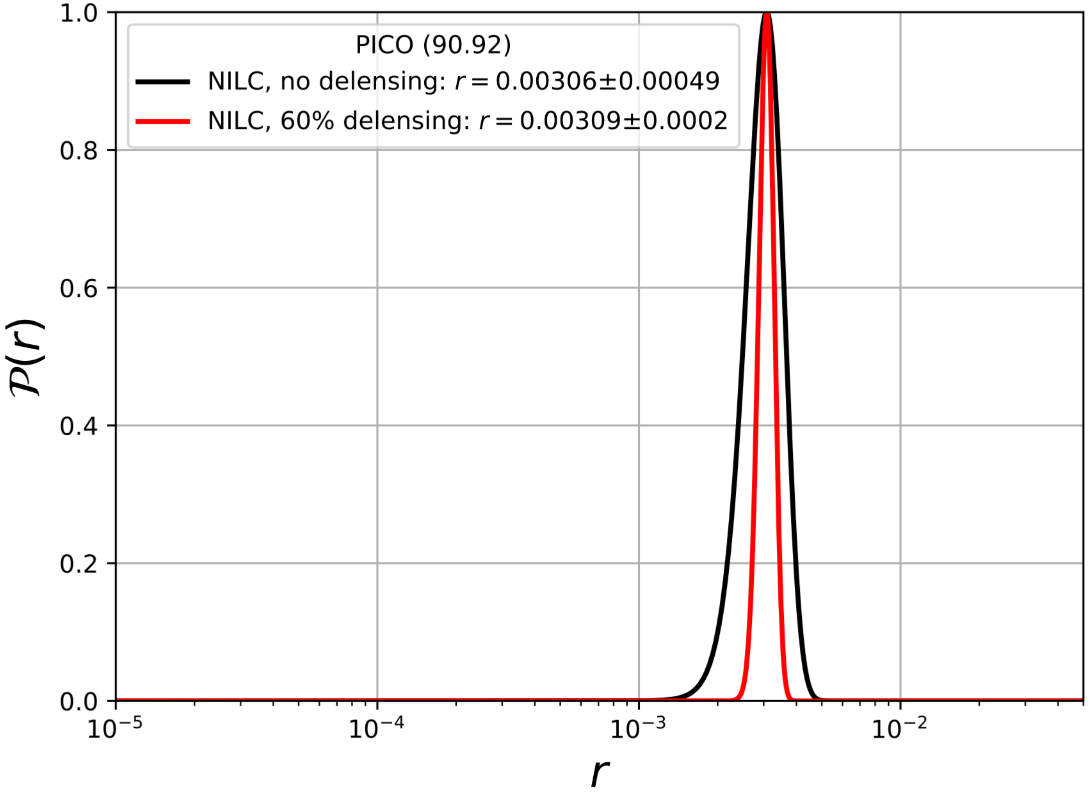
Linear scale



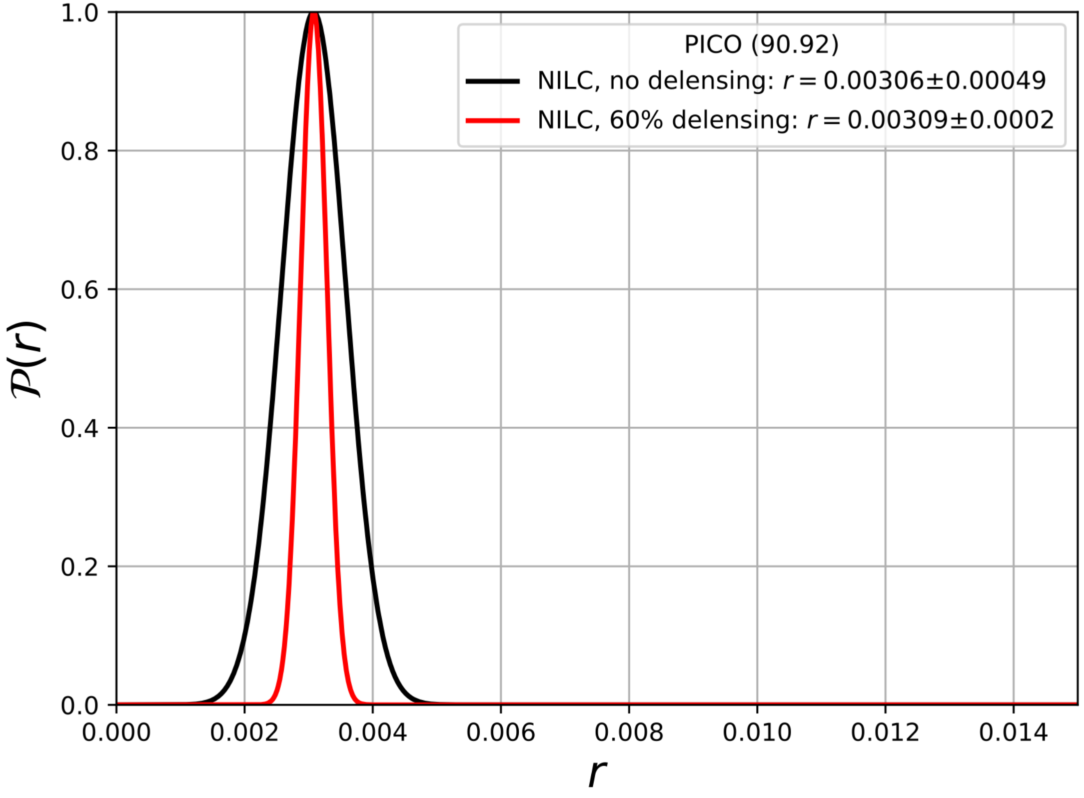
90.92, $r = 0.003$

NILC

Logarithmic scale



Linear scale



Note on the likelihood

The component separation exercise has been performed on sky maps with full lensing contamination.

Suppose that PICO can perform e.g. 60% delensing, then the fraction of residual lensing power will be $A_L = 0.4$ after delensing.

Now for the r forecasts, we do the following shortcut to account for "delensing":

- $C_\ell^{BB,\mathrm{NILC}}$ is corrected for the residual noise bias and the residual lensing bias:

$$C_\ell^{\mathrm{CMB}} + C_\ell^{\mathrm{fgds}} = C_\ell^{BB,\mathrm{NILC}} - C_\ell^{\mathrm{noise}} - A_L C_\ell^{\mathrm{lens}}$$

- Build a simple Gaussian likelihood to fit r only:

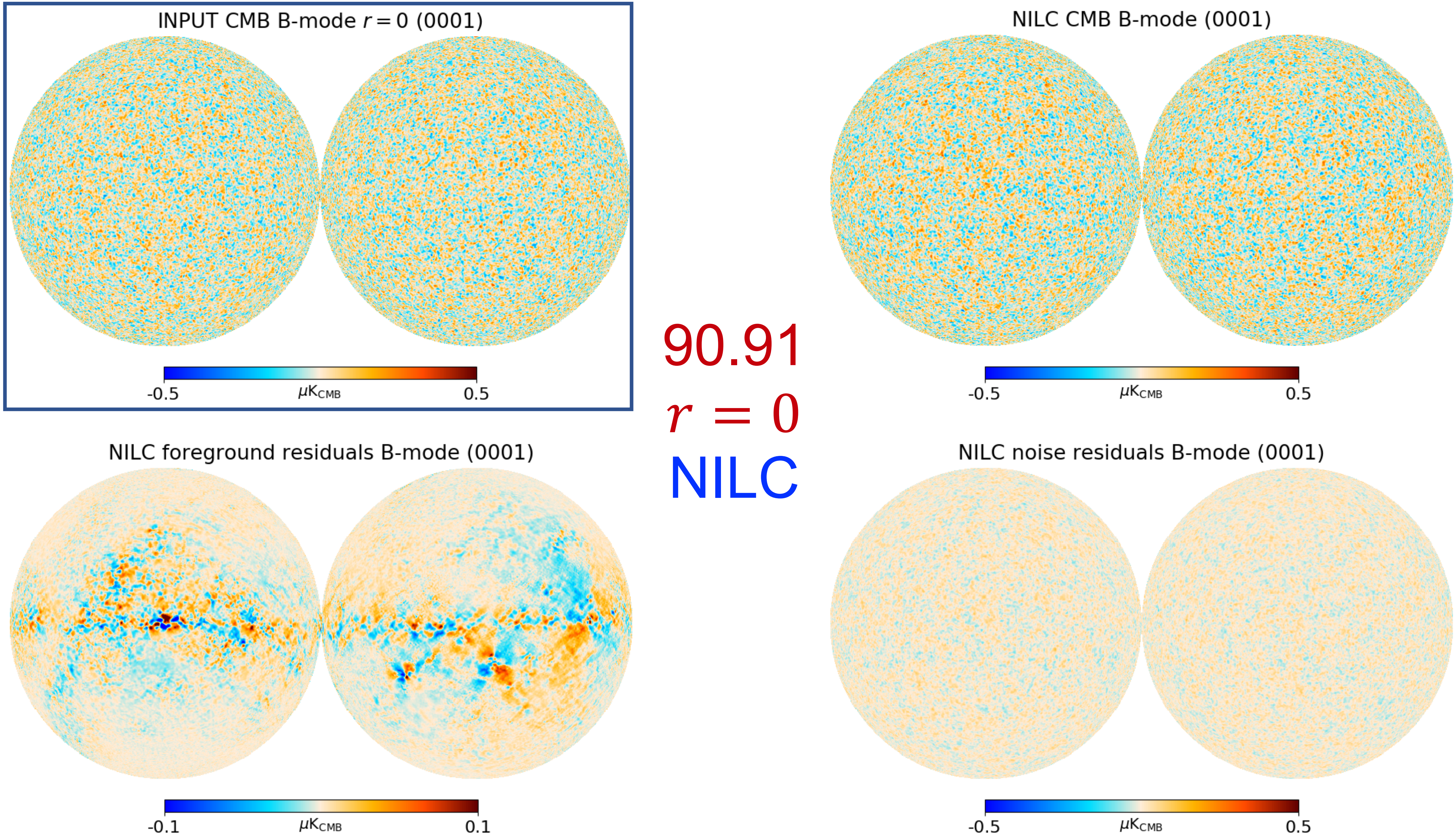
$$-2\ln\mathcal{L}(r) = \sum_{\ell=2}^{\ell_{\max}} \left(C_\ell^{\mathrm{CMB}} + C_\ell^{\mathrm{fgds}} - r\, C_\ell^{prim}(r=1)\right) \mathrm{M}_{\ell\ell'}^{-1} \left(C_\ell^{\mathrm{CMB}} + C_\ell^{\mathrm{fgds}} - r\, C_\ell^{prim}(r=1)\right)$$

- The covariance matrix includes cosmic/sample variance of residual lensing signal, residual foregrounds and residual noise (and cross-terms):

$$\mathrm{M}_{\ell\ell} = \frac{2}{(2\ell+1)f_{\mathrm{sky}}}\left(C_\ell^{BB,\mathrm{NILC}} - (1-A_L)C_\ell^{\mathrm{lens}}\right)^2 = \frac{2}{(2\ell+1)f_{\mathrm{sky}}}\left(C_\ell^{\mathrm{CMB}} + A_L C_\ell^{\mathrm{lens}} + C_\ell^{\mathrm{fgds}} + C_\ell^{\mathrm{noise}}\right)^2$$

Expected residual lensing cosmic variance

Backup


INPUT CMB B-mode $r = 0$ (0001)
-0.5
μK_{CMB}
0.5
NILC CMB B-mode (0001)
-0.5
μK_{CMB}
0.5
90.91
$r = 0$
NILC
NILC foreground residuals B-mode (0001)
-0.1
μK_{CMB}
0.1
NILC noise residuals B-mode (0001)
-0.5
μK_{CMB}
0.5