Large Tensor Non-Gaussianity from Axion-Gauge Fields Dynamics (arXiv : 1707.03023)

Aniket Agrawal,
Tomohiro Fujita, Eiichiro Komatsu

$$\mathcal{L} = \mathcal{L}_{GR} + \mathcal{L}_{\phi} + \mathcal{L}_{\chi} - \frac{1}{4} F^{a}_{\mu\nu} F^{a\mu\nu} + \frac{\lambda \chi}{4f} F^{a}_{\mu\nu} \tilde{F}^{a\mu\nu}$$

- Produces gravitational waves, over a large range of wave numbers that are highly non-Gaussian
- Without producing significant scalar non-Gaussianity

Vacuum or Sources?

- B mode => quantum gravity. Maybe not!

Characteristic	Vacuum Fluctuation	Axion-Gauge-Fields Dynamics	Observable
Scalar NG	small	small	f_{NL}
Scale independence of P_h	All scales	Over >5 orders of k	r or P_h
Tensor NG = B_h/P^2_h	~1	>>1	B-mode bispectrum
Interpretation	QUANTUM GRAVITY	CLASSICAL GRAVITY, QUANTUM SOURCES	

MITIGATING SYSTEMATICS IN FUTURE CMB SPACE MISSIONS

Ranajoy Banerji – APC, Paris

NORDITA, Stockholm – 17/07/2017

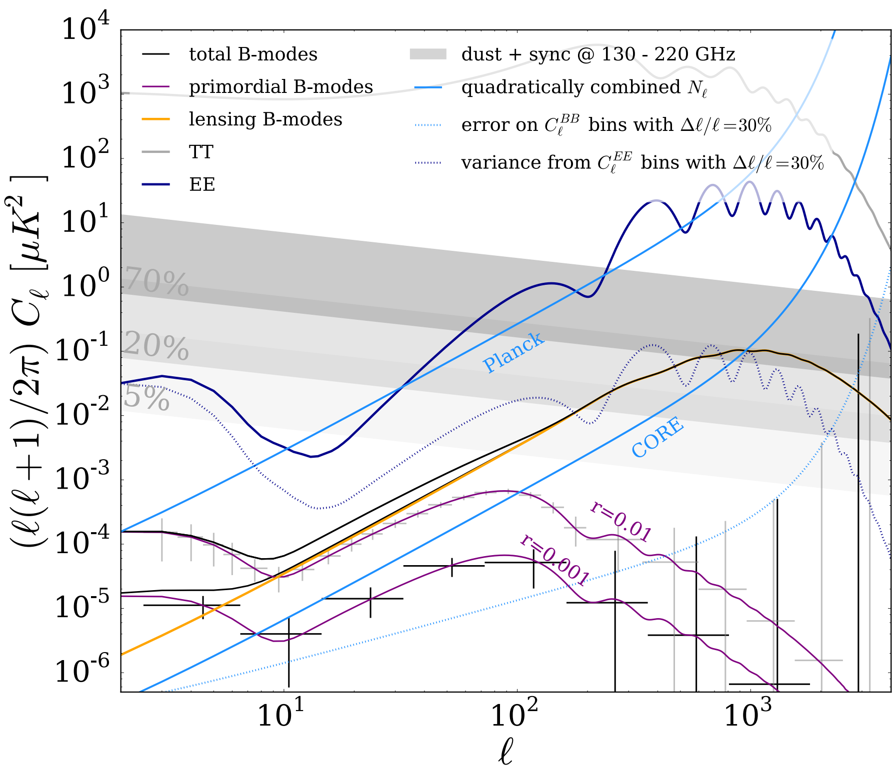
- Next generation of CMB space missions

M6?
CMB Probe?

LiteBIRD

Not only do we have to deal with foregrounds and the lensing signal.

Systematics will be a major contributor to the noise budget.



Typical sources of systematics

- Bandpass mismatch
- Beam asymmetry and misalignment
- Pointing inaccuracies
- Gain mismatch

These cause leakage of signal from Intensity to Polarisation

How do we approach the issue?

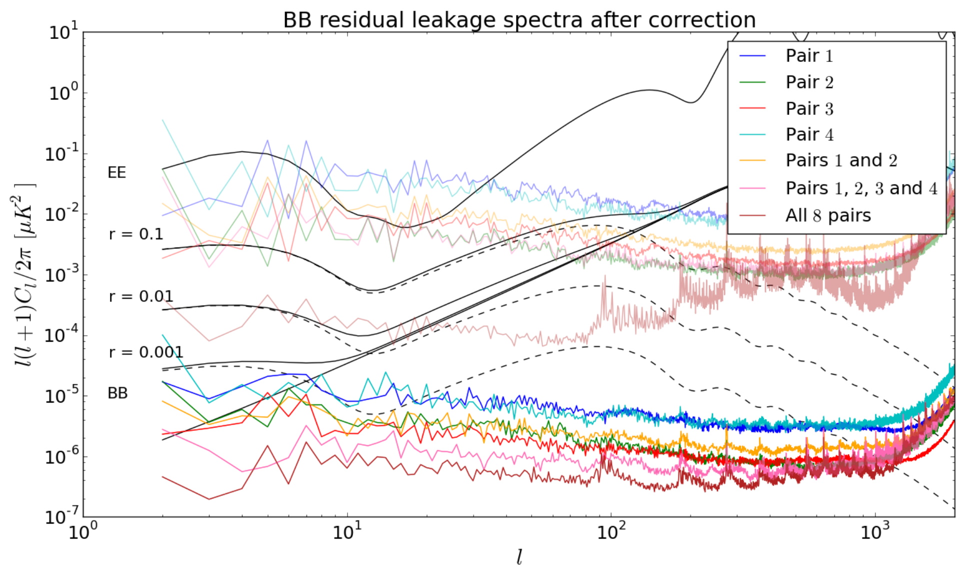
- Develop models of how the leakage projects on the timestream and polarisation maps

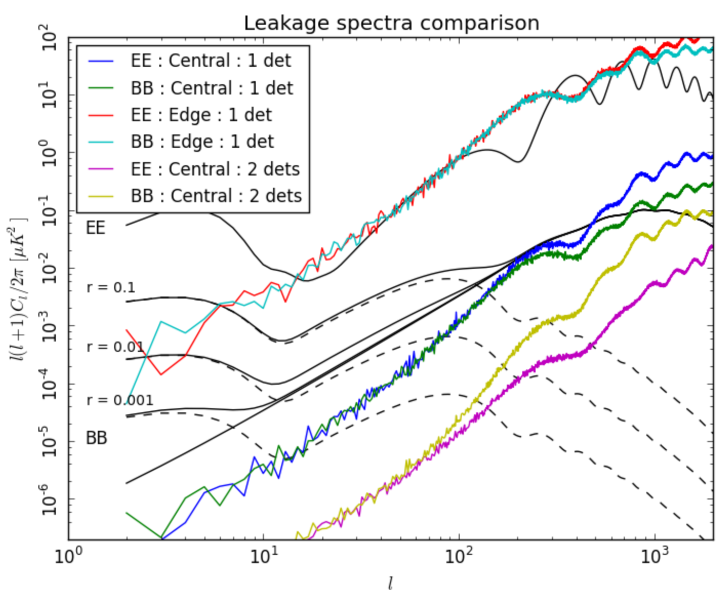
$$\boldsymbol{d} = \mathbf{A}\boldsymbol{S} + \mathbf{T}\boldsymbol{y} + \boldsymbol{n},$$

- Estimate and correct for the leakage signal

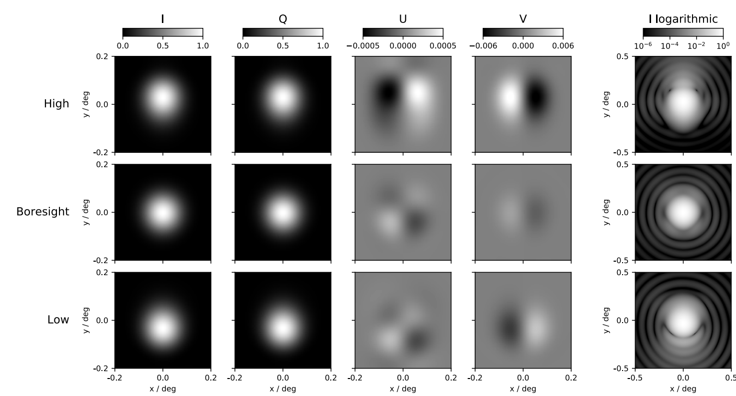
$$\boldsymbol{S} = \left[\mathbf{A}^T \mathbf{C}_n^{-1} \mathbf{F}_\mathrm{T} \mathbf{A}\right]^{-1} \mathbf{A}^T \mathbf{C}_n^{-1} \mathbf{F}_\mathrm{T} \boldsymbol{d}$$

- Requires End-2-End simulations to validate the techniques.





- Brute force estimation of leakage assuming knowledge of the beams



Extreme Scenarios

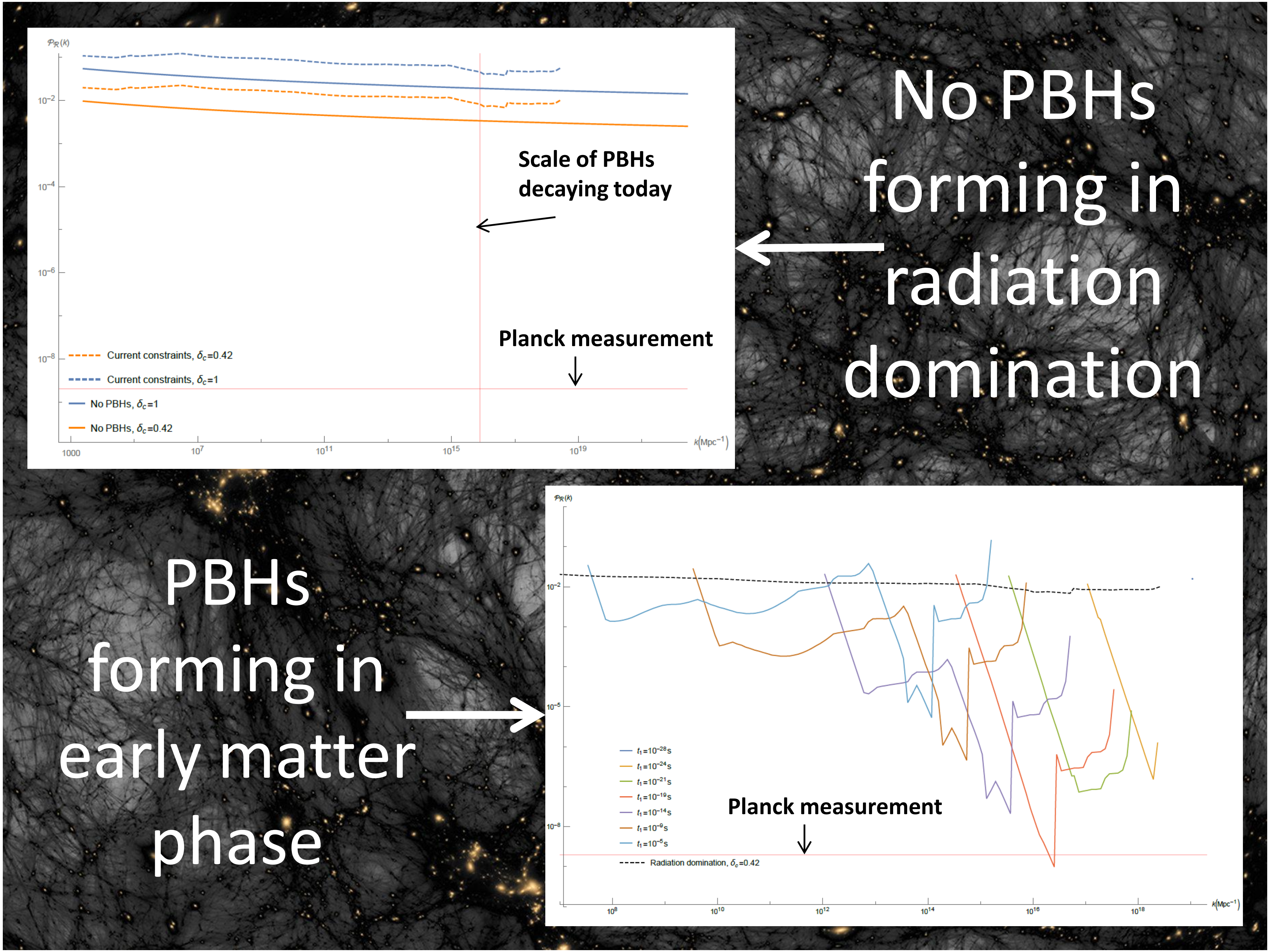
The tightest possible constraints on the power spectrum due to primordial black holes

arXiv:1706.10288

Philippa Cole

University of Sussex, United Kingdom

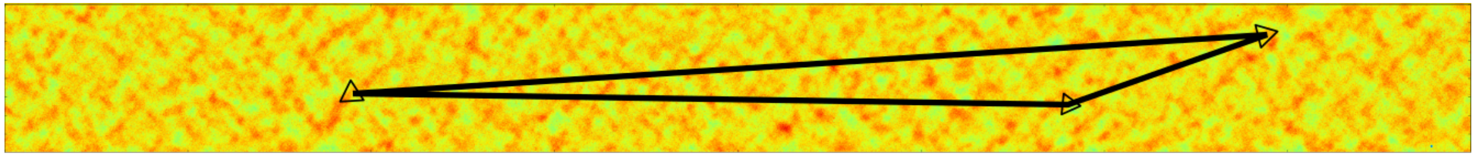
Supervised by Christian Byrnes



No PBHs forming in radiation domination
Scale of PBHs decaying today
Planck measurement
Current constraints, δ_c=0.42
Current constraints, δ_c=1
No PBHs, δ_c=1
No PBHs, δ_c=0.42
k(Mpc^{-1})
PBHs forming in early matter phase
Planck measurement
$t_1=10^{-28}$s
$t_1=10^{-24}$s
$t_1=10^{-21}$s
$t_1=10^{-19}$s
$t_1=10^{-14}$s
$t_1=10^{-9}$s
$t_1=10^{-5}$s
Radiation domination, δ_c=0.42
k(Mpc^{-1})

Investigating the bispectrum of secondary CMB sources with ACTPol

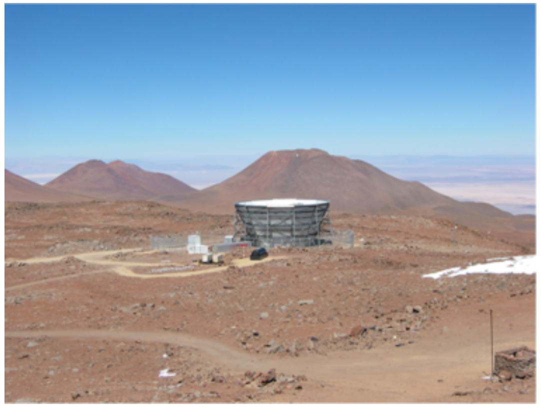
What is the bispectrum?



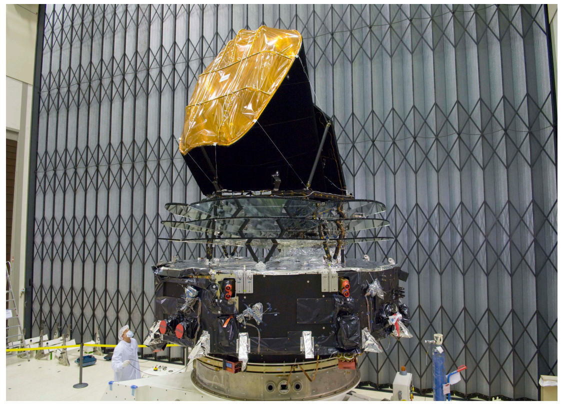
How do we measure it?

$$\hat{f}_j = N_{j,i} 4\pi^2 \int \mathrm{d}\vec{\ell}_1 \mathrm{d}\vec{\ell}_2 \mathrm{d}\vec{\ell}_3 \delta(\vec{\ell}_1 + \vec{\ell}_2 + \vec{\ell}_3) b_i^T(\ell_1, \ell_2, \ell_3) C^{-1} a(\vec{\ell}_1) C^{-1} a(\vec{\ell}_2) C^{-1} a(\vec{\ell}_3)$$

The data sets



- Deep56 field ~600 $\deg^2$
- ACTPol 148GHz
- Planck 100GHz and 217GHz



Current Measurements

Type	Measured f_{NL}
lensing-tSZ	0.68 ± 0.41
lensing-DSFG	0.26 ± 0.20
lensing-ISW	-6.84 ± 9.59
tSZ-tSZ-tSZ	1.31 ± 0.37
tSZ-tSZ-DSFG	1.54 ± 0.62
tSZ-DSFG-DSFG	-1.23 ± 0.86
Poisson Radio	1.00 ± 0.14
radio-DSFG-tSZ	7.72 ± 1.50
DSFG Poisson and Clustered	0.87 ± 0.57
radio-tSZ	3.07 ± 0.63
radio-DSFG	1.07 ± 1.66

Adri Duivenvoorden

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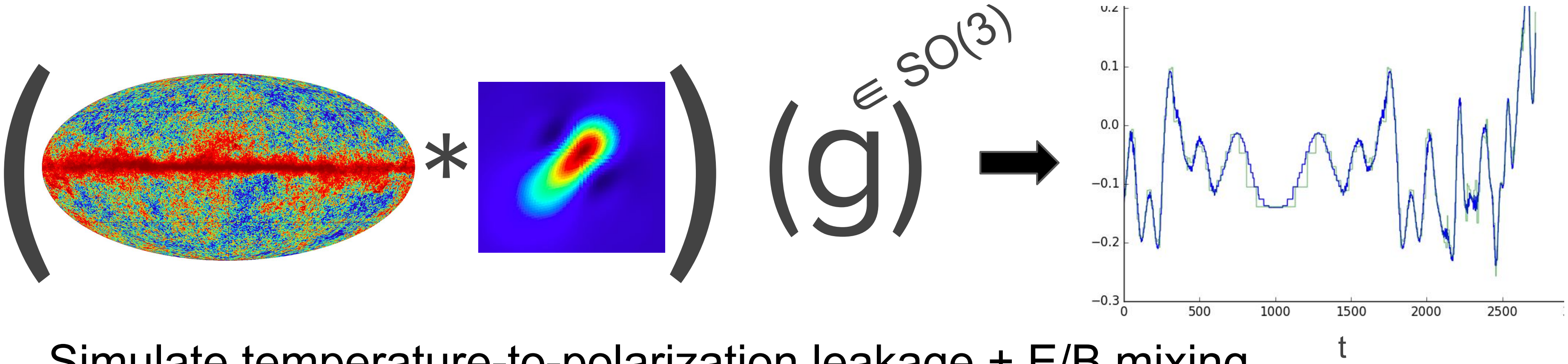
Supervisor: Katherine Freese

SPIDER (balloon-borne CMB polarimeter) (w/ J. Gudmundsson)

- Analyzing 90 & 150 GHz data from Jan. 2015 flight (Next flight (incl. 280 GHz) Dec. 2018)



➔ Simulate temperature-to-polarization leakage + E/B mixing due to asymmetric beams.

- ◆ Jointly infer sky + beams w/ Hamiltonian Monte Carlo.

Estimate the CMB **BTT**-correlation (also **BTE, BEE**) w/ D. Meerburg

- Non-vanishing in parity-conserving universe
- Unconstrained observable:
  - Natural to cross-correlate low-resolution B-mode experiments w/ high resolution TT, TE, EE observations to obtain squeezed limit.
  - Constrains primordial scalar-tensor non-Gaussianity:

$$\langle BTT\rangle \sim \langle\gamma_\sigma(\mathbf{k}_1)\zeta(\mathbf{k}_2)\zeta(\mathbf{k}_3)\rangle$$

(e.g. see Lee, Baumann, Pimentel, 2016 for signal due to massive spin fields during inflation)

➔ Working on full-sky (KSW-like) cubic estimator

- For all combinations of T, E, B

Impact of modeling foreground uncertainties on future CMB polarization satellite experiments

Carlos Hervías-Caimapo
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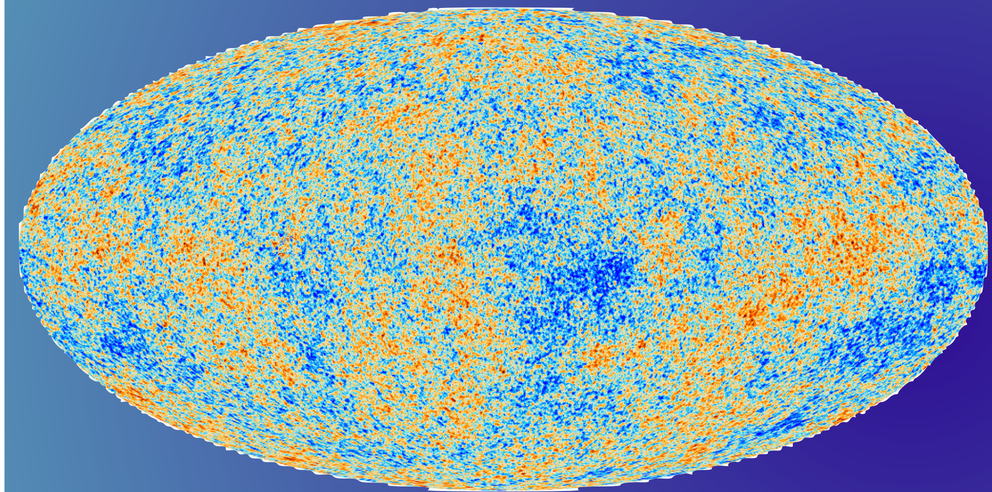
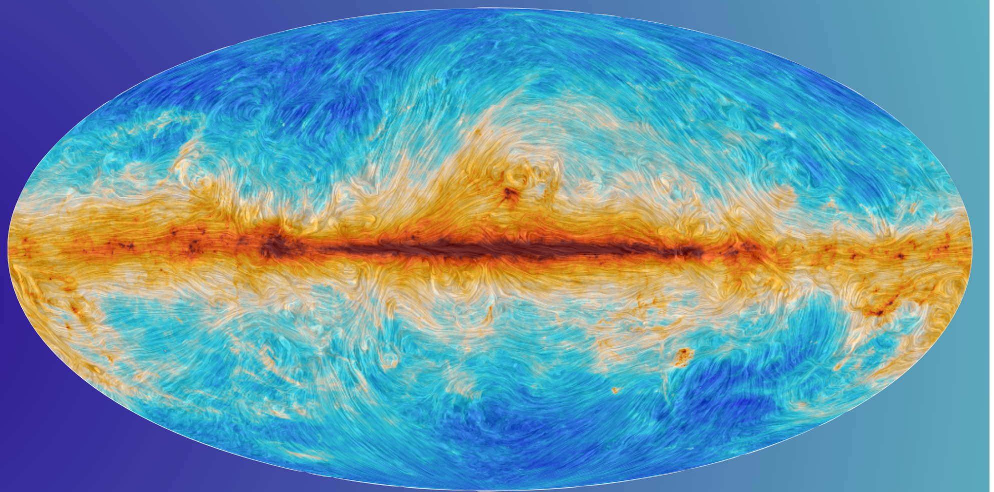
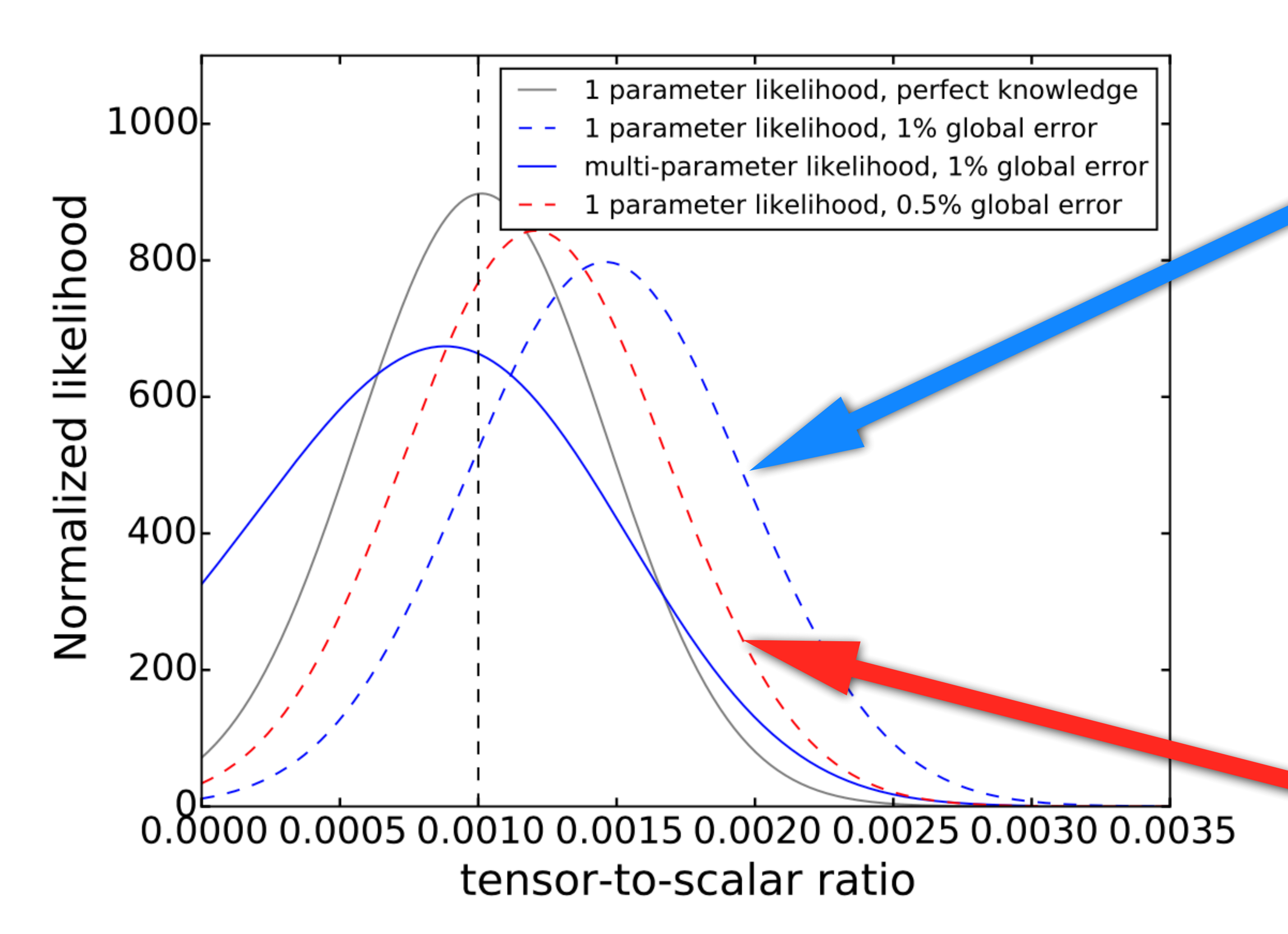




Forecast on the detectability of $r=10^{-3}$.



Assuming 1% error on β_{syn} and β_{dust}

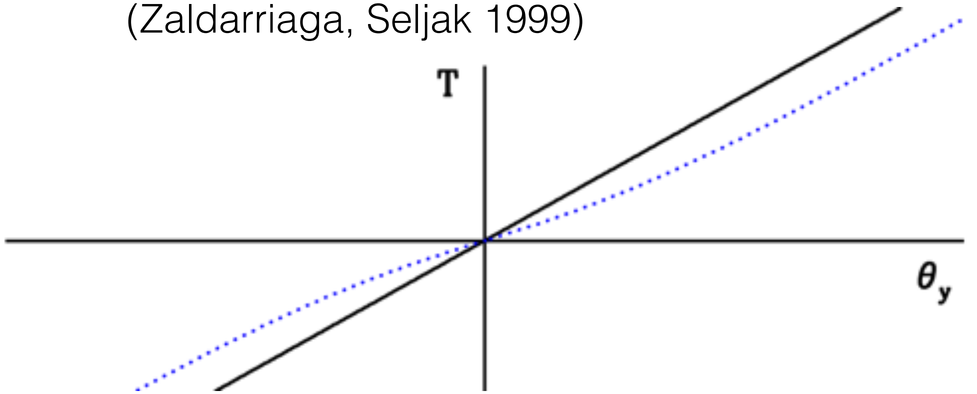
Assuming 0.5% error on β_{syn} and β_{dust}

Main conclusion: foregrounds characterization must be very accurate to hope to measure $r=10^{-3}$

Cluster-Scale CMB Lensing

Ben Horowitz (UC Berkeley) w/ Sherwin, Ferraro

(Zaldarriaga, Seljak 1999)



Gradient Approximation

Lensed, Deflection

$$\tilde{T}(\theta_y) - T(\theta_y) \approx \alpha(\theta_y)\frac{dT}{d\theta_y}$$

Unlensed, Gradient

Idea: Gradient of CMB is roughly constant on small scales, so essentially just divide out the gradient to get the deflection!

Matched Filter on Temperature

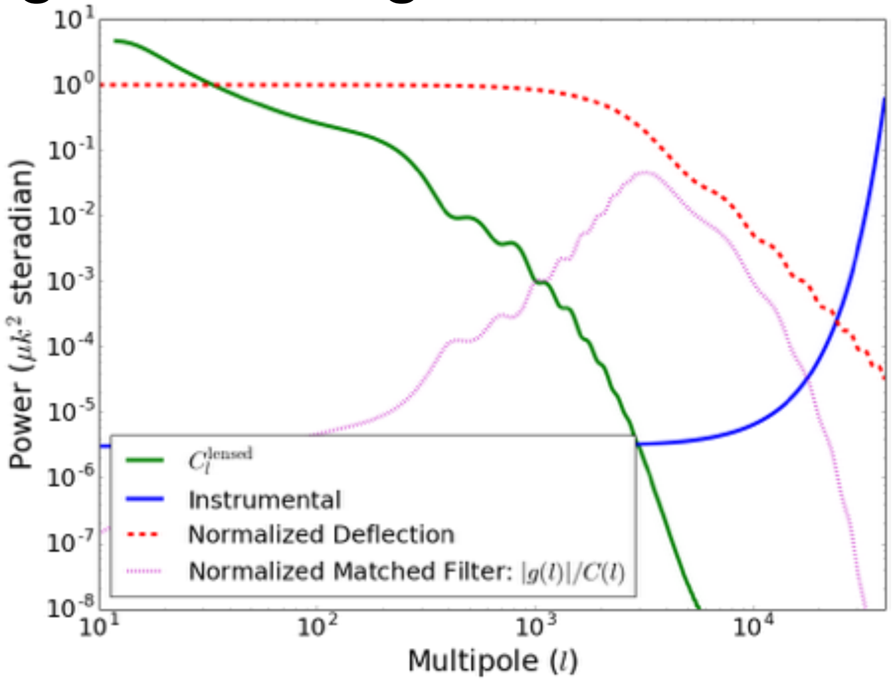
Filter Amplitude, "Noise"

$$\tilde{T}(\boldsymbol{\theta}) = Ag(\boldsymbol{\theta}) + n(\boldsymbol{\theta})$$

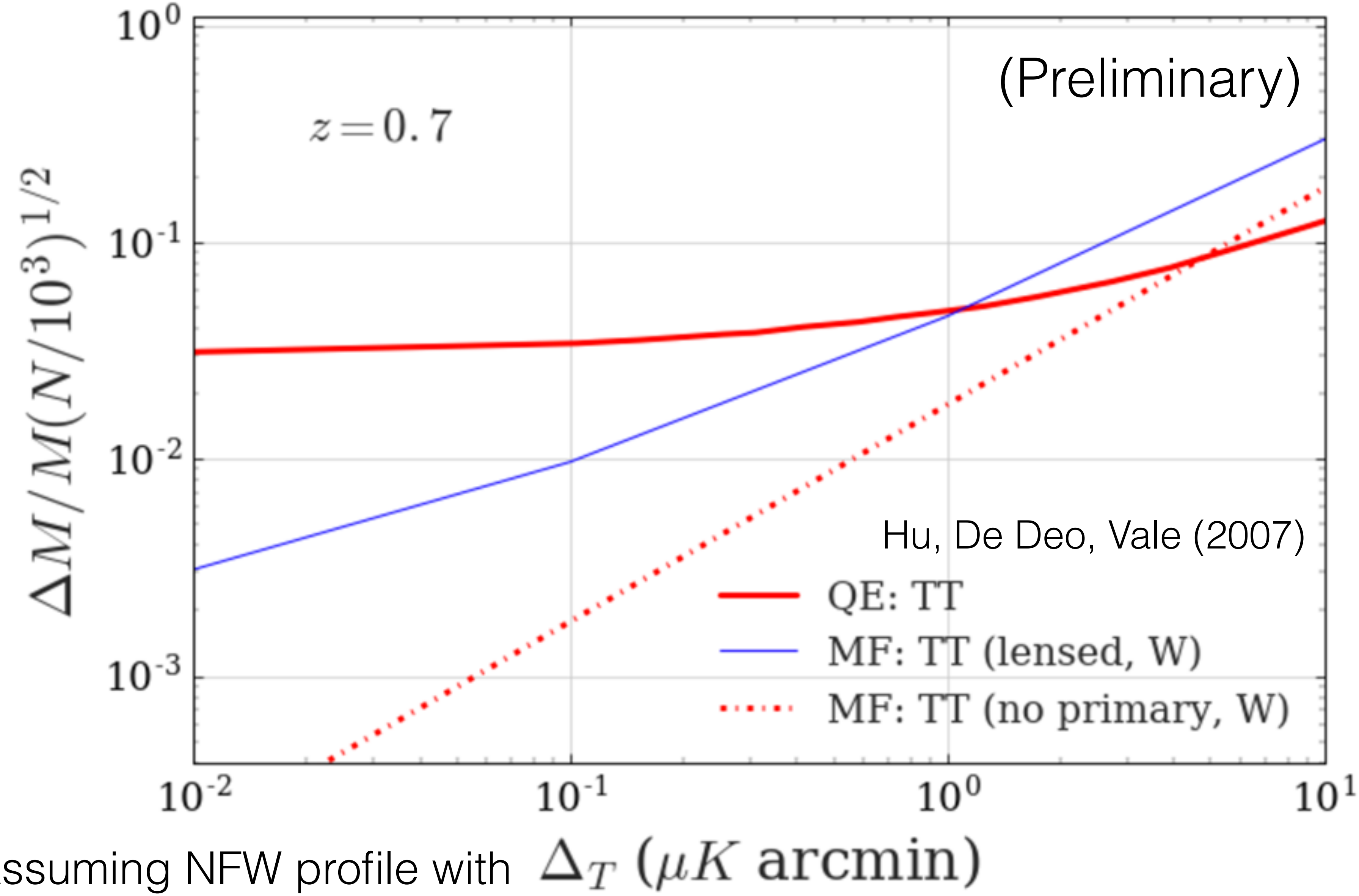
Profile

Estimated Amplitude

$$\hat{A} = \int \Psi(\boldsymbol{\theta})\tilde{T}(\boldsymbol{\theta})d^2\theta$$



More accurate mass estimates than quadratic estimator at low noise



Assuming NFW profile with known concentration and redshift