

# The WebSky Suite of Extragalactic CMB Mocks

George Stein, Dick Bond, Marcelo Alvarez,  
Alex van Engelen, Nick Battaglia

George Stein

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## CITA Extragalactic Mocks

Primary CMB Lensing tSZ kSZ CIB Observed CMB

Mocks included on this Wiki

Provided in the links below are fits files at  $n_{\text{side}}=2048$  of CIB (in MJy/sr) intensity, Compton- $y$ , CMB lensing convergence, and lensed and unlensed CMB temperature, all from the same  $8192^3$  16 Gpc simulation. The minimum halo mass used was  $2.62e13 M_{200}$ , resolution maps and different frequencies are available upon request. Please contact [Marcelo](#)

**Almost finally**  
PREPARED FOR SUBMISSION TO JCAP

Paper Imminent

## The WebSky Suite of Extragalactic CMB Sky Simulations

M. A. Alvarez,<sup>a,1</sup> J. R. Bond,<sup>b</sup> G. Stein,<sup>b</sup> A. Bahmanyar,<sup>b</sup> N. Battaglia,<sup>c</sup> A. Hajian,<sup>b</sup> L. Pham,<sup>b</sup> A. van Engelen<sup>b</sup>



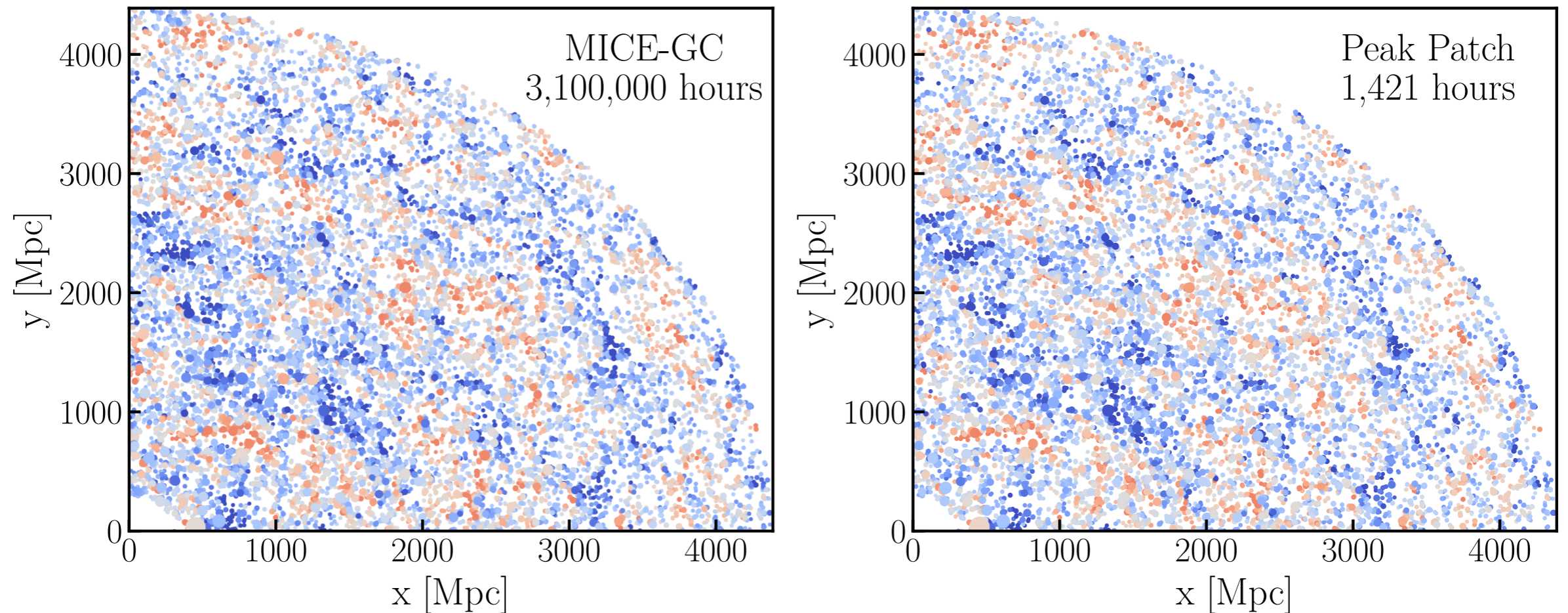
# Halo Catalogue

\* Many Peak Patch Full-sky catalogues available

$z < 1.4$  light-cone validation (3Gpc/h,  $4096^3$  particles)

size  $\propto$  halo radius

colour  $\propto$  peculiar velocity

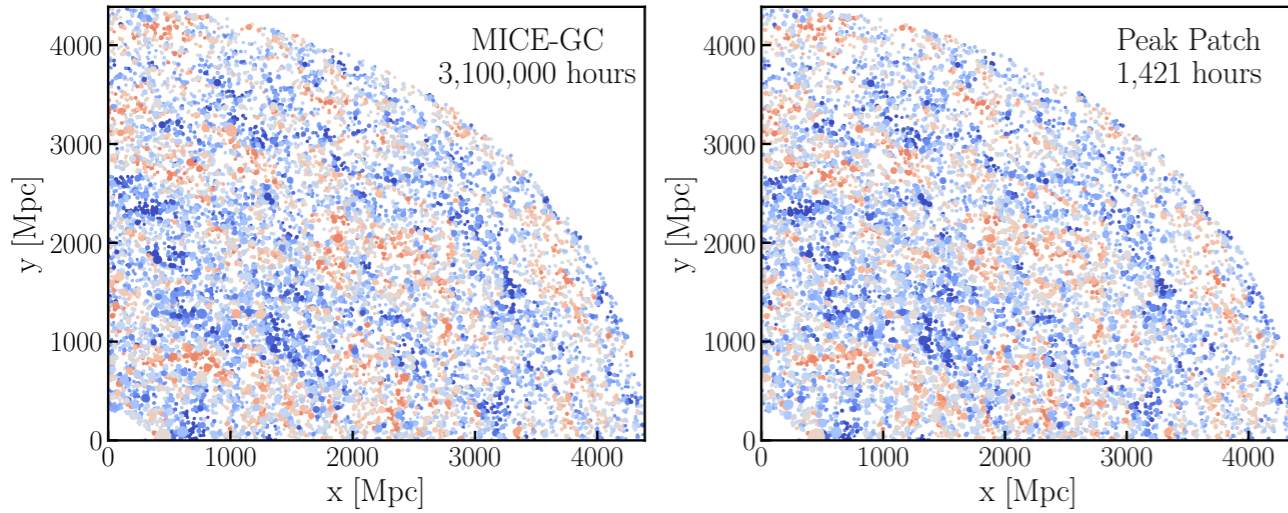


Validated with N-body at HMF+2point  
+covariance+visual



# Halo Catalogue

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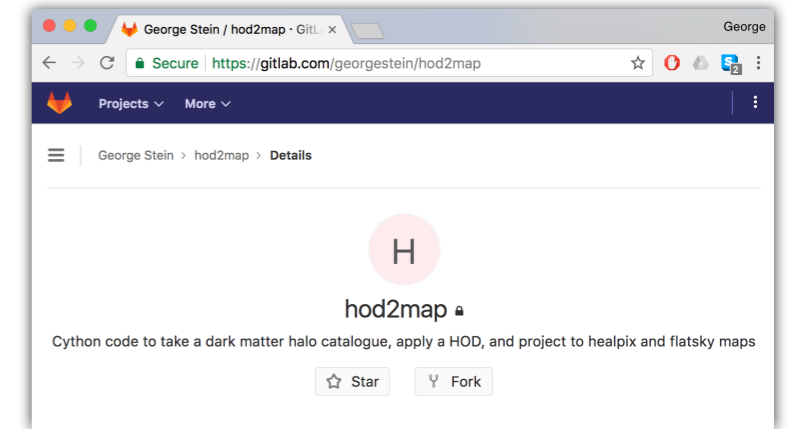
Validated with N-body at HMF+2point  
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+

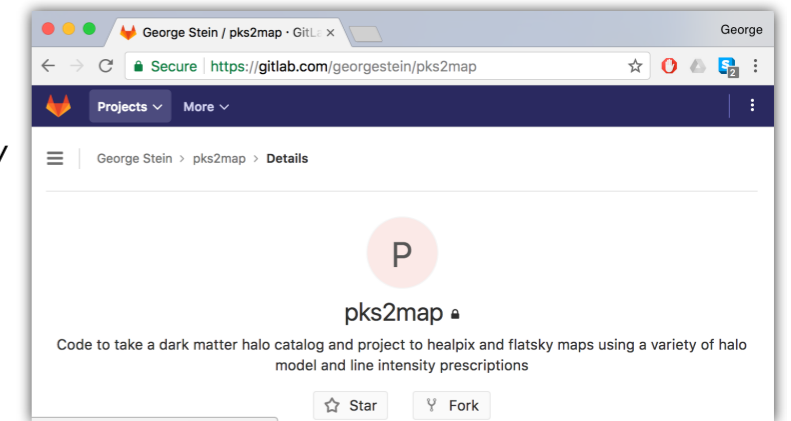
# Mapmaking Codes

\* Available to the collaboration

stochastic  
HOD model



continuous density  
&  
pressure profiles



apply to each halo and project  
along the line of sight



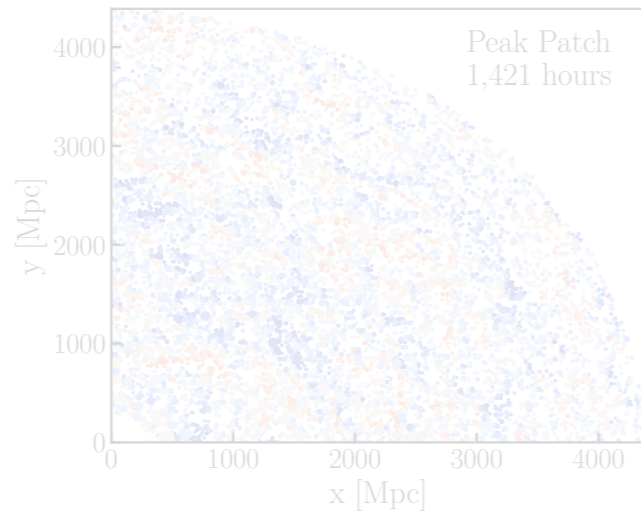
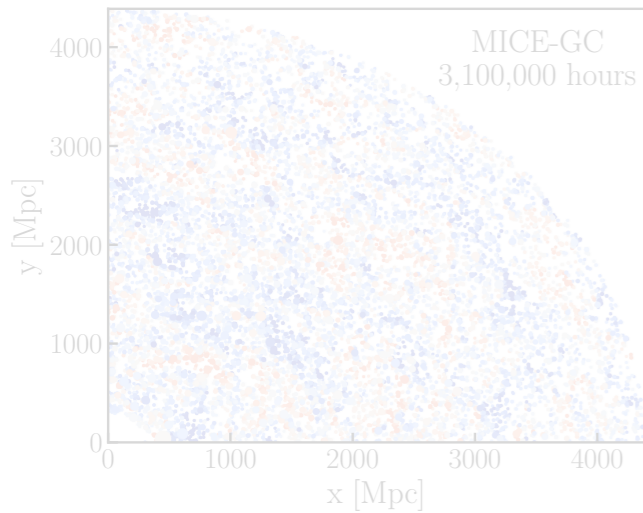
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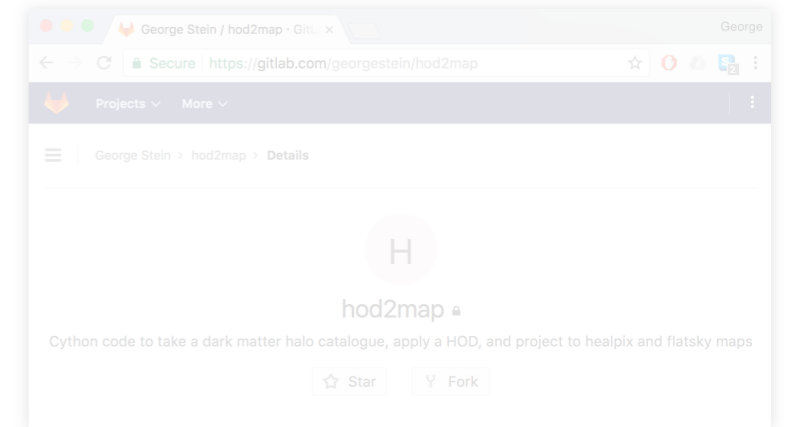
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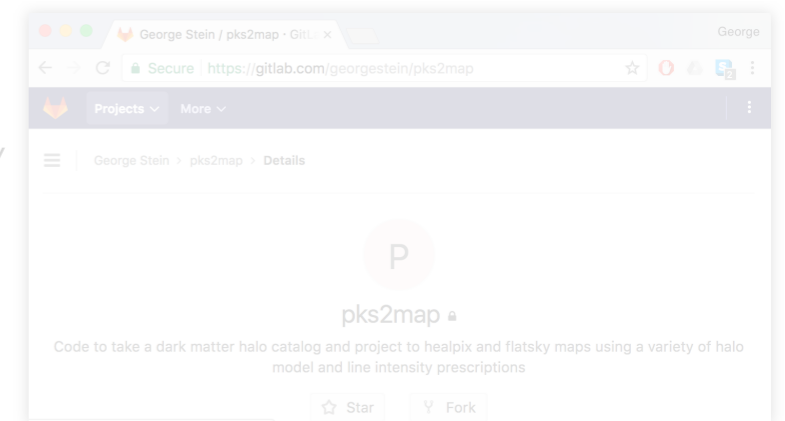


Validated with N-body at HMF+2point  
+covariance+visual

stochastic  
HOD model

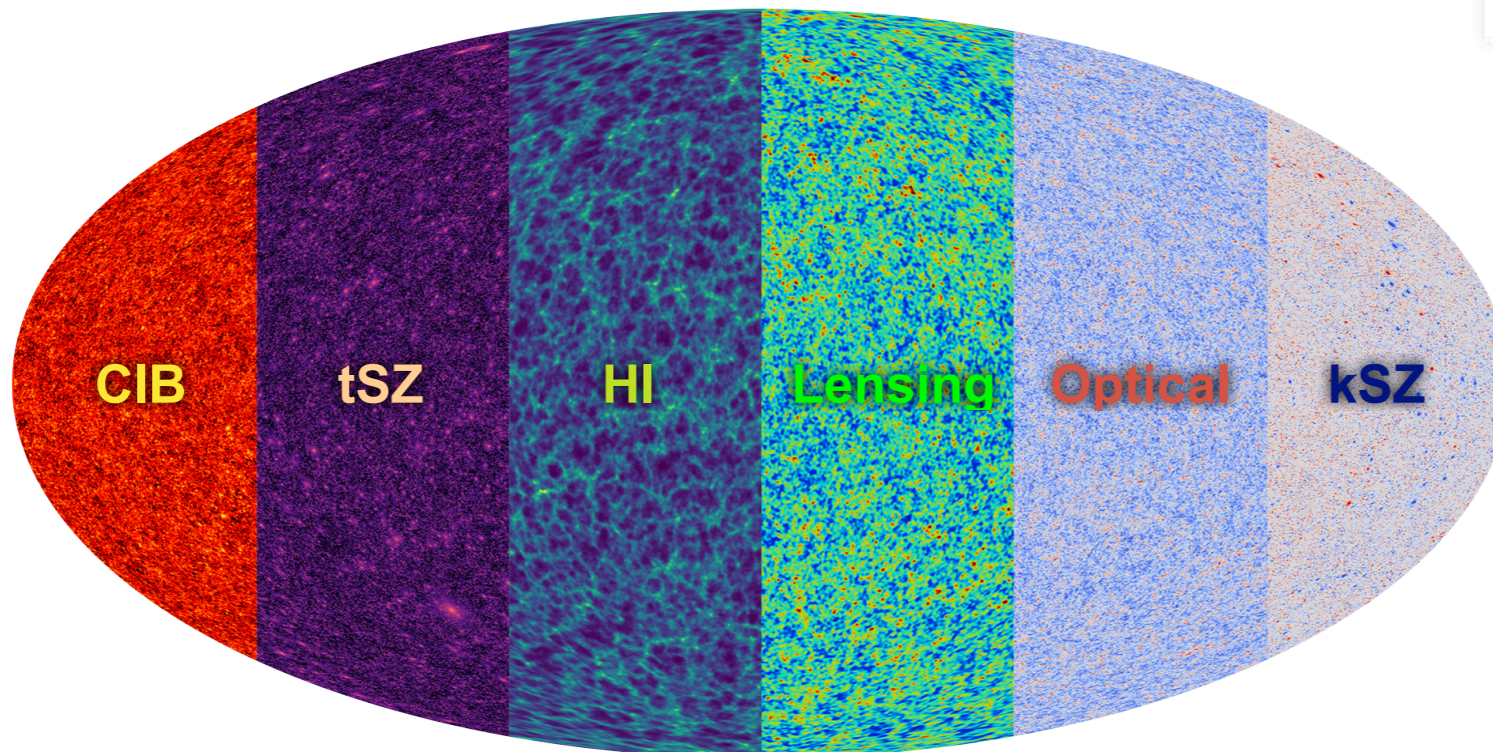


continuous density  
&  
pressure profiles



apply to each halo and project  
along the line of sight

=



cross correlations automatically included!



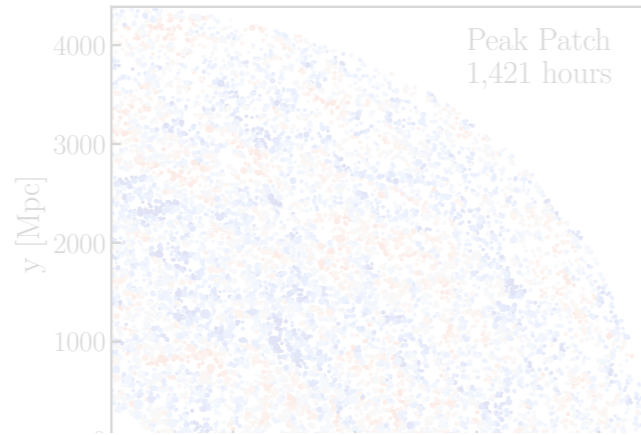
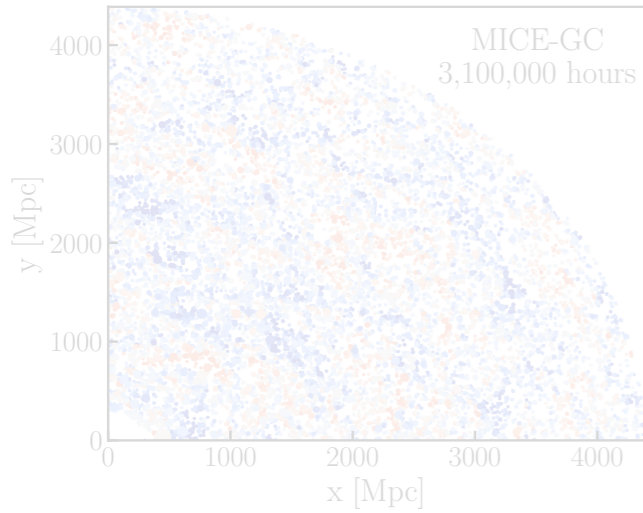
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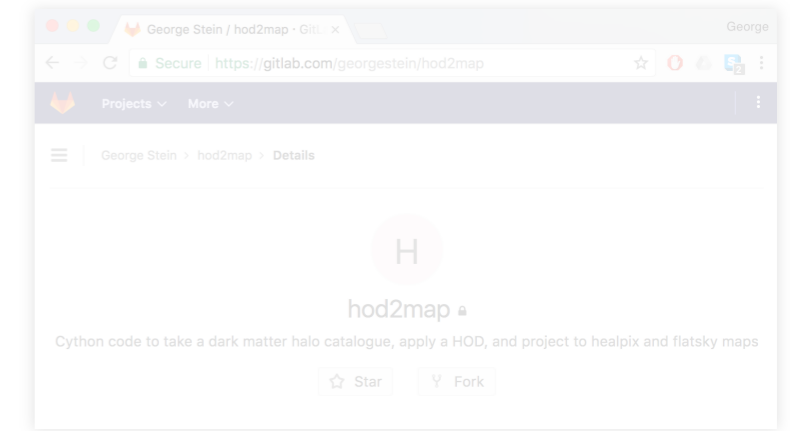
\* Available to the collaboration



## MICE-GC

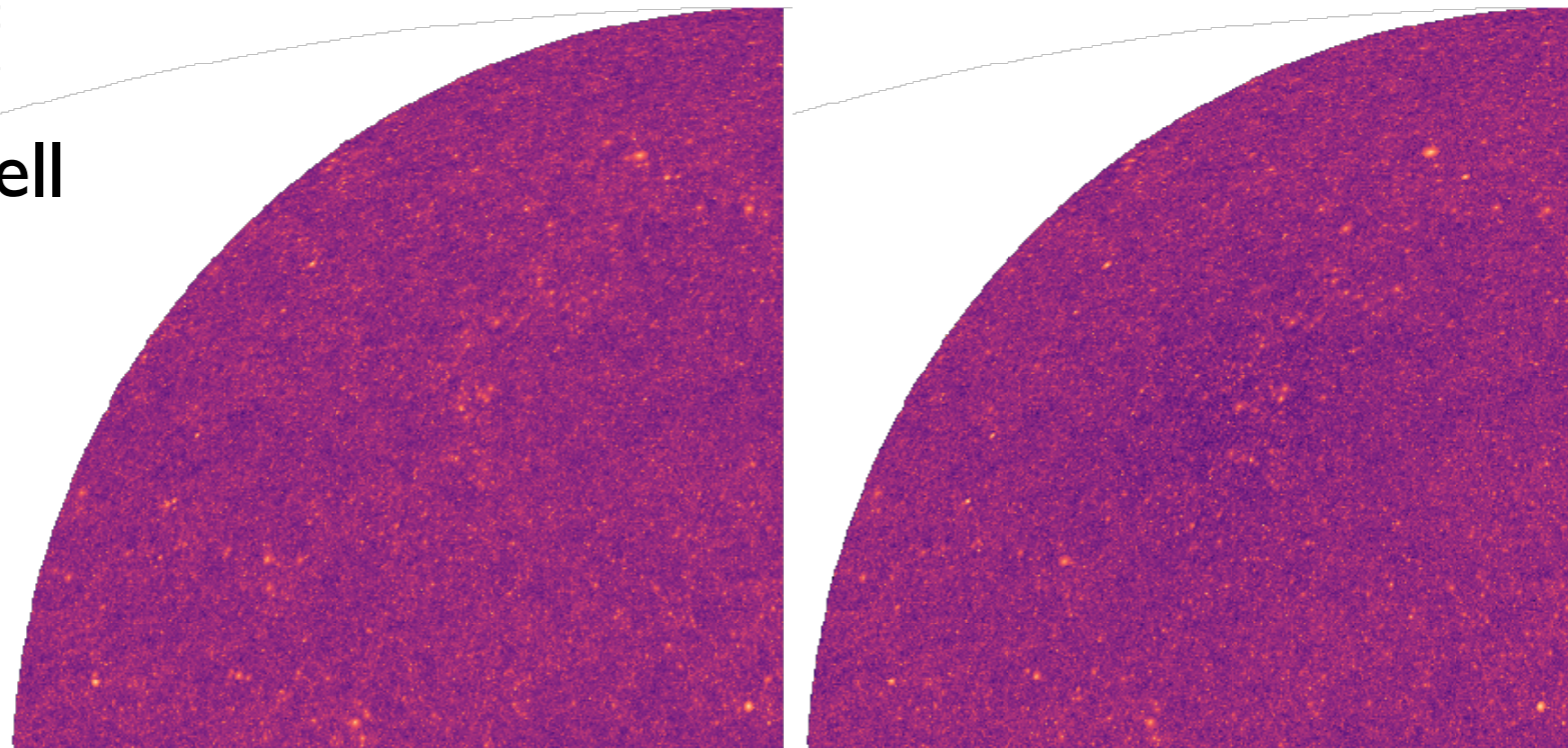
## Peak Patch

stochastic  
HOD model



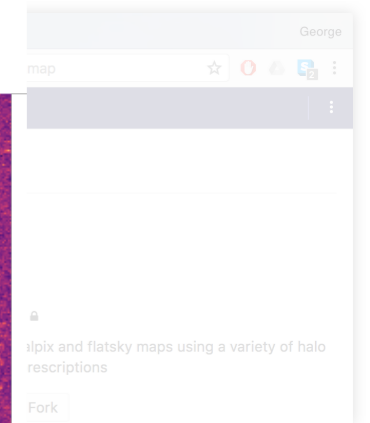
Validated with N-body  
+covarian

### Mocks match very well with N-body



-7.2    -6.4    -5.6    -4.8    -4.0

log Compton-y



o and project  
e of sight



# Halo Catalogue

\* Many Peak Patch Full-sky catalogues available

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# Mapmaking Codes

\* Available to the collaboration

## The WebSky Suite of Extragalactic CMB Mocks

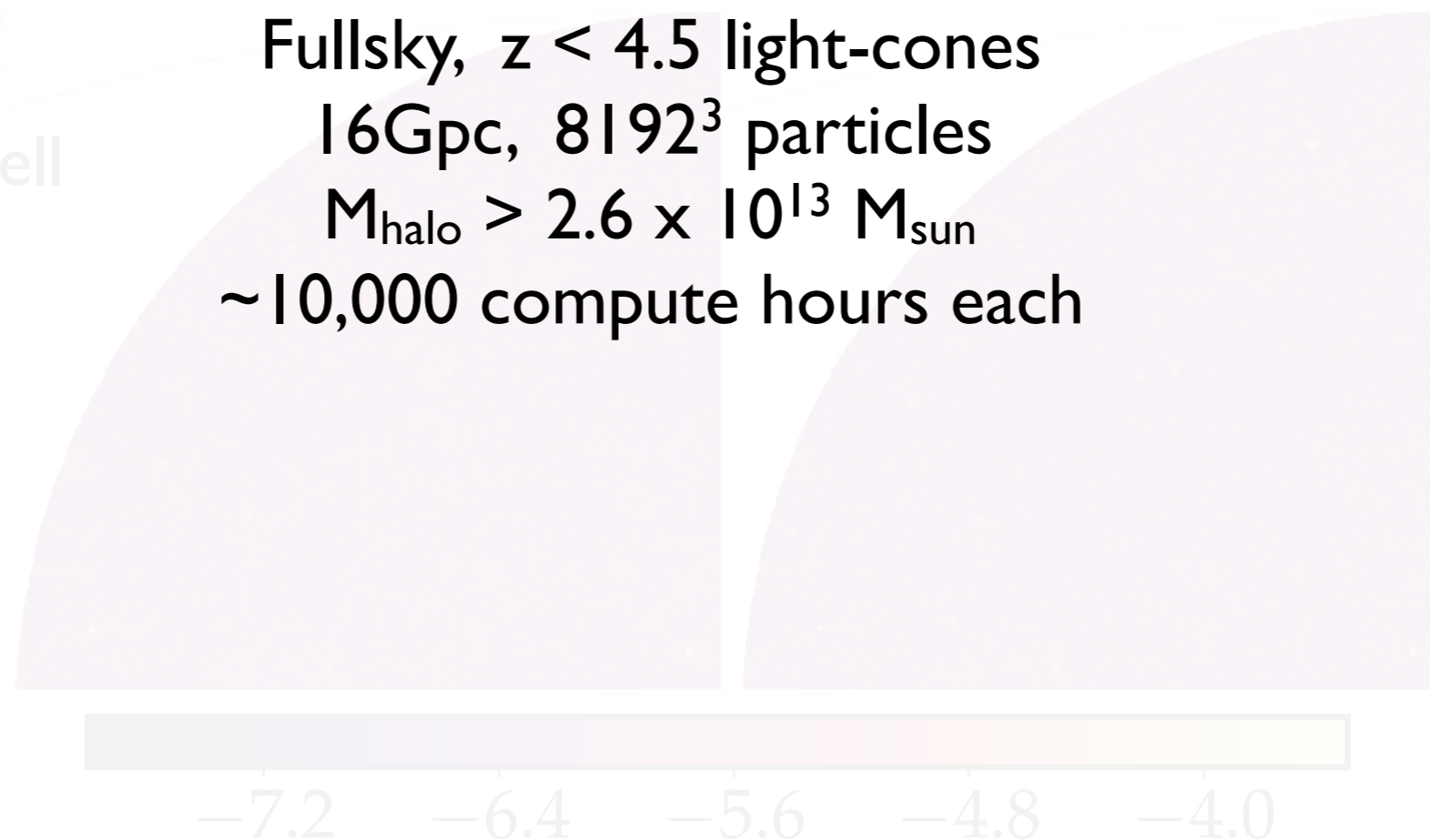
Fullsky,  $z < 4.5$  light-cones

16Gpc,  $8192^3$  particles

$M_{\text{halo}} > 2.6 \times 10^{13} M_{\text{sun}}$

~10,000 compute hours each

Mocks match very well  
with N-body

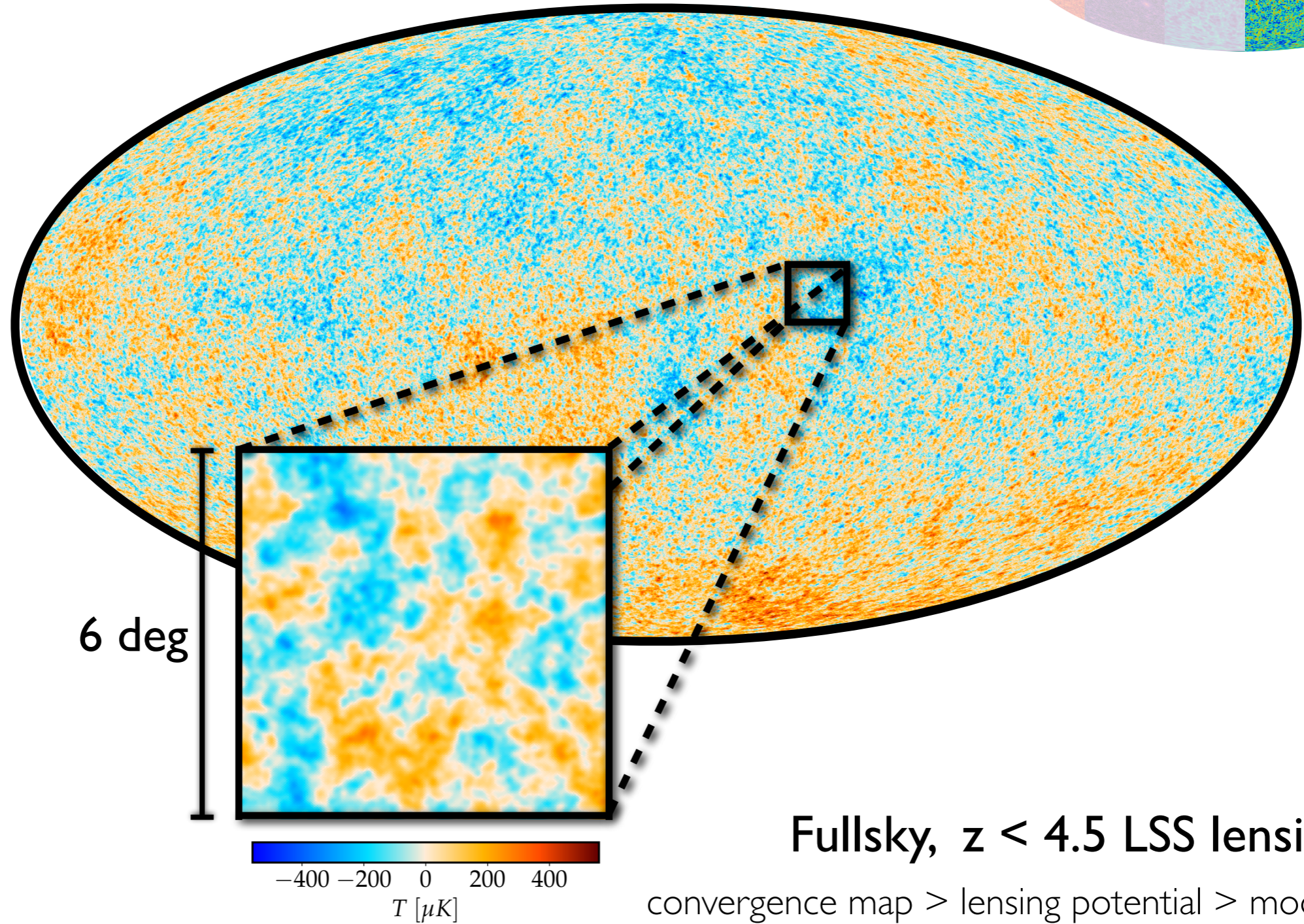
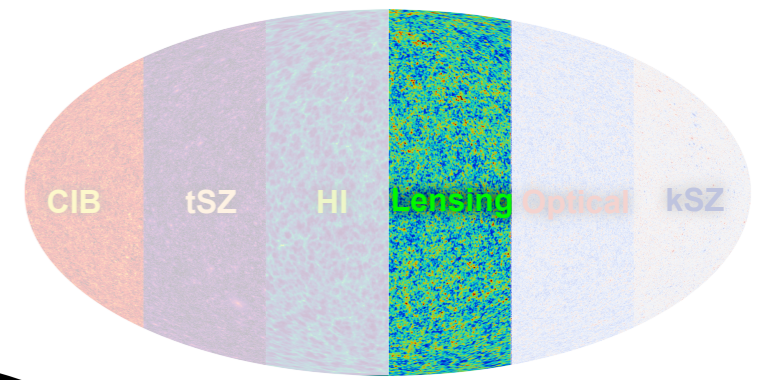


-7.2 -6.4 -5.6 -4.8 -4.0

log Compton-y



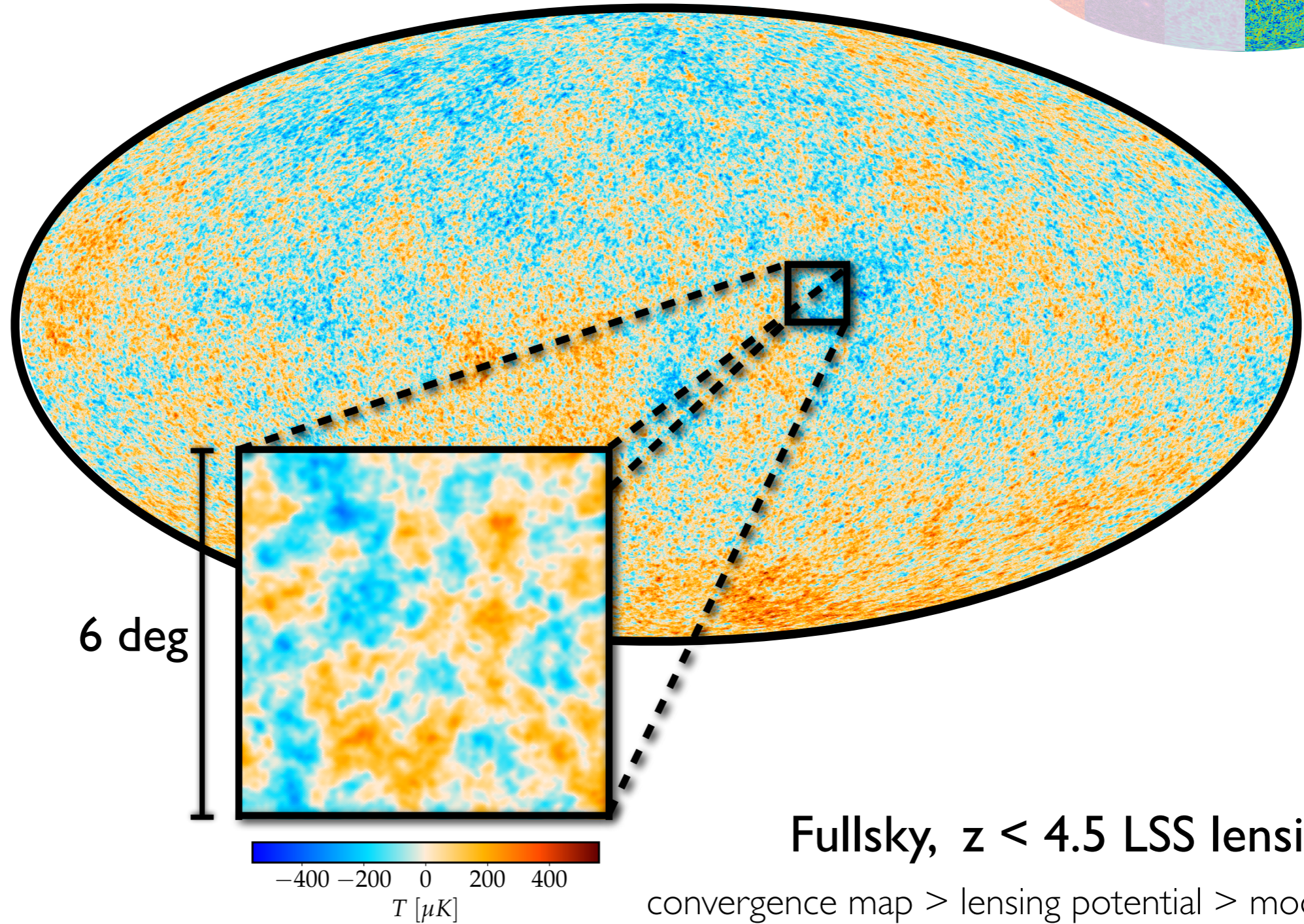
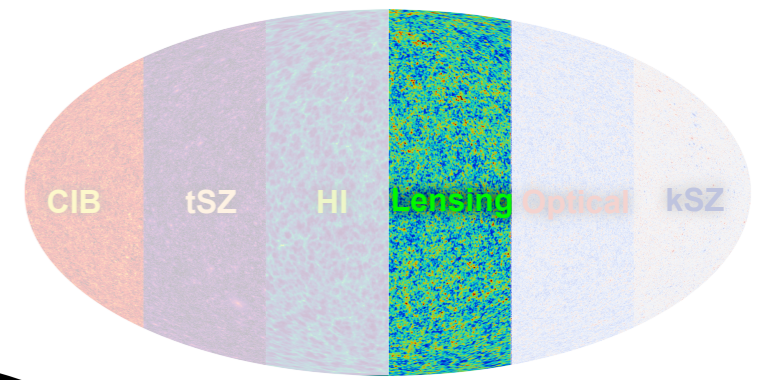
# Unlensed CMB



**Fullsky,  $z < 4.5$  LSS lensing**

convergence map  $>$  lensing potential  $>$  modified lenspix

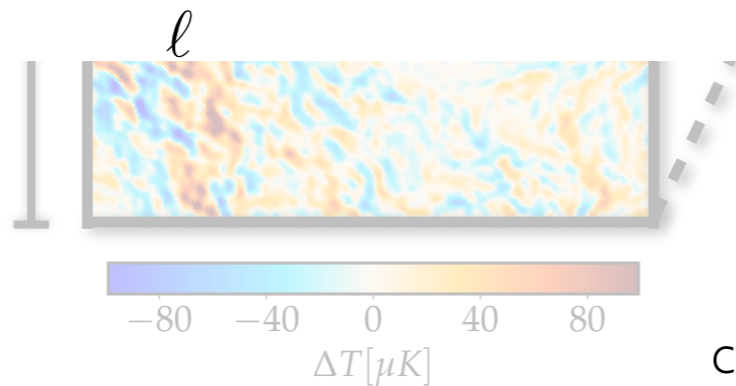
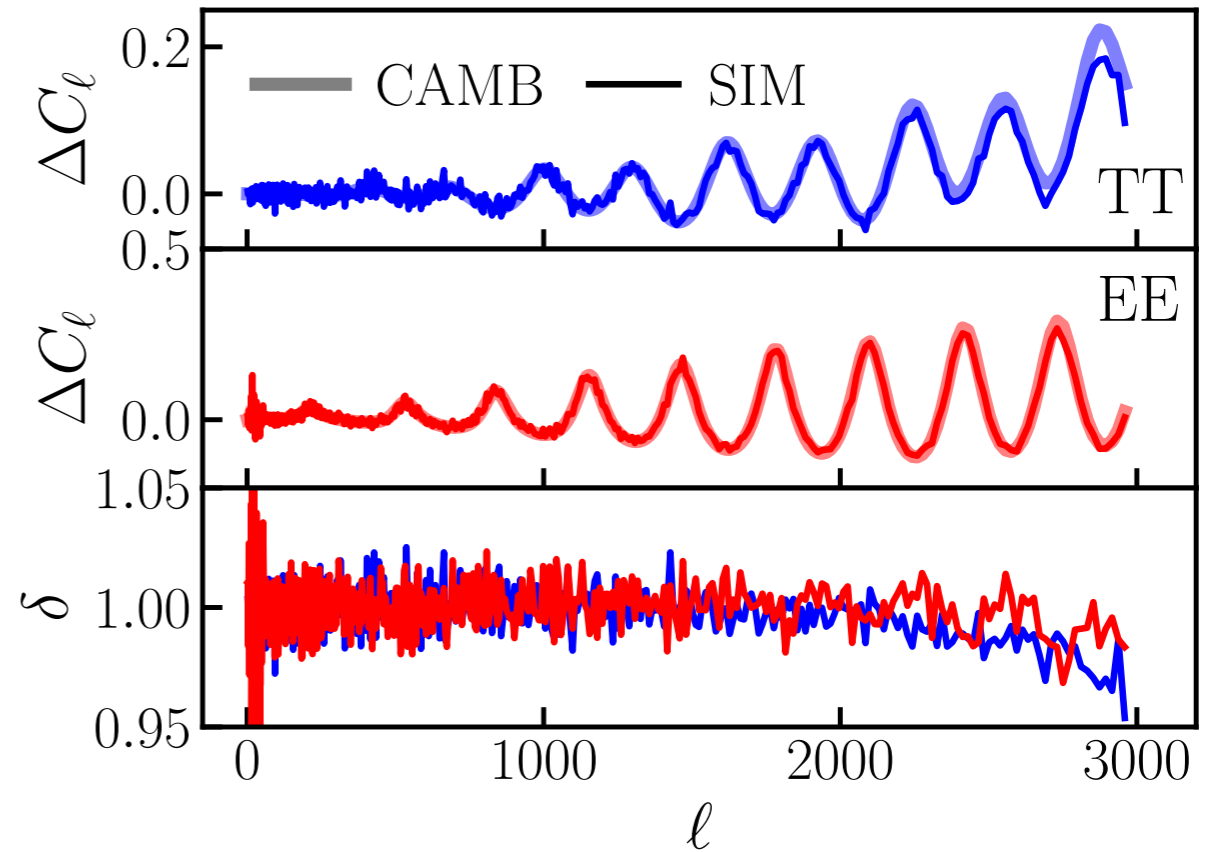
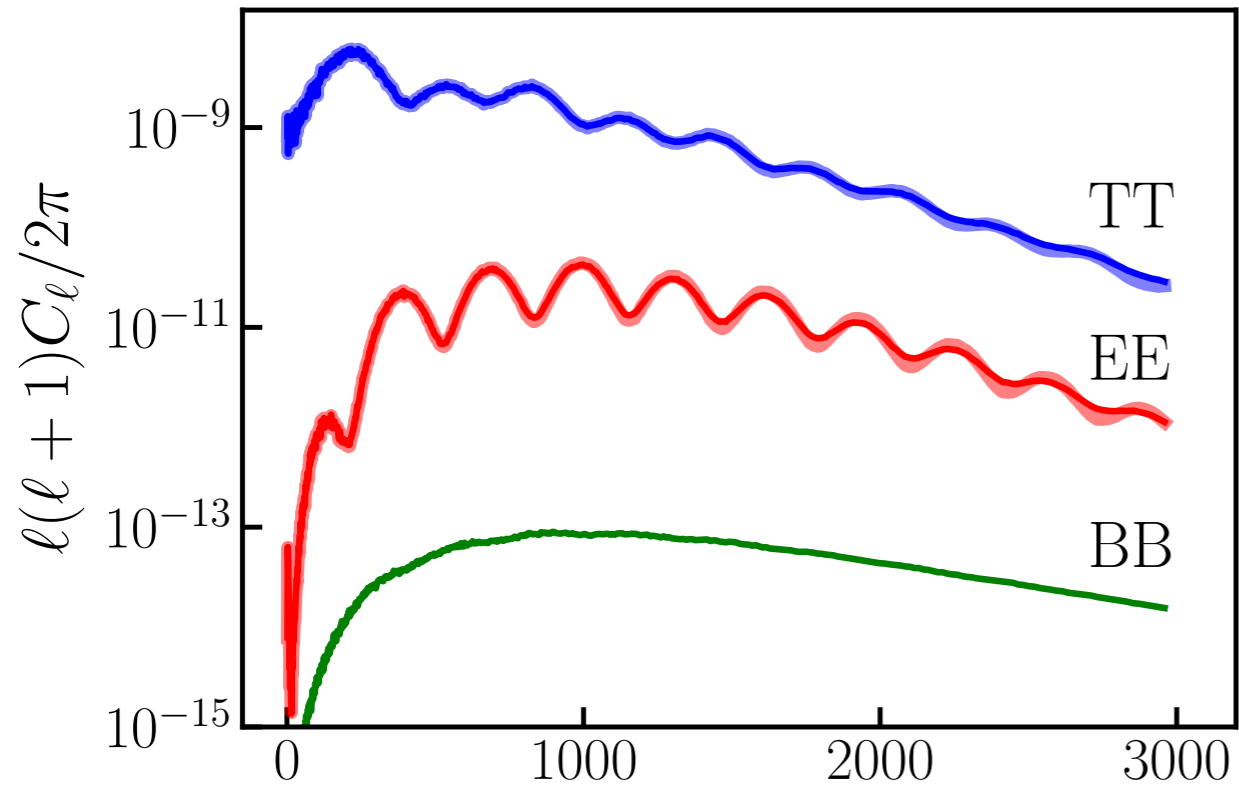
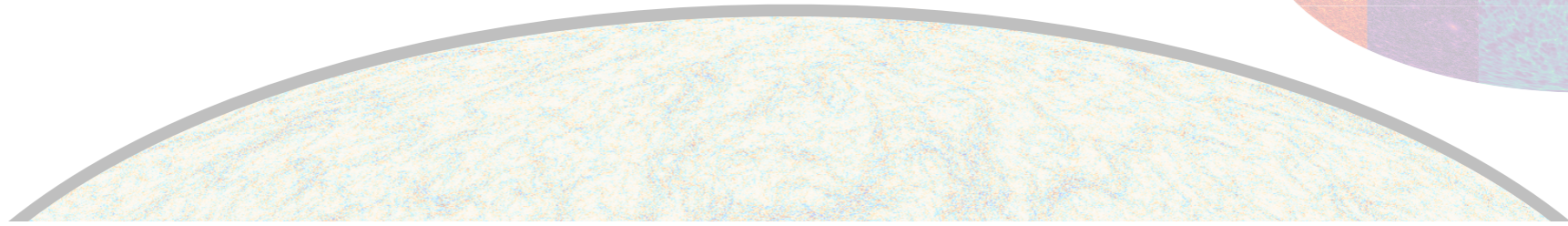
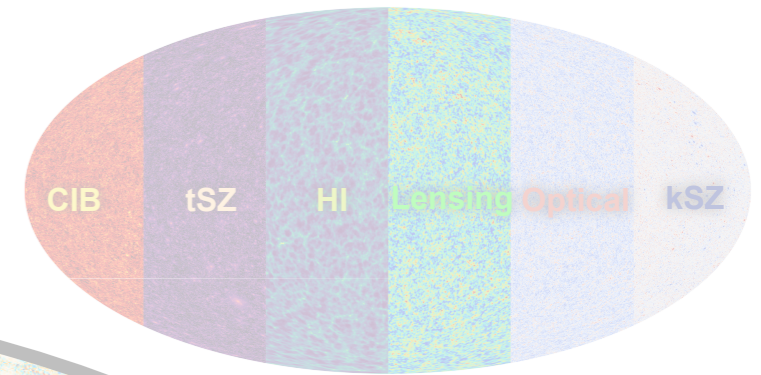
# Lensed CMB



**Fullsky,  $z < 4.5$  LSS lensing**  
convergence map  $>$  lensing potential  $>$  modified lenspix



# Lensing Difference



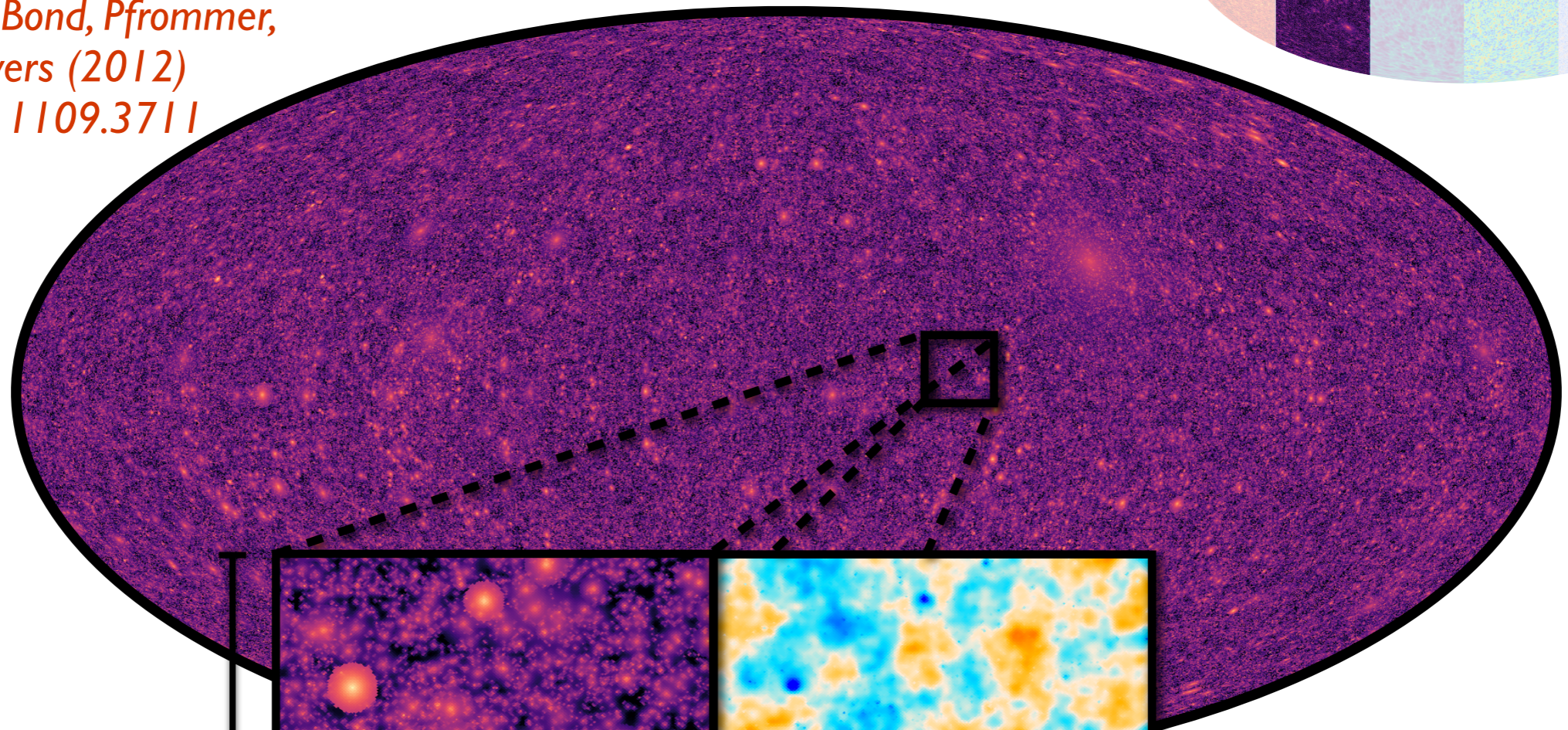
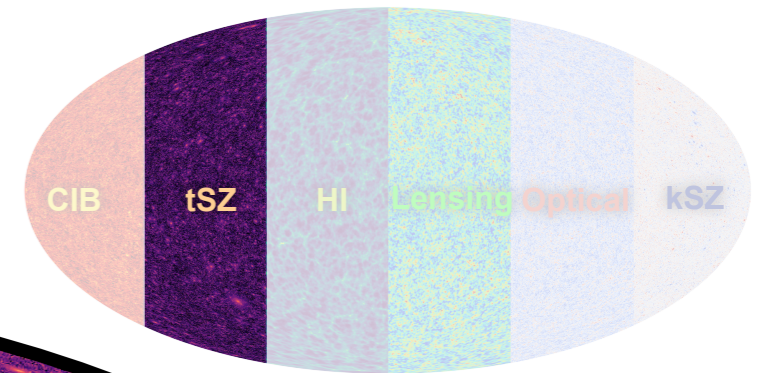
## Fullsky, $z < 4.5$ LSS lensing

convergence map > lensing potential > modified lenspix

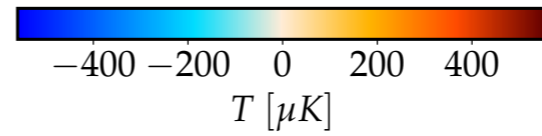
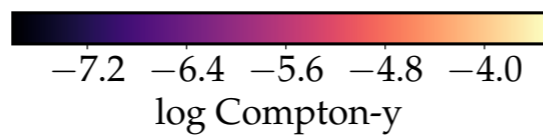
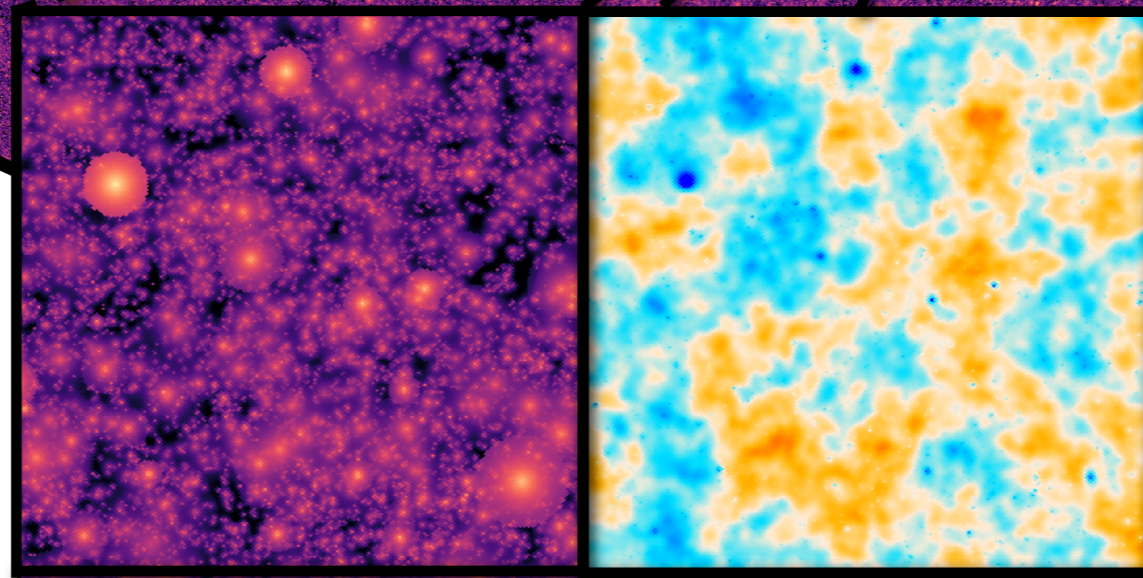
# tSZ

Continuous gNFW pressure profile fit to  
gas dynamical sims

*Battaglia, Bond, Pfrommer,  
Sievers (2012)  
arxiv: 1109.3711*



6 deg



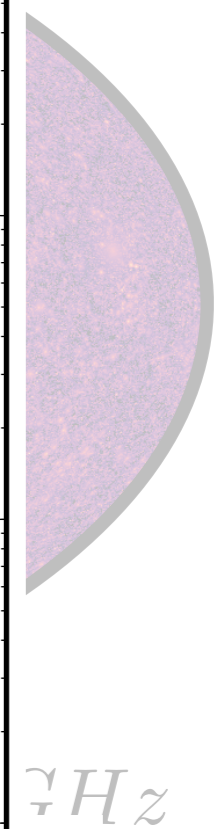
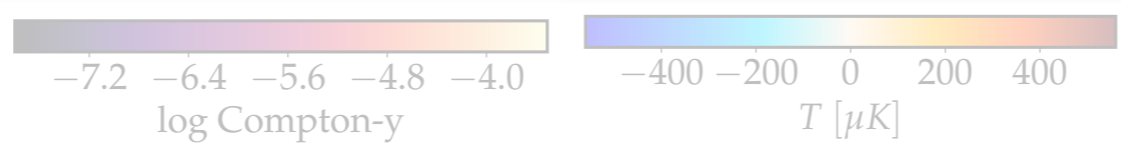
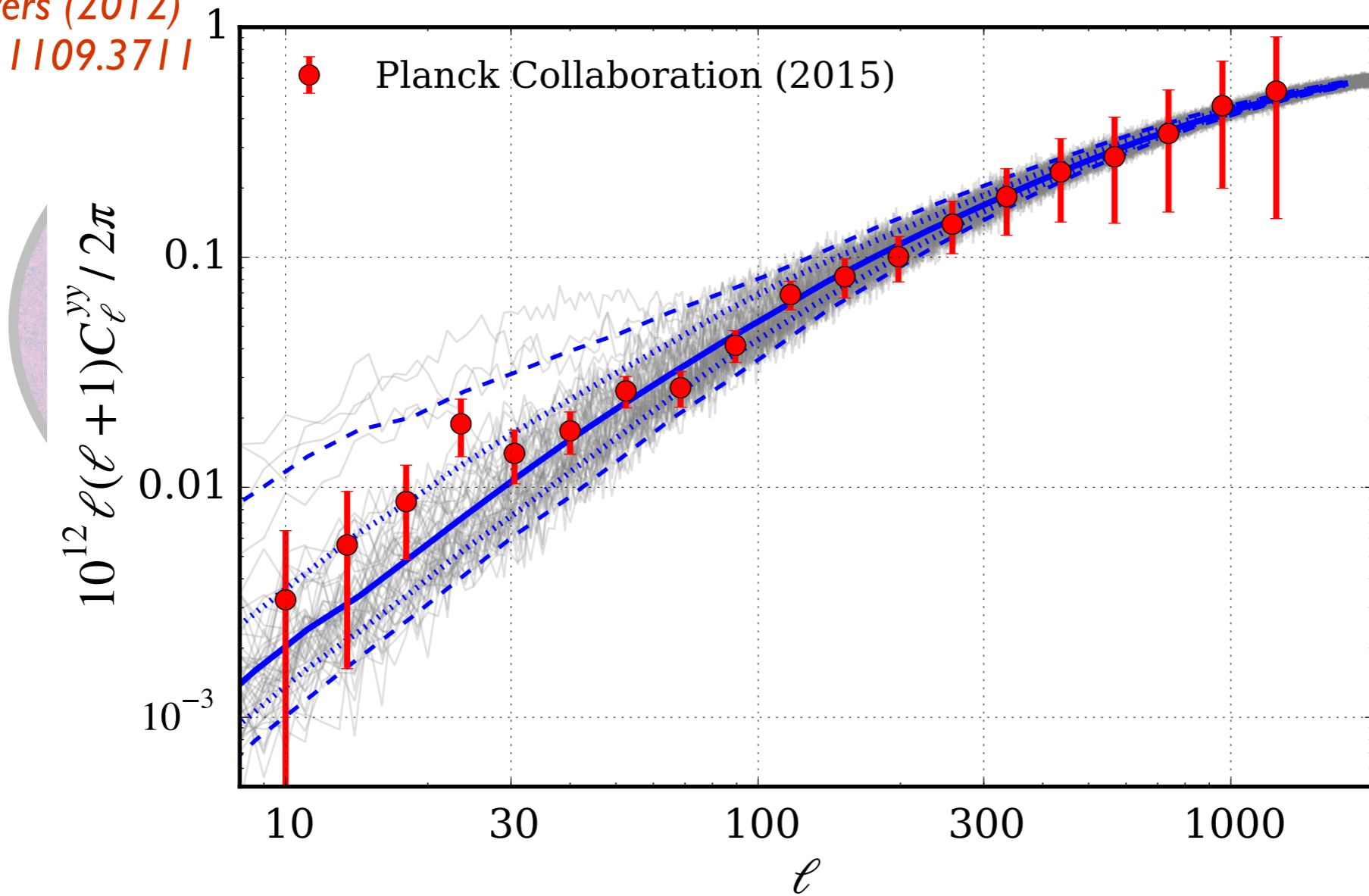
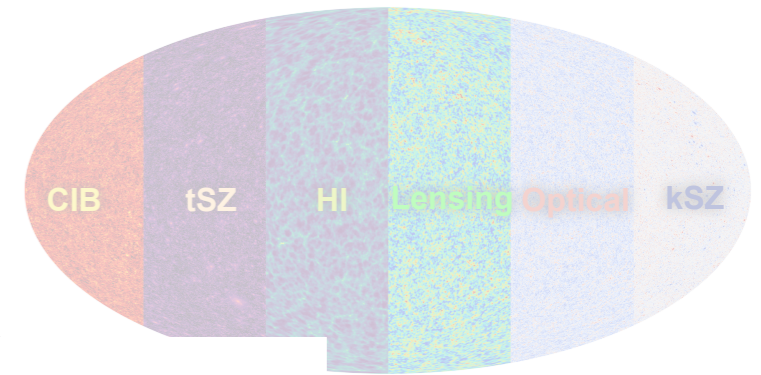
$$T^{CMB} + \Delta T_{\nu=148GHz}^{tSZ}$$



# tSZ

Continuous gNFW pressure profile fit to  
gas dynamical sims

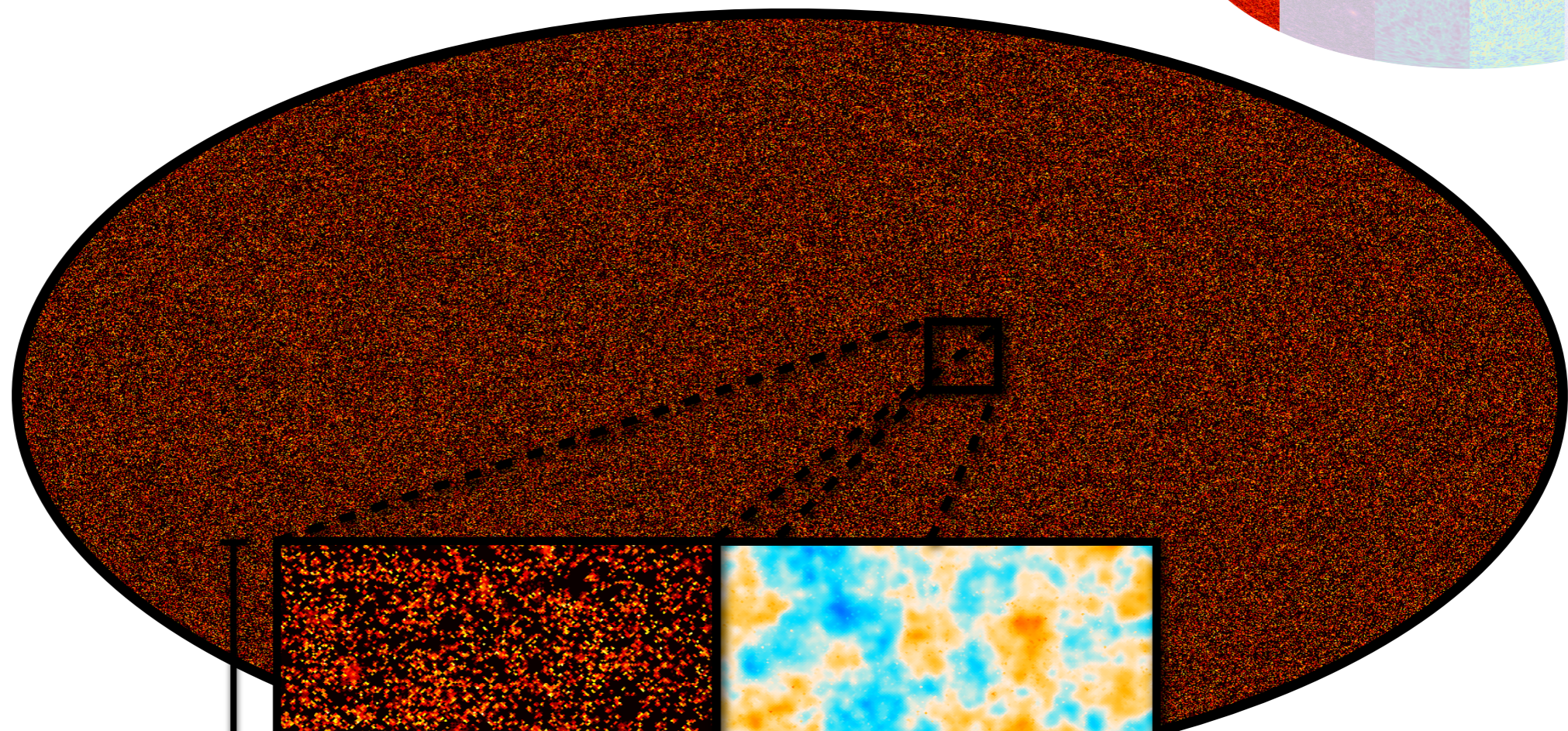
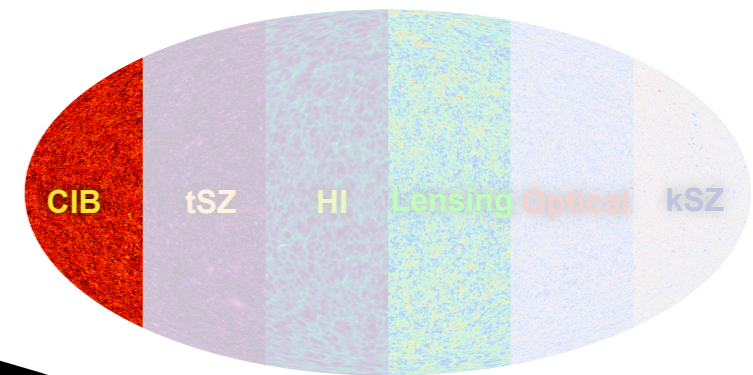
*Battaglia, Bond, Pfrommer,  
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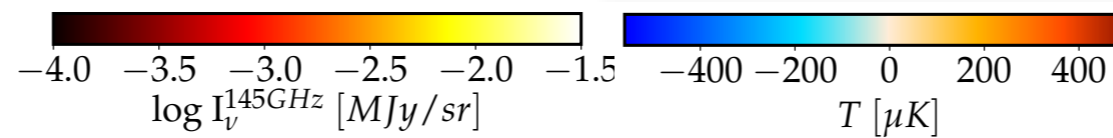
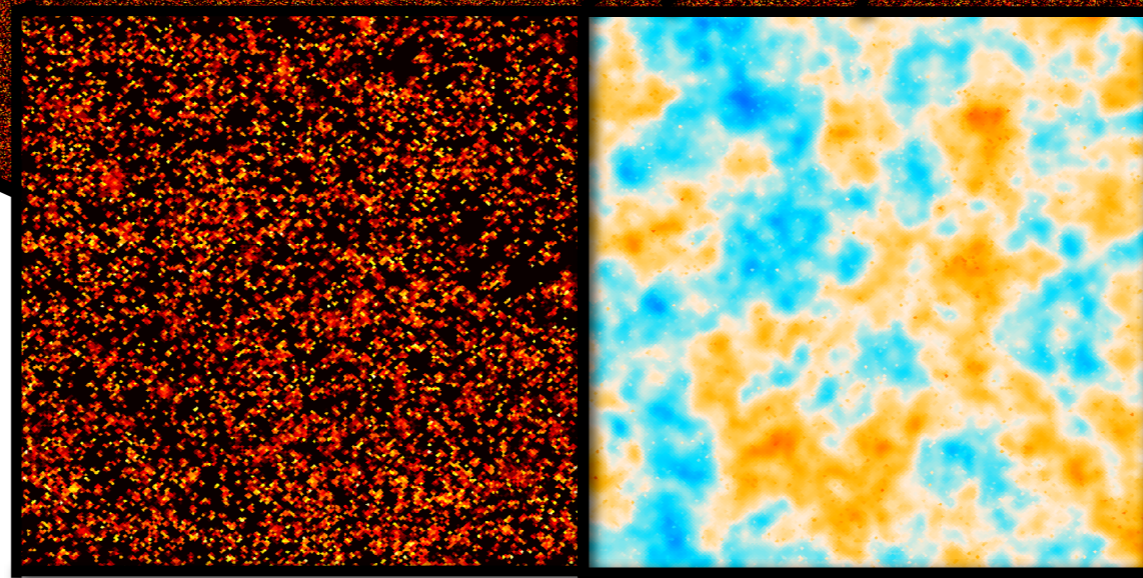
# CIB

## Stochastic Halo Occupation Distribution (HOD)

Planck 2013 (XXX) & 2015 (XXIII) models



6 deg



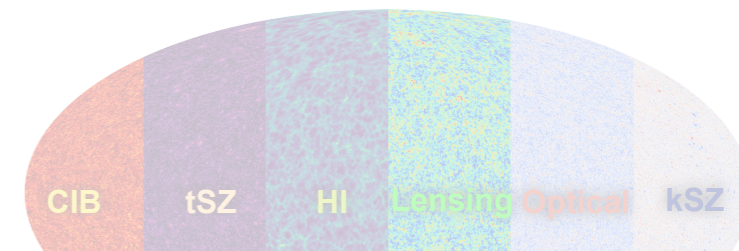
$$T^{CMB} + \Delta T_{\nu=148\text{GHz}}^{CIB}$$



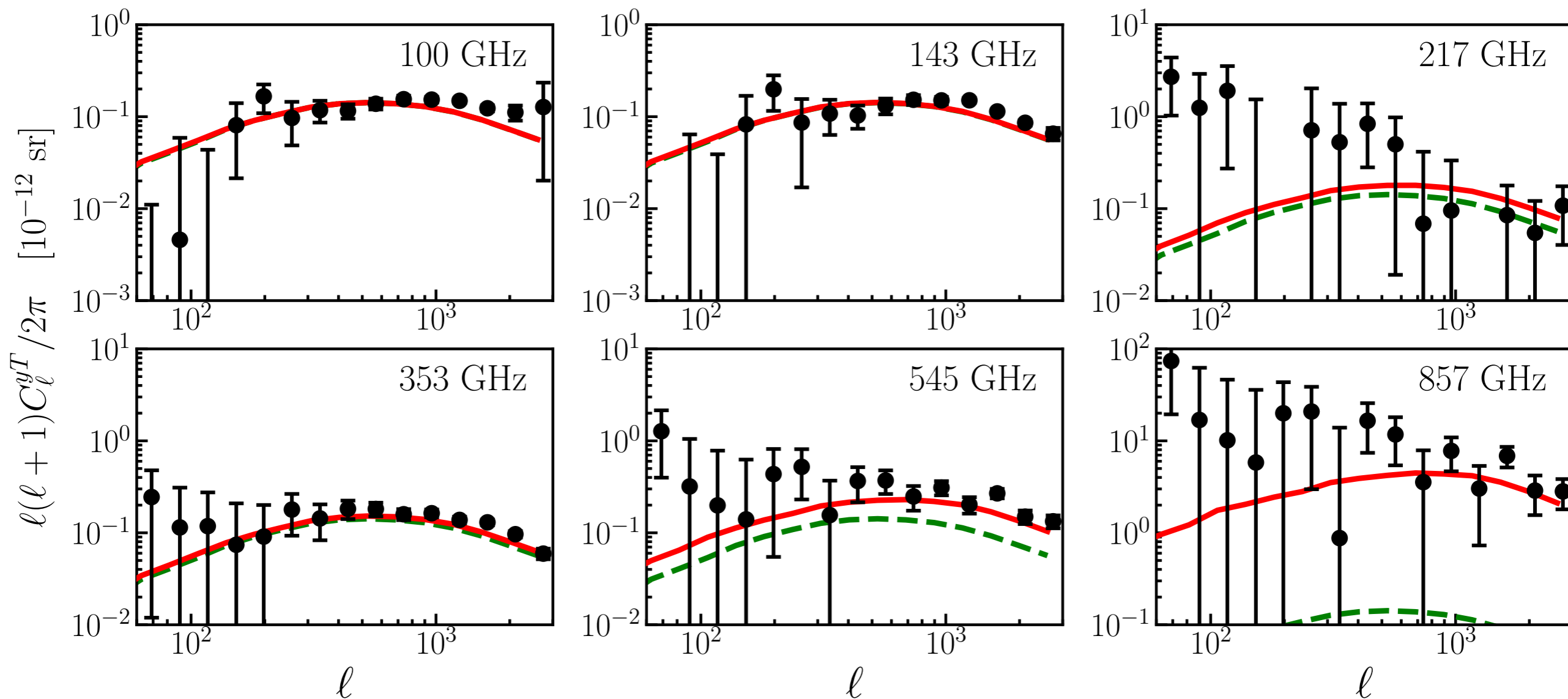
# CIB

## Stochastic Halo Occupation Distribution (HOD)

Planck 2013 (XXX) & 2015 (XXIII) models



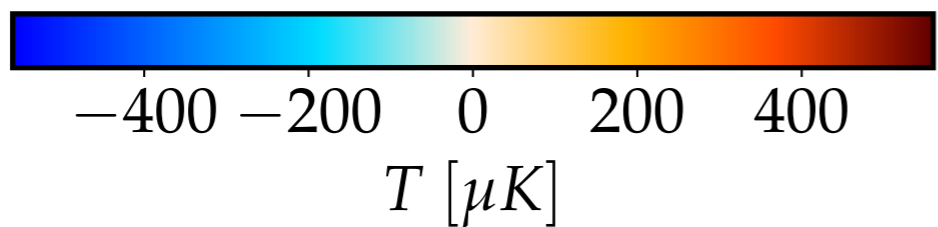
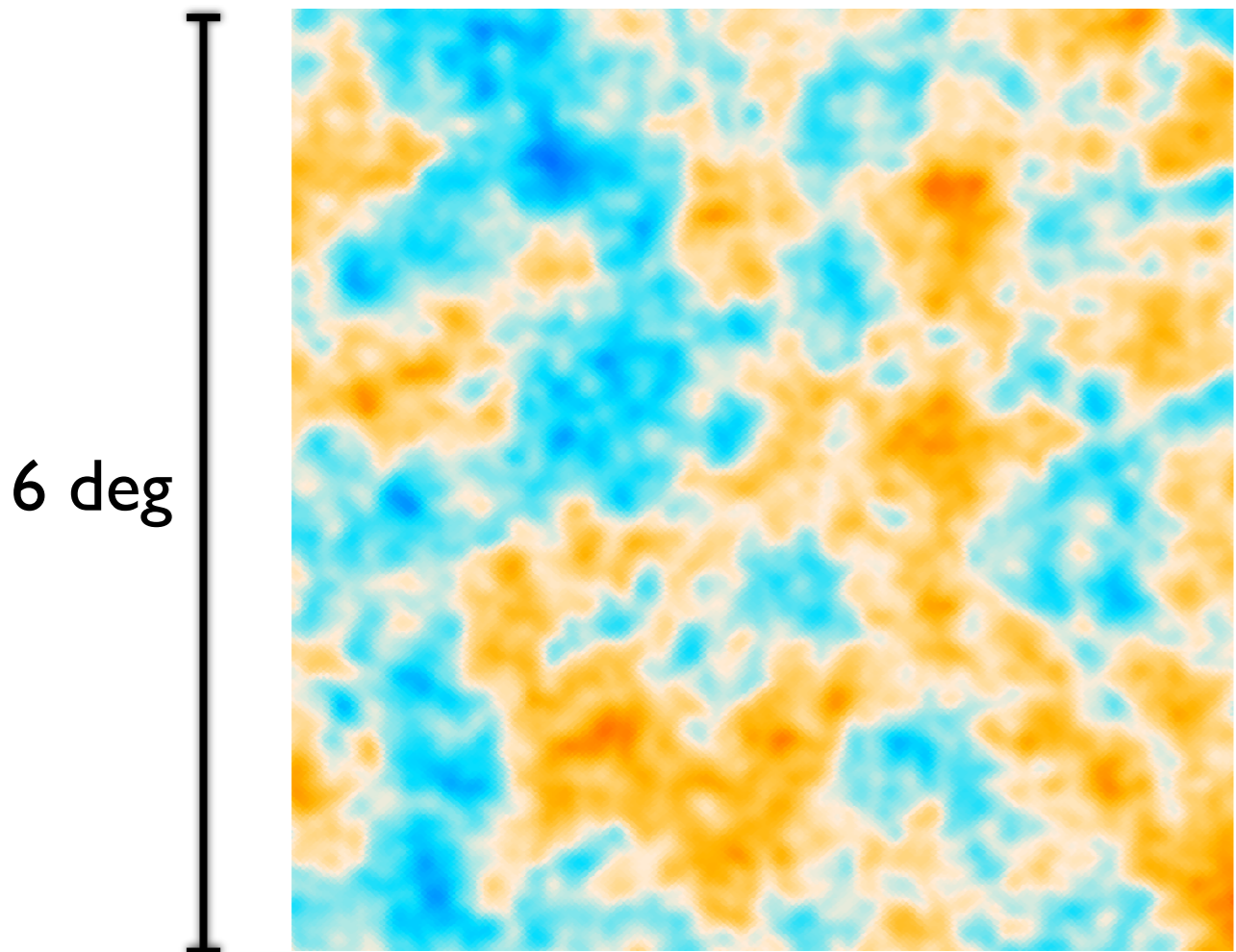
—  $y_c \times (y + I_{\text{CIB}})$      
 - - -  $y_c \times y_c$



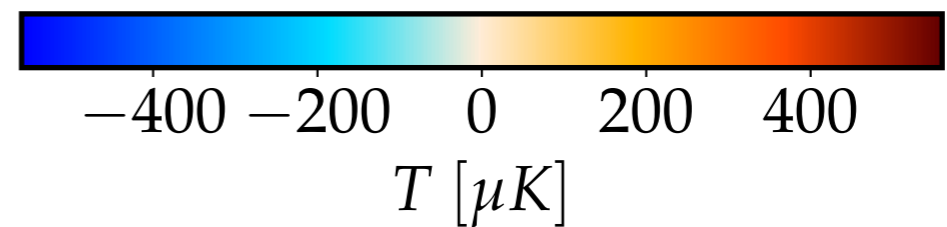
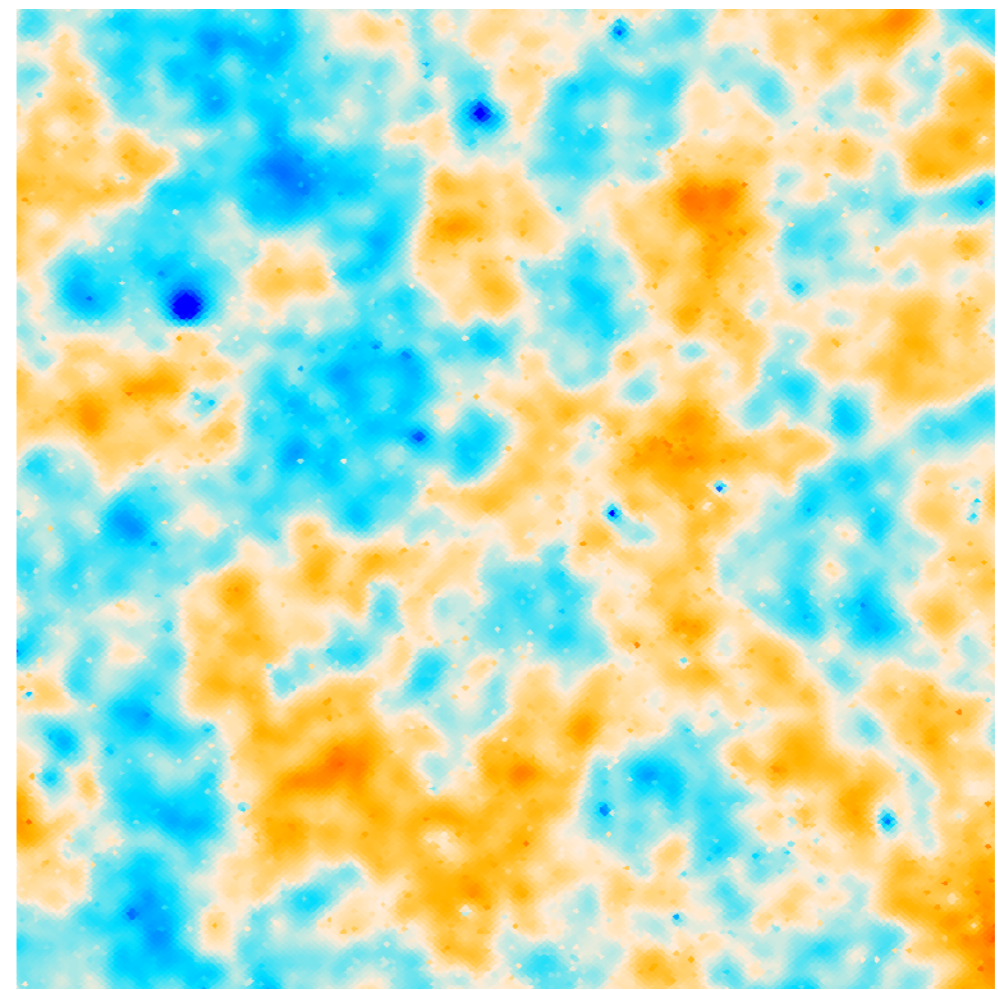
CIB x y (PSZ2 clusters)  
Matches Planck XXIII figure 12



CMB without Extragalactic Foregrounds



CMB with Extragalactic Foregrounds  
lensing + tSZ + kSZ + CIB



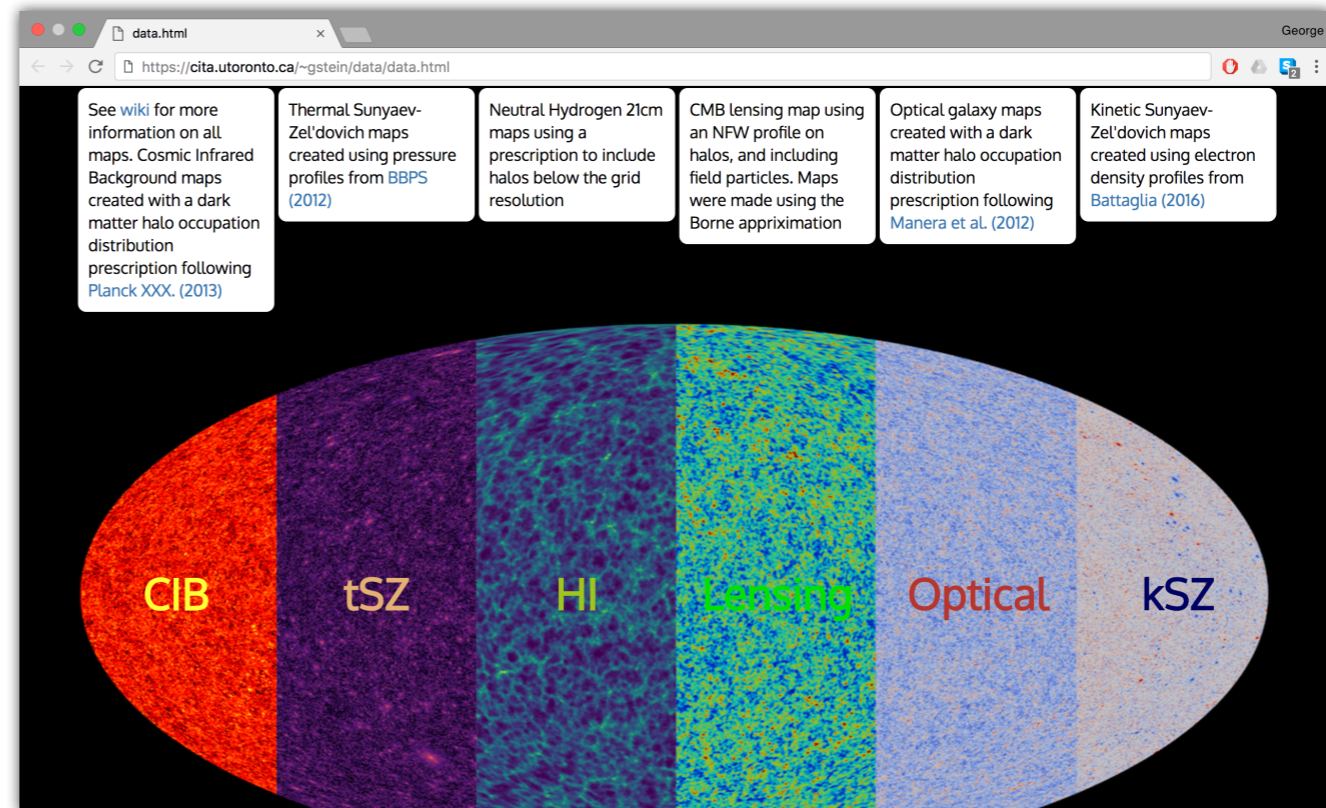
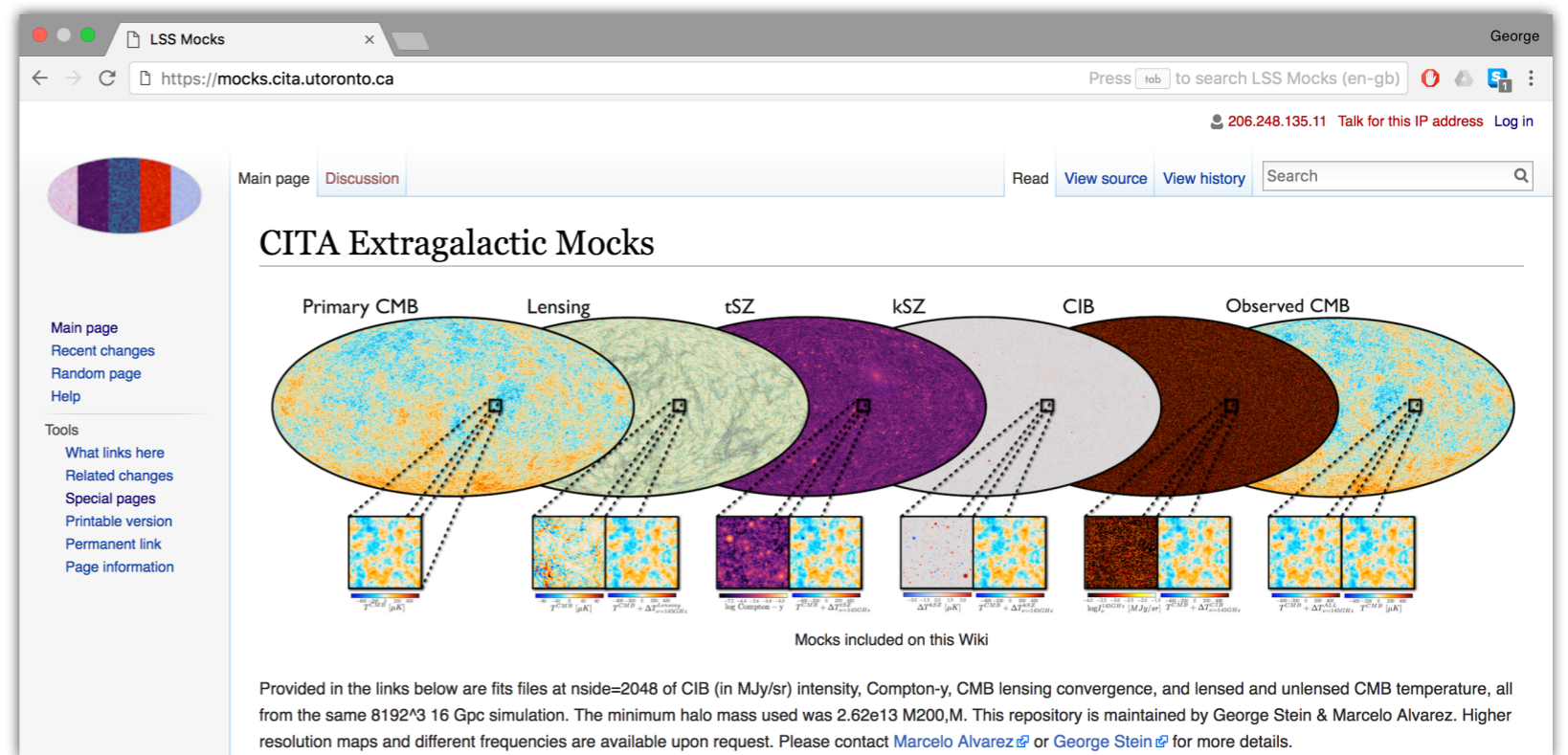
$\nu = 148 GHz$

# WebSky CMB Mocks

Available at  
[mocks.cita.utoronto.ca](https://mocks.cita.utoronto.ca)

Sims being used for EUCLID, ACT, SO, CMB-S4, COMAP, CHIME, CCAT-p, ...

Or through my website at  
[cita.utoronto.ca/~gstein](https://cita.utoronto.ca/~gstein)



Other useful links:

“Simulations of the Microwave Sky” - Sehgal et al 2009, [https://lambda.gsfc.nasa.gov/toolbox/tb\\_sim\\_ov.cfm](https://lambda.gsfc.nasa.gov/toolbox/tb_sim_ov.cfm)  
 Euclid halo + galaxy mocks - cosmohub, <https://cosmohub.pic.es/>, MICE-GC - [http://maia.ice.cat/mice/grand\\_challenge.html](http://maia.ice.cat/mice/grand_challenge.html)

