

CMB Lensing with S4

Neelima Sehgal

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With S4 Lens chapter and parallel session contributions from:

Gil Holder, Mathew Madhavacheril, Blake Sherwin, Kendrick
Smith, Kyle Story, Alexander van Engelen

- Brief Overview of Chapter
- Issues focused on in parallel

CMB Lensing does 2 things:

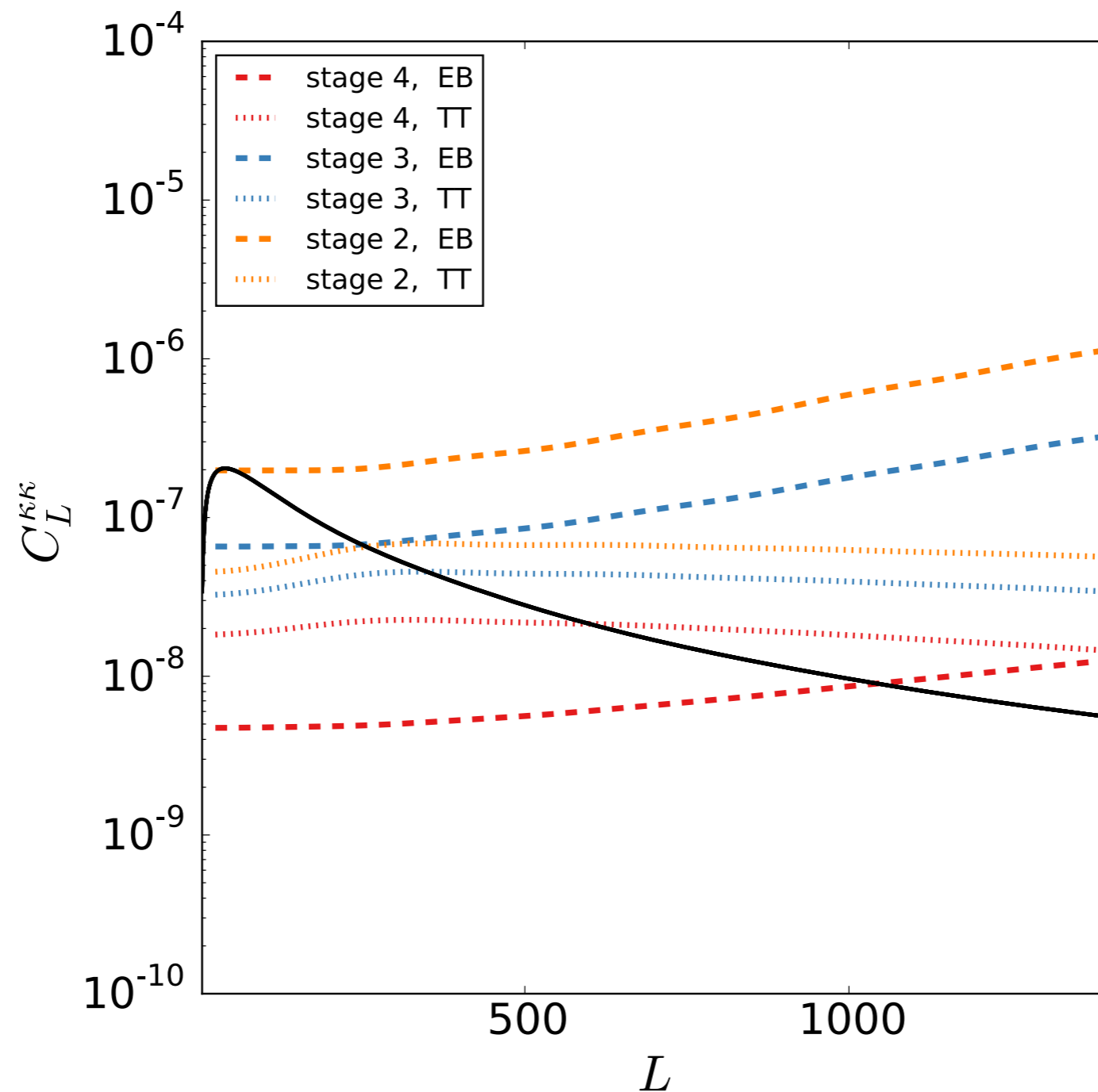
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- CMB lensing encodes info about large-scale structure — sensitive to neutrino mass and dark energy

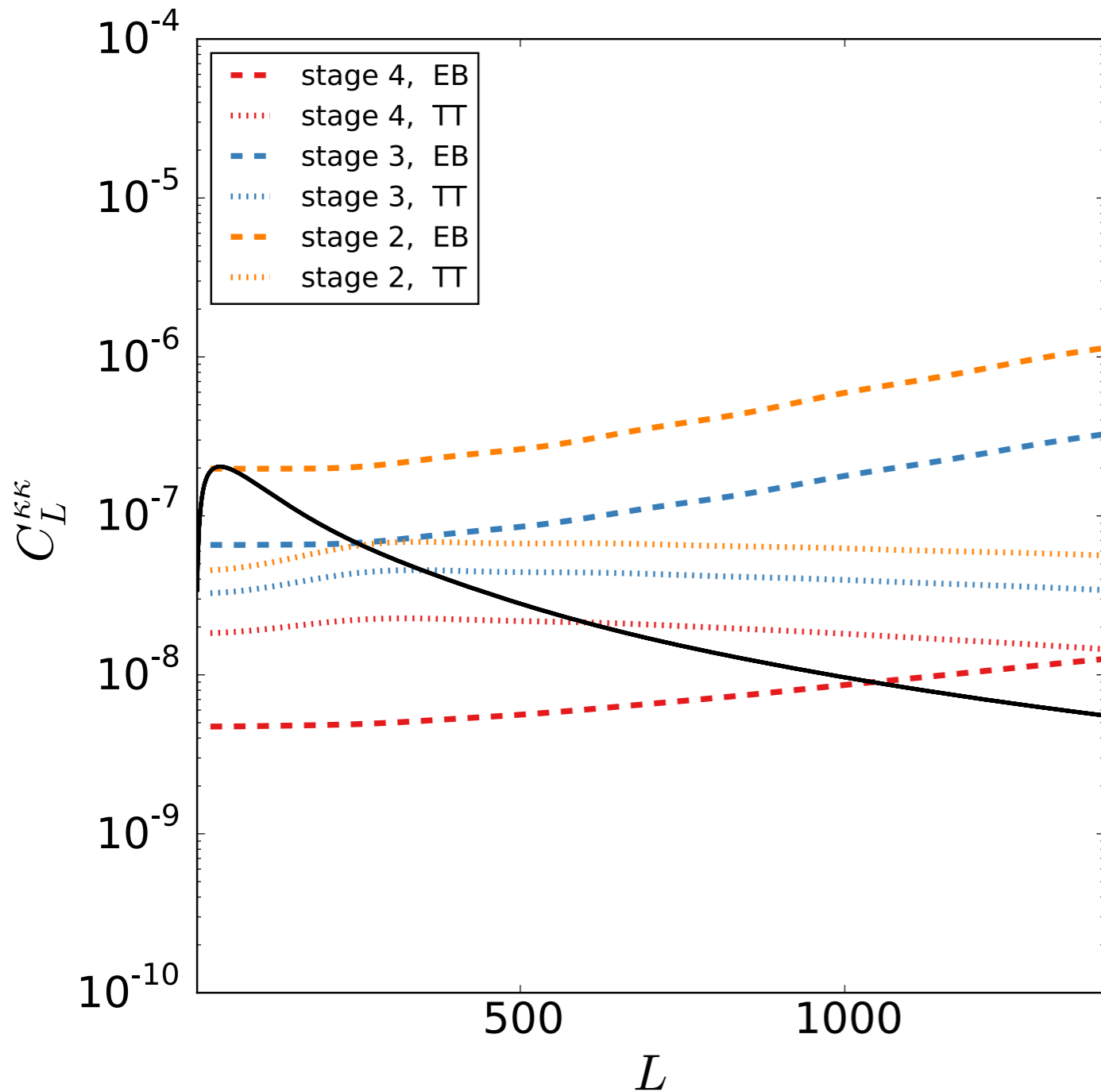
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- CMB lensing encodes info about large-scale structure — sensitive to neutrino mass and dark energy
- CMB lensing obscures our view of primordial Universe — removing lensing noise brings inflationary signals into sharper focus

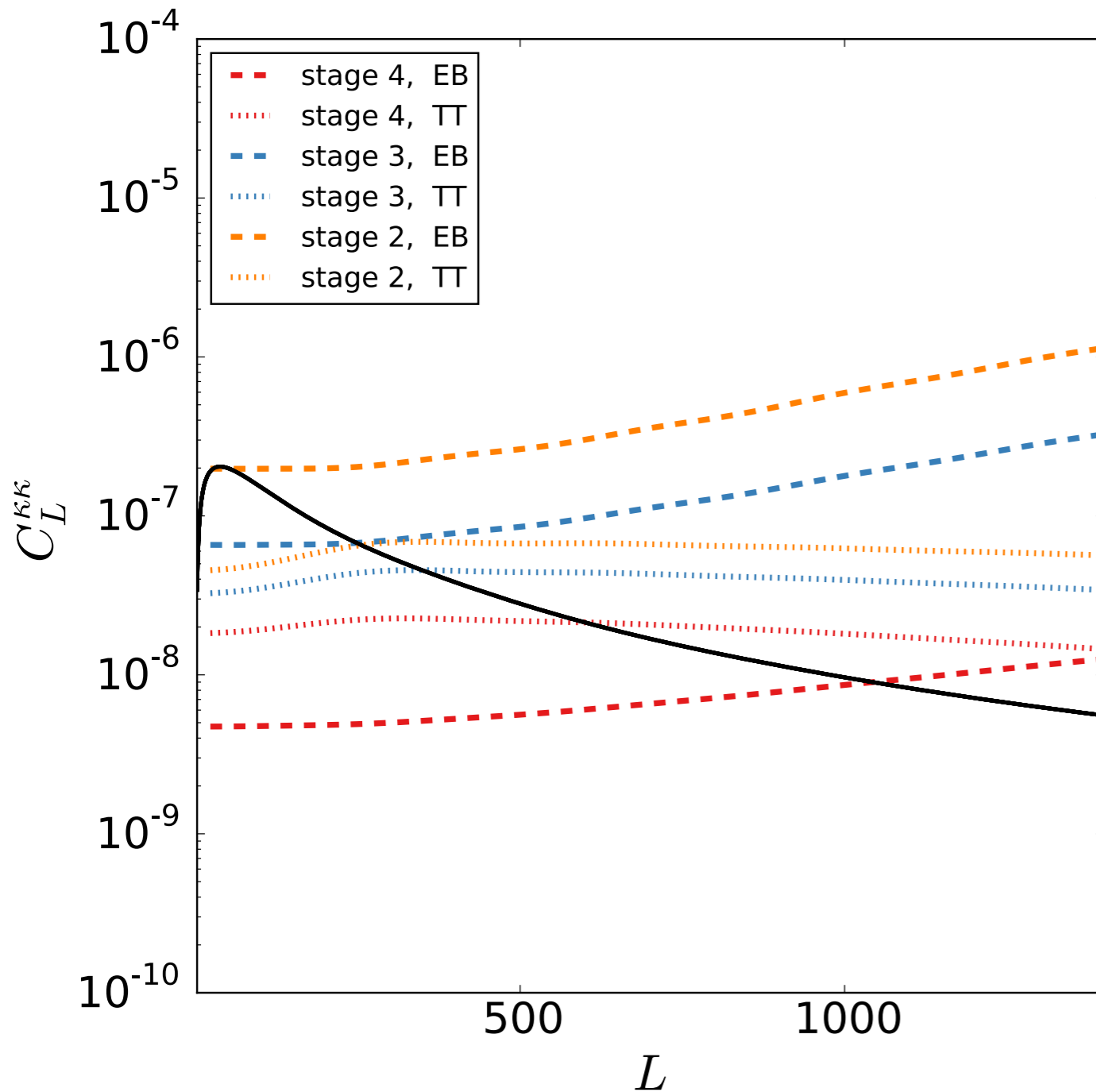
S4 Pushes Lensing into New Regime



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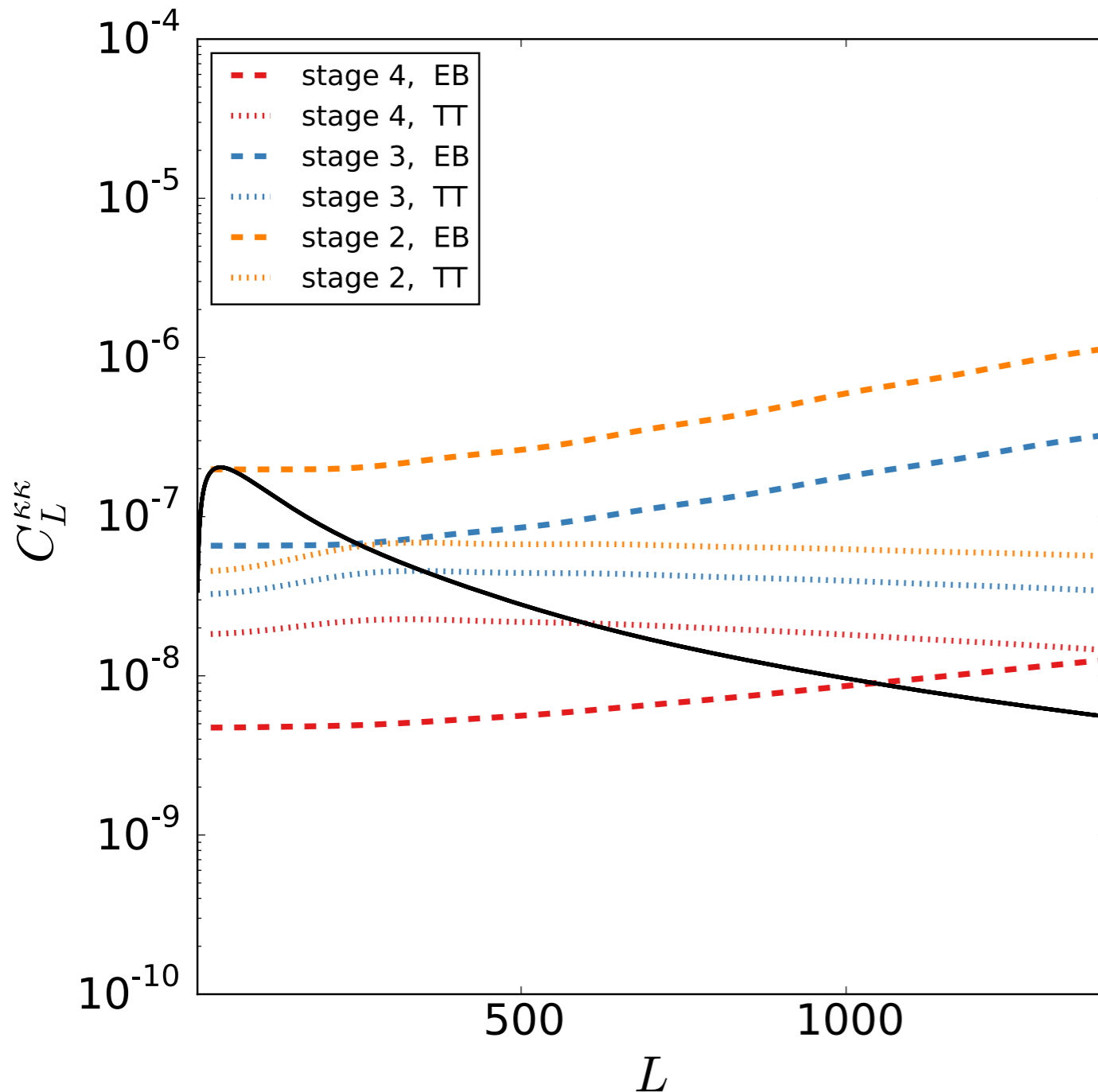


S4 Pushes Lensing into New Regime



Most lensing weight in EB estimator:

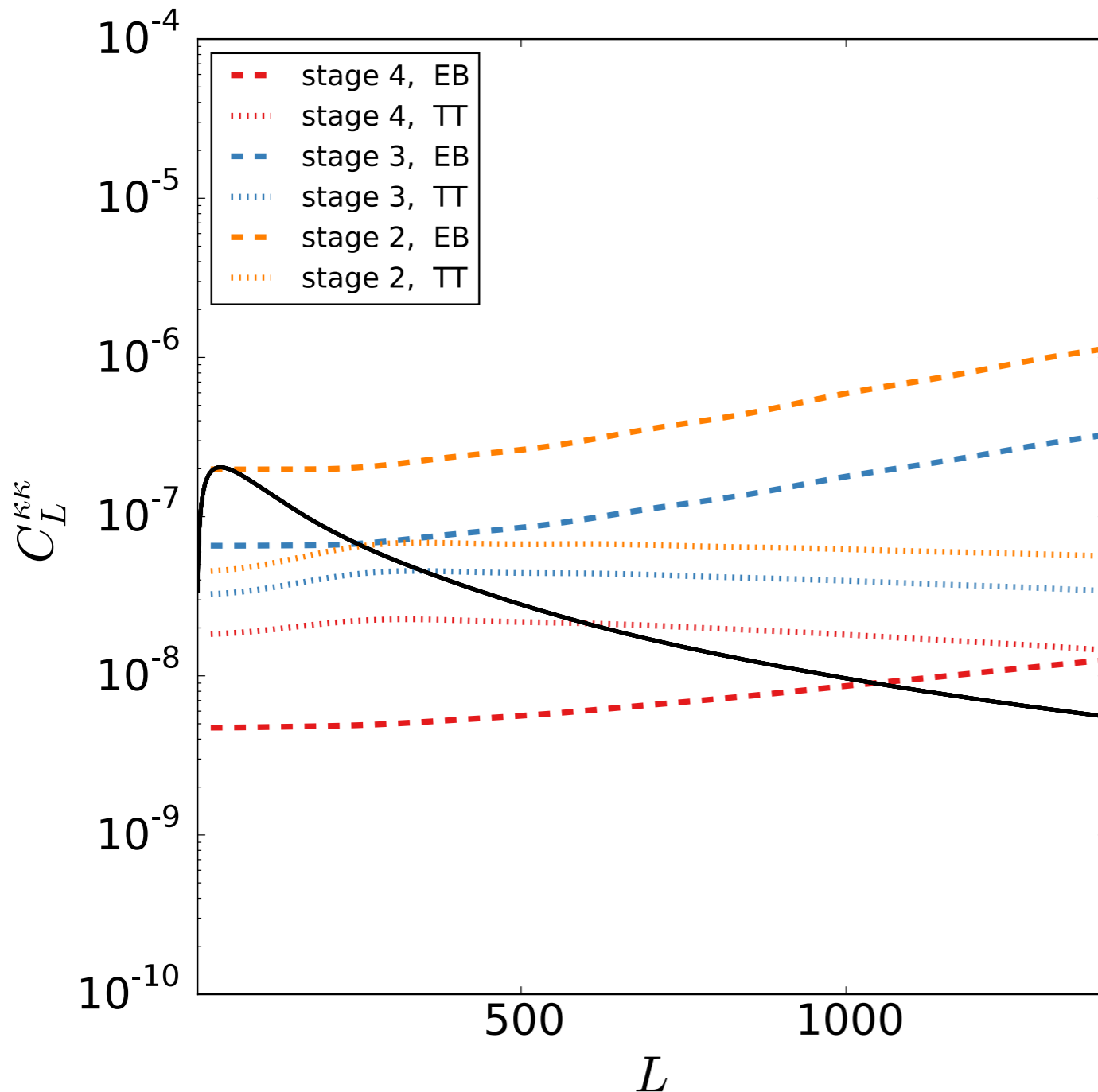
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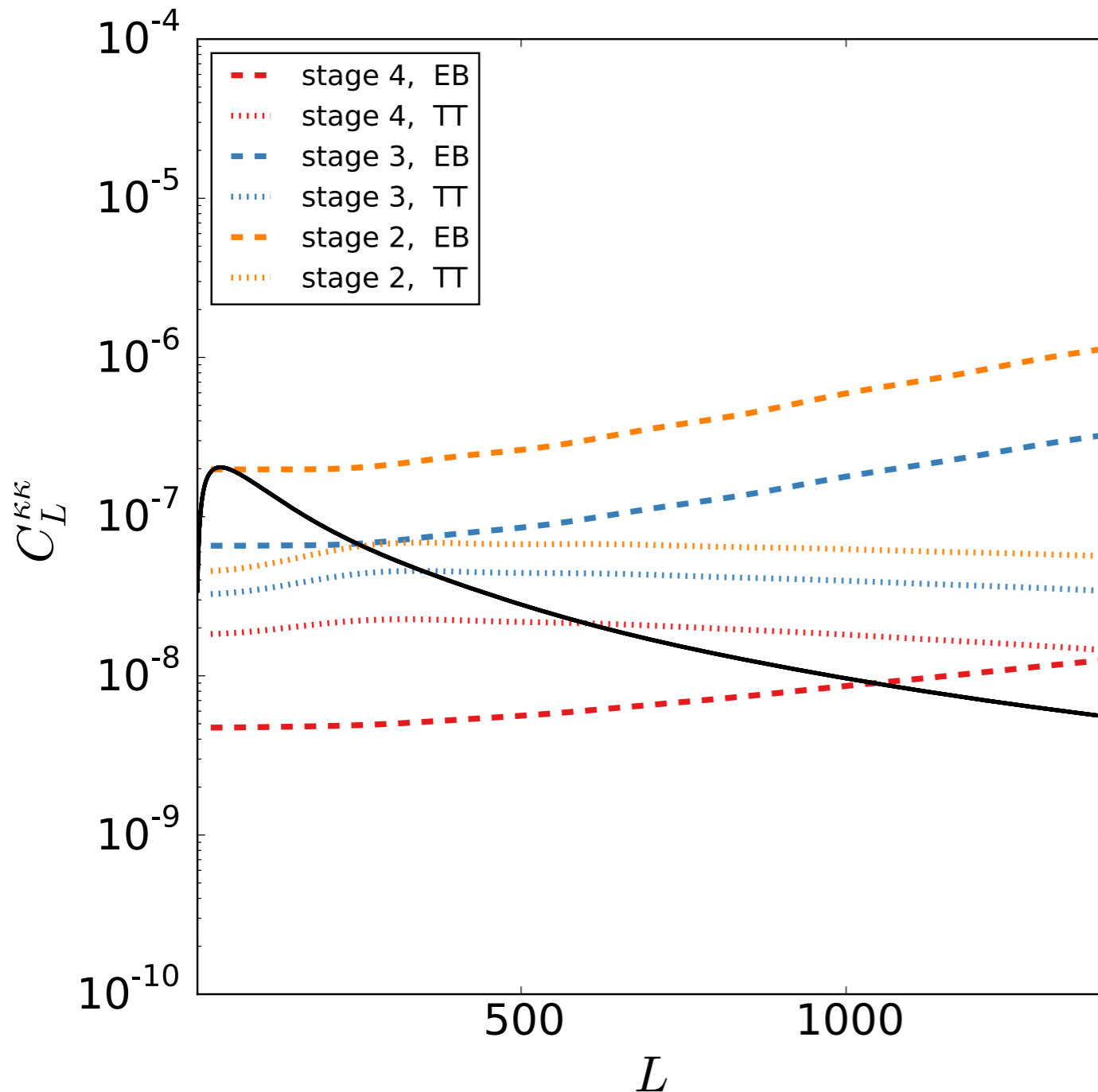
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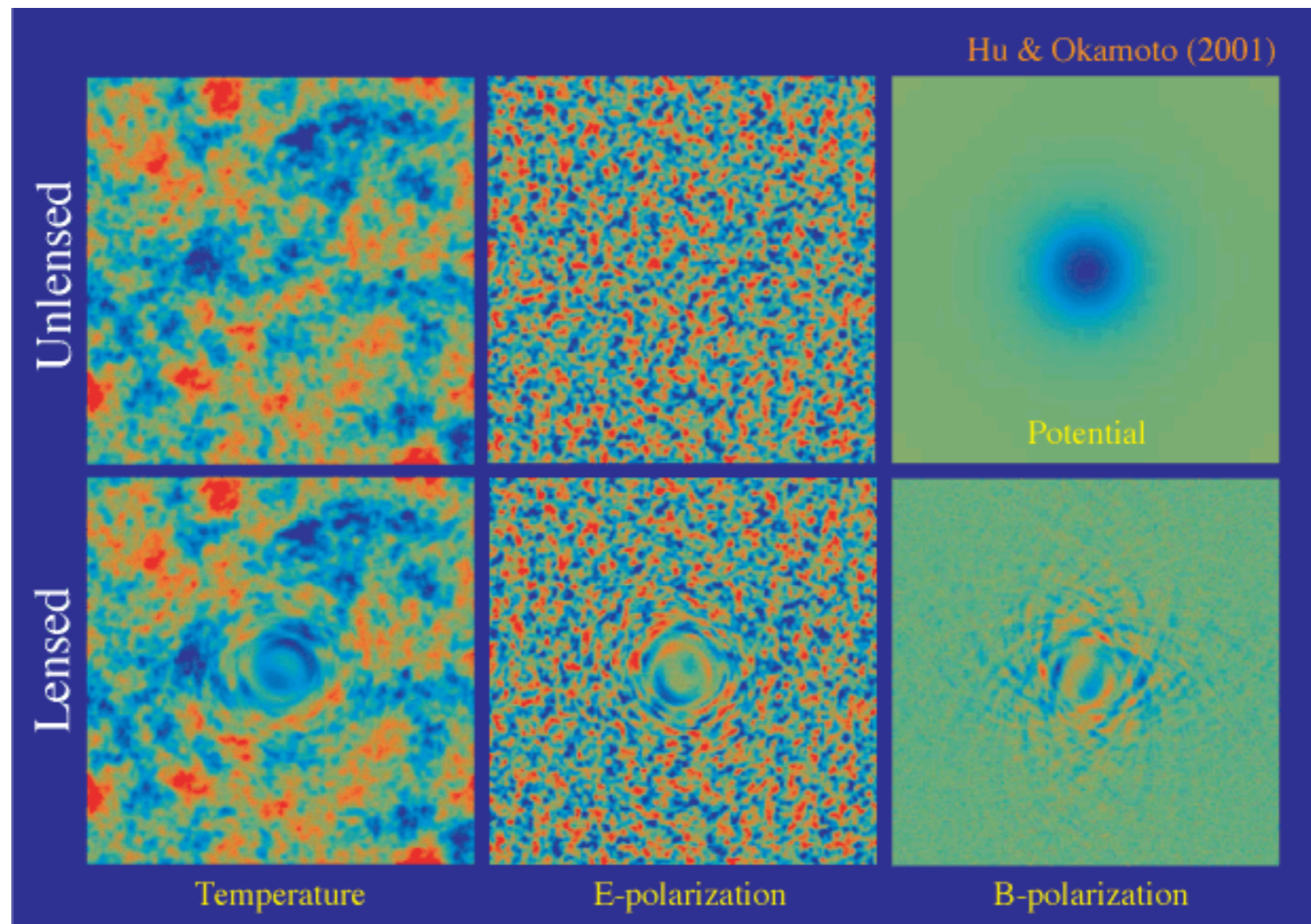
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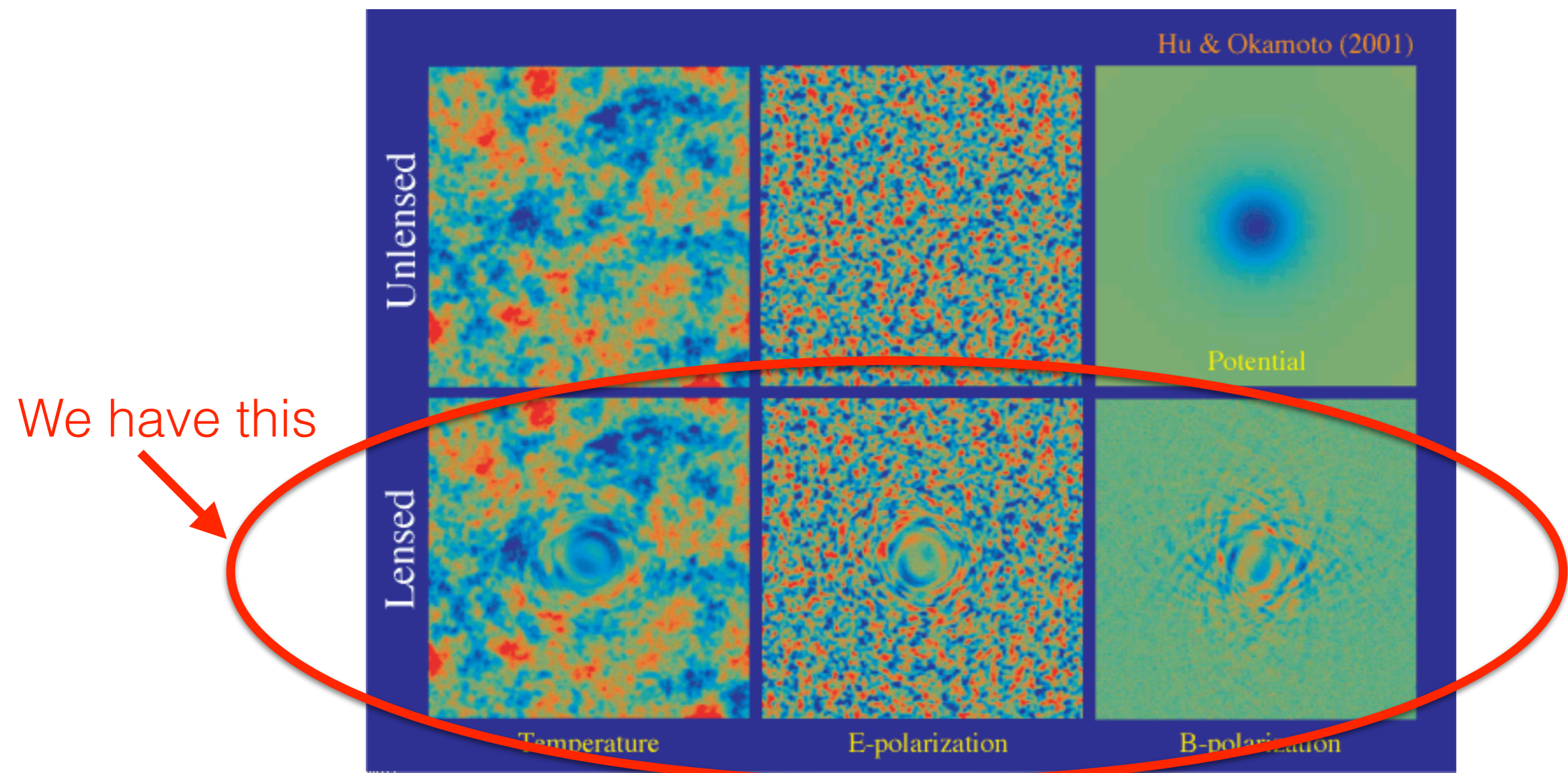
Most lensing weight in EB estimator:

- less sensitive to foreground bias and atmospheric noise
- not limited by primordial CMB cosmic variance
- perfect lensing/
delensing possible in limit of no inst. noise

Better Lensing = Better Delensing



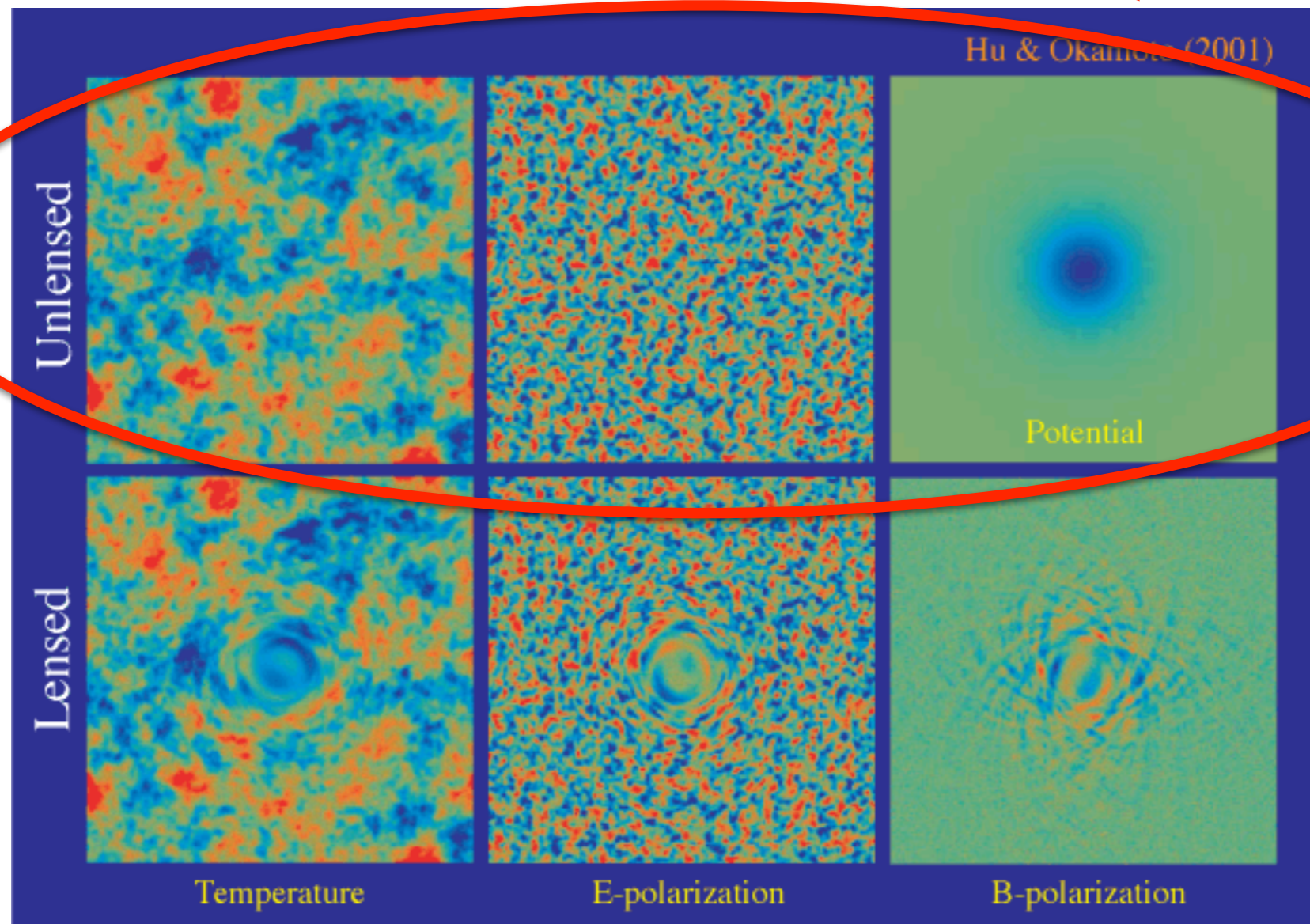
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Separation of primordial CMB and mass map

We want this



Better Lensing = Better Delensing

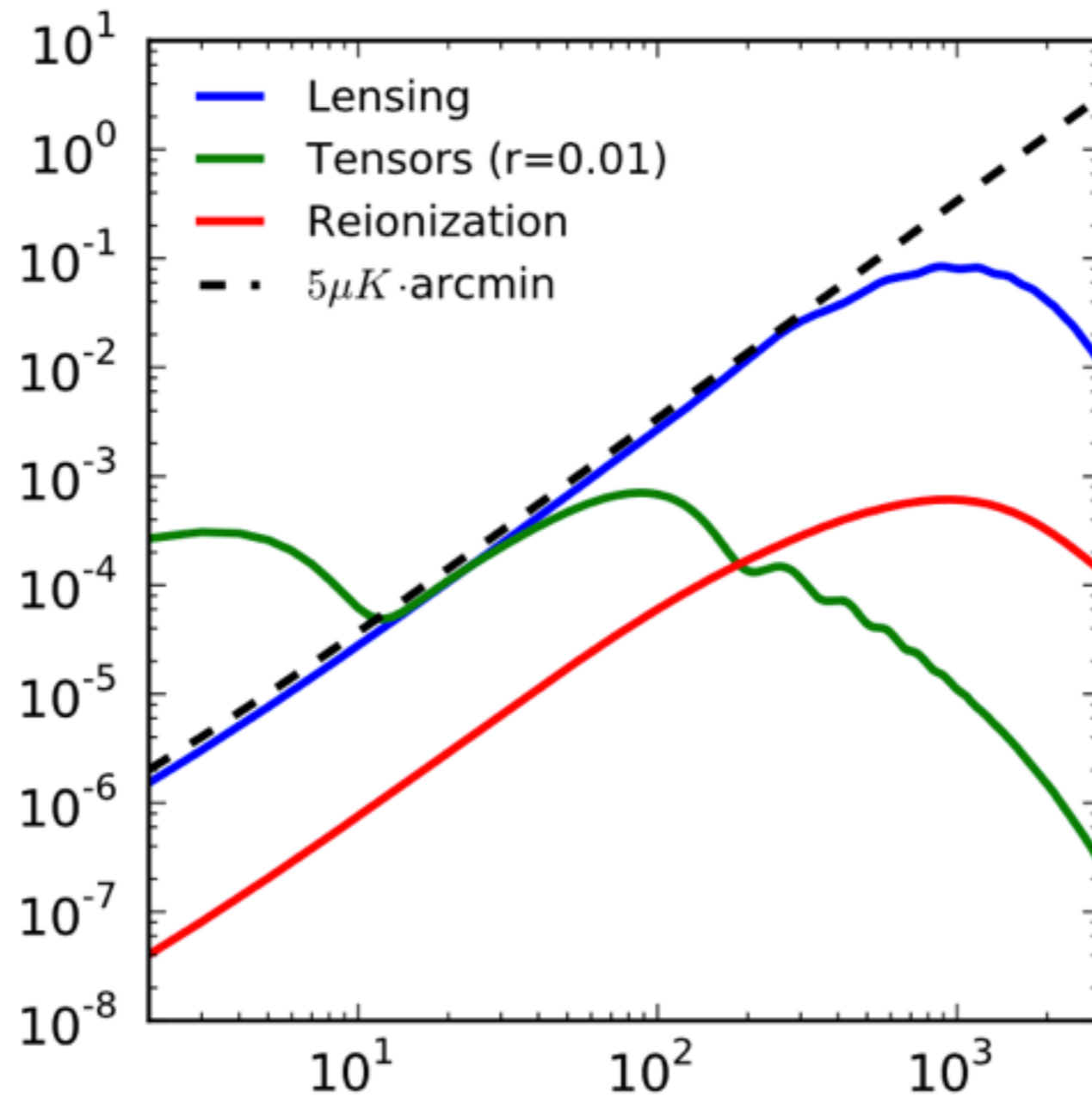
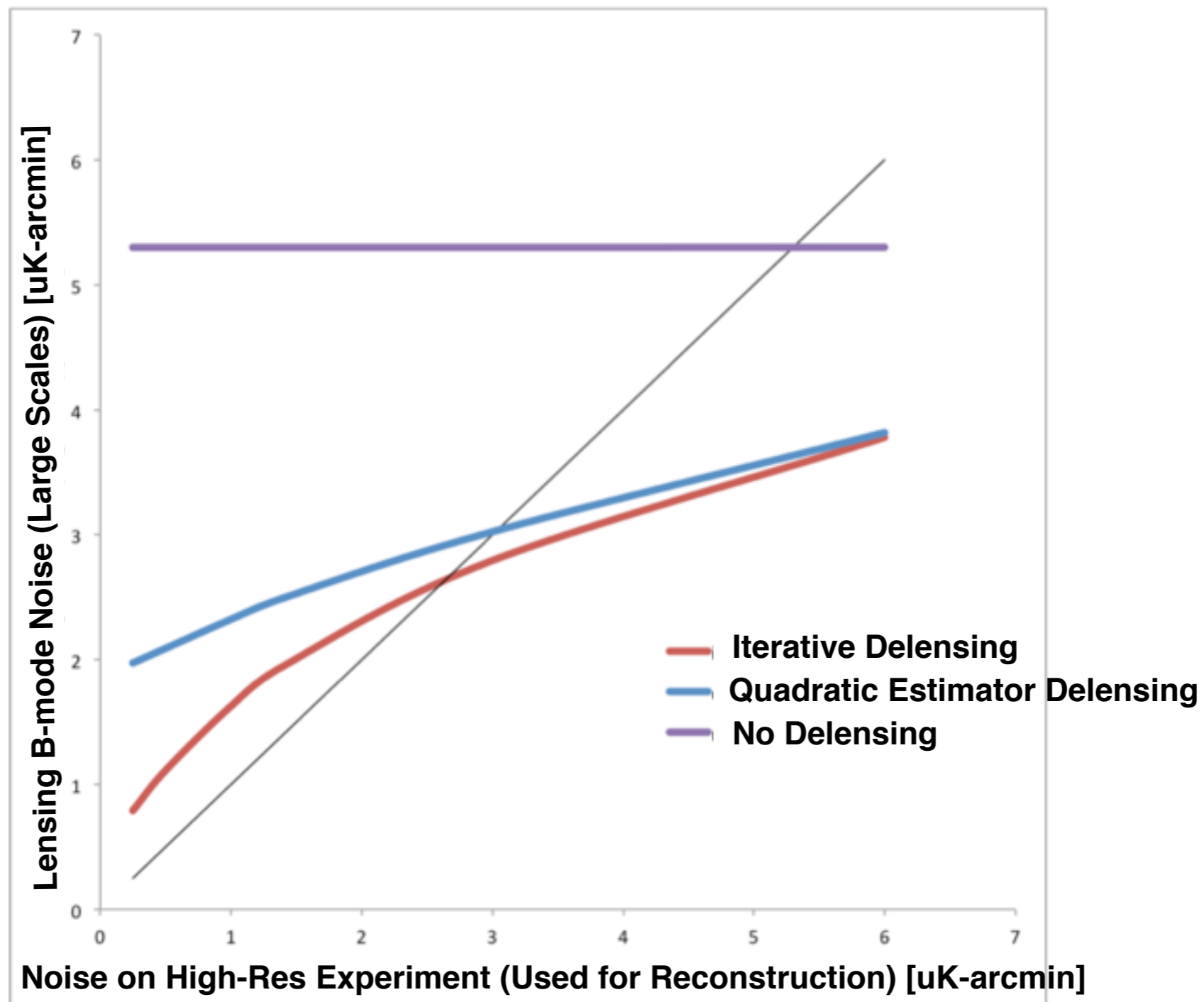
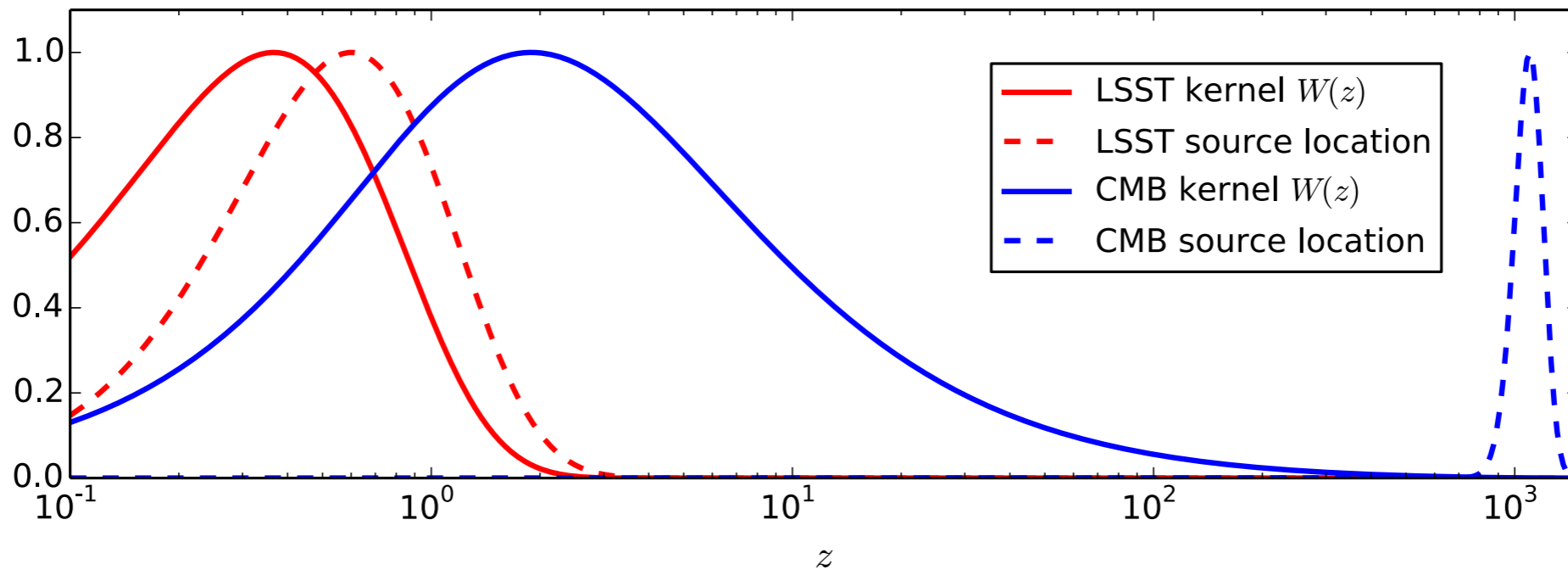


Figure credit: D. Hanson

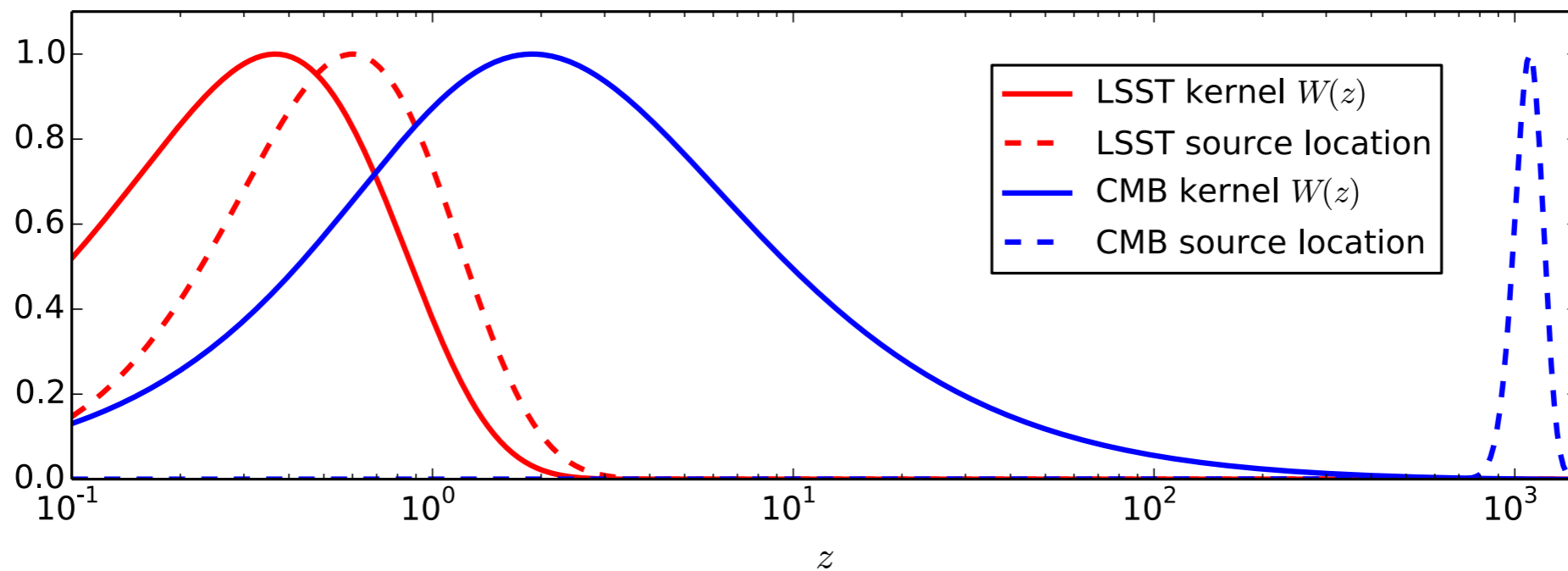
Iterative Lensing/Delensing



Cross Correlations with CMB Lensing

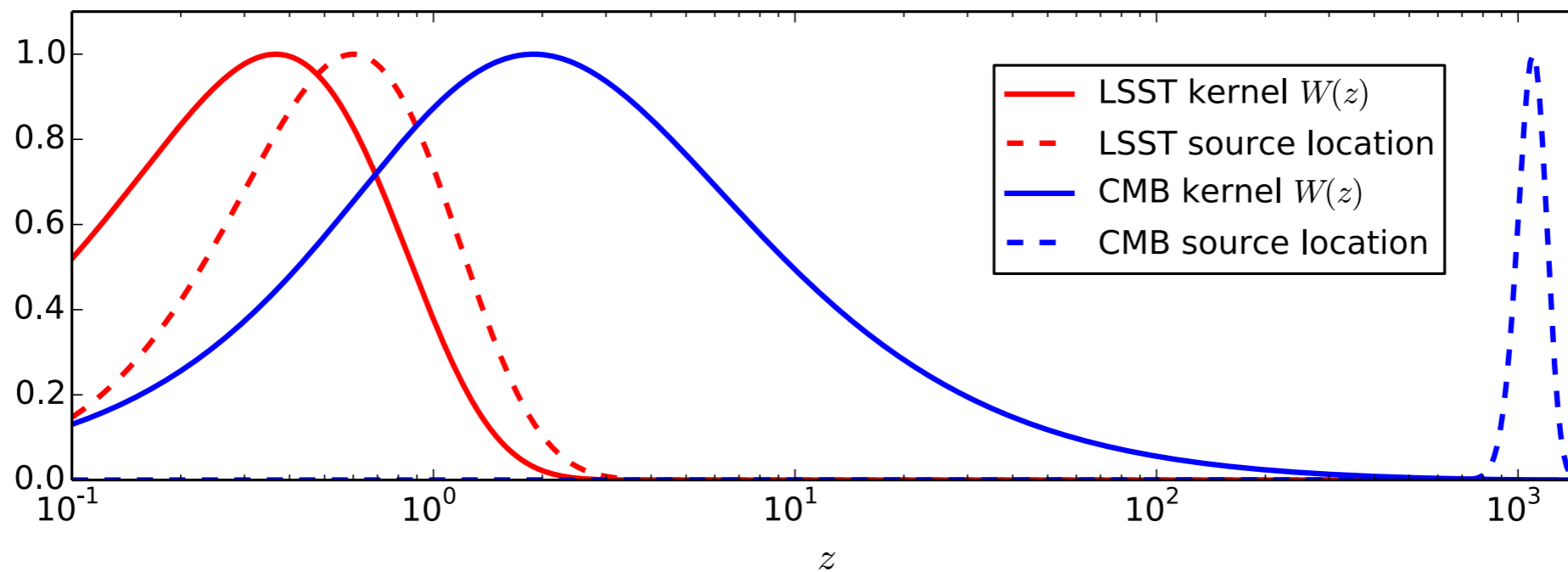


Cross Correlations with CMB Lensing



Yields tighter constraints on dark energy

Cross Correlations with CMB Lensing



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CMB lens has orthogonal systematics to galaxy shear

Parameter Forecasts with Lensing

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- r , N_{eff} from delensing cmb 2-point function

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We discussed folding in last three in parallel session

Parameter Forecasts with Lensing

$\sigma(\sum m_\nu)$ meV	S4 Primordial	S4 Primordial +Lens	S4 Primordial +Lens+DESI
1' , 1 μ K'	324	55	18
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Iterative lensing not added yet, which may widen spread

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High sensitivity (1 μ K-arcmin) needed so almost all weight is in foreground/atmosphere-free EB estimator

Parallel Session Discussion

Low ℓ / τ limiting neutrino mass:

- For neutrino mass, need to know A_s and τ . Can we get around this with LSST shear x CMB lens?
- Putting in current Planck low ℓ in forecasts as opposed to Fisher Planck low ℓ increases forecasts errors by a factor a factor of 2. What should we use for forecasts? Can we assume CLASS etc.? Do we assume S4 gets τ ?

Parallel Session Discussion

2pt/4pt lens covariance:

- Marcel discussed analytic covmats are in hand
 - while they need to be finely checked with sims, probably good enough to use
 - we can quantify to what percent they are accurate

Parallel Session Discussion

Iterative lensing/delensing:

- Useful numbers: at 5uK-arcmin, delensing helps / at 2uK-arcmin, iterative delensing helps
- Some literature claims no improvement in params from iterative delensing, but they may be limited by tau
- In limit of no noise, Kendrick claims can delens perfectly - Uros says curl imposes a floor - Kendrick not sure
- Forecasts should be ok, but should really monte carlo error bars
- We will include this in forecasts going forward