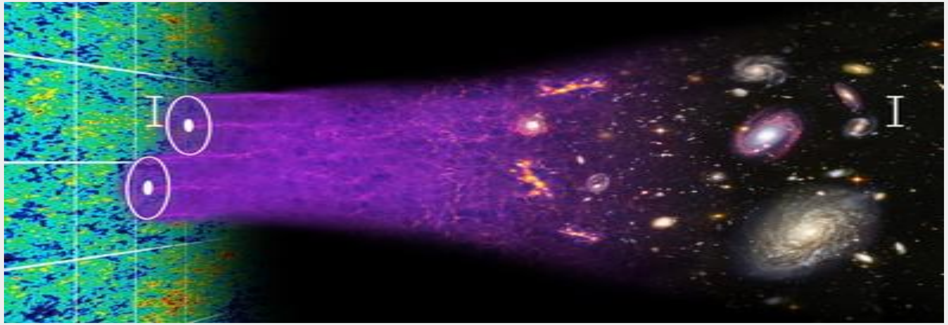
A Model for the Redshift-Space Galaxy 4-Point Correlation Function



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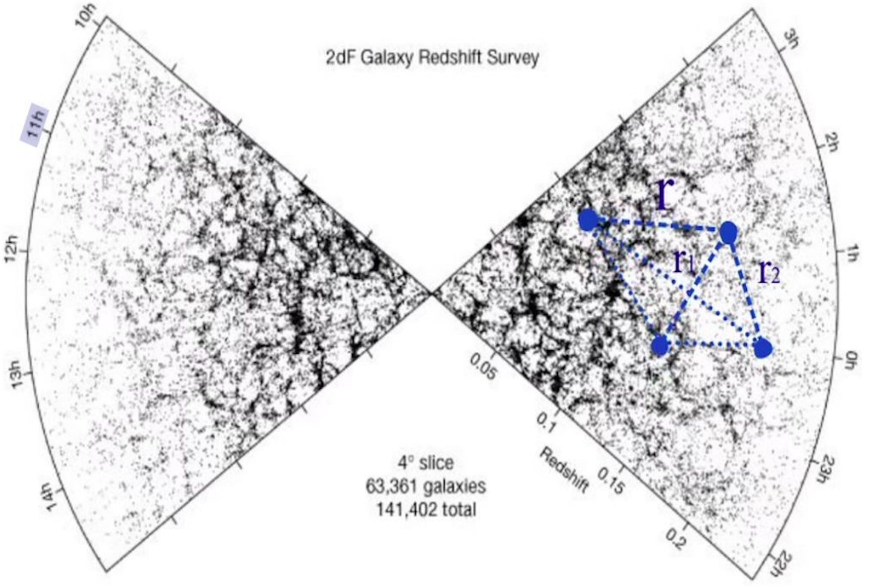
4-Point Correlation Function (4PCF)

Excess probability of finding four galaxies separated by distances r, r_1, r_2.

$$\xi(\mathbf{r},\mathbf{r}_1,\mathbf{r}_2) = \langle\delta(\mathbf{x}+\mathbf{r})\delta(\mathbf{x}+\mathbf{r}_1)\delta(\mathbf{x}+\mathbf{r}_2)\delta(\mathbf{x})\rangle$$
$$- \langle\delta(\mathbf{x}+\mathbf{r})\delta(\mathbf{x}+\mathbf{r}_1)\rangle\langle\delta(\mathbf{x}+\mathbf{r}_2)\delta(\mathbf{x})\rangle$$
$$-2 \text{ Permutations}$$



F. Bernardeau et al. 2001

Tree Level Trispectrum

$$T_{3111}\left(\mathbf{k_1},\mathbf{k_2},\mathbf{k_3},\mathbf{k_4}\right) = 6\, Z^{(3)}\left(\mathbf{k_1},\mathbf{k_2},\mathbf{k_3}\right) Z^{(1)}\left(\mathbf{k_1}\right) Z^{(1)}\left(\mathbf{k_2}\right) Z^{(1)}\left(\mathbf{k_3}\right) P(k_1)P(k_2)P(k_3) + 3 \text{ perm.}$$

and

$$T_{2211}\left(\mathbf{k_1},\mathbf{k_2},\mathbf{k_3},\mathbf{k_4}\right) = 4Z^{(1)}\left(\mathbf{k_1}\right) Z^{(1)}\left(\mathbf{k_2}\right) P(k_1)P(k_2) \Big\{ Z^{(2)}\left(\mathbf{k_1},-\mathbf{k_{13}}\right) Z^{(2)}\left(\mathbf{k_2},\mathbf{k_{13}}\right) P(k_{13}) + Z^{(2)}\left(\mathbf{k_1},-\mathbf{k_{14}}\right) Z^{(2)}\left(\mathbf{k_2},\mathbf{k_{14}}\right) P(k_{14}) \Big\} + 5 \text{ perm.}$$

D. Gualdi et al. 2021

Configuration-Space 4PCF

Results

We find 17 equations describing the full tree-level configuration-space 4PCF in the same format as:

$$R_{1,(3)}(\mathbf{r_1},\mathbf{r_2},\mathbf{r_3}) = (4\pi)^4 \sum_{j,n} \sum_{j_1,j_2,j_3} \sum_{L_2,L_3=0}^{j+j_2,j+j_3} c^{(2)}_{j,n} \mathcal{C}^{n_1,n_2,n_3}_{j_1,j_2,j_3} \times \mathcal{G}_{j_1,L_2,L_3} \Upsilon_{j_1,L_2,L_3} C_{L_1,L_2,L_3} \times \mathcal{P}_{j_1,L_2,L_3}(\widehat{\mathbf{r}}_1,\widehat{\mathbf{r}}_2,\widehat{\mathbf{r}}_3)\xi^{[n_1'=0]}_{j_1}(r_1)\xi^{[n]}_{L_2}(r_2)\xi^{[-n]}_{L_3}(r_3)$$

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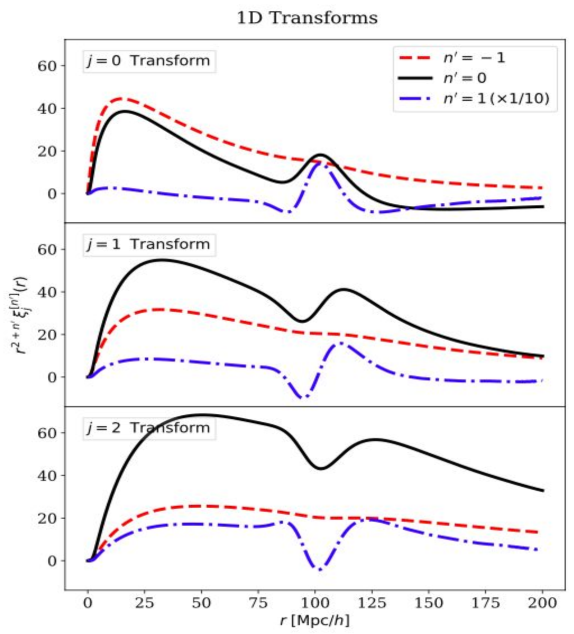
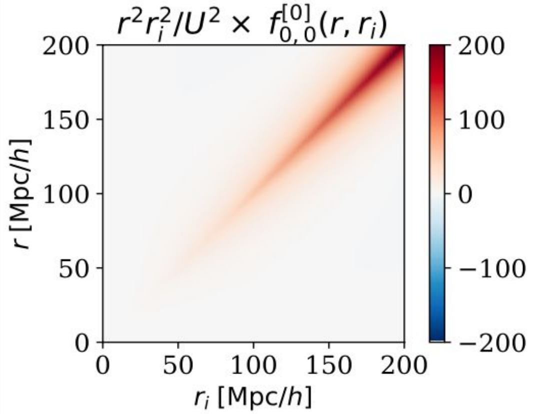
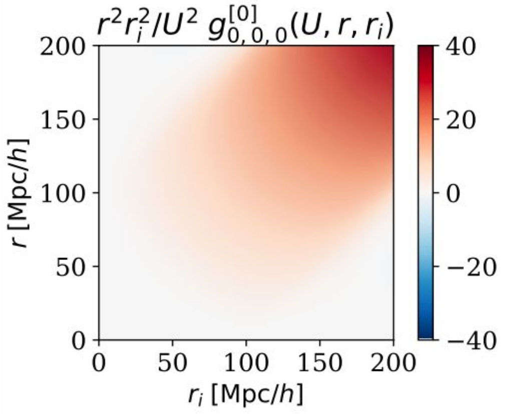
Plotting the Radial Integrals



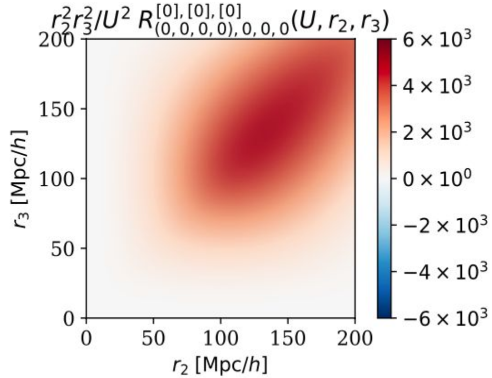
$$\xi_j^{[n']}(r_i) = \int_0^\infty \frac{dk_i}{2\pi^2}\, k_i^{n'+2} j_j(k_i r_i) P(k_i).$$





$$f_{\ell,L}^{[n']}(r, r_i) \equiv \int_0^\infty \frac{dk_i}{2\pi^2}\, k_i^{n'+2} j_\ell(k_i r) j_L(k_i r_i) P(k_i).$$

$$g_{\ell',\ell,L}^{[n']}(r', r, r_i) \equiv \int_0^\infty \frac{dk_i}{2\pi^2}\, k_i^{n'+2} j_{\ell'}(k_i r') j_\ell(k_i r) j_L(k_i r_i) P(k_i).$$



$$R^{[n_1'],[n_2'],[n_3']}_{(\ell_2,\ell_1',\ell_2',\ell_3'),L_1,L_2,L_3}(r_1, r_2, r_3) \equiv \int_0^\infty dr'\, r'\, f^{[n_1']}_{\ell_1',L_1}(r', r_1) \int_0^\infty dr\, r \times g^{[n_2']}_{\ell_2',\ell_2,L_2}(r', r, r_2)\, g^{[n_3']}_{\ell_3',\ell_2,L_3}(r', r, r_3).$$

U = 100 Mpc/*h*

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