Lensing of a Primordial Squeezed CMB Bispectrum

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work with Antony Lewis & Donough Regan (arXiv: 1201.1010)

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Non-Gaussianity can constrain early universe physics

The CMB is gravitationally lensed

A new approximation for the lensed squeezed CMB bispectrum

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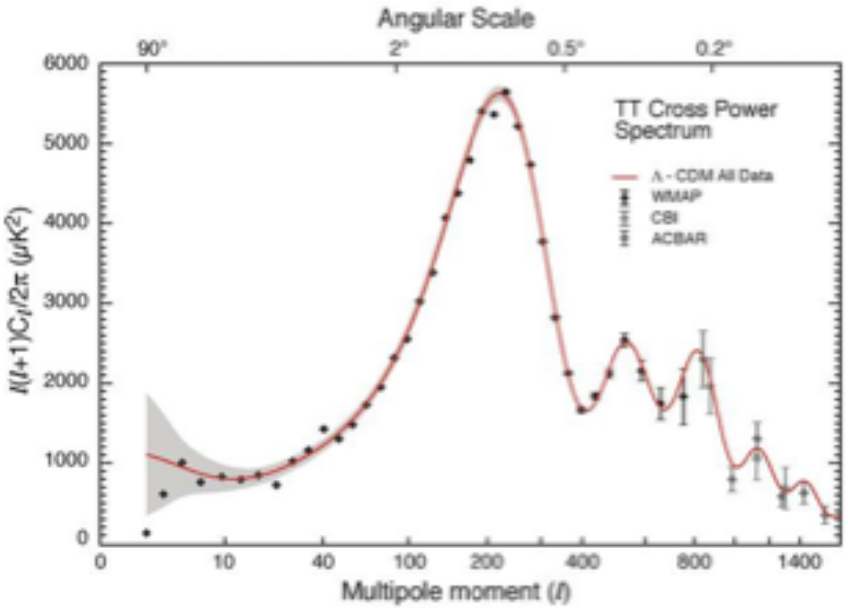
$$\Delta T(\hat{n}) = \sum_{lm} T_{lm} Y_{lm}(\hat{n})$$

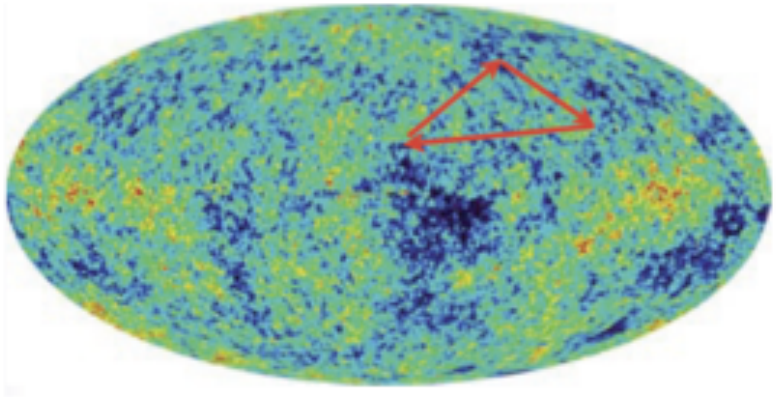
$$< T_{lm} T_{l'm'} >= \delta_{ll'} \delta_{mm'} C_l \qquad < T_{lm} T_{l'm'} T_{l''m''} >=< T_{lm} >< T_{l'm'} T_{l''m''} >= 0$$

μ=0



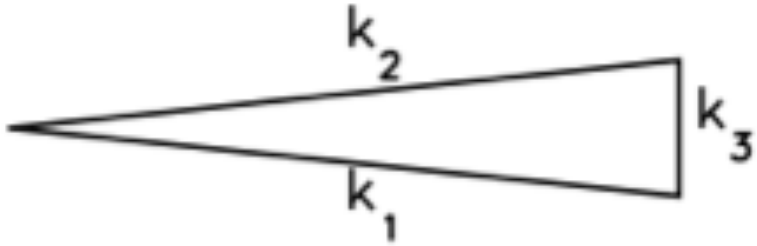
$$\Phi(k) \xleftrightarrow{\triangle_l(k)} T_{lm} = 4\pi(-i)^l \int d^3k \triangle_l(k)\Phi(k)Y_{lm}(k)$$

$$\langle \Phi(\mathbf{k}_1)\Phi(\mathbf{k}_2)\Phi(\mathbf{k}_3)\rangle = (2\pi)^3\delta(\mathbf{k}_1+\mathbf{k}_2+\mathbf{k}_3)B_\Phi(k_1,k_2,k_3) \qquad primordial$$

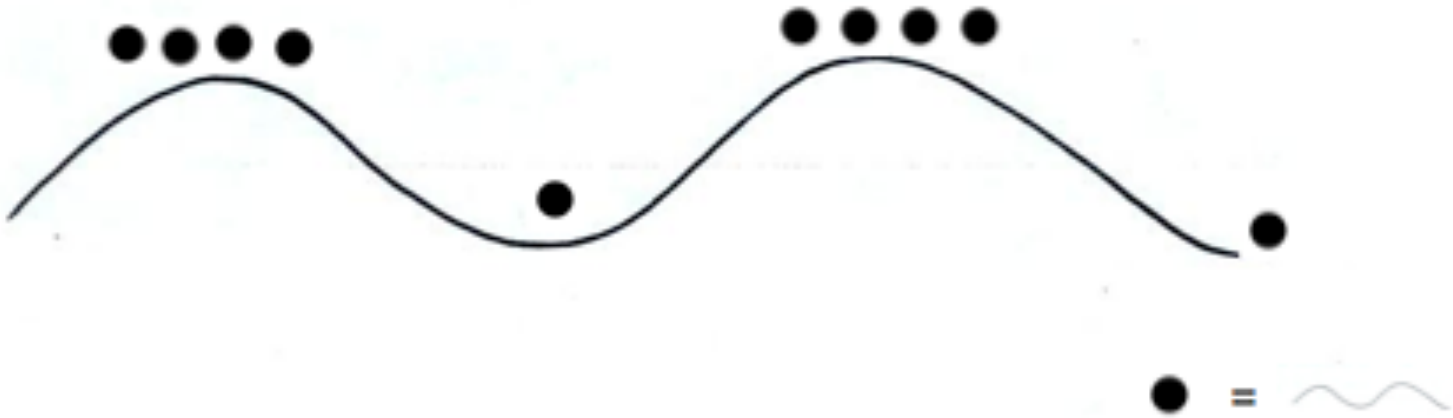


$$B_{l_1l_2l_3} \sim < T_{l_1m_1}T_{l_2m_2}T_{l_3m_3} > \qquad CMB$$

squeezed triangle
$(k_1 \simeq k_2 >> k_3)$



$$\Phi = \Phi_L + f_{\rm NL}^{\rm local} \Phi_L^2$$



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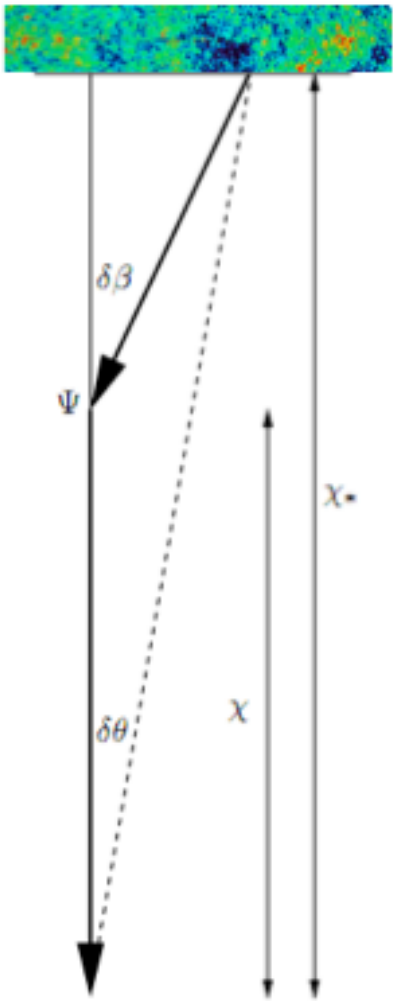


- Lensing turns E modes into B modes
- Lensing generates non-Gaussianities

$$\tilde{T}(\hat{\mathbf{n}}) = T(\hat{\mathbf{n}}') = T(\hat{\mathbf{n}} + \boldsymbol{\alpha})$$

$$\alpha = \nabla_{\hat{n}} \psi(\hat{n})$$

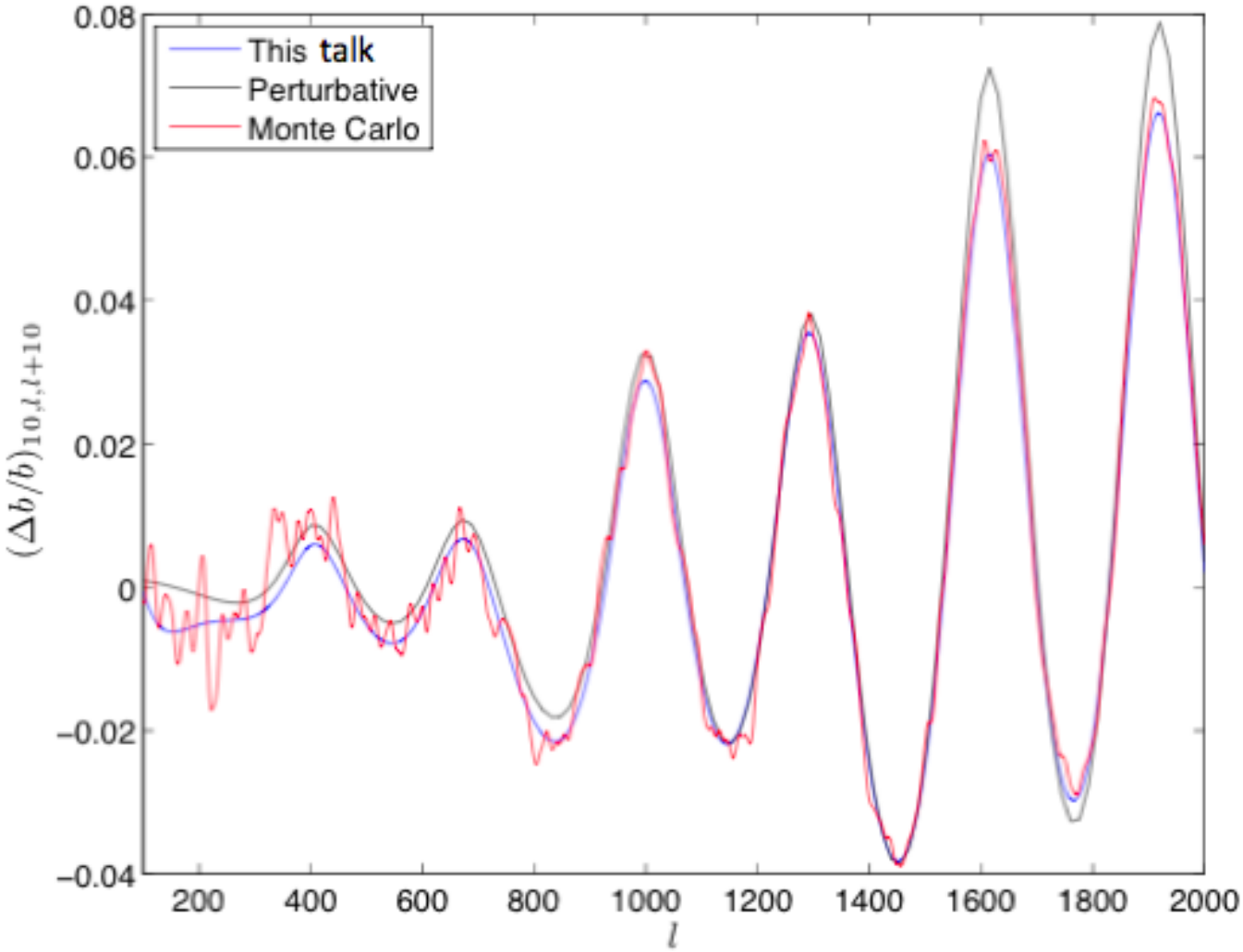
A new approximation for the lensed squeezed CMB bispectrum

$$\tilde{T}(\mathbf{l}) = \int \frac{d^2\mathbf{x}}{2\pi} T(\mathbf{x}+\boldsymbol{\alpha}) e^{-i\mathbf{l}\cdot\mathbf{x}}.$$

squeezed triangles with $l_1 \ll l_2, l_3$

$$\langle T(\mathbf{l}_1)\tilde{T}(\mathbf{l}_2)\tilde{T}(\mathbf{l}_3)\rangle \approx \langle \tilde{T}(\mathbf{l}_1)\tilde{T}(\mathbf{l}_2)\tilde{T}(\mathbf{l}_3)\rangle = \frac{1}{2\pi}\tilde{b}_{l_1 l_2 l_3}\delta(\mathbf{l}_1+\mathbf{l}_2+\mathbf{l}_3)$$

$$\tilde{b}^m_{l_1 l} \approx \int r dr J_m(lr) \int dl' l' b^m_{l_1 l'} e^{-l'^2\sigma^2(r)/2} \sum_n I_n[l'^2 C_{\mathrm{gl},2}(r)/2] J_{2n+m}(l'r)$$


This talk
Perturbative
Monte Carlo
0.08
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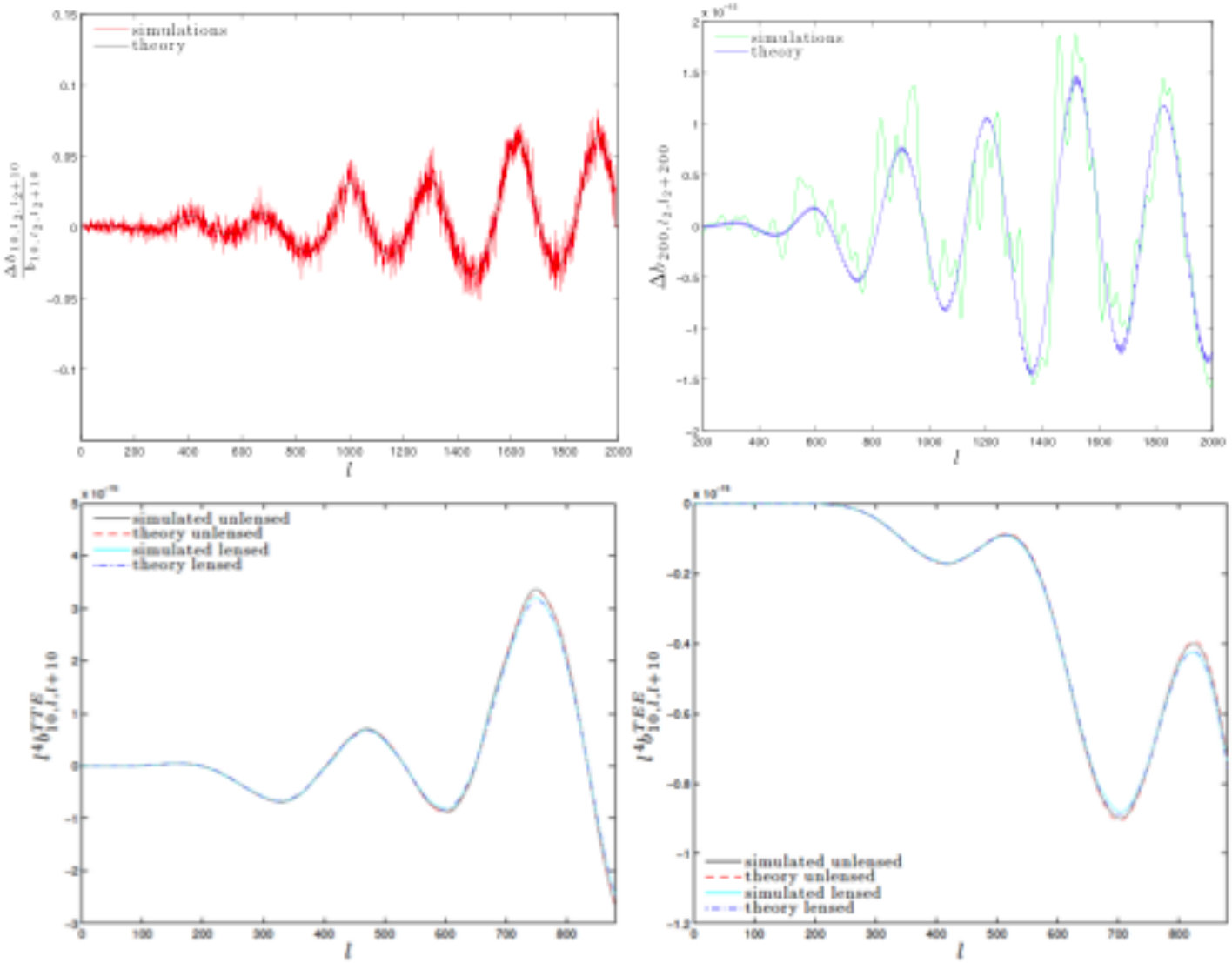
0.04
0.02
0
−0.02
−0.04
200
400
600
800
1000
1200
1400
1600
1800
2000
l
$(\Delta b/b)_{10,l,l+10}$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