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Redshift Space Distortion Effect on Two-point Correlation Function at scales < 50 Mpc/*h*

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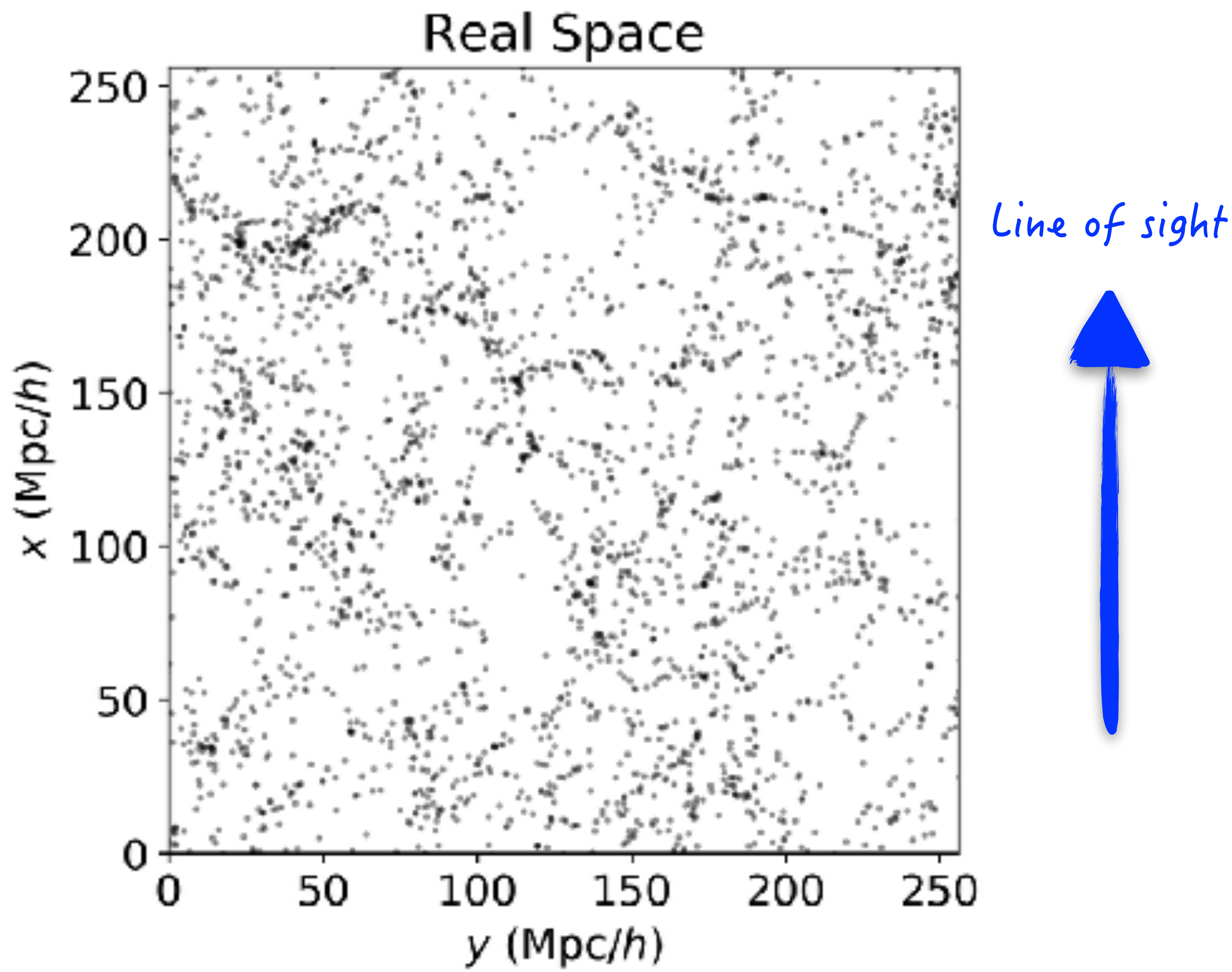
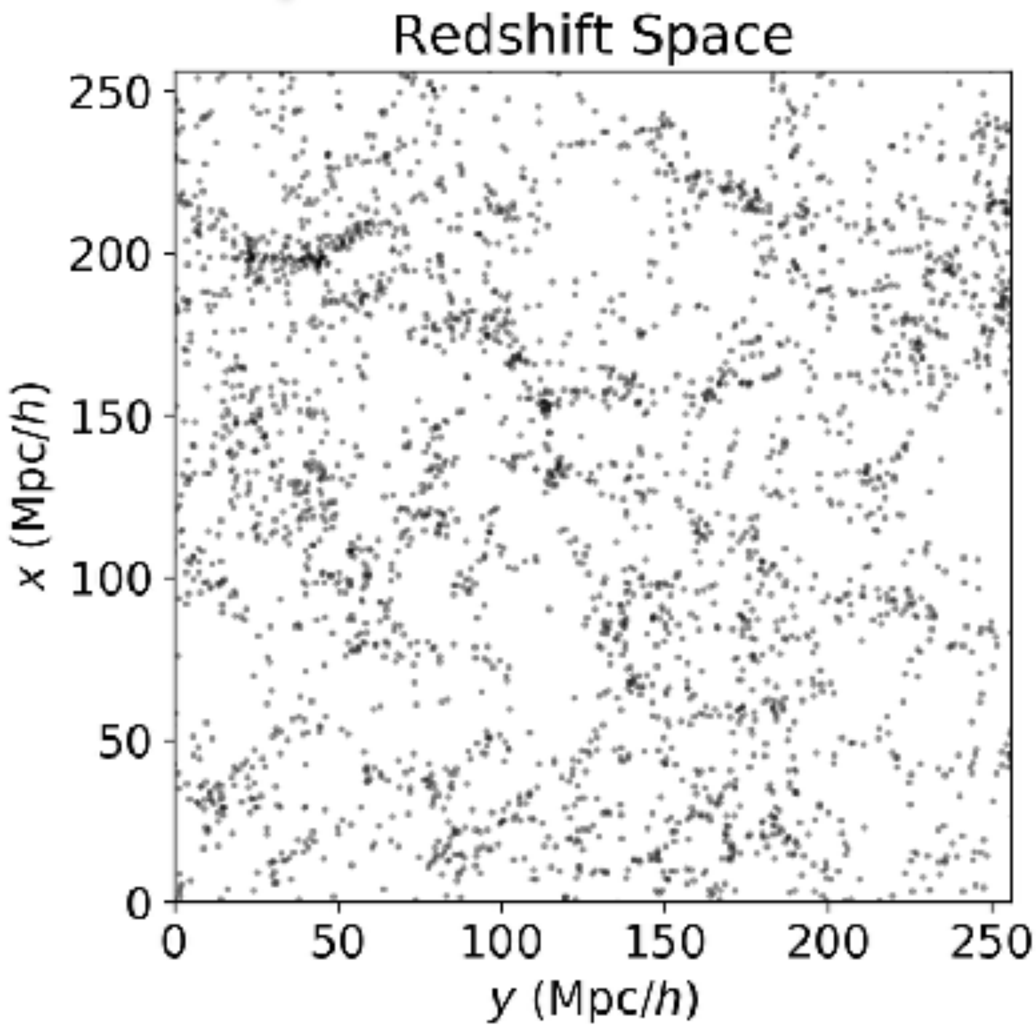
Redshift Space Distortion Effect



Looks more collapsed in the redshift space.

Redshift Space Distortion Effect

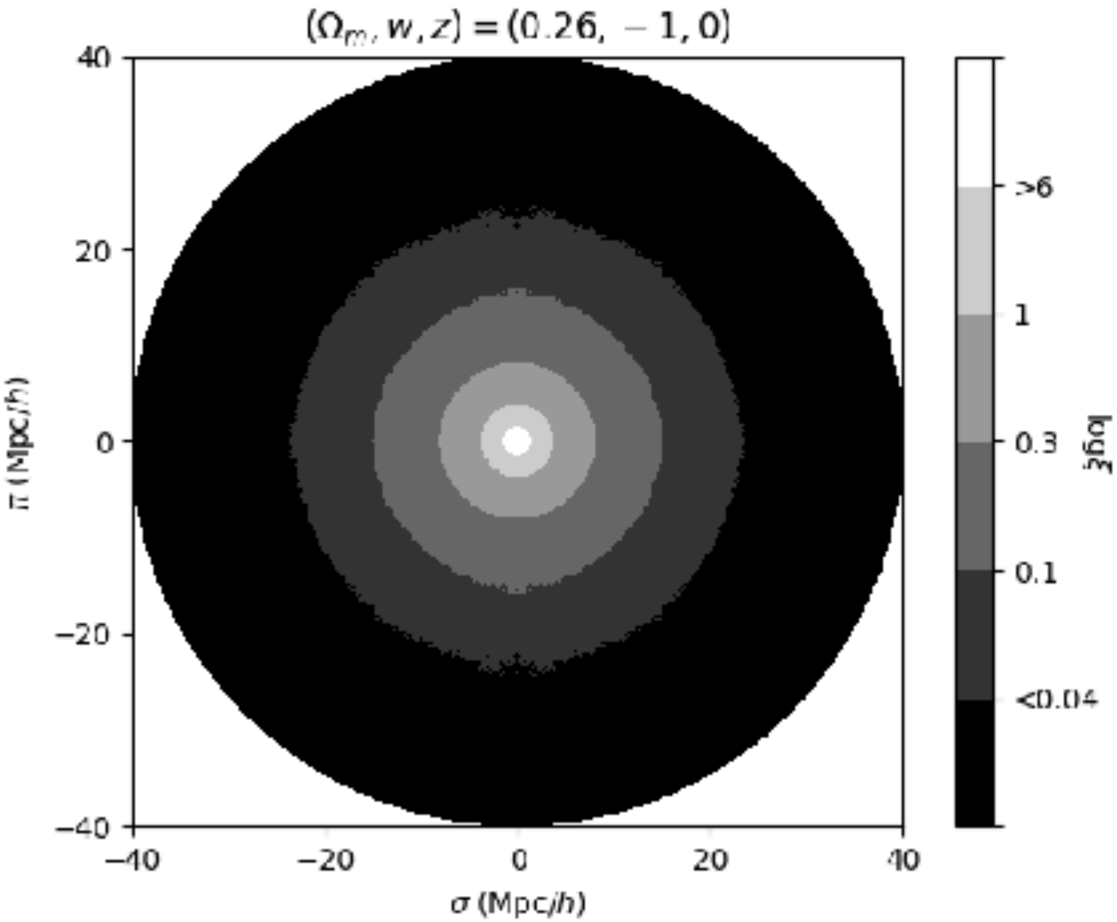


Line of sight

Looks more collapsed in the redshift space.

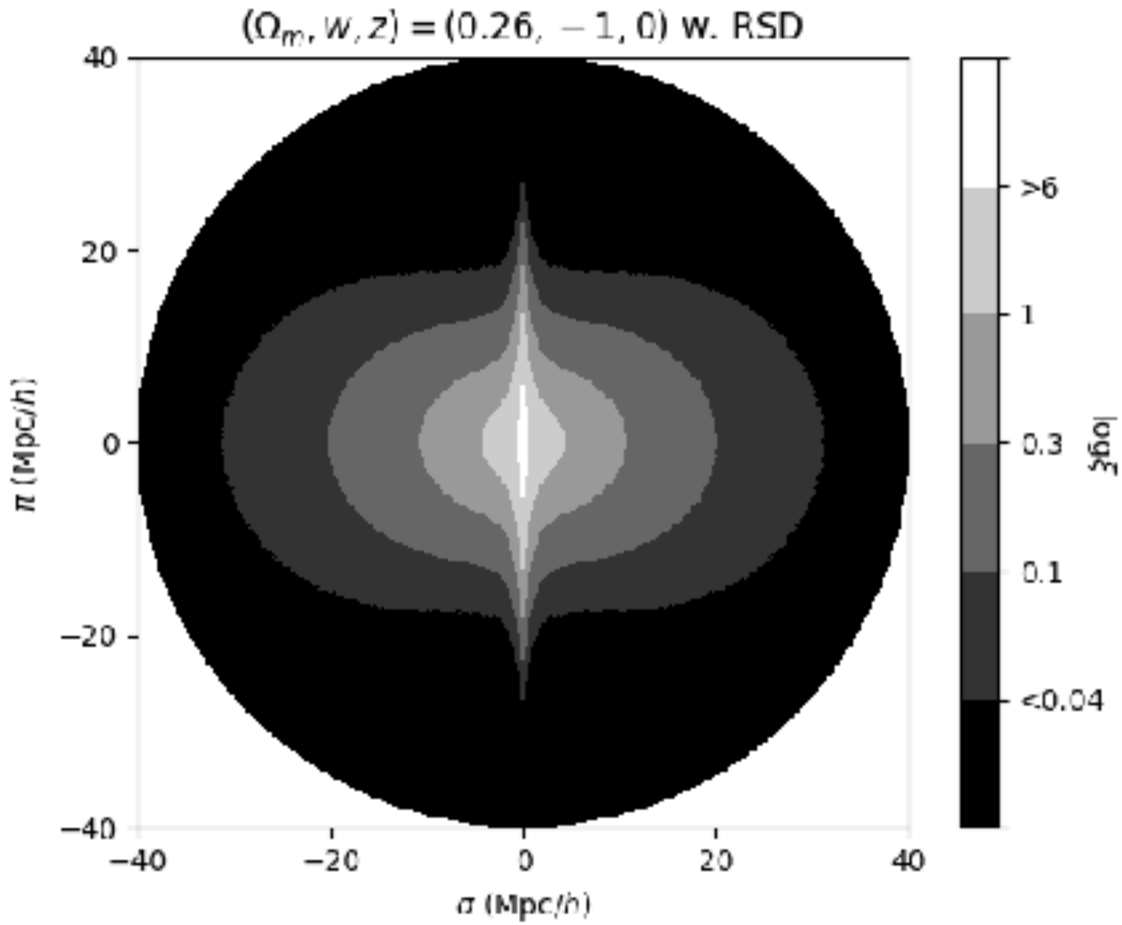
Two-point Correlation in the Real Space

for dark matter



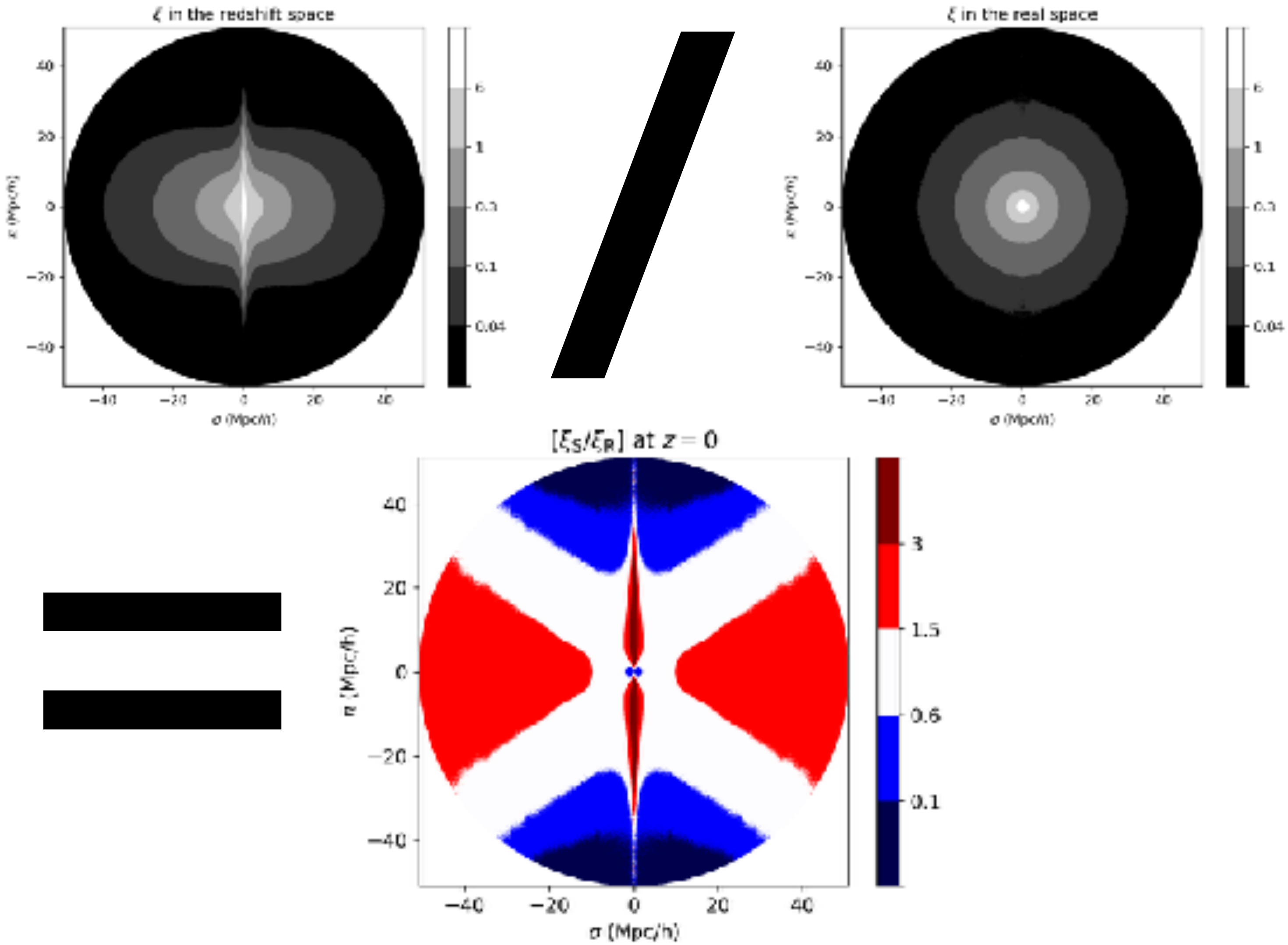
Isotropic and increasing toward low-r

Two-point Correlation in the Redshift Space

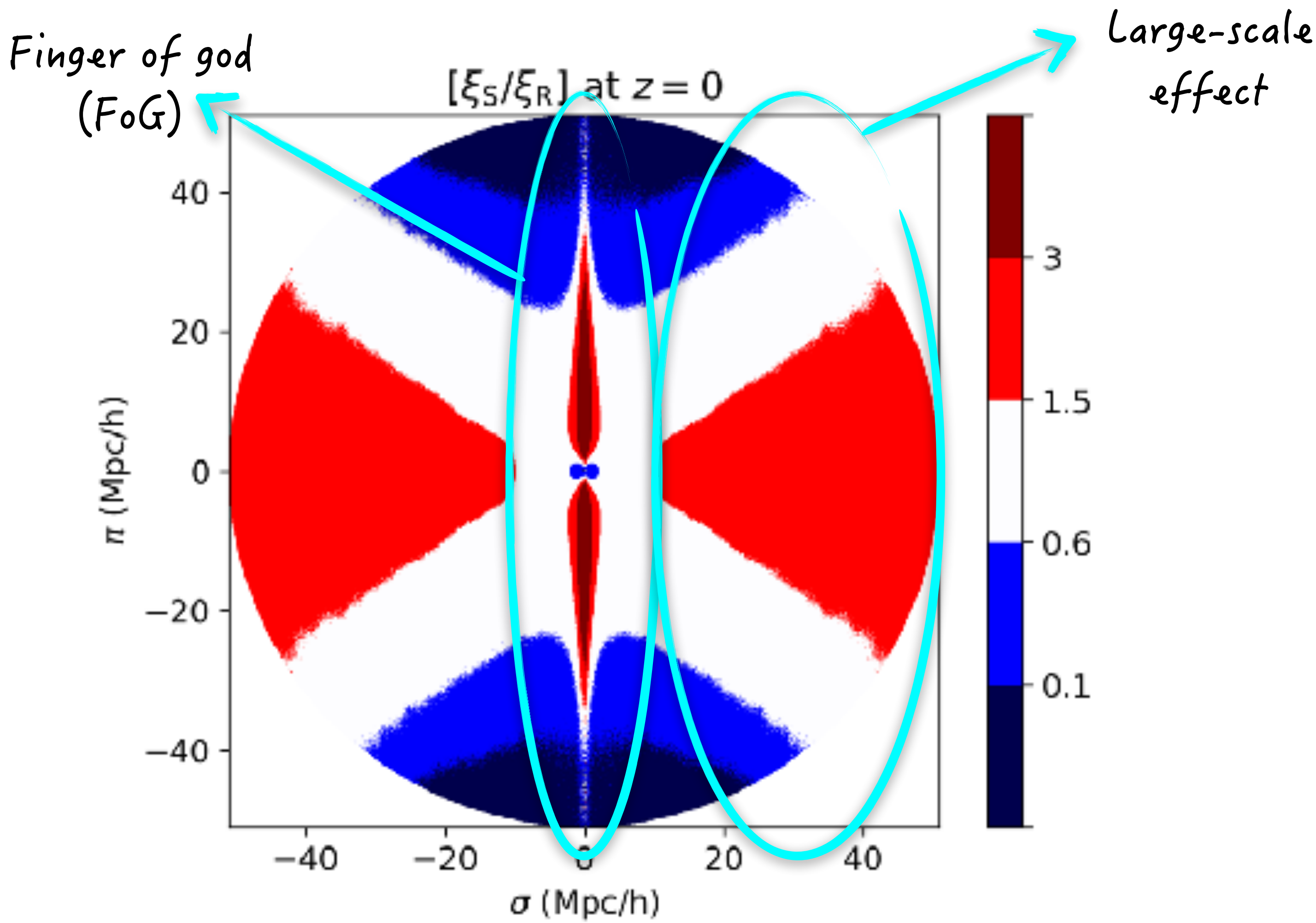


No longer isotropic in redshift space

Focusing on the RSD effect



Focusing on the RSD effect



Ultimately, we want to understand how this distortion changes a function of redshift and cosmology parameters like Ω_m and ω.

1) Kaiser Effect

In Fourier space,

$$\tilde{\delta}_S = (1 + f\mu^2)\tilde{\delta}_R \qquad \begin{matrix}(f \approx \Omega_M^{0.6}) \\ (\mu = \hat{\mathbf{k}} \cdot \hat{\mathbf{n}})\end{matrix}$$

In real space,

$$\xi(\mathbf{r}) = \xi_0(r)P_0(\mu) + \xi_2(r)P_2(\mu) + \xi_4(r)P_4(\mu) \tag{5}$$

with

$$\xi_0(r) = (1 + \tfrac{2}{3}f + \tfrac{1}{5}f^2)\xi(r) \tag{6}$$

$$\xi_2(r) = (\tfrac{4}{3}f + \tfrac{4}{7}f^2)[\xi(r) - \bar{\xi}(r)] \tag{7}$$

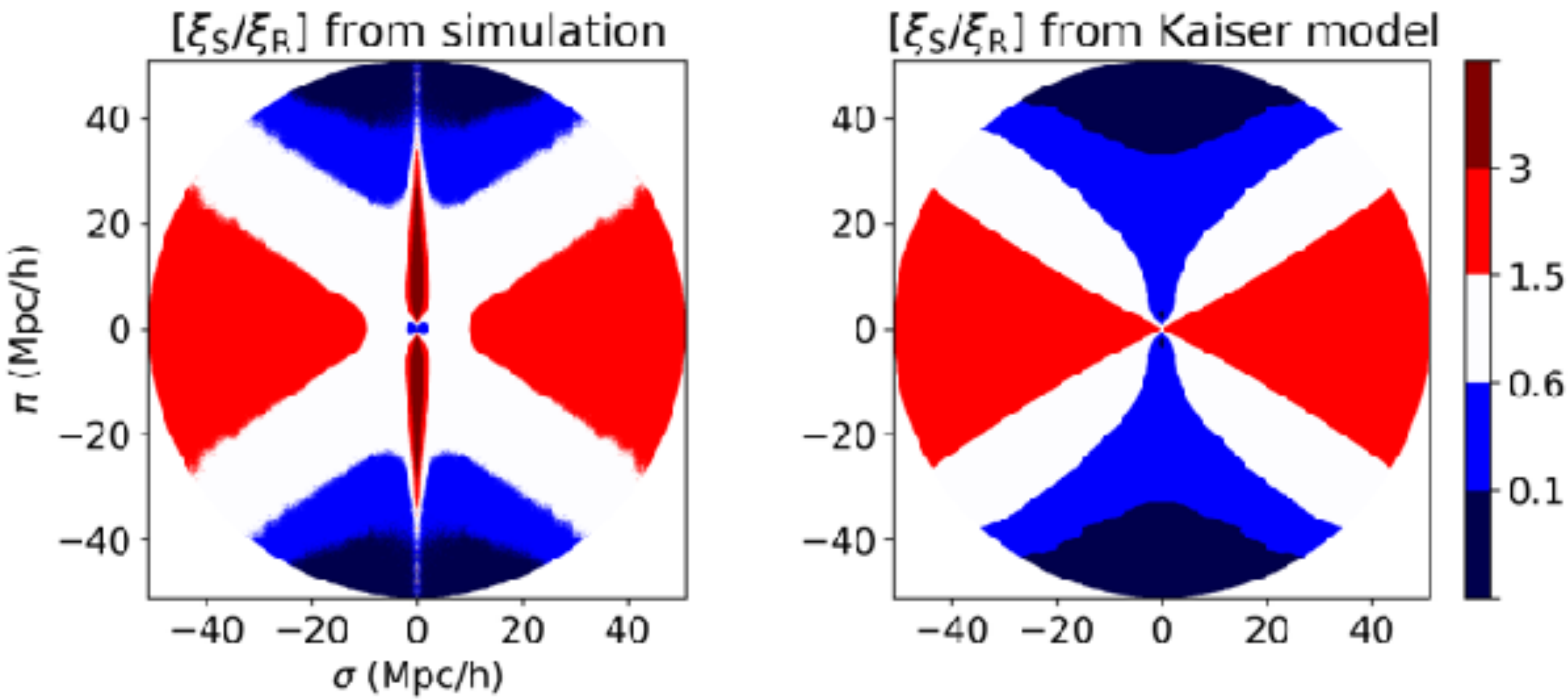
$$\xi_4(r) = \tfrac{8}{35}f^2[\xi(r) + \tfrac{5}{2}\bar{\xi}(r) - \tfrac{7}{2}\bar{\bar{\xi}}(r)] \,. \tag{8}$$

Here $\mu = \hat{r} \cdot \hat{z}$ is the cosine of the angle, now in real space, between the pair separation r and the line of sight z, the $P_l(\mu)$ are Legendre polynomials $[P_0 = 1,\ P_2 = (3\mu^2 - 1)/2,\ P_4 = (35\mu^4 - 30\mu^2 + 3)/8]$, and

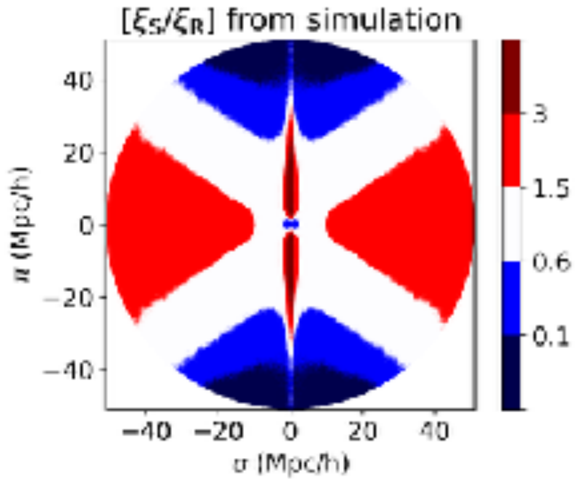
$$\bar{\xi}(r) \equiv 3r^{-3}\int_0^r \xi(s)s^2\,ds \quad \text{and} \quad \bar{\bar{\xi}}(r) \equiv 5r^{-5}\int_0^r \xi(s)s^4\,ds \,. \tag{9}$$

(Hamilton 1992)

1) Kaiser Effect



1) Kaiser Effect



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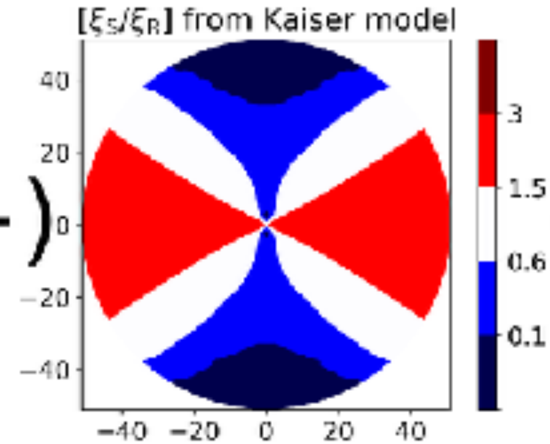

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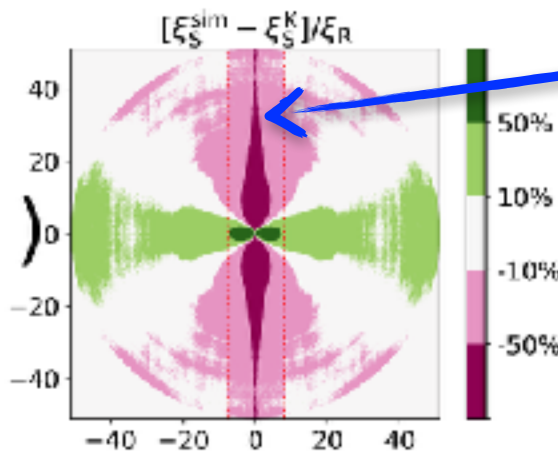
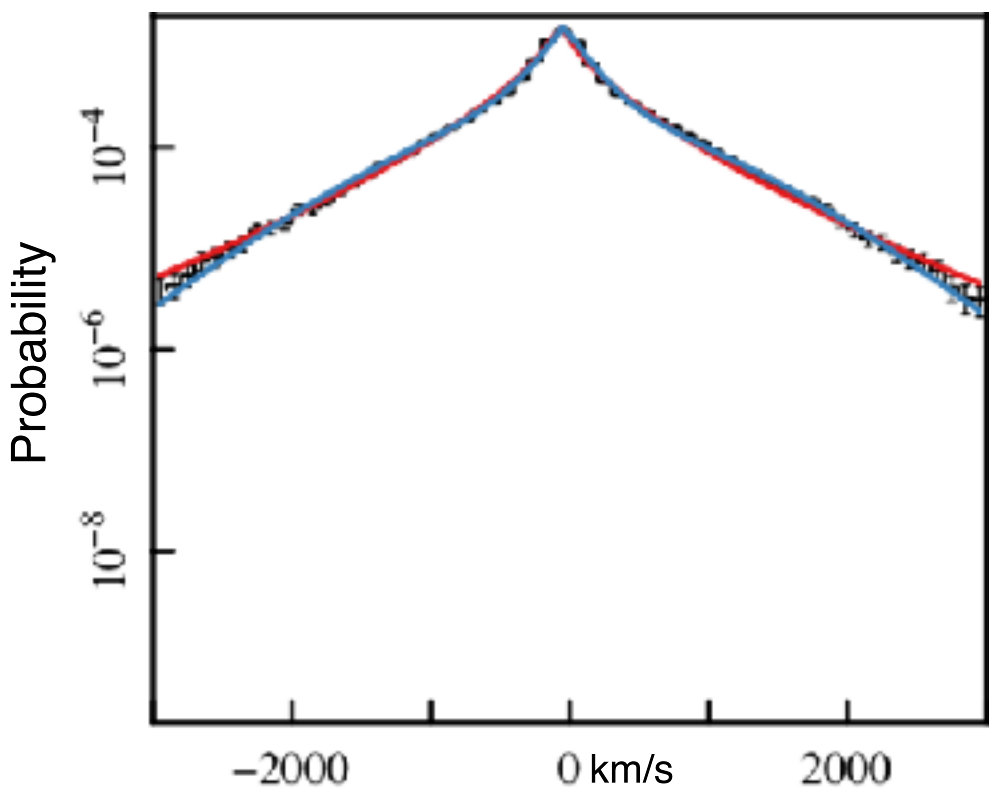


Let's forget about σ < 8 Mpc/h that is dominated by the FoG effect.

Accuracy at σ > 8 Mpc/*h* : > 10 % error

Scatter in the pairwise peculiar velocity



The relative velocity between a galaxy pair has a certain statistical scatter.

2) Kaiser + Gaussian Dispersion

- Why should there be a gaussian scatter?

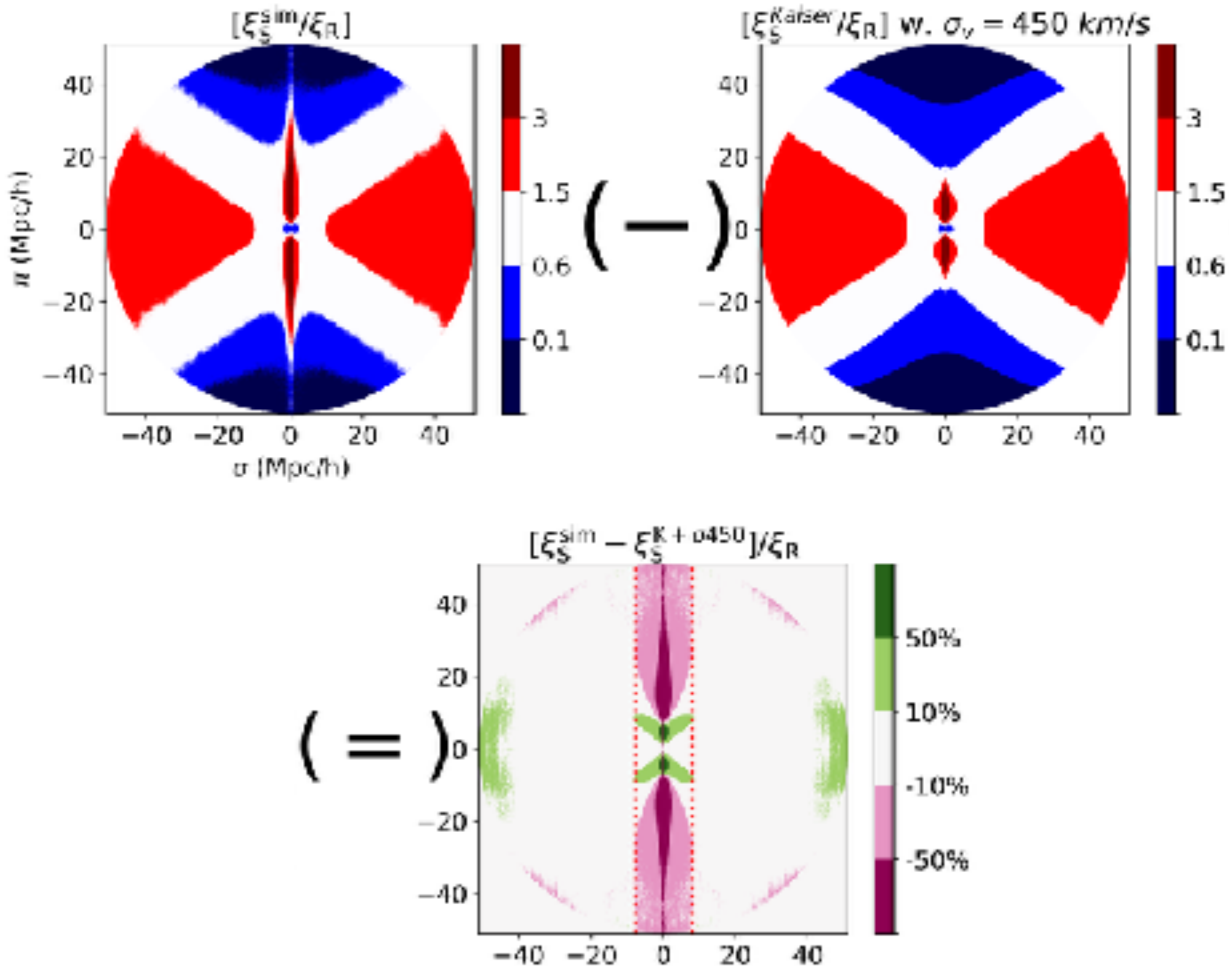
  - Random thermal motion inside clusters/ groups

  - Combination of gravitational motions from two separate modes

$$\xi_{\rm S}(\sigma,\pi) = \int \xi_{\rm S}^{K}(\sigma, \pi + v_{||}/H) f(v_{||}) dv_{||}$$

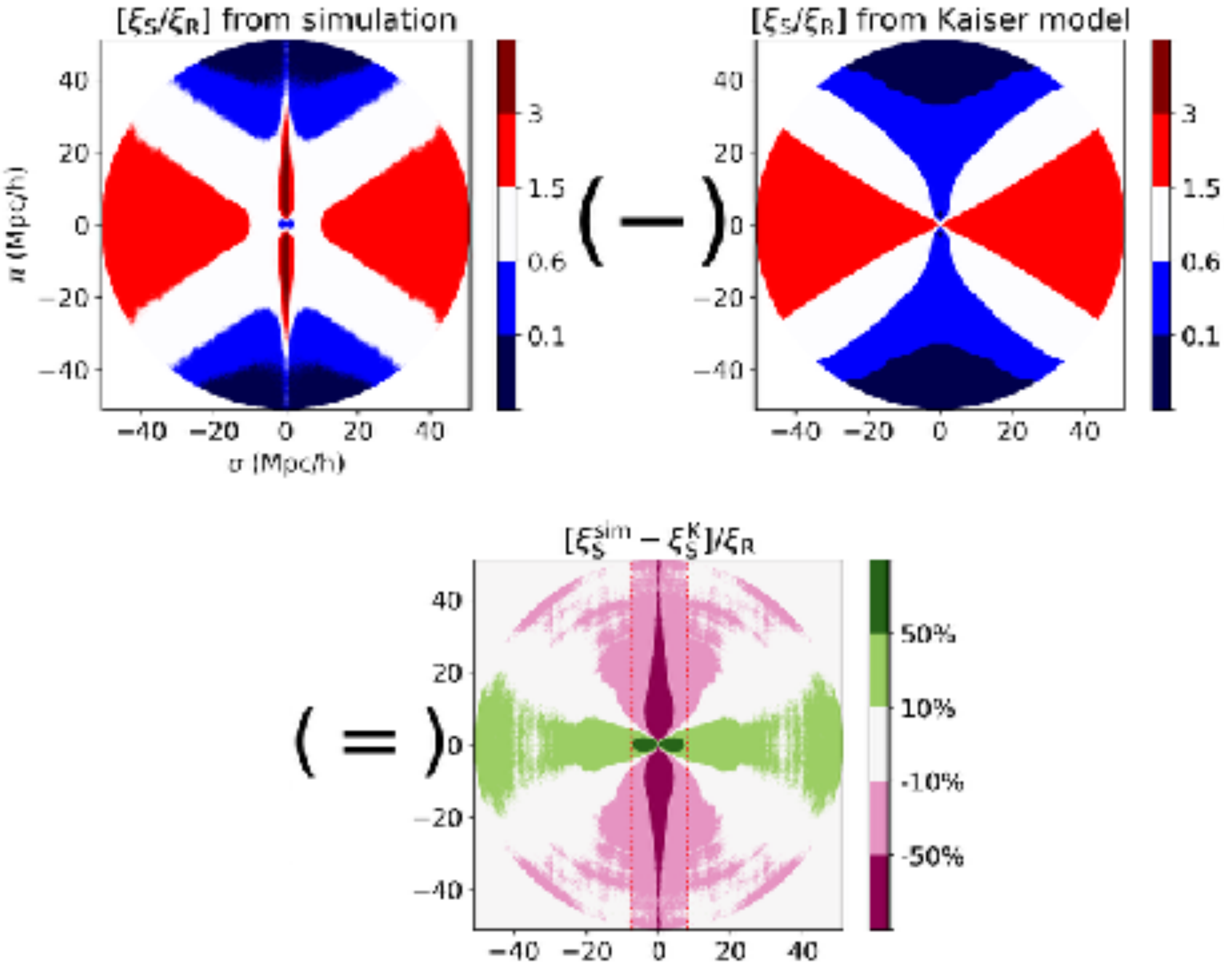
where, $f(v_{||}) \propto e^{-v_{||}^2/2\sigma_v^2}$

2) Kaiser + Gaussian Dispersion



Accuracy: ~ 10 % error

1) Kaiser Effect



Accuracy: > 10 % error

3) Kaiser + Gaussian Dispersion as a function of separation

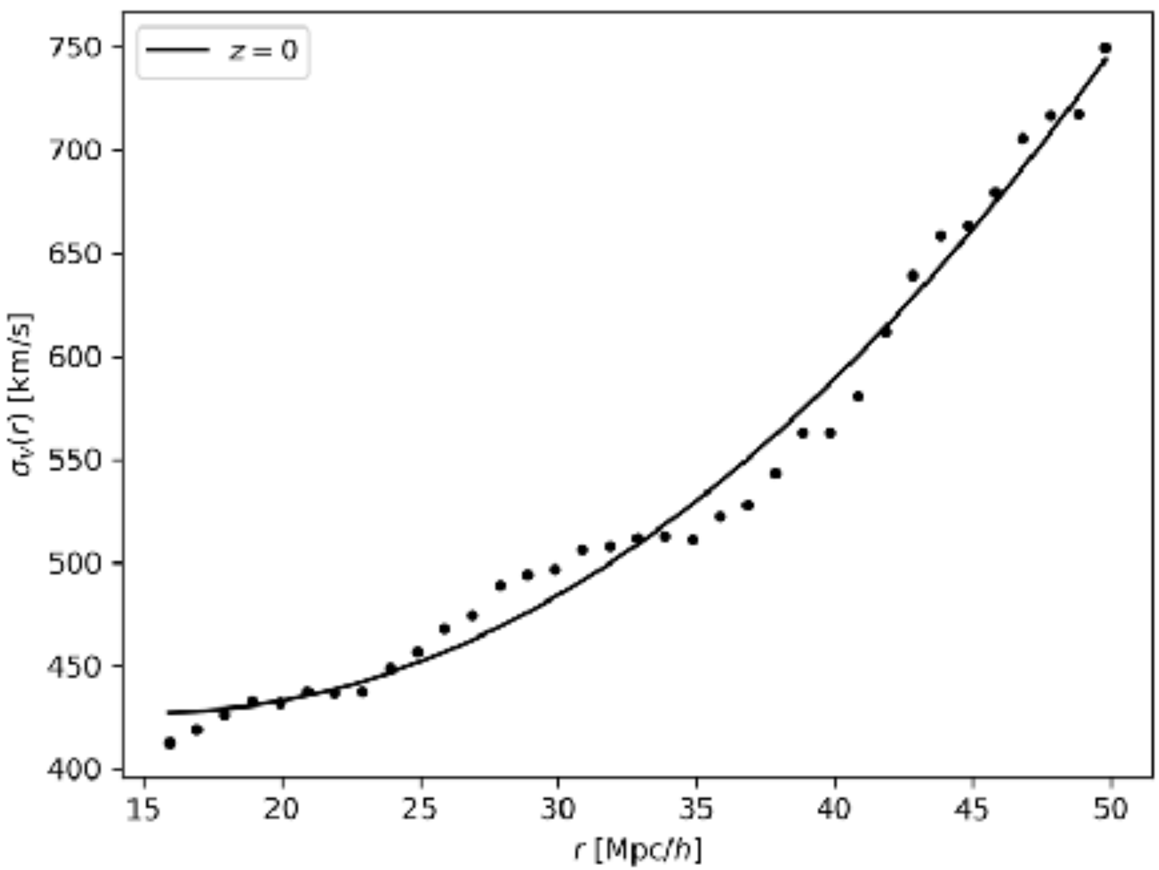
- Is the gaussian dispersion really constant?

  - For the thermal motion inside clusters, it should be constant.

  - For the gravitational motions from separate modes, it should be larger for larger separation.

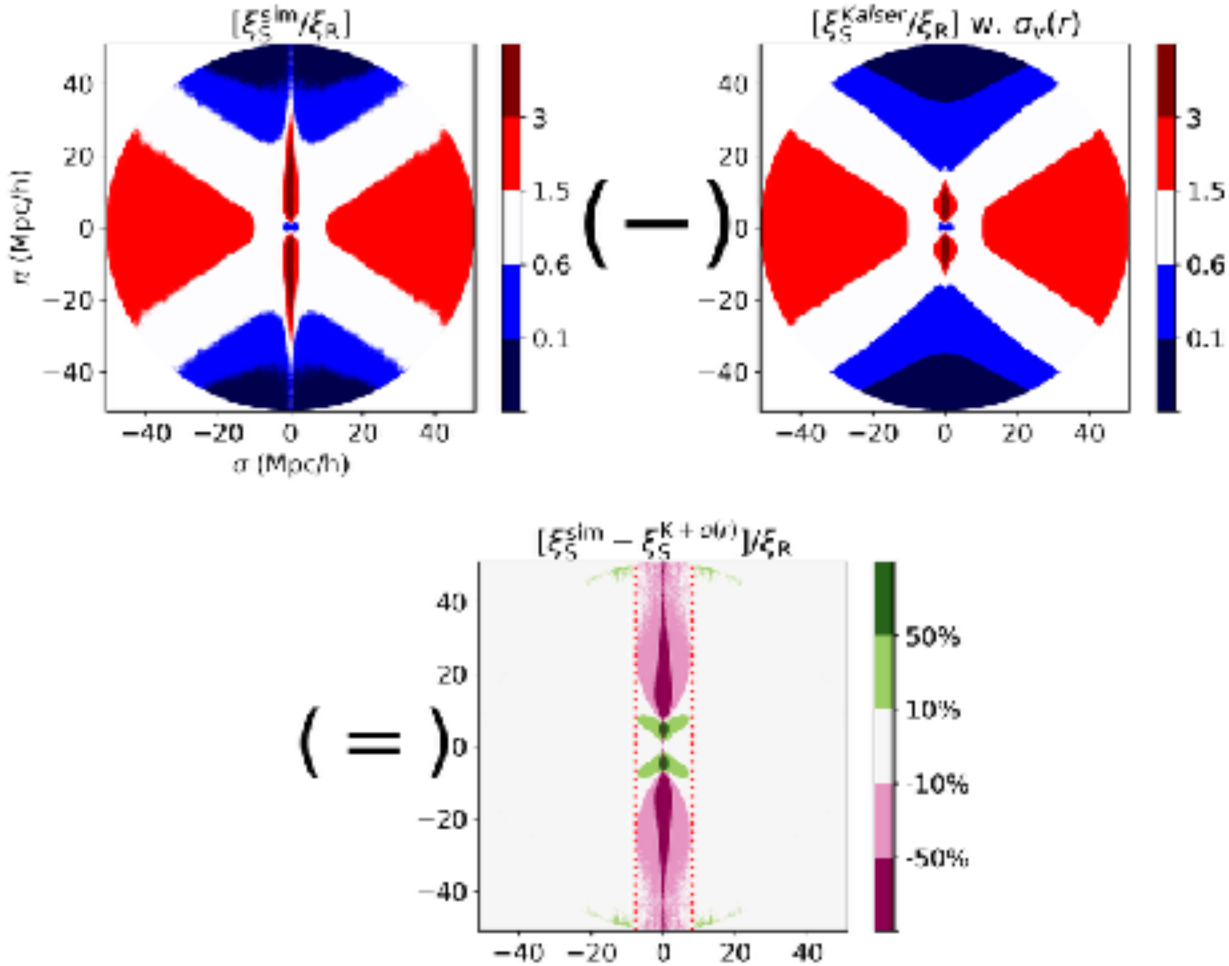
3) Kaiser + Gaussian Dispersion as a function of separation

We searched for σ_v^2 at each r that best fits the 2pCF …



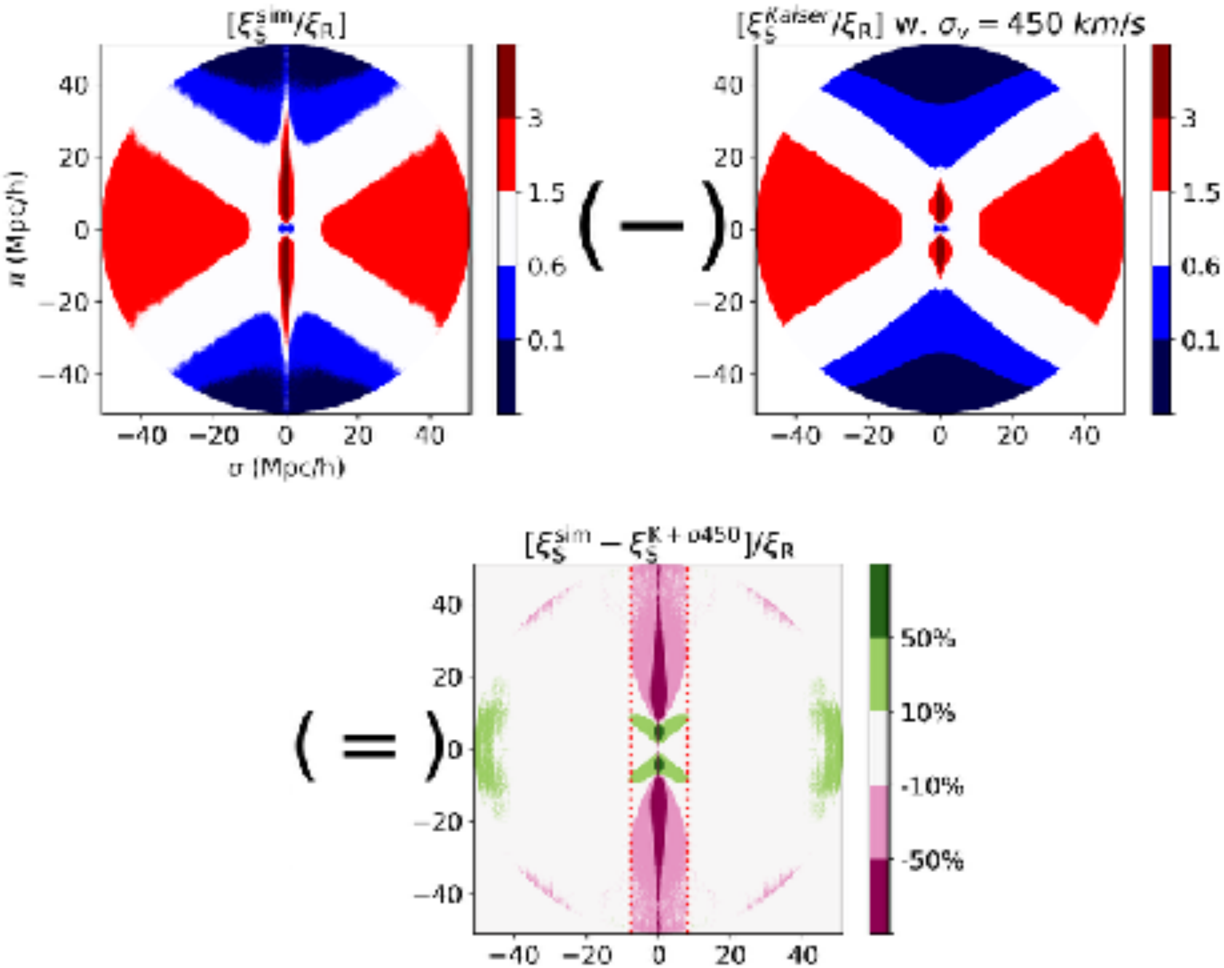
… and it increase as a function of r !

3) Kaiser + Gaussian Dispersion as a function of separation



Accuracy: < 10 % error

2) Kaiser + Gaussian Dispersion



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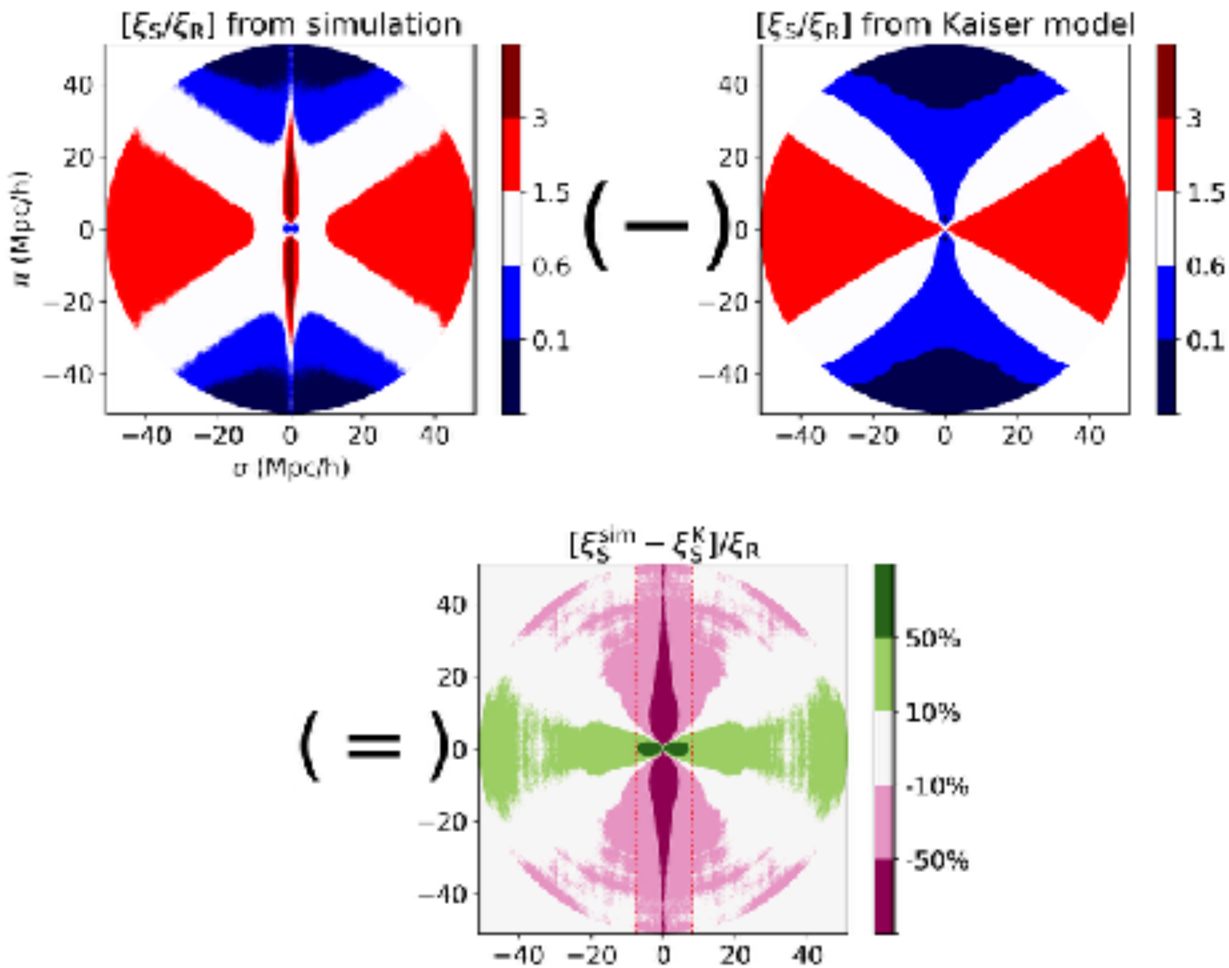
1) Kaiser Effect



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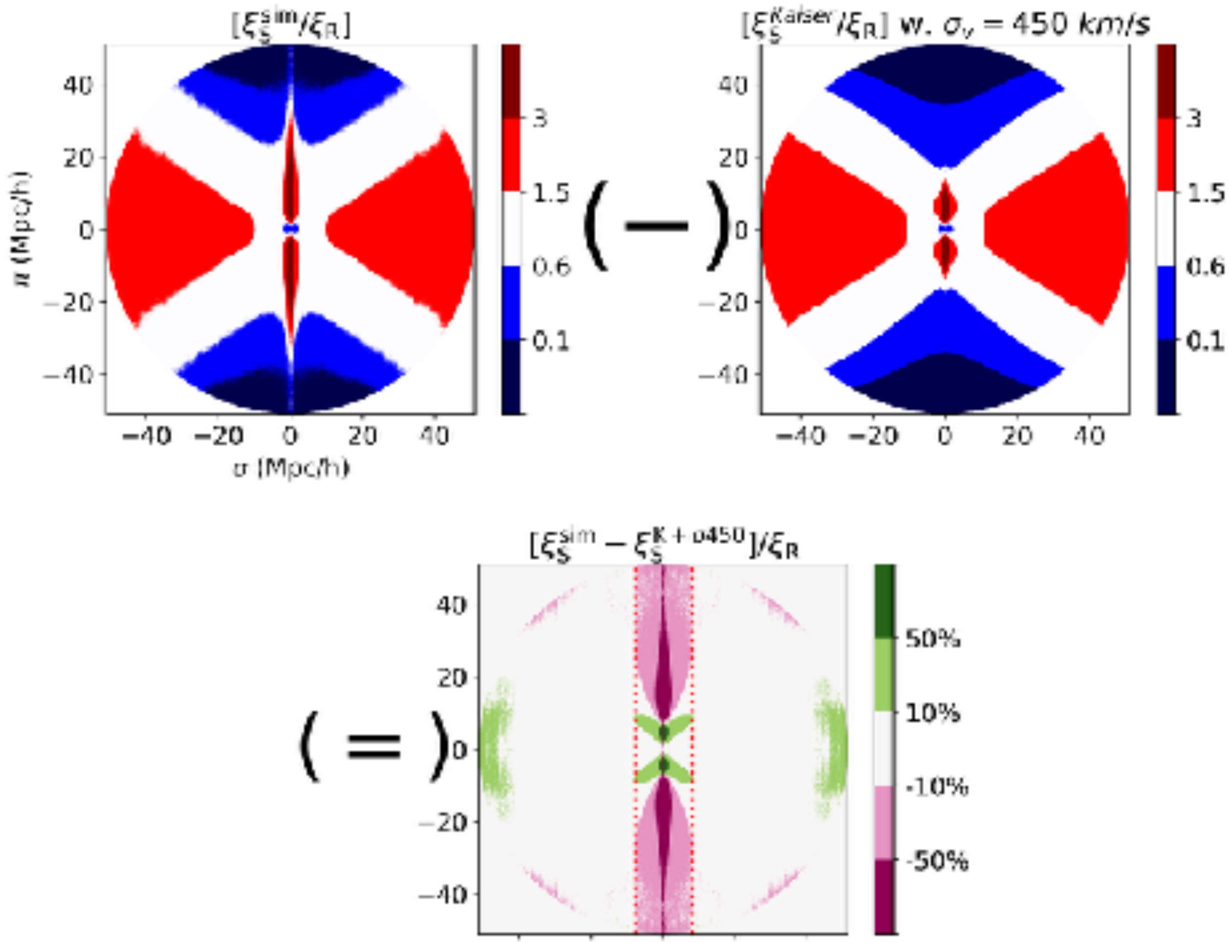

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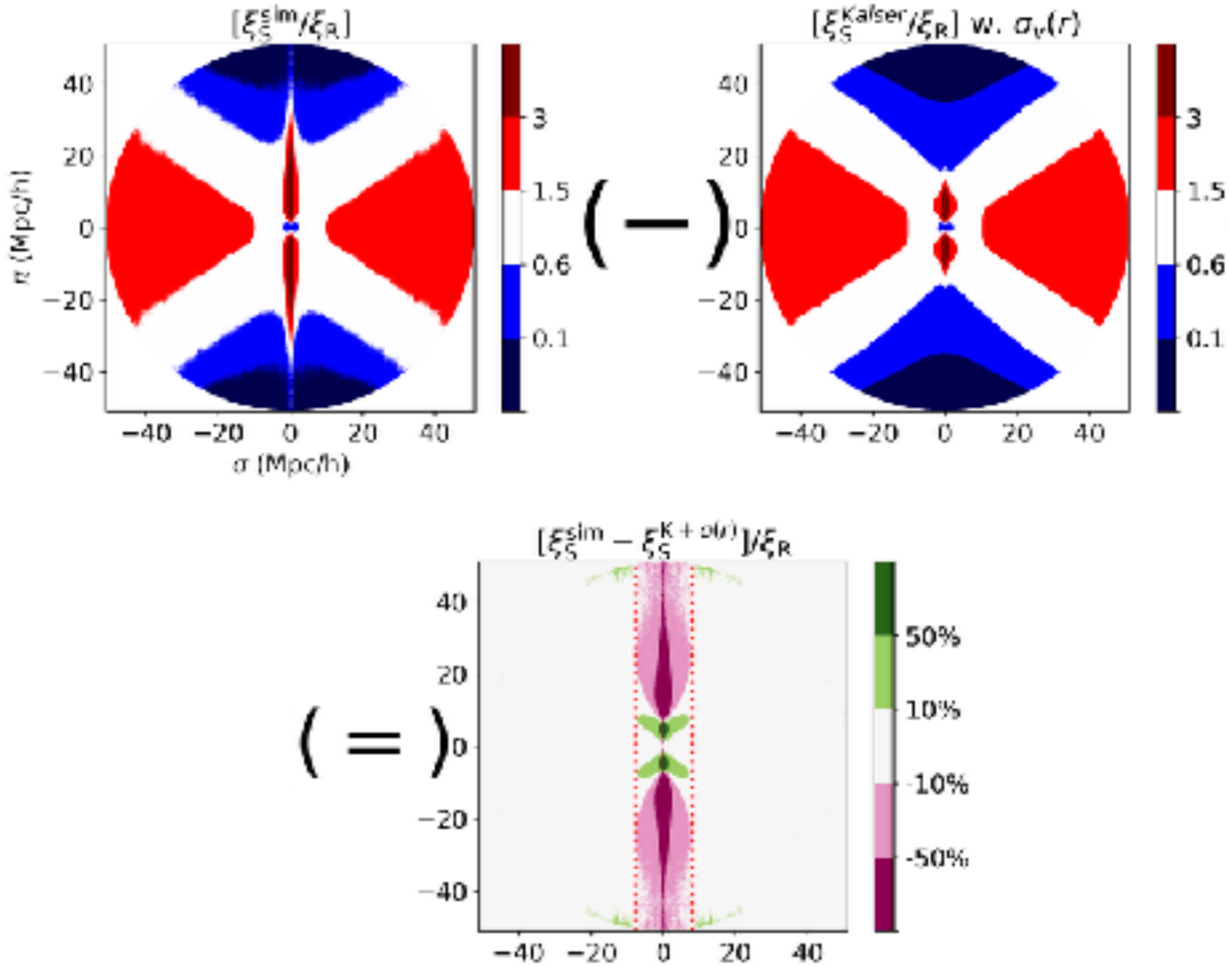
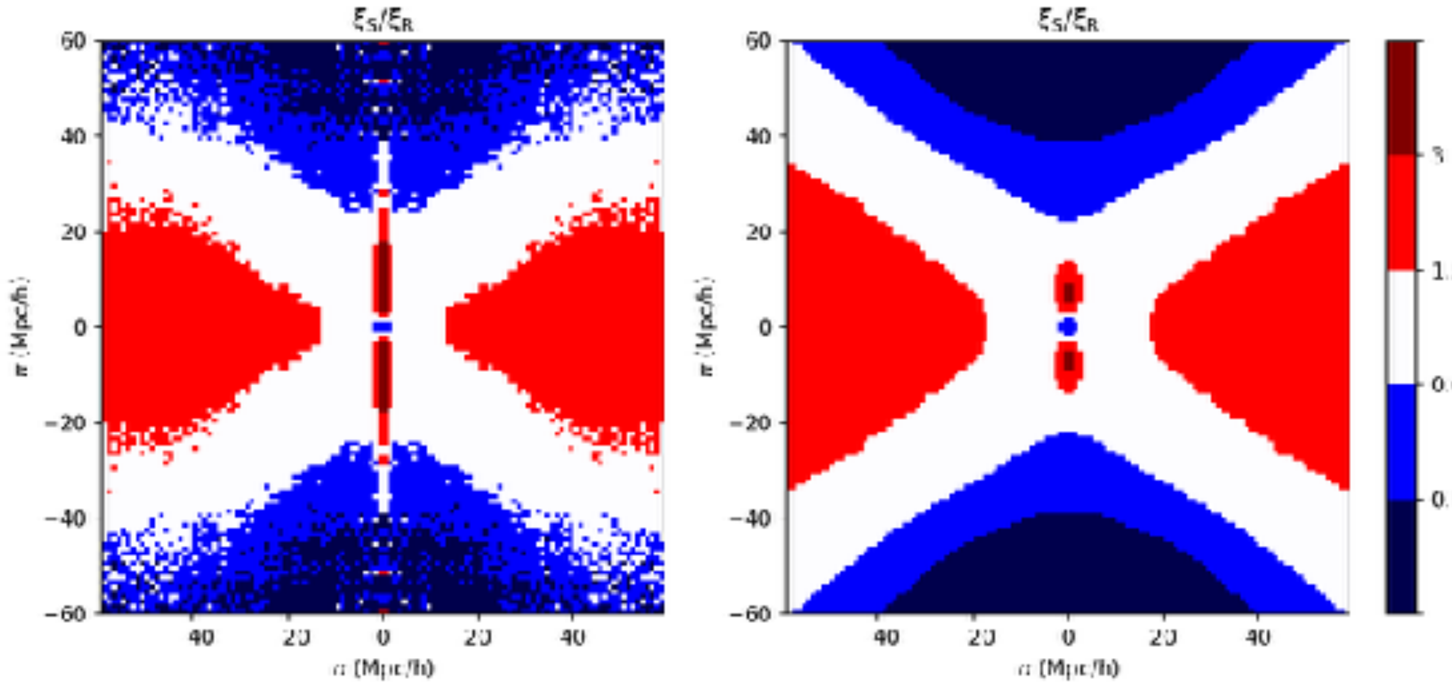
3) Kaiser + Gaussian Dispersion as a function of separation



Accuracy: < 10 % error

4) Halo 2pCF Modeling

Simulation **Kaiser + Gaussian disp.**



This will be the next task to do.

Summary

- Adding a gaussian dispersion to the Kaiser effect models the 2pCF quite accurately at $\sigma > 8$ Mpc/*h*.
- The accuracy improves even more (below 10%) when we fit the Gaussian dispersion to be a function of separation.
- We shall extend the model to the halo 2pCF.
- We shall extend the model to include redshift and cosmology parameter dependence.