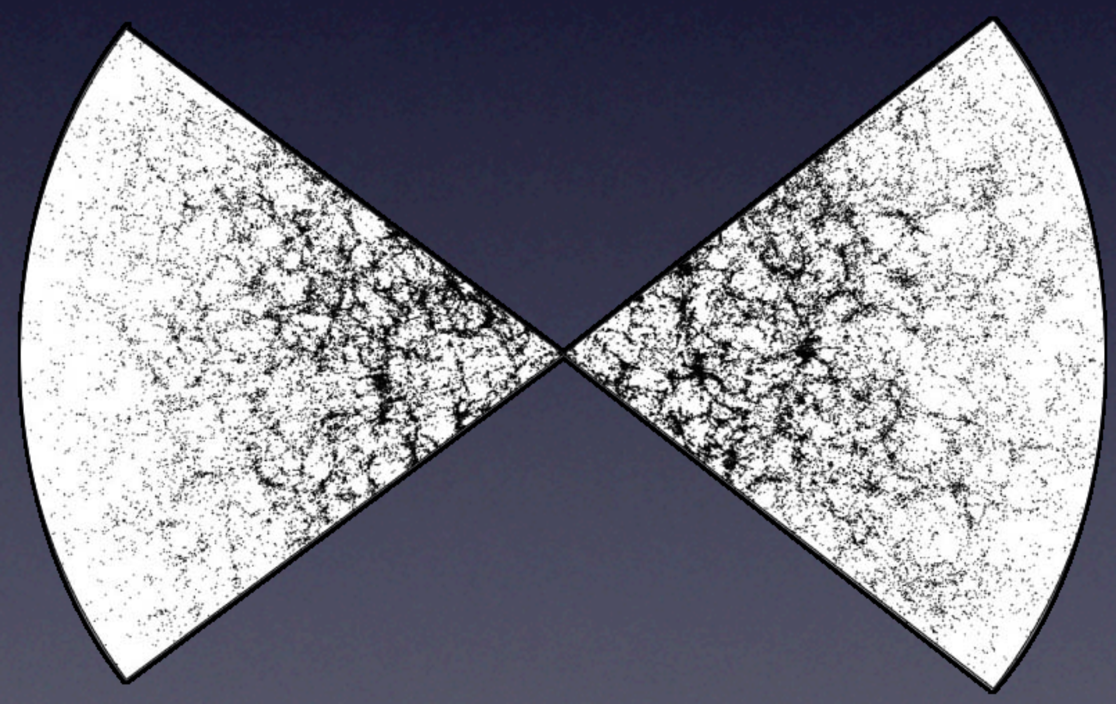
A measurement of the cosmological mass density from clustering in the 2dF Galaxy Redshift Survey



Peacock et al. 2001
Nature Vol. 410

Review

- Large scale structure formed from the gravitational collapse of small fluctuations in the initial mass distribution of the universe
- Hubble's Law ($v = H_0 r$) allows us to use redshift to determine the distance to an observed object
- By making 3-D maps of galaxy distributions we can test this theory of large scale structure formation

If the theory is right...
What do we expect?

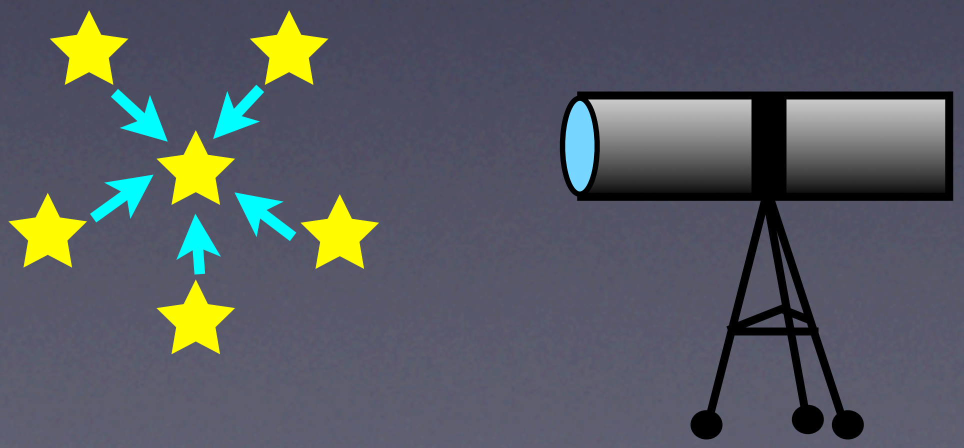
- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - “Fingers of God” phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

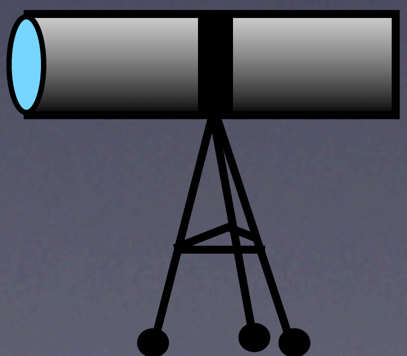


If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

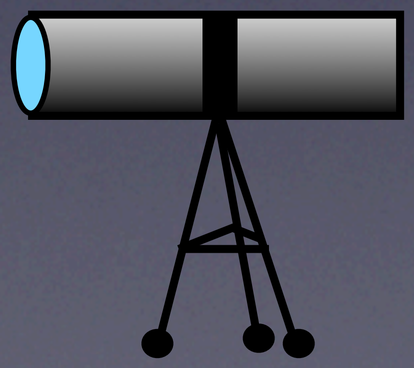
If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
    - “Fingers of God” phenomenon
    - Kaiser Infall



If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall



If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

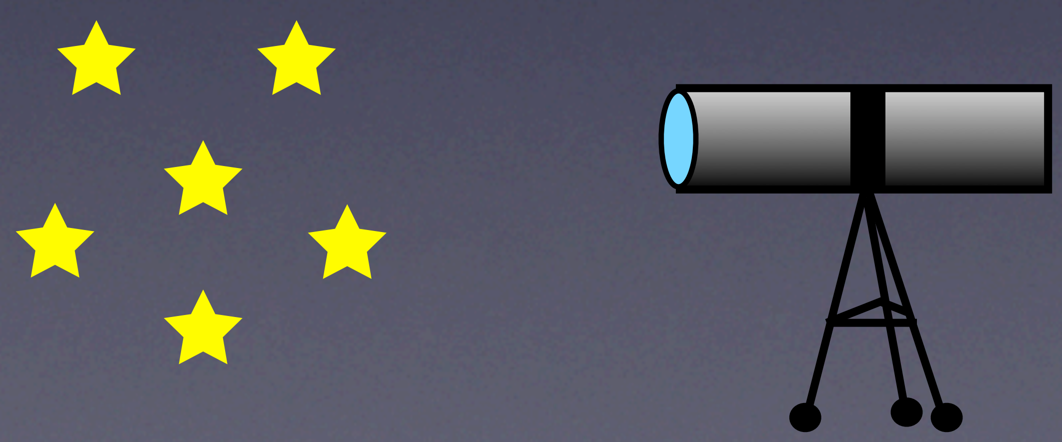
- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - “Fingers of God” phenomenon
  - Kaiser Infall



If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - “Fingers of God” phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

If the theory is right...
What do we expect?

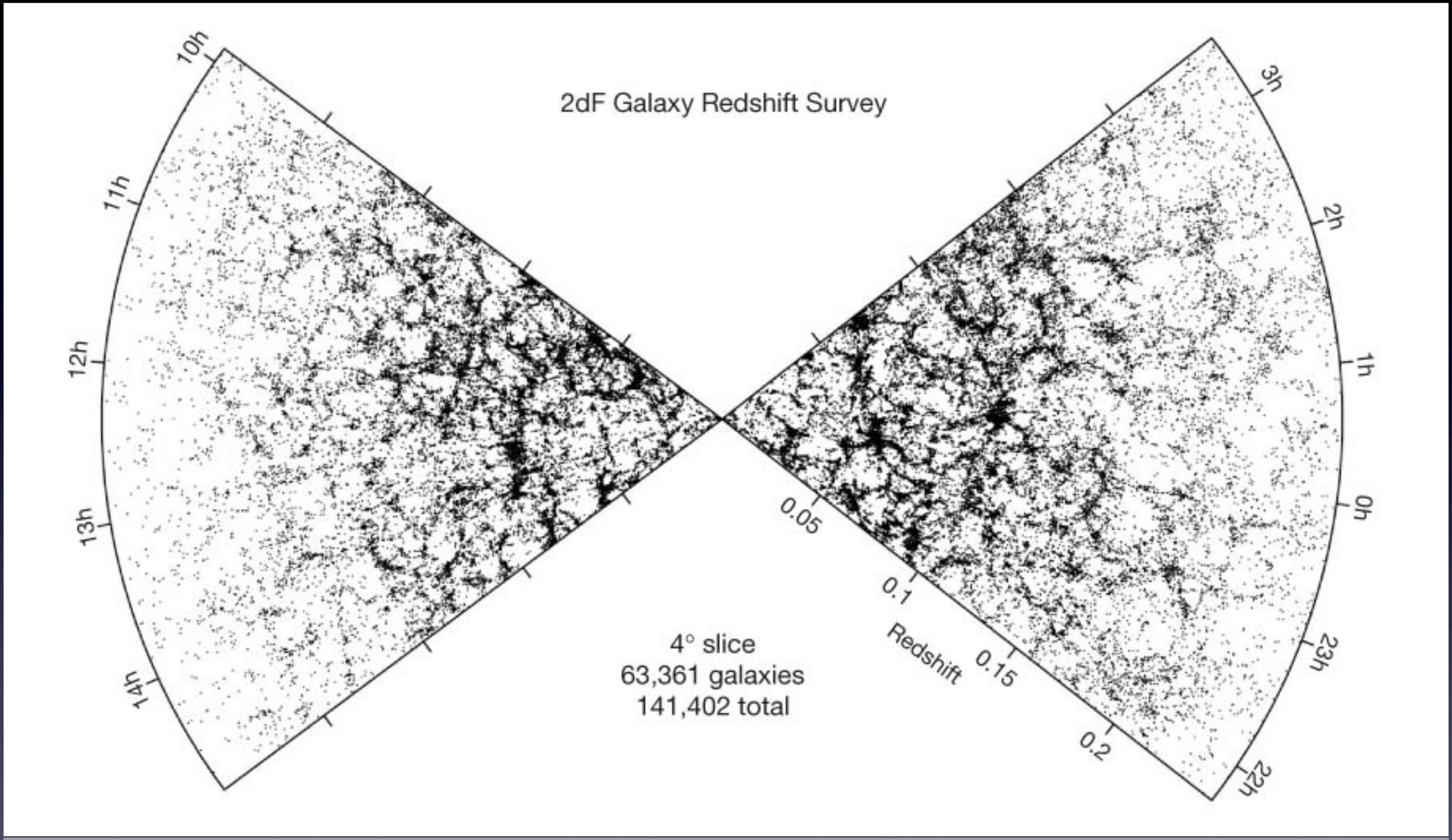
- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

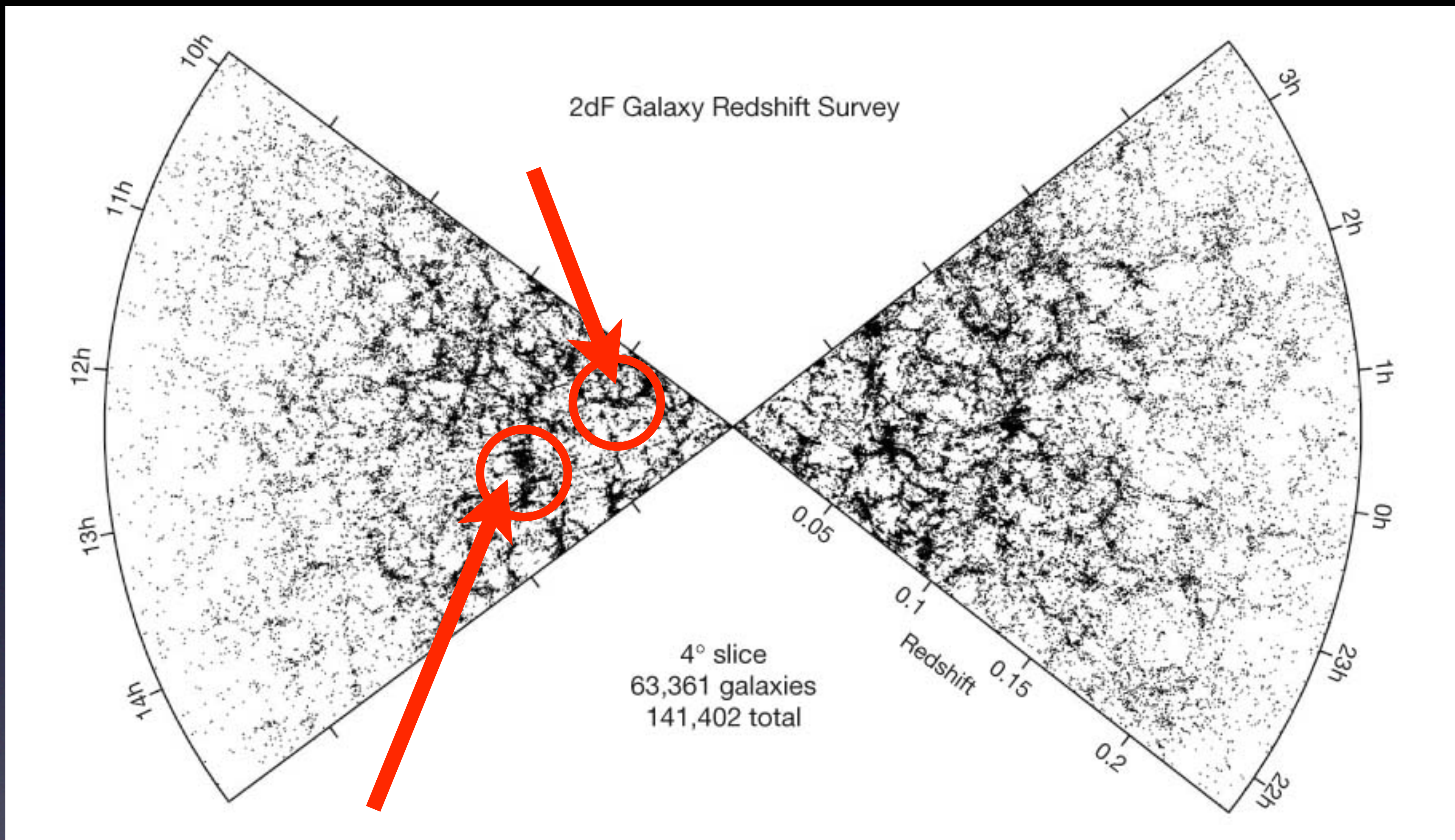
If the theory is right...
What do we expect?

- Clusters and voids (next paper)
- Peculiar velocities (this paper)
  - "Fingers of God" phenomenon
  - Kaiser Infall

The Survey (2dFGRS)

- Anglo-Australian Telescope, 2dF
- Observations made from 1998-2001
- Spectroscopic redshifts of 141,402 galaxies
- Flux limited sample to b_j=19.45
- Two strips along N & S galactic poles


2dF Galaxy Redshift Survey
10h
11h
12h
13h
14h
3h
2h
1h
0h
23h
22h
0.05
0.1
0.15
0.2
Redshift
4° slice
63,361 galaxies
141,402 total



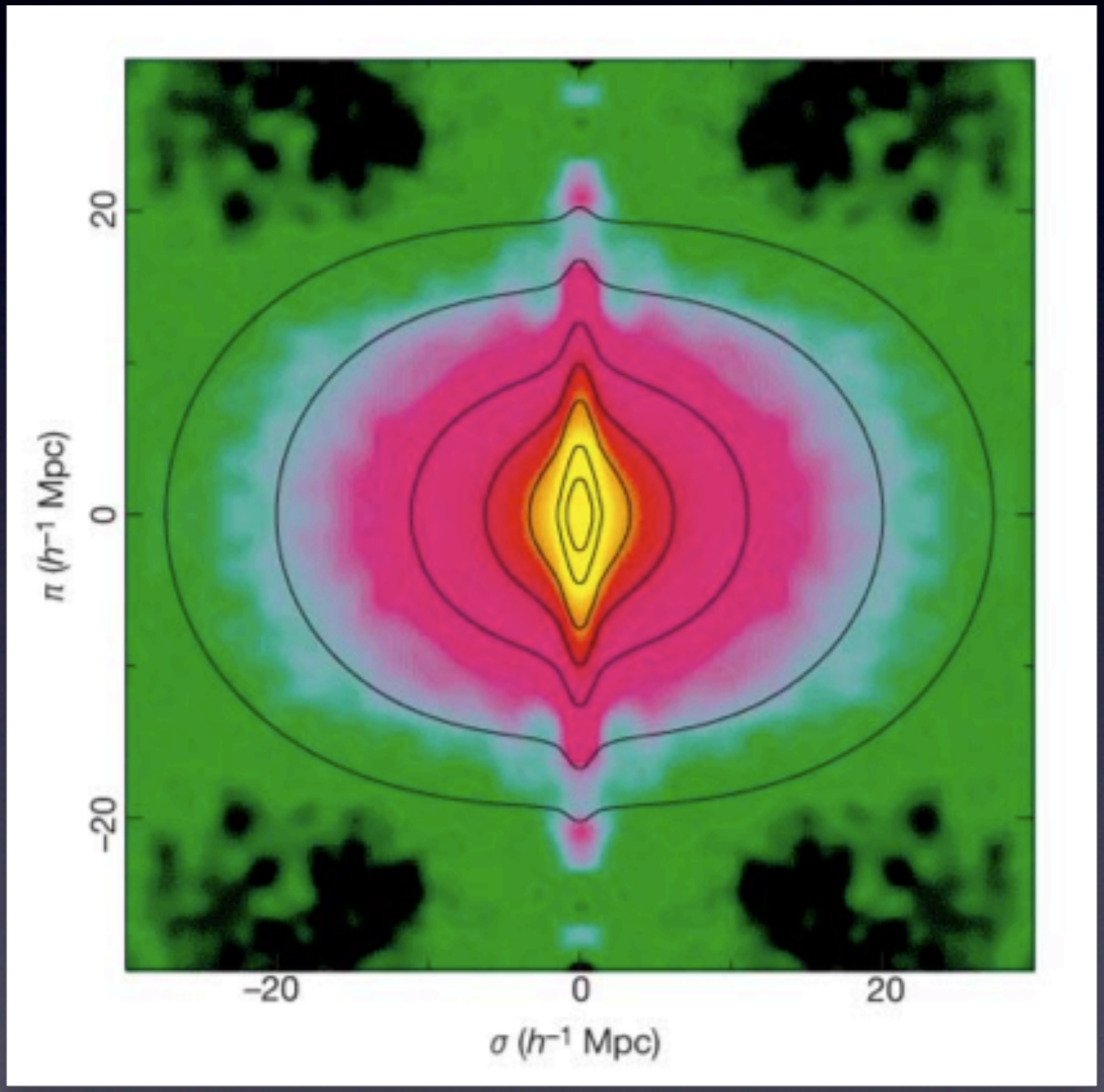
2dF Galaxy Redshift Survey
10h
11h
12h
13h
14h
3h
2h
1h
0h
23h
22h
0.05
0.1
0.15
0.2
Redshift
4° slice
63,361 galaxies
141,402 total

Measurements

$\beta = \Omega^{0.6}/b$

- Correlation: $\xi(\sigma, \pi)$
- Quadrupole-to-monopole ratio of power spectrum

$$\xi_2/\xi_0 = f(n)\ \frac{(4\beta/3 + 4\beta^2/7)}{(1+2\beta/3+\beta^2/5)}$$

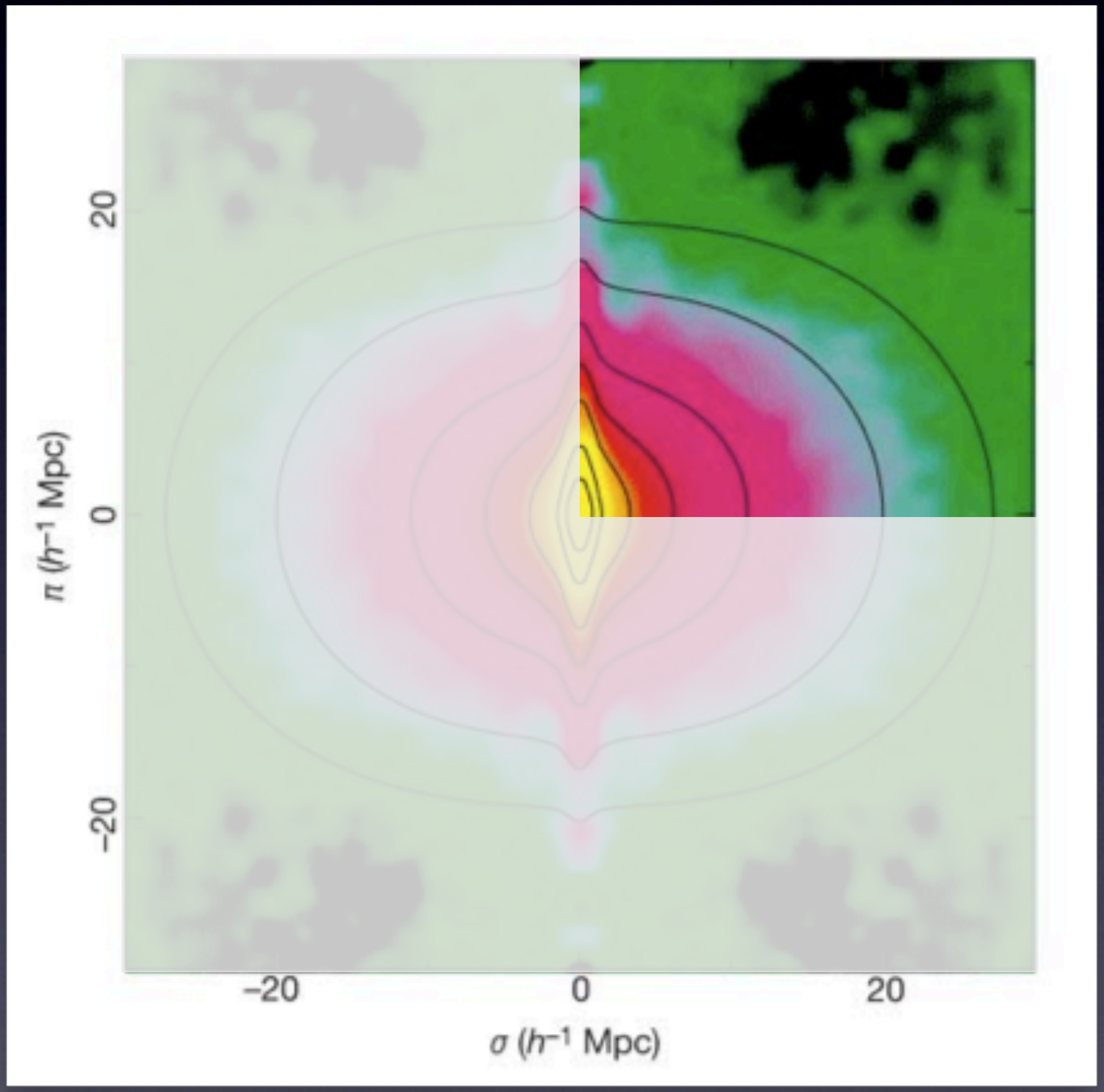


Measurements

$\beta = \Omega^{0.6}/b$

- Correlation: $\xi(\sigma, \pi)$
- Quadrupole-to-monopole ratio of power spectrum

$$\xi_2/\xi_0 = f(n)\ \frac{(4\beta/3 + 4\beta^2/7)}{(1 + 2\beta/3 + \beta^2/5)}$$

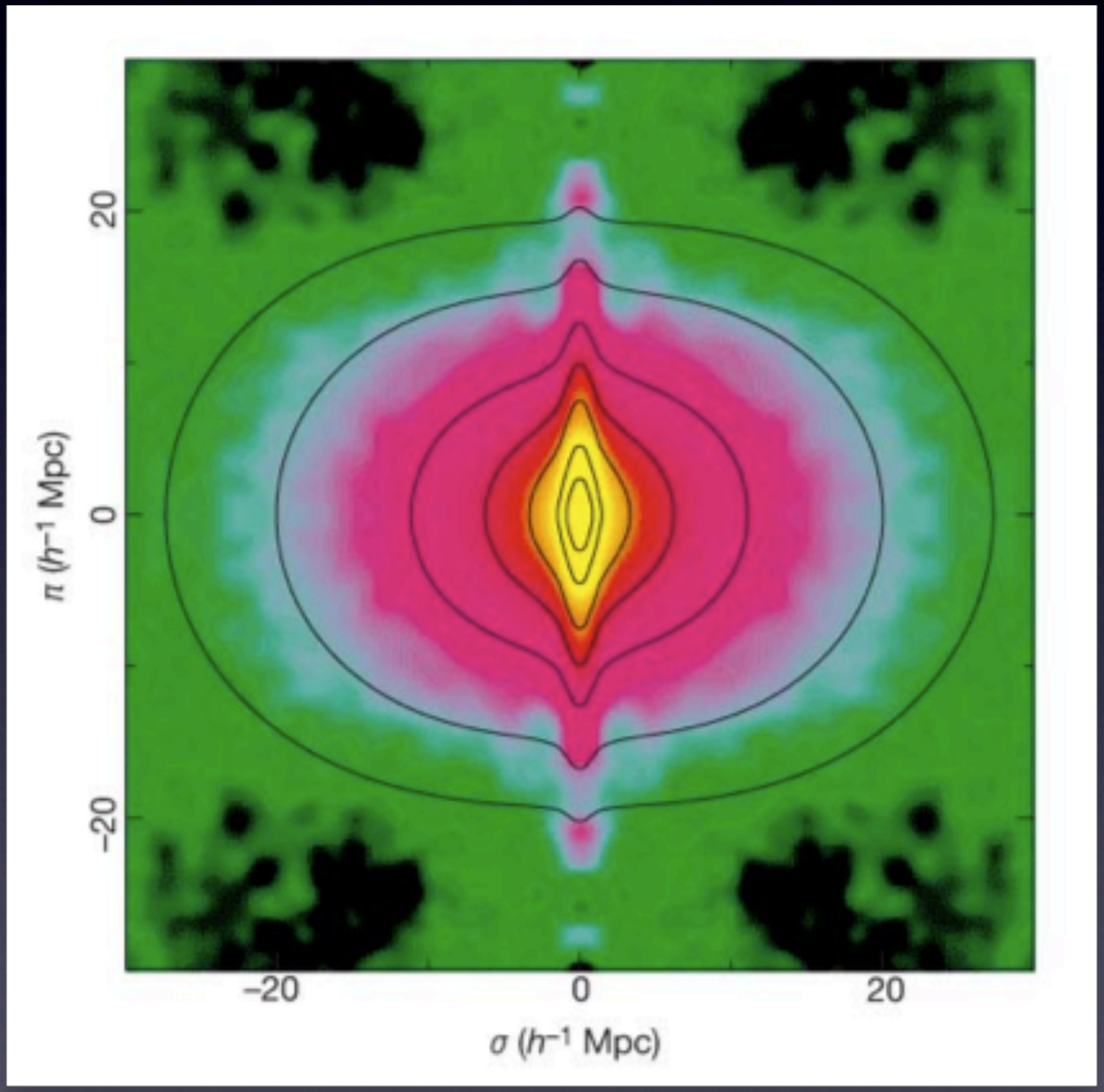


Measurements

$\beta = \Omega^{0.6}/b$

- Correlation: $\xi(\sigma, \pi)$
- Quadrupole-to-monopole ratio of power spectrum

$$\xi_2/\xi_0 = f(n)\ \frac{(4\beta/3+4\beta^2/7)}{(1+2\beta/3+\beta^2/5)}$$

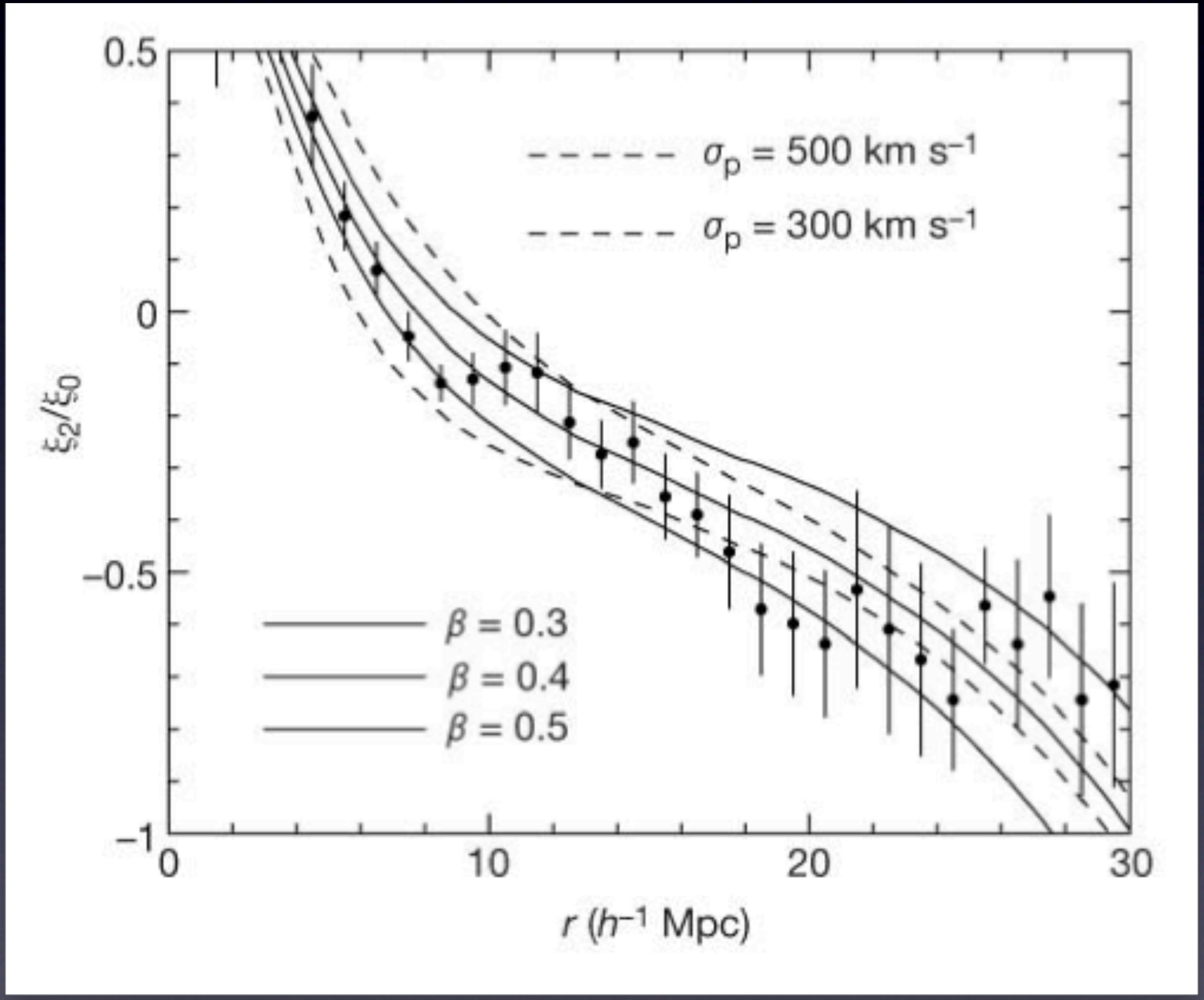


Measurements

$\beta = \Omega^{0.6}/b$

- Correlation: $\xi(\sigma, \pi)$
- Quadrupole-to-monopole ratio of power spectrum

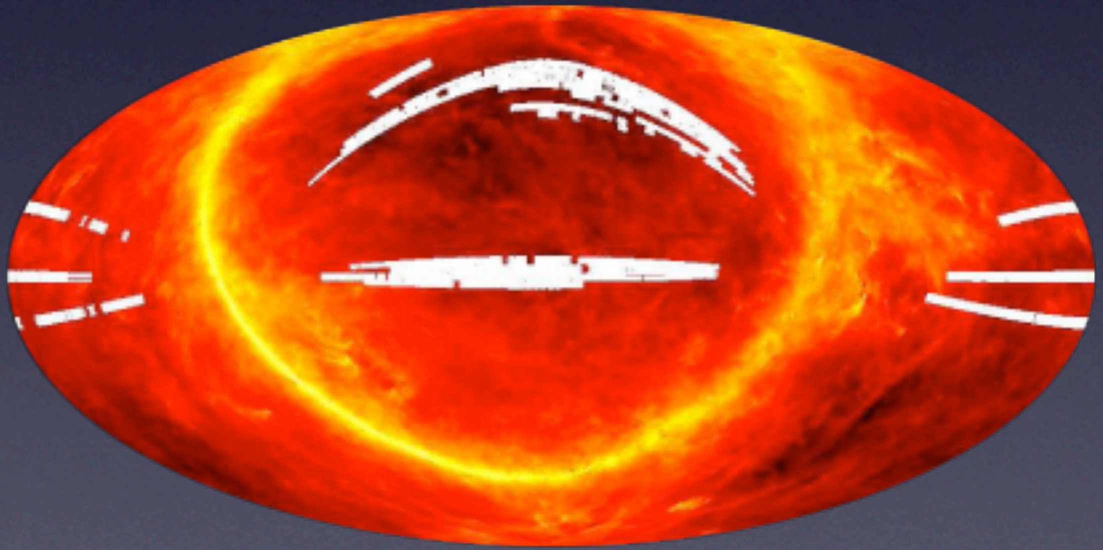
$$\xi_2/\xi_0 = f(n)\,\frac{(4\beta/3+4\beta^2/7)}{(1+2\beta/3+\beta^2/5)}$$



Results

- β=0.43±0.07 $\xrightarrow{\text{Luminosity correction}}$ 0.54±0.09
- Ω=0.36±0.10
- Ω and β consistent with CMB and APM
- Spatially flat, vacuum-dominated universe

The three-dimensional power spectrum of galaxies from the Sloan Digital Sky Survey



Tegmark et al.

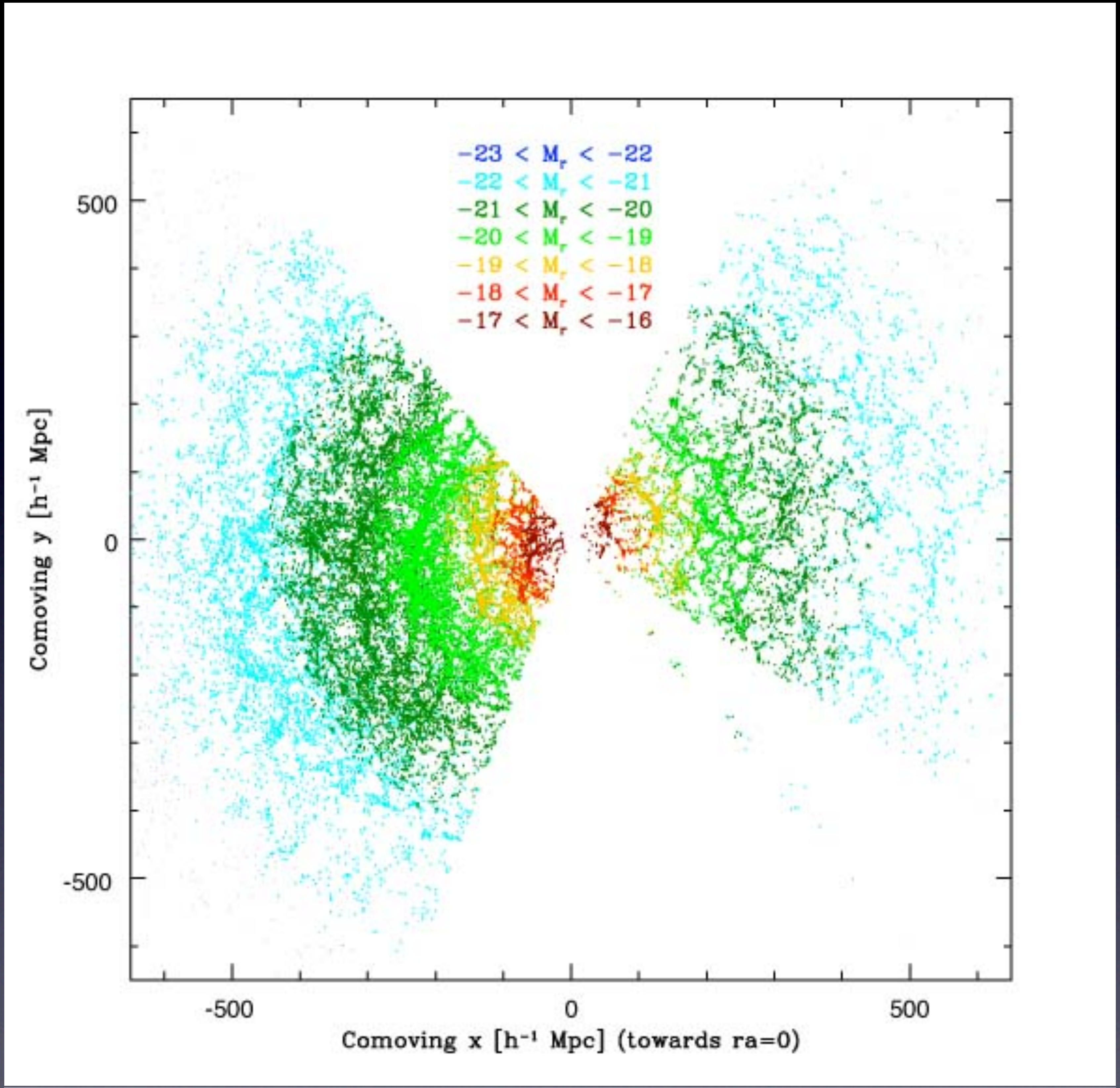
The Astrophysical Journal Vol. 606, 2004

If the theory is right...
What do we expect?

- Clusters and voids (this paper)
  - Power spectrum
- Peculiar velocities (last paper)

The Survey (SDSS)

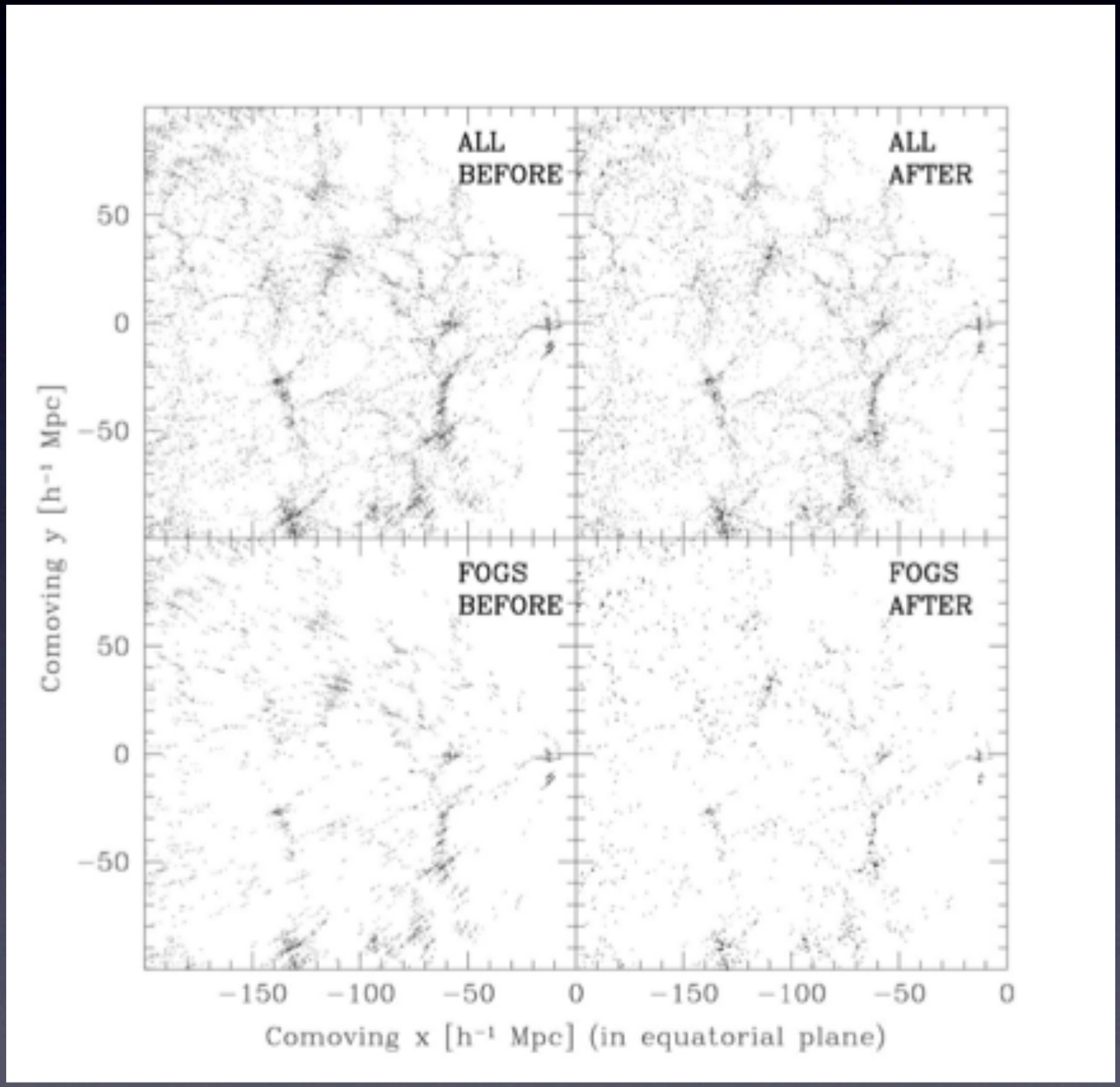
- 2.5 m telescope in New Mexico
- Observations made from 1998-2002
- Spectroscopic redshifts of 205,443 galaxies
- Flux limited sample to m_r=19.45
- Several strips along N & S galactic poles



-23 < M_r < -22
-22 < M_r < -21
-21 < M_r < -20
-20 < M_r < -19
-19 < M_r < -18
-18 < M_r < -17
-17 < M_r < -16
500
0
-500
Comoving y [h⁻¹ Mpc]
-500
0
500
Comoving x [h⁻¹ Mpc] (towards ra=0)

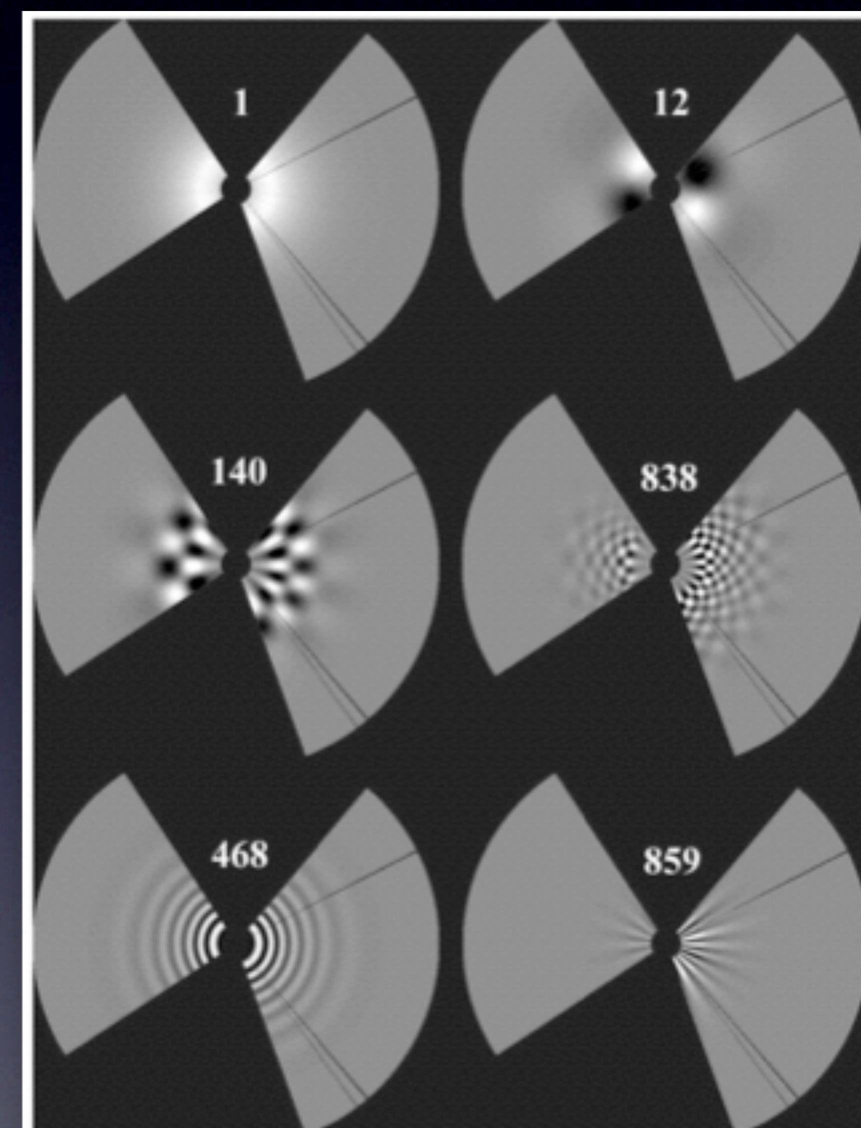
Removing Bias

- Finger of God Compression
  - friends-of-friends
- Leakage from other spectra
  - Disentanglement
  - Modeling
- Luminosity Bias
  - redshift slope



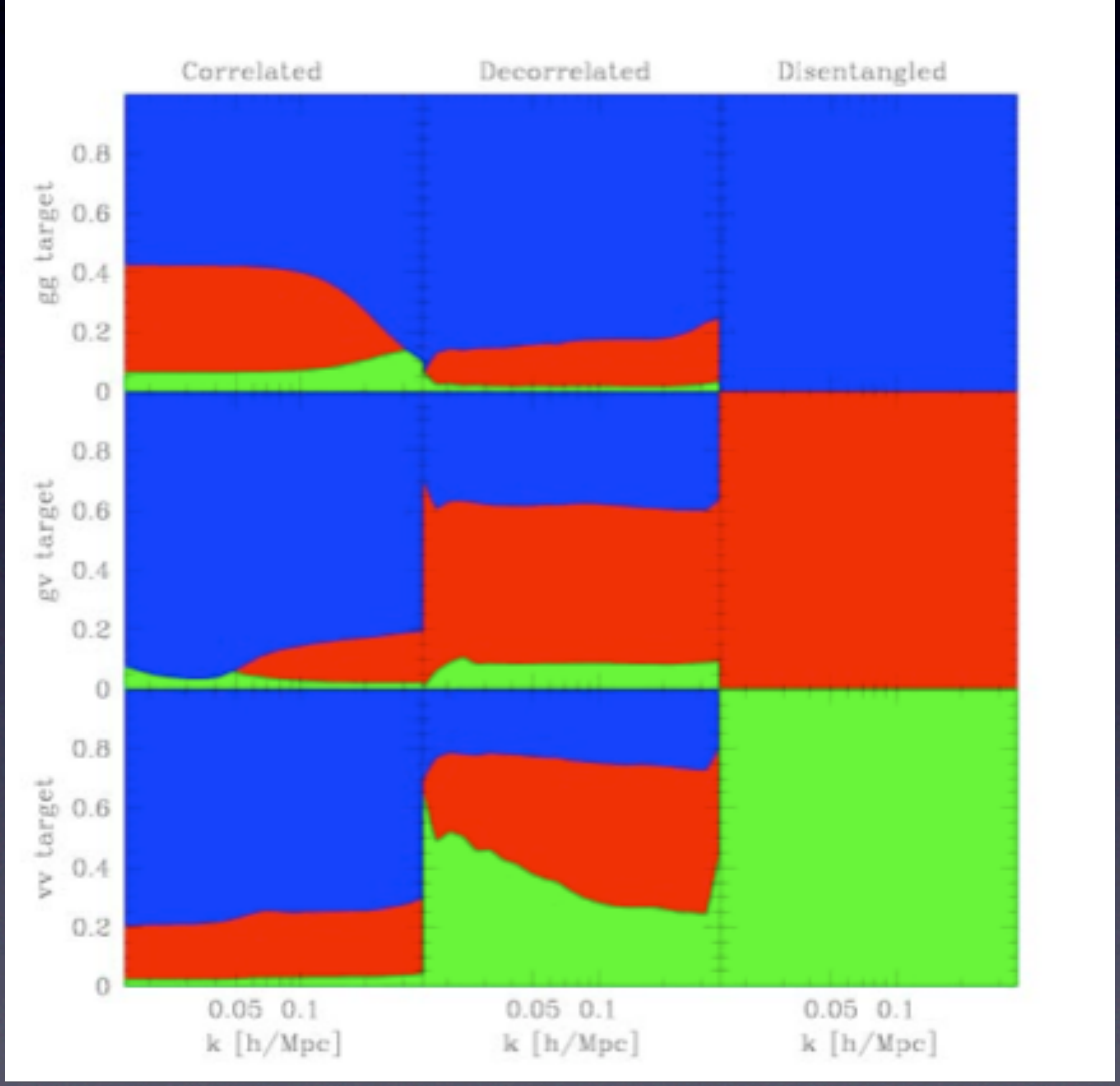
Removing Bias

- Finger of God Compression
    - friends-of-friends
- Leakage from other spectra
    - Disentanglement
    - Modeling
- Luminosity Bias
    - redshift slope



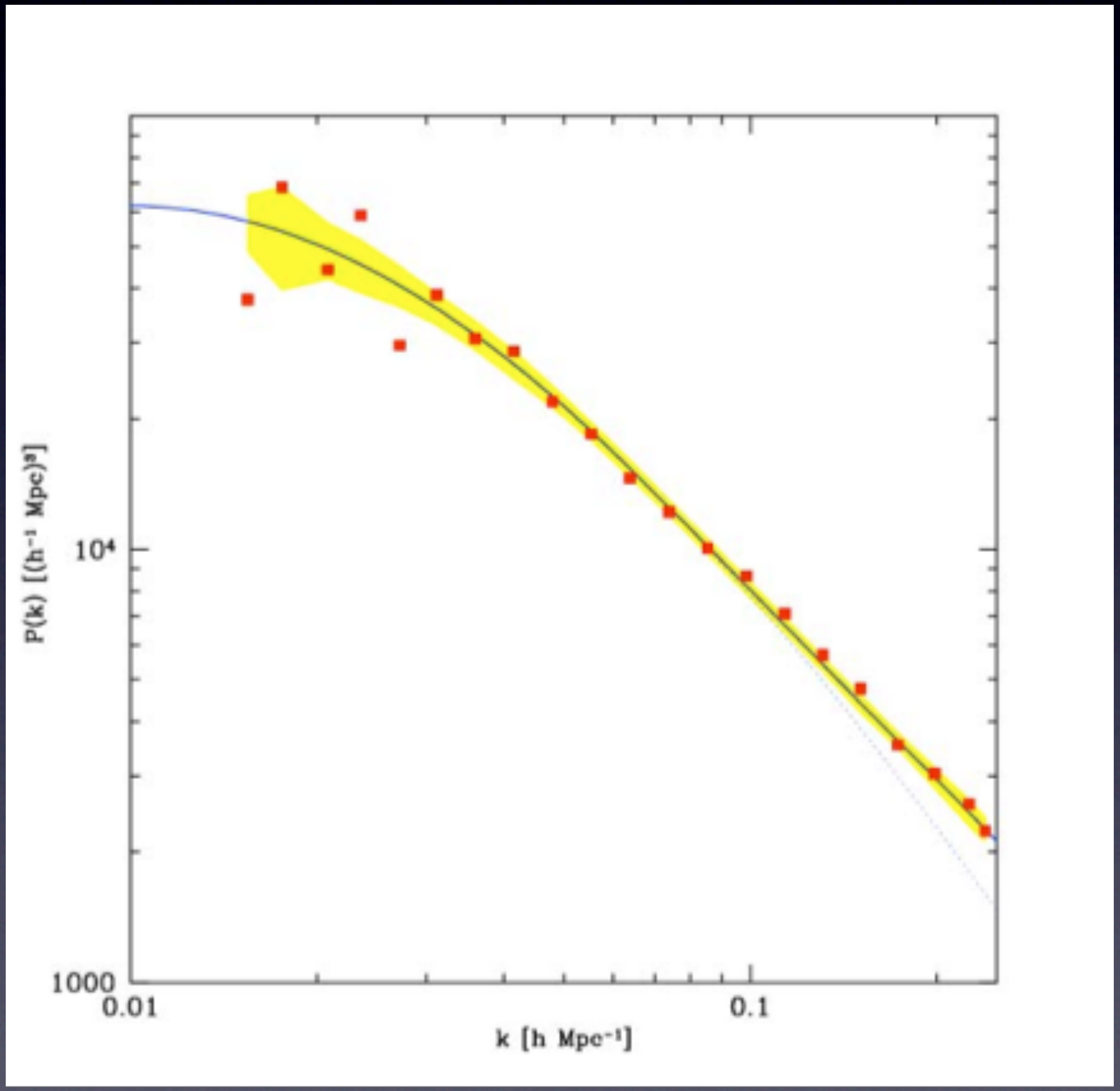
Removing Bias

- Finger of God Compression
  - friends-of-friends
- Leakage from other spectra
  - Disentanglement
  - Modeling
- Luminosity Bias
  - redshift slope



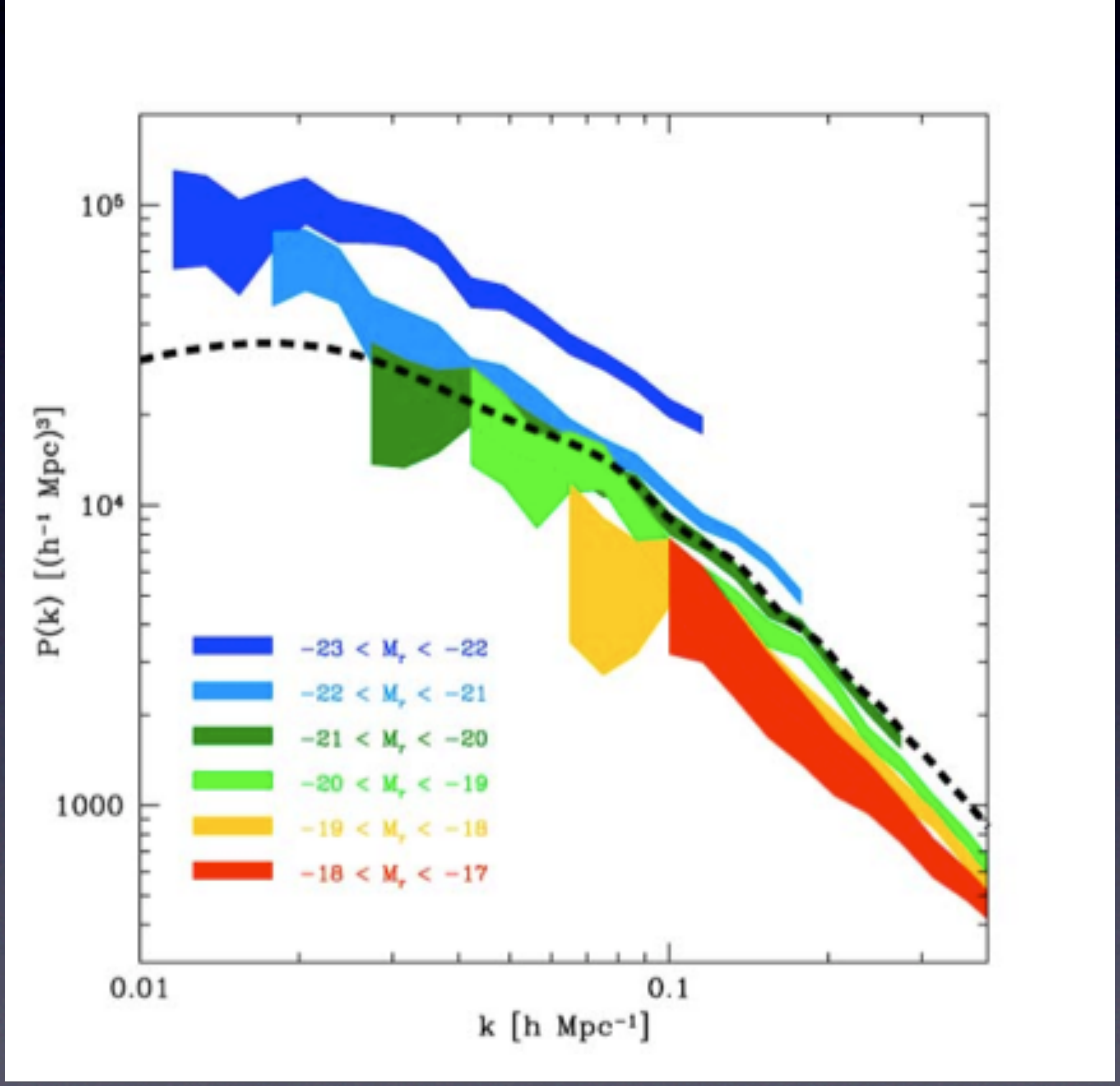
Removing Bias

- Finger of God Compression
  - friends-of-friends
- Leakage from other spectra
  - Disentanglement
  - Modeling
- Luminosity Bias
  - redshift slope

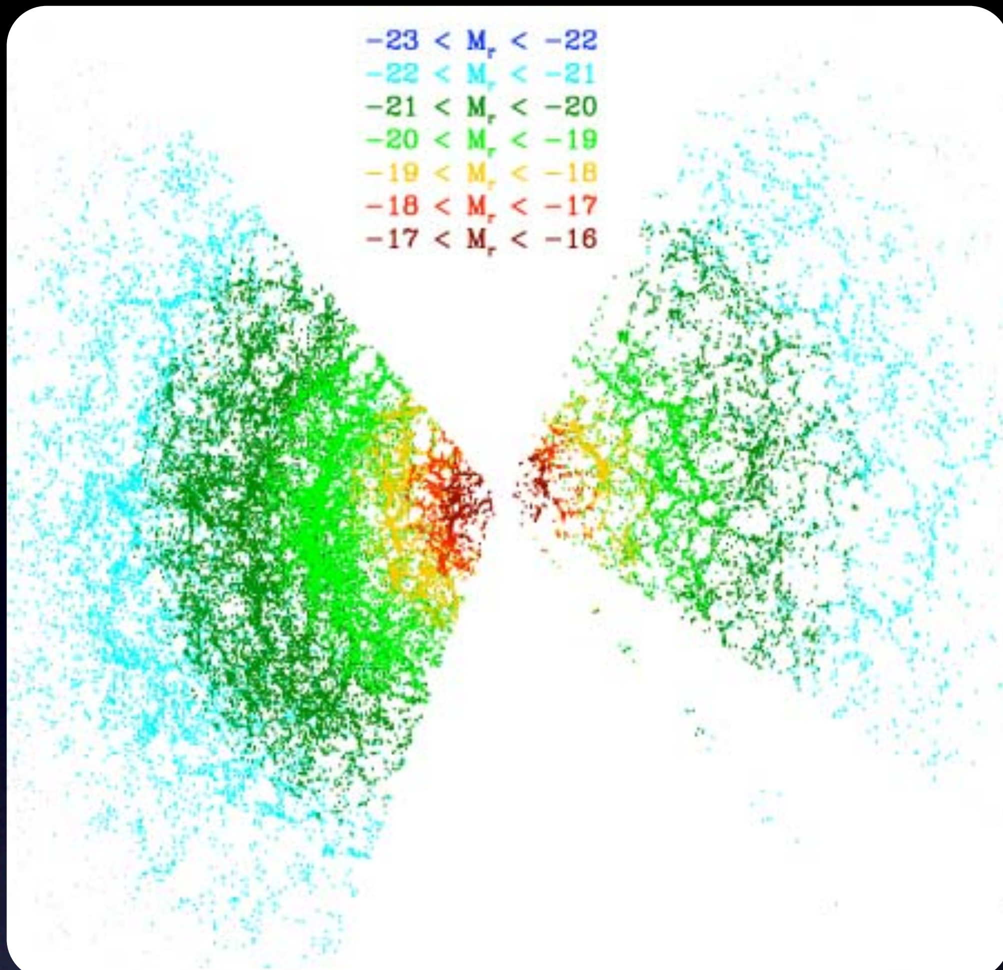


Removing Bias

- Finger of God Compression
  - friends-of-friends
- Leakage from other spectra
  - Disentanglement
  - Modeling
- Luminosity Bias
  - redshift slope



oving Bias

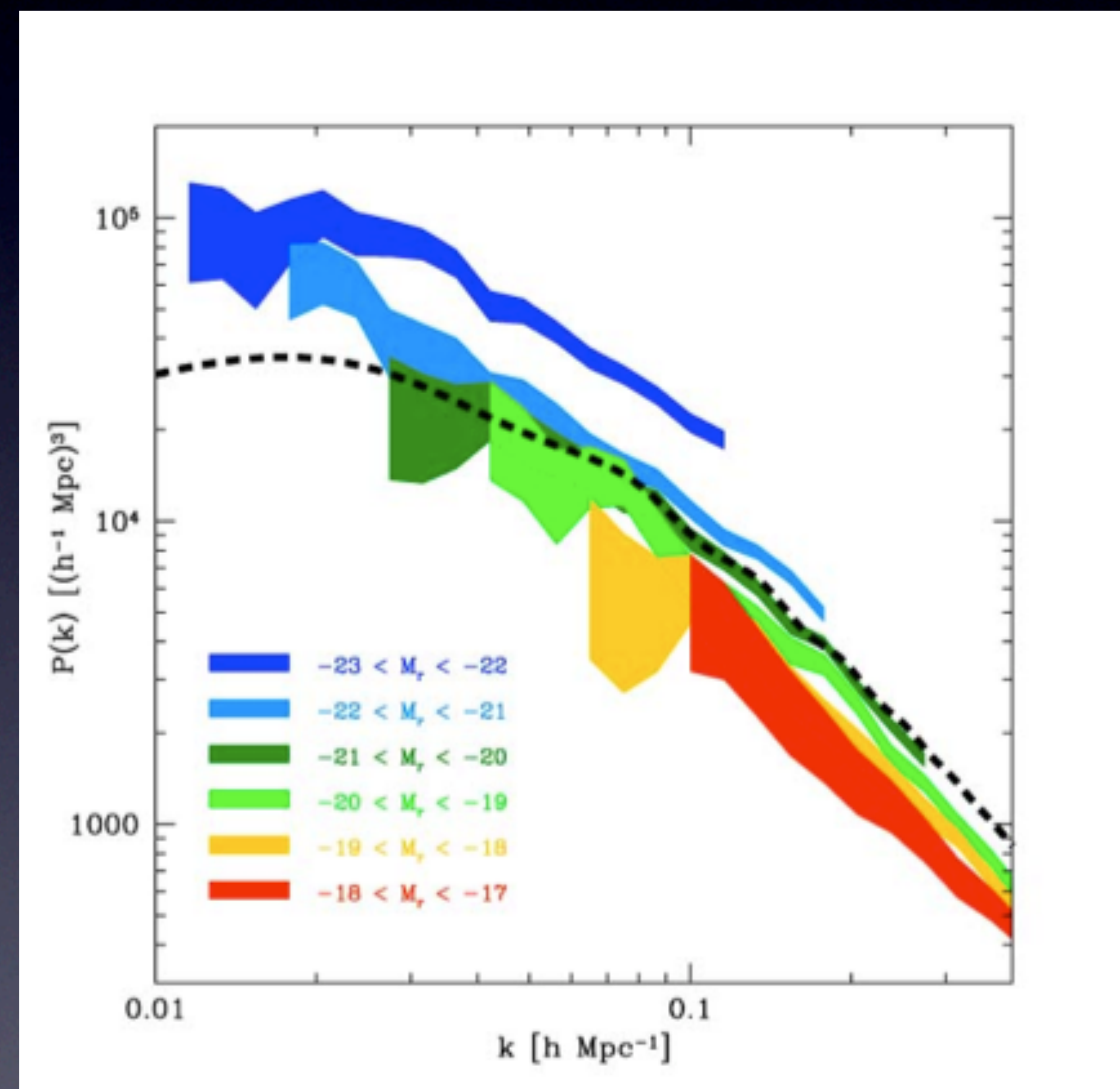


on

ra

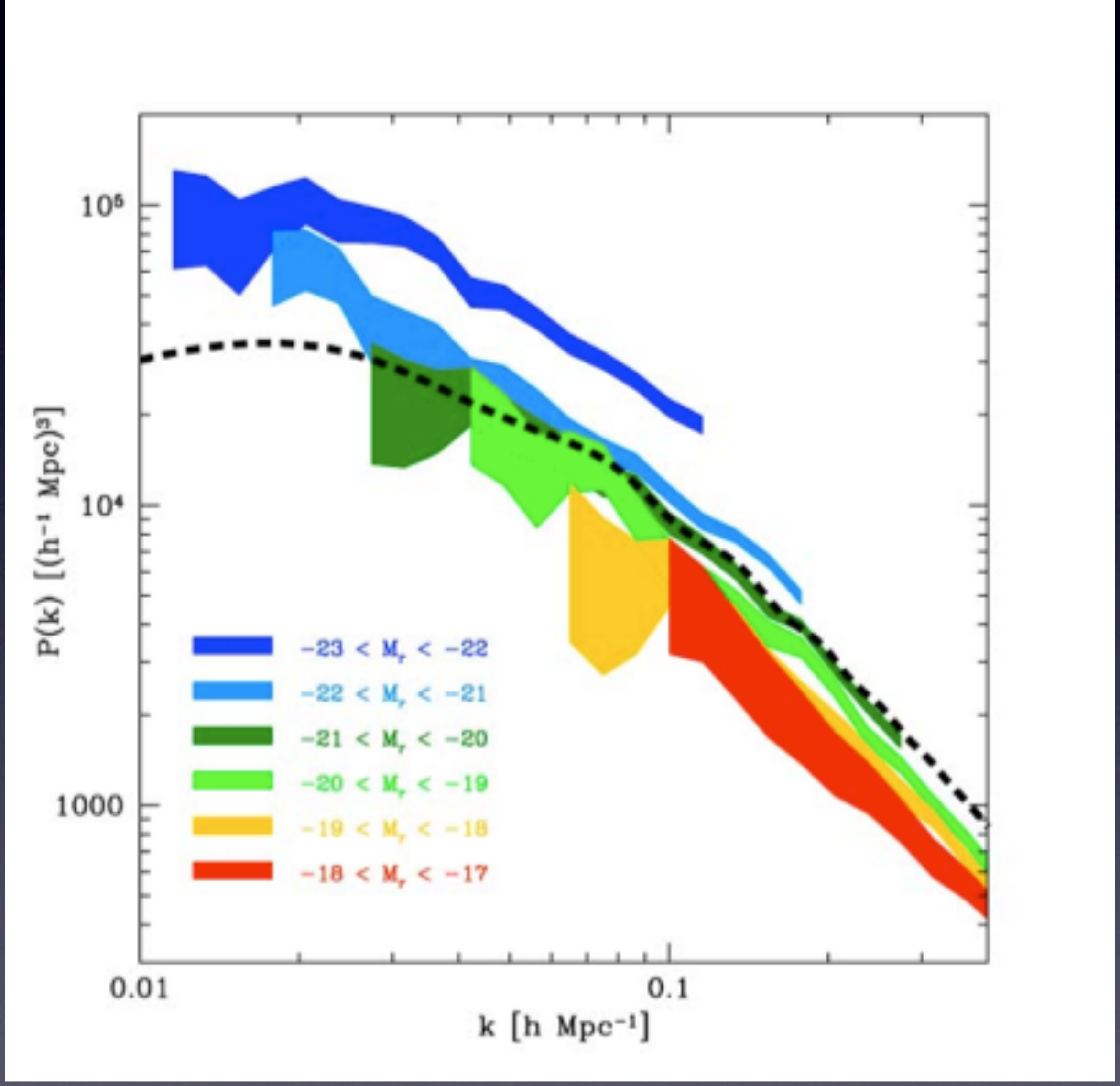
- Disentanglement
- Modeling

- Luminosity Bias
  - redshift slope



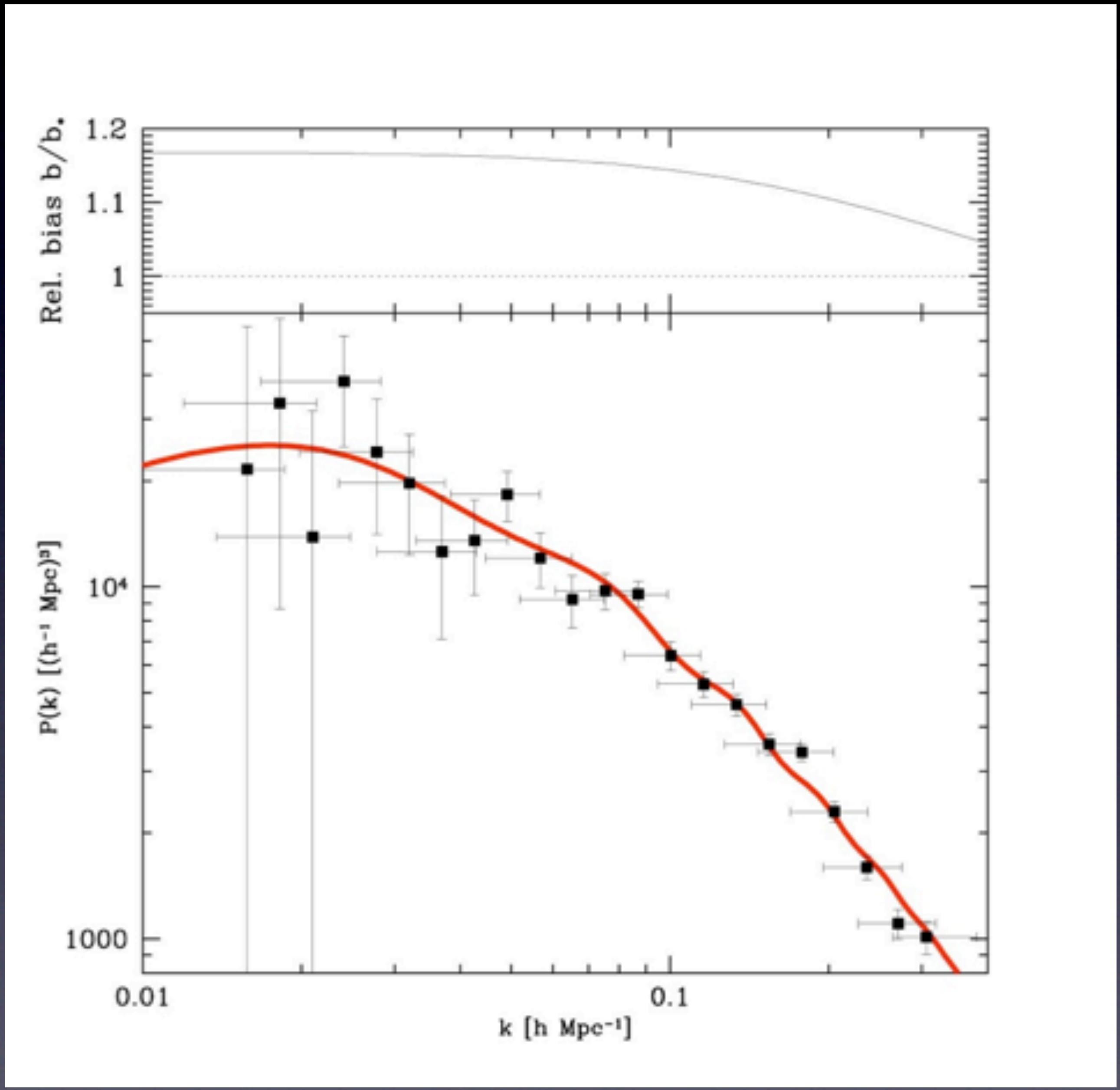
Removing Bias

- Finger of God Compression
  - friends-of-friends
- Leakage from other spectra
  - Disentanglement
  - Modeling
- Luminosity Bias
  - redshift slope



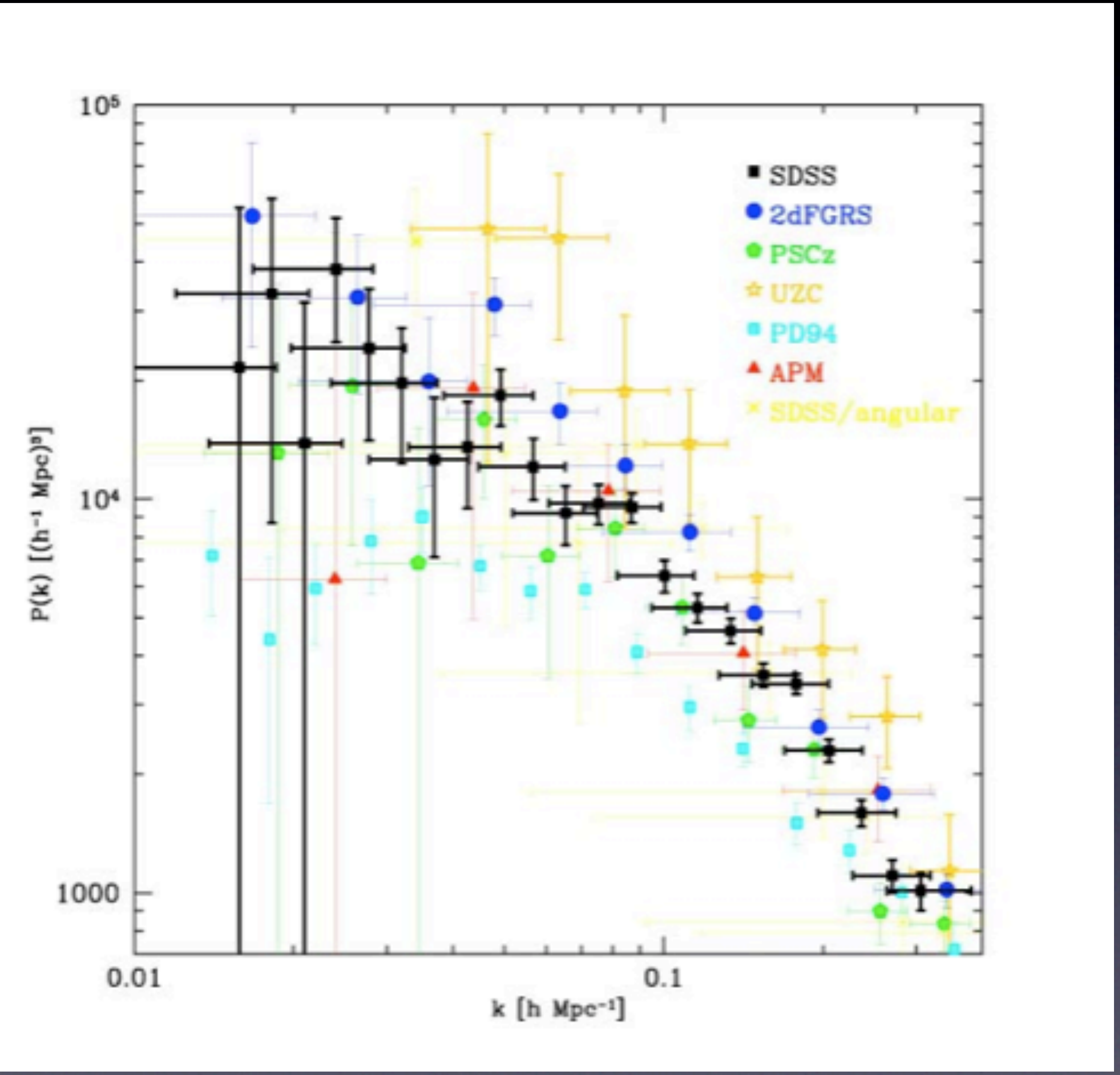
Results

- Ω=0.295±0.0323
- σ_8=0.89±0.02
- Similar to other results
- Favors “vanilla” flat ΛCDM model



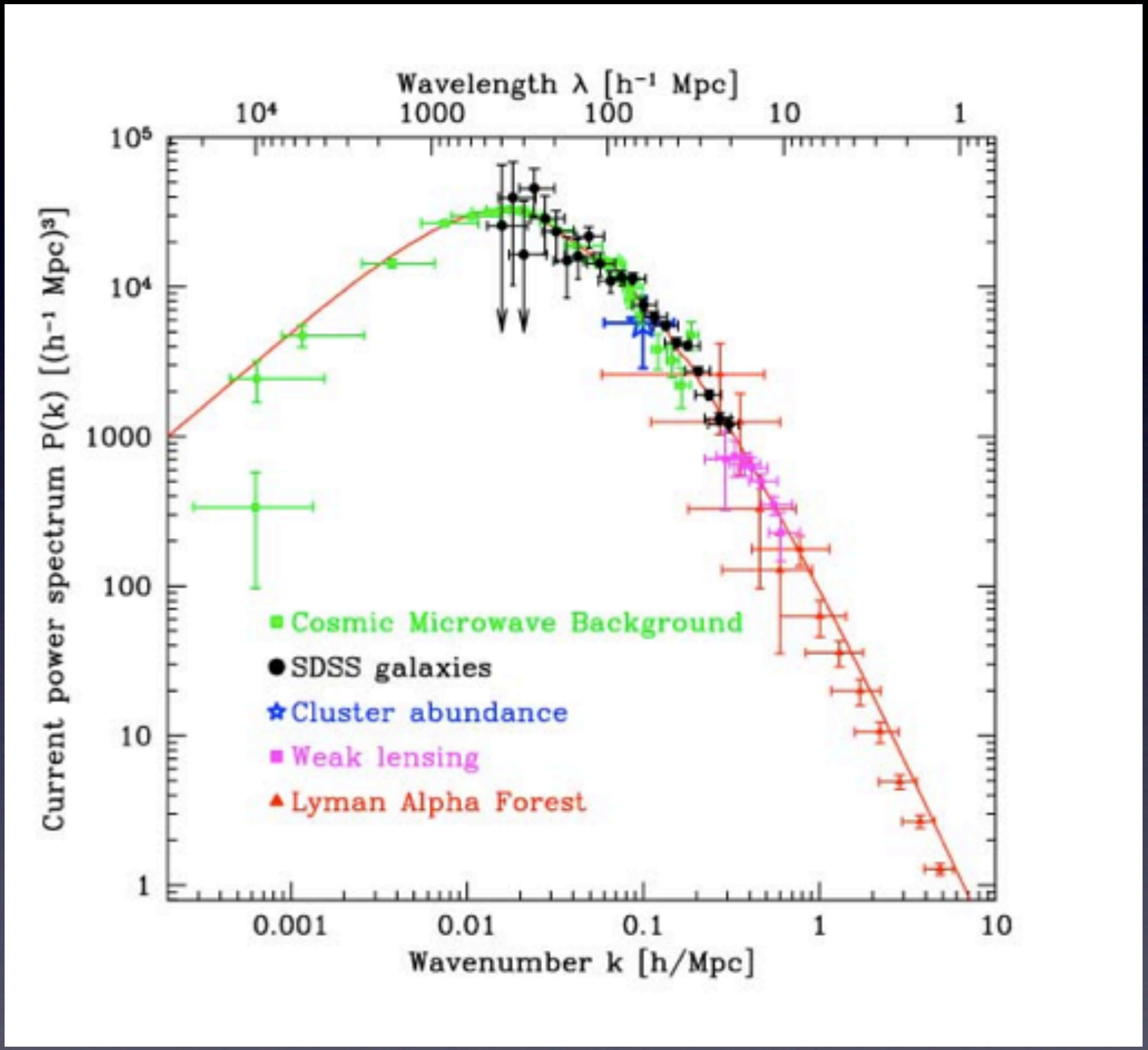
Results

- Ω=0.295±0.0323
- σ_8=0.89±0.02
- Similar to other results
- Favors "vanilla" flat ΛCDM model



Results

- Ω=0.295±0.0323
- σ_8=0.89±0.02
- Similar to other results
- Favors "vanilla" flat ΛCDM model



Results

- Ω=0.295±0.0323
- σ_8=0.89±0.02
- Similar to other results
- Favors "vanilla" flat ΛCDM model