

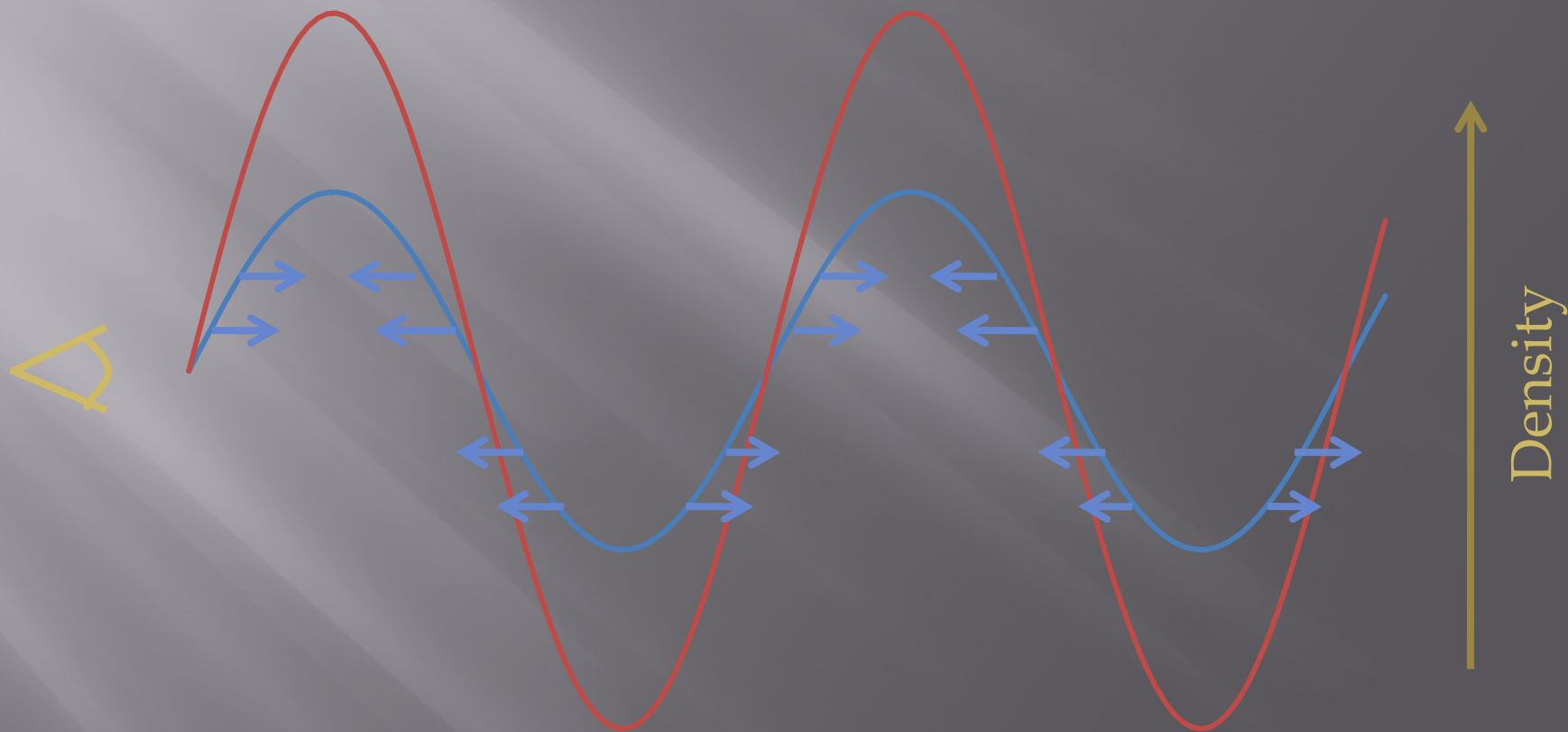
REDSHIFT SPACE DISTORTIONS DURING THE EPOCH OF REIONIZATION

Geraint Harker

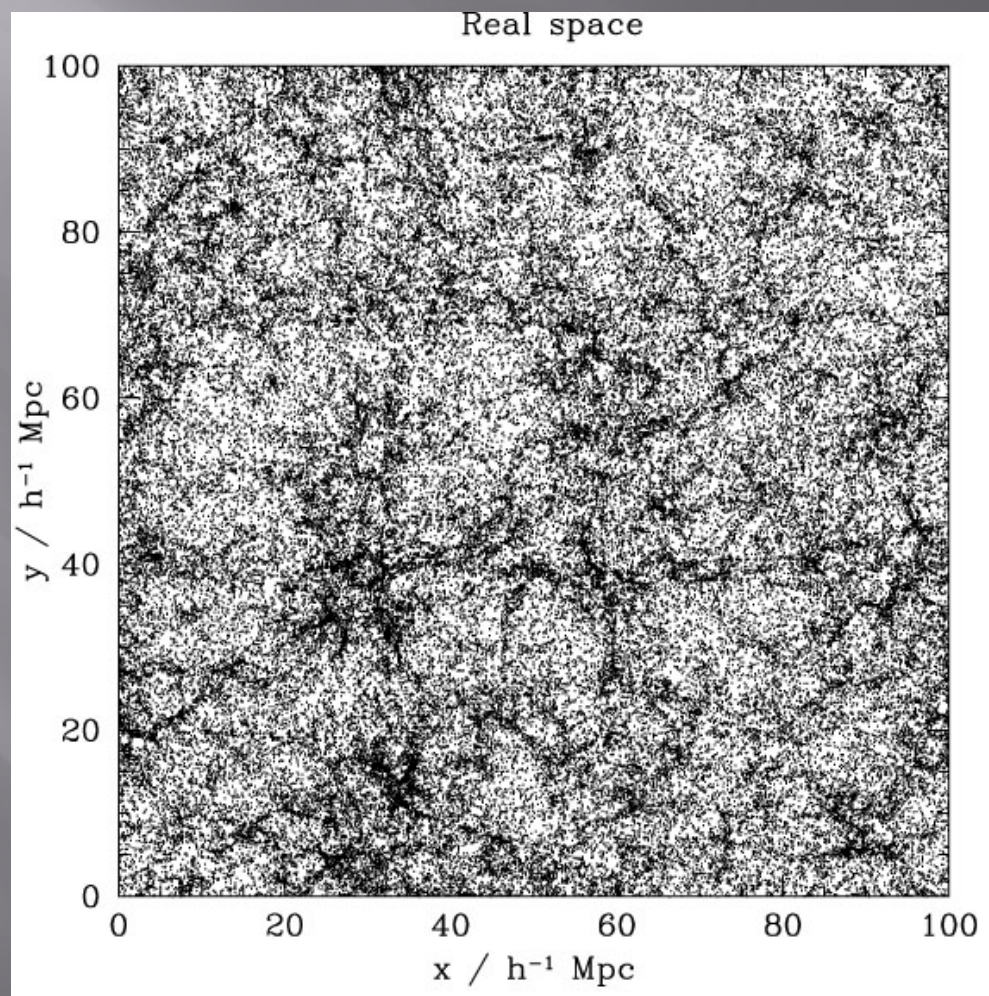
Redshift space distortions

- ▣ Hubble's Law: $cz = H_0 d$
- ▣ Real space distance $r = H_0 d$
- ▣ Redshift space distance $s = cz$
- ▣ But $s = r + \hat{\mathbf{r}} \cdot \mathbf{v}$

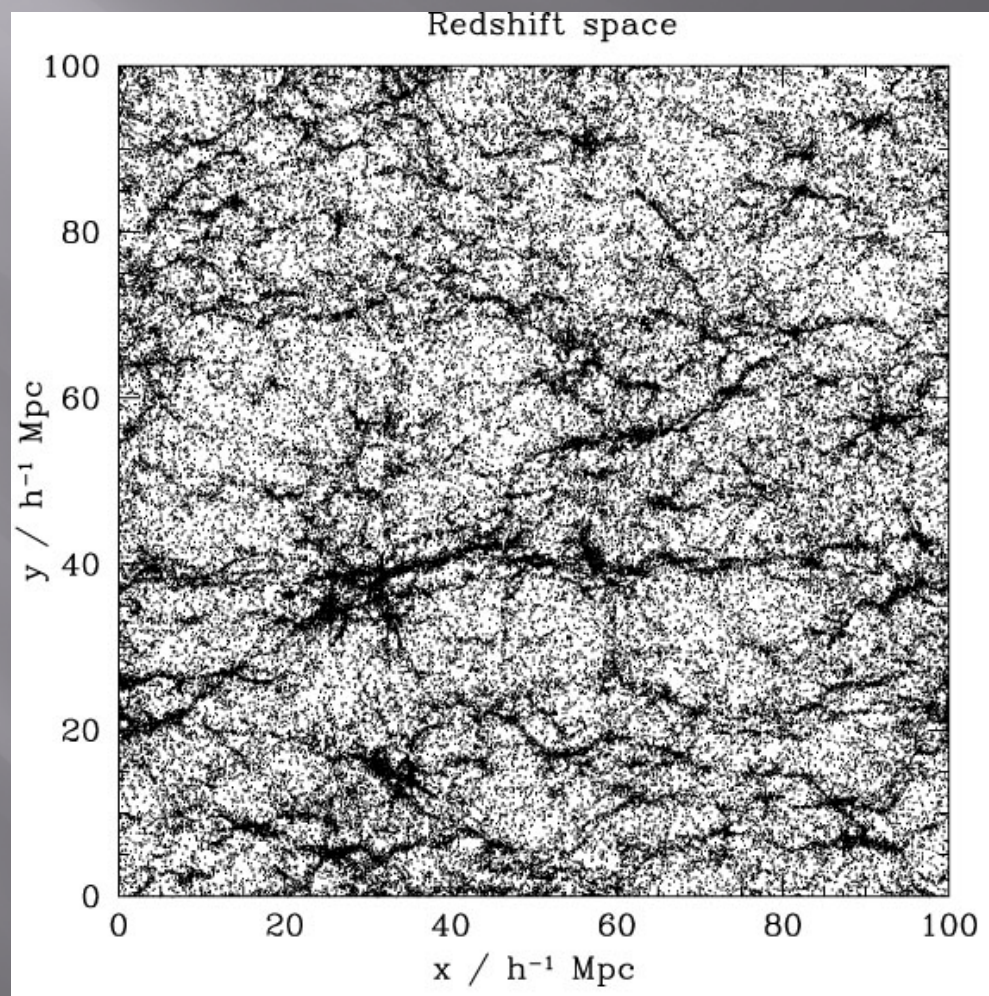
Linear distortions



High redshift



High redshift



Kaiser's formula

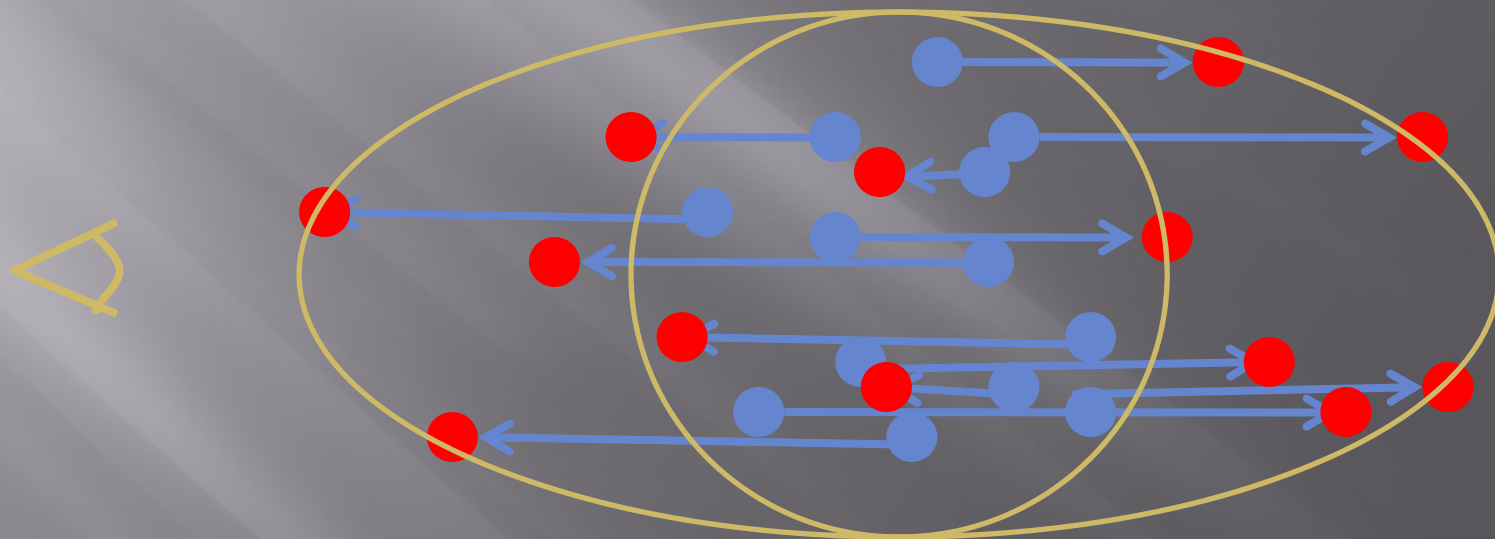
$$P_s(\mathbf{k}) = P_r(\mathbf{k}) \left(1 + f(\Omega) \mu^2 \right)^2$$

$$f(\Omega) \equiv \frac{d \ln D}{d \ln a} \approx \Omega^{0.6}$$

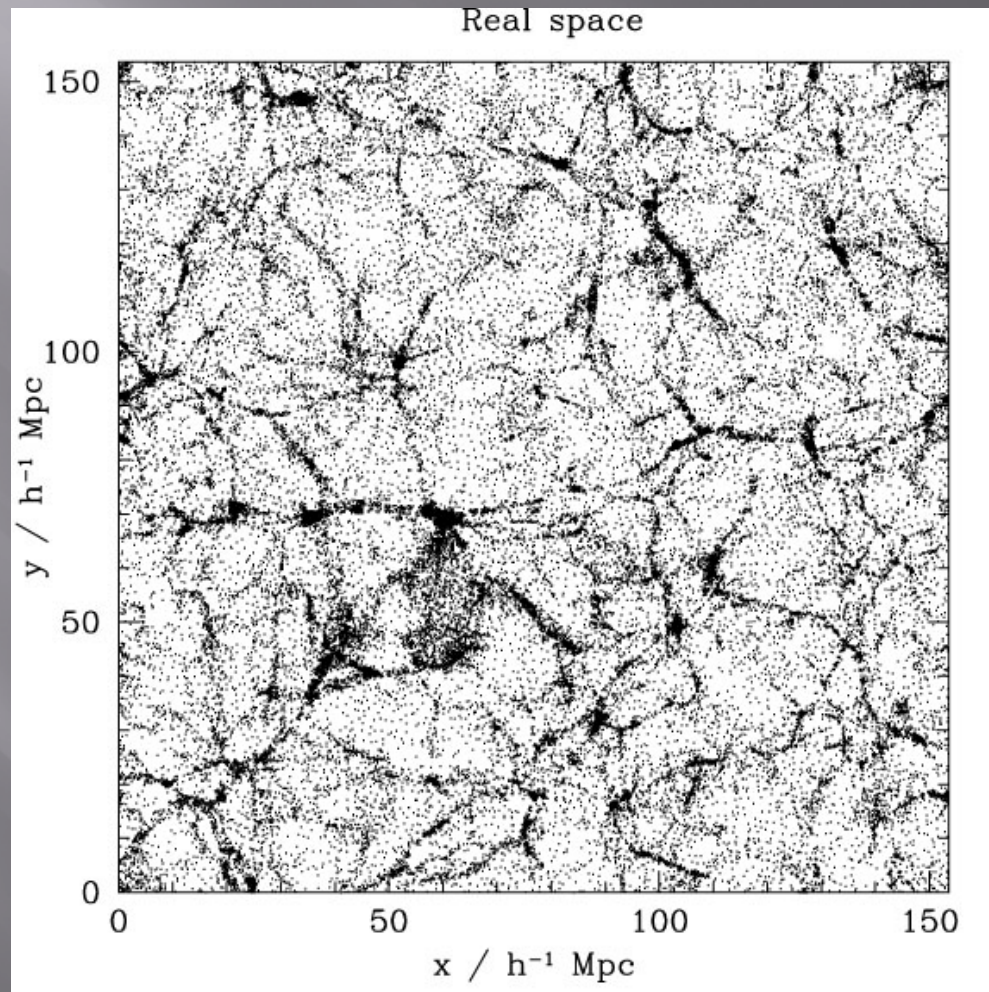
$$\mu \equiv \hat{\mathbf{z}} \cdot \hat{\mathbf{k}}$$

$$P_0^s(k) = \left(1 + \frac{2}{3} f + \frac{1}{5} f^2 \right) P^r(k)$$

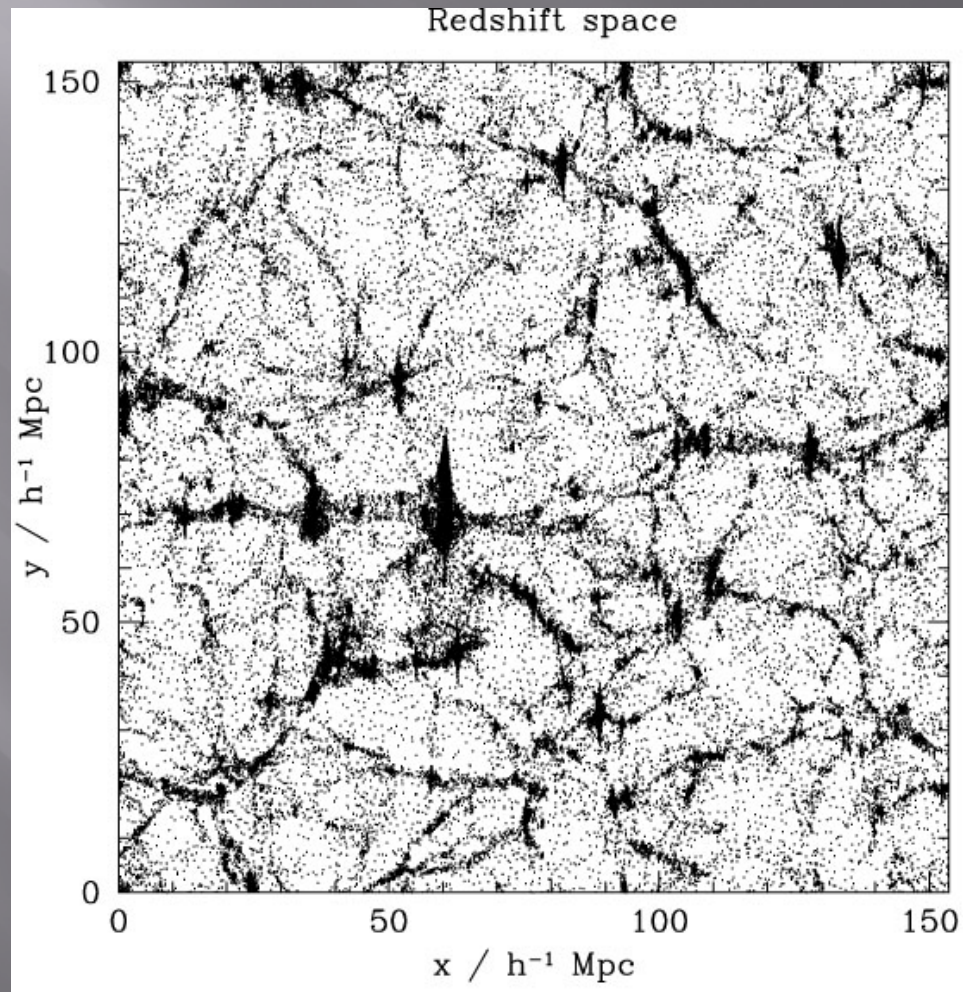
'Fingers of God'



Low redshift



Low redshift



Dispersion model

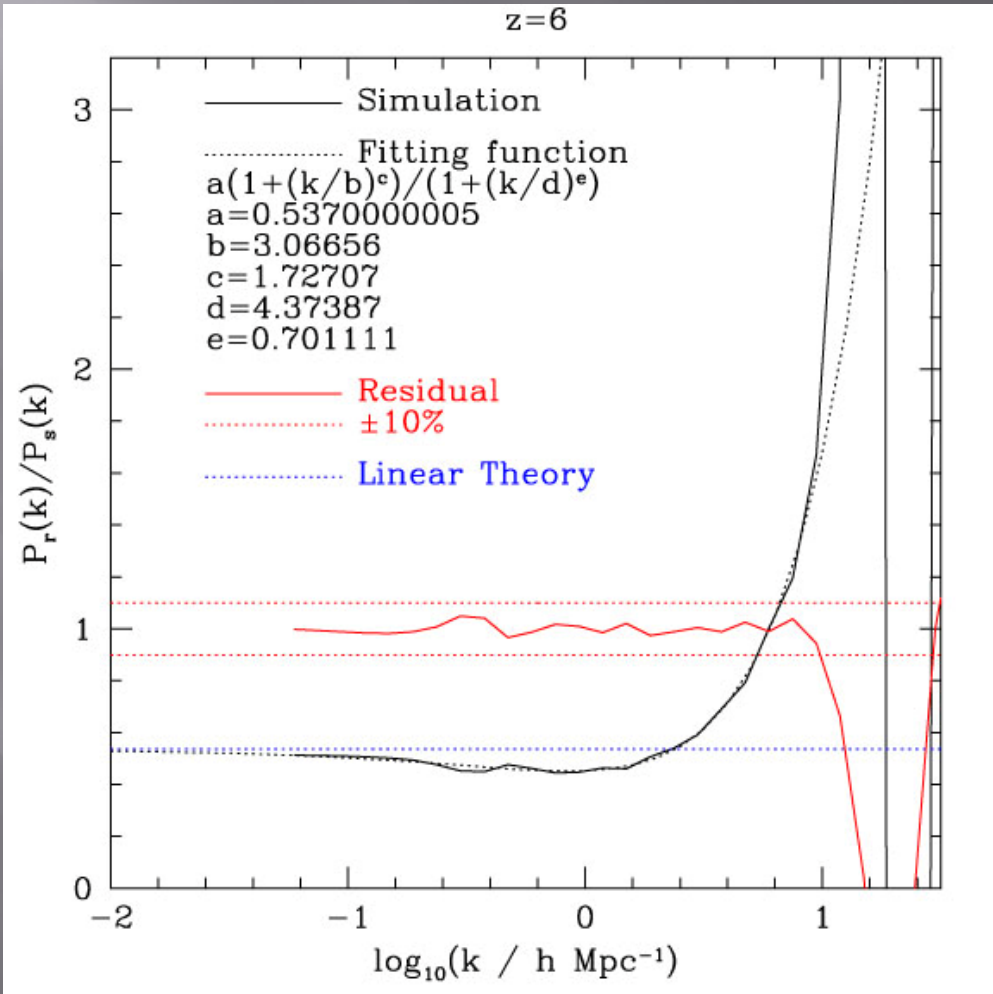
$$\beta \equiv f(\Omega)/b$$

$$P_s(\mathbf{k}) = P_r(\mathbf{k}) \underbrace{\left(1 + \beta \mu^2\right)^2}_{\text{Linear theory with bias}} \underbrace{\frac{1}{1 + k^2 \mu^2 \sigma_p^2 / 2}}_{\text{Velocity dispersion corresponding to exponential pairwise velocity distribution function}}$$

Linear theory
with bias

Velocity dispersion
corresponding to
exponential
pairwise velocity
distribution
function

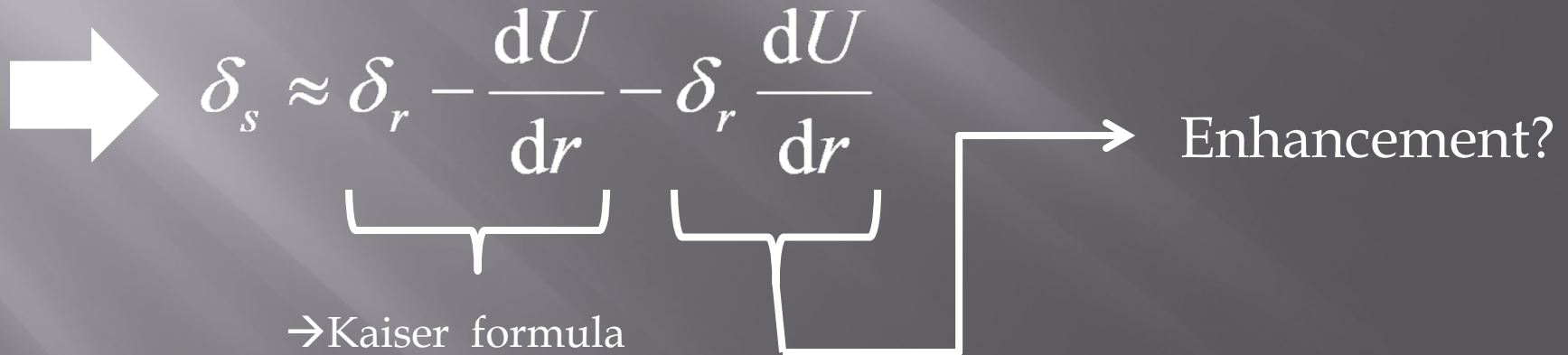
Fitting the ratio



An enhancement in excess of linear theory

$$U \equiv \hat{\mathbf{r}} \cdot \mathbf{v}$$

$$1 + \delta_s(\mathbf{r}) = \left(1 + \frac{dU}{dr}\right)^{-1} (1 + \delta_s(\mathbf{r}))$$



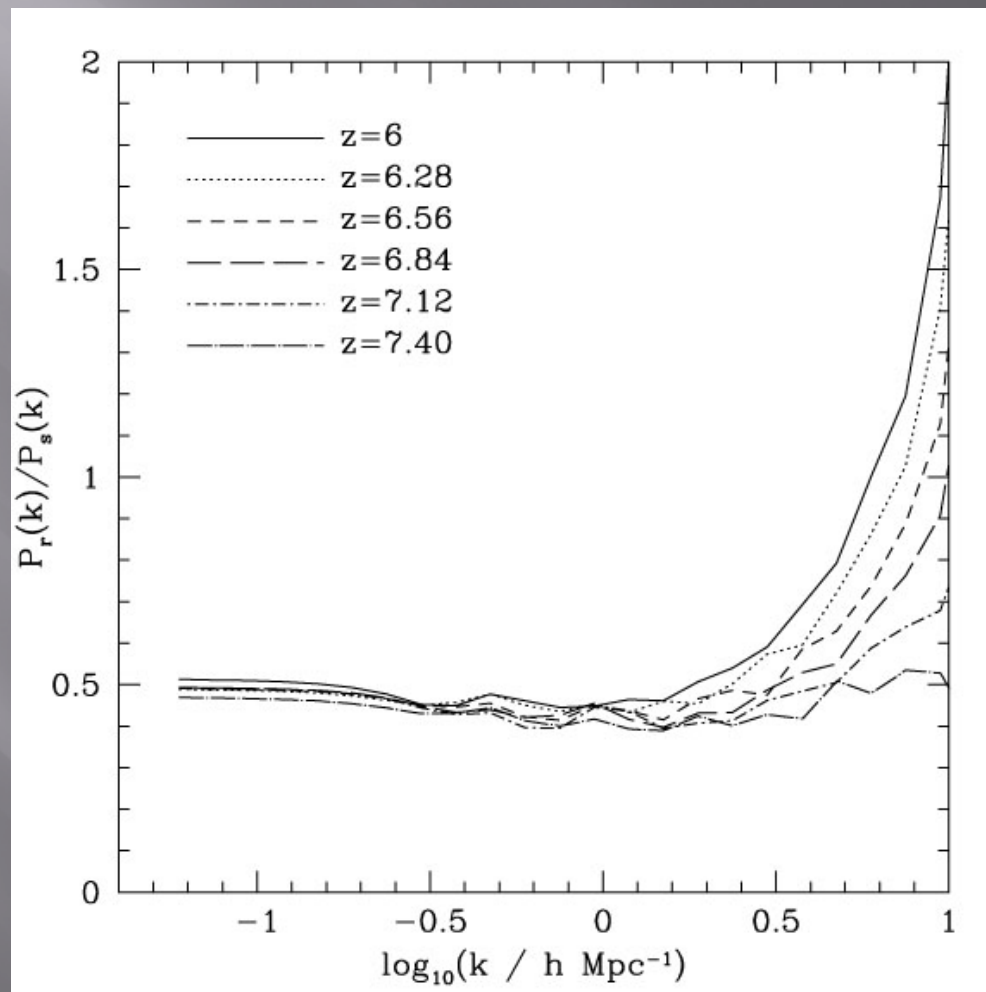
A large white arrow points from the left towards the equation $\delta_s \approx \delta_r - \frac{dU}{dr} - \delta_r \frac{dU}{dr}$. Below the first two terms, δ_r and $-\frac{dU}{dr}$, is a bracket with the text "→Kaiser formula". Below the last two terms, $-\frac{dU}{dr}$ and $-\delta_r \frac{dU}{dr}$, is another bracket. An arrow originates from this second bracket and points to the text "Enhancement?".

$$\delta_s \approx \delta_r - \frac{dU}{dr} - \delta_r \frac{dU}{dr}$$

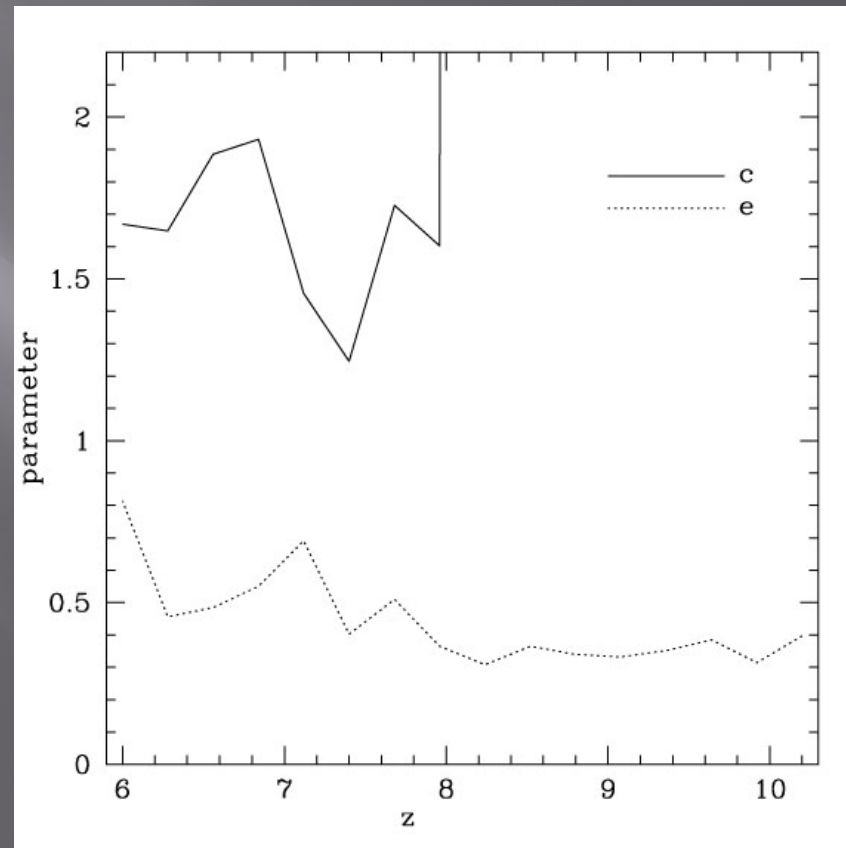
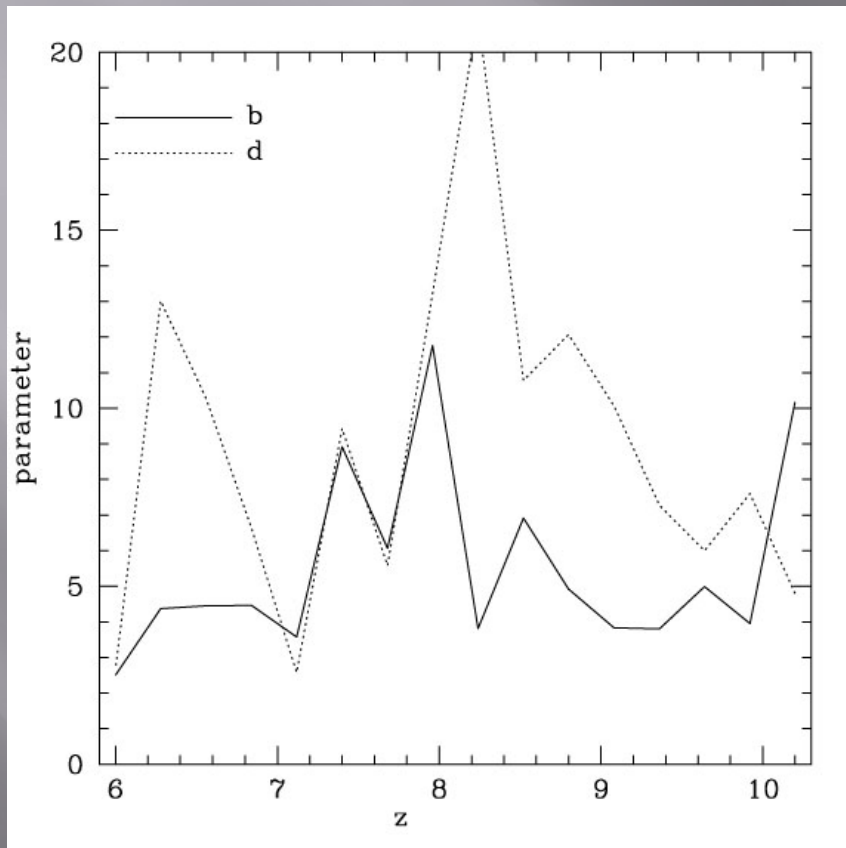
→Kaiser formula

Enhancement?

Variation with redshift



Parameter variation



Conclusions and further work

- ▣ We see an enhancement in the redshift-space power spectrum in excess of linear theory at quasilinear scales.
- ▣ A simple fitting function describes the ratio of the power spectra very well over the scales accessible to LOFAR.
- ▣ Further theoretical work is required to understand the form of this function and its dependence on redshift.
- ▣ Robustly determine the dependence on μ and z (more volume and fewer transients?)

Anomalies in the correlation function

