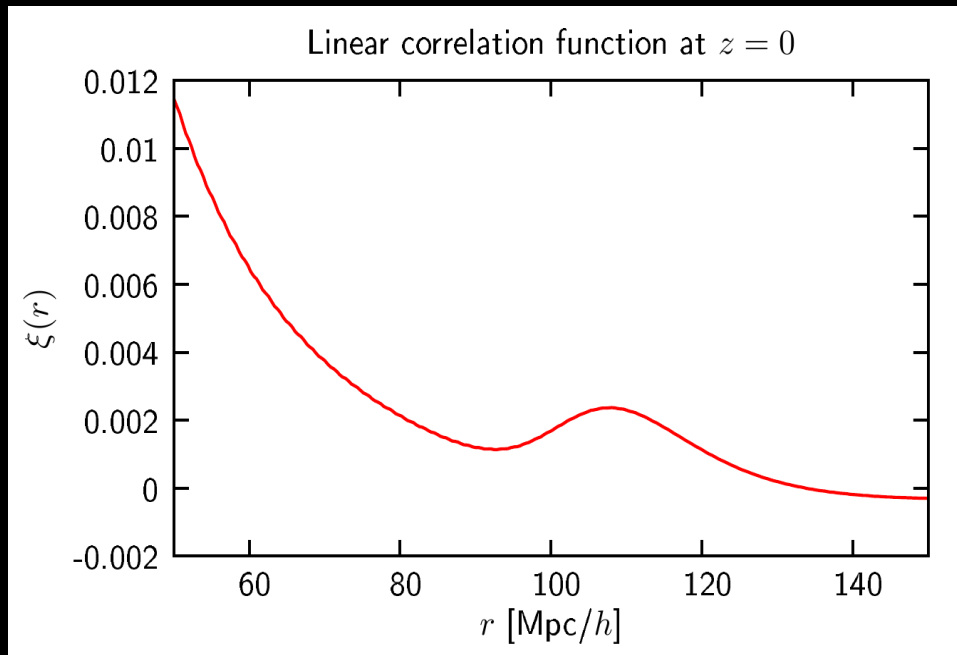
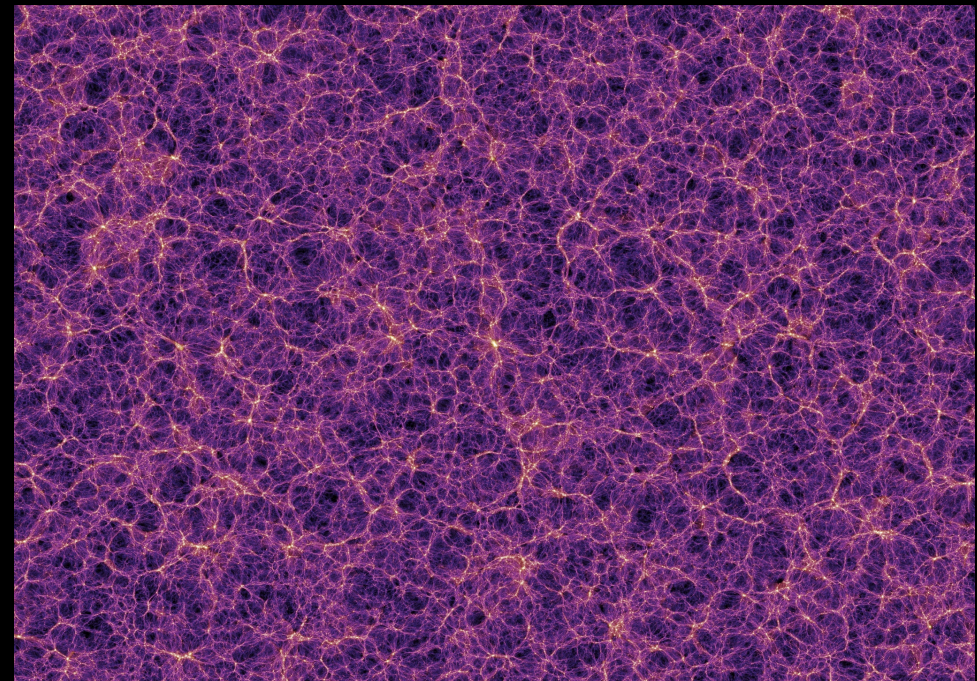


KORELACIJE V VESOLJU



Vid Iršič
FMF, UL



Homogenost in izotropija

Izotropija: v vse strani enako (rotacijska invarianca)

Homogenost: v vsaki točki enako (translacijska invarianca)

Dva pogleda

Fizična homogenost in
izotropija

- Velja za fizikalne količine (gostota, tlak, hitrost, ipd.)
- Mlajše kot je vesolje bolj je to res

$$\xi(\mathbf{x}_1, \mathbf{x}_2) = 0$$

Statistična homogenost in
izotropija

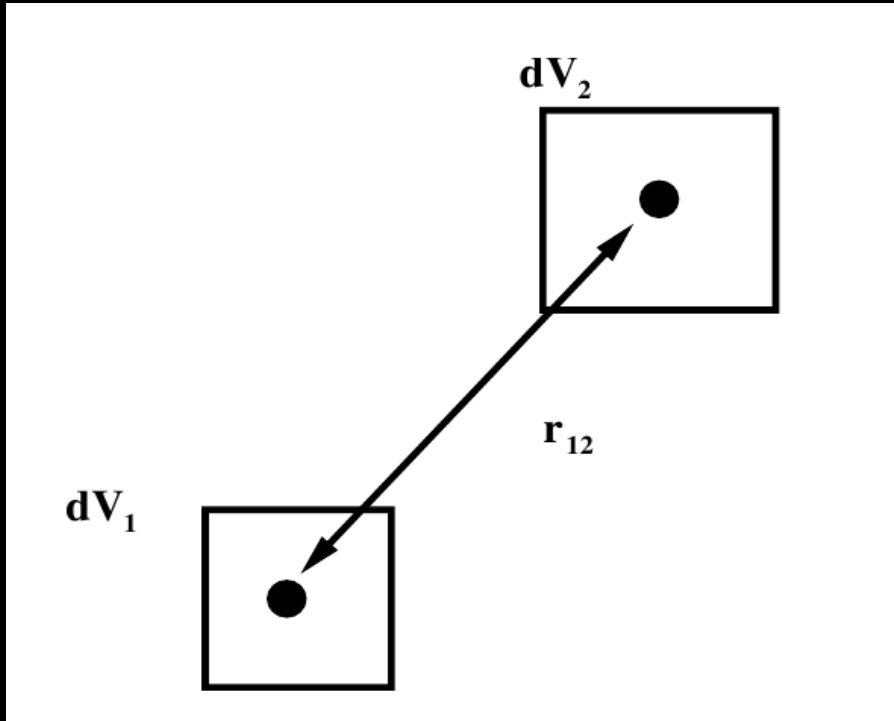
- Velja za statistiko fizikalnih količine (porazdelitev, povprečje, varianca, ipd.)
- To je zelo res

$$\xi(\mathbf{x}_1, \mathbf{x}_2) = \xi(\mathbf{x}_1 - \mathbf{x}_2) = \xi(|\mathbf{x}_1 - \mathbf{x}_2|)$$

homogenost

izotropija

Korelacija



Verjetnost, da najdemo galaksijo v volumnu dV , če je povprečna gostota galaksij n :

$$dP_1 = n dV_1$$

Enako za nek drug volumen:

$$dP_2 = n dV_2$$

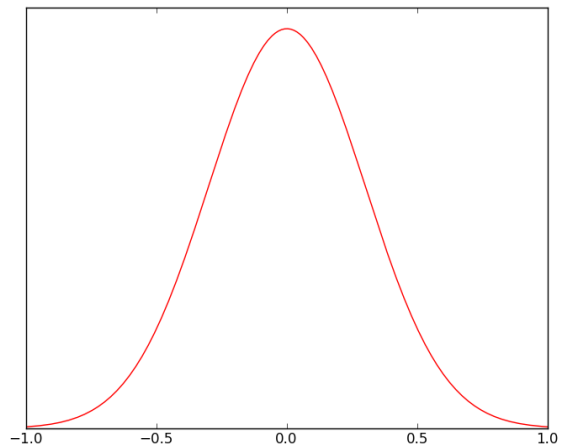
Verjetnost, da najdemo dve galaksiji na oddaljenosti r :

$$dP_{12} = n^2 dV_1 dV_2 [1 + \xi(r_{12})]$$

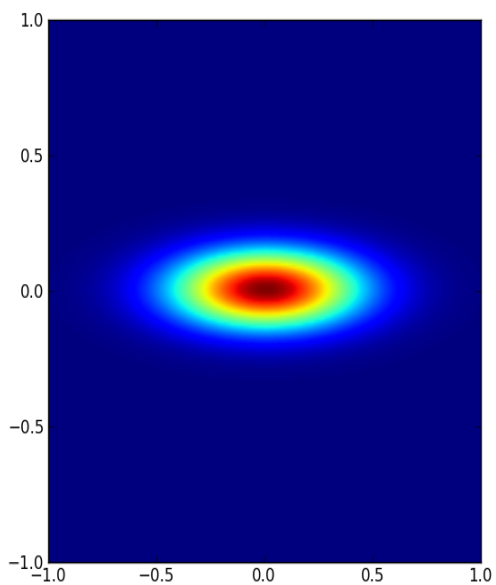
Koliko večja je verjetnost, da najdemo dve galaksiji na oddaljenosti r , glede na enakomerno porazdelitev

← Korelacija

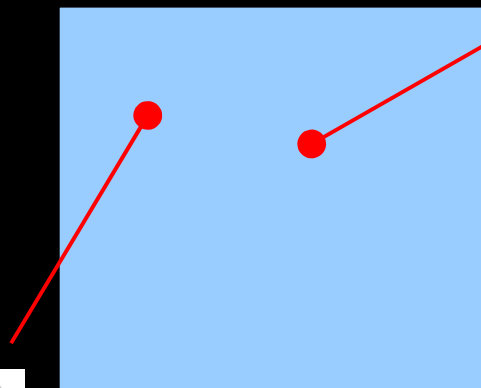
Korelacija polja



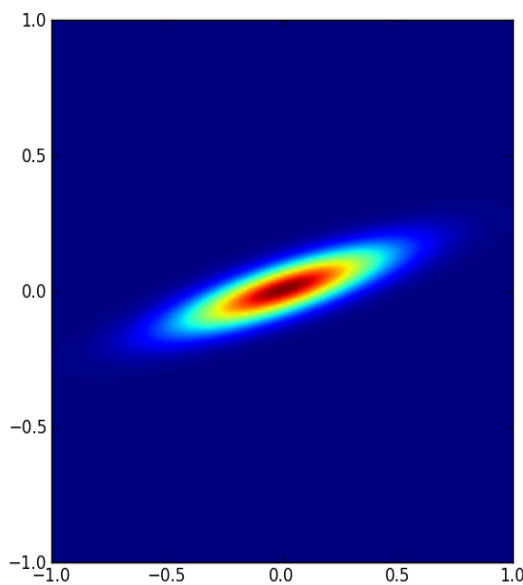
$\xi = 0$



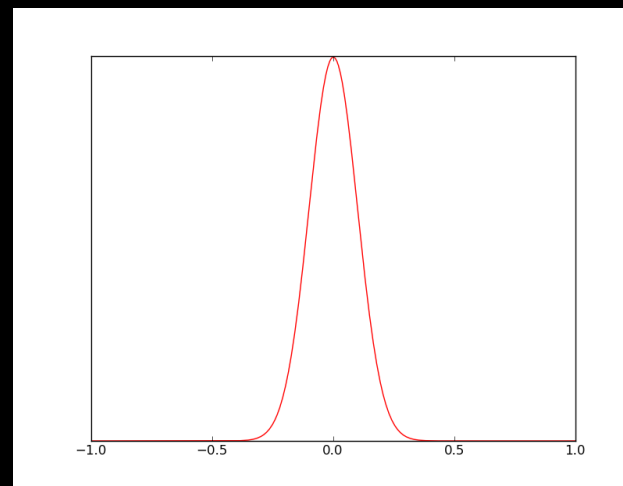
$\phi(\mathbf{x}_2)$



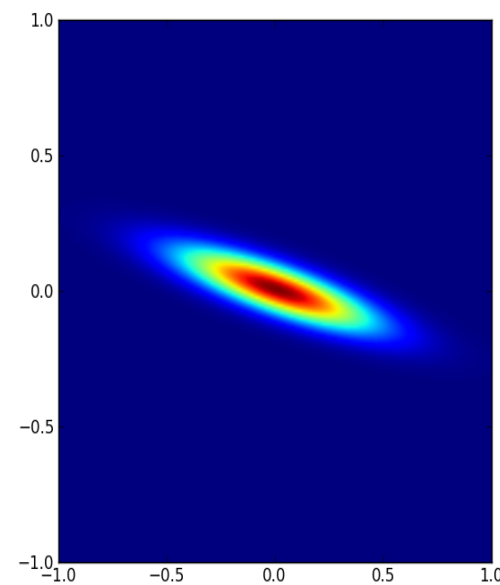
$\xi > 0$



$\phi(\mathbf{x}_1)$

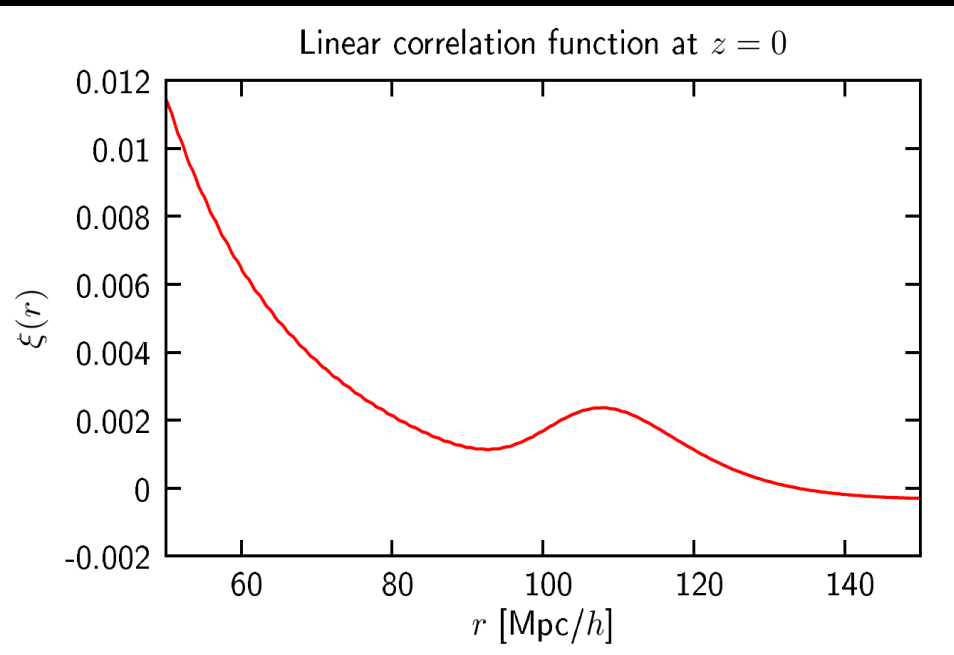


$\xi < 0$



Naključno polje v
točki x

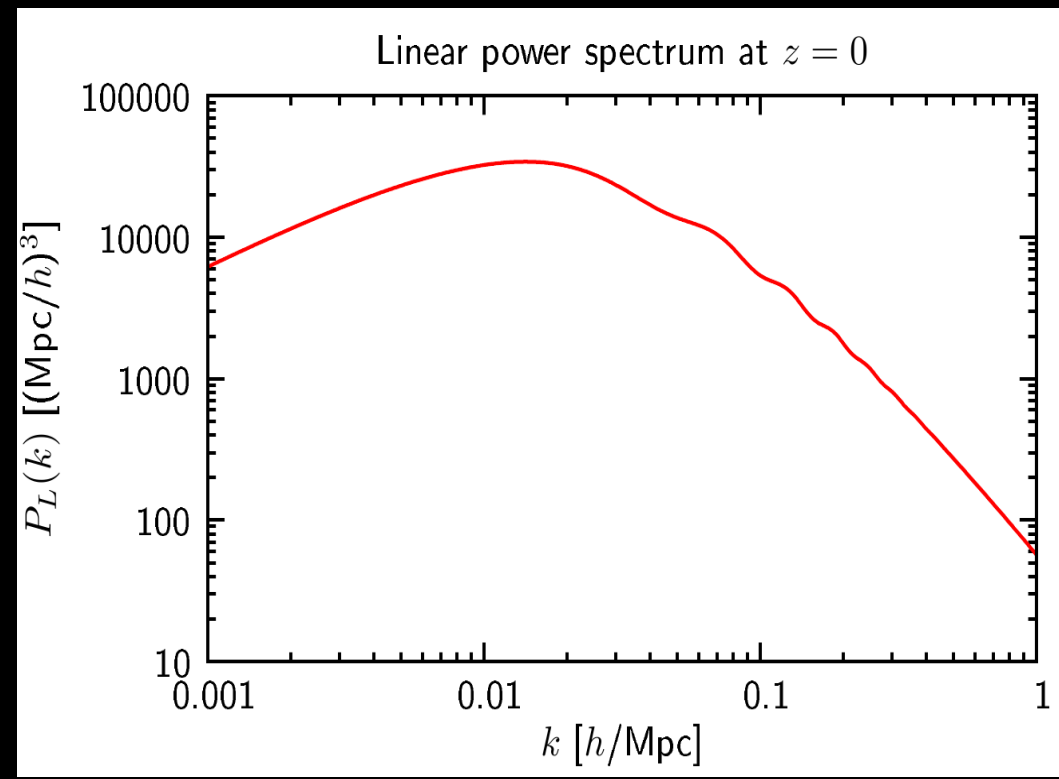
Korelacija → Spekter moči



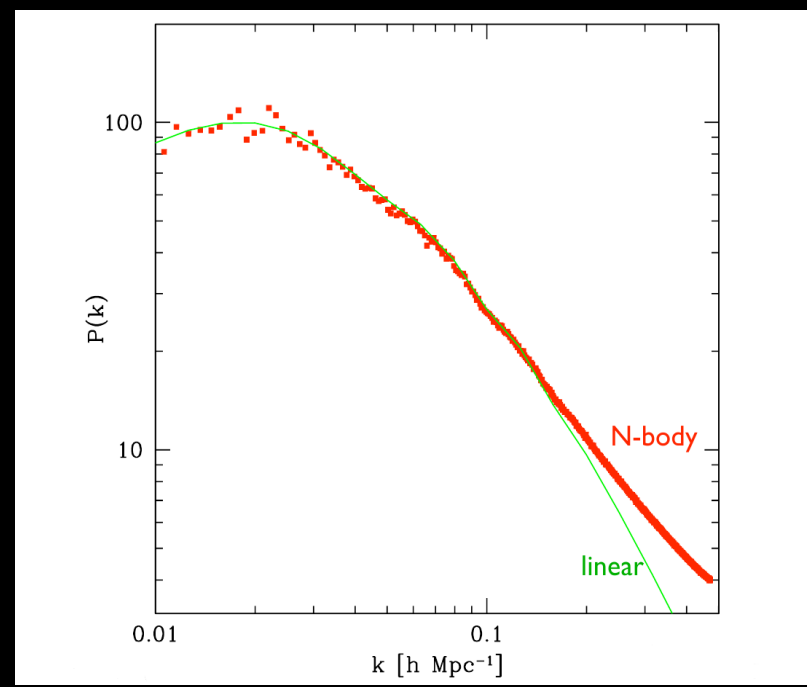
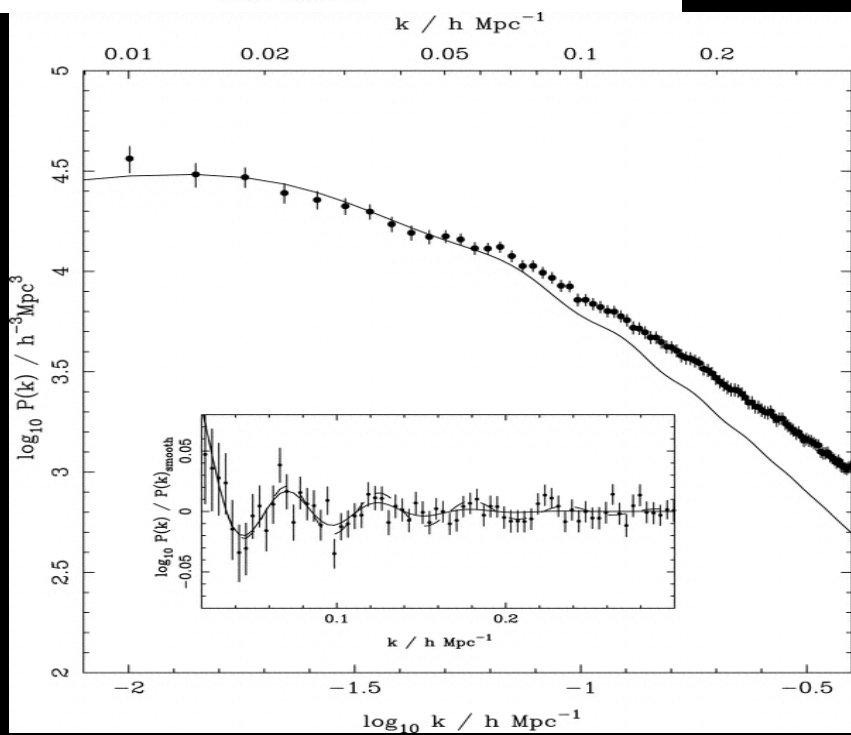
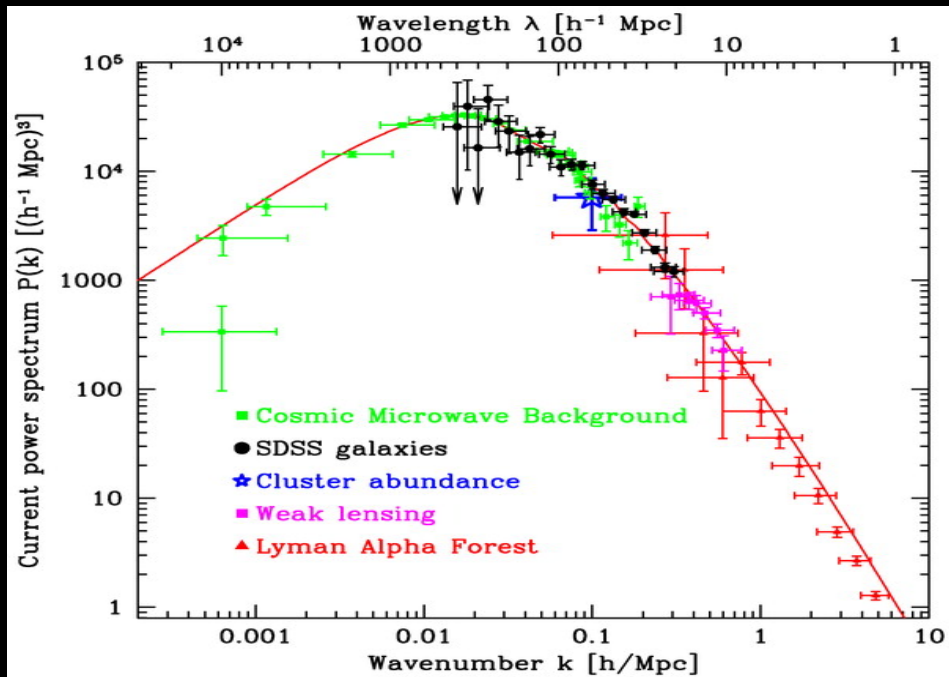
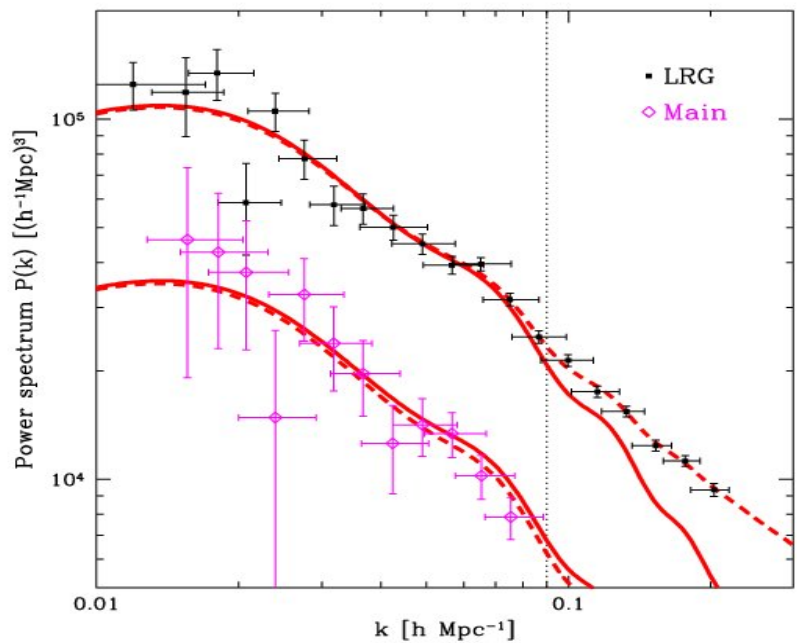
Korelacija flukutacij gostote

Bolj pošten opis →

(3D) Fourierjeva transformacija



Spekter moči - meritve

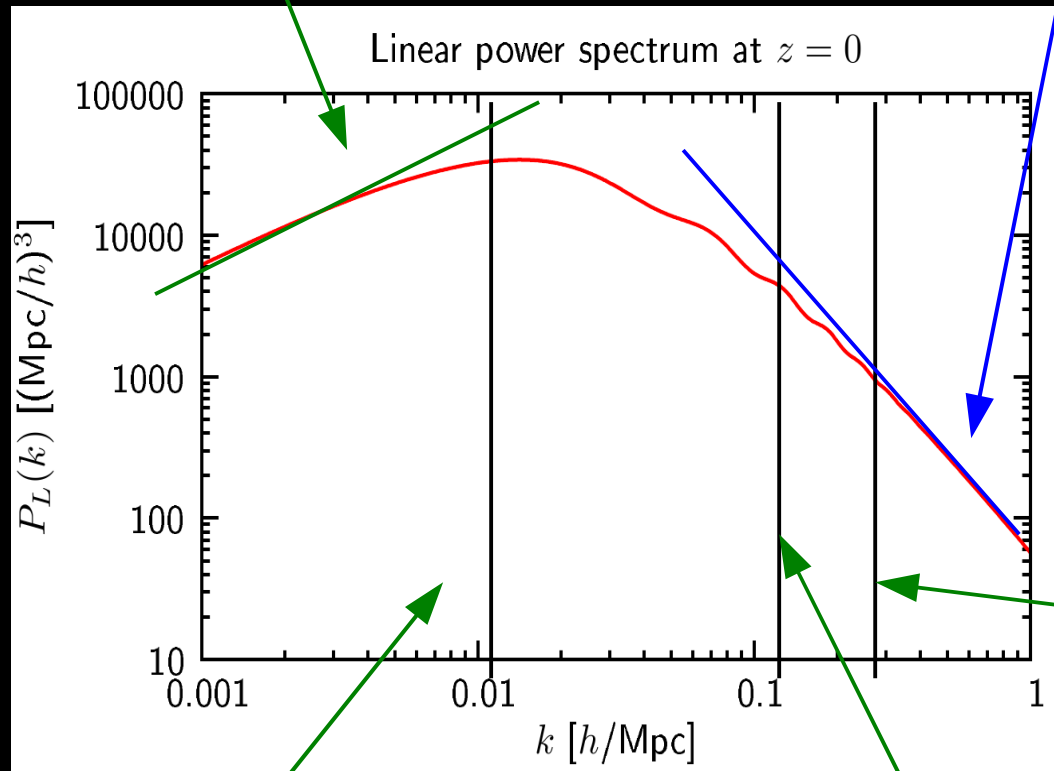


Spekter moči - razlaga

Harrison-Zel'dovich

$$P(k) \propto k$$

$$P(k) \propto k^{-3}$$



$$k_{\text{Silk}} \sim 0.5 h/\text{Mpc}$$

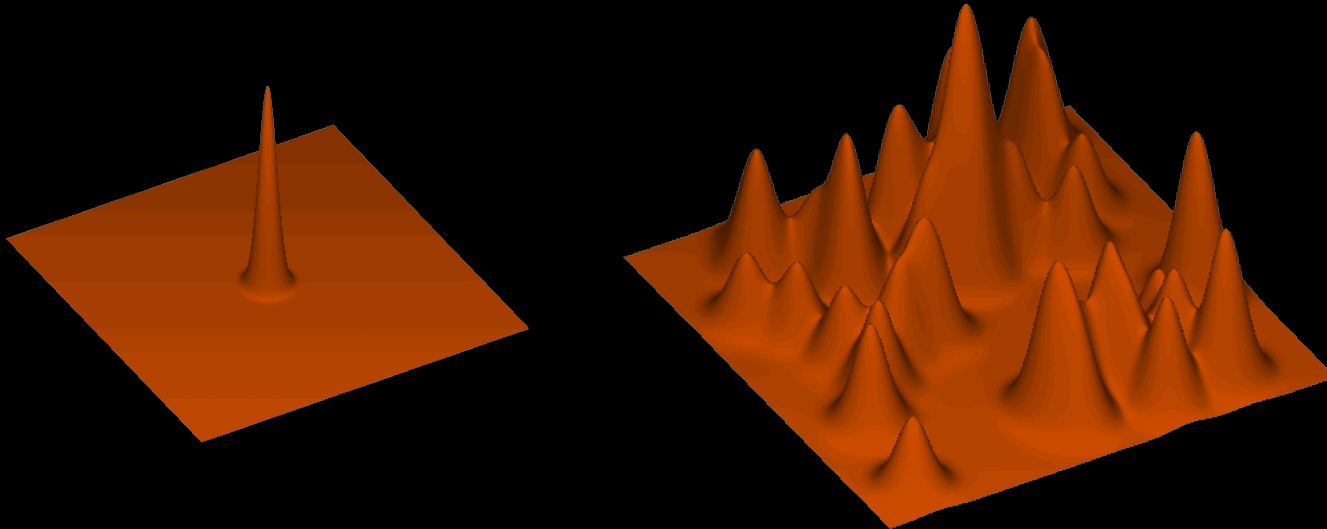
$$k_{\text{eq}} \sim 0.01 h/\text{Mpc}$$

$$k_{nL} \sim 0.1 h/\text{Mpc}$$

Gostota snovi = gostota sevanja

Nelinearnosti

Spekter moči – odtis barionov



Tipična skala
barionskih akustičnih
oscilacij (BAO vrh)

