

# The Galaxy-Dark Matter Connection from the Sloan Digital Sky Survey

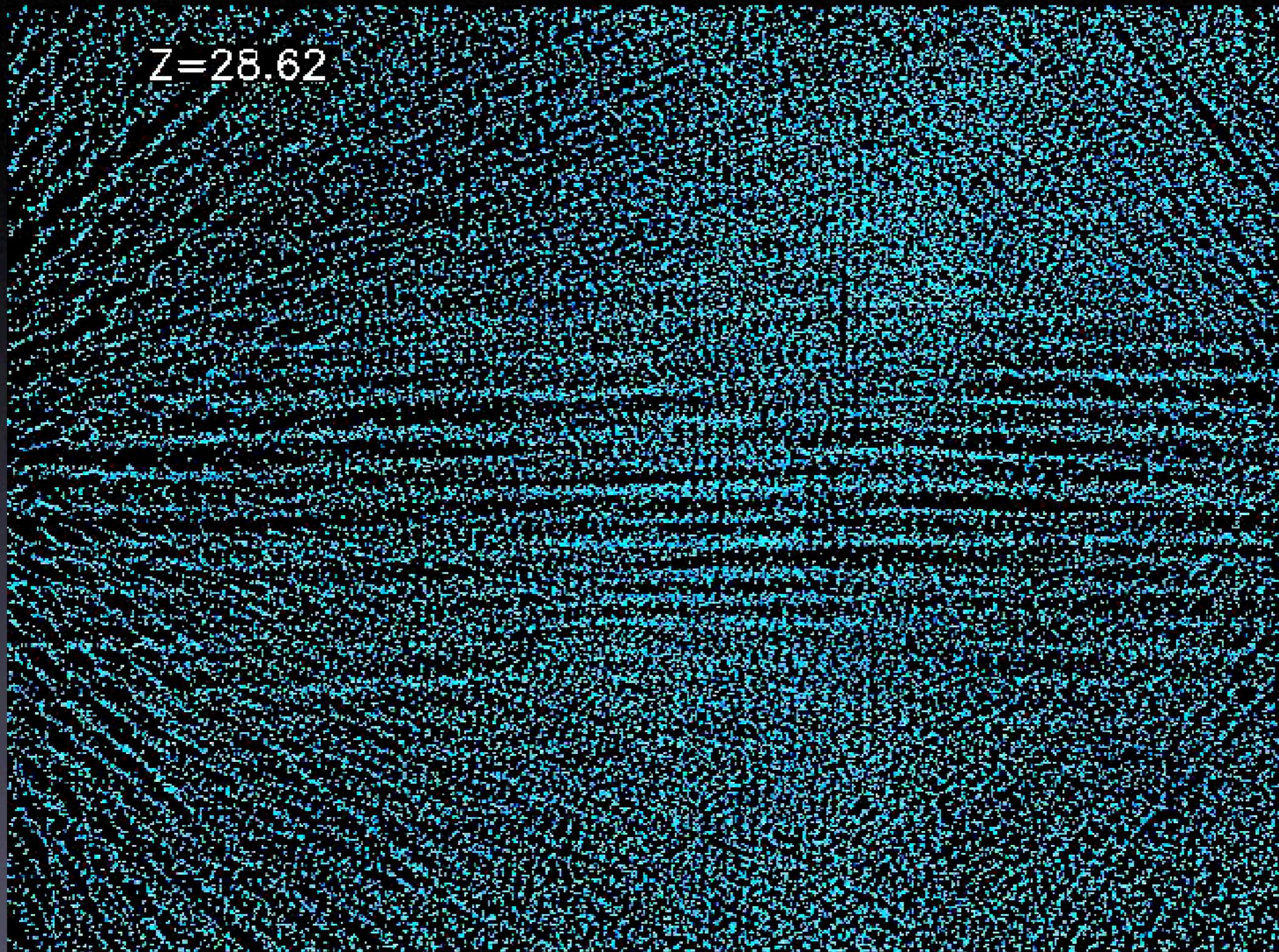
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Zheng Zheng (IAS Princeton), David Weinberg (Ohio)

SDSS Collaboration



$Z=28.62$

[courtesy Andrey Kravtsov]

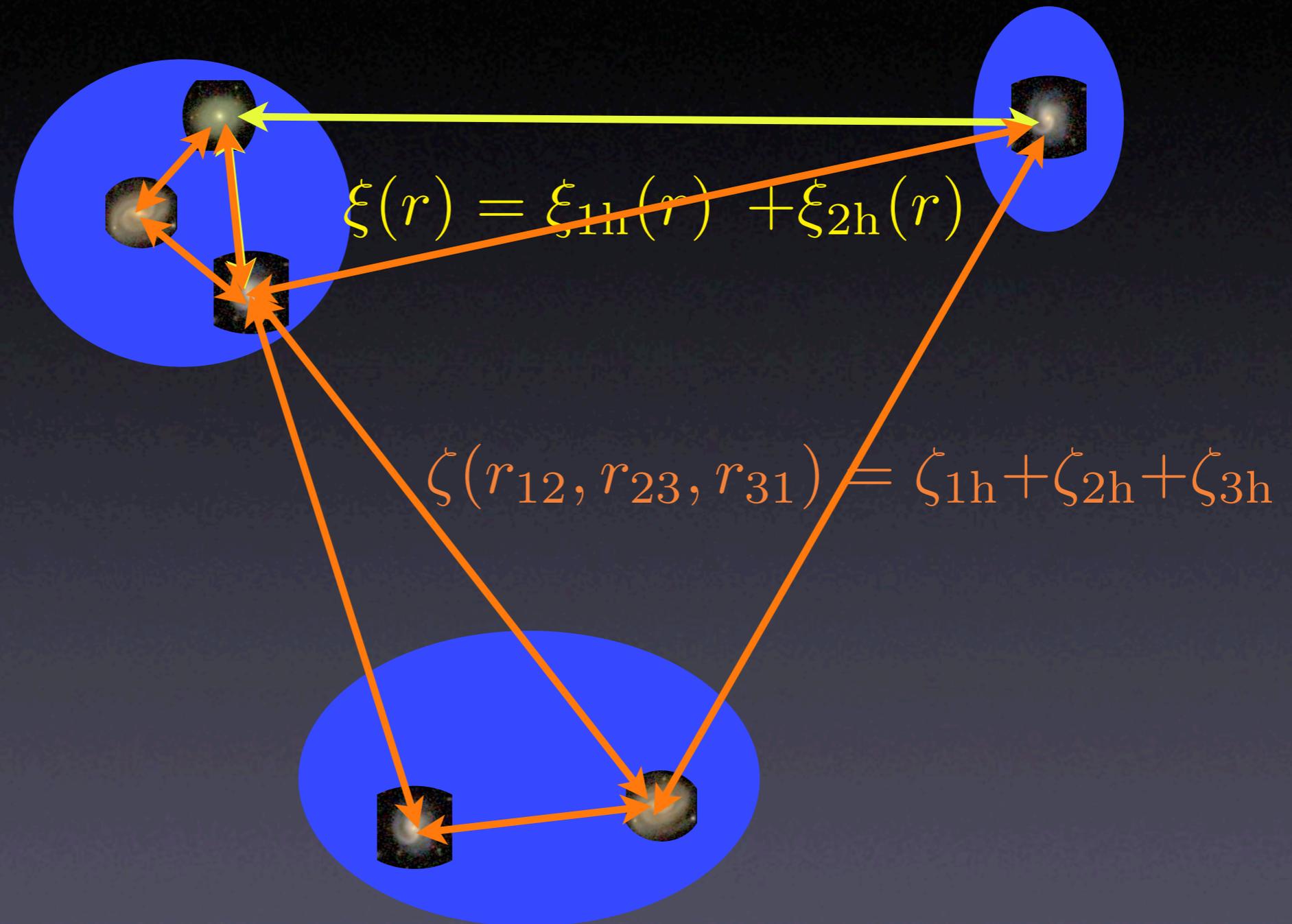
# Predicting all Galaxy Clustering via The Halo Model & Halo Occupation Distribution

- The halo model gives statistics of the dark matter halo and mass distribution, given
  - - The number density of halos of a given mass  $n(m)$ , i.e., the mass function
    - The density distribution within the halos  $\rho(m)$ : typically an NFW profile
    - The bias of halos of given mass,  $b(m)$ : analytically from  $n(m)$ , plus any scale dependence
  - 
  -
- Combined with the **probability distribution function** of galaxies in dark matter halos (HOD) gives a full model for galaxy clustering
  - the expected number of galaxies in a halo of a given mass, i.e.  $P(N|M)$
  - the spatial distribution of galaxies with respect to the dark matter

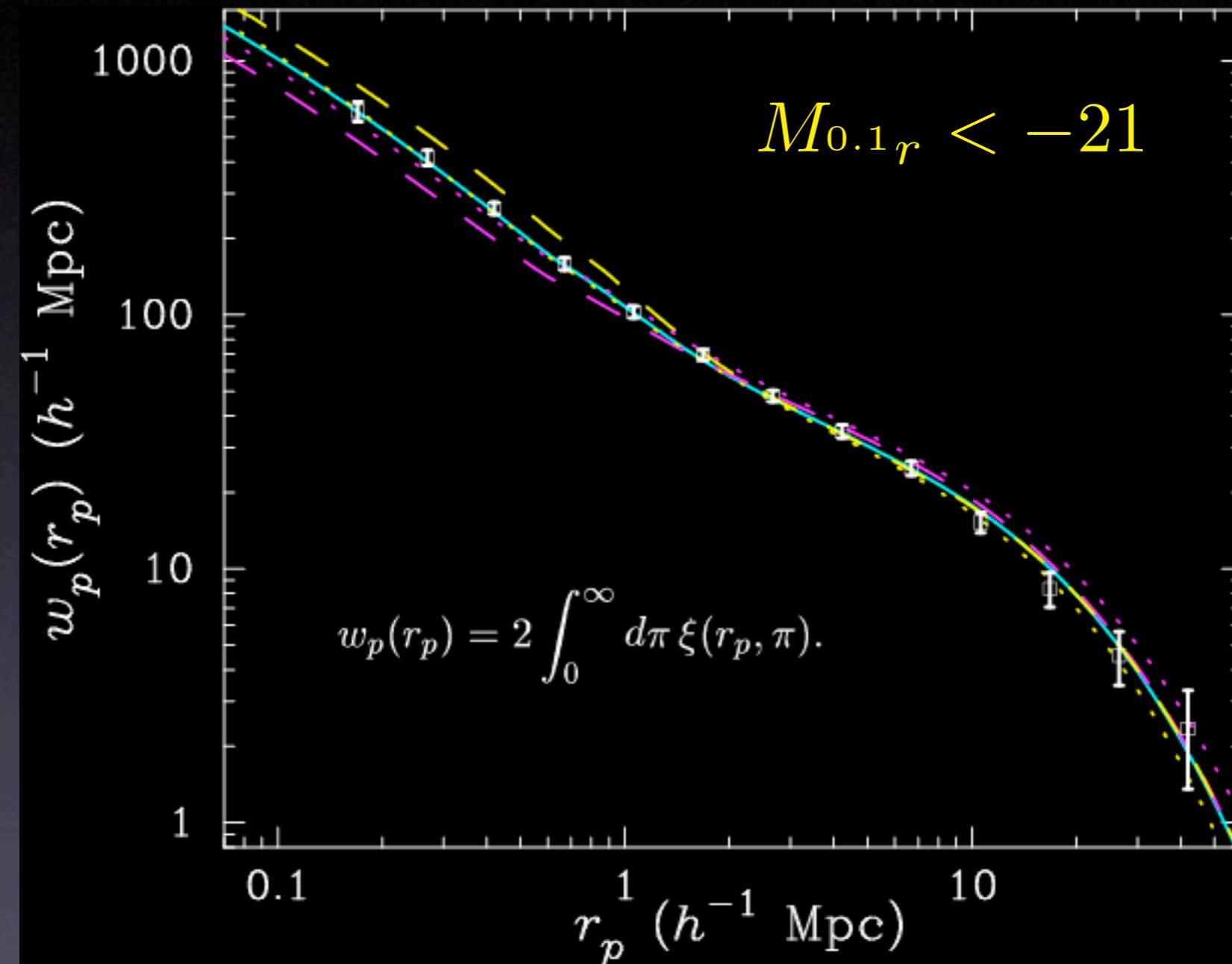


$$w_p(r_p) = 2 \int_0^{\pi_{\max}} d\pi \xi(r_p, \pi)$$

# The Halo Model in its Simplest Form



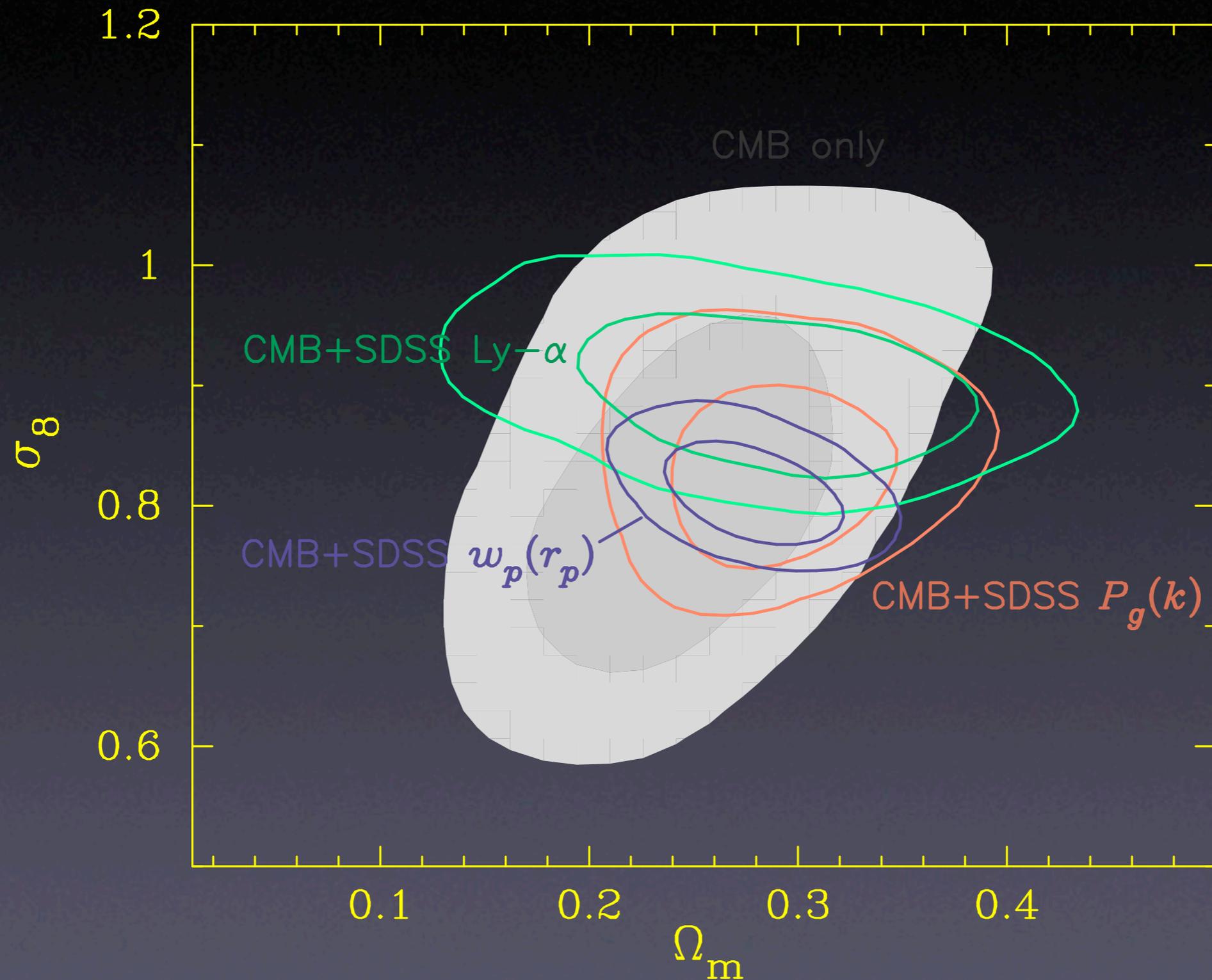
# The Projected Galaxy Correlation Function from SDSS



Measurement:  
Zehavi et al., 2004

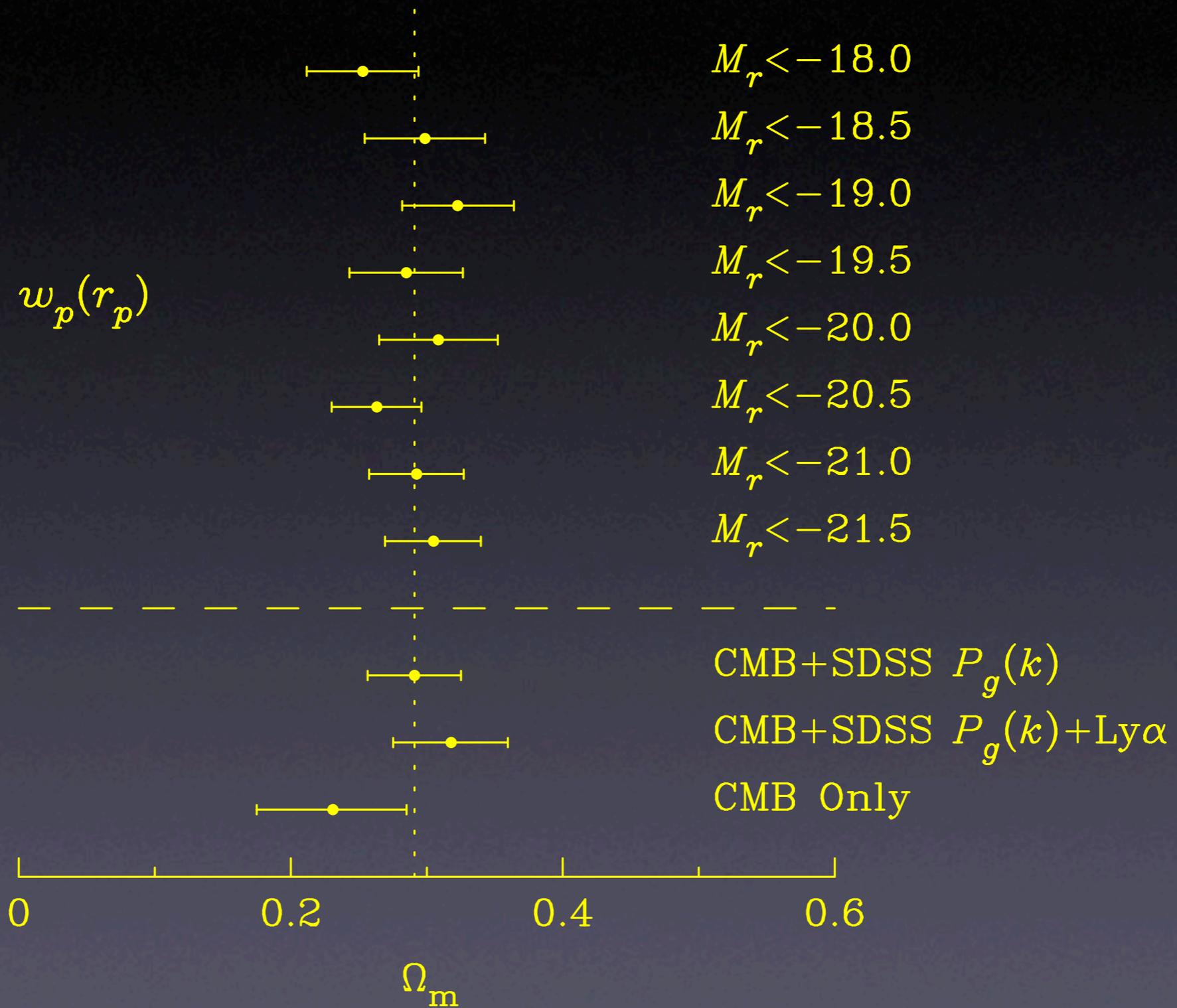
Cosmology:  
Abazajian et al 2005

# Multiple Methods of Extracting Cosmology with the Sloan Digital Sky Survey



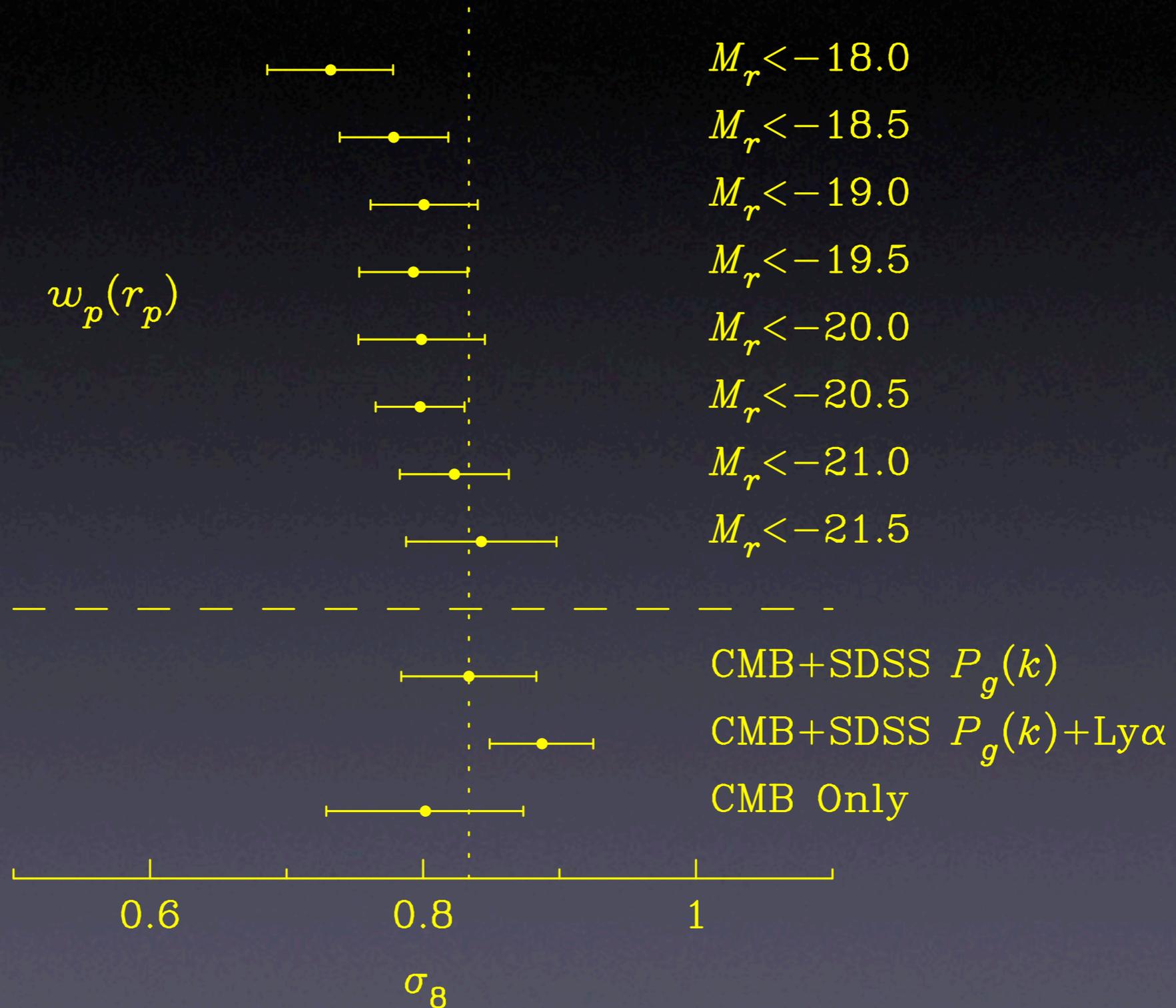
# Matter Density:

$$\Omega_m$$



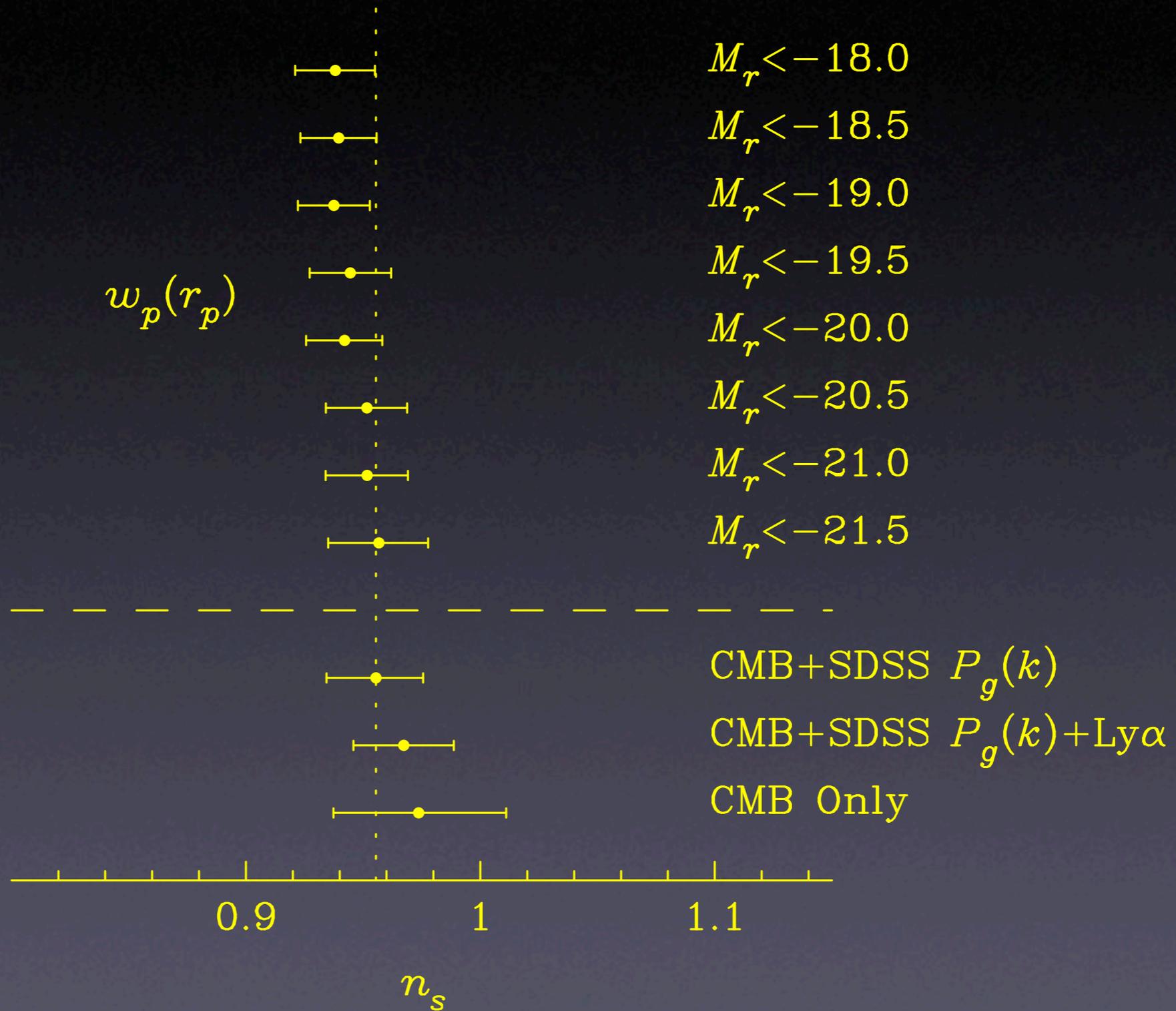
# Fluctuation Amplitude:

# $\sigma_8$



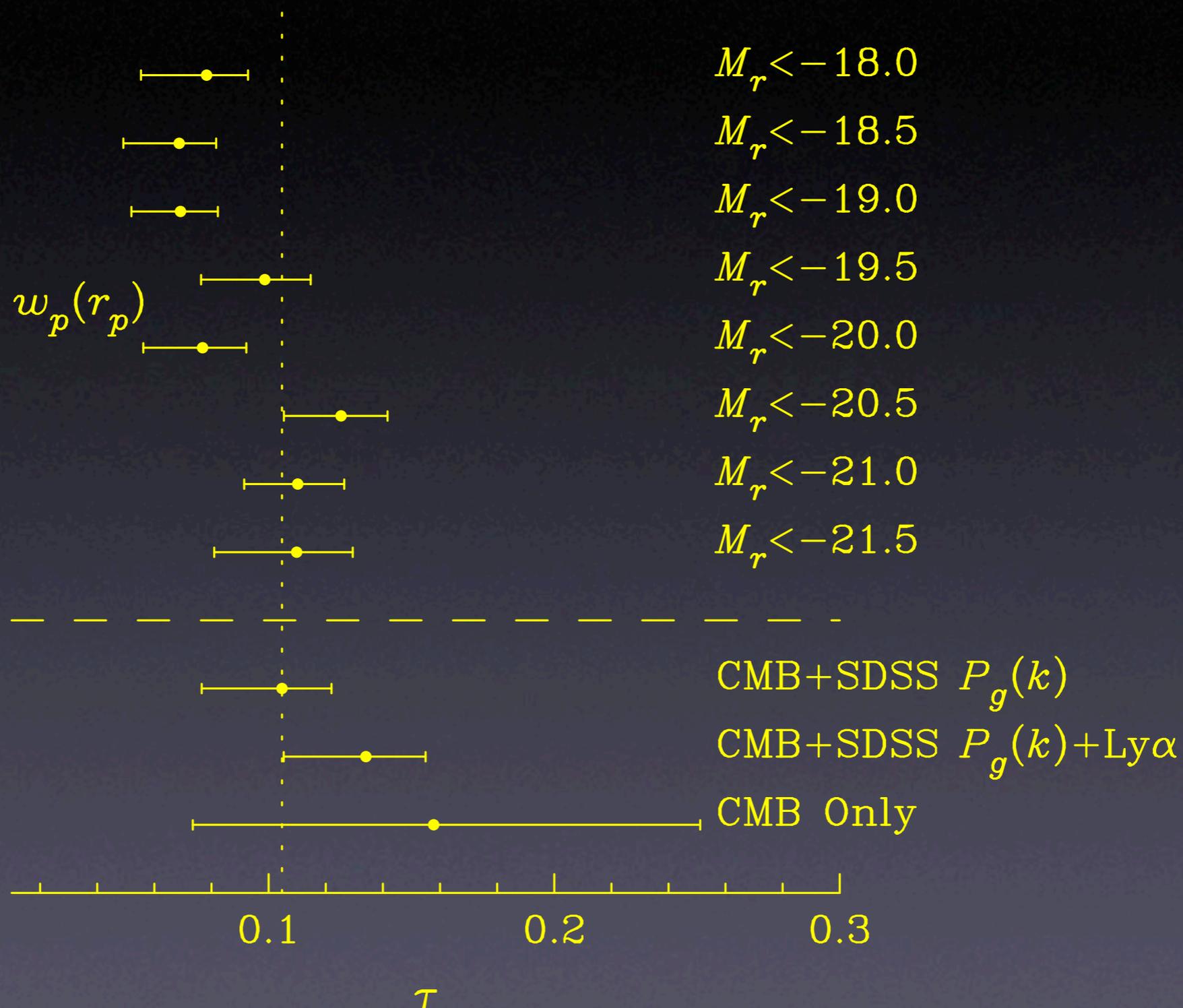
# Spectral Index of Primordial Fluctuations:

$n_s$

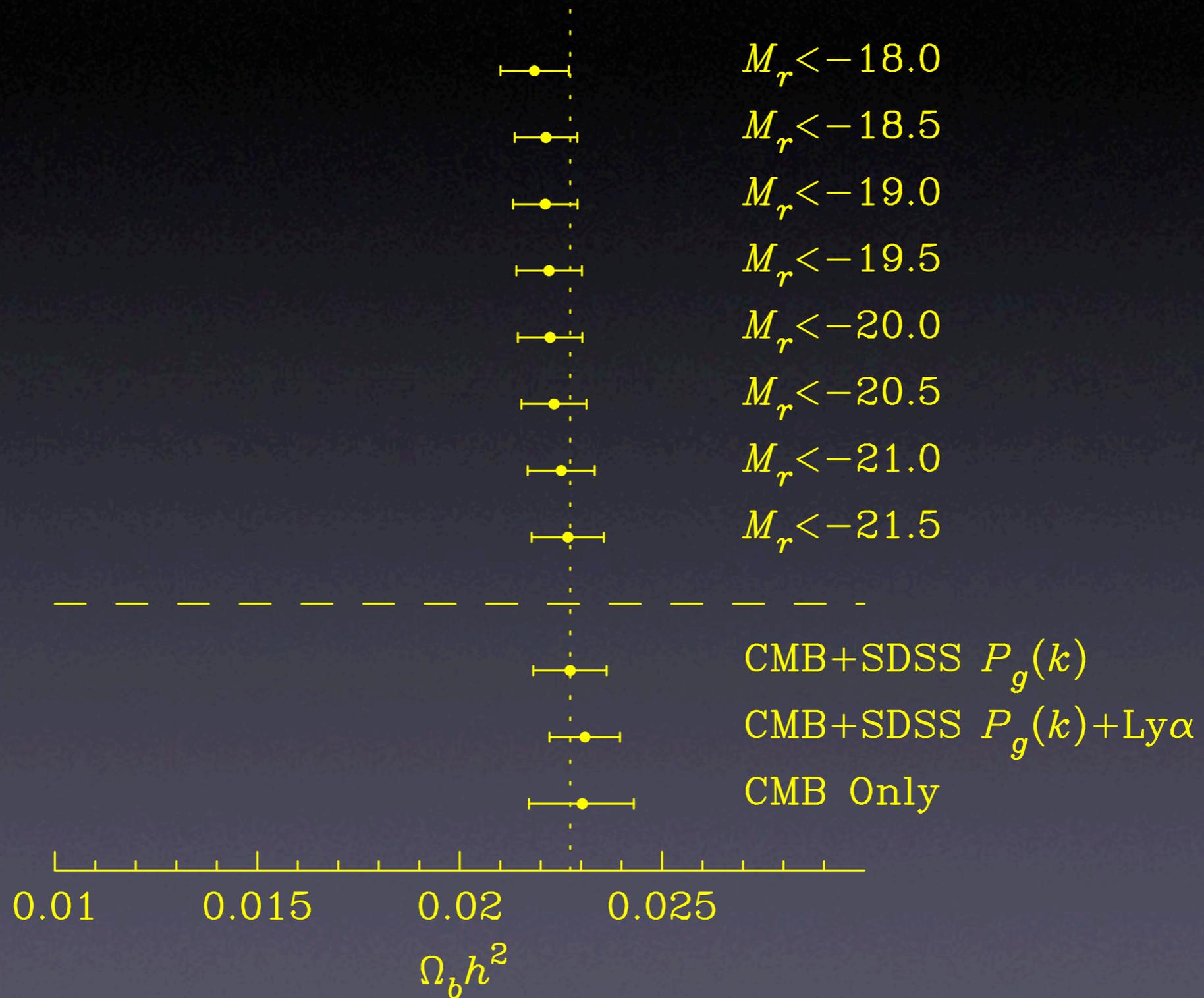


# Optical Depth to CMB Last Scattering Surface:

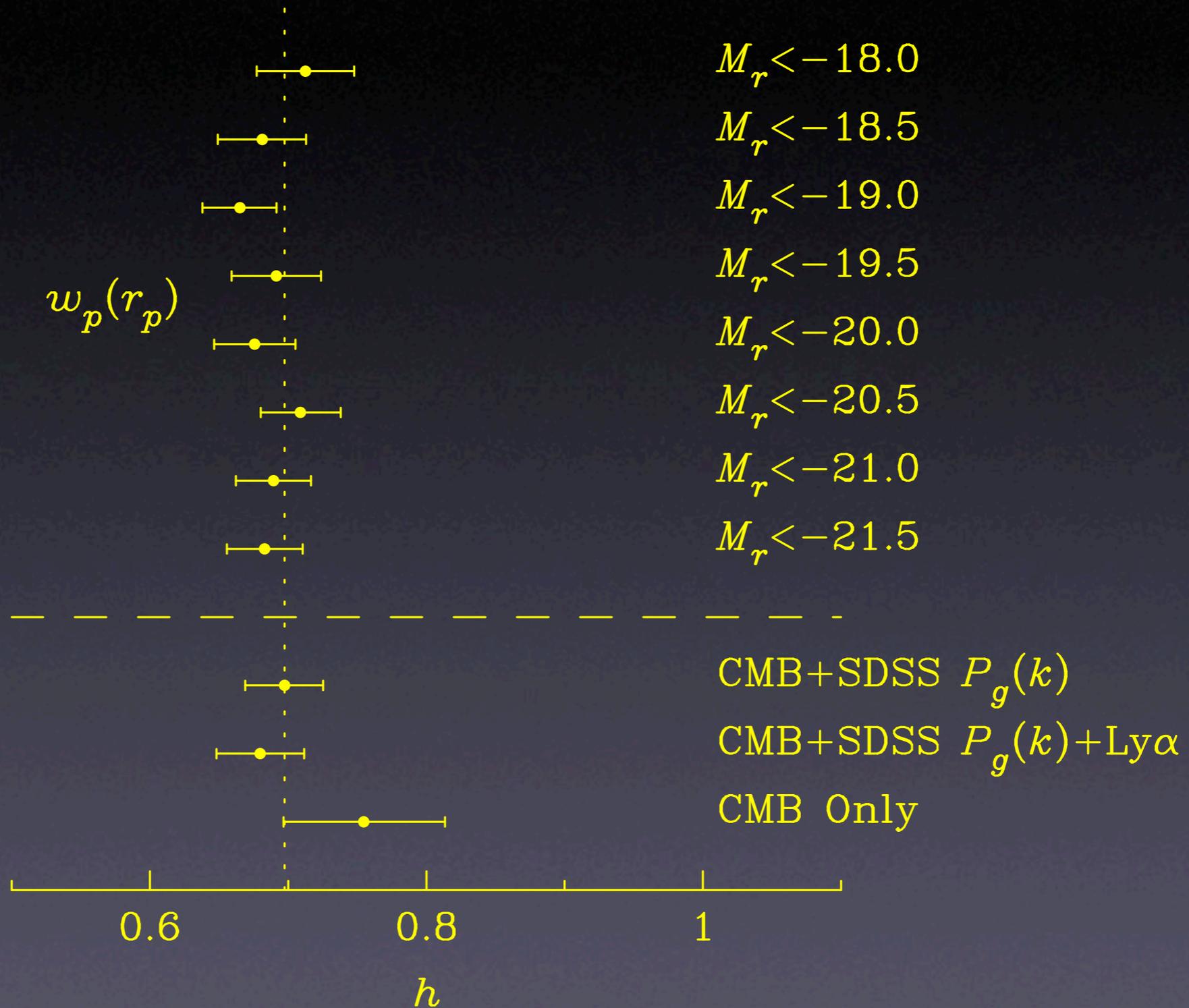
$\tau$



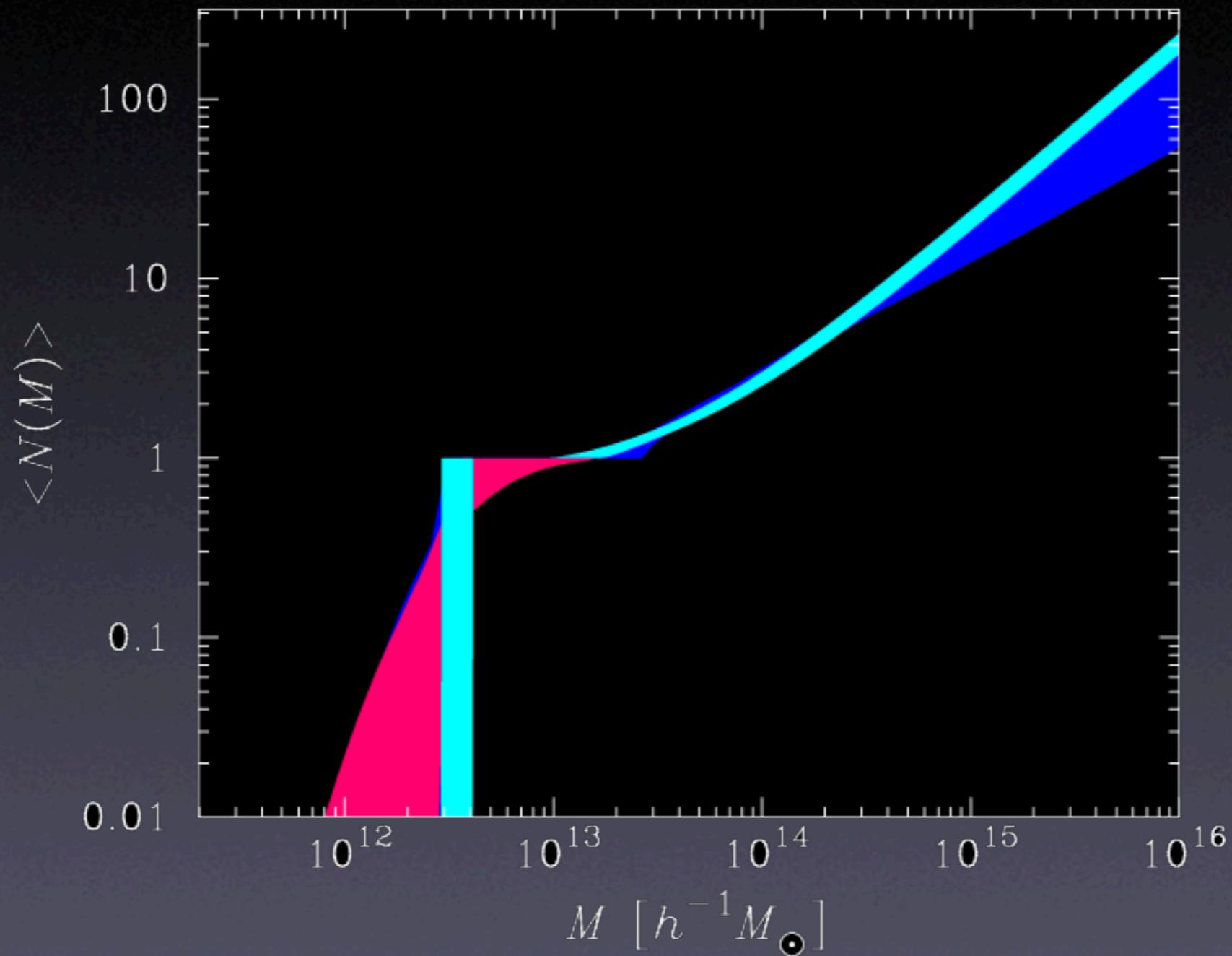
# Baryon Density: $\Omega_b h^2$



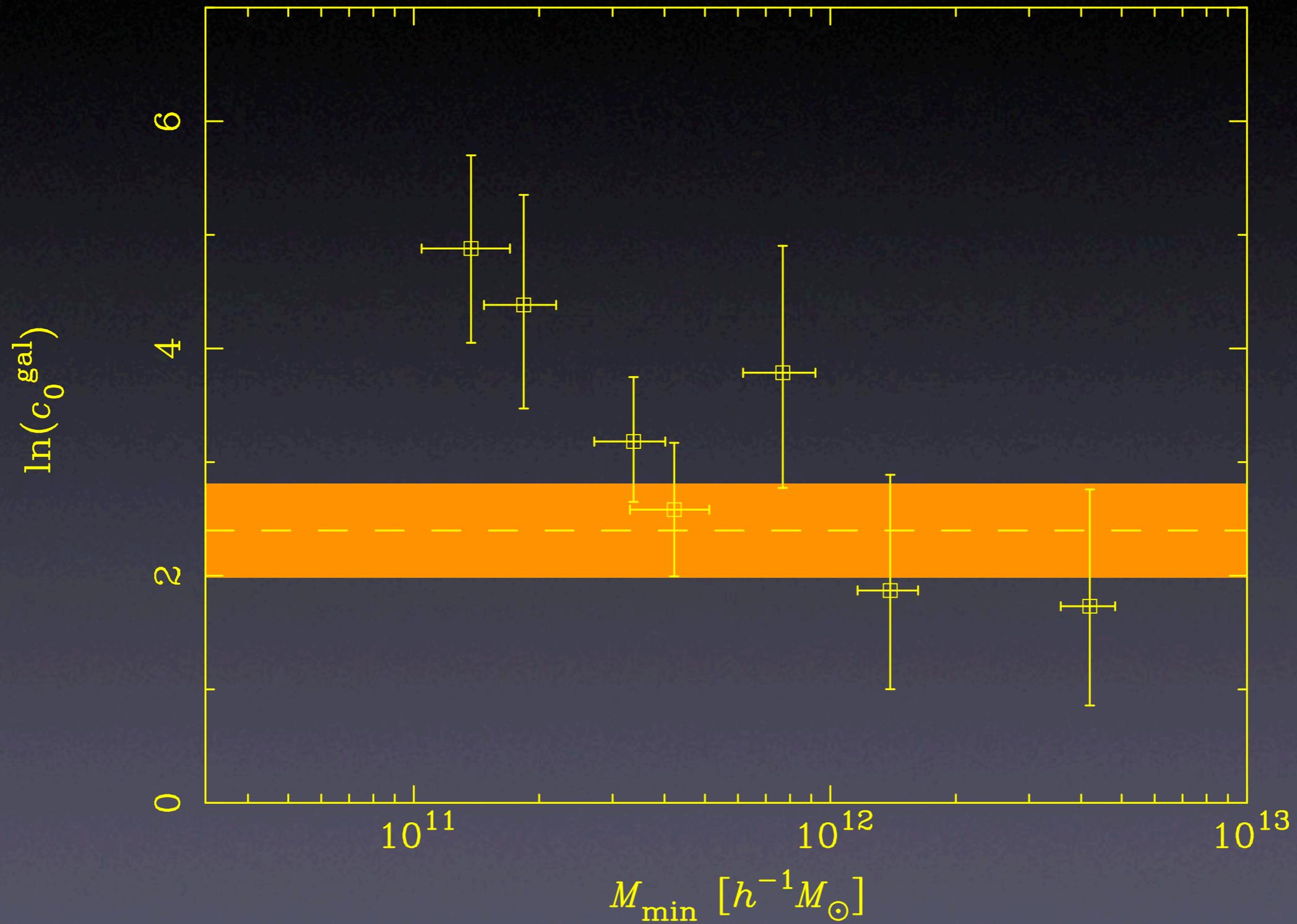
# The Hubble Parameter: $H_0 = 100h$ km/s/Mpc



# The Halo Occupation Distribution

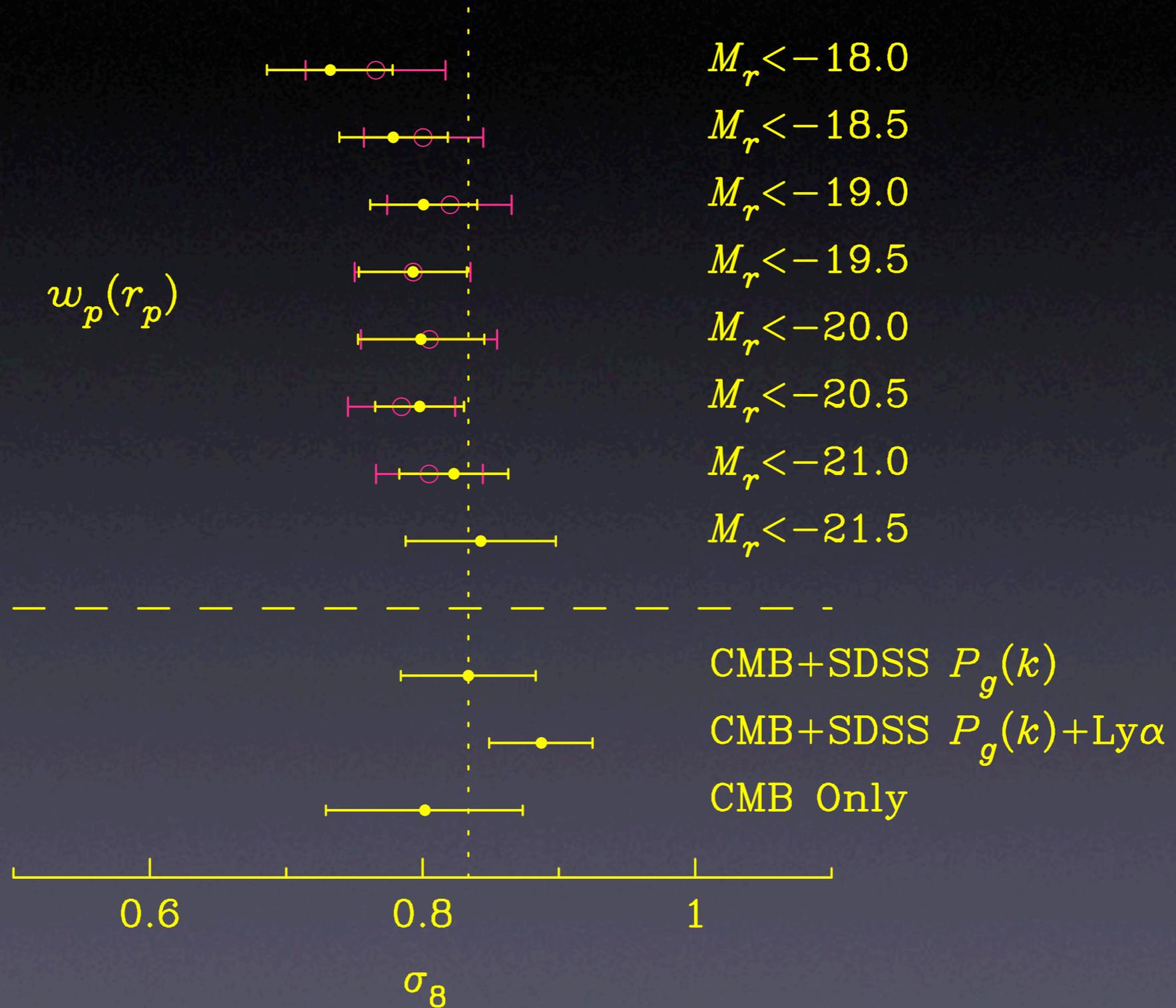


# Galaxy Concentration vs. Halo Mass



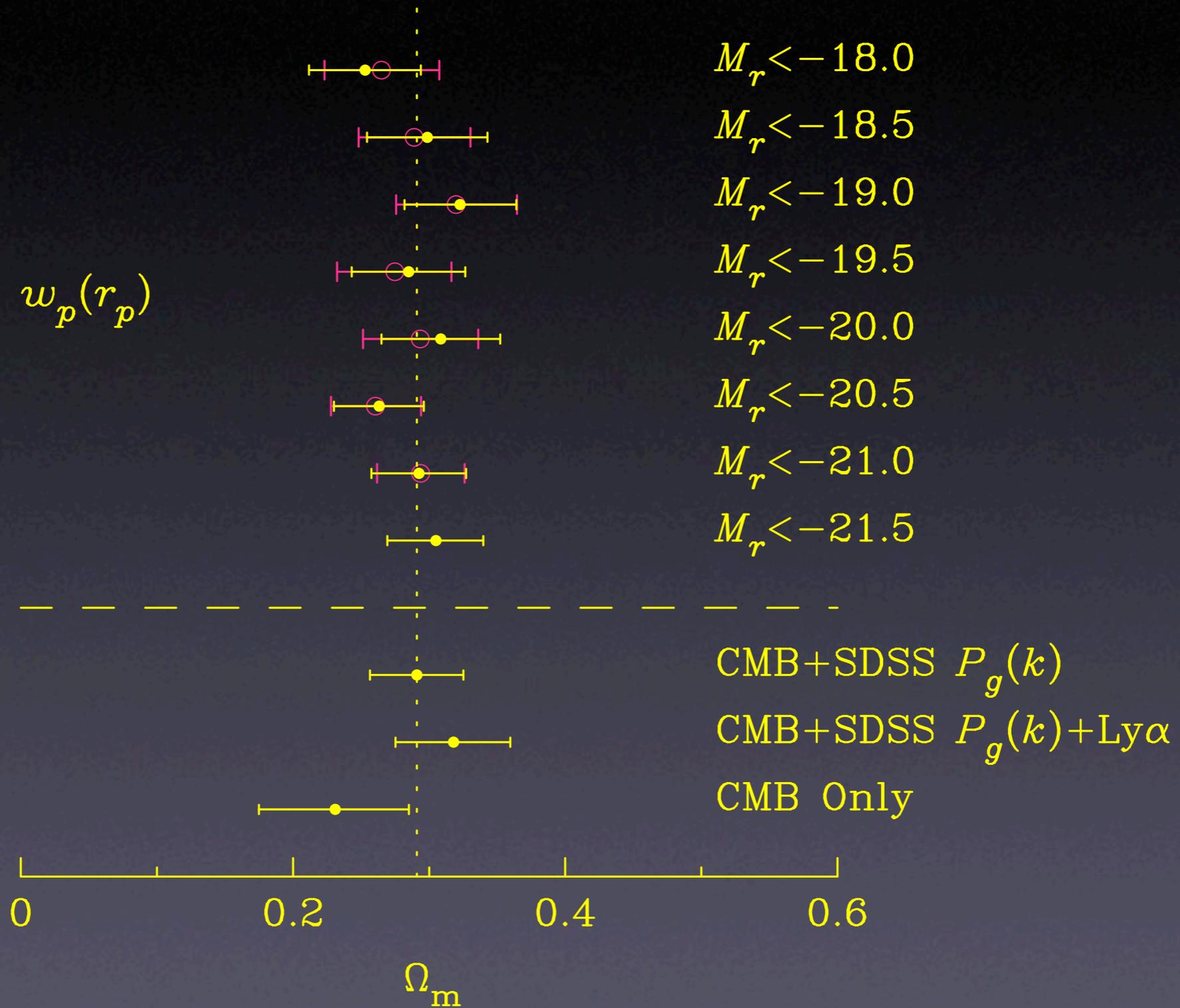
# Fluctuation Amplitude:

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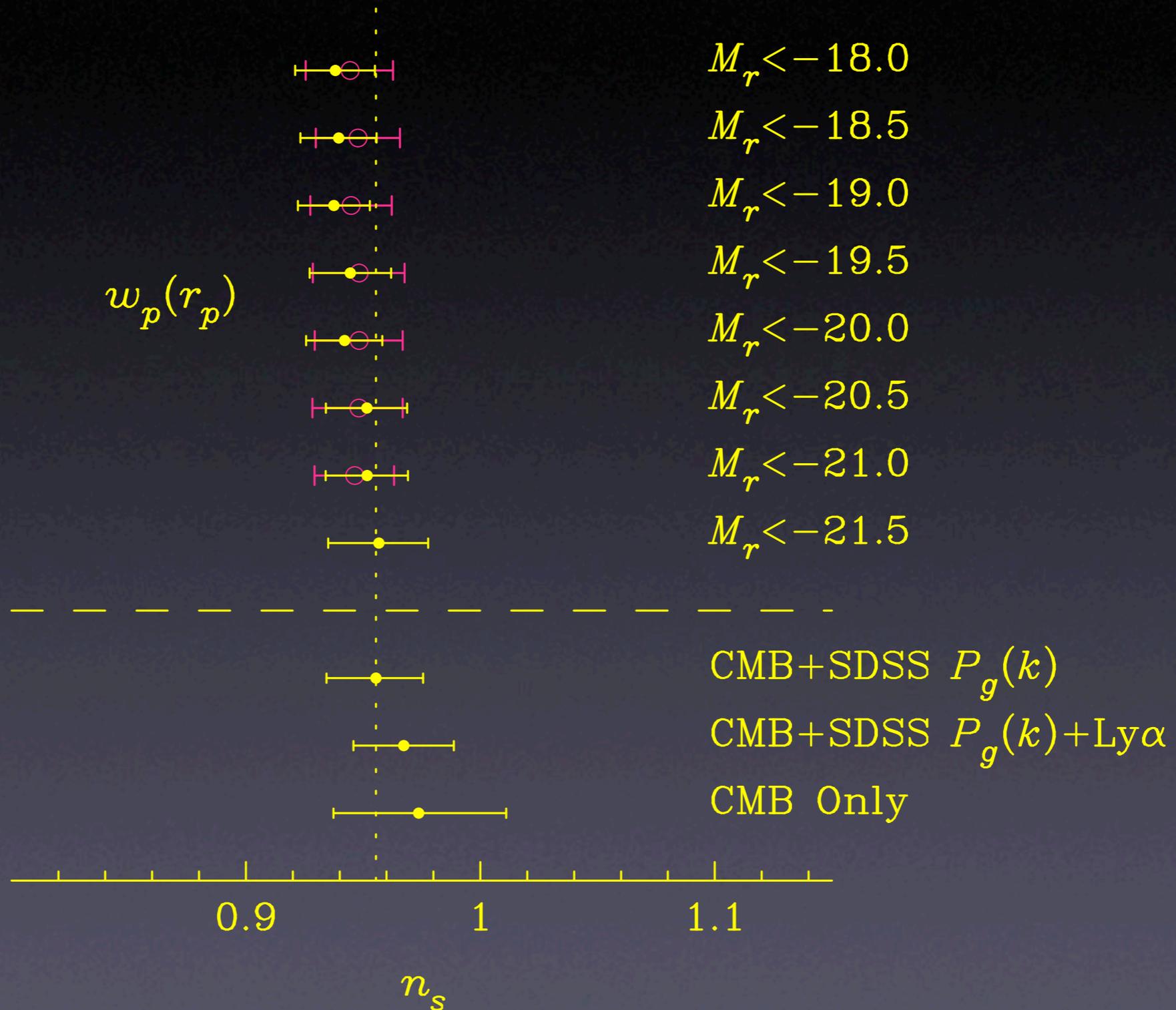
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$$\Omega_m$$



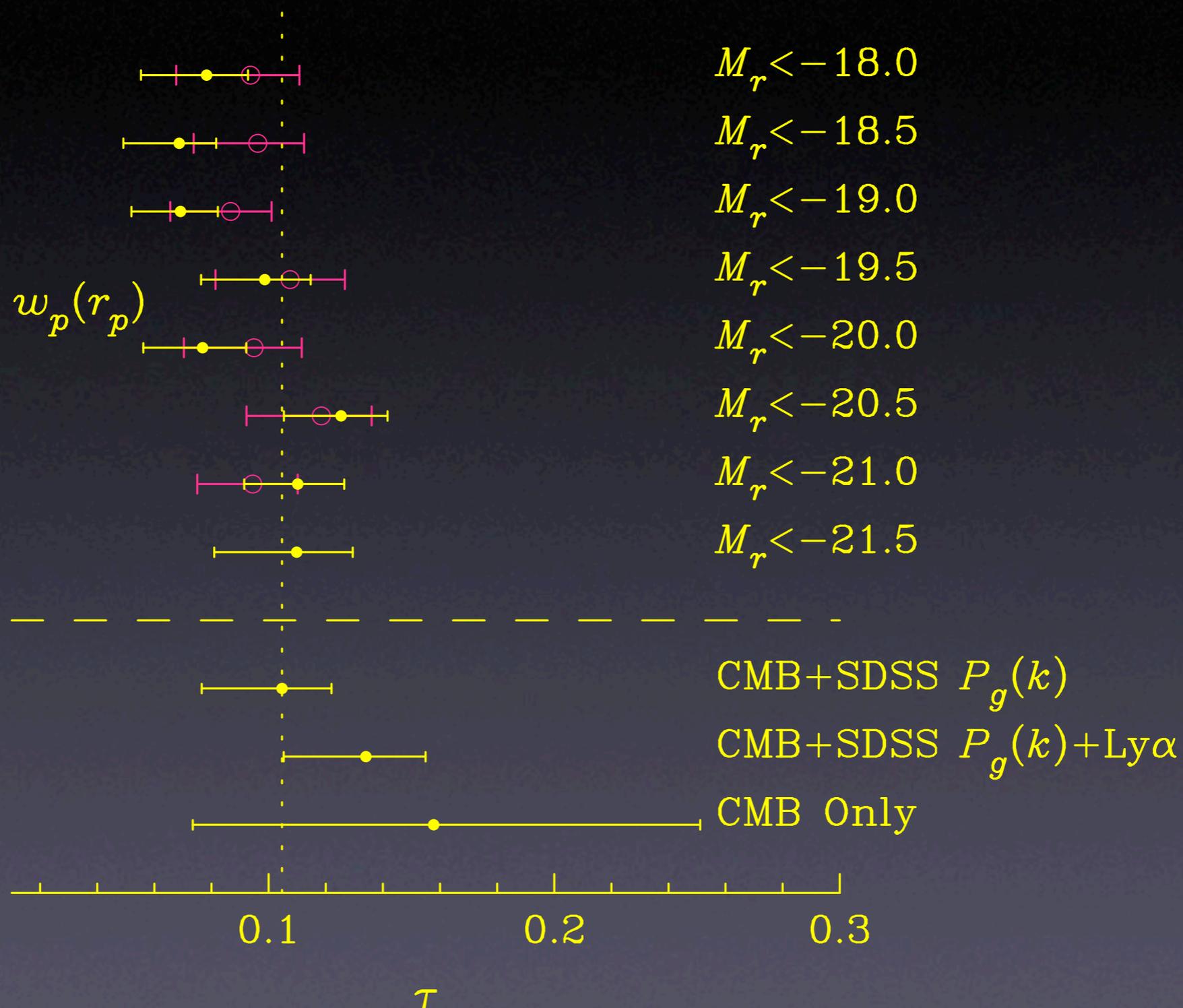
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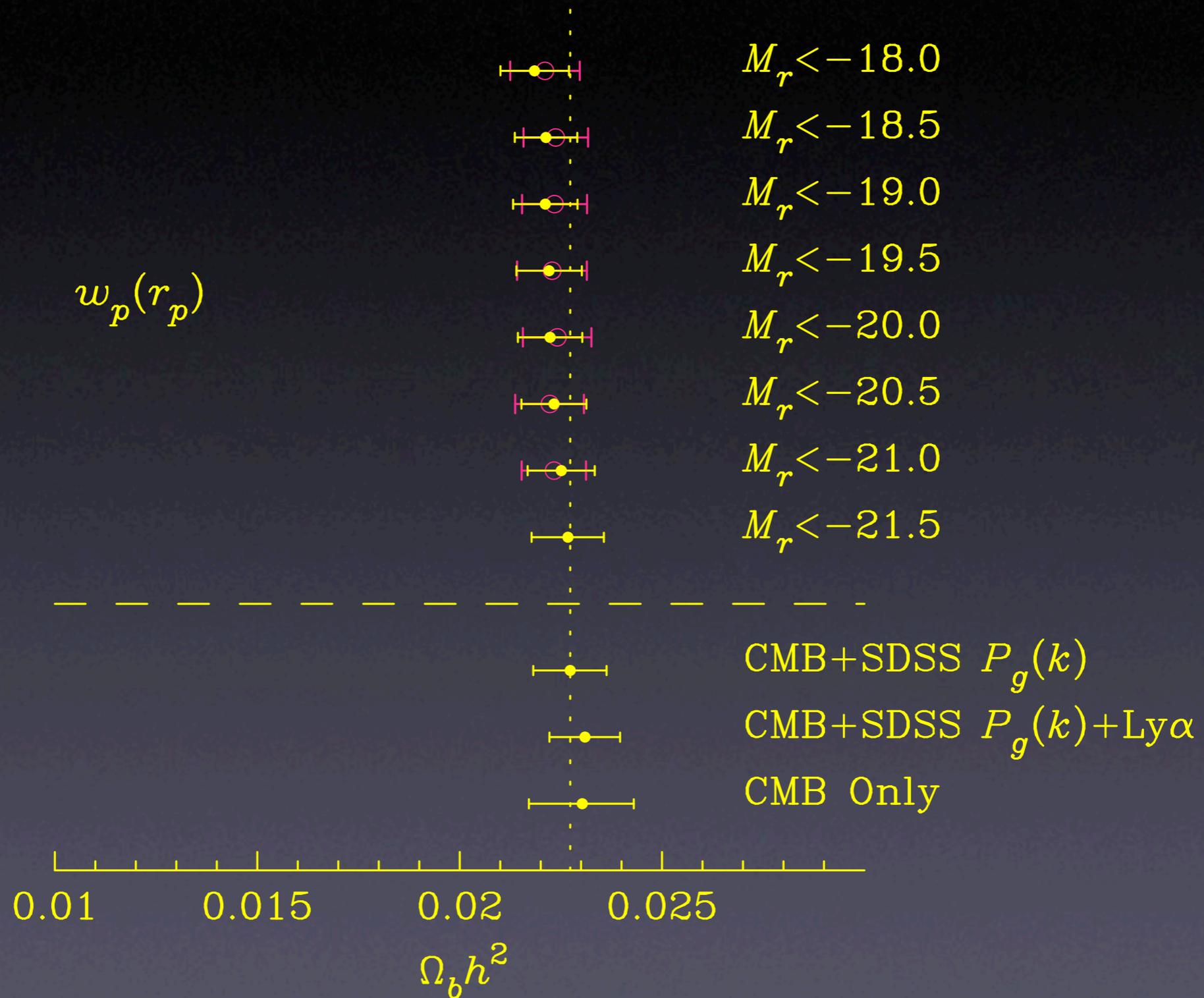


# Optical Depth to CMB Last Scattering Surface:

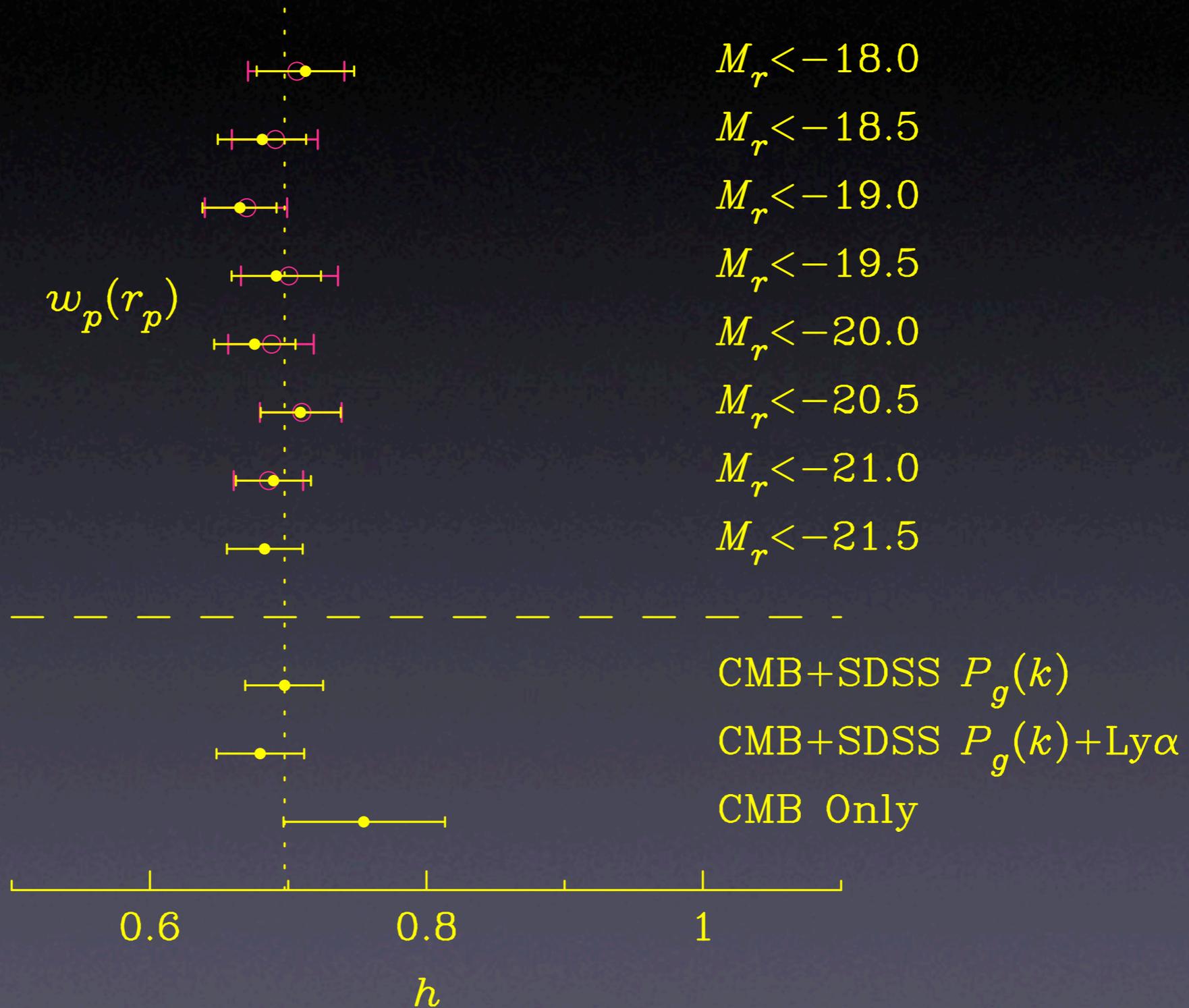
$\tau$



# Baryon Density: $\Omega_b h^2$



# The Hubble Parameter: $H_0 = 100h$ km/s/Mpc



# Summary

- The Sloan Digital Sky Survey provides a tremendous wealth of information
- The halo model of dark matter, combined with
  - the **Halo Occupation Distribution** of Galaxies and
  - **High-Resolution simulations** of structure and halo formation and
  - The **Sloan Digital Sky Survey**
- Provide a window into the structure, composition, and formation of the Universe