At the Party with the Physicists (and some non-)...

- Coulomb got a real charge out of the whole thing.
- Einstein thought it was a relatively good time
- Cauchy, being the mathematician, still managed to integrate well with everyone.
- Thompson enjoyed the plum pudding.
- Pascal was under too much pressure to enjoy himself.
- Ohm spent most of the time resisting Ampere's opinions on current events.
- Volta thought the social had a lot of potential.
- Hilbert was pretty spaced out for most of it.
- Heisenberg may or may not have been there.
- Feynman got from the door to the buffet table by taking every possible path.
- van der Waals forced himself to mingle.
- Millikan dropped his Italian oil dressing.
- de Broglie mostly just stood in the corner and waved.
- Hollerith liked the hole idea.
- Stefan and Boltzman got into some hot debates.

http://www.physlink.com/fun/PhysicsParty.cfm

At the Party with the Physicists (and some non-)...

- Compton was a little scatter-brained at times.
- Watt turned out to be a powerful speaker.
- Hertz went back to the buffet table several times a minute.
- Faraday had quite a capacity for food.
- The microwave started radiating in the background when Penzias and Wilson showed up.
- Instead of coming through the front door Josephson tunnelled through.
- Shakespeare could not decide whether to be or not to be at the party.
- Witten bought a present all tied up with superstrings.
- The food was beautifully laid out by Mendeleyev on the periodic table.
- Maxwell's demon argued with Dawkin's friend, the selfish Gene.
- Rontgen saw through everybody.
- After one bite Chandrasekhar reached his limit.
- Gamow left the party early with a big bang while Hoyle stayed late in a steady state.

http://www.physlink.com/fun/PhysicsParty.cfm

Probing Dark Energy and Primordial Non-Gaussianity in 15 Minutes

Devdeep Sarkar
Center for Cosmology, UC Irvine

In collaboration with:
Scott Sullivan (UCI/UCLA), Shahab Joudaki (UCI), Alexandre Amblard (UCI), Paolo Serra (UCI), Daniel Holz (Los Alamos), Asantha Cooray (UCI).

KIPAC, Stanford — Tea Talk — November 18, 2008

“The Poser”

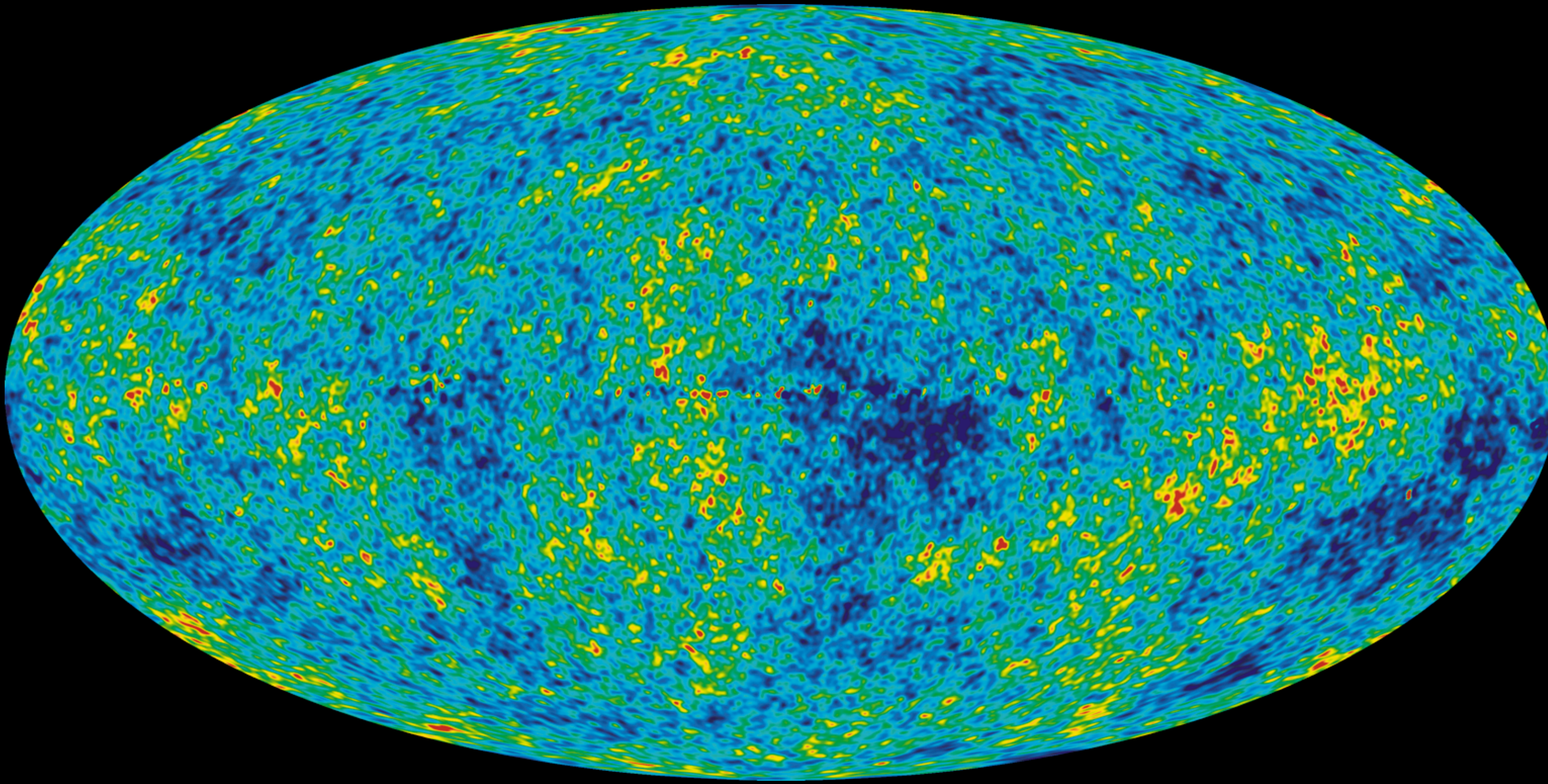
“A thorny problem that you’d like to explain and then get help with”

What is Dark Energy?

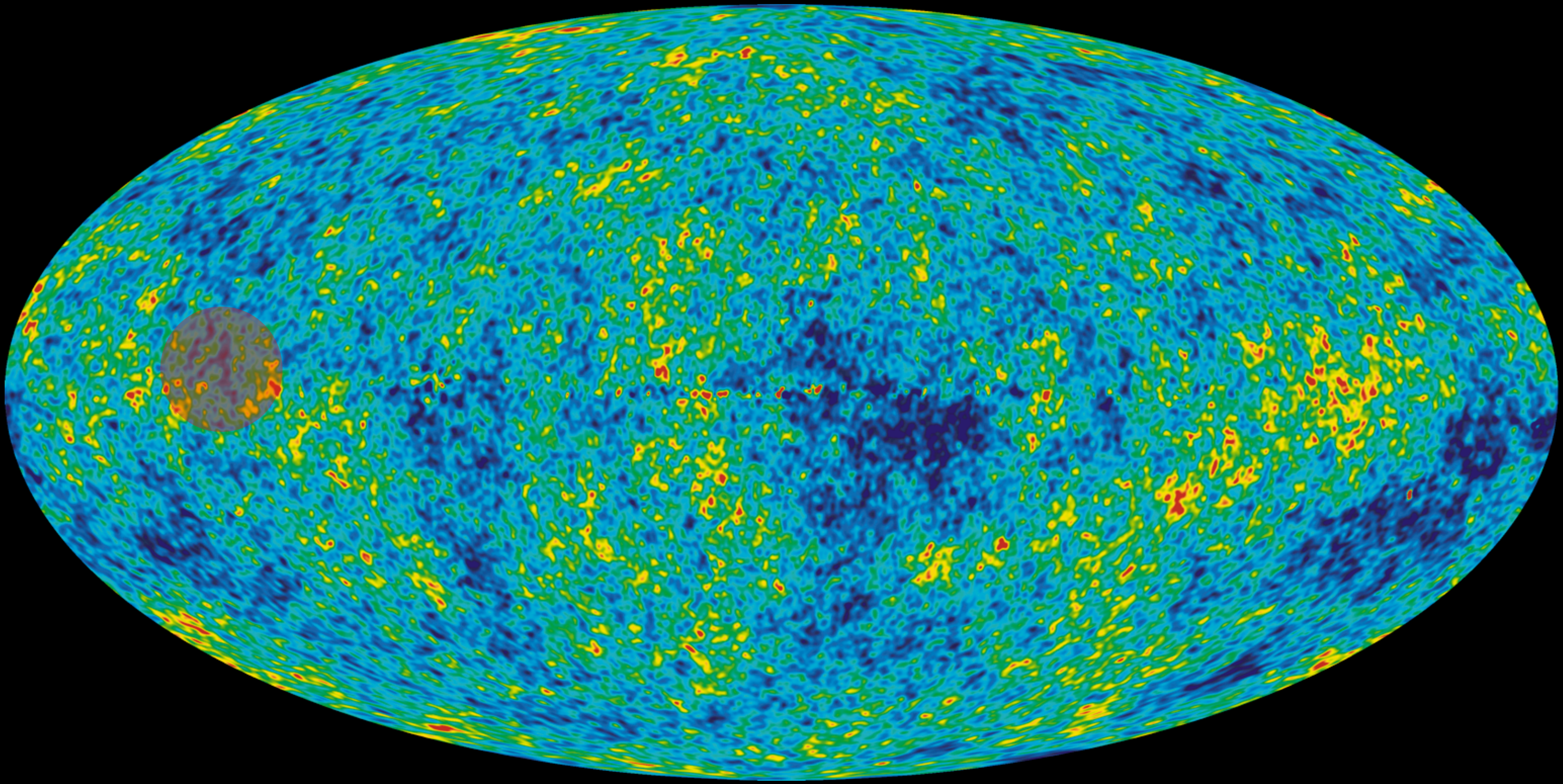
What is Dark Energy?

"Dark Energy is made from an exclusive blend of vital L-amino acids, beneficial vitamins and bionutrients that allows faster and greater ion penetration of the cell walls, visibly enhancing the rate of growth"

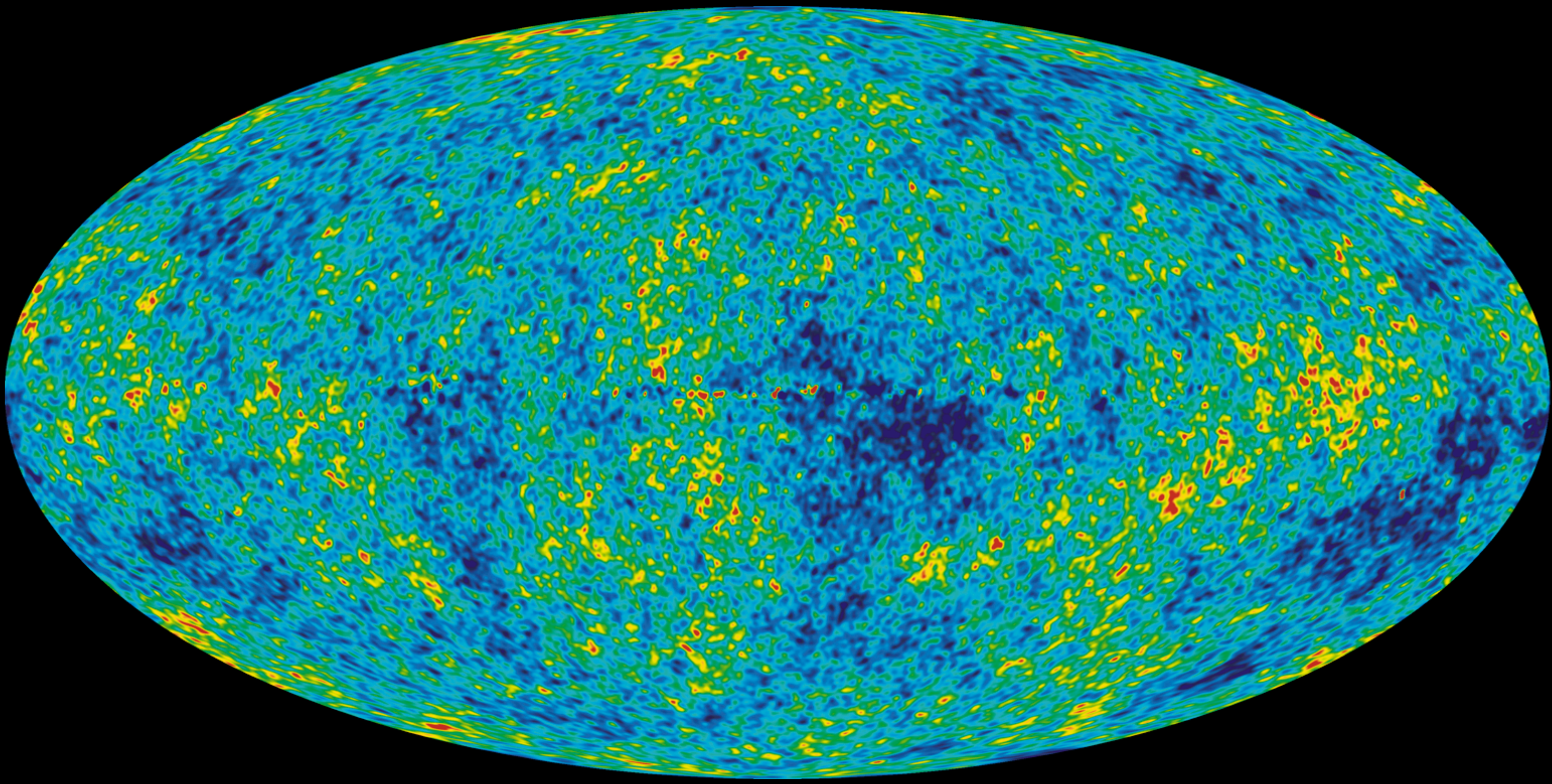
GrowLightSource.com



Credit: NASA/WMAP Science Team



Credit: NASA/WMAP Science Team



Credit: NASA/WMAP Science Team

The Astronomical Journal, 116:1009–1038, 1998 September

OBSERVATIONAL EVIDENCE FROM SUPERNOVAE FOR AN ACCELERATING UNIVERSE AND A COSMOLOGICAL CONSTANT

Adam G. Riess,[1] Alexei V. Filippenko,[1] Peter Challis,[2] Alejandro Clocchiatti,[3] Alan Diercks,[4] Peter M. Garnavich,[2] Ron L. Gilliland,[5] Craig J. Hogan,[4] Saurabh Jha,[2] Robert P. Kirshner,[2] B. Leibundgut,[6] M. M. Phillips,[7] David Reiss,[4] Brian P. Schmidt,[8,9] Robert A. Schommer,[7] R. Chris Smith,[7,10] J. Spyromilio,[6] Christopher Stubbs,[4] Nicholas B. Suntzeff,[7] and John Tonry[11]
Received 1998 March 13; revised 1998 May 6

Illustration: John Kascht

The Astrophysical Journal, 517:565–586, 1999 June 1

MEASUREMENTS OF Ω AND Λ FROM 42 HIGH-REDSHIFT SUPERNOVAE

S. Perlmutter,[1] G. Aldering, G. Goldhaber,[1] R. A. Knop, P. Nugent, P. G. Castro,[2] S. Deustua, S. Fabbro,[3]
A. Goobar,[4] D. E. Groom, I. M. Hook,[5] A. G. Kim,[1,6] M. Y. Kim, J. C. Lee,[7] N. J. Nunes,[2] R. Pain,[3]
C. R. Pennypacker,[8] and R. Quimby
Institute for Nuclear and Particle Astrophysics, E. O. Lawrence Berkeley National Laboratory, Berkeley, CA 94720

C. Lidman
European Southern Observatory, La Silla, Chile

R. S. Ellis, M. Irwin, and R. G. McMahon
Institute of Astronomy, Cambridge, England, UK

P. Ruiz-Lapuente
Department of Astronomy, University of Barcelona, Barcelona, Spain

N. Walton
Isaac Newton Group, La Palma, Spain

B. Schaefer
Department of Astronomy, Yale University, New Haven, CT

B. J. Boyle
Anglo-Australian Observatory, Sydney, Australia

A. V Filippenko and T. Matheson
Department of Astronomy, University of California, Berkeley, CA

A. S. Fruchter and N. Panagia[9]
Space Telescope Science Institute, Baltimore, MD

H. J. M. Newberg
Fermi National Laboratory, Batavia, IL

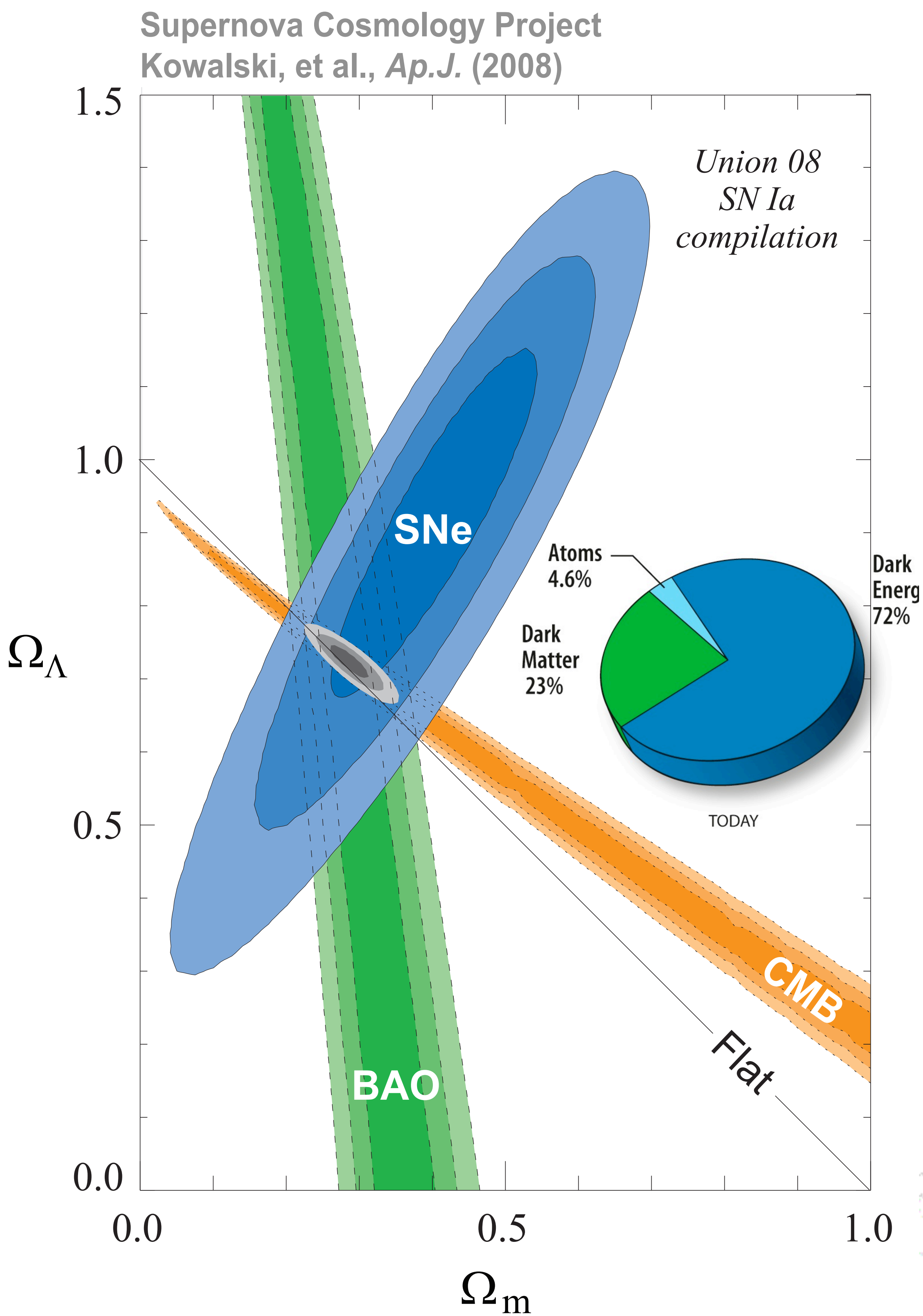
and

W. J. Couch
University of New South Wales, Sydney, Australia

(The Supernova Cosmology Project)

Received 1998 September 8; accepted 1998 December 17

$$\Omega_\Lambda = 0.713^{+0.027}_{-0.029}(\text{stat})^{+0.036}_{-0.039}(\text{sys})$$

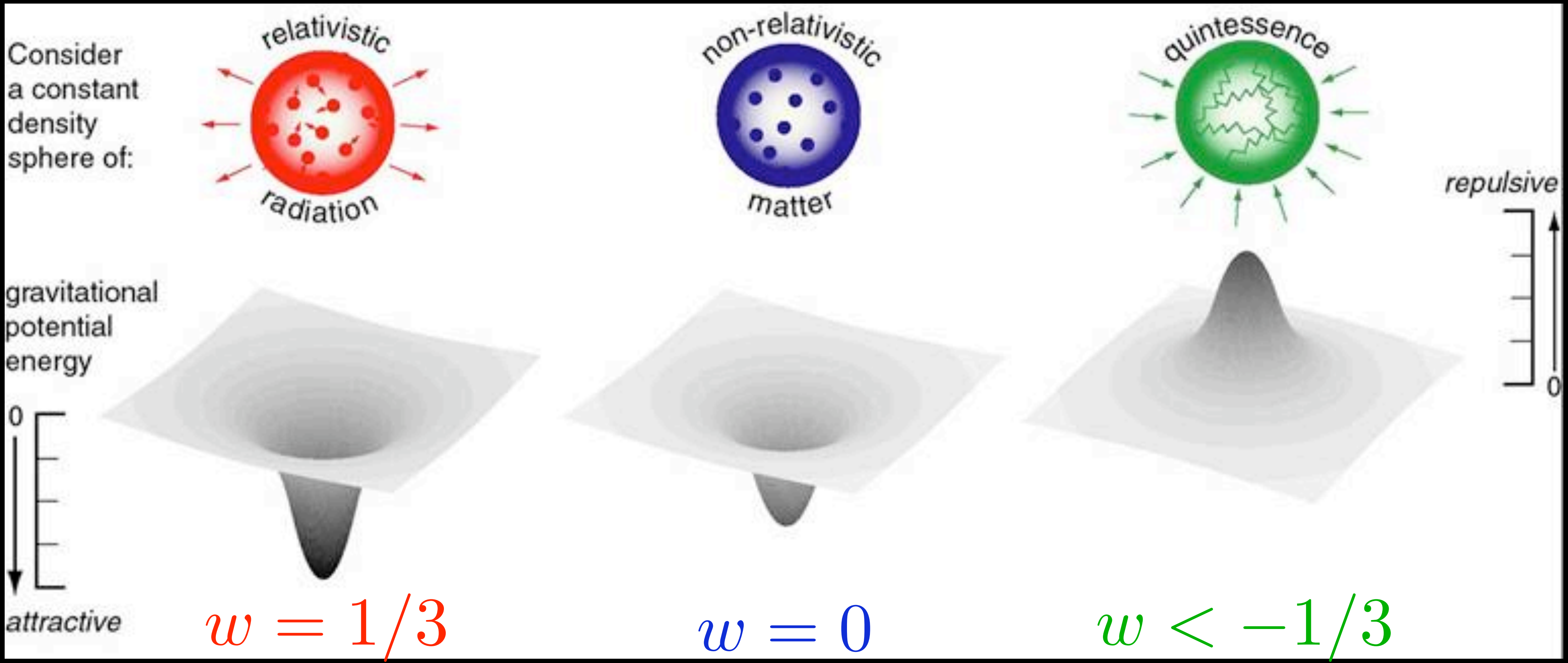


“The Titbit”

“An interesting aspect of your current research that others would benefit from”

Dark Energy Equation Of State

$$T^{\nu}_{\mu} = diag(\rho, -p, -p, -p) \qquad p = w\rho$$



For Cosmological Constant... $w = -1$

DE EOS Revisited: Different Approaches...

(A) Parameterize w(z) [Adopted by the DETF]

$$w(a) = w_0 + (1 - a)w_a$$

Chevallier & Polarski (2001)
(Linder 2003)

DE EOS Revisited: Different Approaches...

(A) Parameterize w(z) [Adopted by the DETF]

$$w(z) = w_0 + w_a z/(1+z)$$

Chevallier & Polarski (2001)
(Linder 2003)

DE EOS Revisited: Different Approaches...

(A) Parameterize w(z) [Adopted by the DETF]

$$w(z) = w_0 + w_a z/(1+z)$$

Chevallier & Polarski (2001)
(Linder 2003)

(B) Non-Parametric w(z)

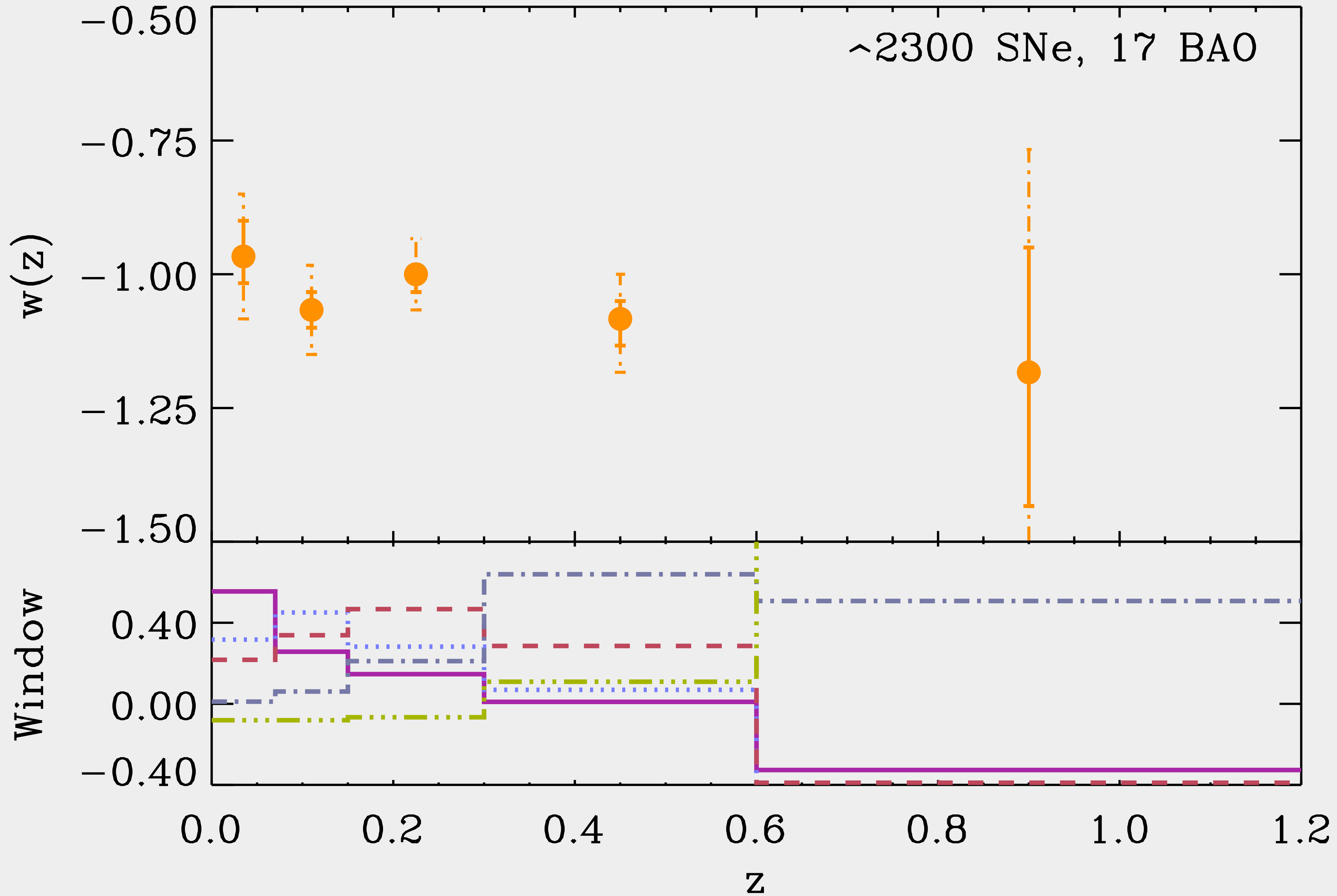
✓ Unbiased Estimate of DE Density (Wang & Lovelace 2001)
✓ Principal Component Approach (Huterer & Starkman 2003)
✓ Uncorrelated Estimates (Huterer & Cooray 2005)

✓ ...

For a review: Please see Sahni and Starobinsky (2006) [arXiv:astro-ph/0610026]

Binned Estimates: Future

$$F(z_n > z > z_{n-1}) = (1+z)^{3(1+w_n)} \prod_{i=0}^{n-1} (1+z_i)^{3(w_i - w_{i+1})}$$



w_1	0-.07
w_2	.07-.15
w_3	0.15-.3
w_4	0.3-0.6
w_5	0.6-1.2
w_6	1.2-2.0

D.S., S. Sullivan, S. Joudaki, A. Amblard, D. Holz, A. Cooray; PRL, 100, 241302 (2008)

Binned Estimates: Future

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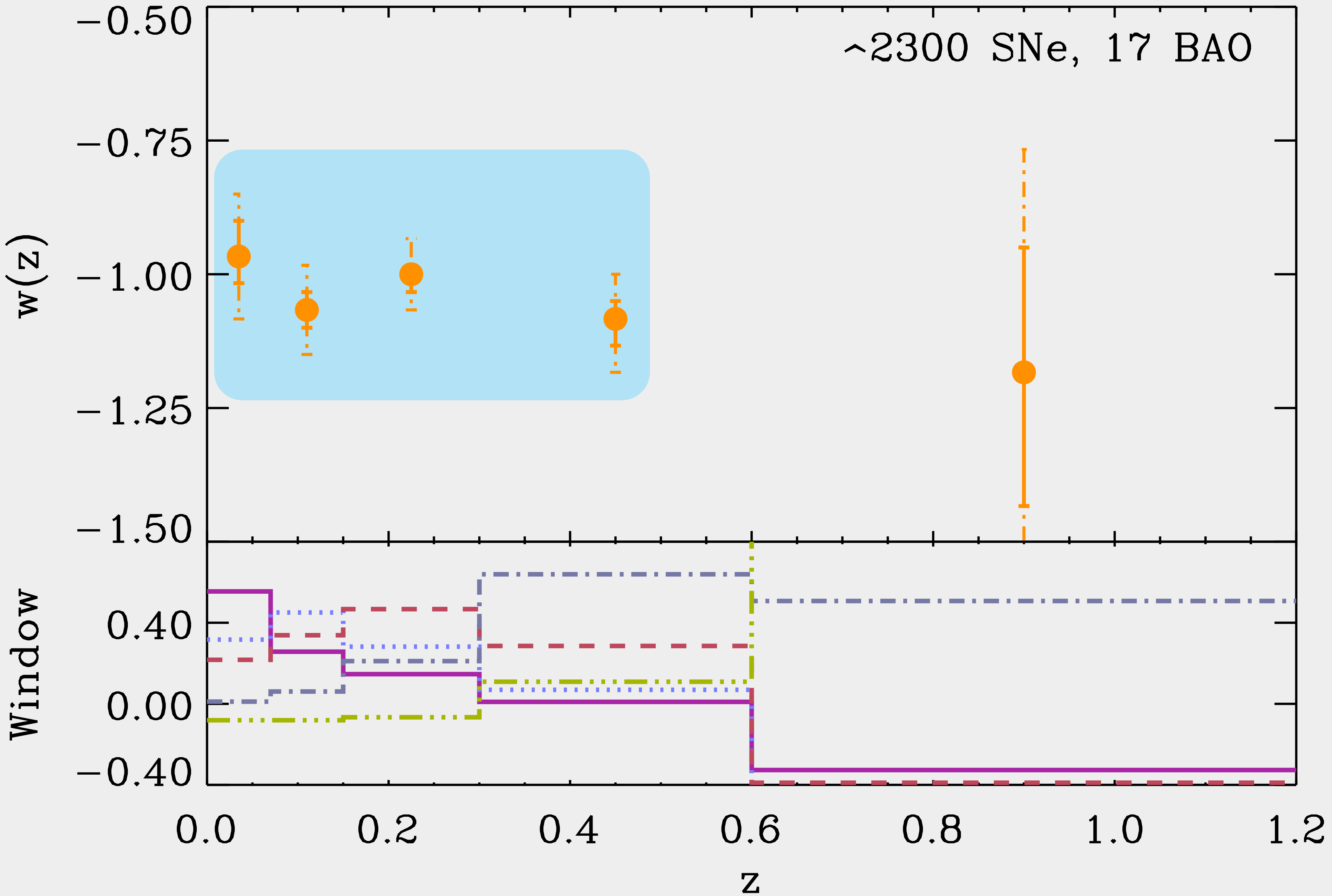

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w_6	1.2-2.0

D.S., S. Sullivan, S. Joudaki, A. Amblard, D. Holz, A. Cooray; PRL, 100, 241302 (2008)

Challenges: Systematic Uncertainties

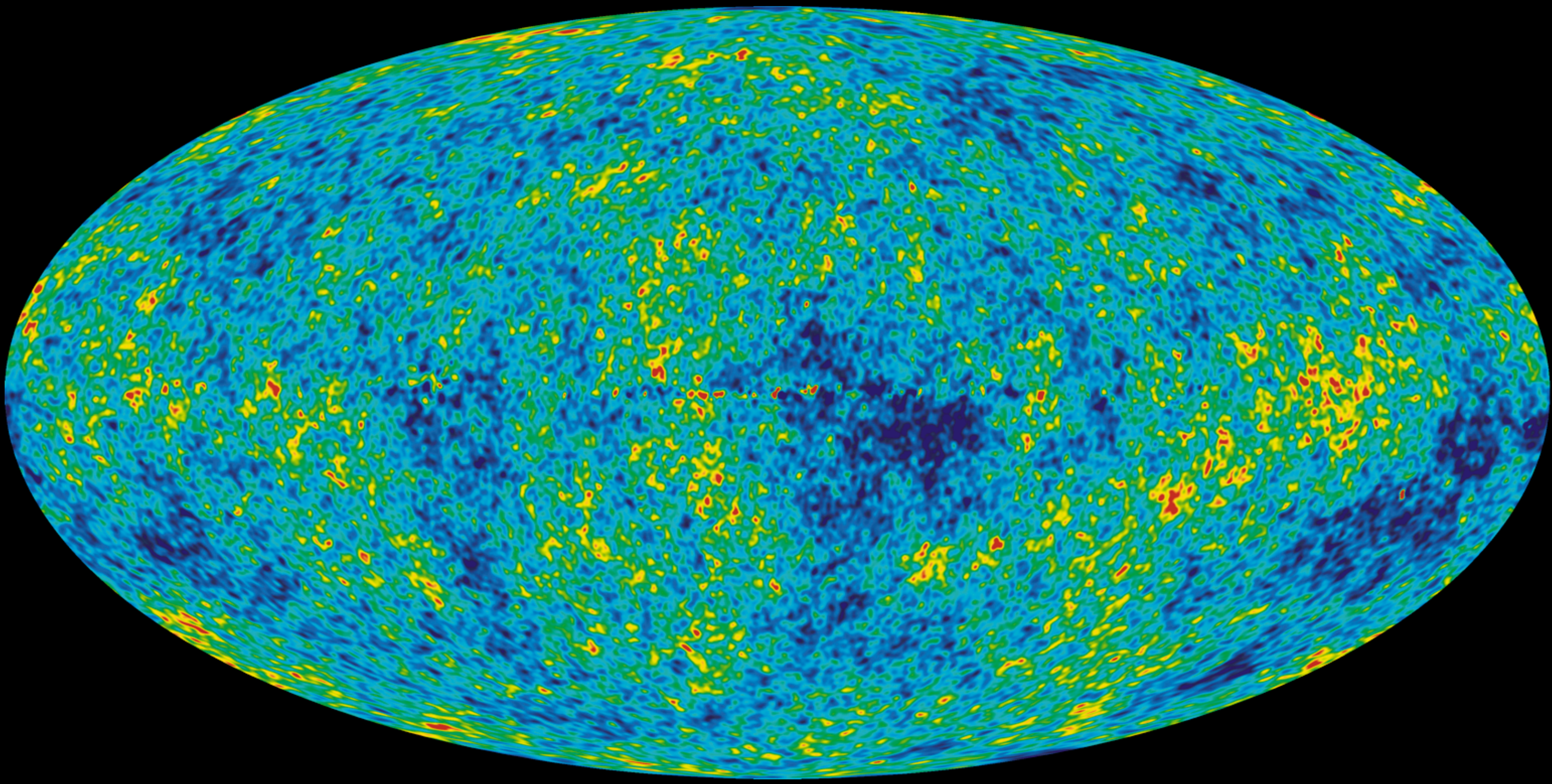
source of uncertainty	common (mag)	sample-dep.(mag)	treatment
Extinction	0.013	-	Multi-band photometry including near-IR
Calibration	0.021	0.021	Calibration of standard stars (optical thru near-IR) to <1%
Malmquist	-	0.020	High S/N lightcurves & spectra; requirement of pre-rise data
Lightcurve	0.028	-	SN spectra with broad λ, temporal coverage
Evolution	0.015	-	High-resolution spectroscopy

Kowalski et al. (2008), Carnegie Supernova Project: W. Freedman

Lensing	*D.S., A. Amblard, D. Holz, A. Cooray; ApJ, 678, 1 (2008)*
2-Population	*D.S., A. Amblard, A. Cooray, D.Holz; ApJL, 684, L13 (2008)*

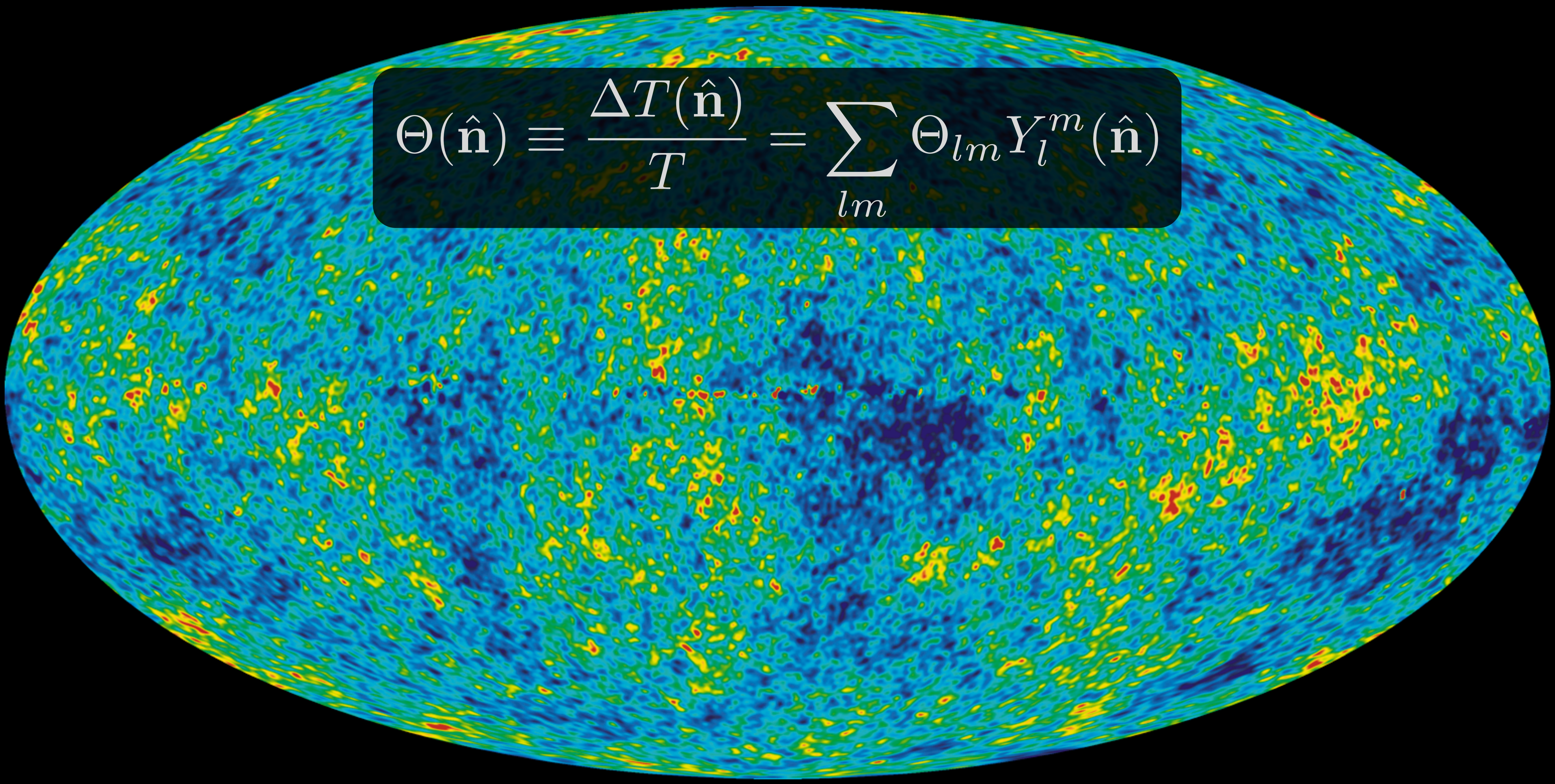
“The Titbit”

“Another interesting aspect of your current research that others would benefit from”

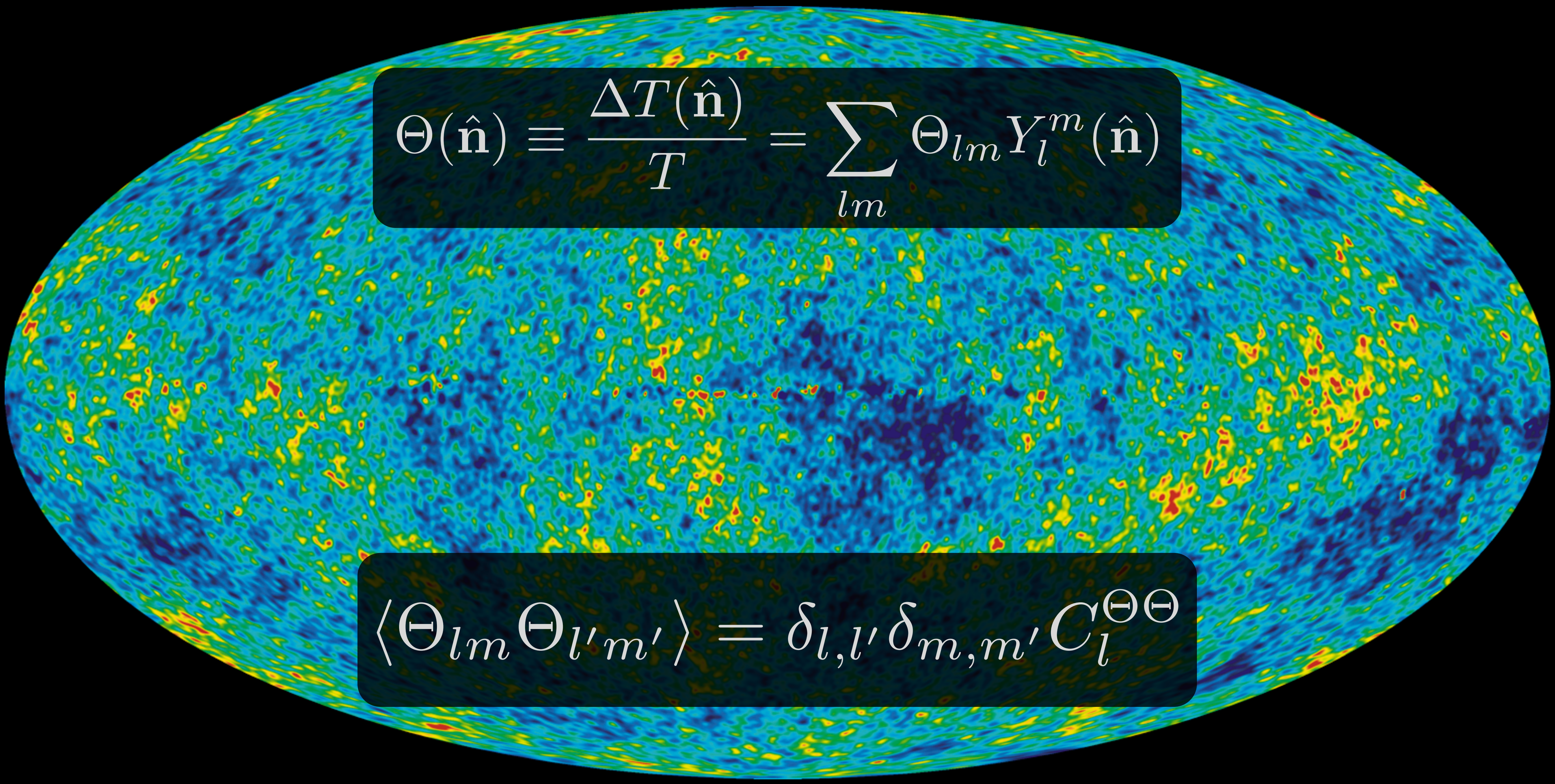


Credit: NASA/WMAP Science Team

$$\Theta(\hat{\mathbf{n}}) \equiv \frac{\Delta T(\hat{\mathbf{n}})}{T} = \sum_{lm} \Theta_{lm} Y_l^m(\hat{\mathbf{n}})$$



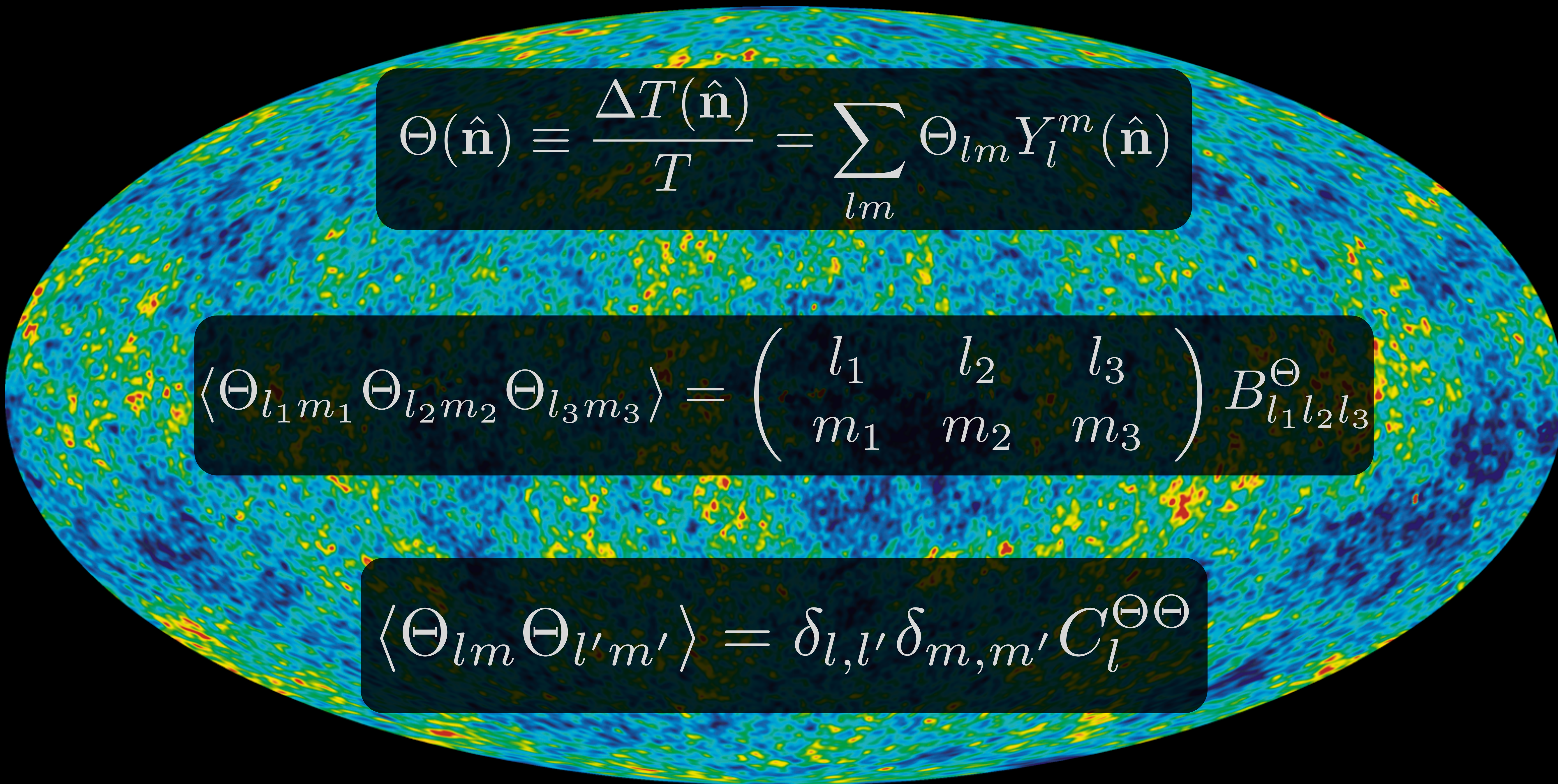
Credit: NASA/WMAP Science Team



$$\Theta(\hat{\mathbf{n}}) \equiv \frac{\Delta T(\hat{\mathbf{n}})}{T} = \sum_{lm} \Theta_{lm} Y_l^m(\hat{\mathbf{n}})$$

$$\langle \Theta_{lm} \Theta_{l'm'} \rangle = \delta_{l,l'} \delta_{m,m'} C_l^{\Theta\Theta}$$

Credit: NASA/WMAP Science Team



$$\Theta(\hat{\mathbf{n}}) \equiv \frac{\Delta T(\hat{\mathbf{n}})}{T} = \sum_{lm} \Theta_{lm} Y_l^m(\hat{\mathbf{n}})$$

$$\langle \Theta_{l_1 m_1} \Theta_{l_2 m_2} \Theta_{l_3 m_3} \rangle = \begin{pmatrix} l_1 & l_2 & l_3 \\ m_1 & m_2 & m_3 \end{pmatrix} B^{\Theta}_{l_1 l_2 l_3}$$

$$\langle \Theta_{lm} \Theta_{l'm'} \rangle = \delta_{l,l'} \delta_{m,m'} C_l^{\Theta\Theta}$$

Credit: NASA/WMAP Science Team

Primordial non-Gaussianity

Primary CMB Bispectrum

$$\frac{\Delta T(\mathbf{x})}{T} \sim \Phi(\mathbf{x})$$

$$\Phi(\mathbf{x}) = \Phi_L(\mathbf{x}) + f_{NL}\left[\Phi_L^2(\mathbf{x}) - \langle\Phi_L^2(\mathbf{x})\rangle\right]$$

Non-Linear Coupling Parameter

Measurement of non-Gaussian CMB anisotropies can potentially constrain non-linearity, "slow-rollness", and "adiabaticity" in inflation.

Primordial non-Gaussianity

Primary CMB Bispectrum

Non-Gaussianity from the simplest inflation model is very small:

$$f_{NL} \sim 0.01 - 1$$

Much higher level of primordial non-Gaussianity is predicted by:

- Models with Multiple Scalar Fields
- Non-Adiabatic Fluctuations
- Features in the Inflation Potential
- Non-Canonical Kinetic Terms
- ...

Review: N. Bartolo, E. Komatsu, S. Matarrese, and A. Riotto, Phys. Rep. 402, 103 (2004)

PRL **100,** 181301 (2008) PHYSICAL REVIEW LETTERS week ending 9 MAY 2008

Evidence of Primordial Non-Gaussianity (f_{NL}) in the Wilkinson Microwave Anisotropy Probe 3-Year Data at 2.8σ

Amit P. S. Yadav[1] and Benjamin D. Wandelt[1,2]

[1]*Department of Astronomy, University of Illinois at Urbana-Champaign, 1002 W. Green Street, Urbana, Illinois 61801, USA*
[2]*Department of Physics, University of Illinois at Urbana-Champaign, 1110 W. Green Street, Urbana, Illinois 61801, USA*

(Received 7 December 2007; revised manuscript received 6 March 2008; published 7 May 2008)

We present evidence for primordial non-Gaussianity of the local type (f_{NL}) in the temperature anisotropy of the cosmic microwave background. Analyzing the bispectrum of the Wilkinson Microwave Anisotropy Probe 3-year data up to $\ell_{max} = 750$ we find $27 < f_{NL} < 147$ (95% C.L.). This amounts to a rejection of $f_{NL} = 0$ at 2.8σ, disfavoring canonical single-field slow-roll inflation. The signal is robust to variations in l_{max}, frequency and masks. No known foreground, instrument systematic, or secondary anisotropy explains it. We explore the impact of several analysis choices on the quoted significance and find 2.5σ to be conservative.

FIVE-YEAR WILKINSON MICROWAVE ANISOTROPY PROBE (WMAP[1]) OBSERVATIONS: COSMOLOGICAL INTERPRETATION

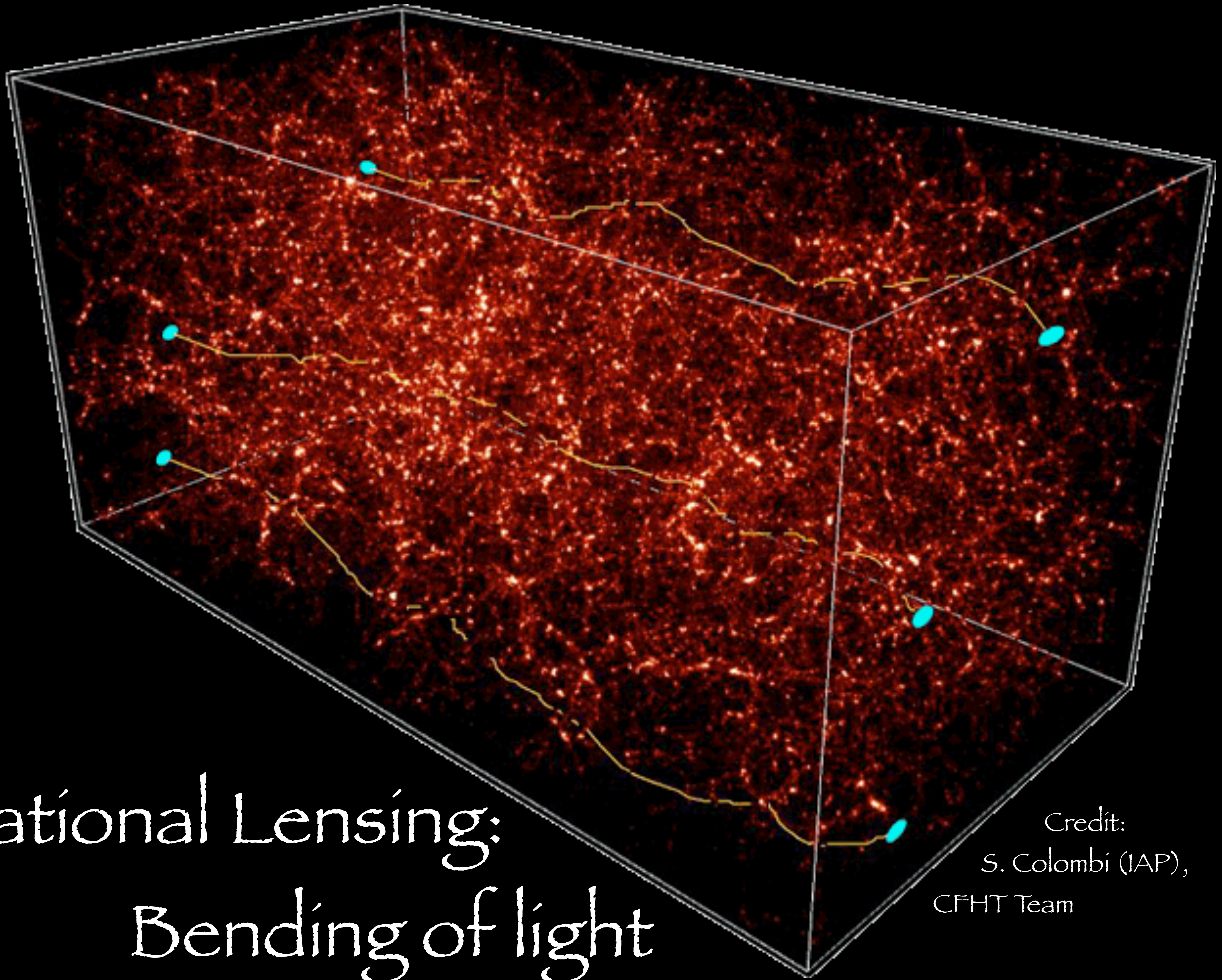
E. Komatsu [1], J. Dunkley [2,3,4], M. R. Nolta [5], C. L. Bennett [6], B. Gold [6], G. Hinshaw [7], N. Jarosik [2], D. Larson [6], M. Limon [8] L. Page [2], D. N. Spergel [3,9], M. Halpern [10], R. S. Hill [11], A. Kogut [7], S. S. Meyer [12], G. S. Tucker [13], J. L. Weiland [10], E. Wollack [7], and E. L. Wright [14]

Submitted to the Astrophysical Journal Supplement Series

ABSTRACT

$$-9 < f_{NL}^{local} < 111 \text{ and } -151 < f_{NL}^{equil} < 253 (95\% \, CL)$$

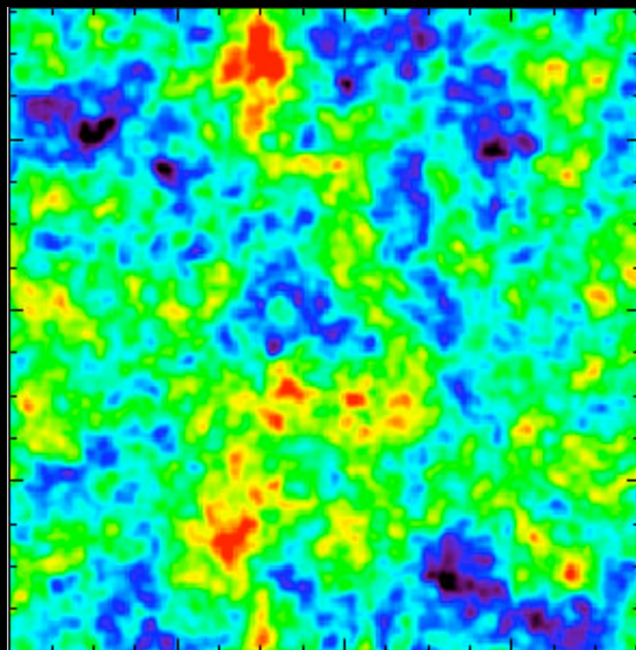
Journey Through the "Clumpy" Universe



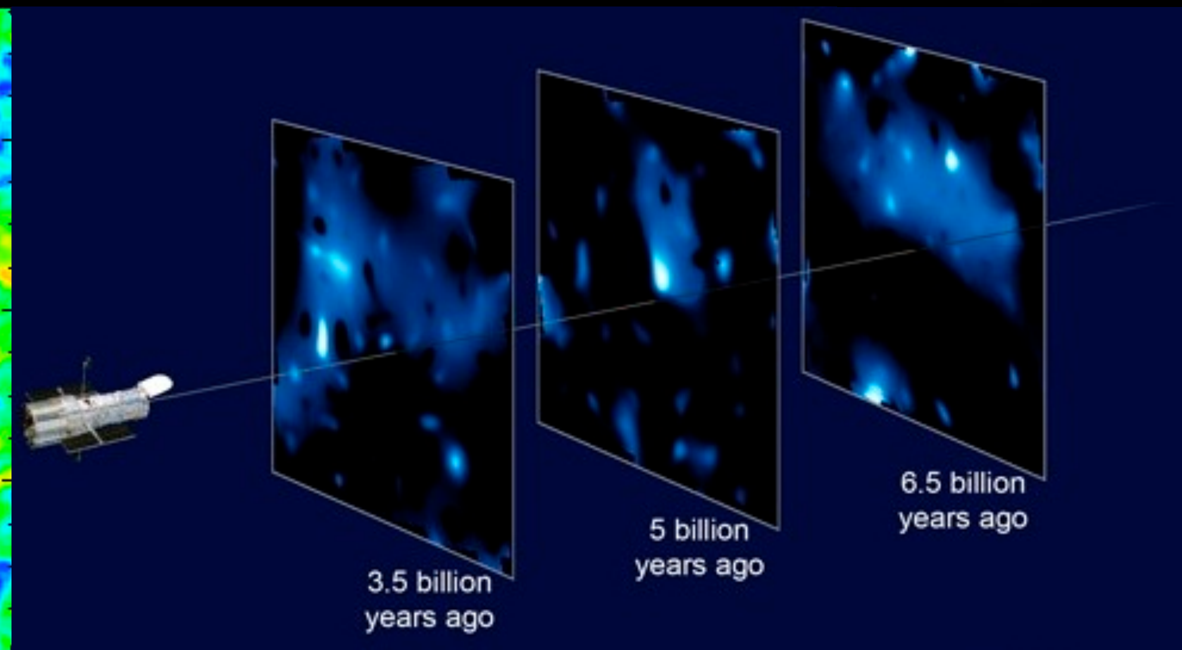
Weak Gravitational Lensing: Bending of light

Credit: S. Colombi (IAP), CFHT Team

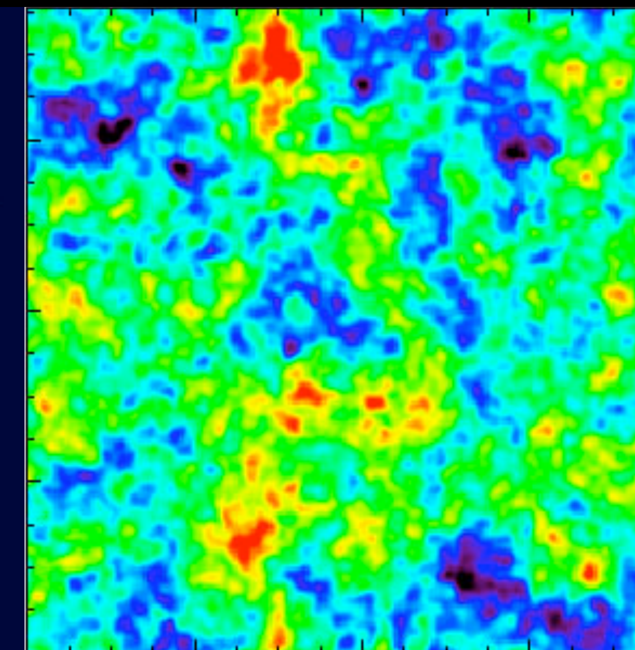
Weak Lensing of the Primary Bispectrum



Credit: Vale, Amblard, White (2004)



NASA, ESA, and R. Massey (CalTech)



Credit: Vale, Amblard, White (2004)

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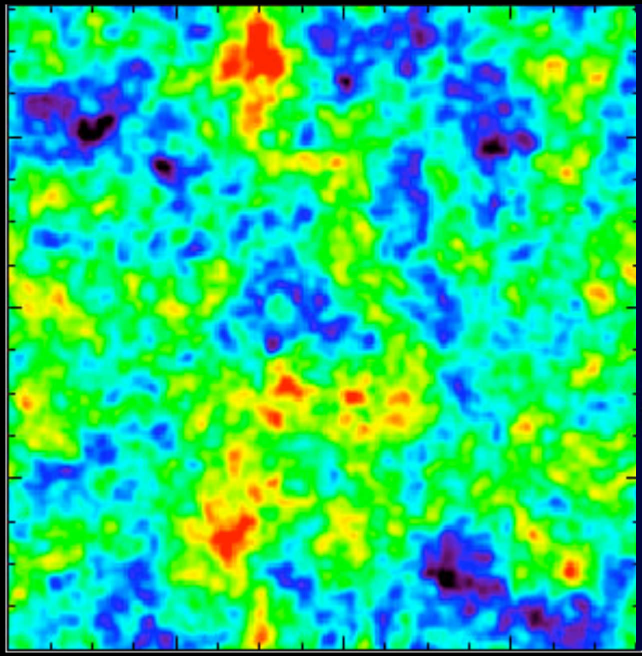
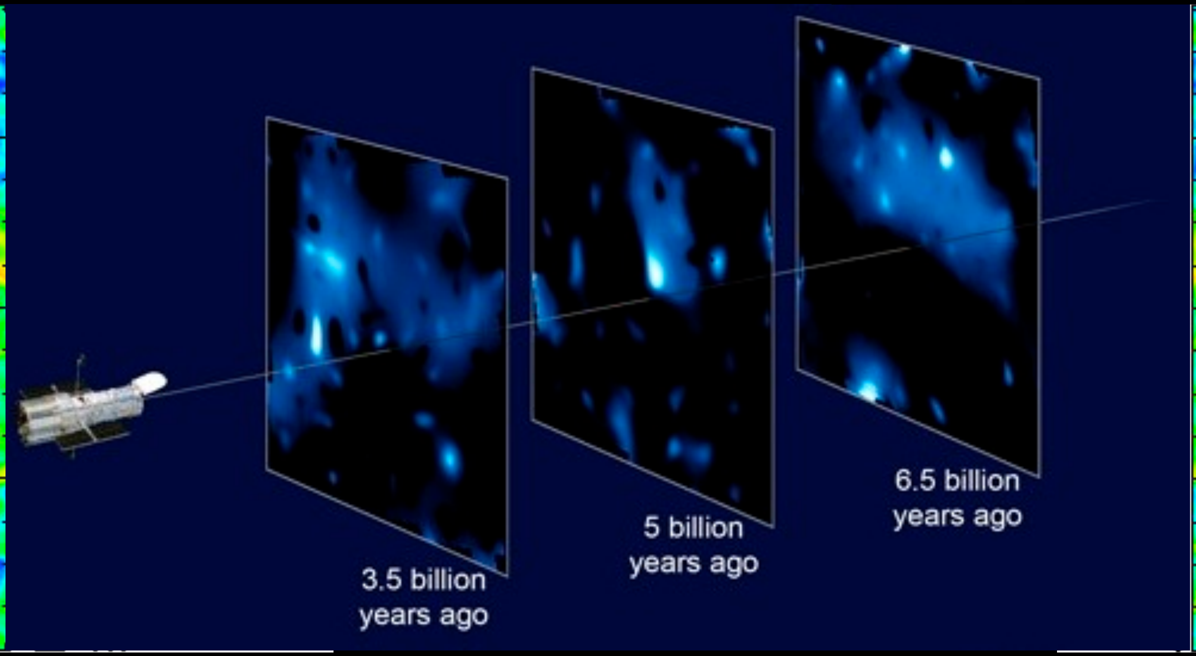


Credit: Vale, Amblard, White (2004)



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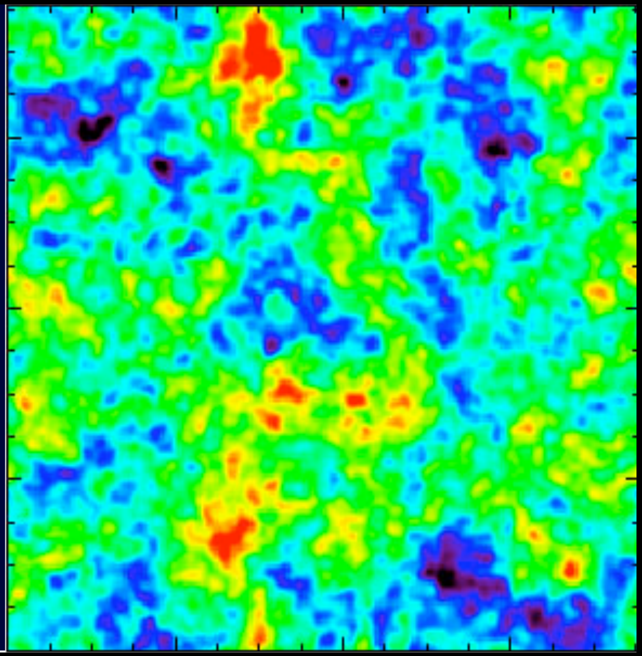
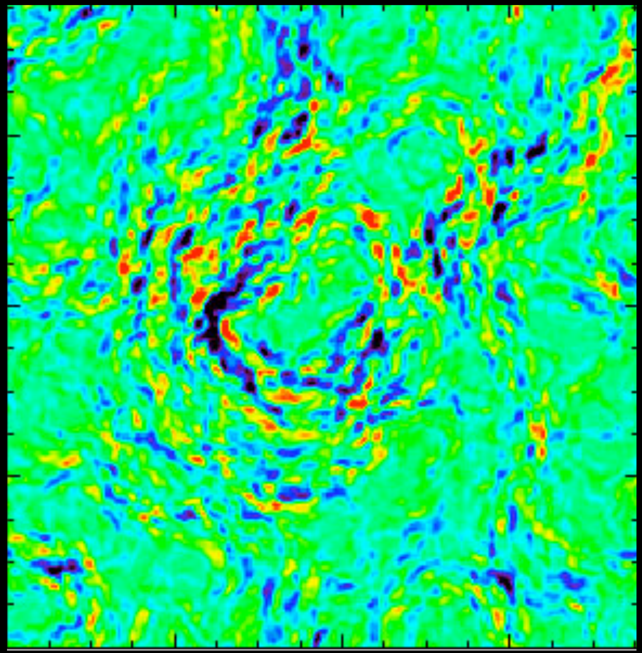
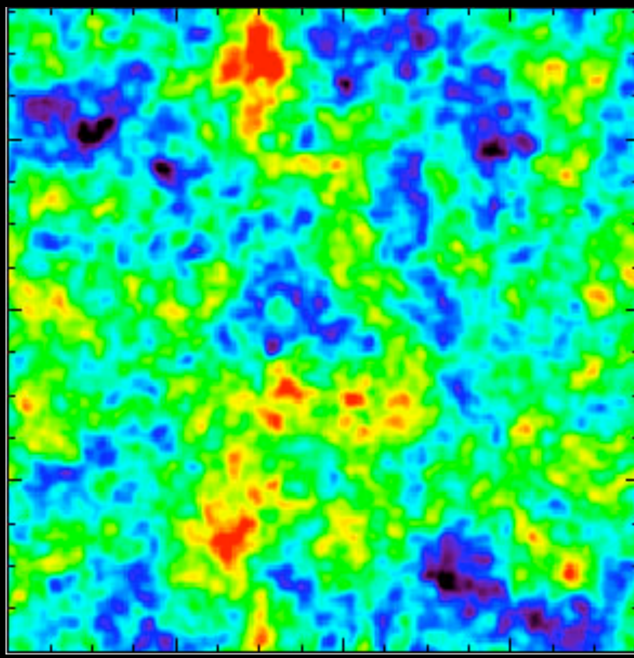


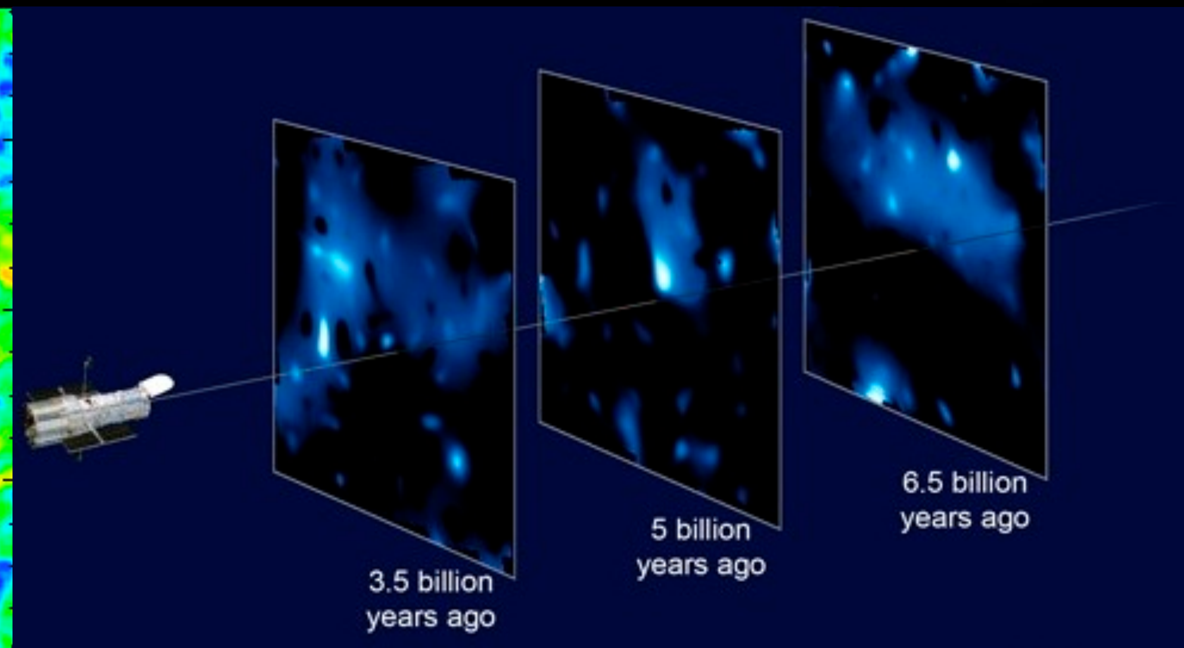
Credit: Vale, Amblard, White (2004)



Weak Lensing of the Primary Bispectrum



Credit: Vale, Amblard, White (2004)



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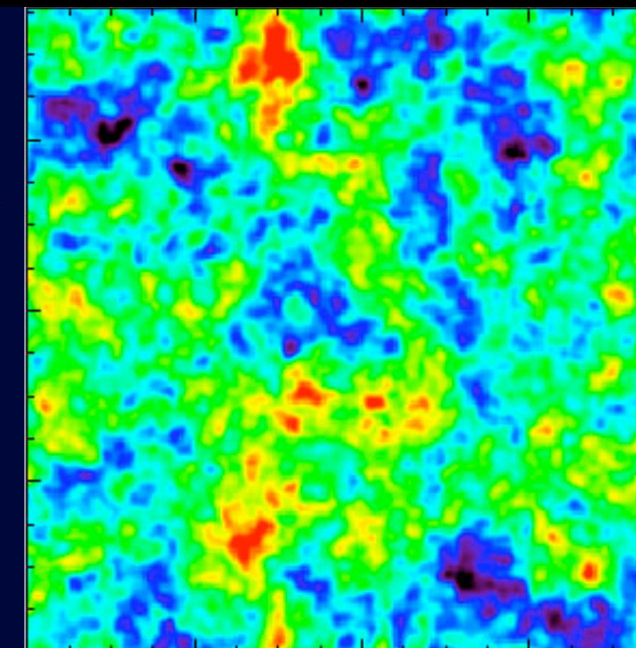
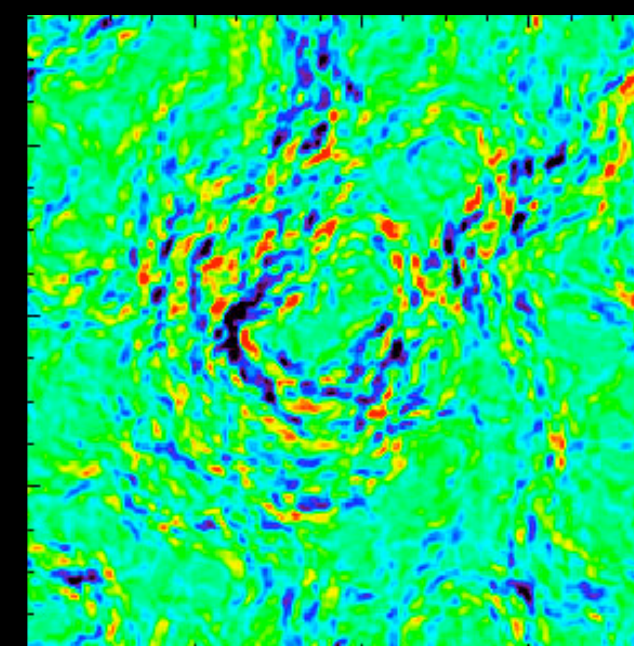
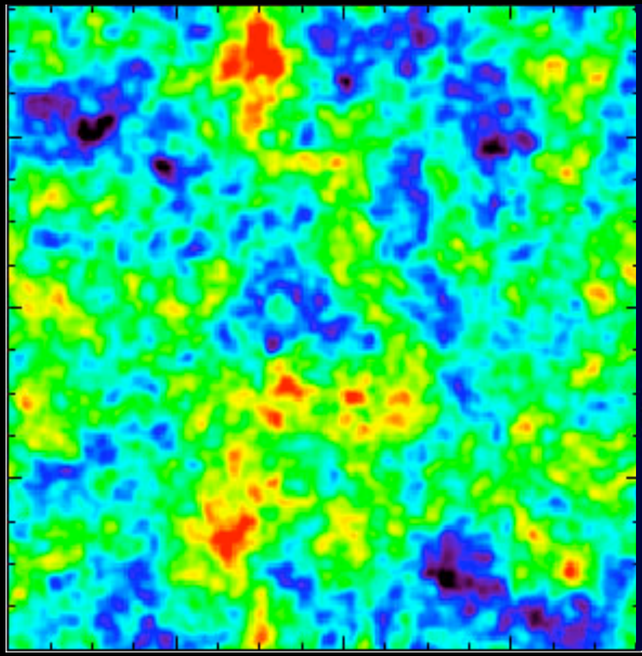


Credit: Vale, Amblard, White (2004)

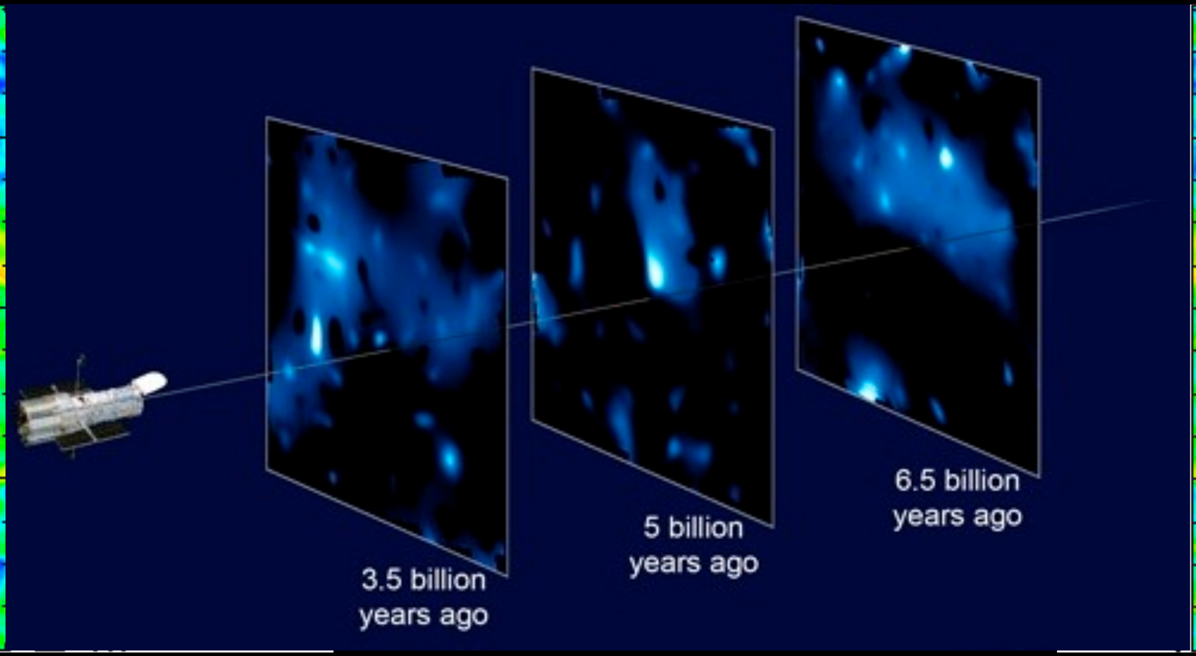
$$
\begin{aligned}
\tilde{\Theta}(\hat{\mathbf{n}}) &= \Theta[\hat{\mathbf{n}} + \hat{\alpha}] \\
&= \Theta[\hat{\mathbf{n}} + \nabla\phi(\hat{\mathbf{n}})] \\
&\approx \Theta(\hat{\mathbf{n}}) + \nabla_i\phi(\hat{\mathbf{n}})\nabla^i\Theta(\hat{\mathbf{n}}) \\
&\quad + \frac{1}{2}\nabla_i\phi(\hat{\mathbf{n}})\nabla_j\phi(\hat{\mathbf{n}})\nabla^i\nabla^j\Theta(\hat{\mathbf{n}})
\end{aligned}
$$



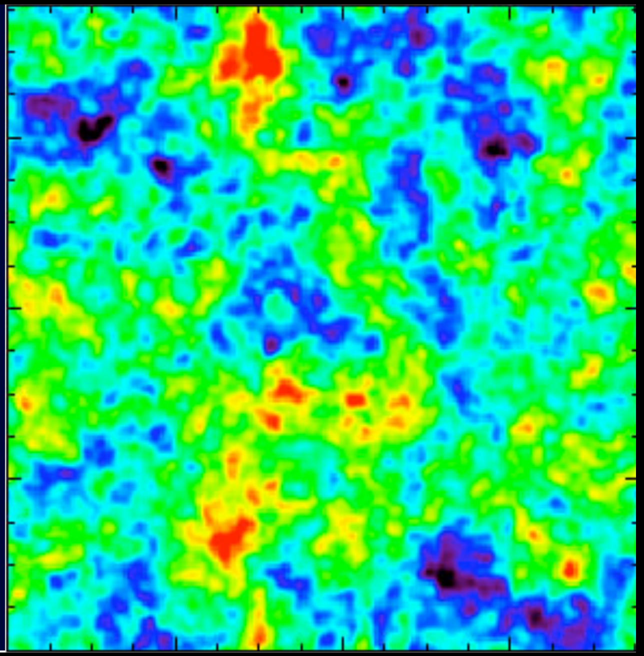
Weak Lensing of the Primary Bispectrum



Credit: Vale, Amblard, White (2004)

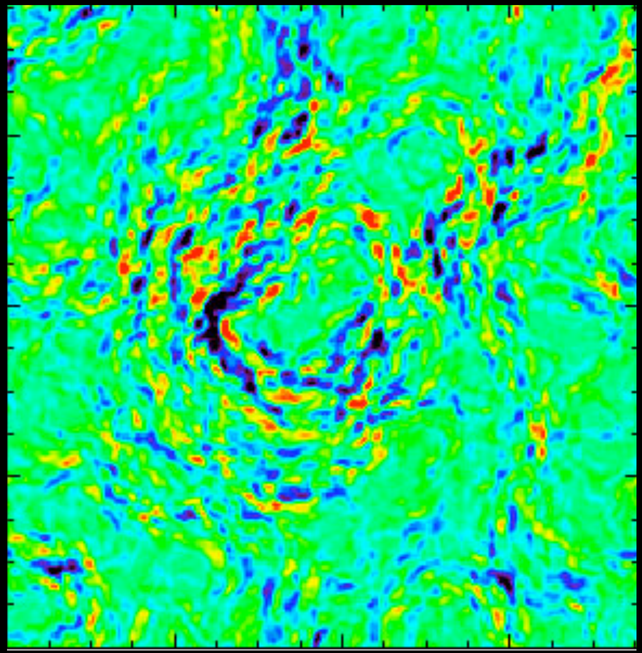


NASA, ESA, and R. Massey (CalTech)



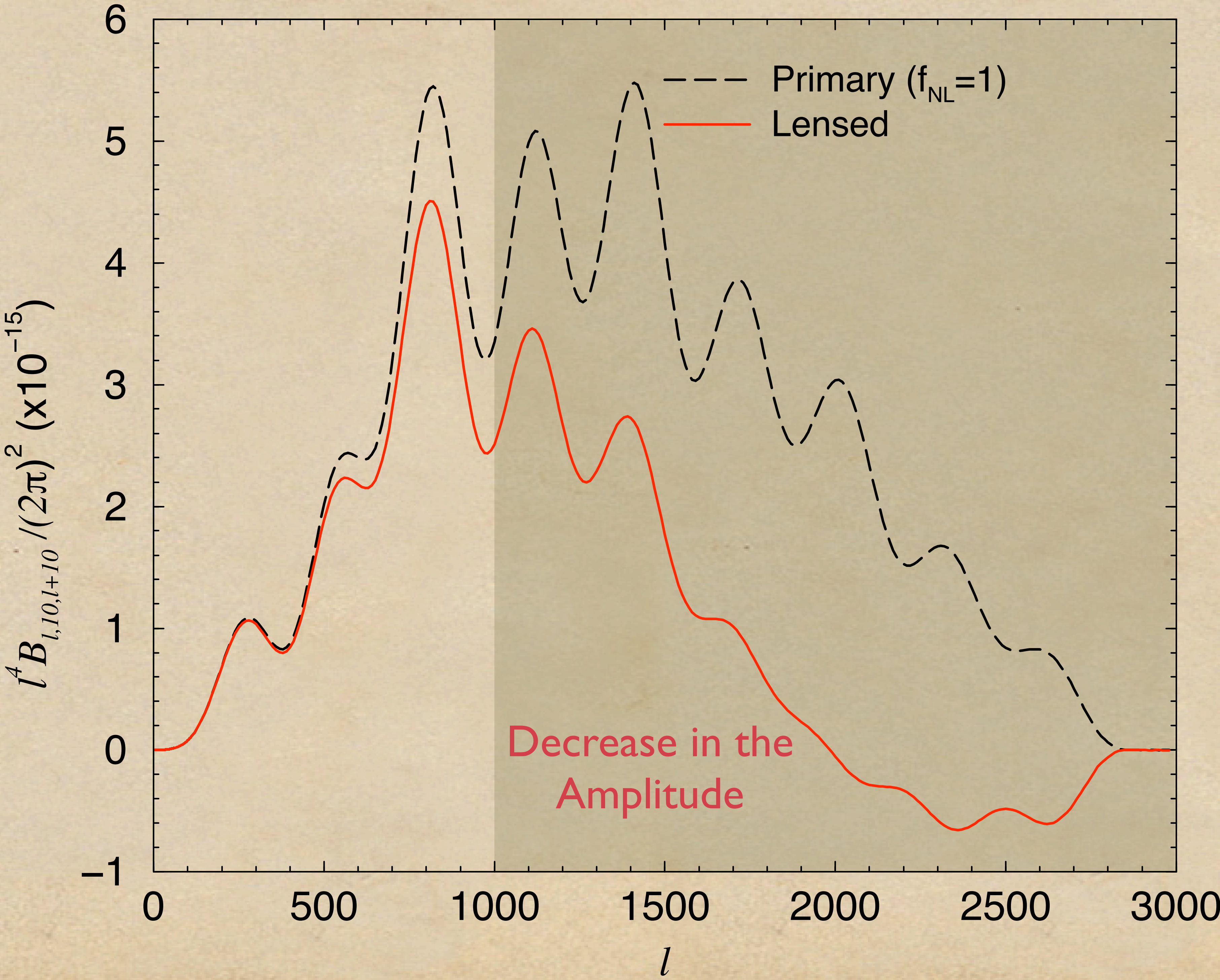
Credit: Vale, Amblard, White (2004)

$$\begin{aligned}\tilde{\Theta}(\hat{\mathbf{n}}) &= \Theta[\hat{\mathbf{n}} + \hat{\alpha}] \\ &= \Theta[\hat{\mathbf{n}} + \nabla\phi(\hat{\mathbf{n}})] \\ &\approx \Theta(\hat{\mathbf{n}}) + \nabla_i\phi(\hat{\mathbf{n}})\nabla^i\Theta(\hat{\mathbf{n}}) \\ &\quad + \frac{1}{2}\nabla_i\phi(\hat{\mathbf{n}})\nabla_j\phi(\hat{\mathbf{n}})\nabla^i\nabla^j\Theta(\hat{\mathbf{n}})\end{aligned}$$



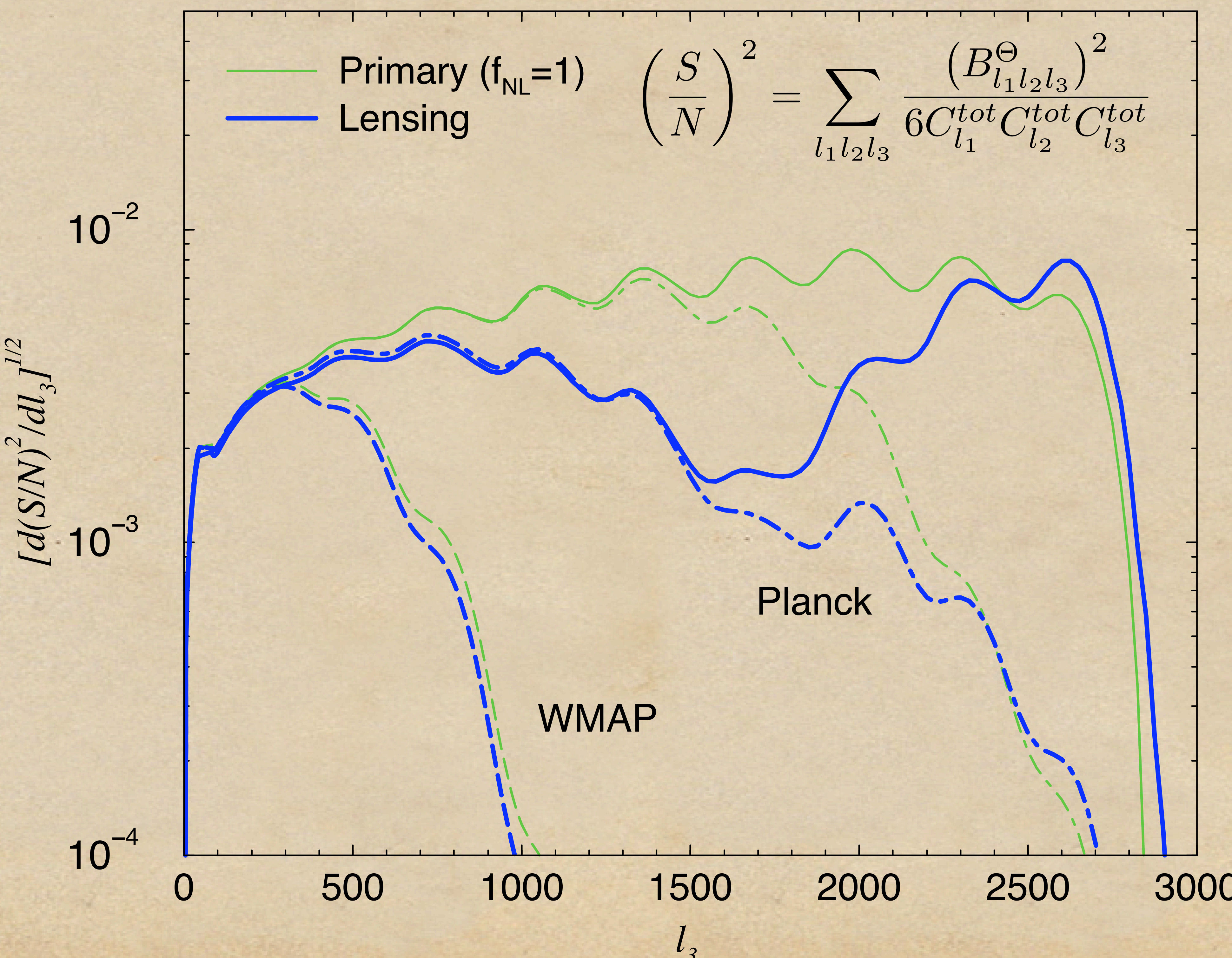
$$\tilde{B}^{\Theta}_{l_1 l_2 l_3} = \sum_{m_1 m_2 m_3} \begin{pmatrix} l_1 & l_2 & l_3 \\ m_1 & m_2 & m_3 \end{pmatrix} \langle \tilde{\Theta}_{l_1 m_1} \tilde{\Theta}_{l_2 m_2} \tilde{\Theta}_{l_3 m_3} \rangle$$

The Effect of Lensing on the Bispectrum



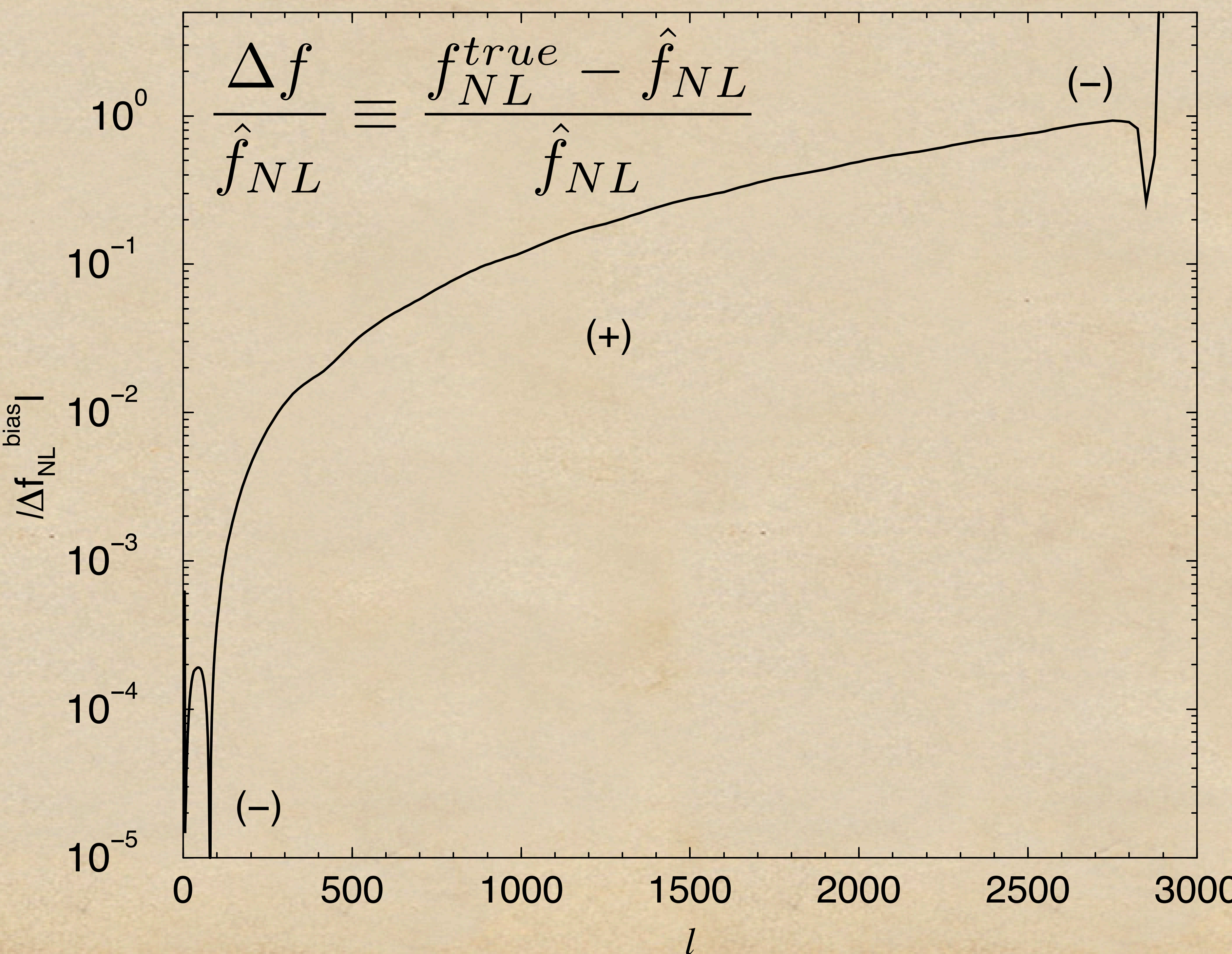
A. Cooray, D. Sarkar, and P. Serra; Phys. Rev. D, 77, 123006 (2008)

Reduction in the S/N due to Lensing



A. Cooray, D. Sarkar, and P. Serra; Phys. Rev. D, 77, 123006 (2008)

Bias in the non-Gaussian Parameter



A. Cooray, D. Sarkar, and P. Serra; Phys. Rev. D, 77, 123006 (2008)

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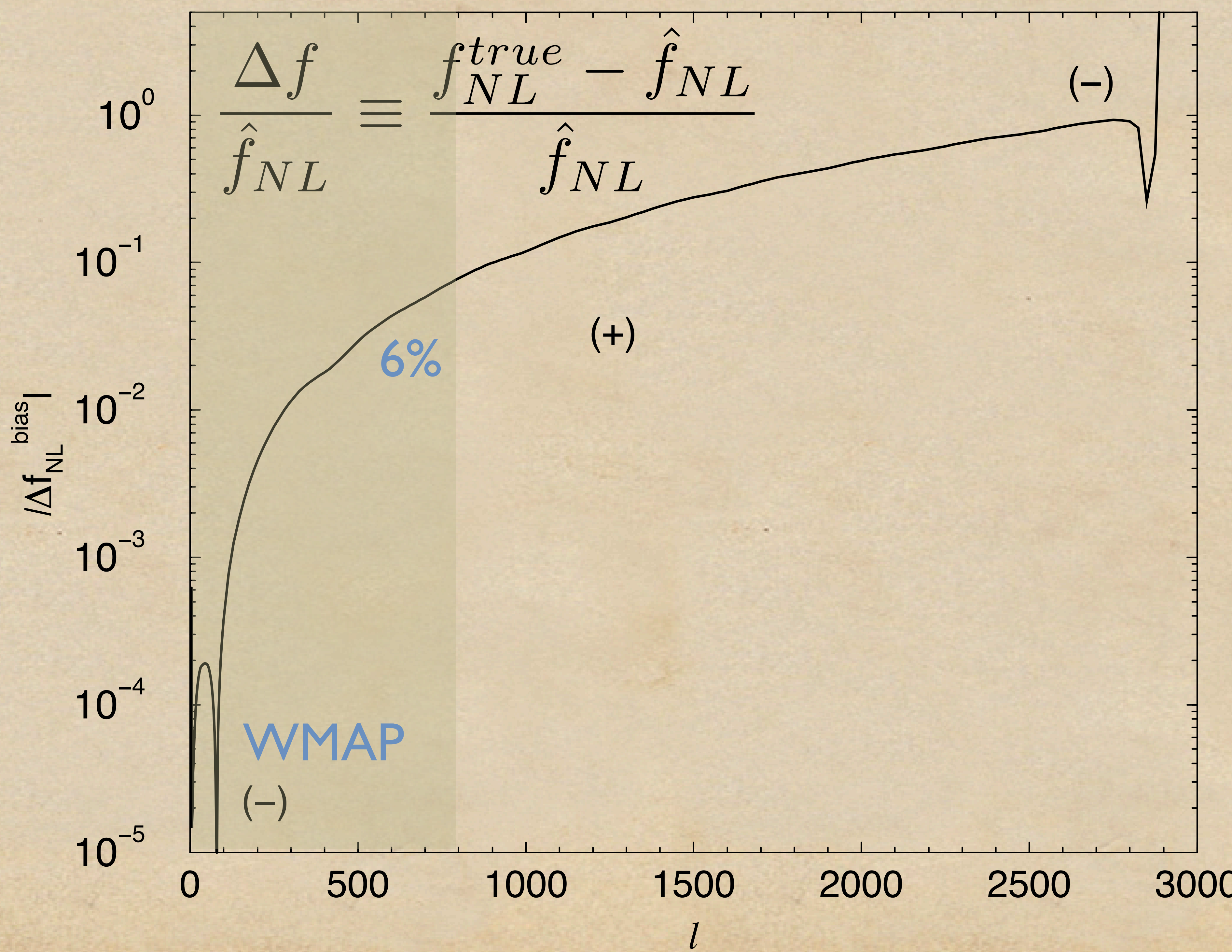

A. Cooray, D. Sarkar, and P. Serra; Phys. Rev. D, 77, 123006 (2008)

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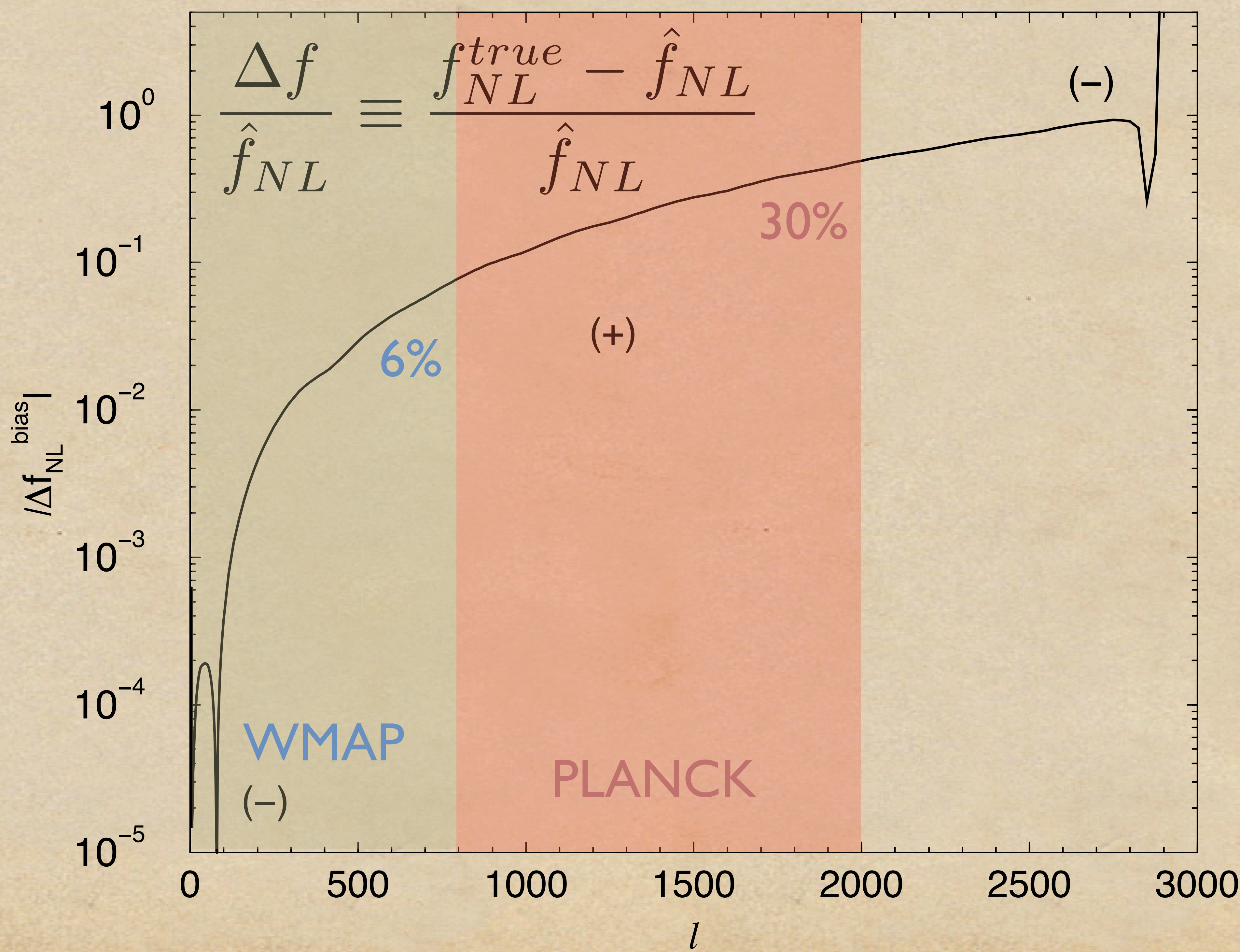
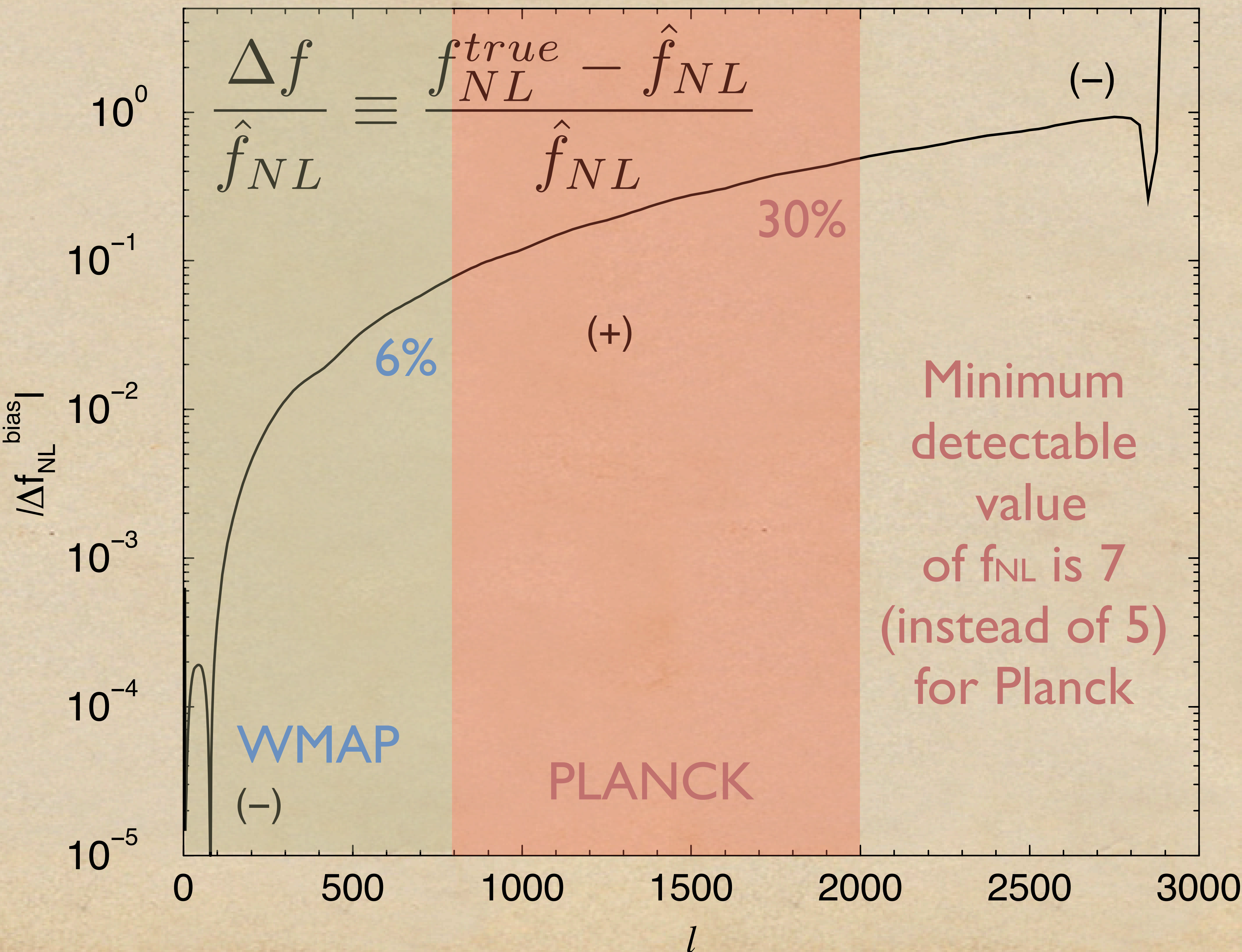


A. Cooray, D. Sarkar, and P. Serra; Phys. Rev. D, 77, 123006 (2008)

Bias in the non-Gaussian Parameter

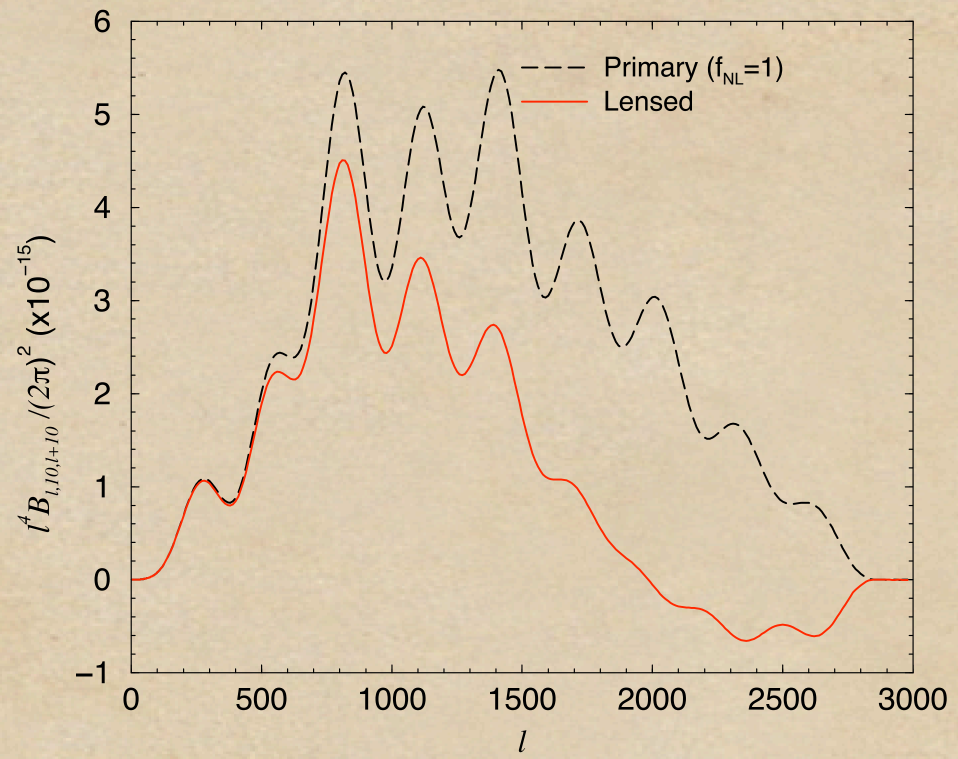


A. Cooray, D. Sarkar, and P. Serra; Phys. Rev. D, 77, 123006 (2008)

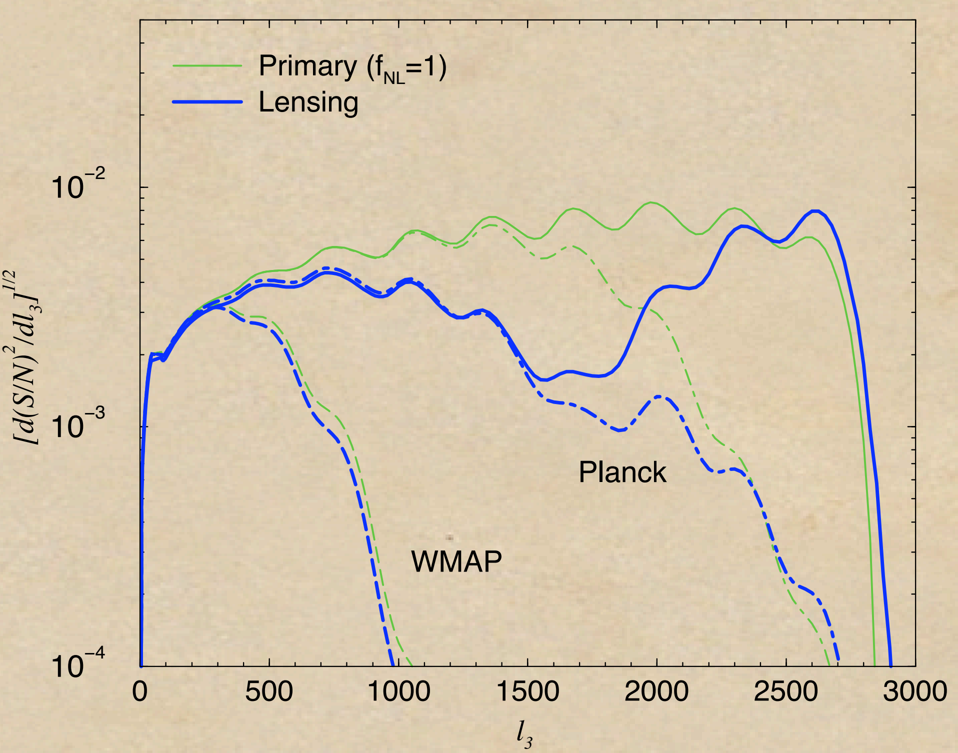
"The New Kid"

"A short summary of your recent work and your future directions"

Summary

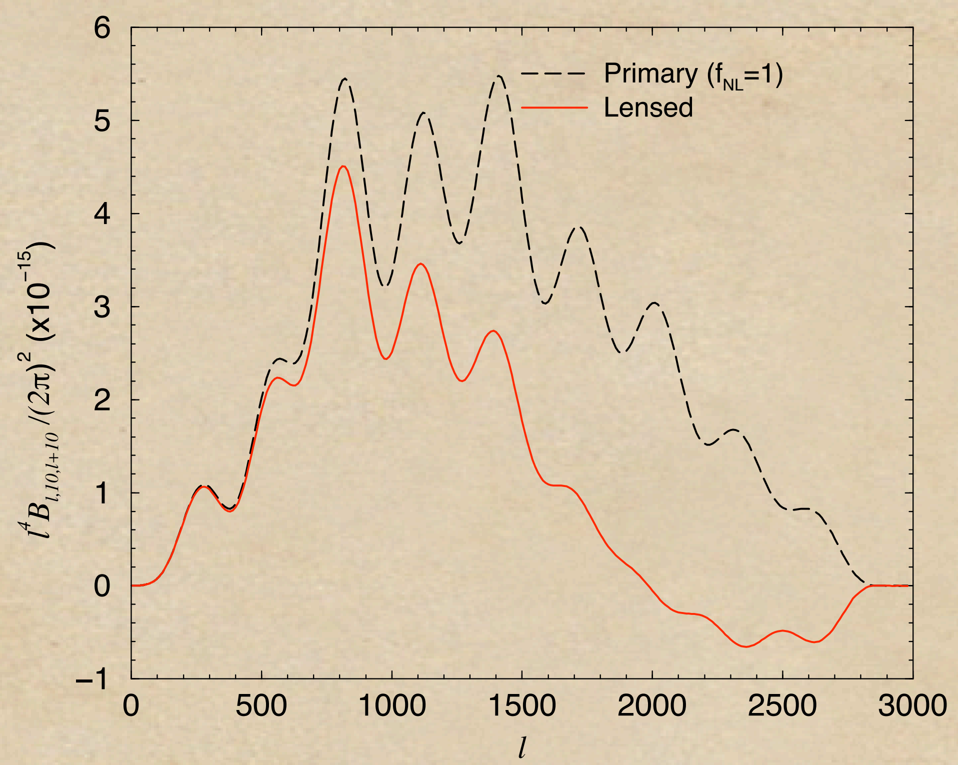


Primary (f_{NL}=1)
Lensed
$l^4 B_{l,10,l+10}/(2\pi)^2$ (x10^{-15})
l



Primary (f_{NL}=1)
Lensing
Planck
WMAP
$[d(S/N)^2/dl_3]^{1/2}$
l_3

Summary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Lensed
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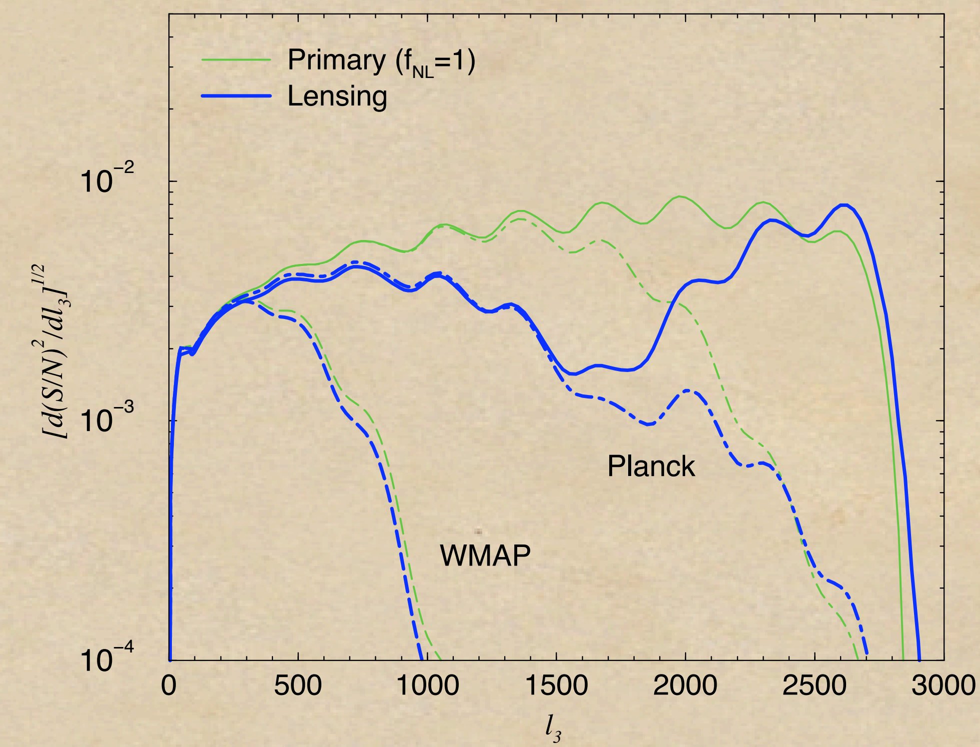
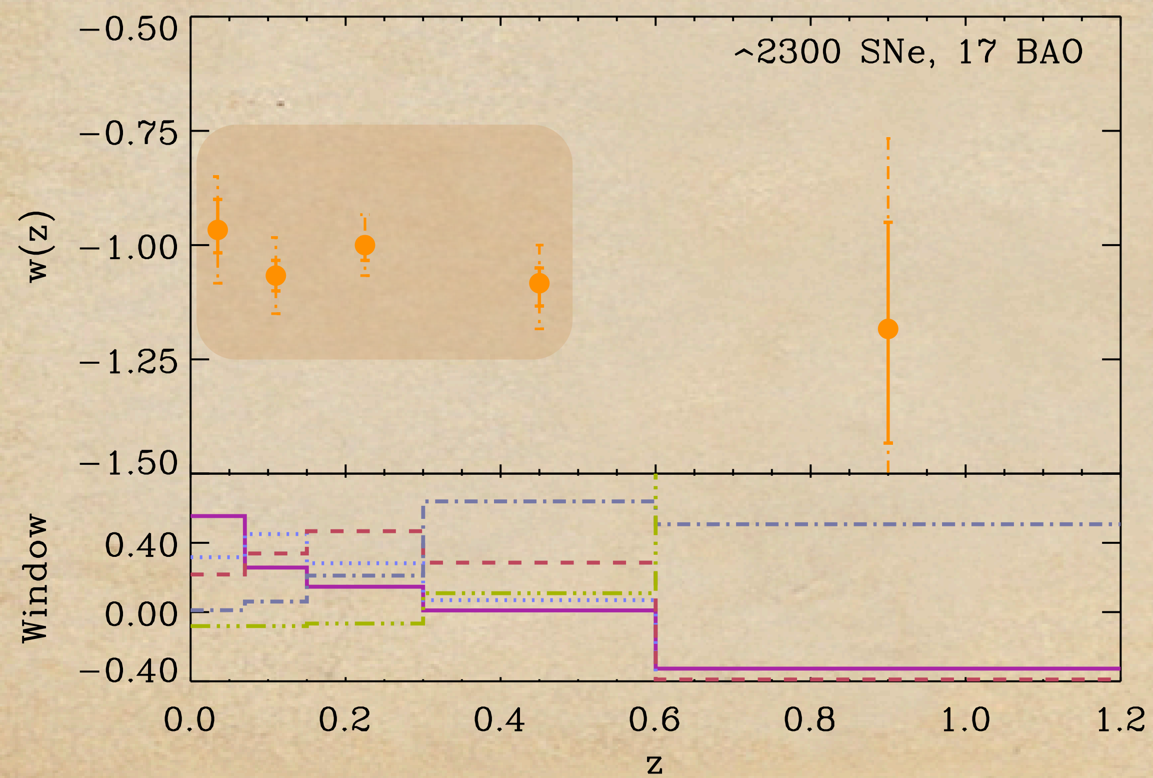
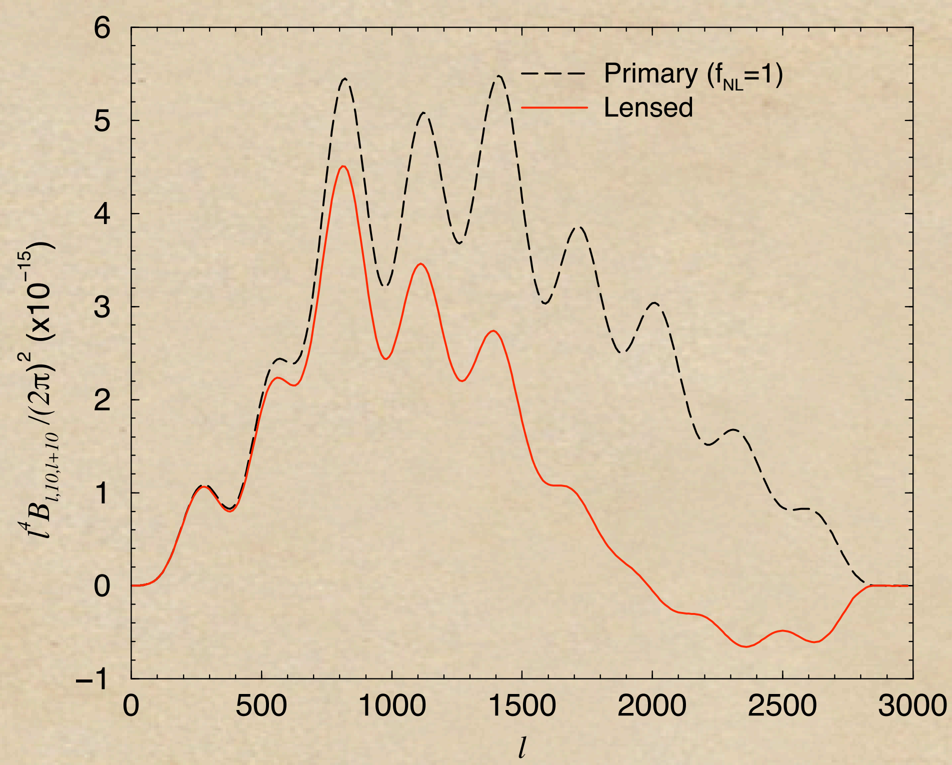
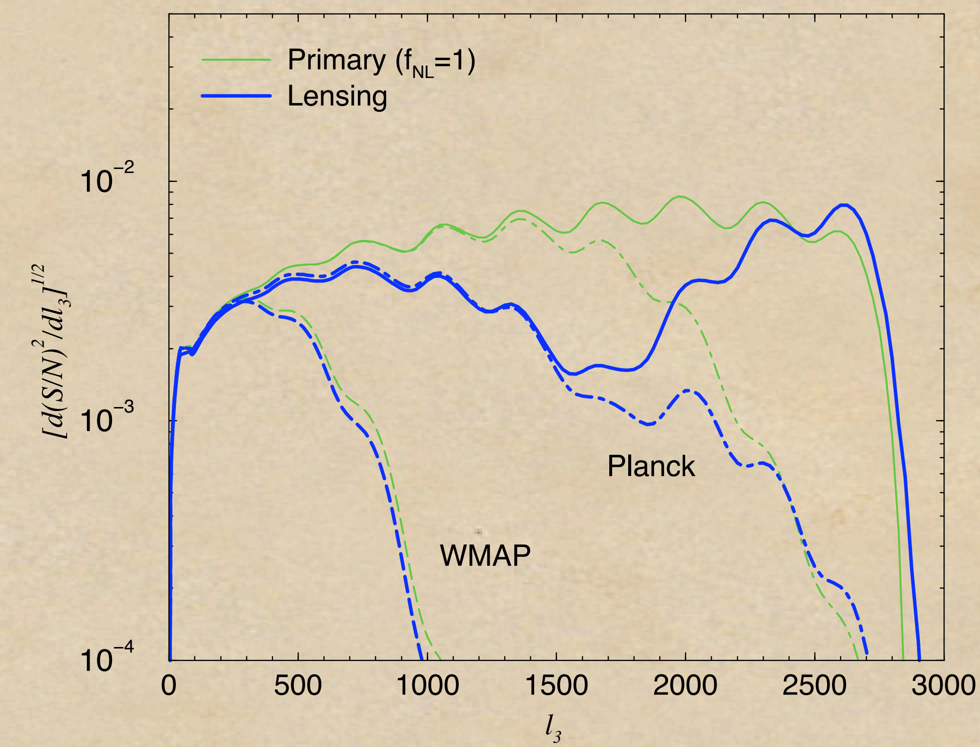
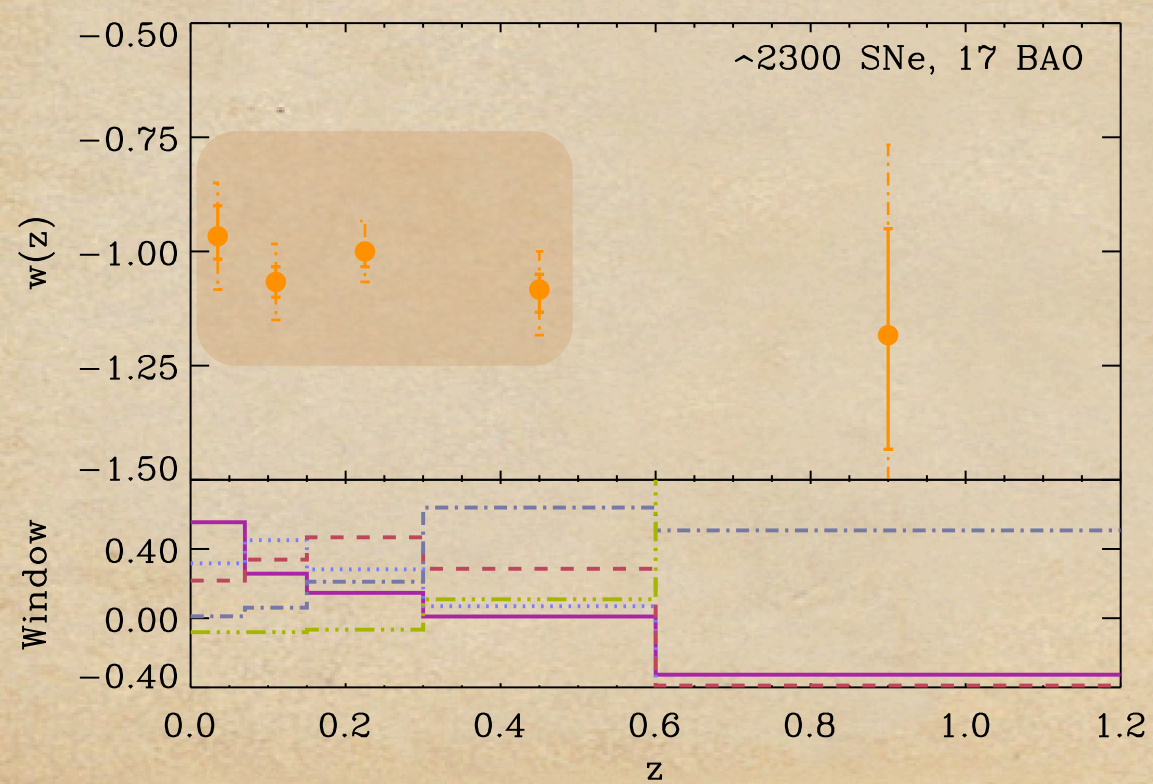

Primary (f_{NL}=1)
Lensing
$[d(S/N)^2/dl_3]^{1/2}$
Planck
WMAP
l_3


~2300 SNe, 17 BAO
w(z)
Window
z

Summary







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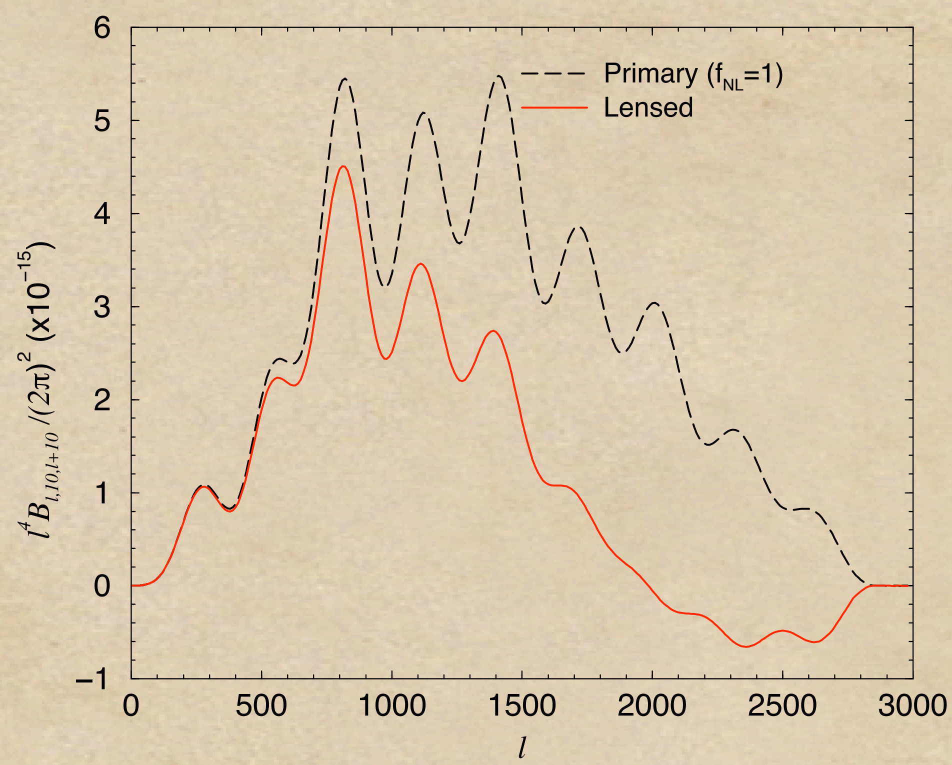
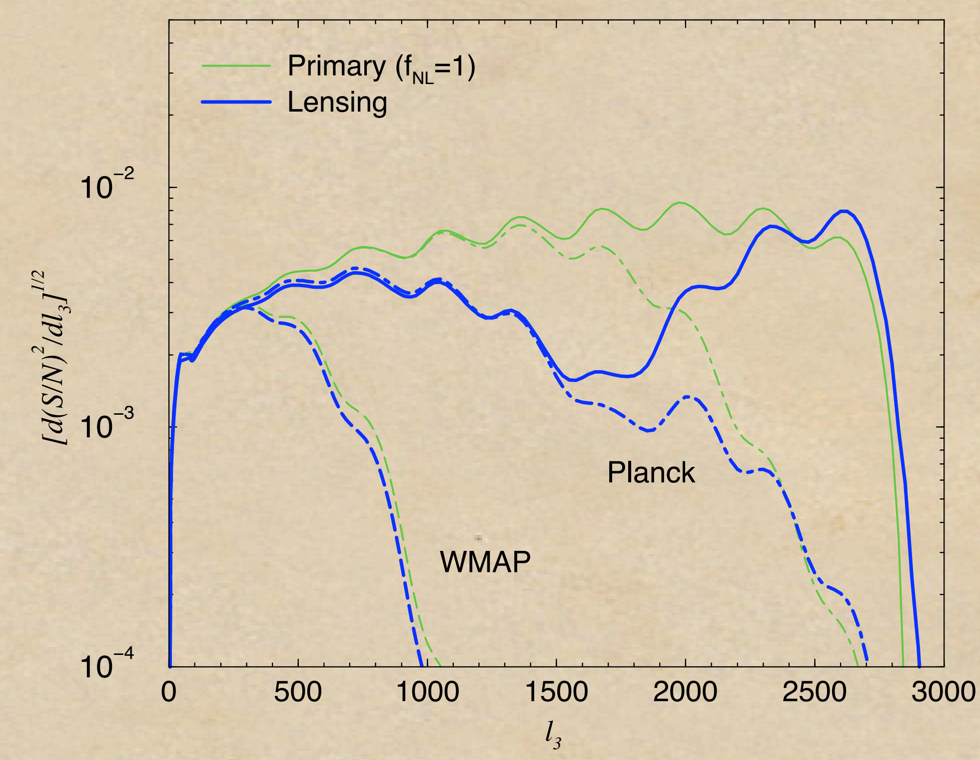
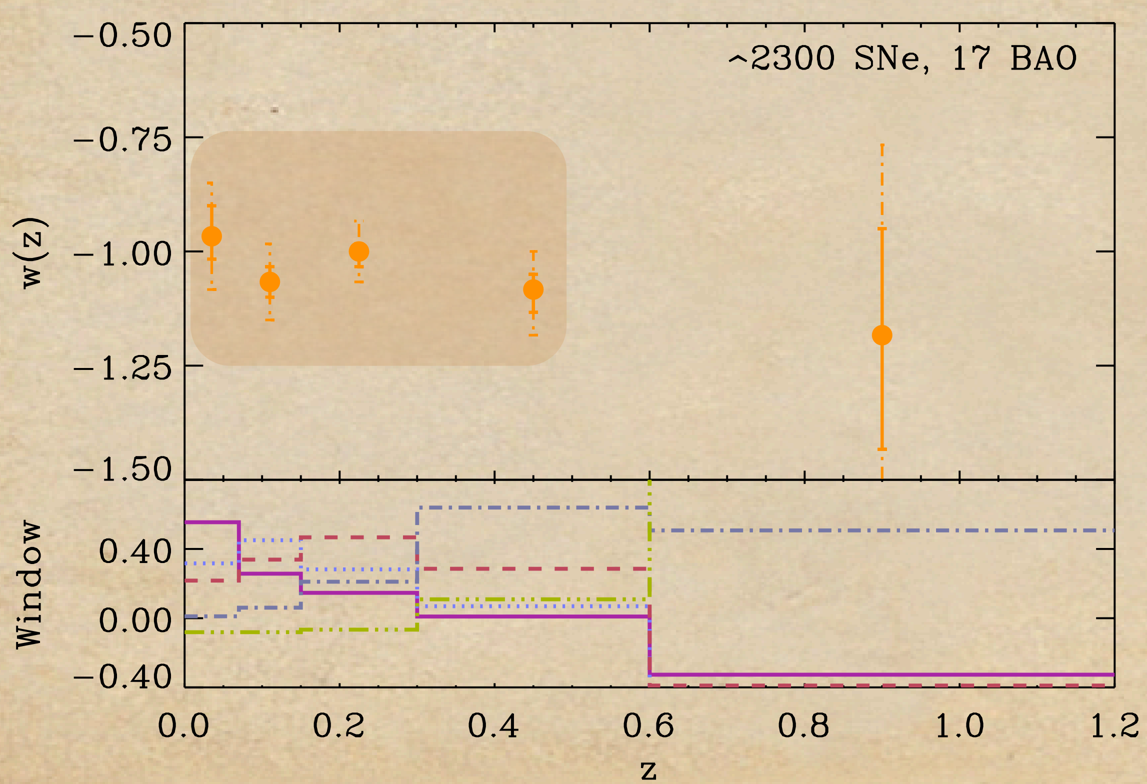
Summary







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