

# 3D Grids to Healpix maps

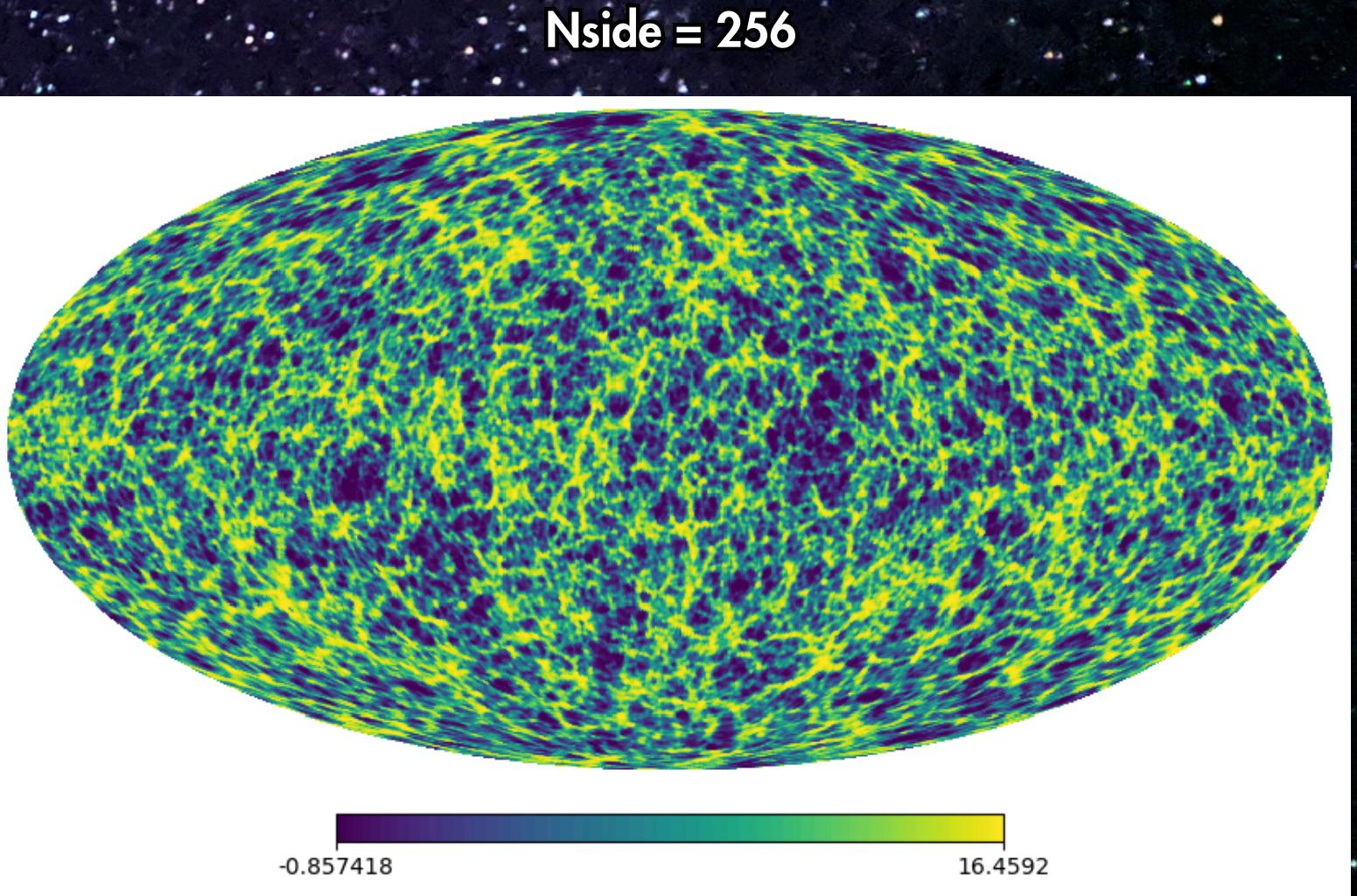
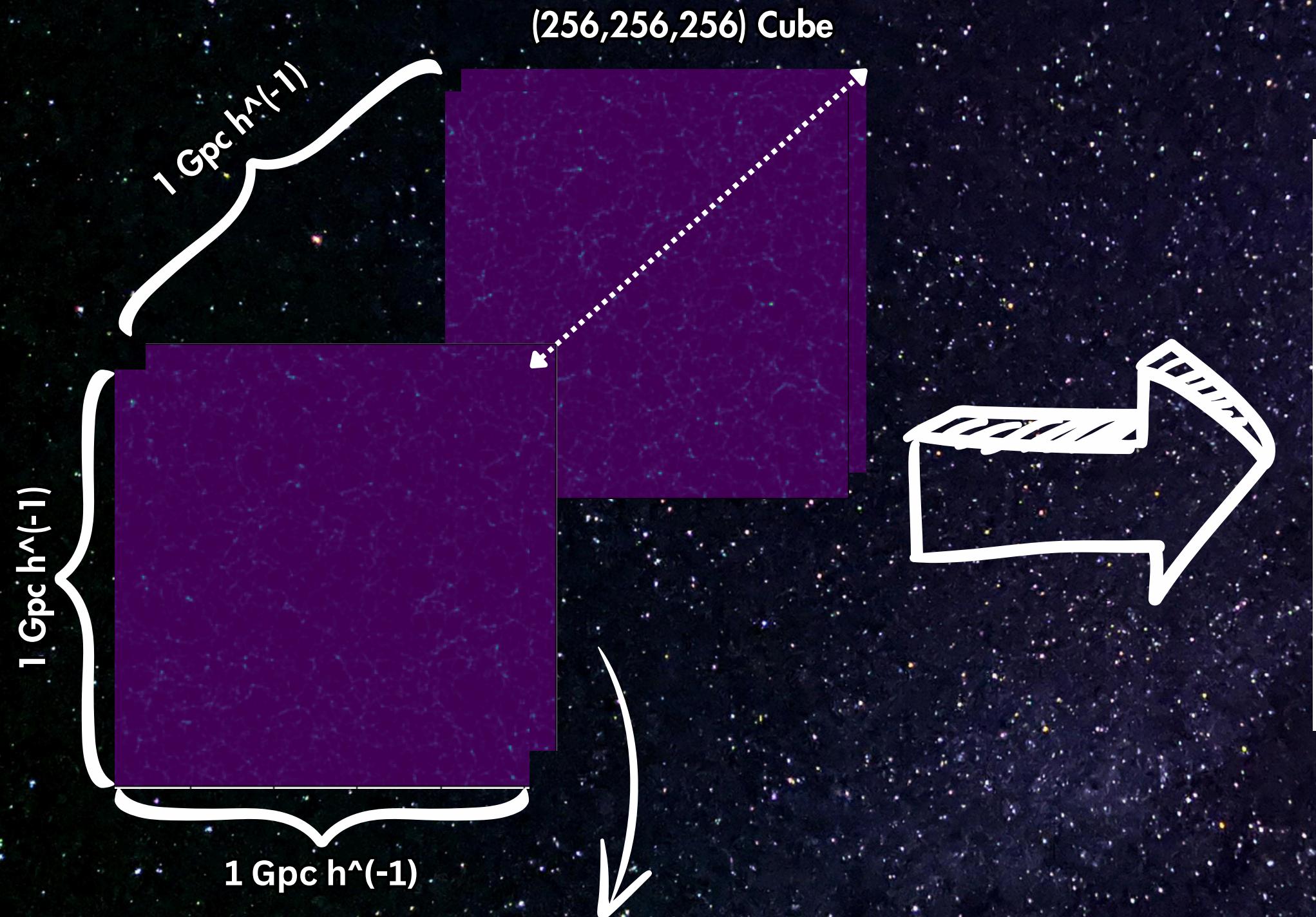
**MSc. Jordany Vieira (Ph.D. Student at USP)**  
**Supervisor: Prof. Dr. Elcio Abdalla**

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# Outline

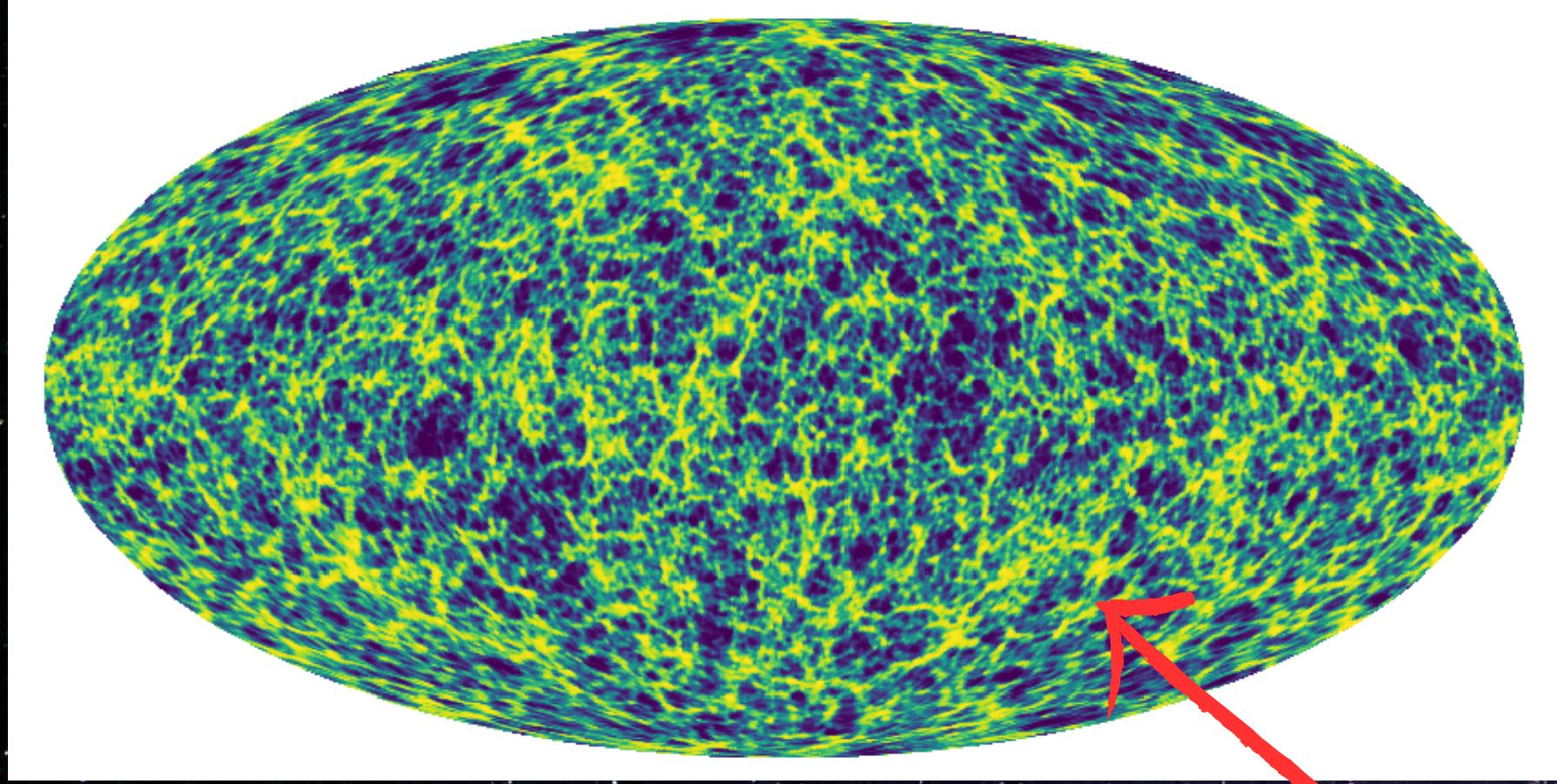
- 1. What need to do**
- 2. The Algorithm**
- 3. CIC Method**
- 4. Previous Results**
- 5. New Results**
- 6. Next Steps**

# What need to do

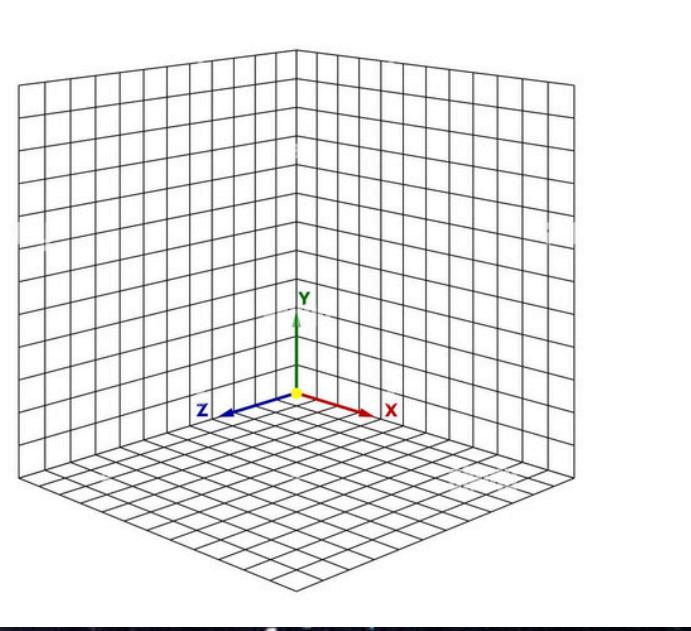


The cubes are from **Quijote N-body simulations with non-gaussianities**

# My Algorithm



Transform the each pixel position  
in 3D grid position



$(x, y, z)$

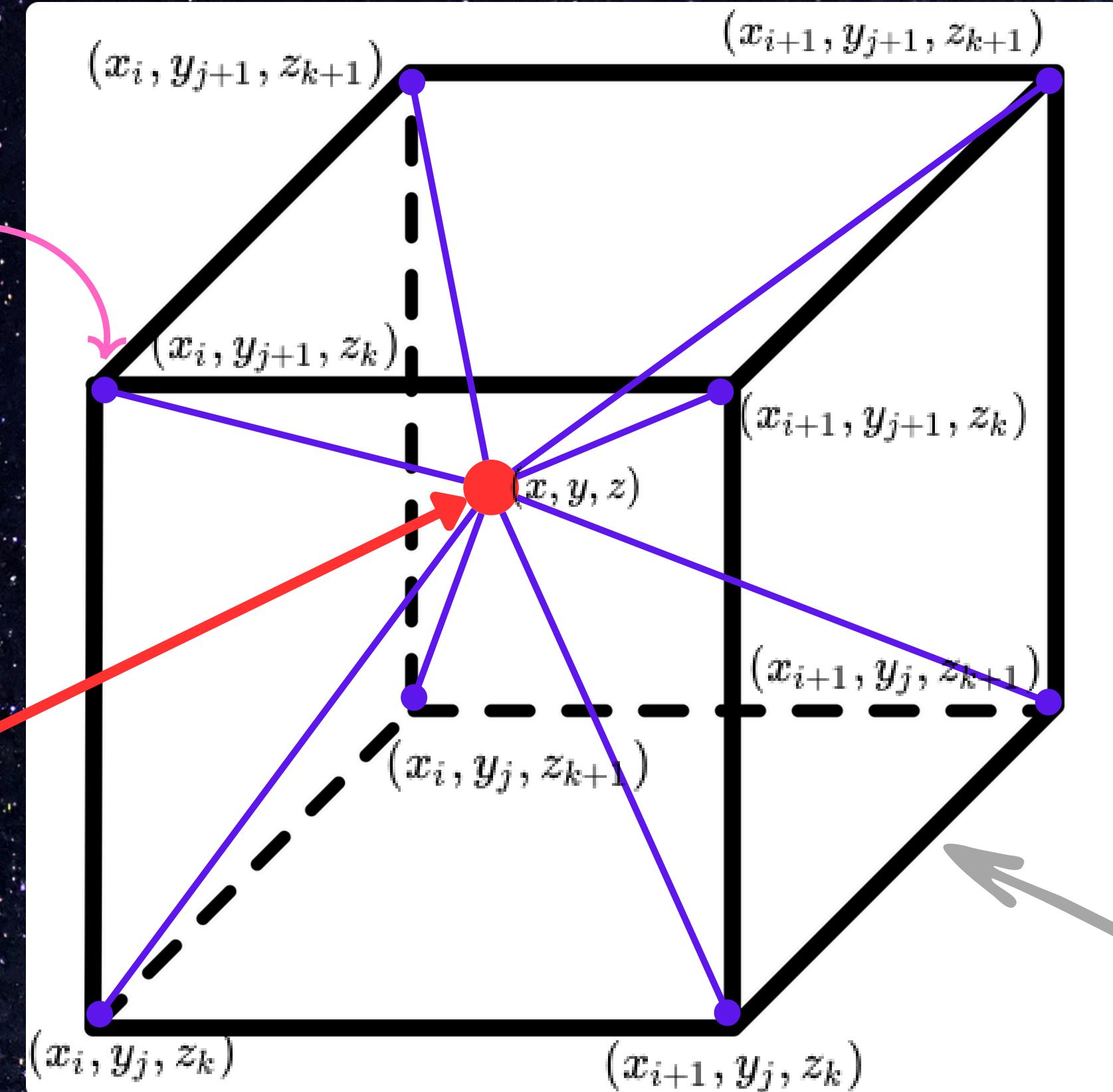
# The Algorithm

- 1. Choose the bin Distance ( $Mpc.h^{-1}$ )**
- 2. Number of Slices (1, 2, 5 and 15)**
- 3. Calculate the vector position with distances**
- 4. Use a CIC method to get the information in the cube**
- 5. Put the information in the pixel vector**
- 6. Take the mean between each slice produced**
- 7. Create the map with the pixel vector of the mean**

# CIC Method

The data information is in  
the corners of the voxel

Pix position  
a vector in the cube  
(it is inside of a voxel)



The voxel

# CIC Method

$$(x_i, y_i, z_i) < (x, y, z) < (x_{i+1}, y_{i+1}, z_{i+1})$$

$$n_{i,j,k} = \delta_{i,j,k}(x_{i+1} - x)(y_{j+1} - y)(z_{k+1} - z)$$



**8 combinations**

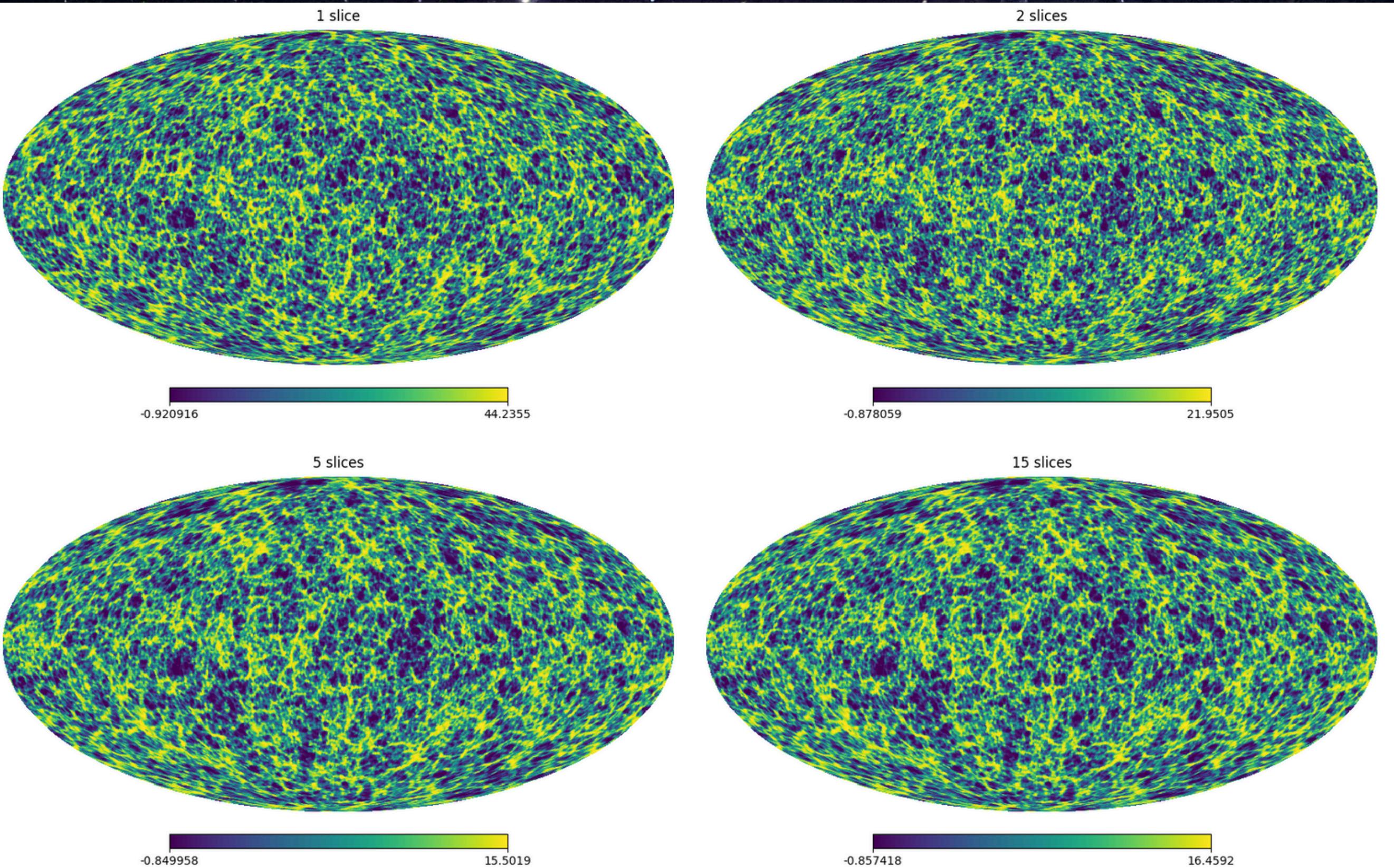


**Sum all n's to the total information for (x,y,z)**

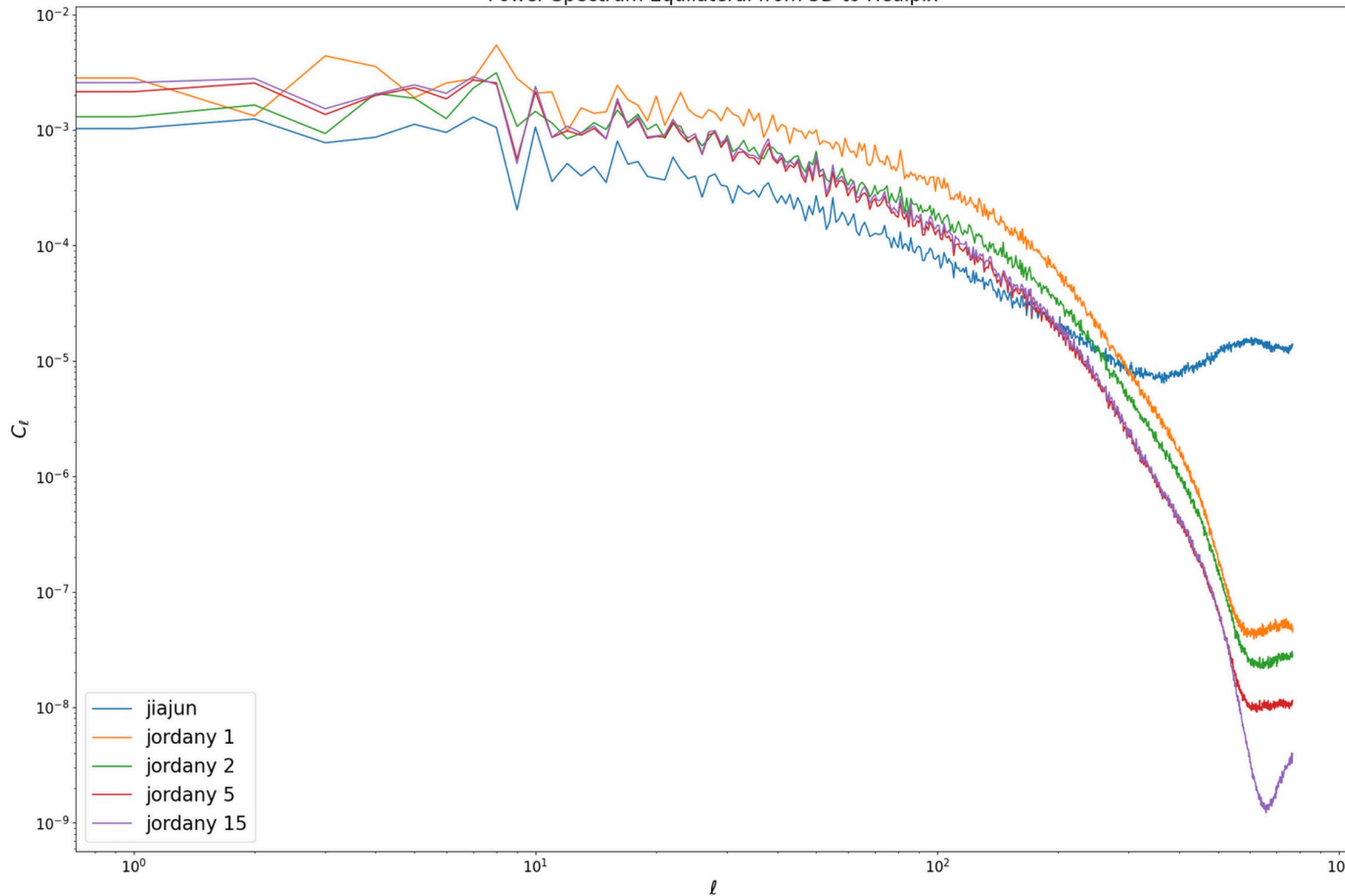
# CIC Method for Redshift

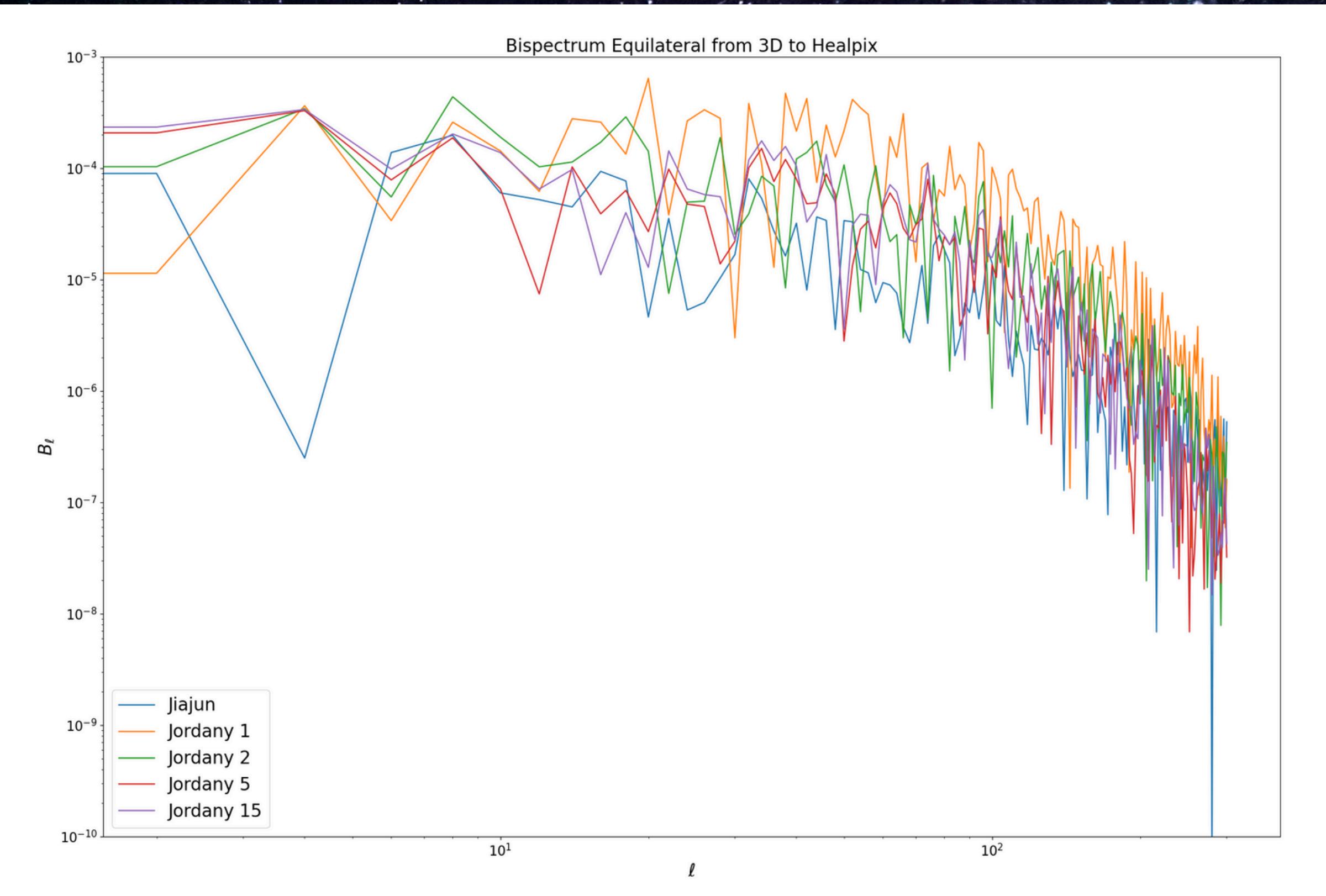
1. We choose the redshift to create the map.
2. Get two cubes with redshifts higher and lower than the chosen one.
3. Create the maps for these two maps.
4. Create the map in the chosen redshift by interpolating these two maps.

# Previous Results

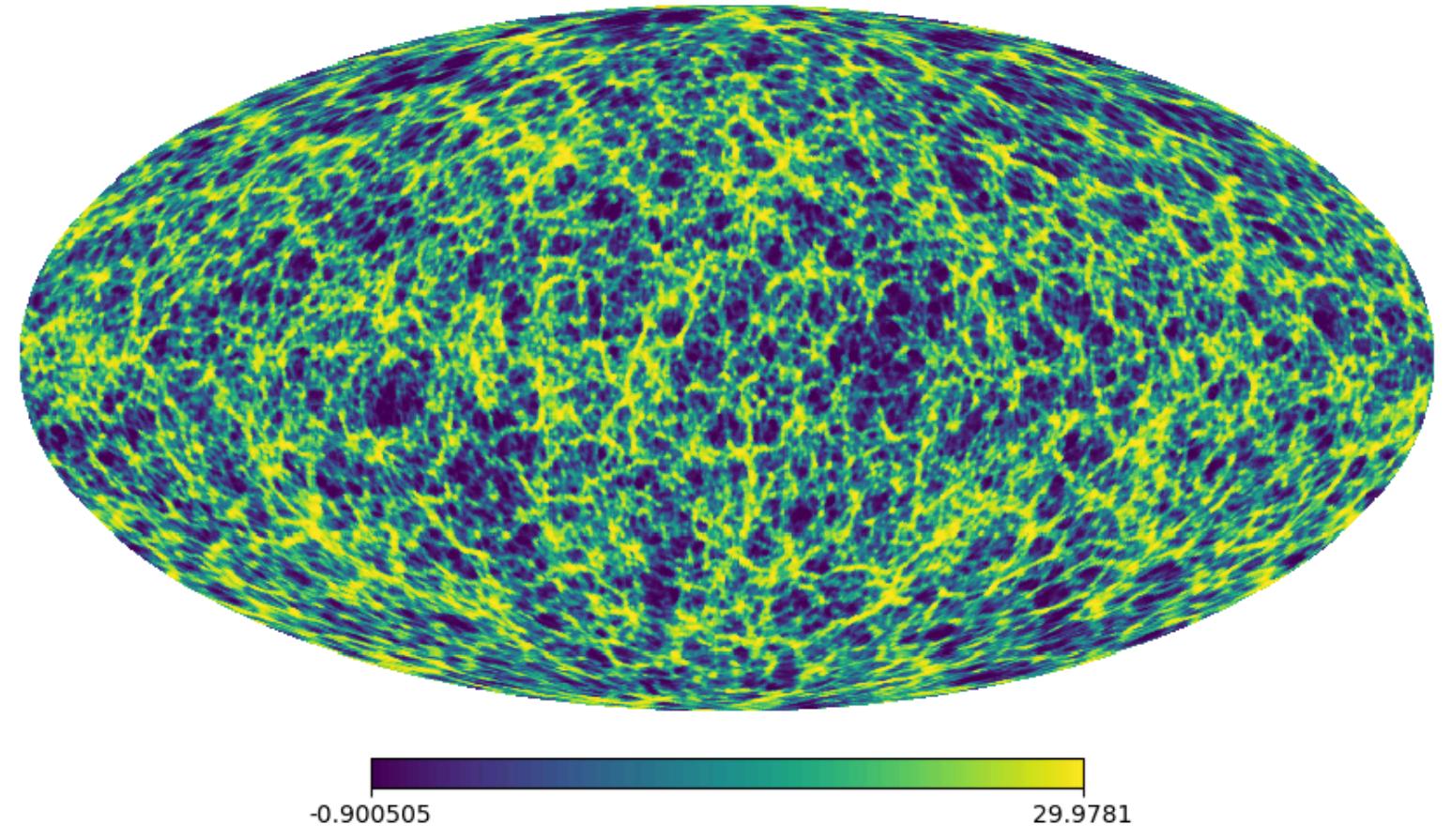


## Power Spectrum Equilateral from 3D to Healpix





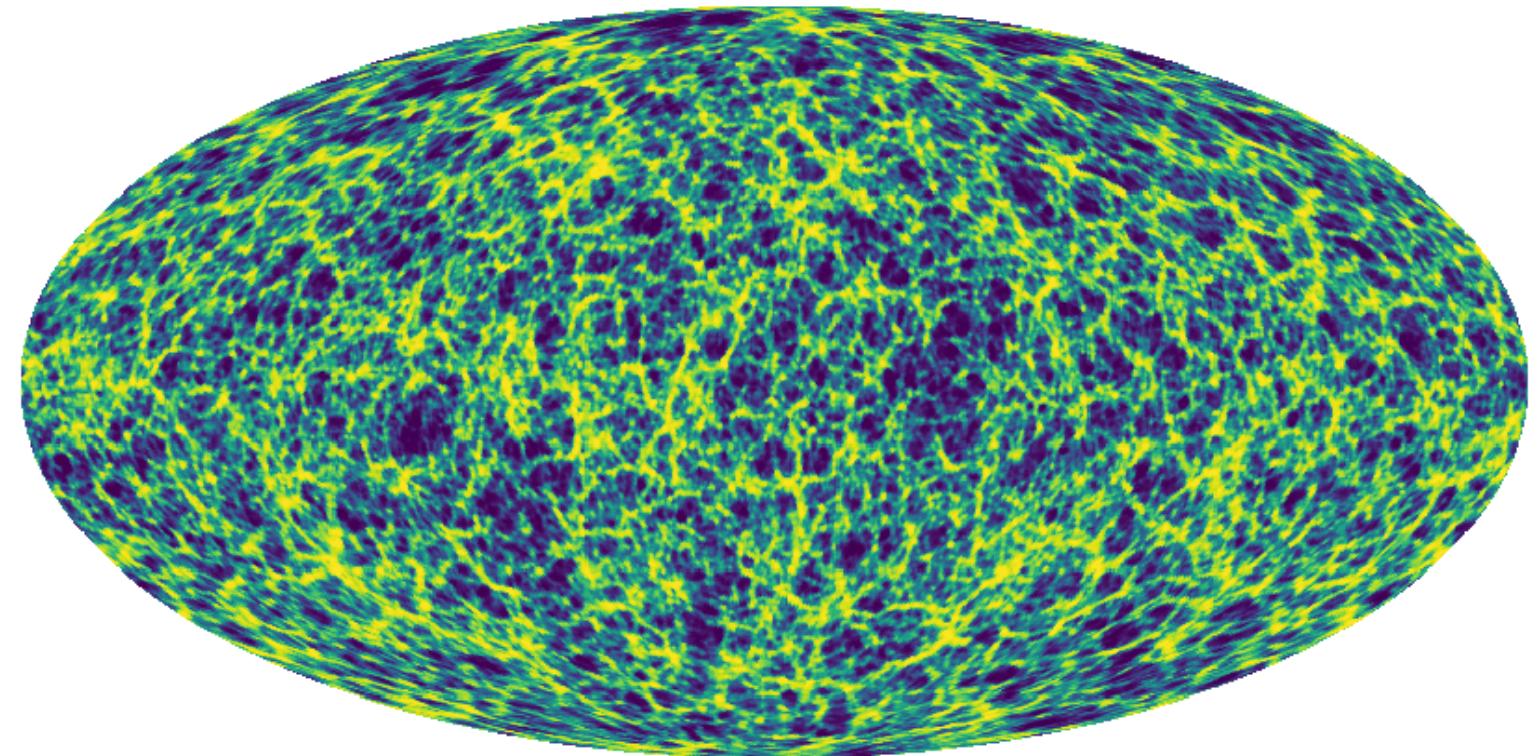
15 slices Fiducial



-0.900505

29.9781

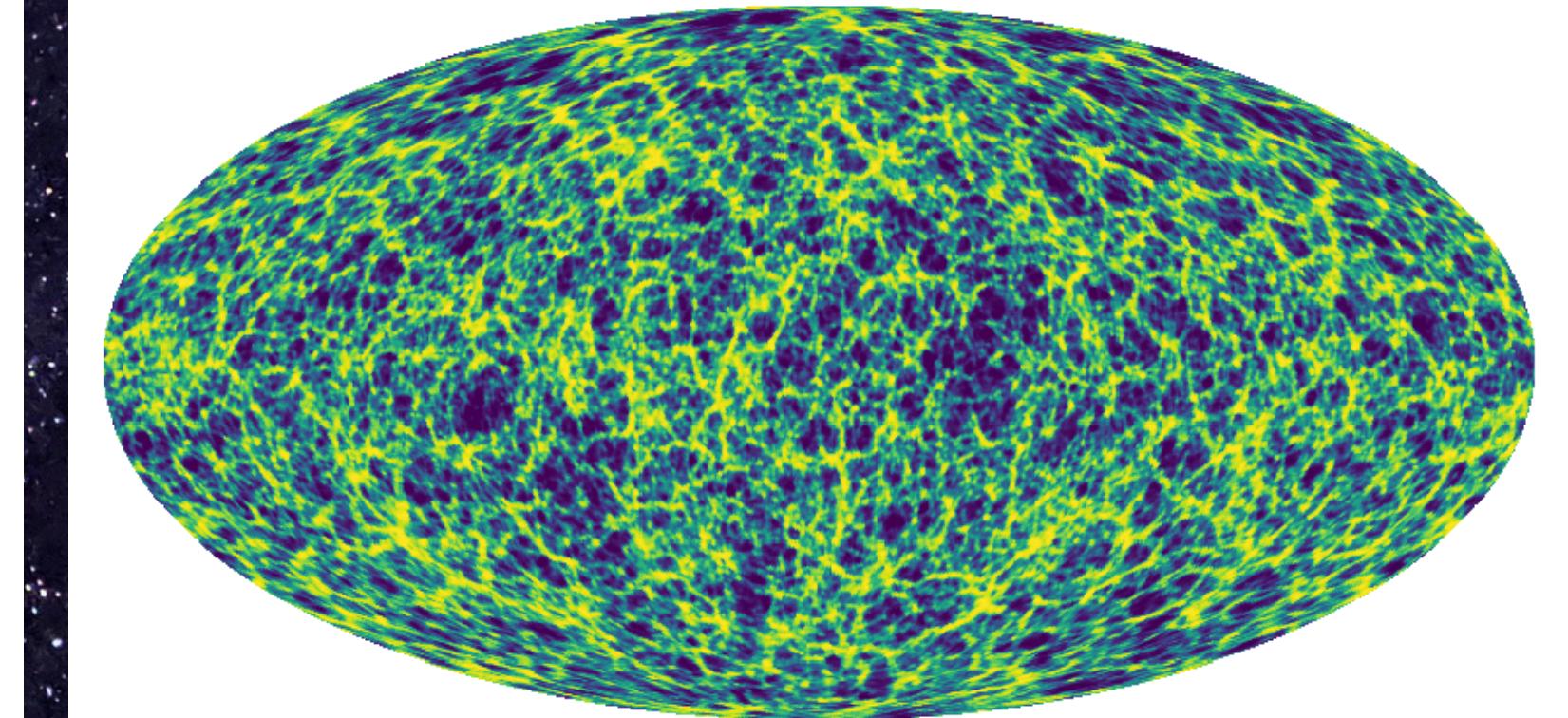
15 slices Plus



-0.896799

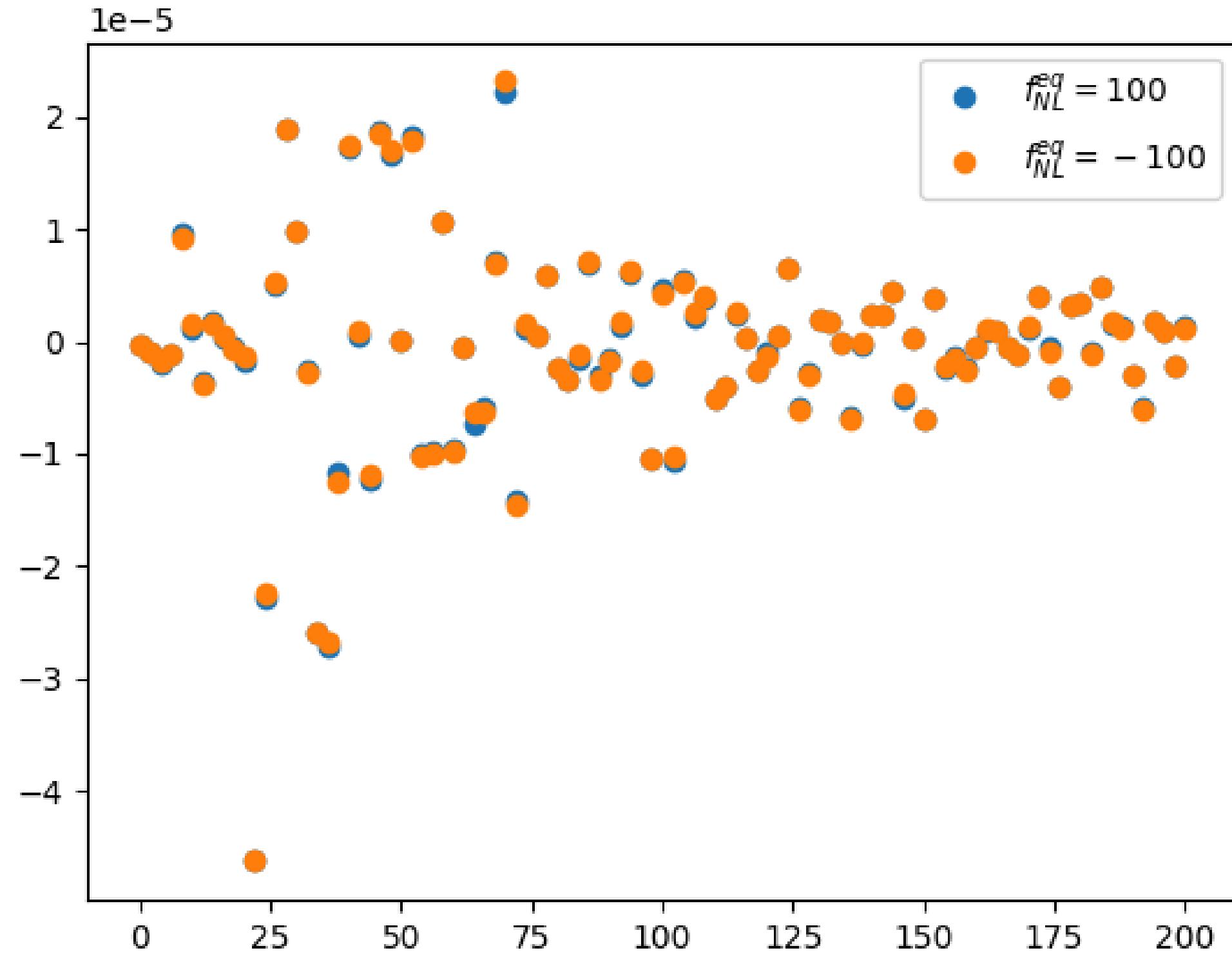
30.6928

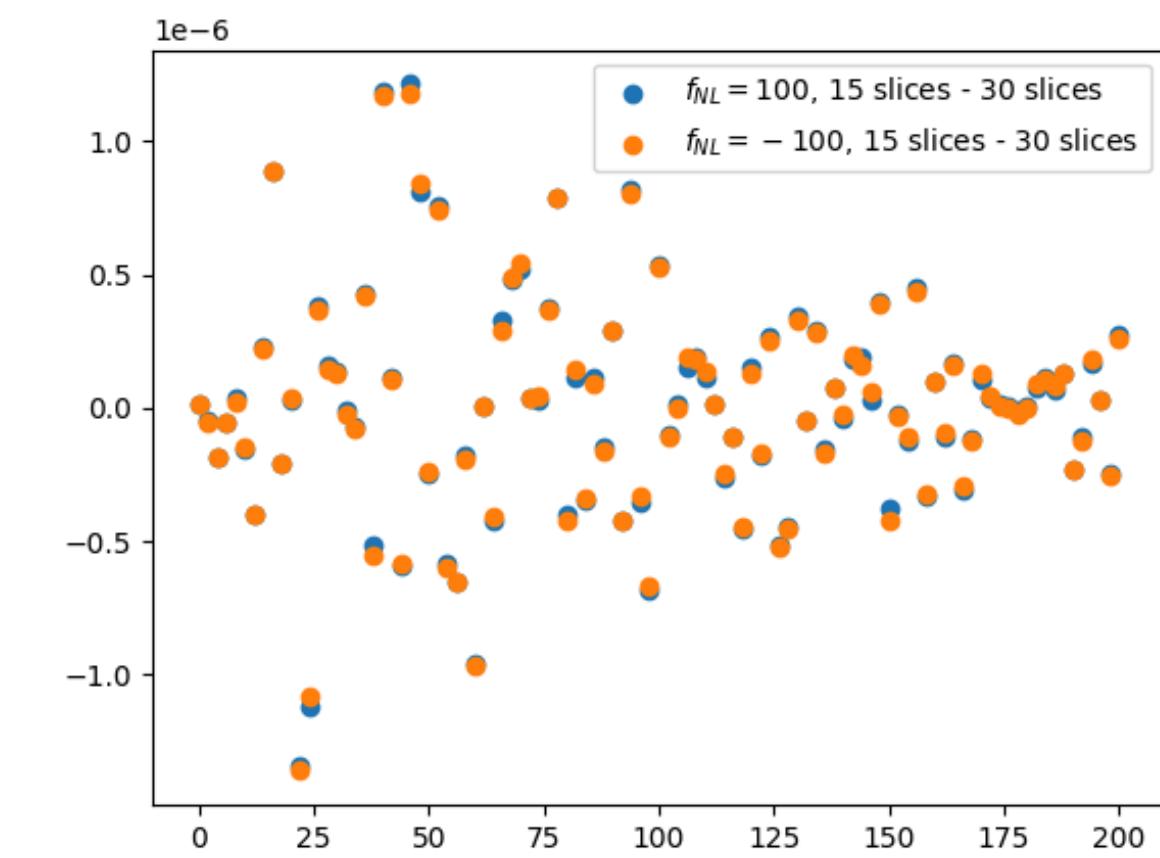
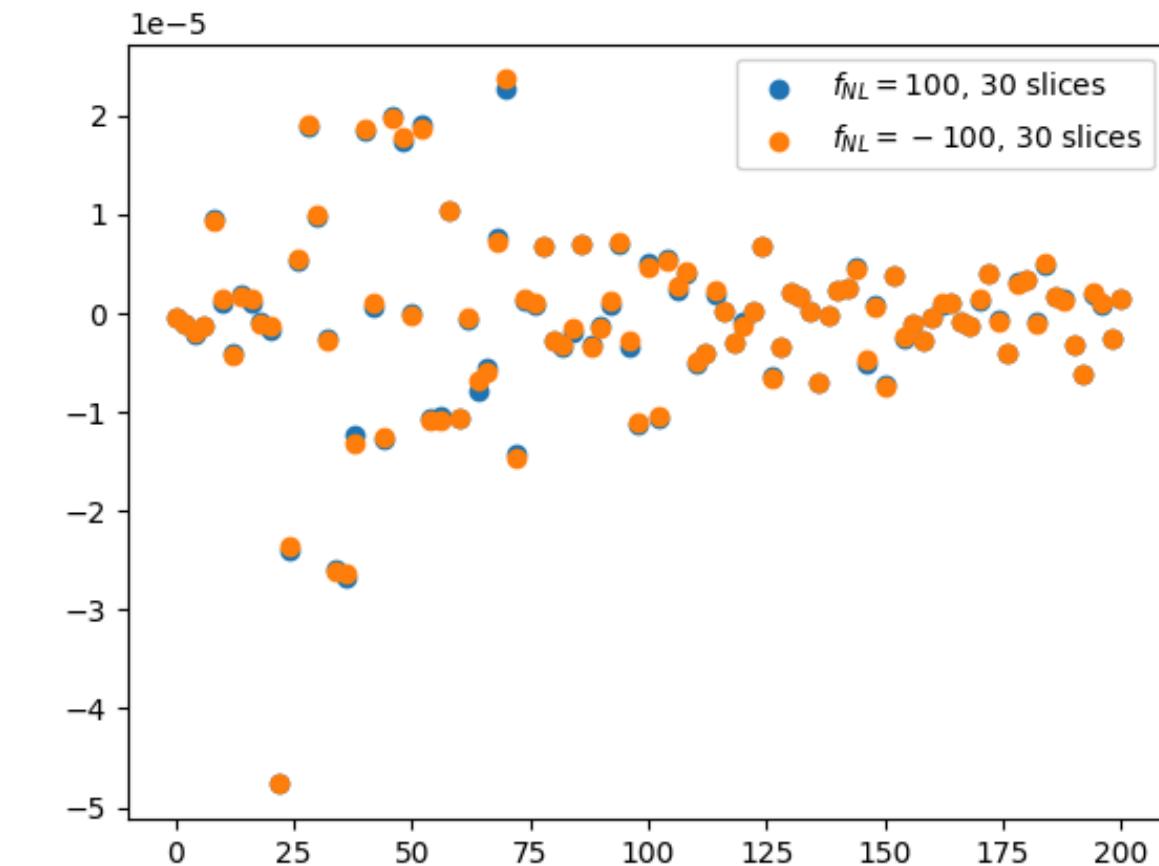
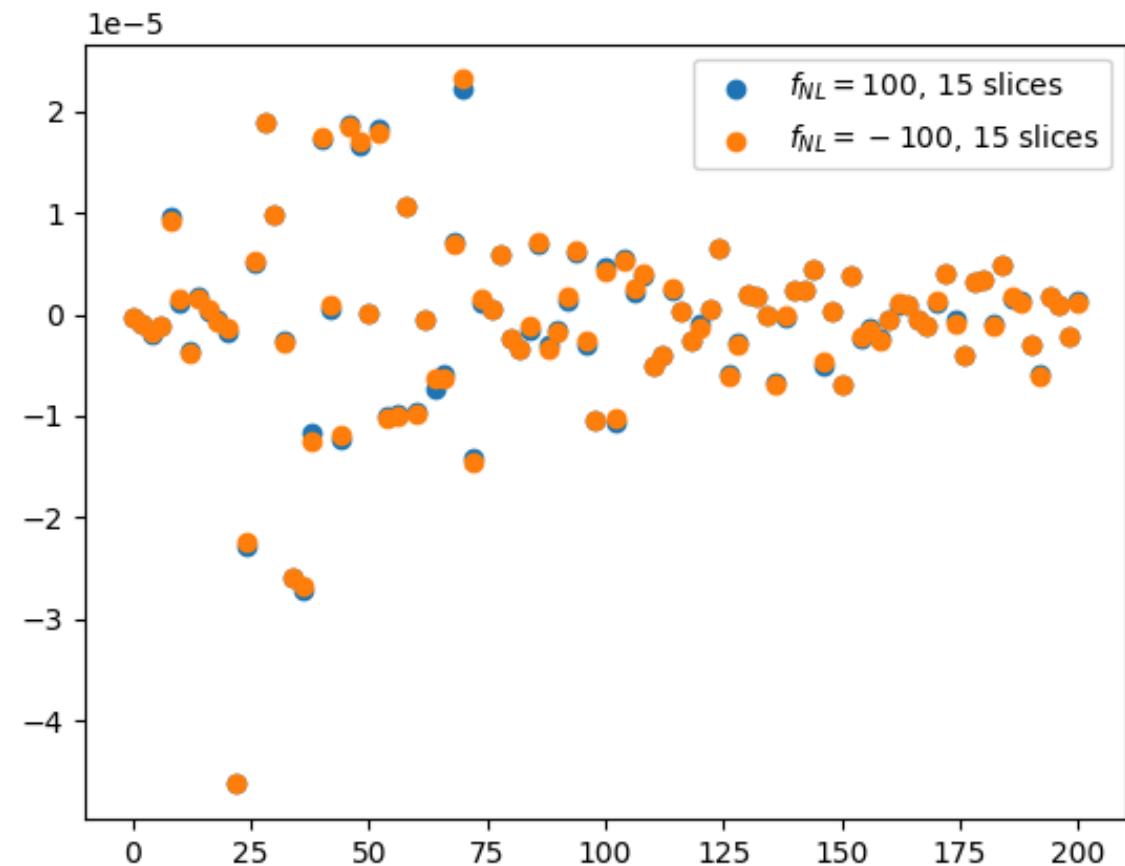
15 slices Minus



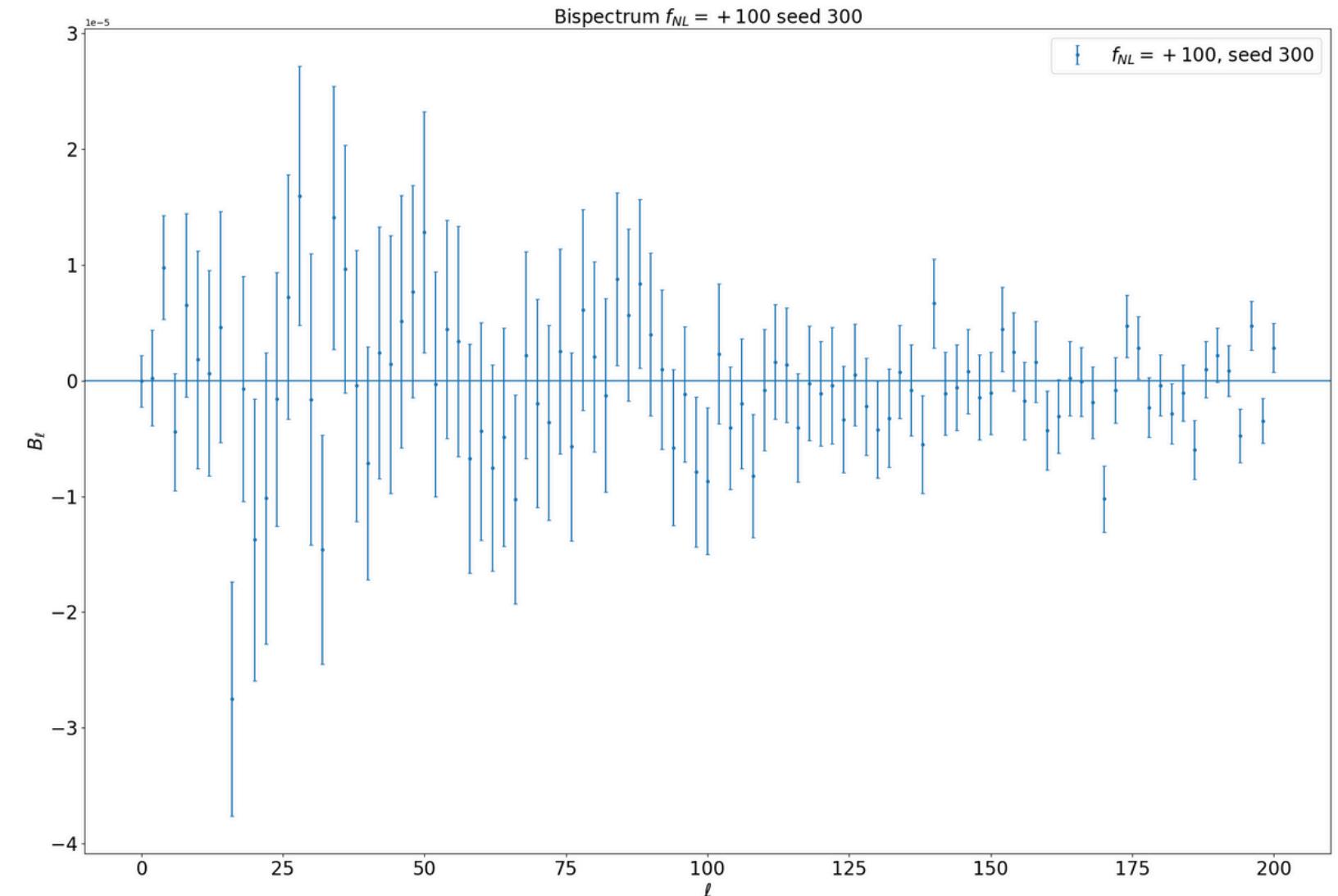
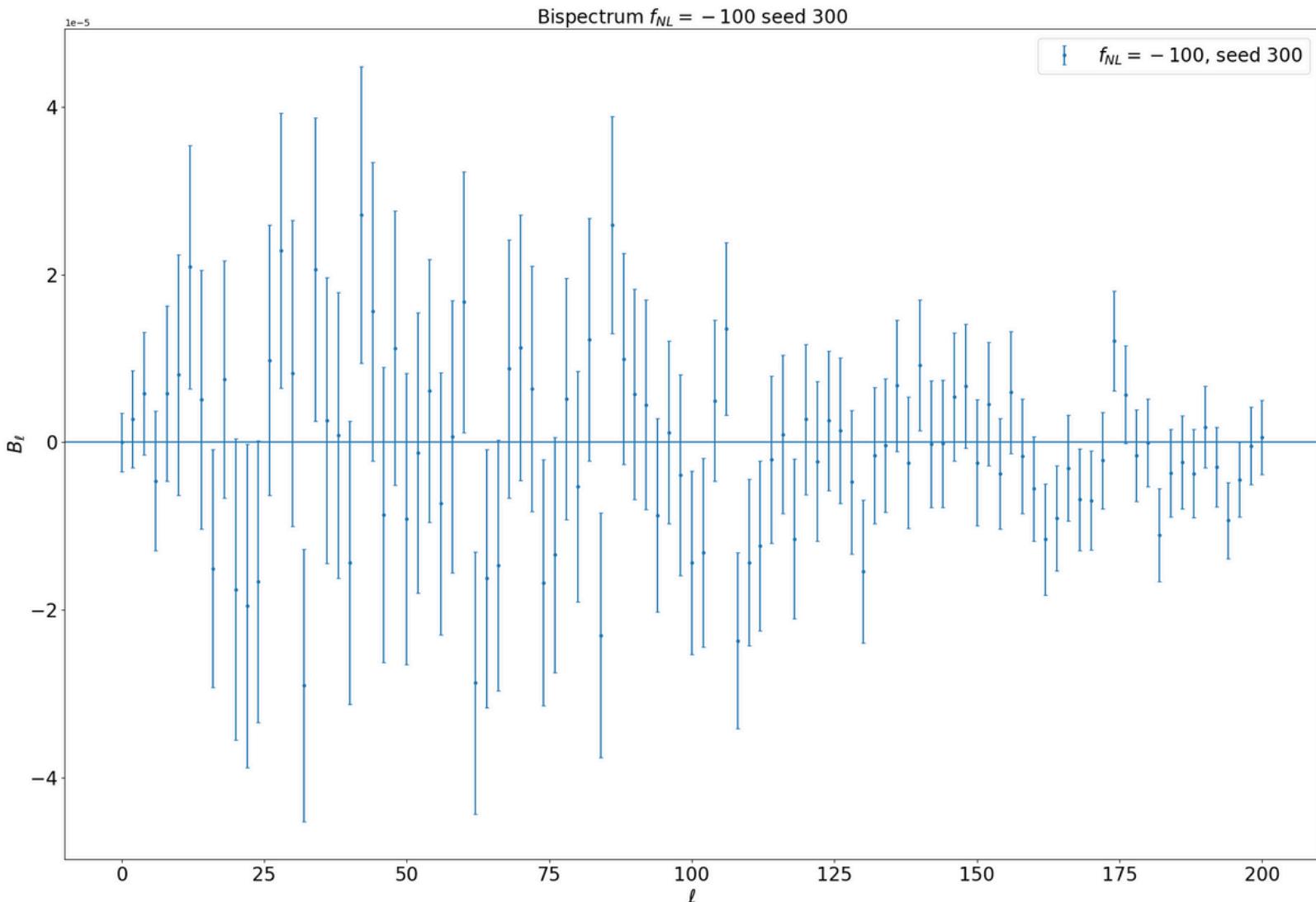
-0.903866

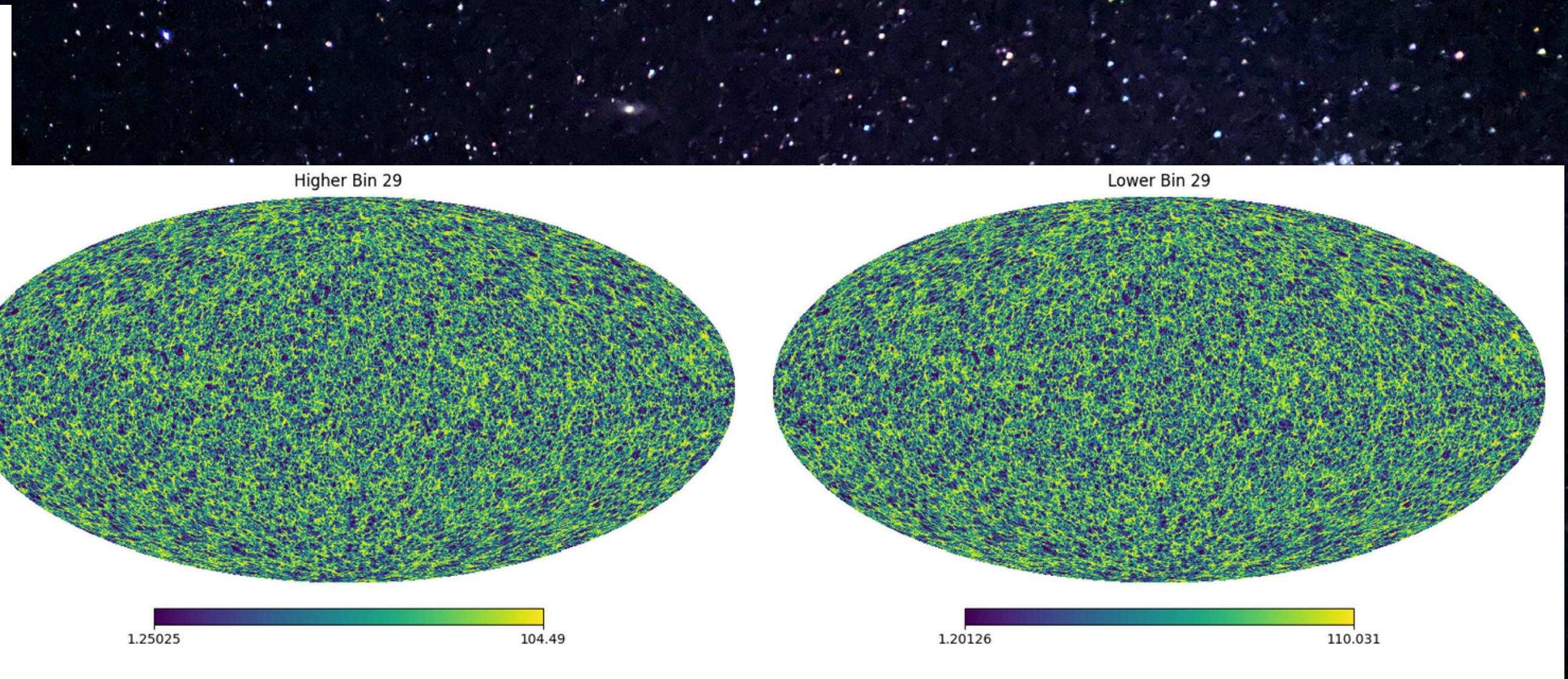
28.7299

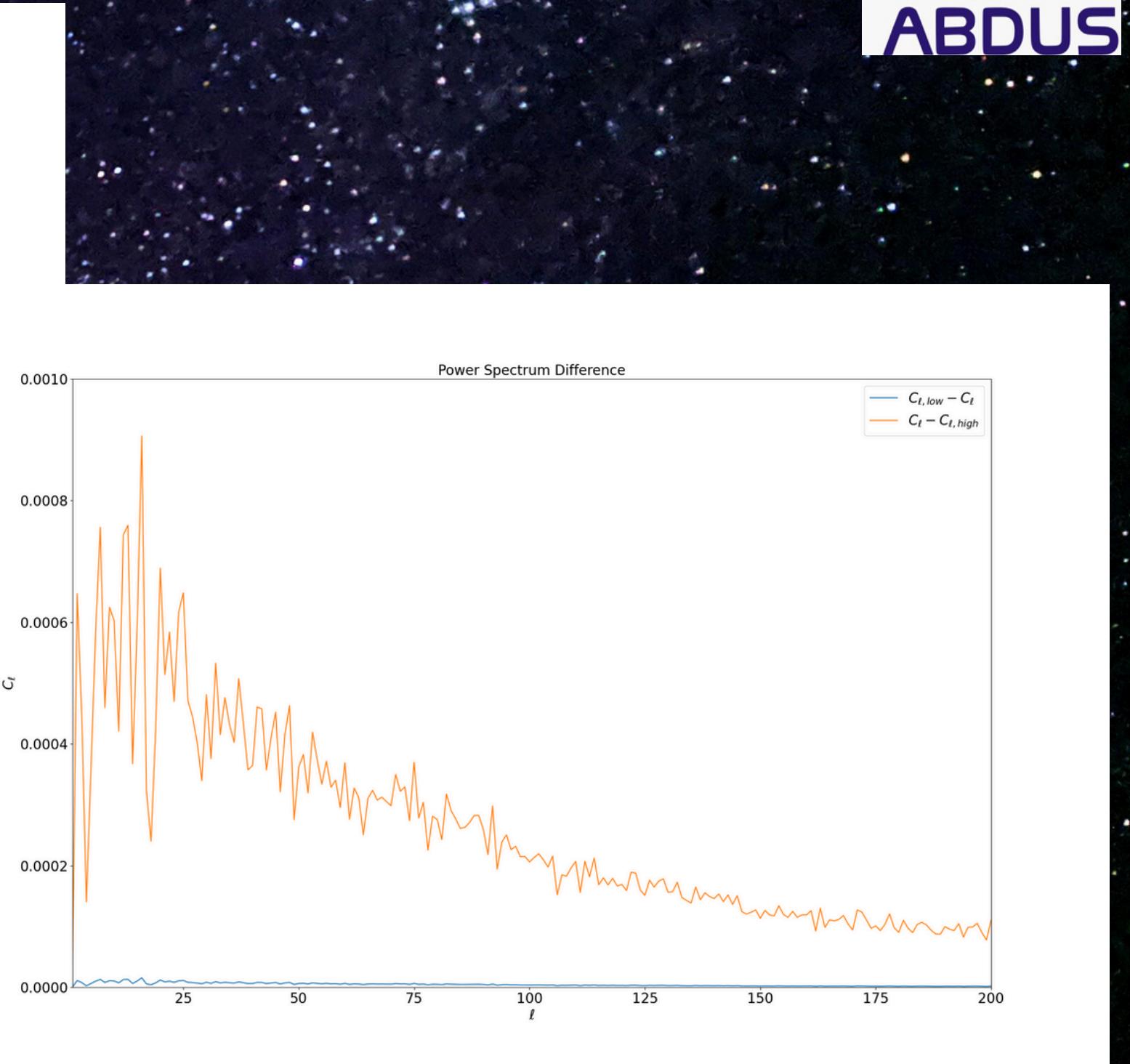
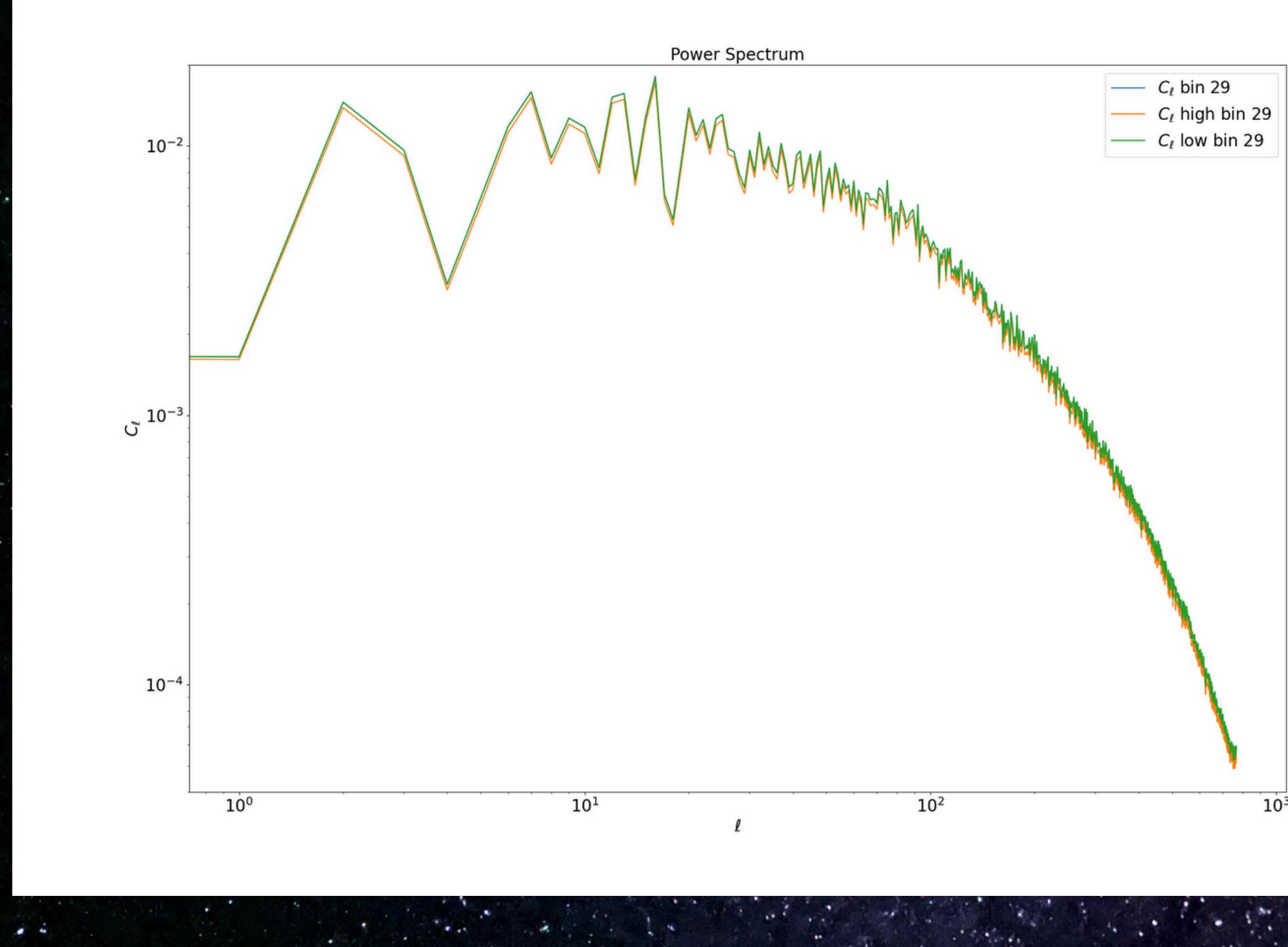


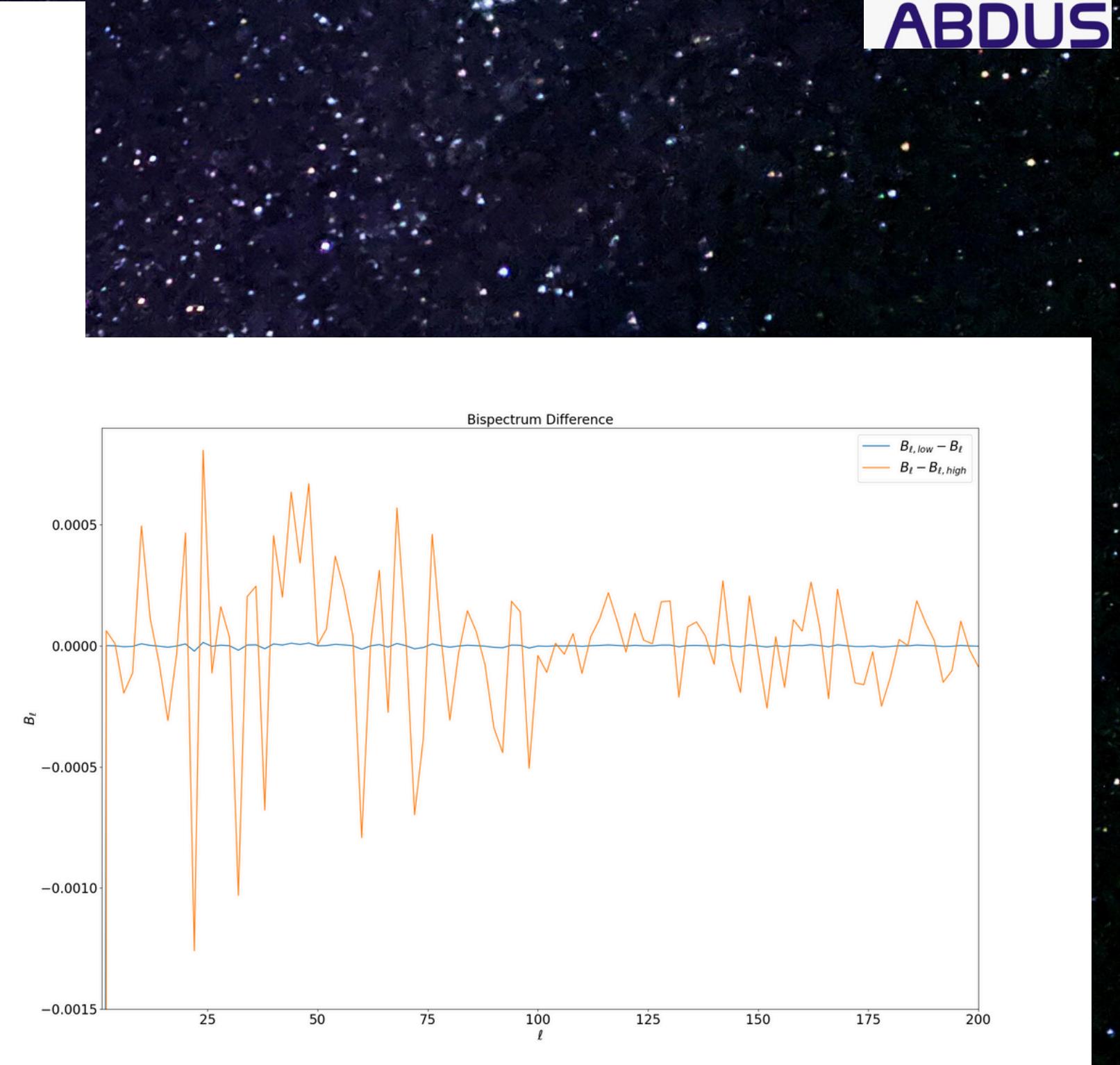
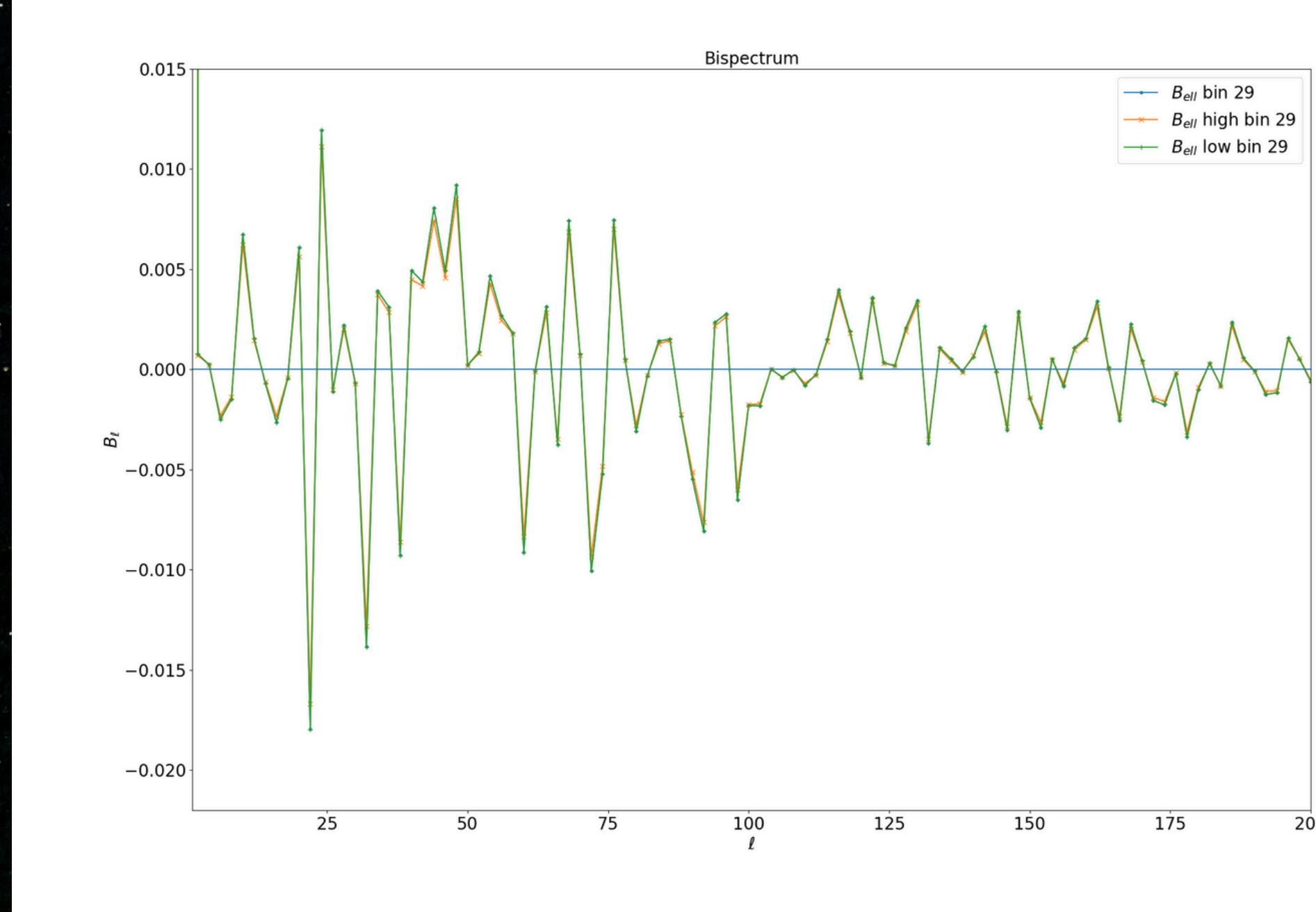


# New Results









# Next Steps

- Study whether we have a better triangle configuration to calculate the bispectrum.
- Find a strategy to estimate the  $f_{NL}$  factor.
- Compare with theoretical results (equilateral case).
- Start the studies of map creation for interaction models with 3D cube simulations.

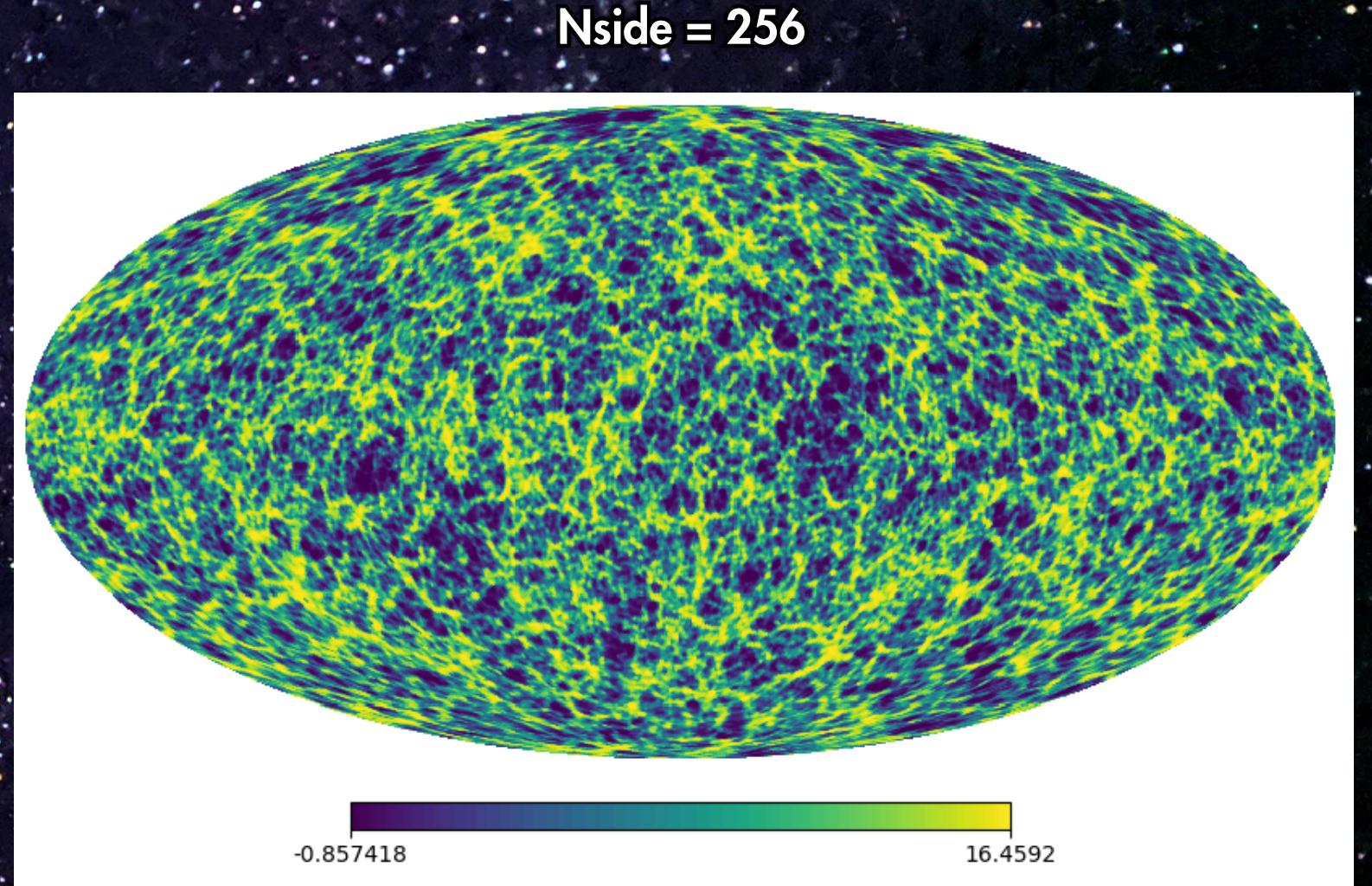
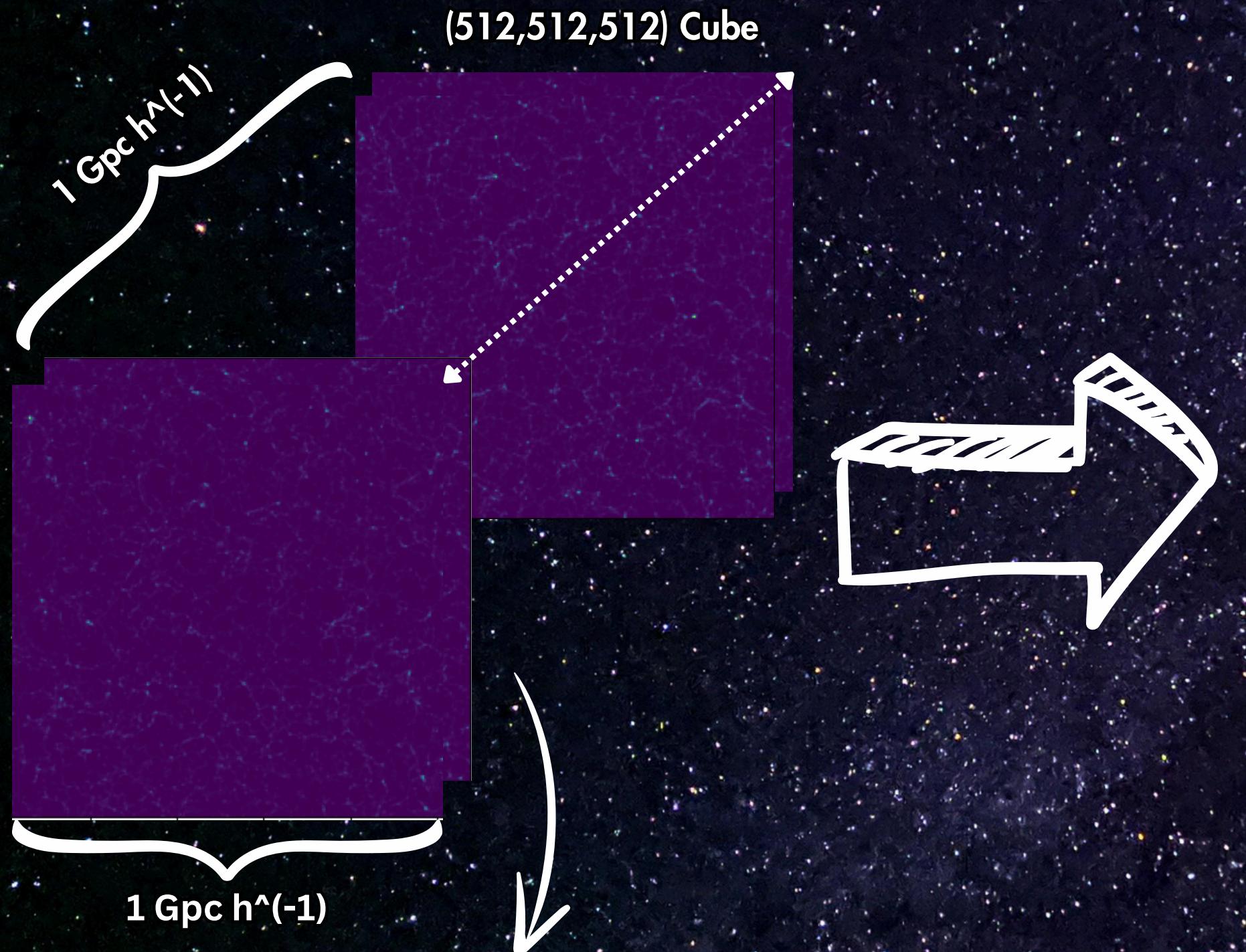
# Update on bispectrum from N-body simulations with non-gaussianities

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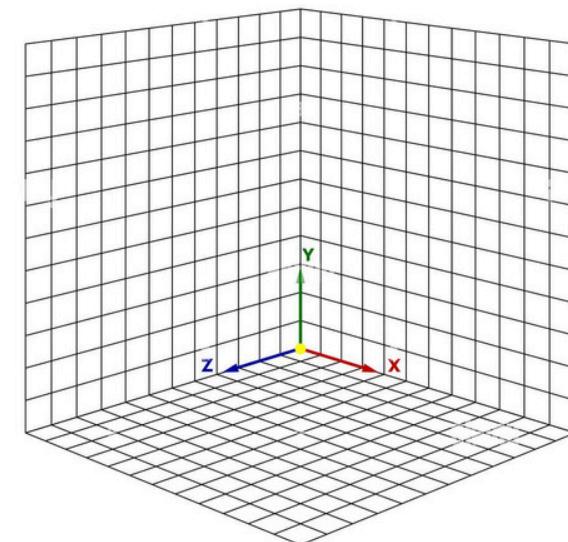
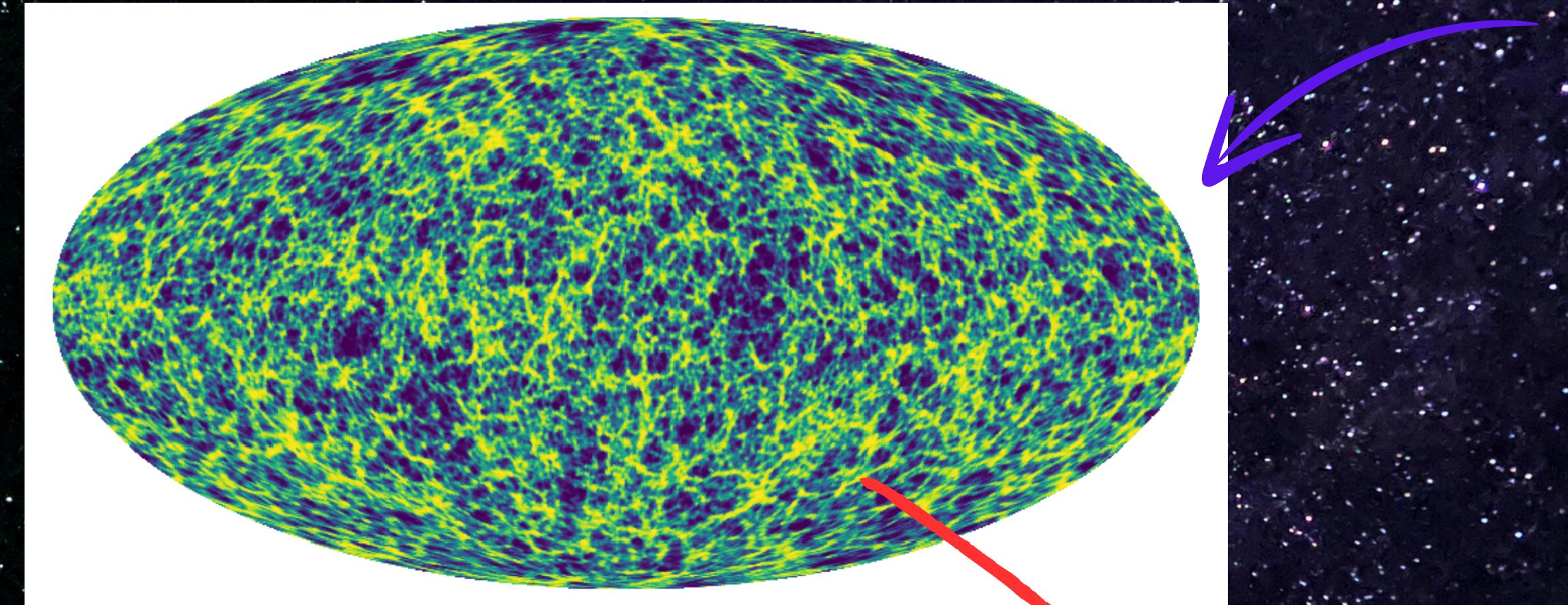
# New data



The cubes are from Jiajun N-body simulations with non-gaussianities

# My Algorithm

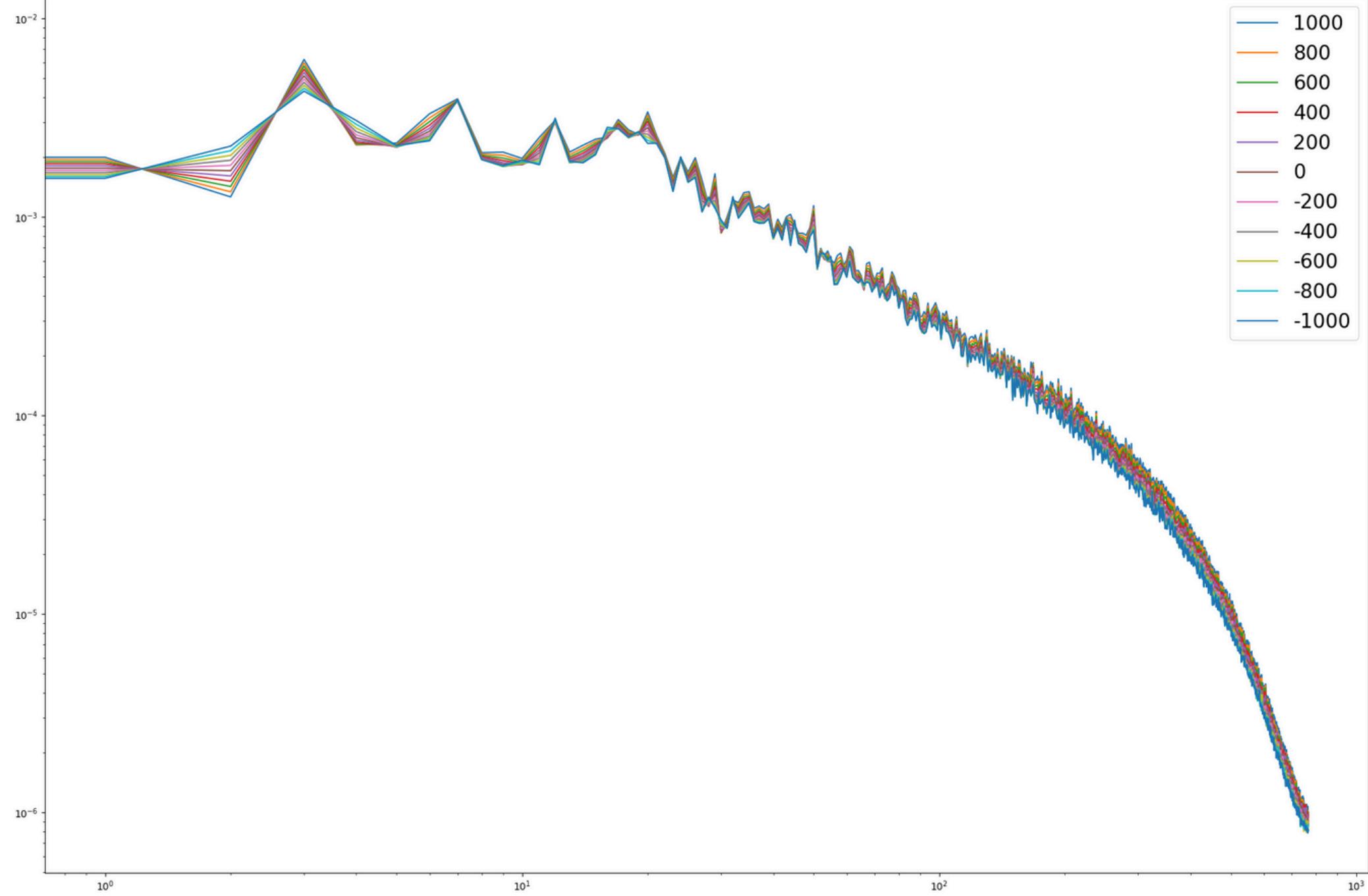
2 Transform back to pixel position with  
data inside the cube

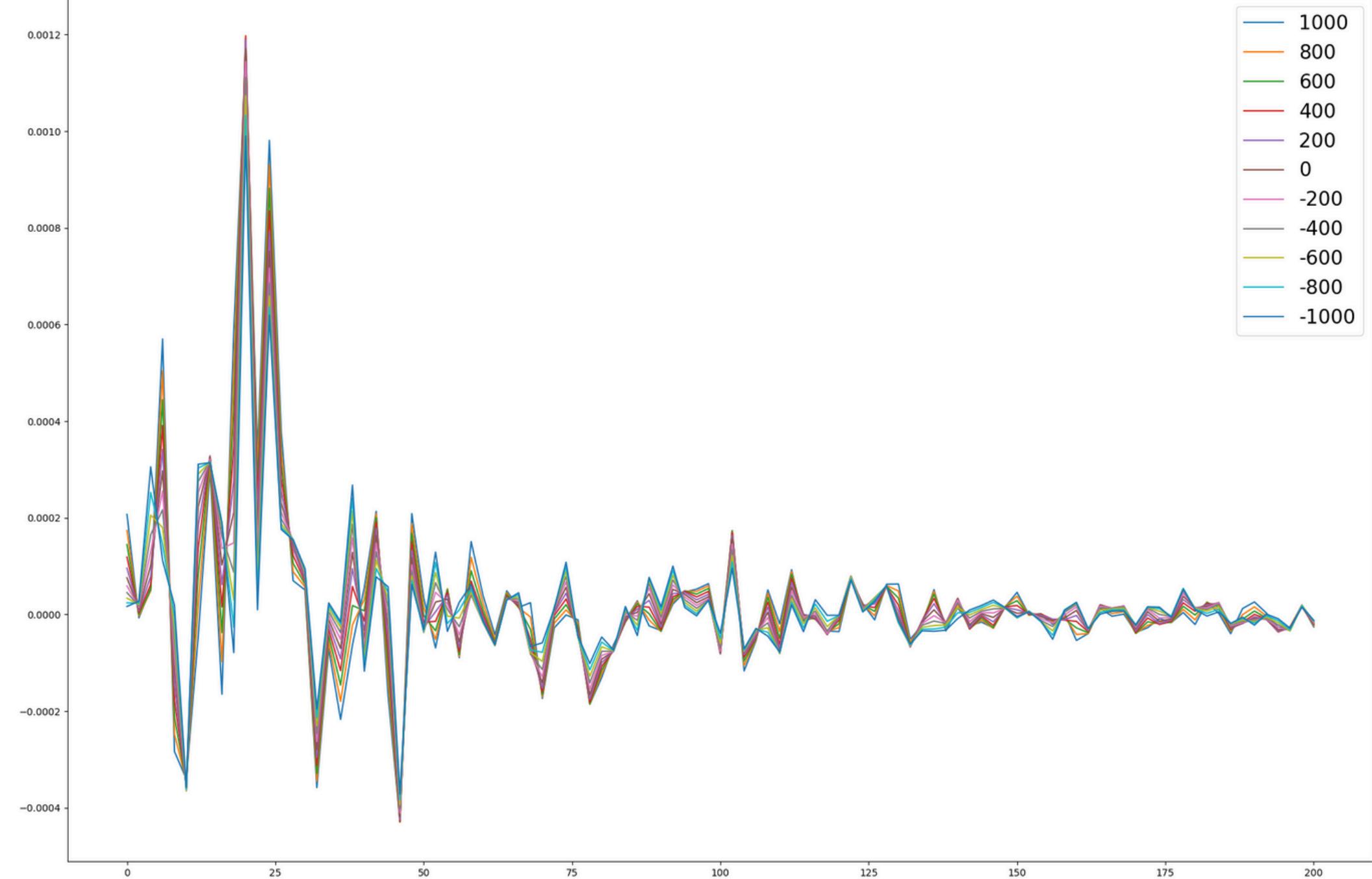


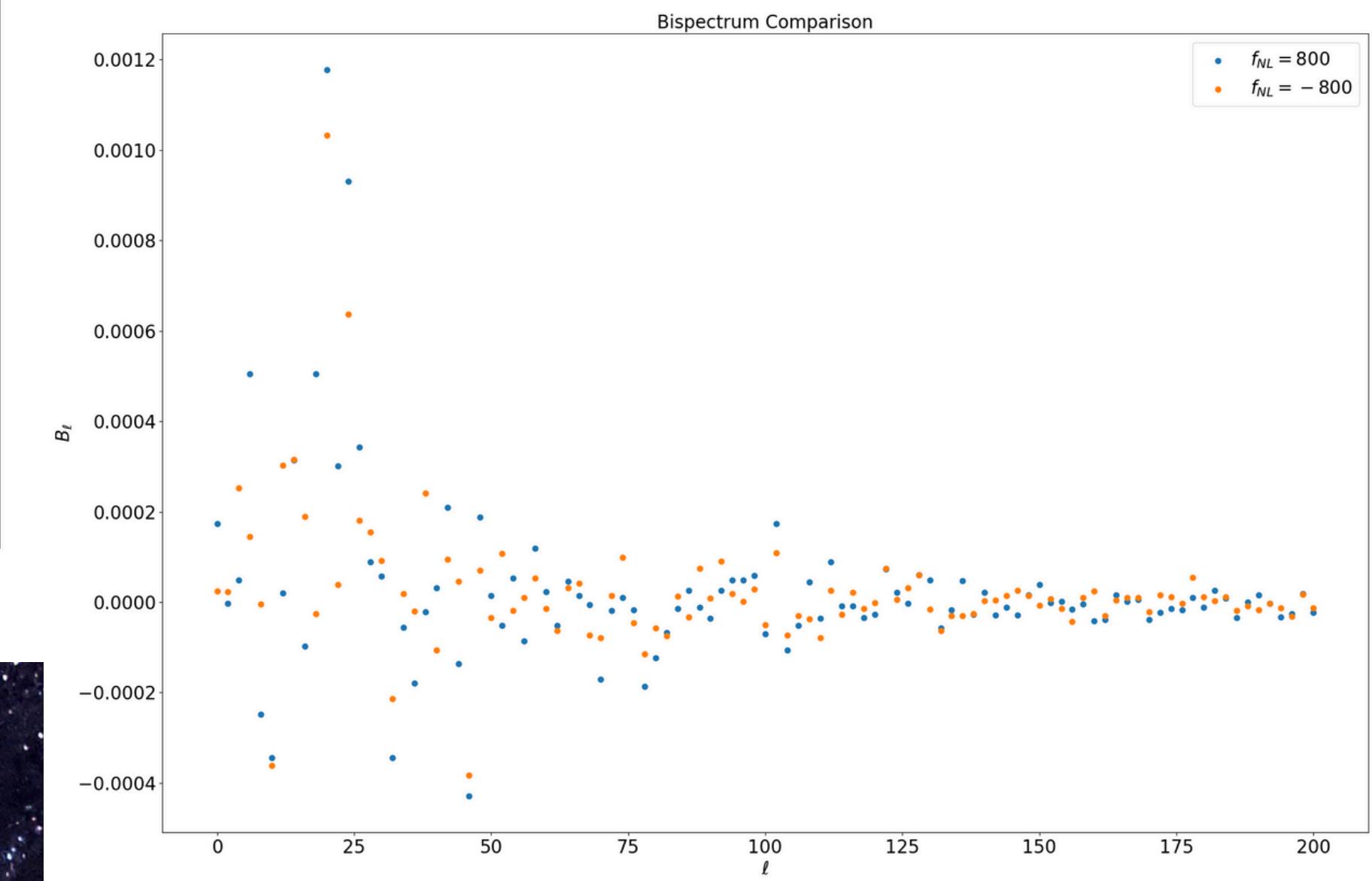
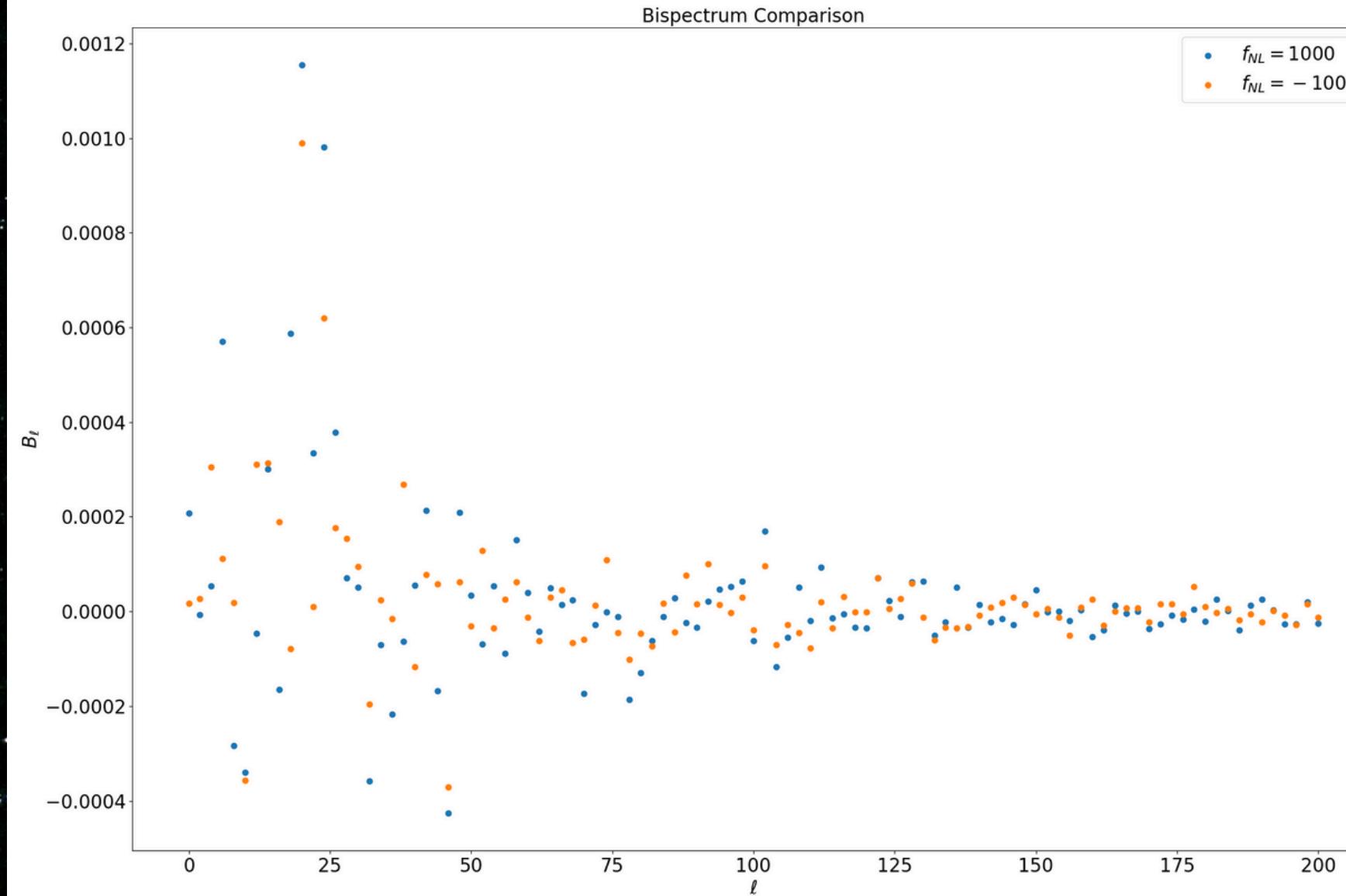
$(x, y, z)$

1 Transform the each pixel position  
in 3D grid position

Power Spectrum from  $f_{NL}$  cubes

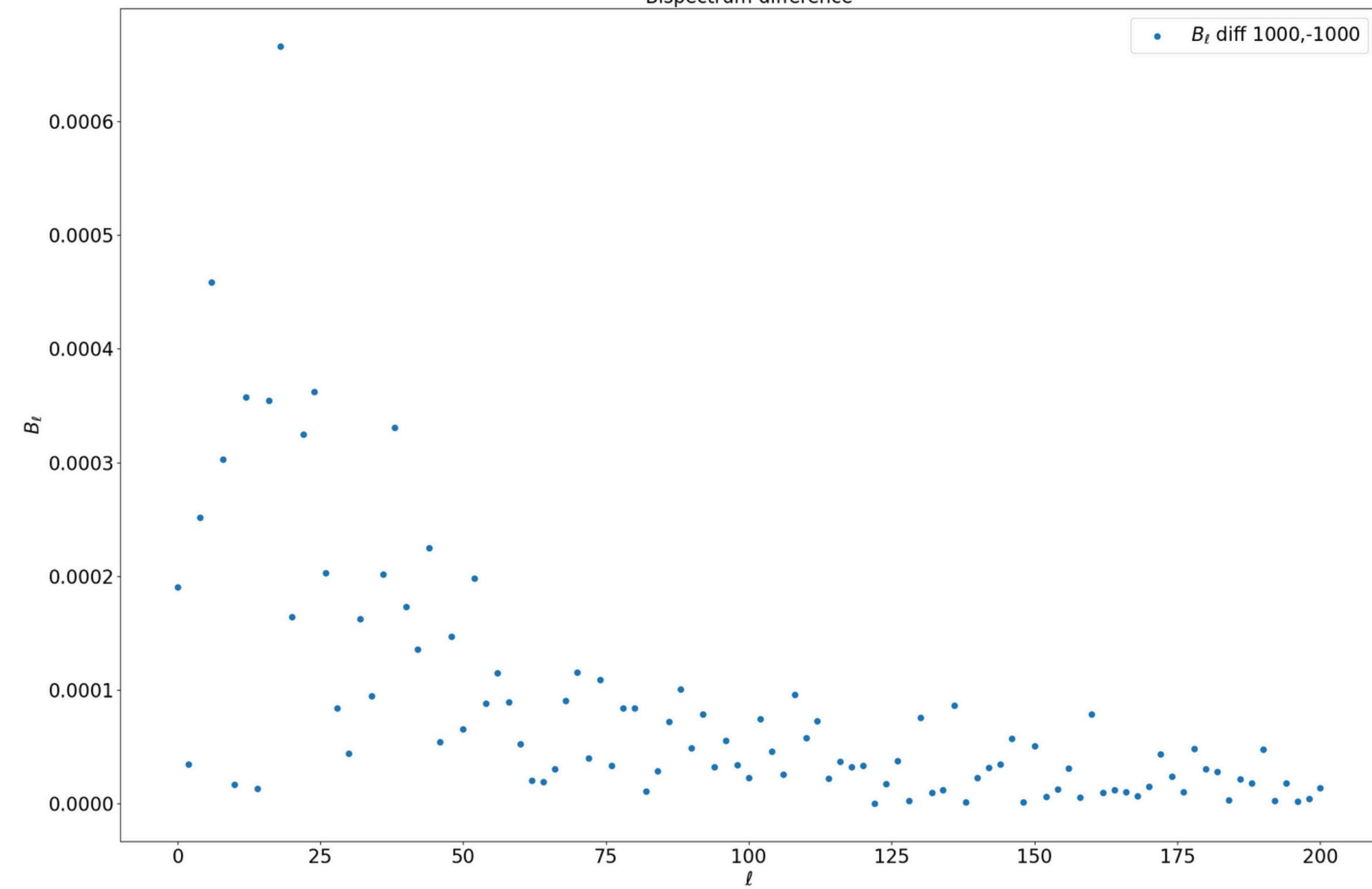


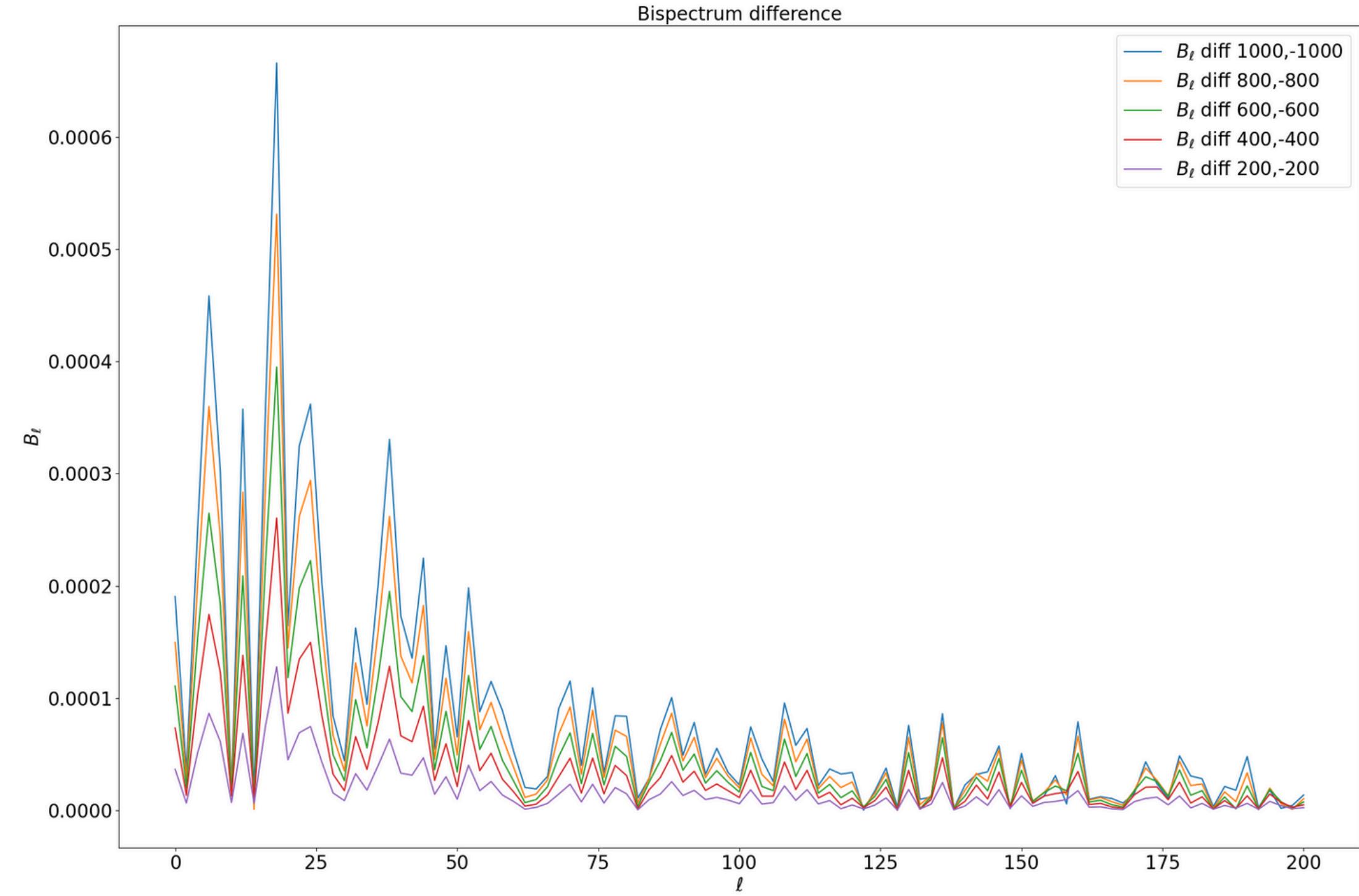
Bispectrum from  $f_{NL}$  cubes



Bispectrum difference

•  $B_\ell$  diff 1000,-1000

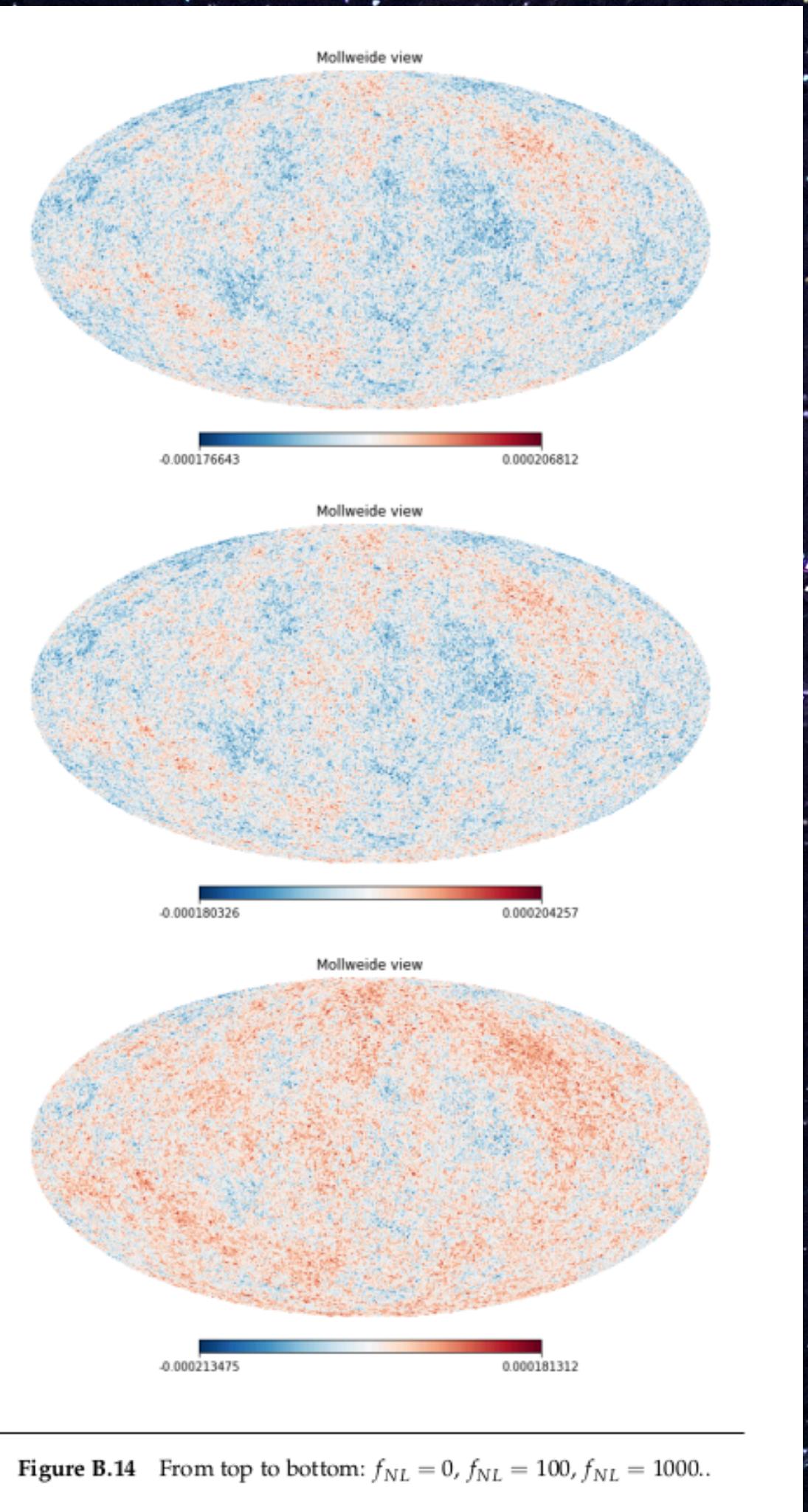




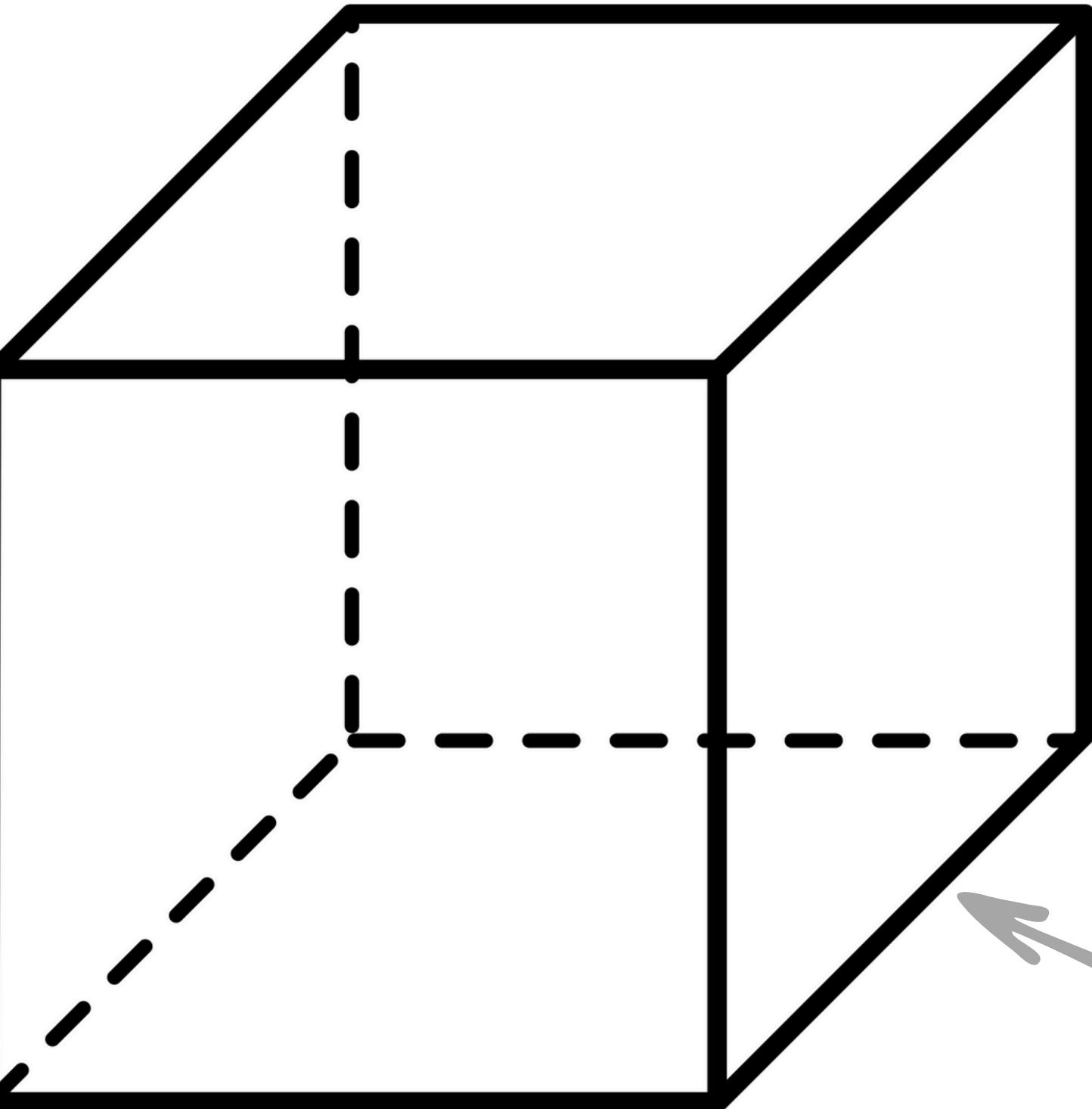
# Next Steps

- Study whether we have a better triangle configuration to calculate the bispectrum.
- Make a statistical analysis from cubes in an equilateral case.

**THANK YOU!**



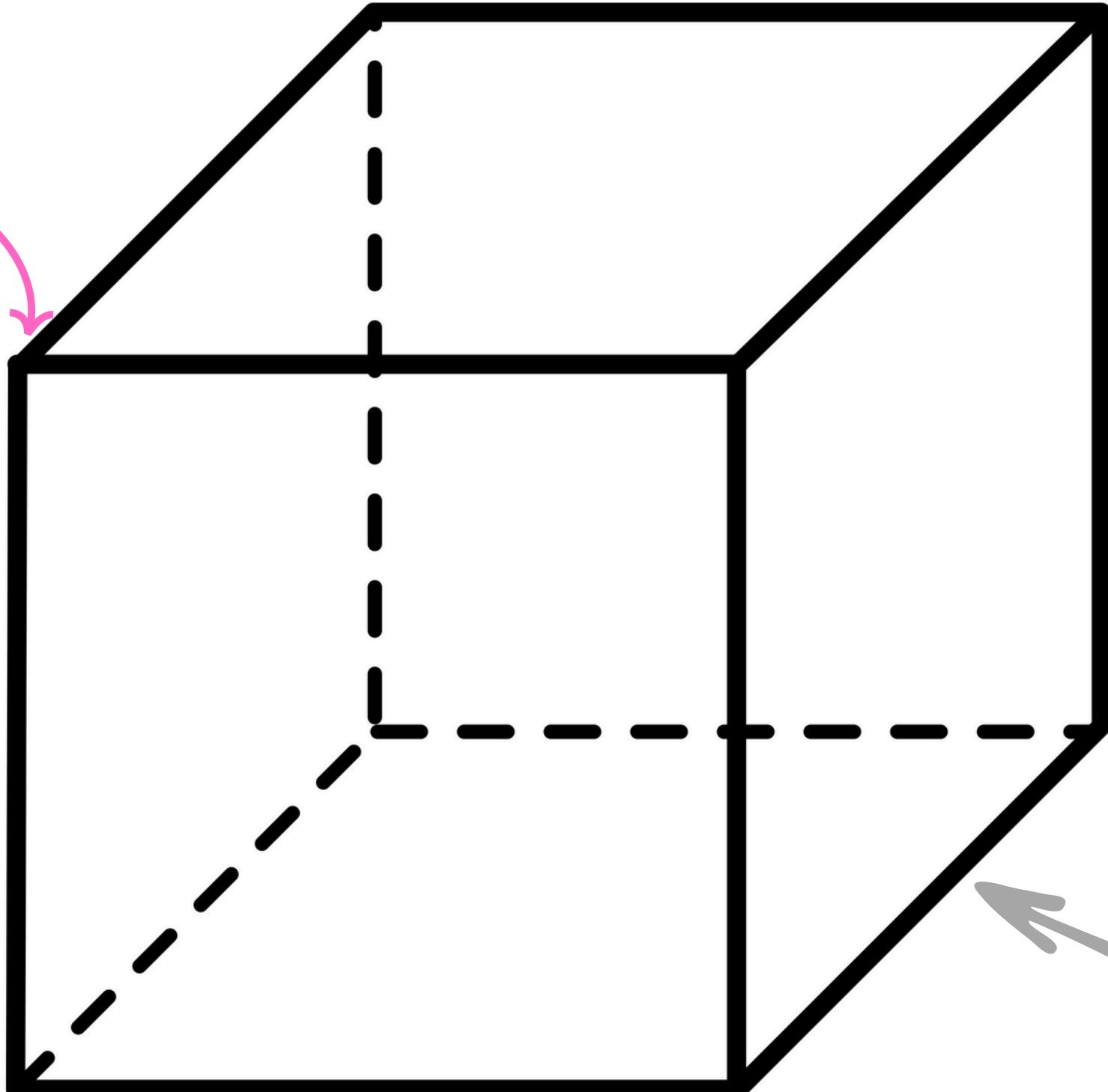
# CIC Method



The Voxel

# CIC Method

The data information is in  
the corners of the voxel

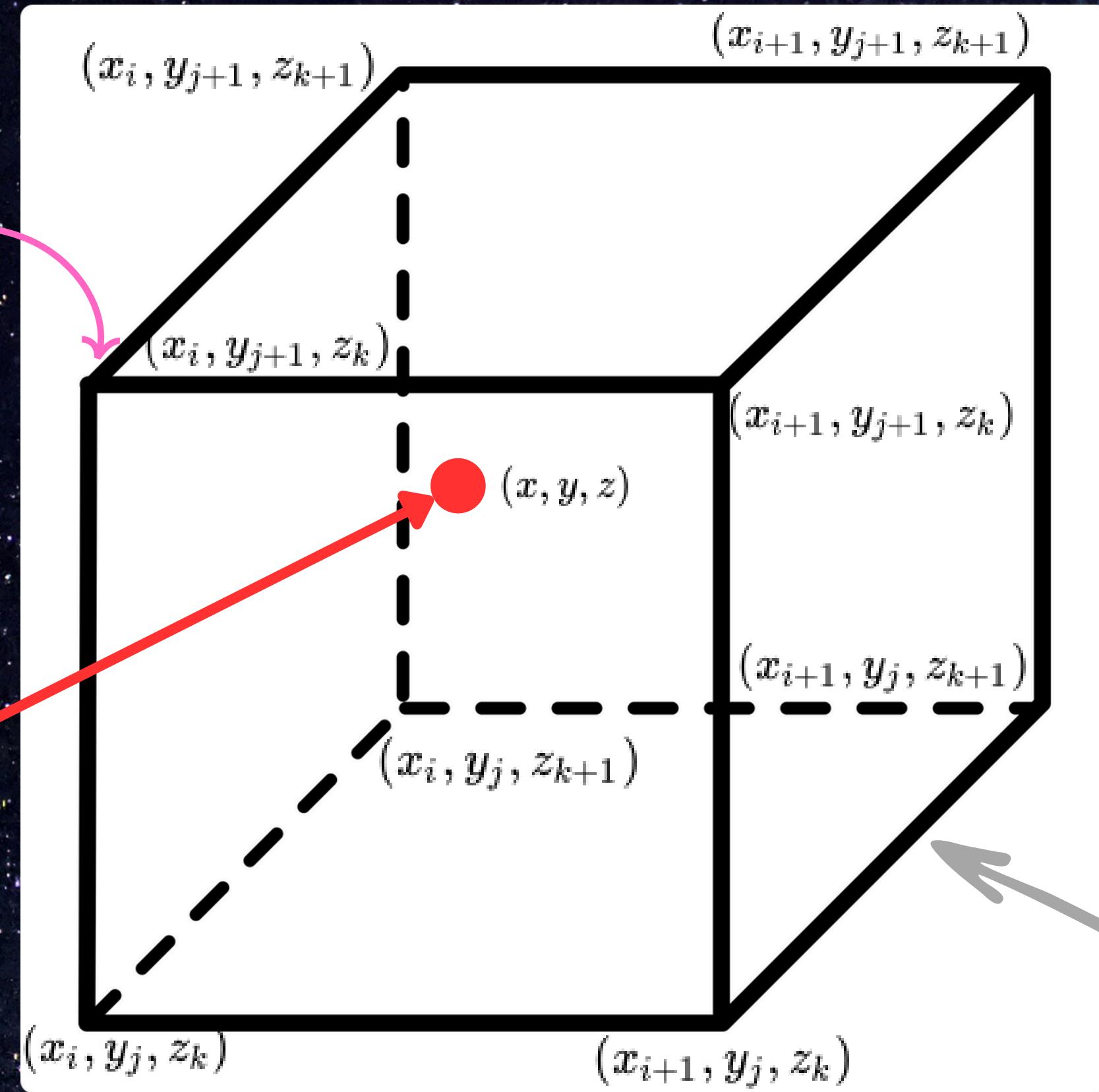


The Voxel

# CIC Method

The data information is in  
the corners of the voxel

Pix position  
a vector in the cube  
(it is inside of a voxel)



The Voxel