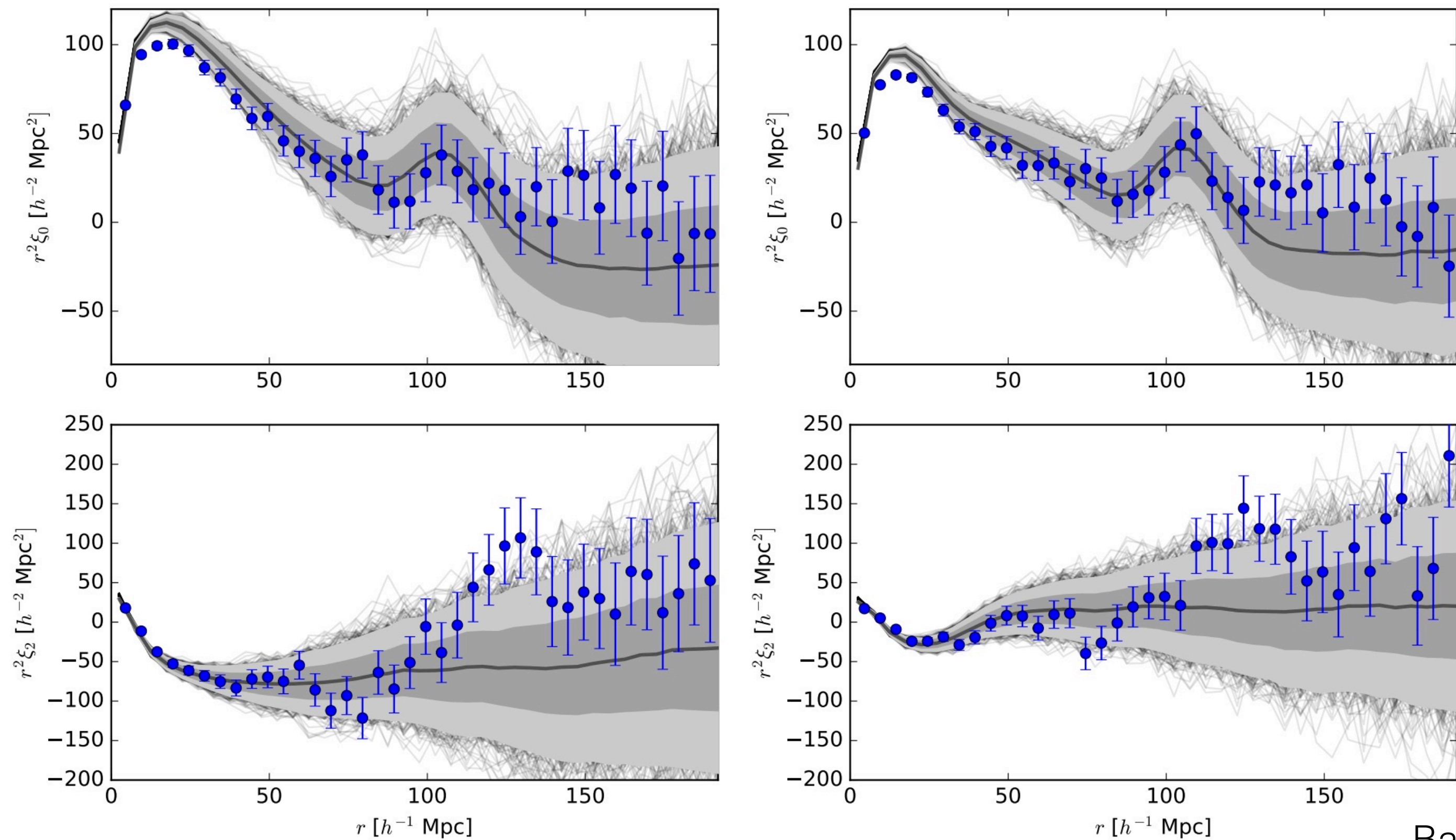


Galaxy clustering at small scale and measurement of structure growth

**Zhongxu Zhai (翟忠旭)
Department of Astronomy, SJTU**

**Dec 15th , 2023
Texas in Shanghai**

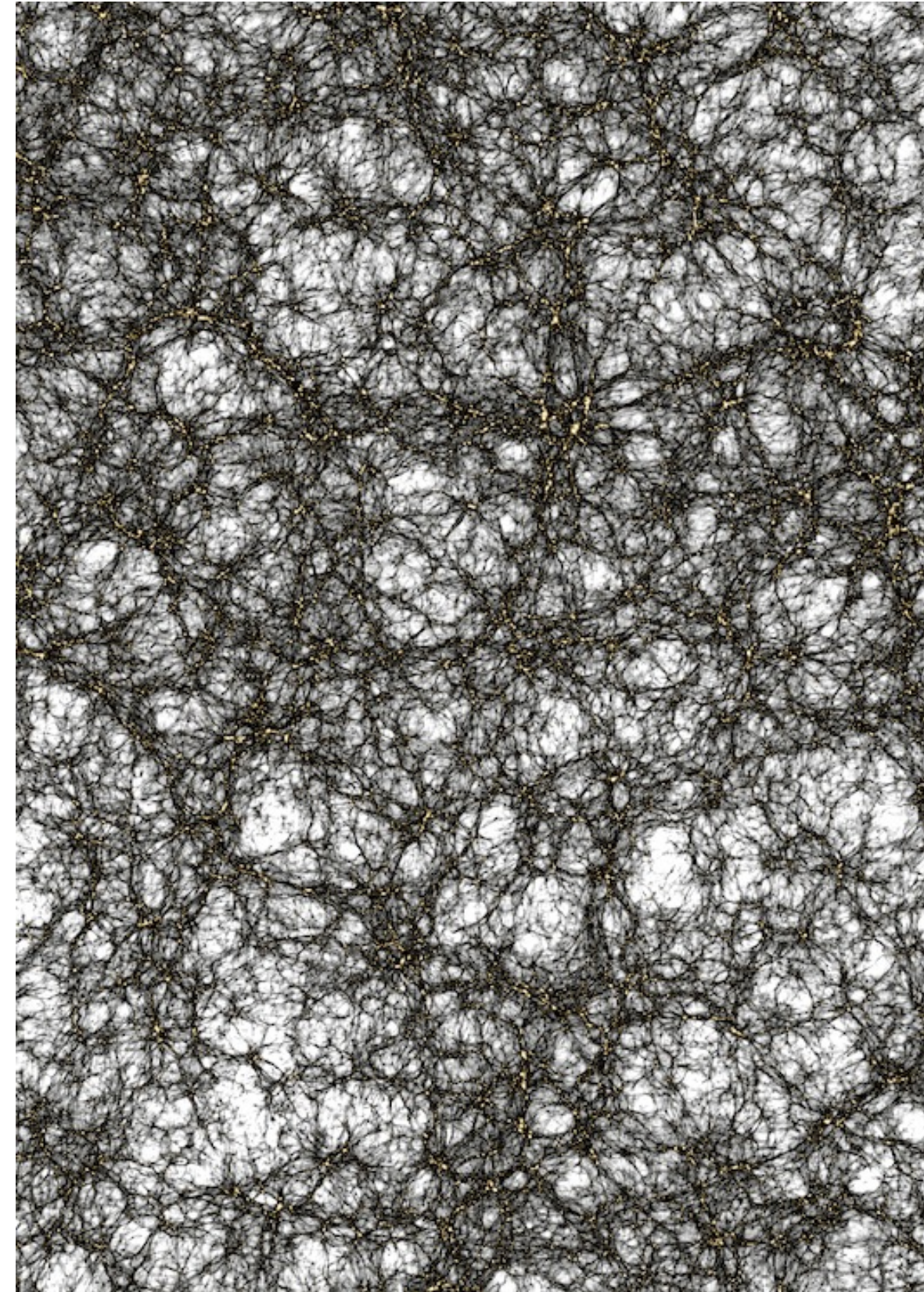
Galaxy 2-point correlation function



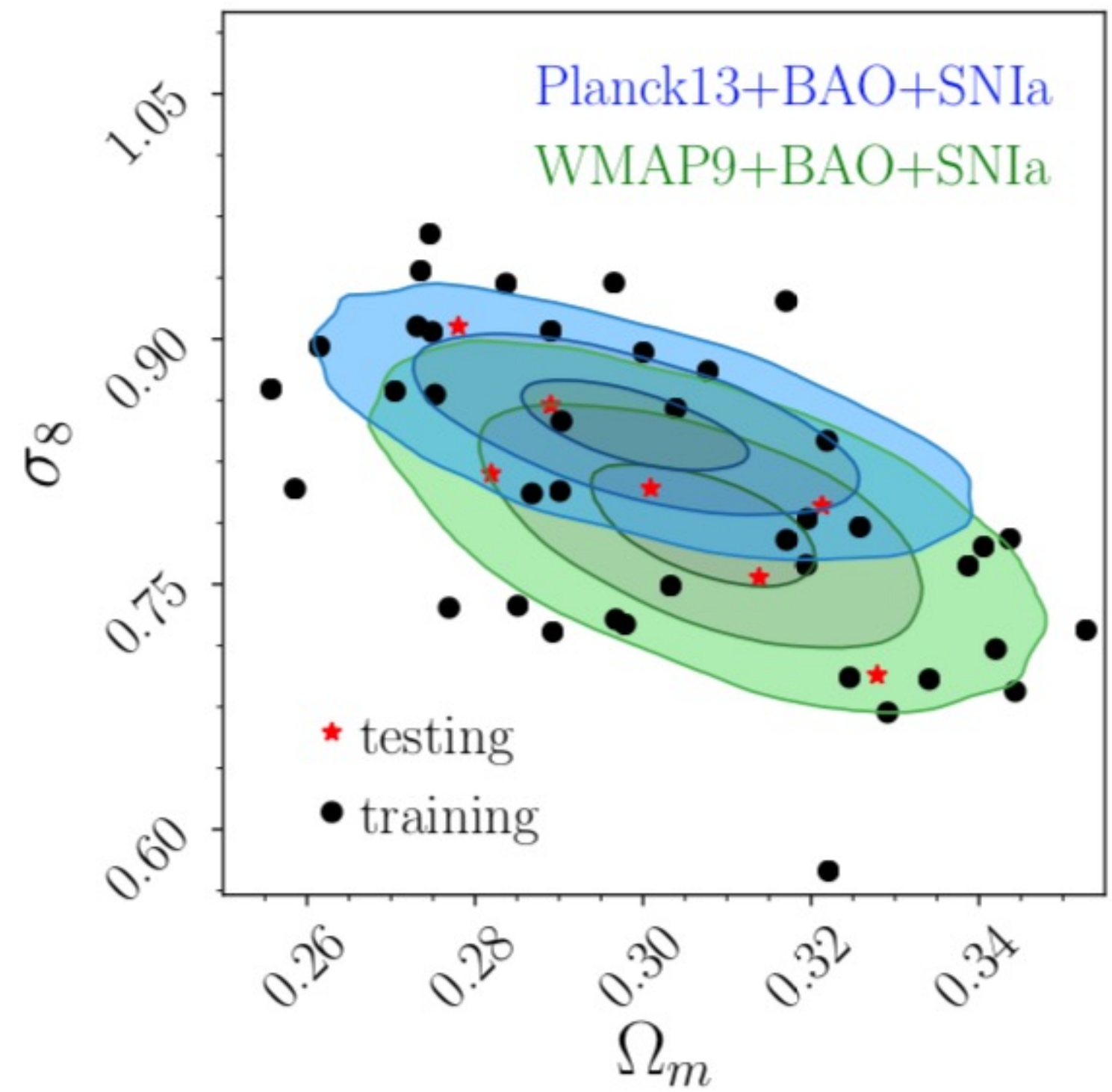
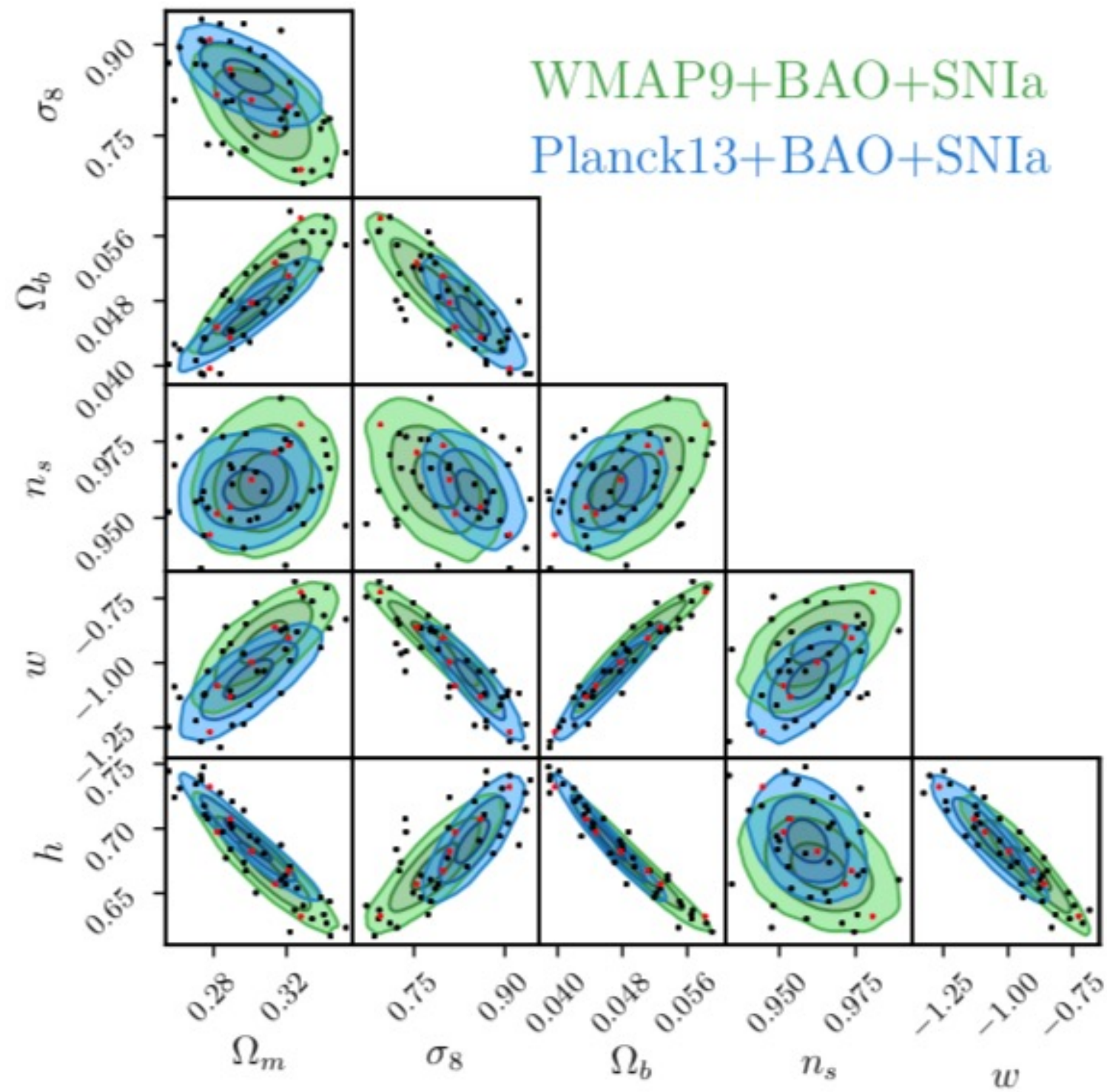
The Aemulus (alpha) Project

- * Multi-institution collaboration
- * Results: Suite(s) of high-resolution N-body simulations spanning currently-allowed cosmological parameter space
- * Goal: precision emulation of statistics of dark matter halos and galaxies:
 - Halo mass function
 - Halo bias function
 - Galaxy correlation function
 - Galaxy-galaxy lensing

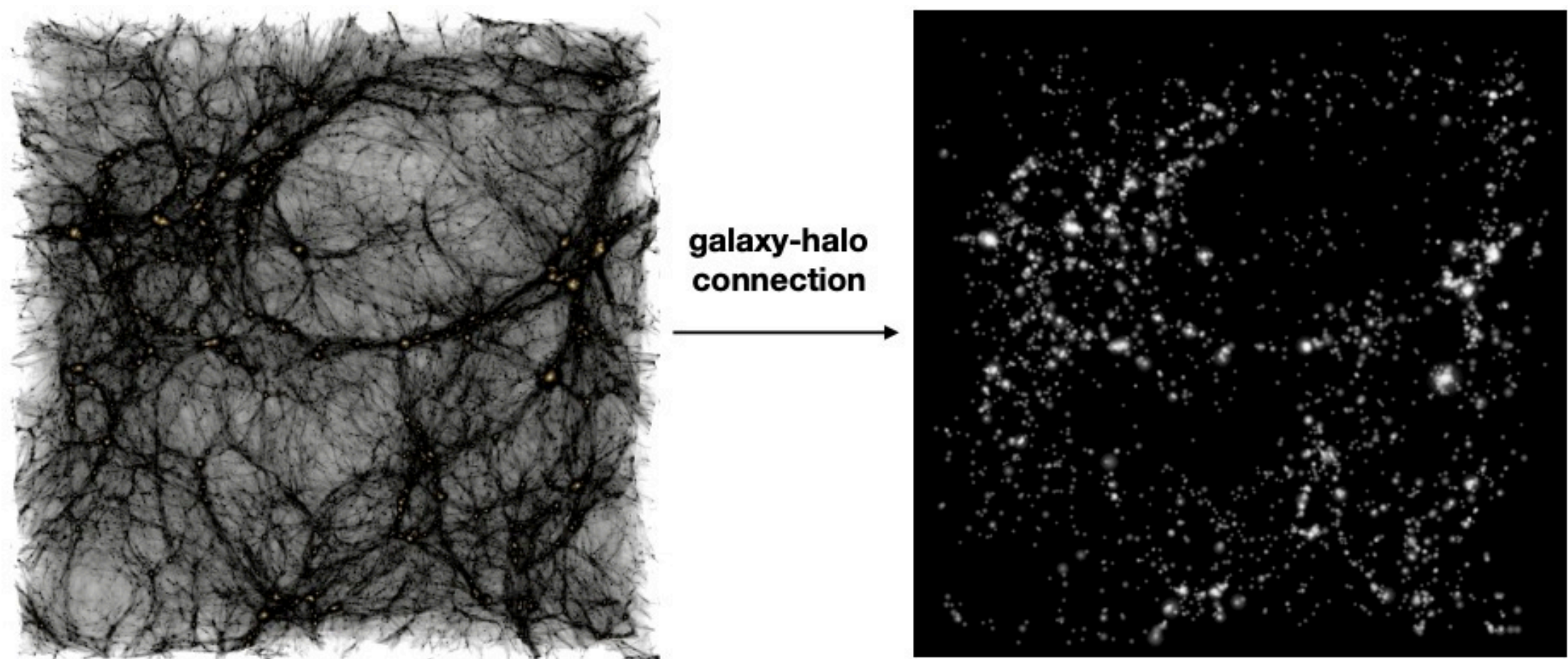
<https://aemulusproject.github.io/>



Aemulus I: cosmological models



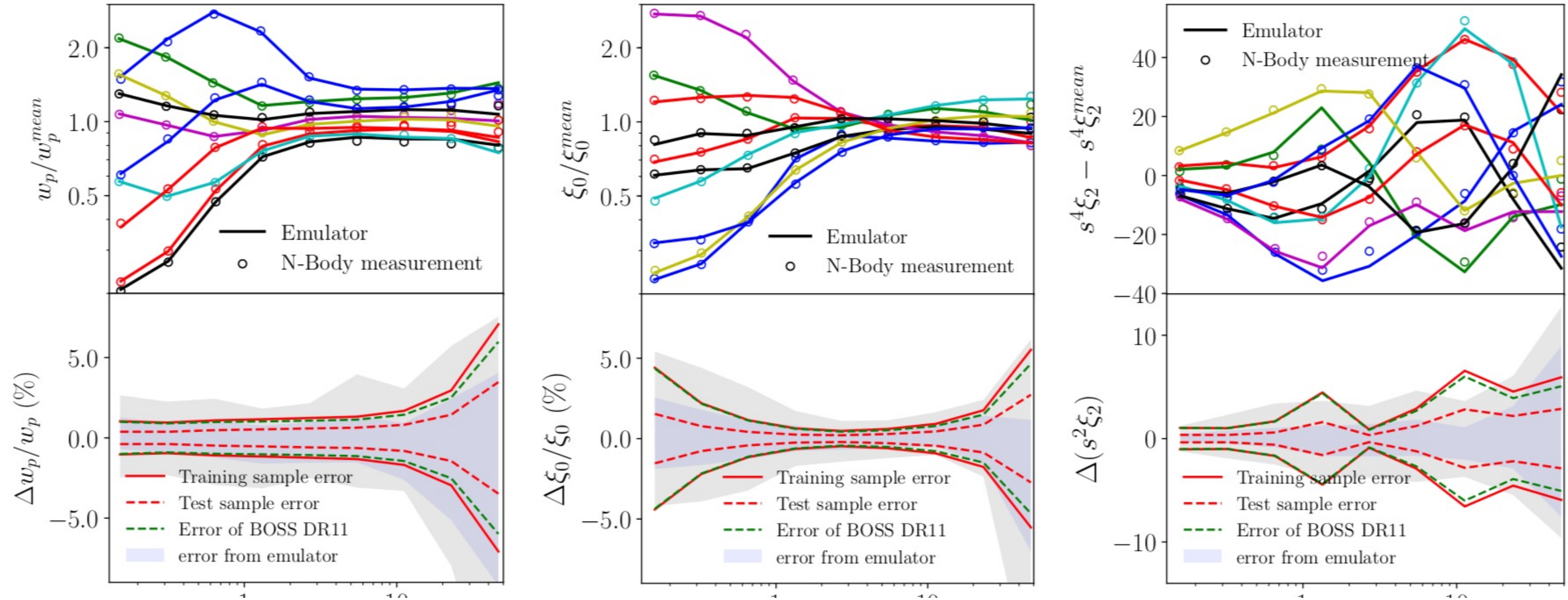
From Halos to Galaxies



Approaches to modeling the galaxy-halo connection

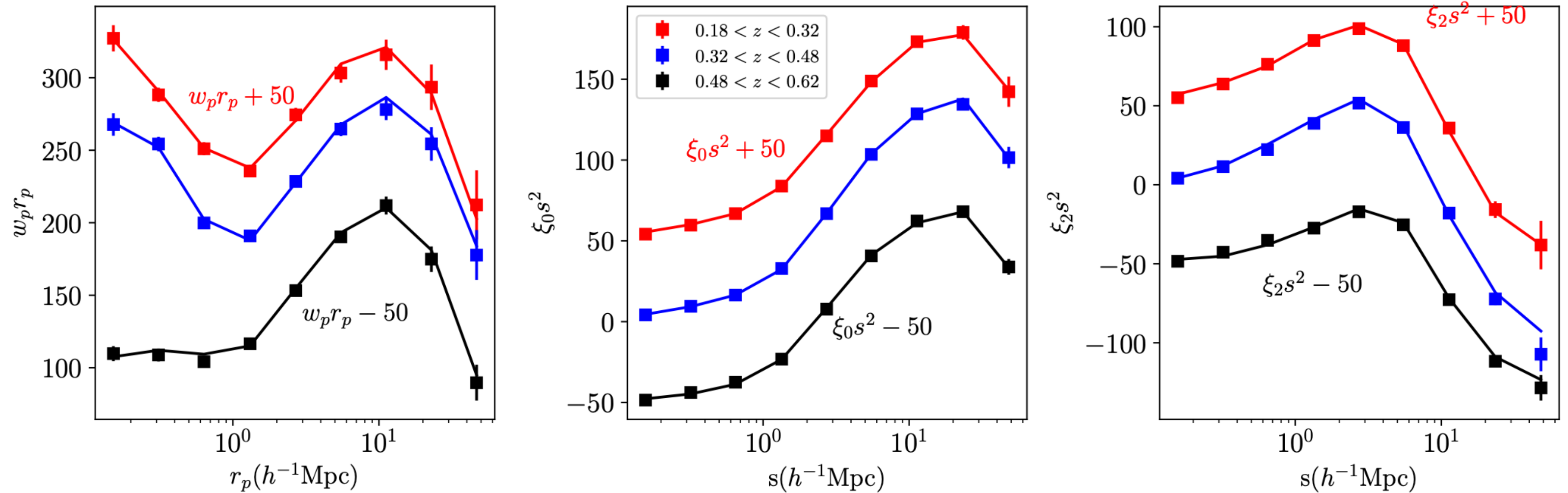
| ← physical models | | empirical models → | | |
|--|---|--|---|---|
| Hydrodynamical Simulations | Semi-analytic Models | Empirical Forward Modeling | Subhalo Abundance Modeling | Halo Occupation Models |
| Simulate halos & gas; Star formation & feedback recipes | Evolution of density peaks plus recipes for gas cooling, star formation, feedback | Evolution of density peaks plus parameterized star formation rates | Density peaks (halos & subhalos) plus assumptions about galaxy—(sub)halo connection | Collapsed objects (halos) plus model for distribution of galaxy number given host halo properties |

Aemulus III: Galaxy clustering



Construct the emulator for real and redshift space correlation function of galaxies at $z=0.55$, the accuracy is better than sample variance and reaches 1% at 1-10 Mpc/h

Modeling SDSS-BOSS galaxies



Aemulus V

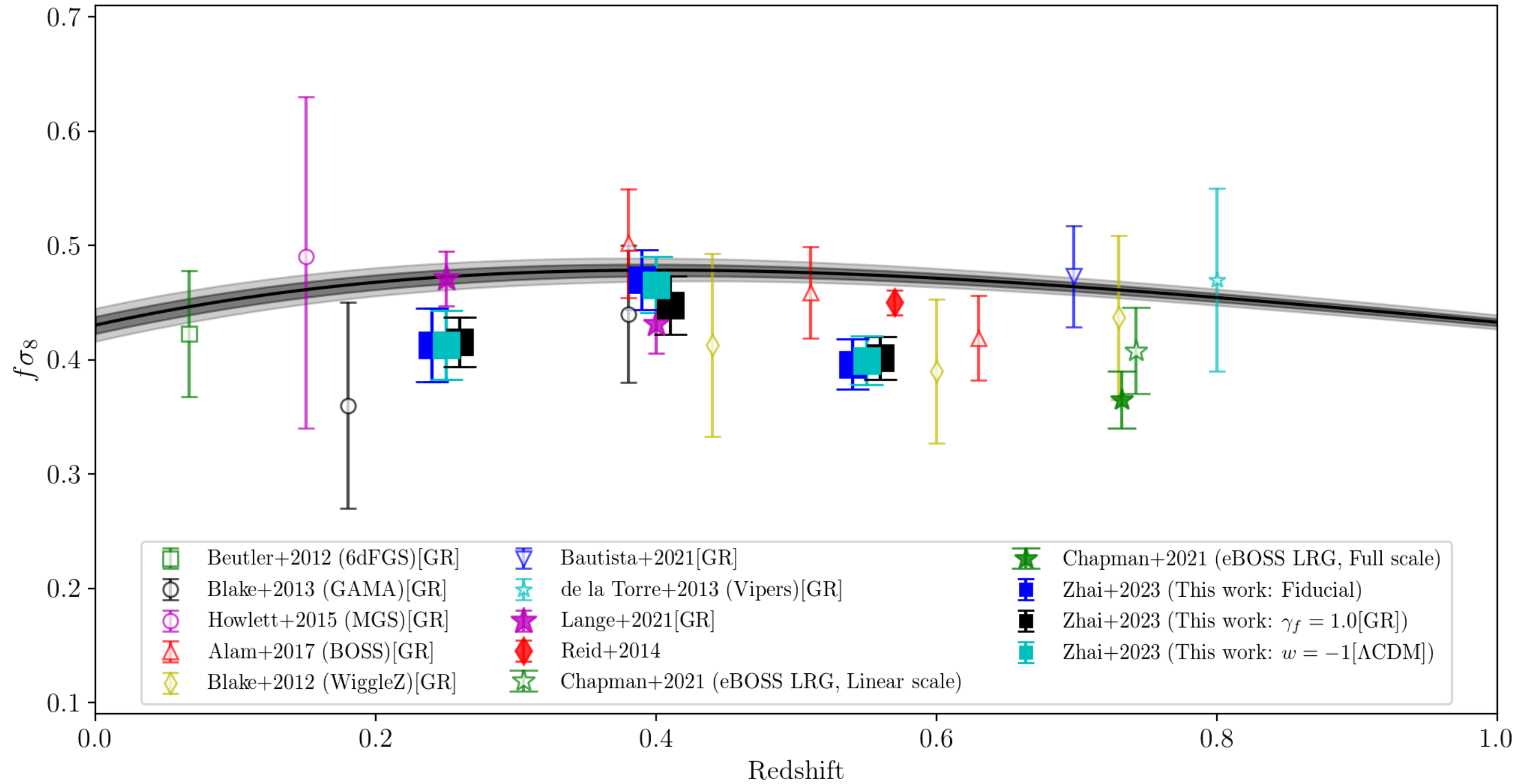
All simulations assume GR

Modeling of galaxies: velocity bias, concentration, assembly bias, etc.

Both real and redshift space clustering can match

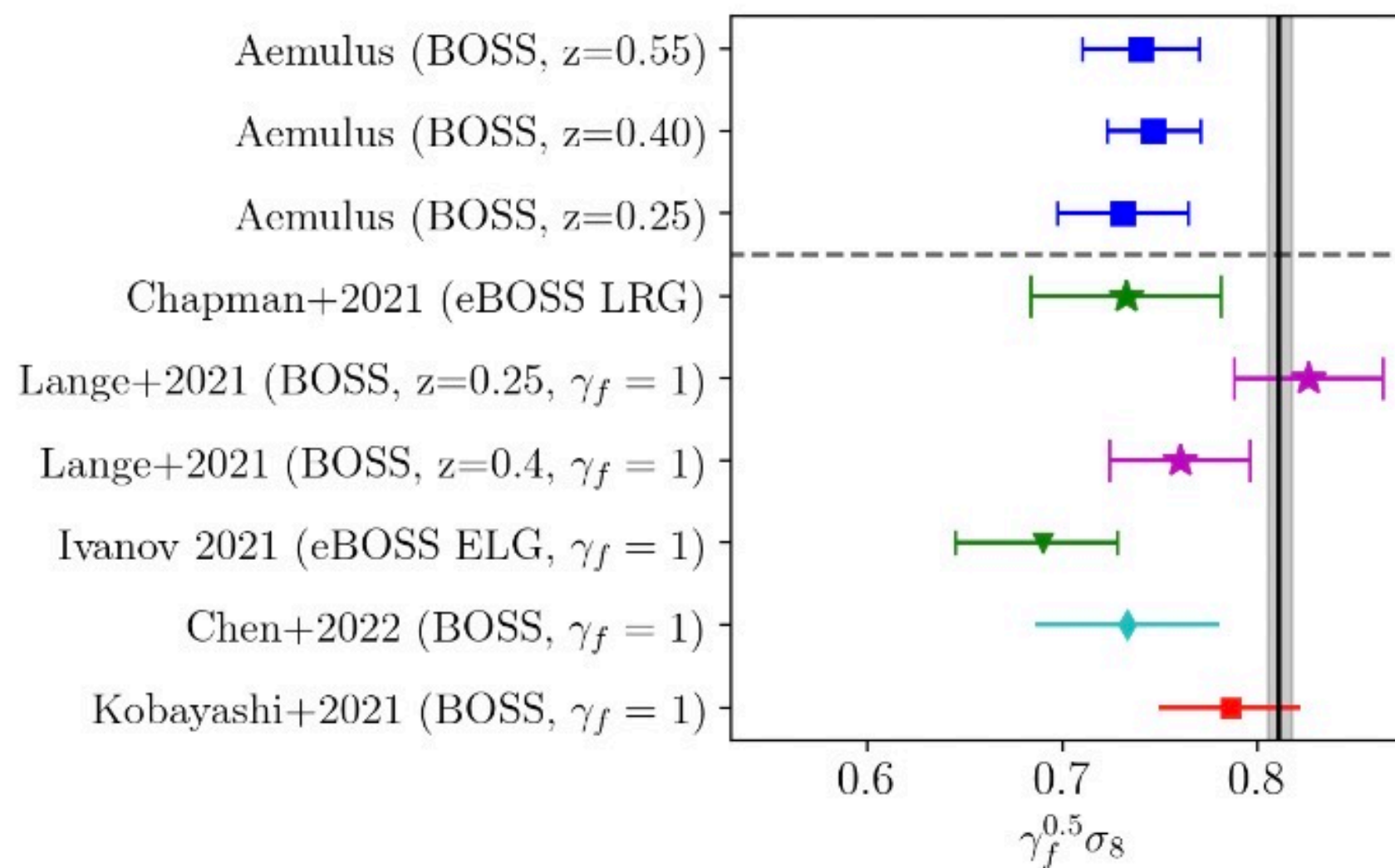
Allows deviation from GR: velocity scaling parameter

Measurement of structure growth

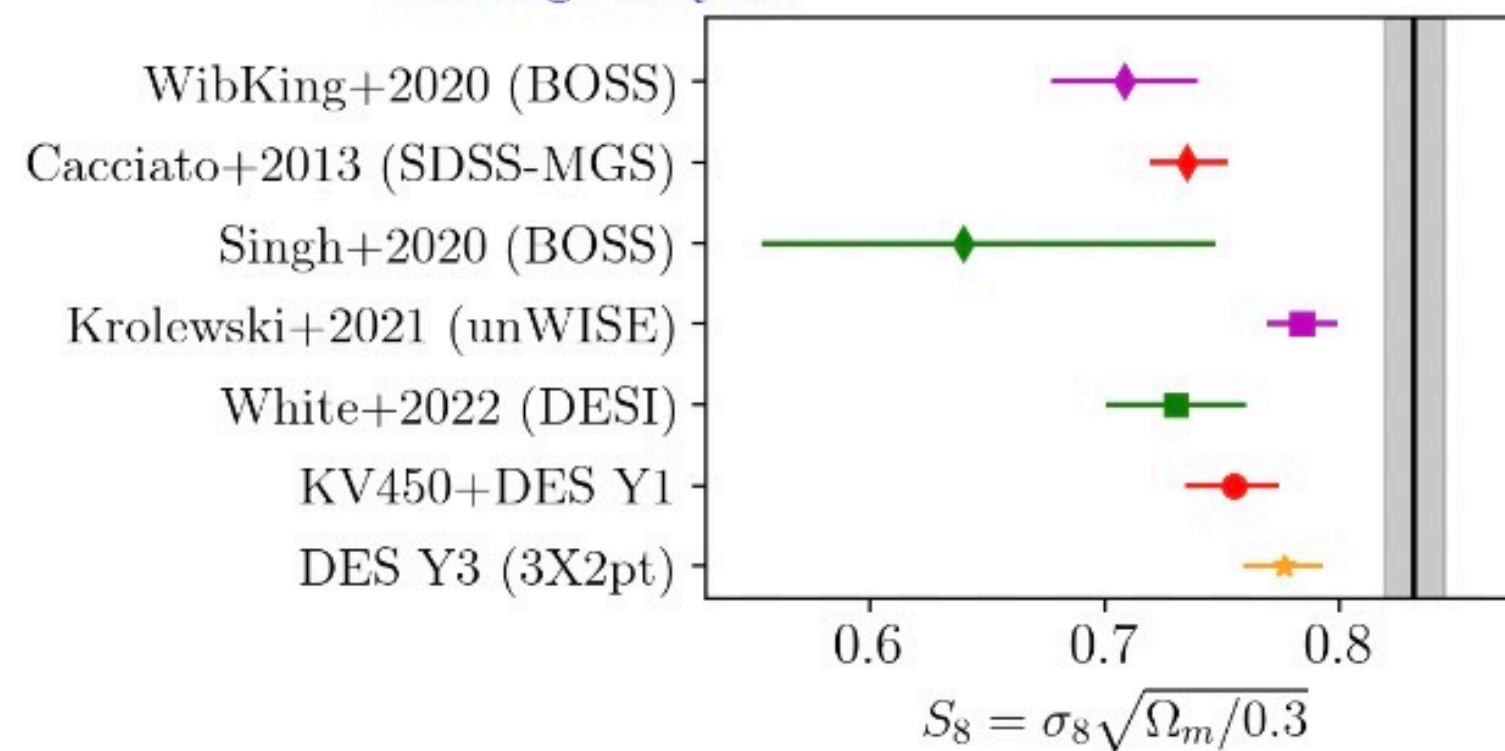


Clustering and Lensing

Clustering Analyses

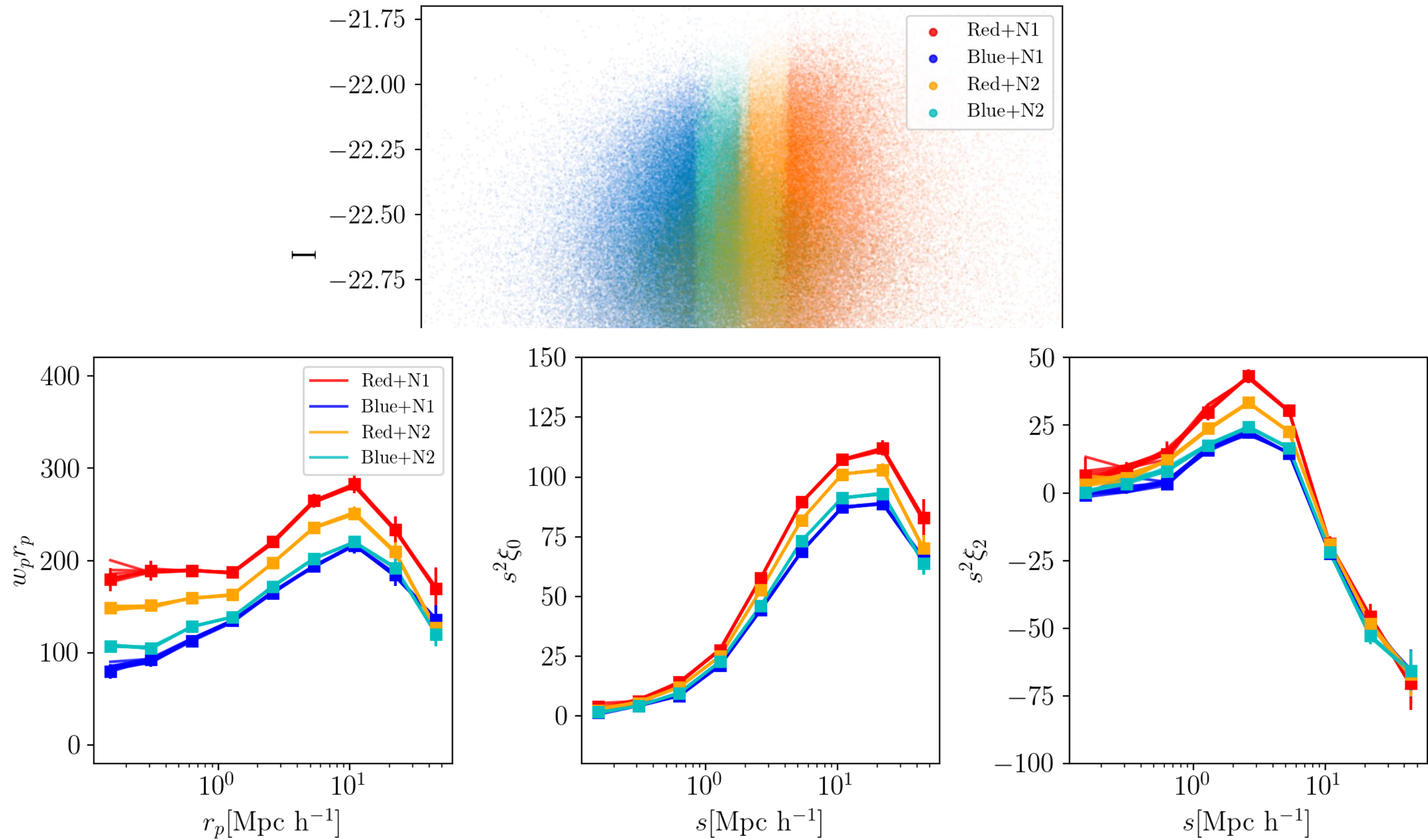


Lensing Analyses

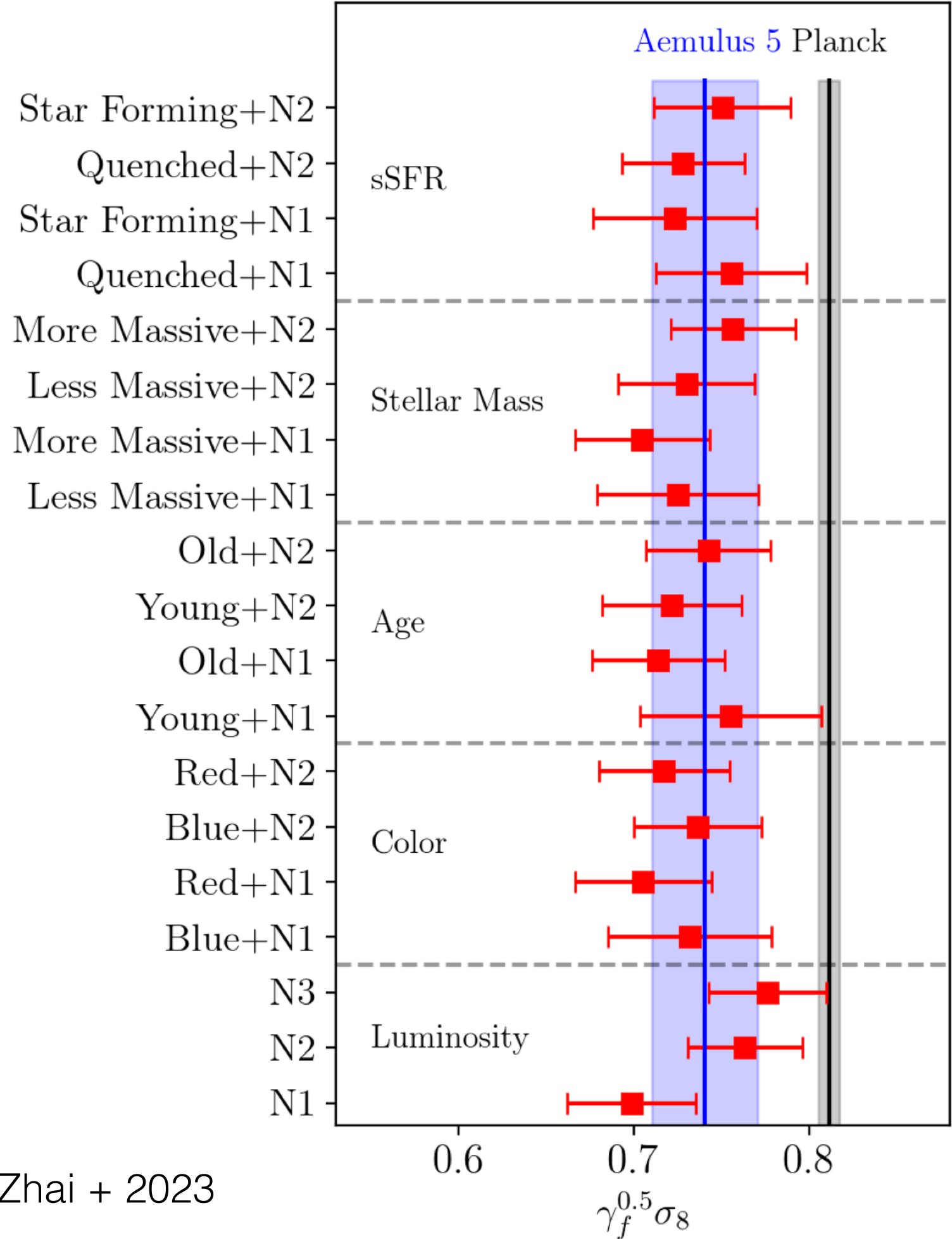


Aemulus V

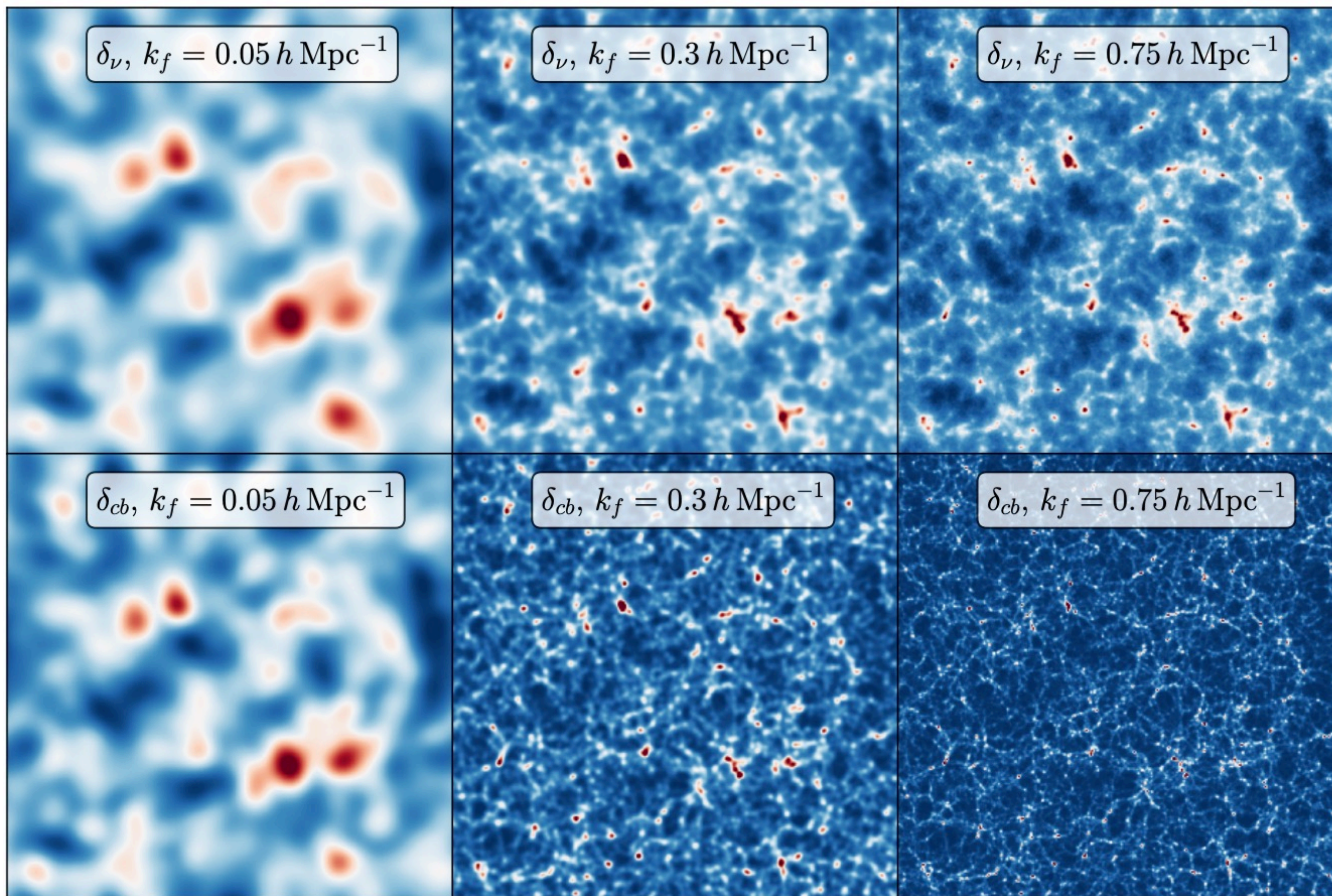
Selections of galaxies



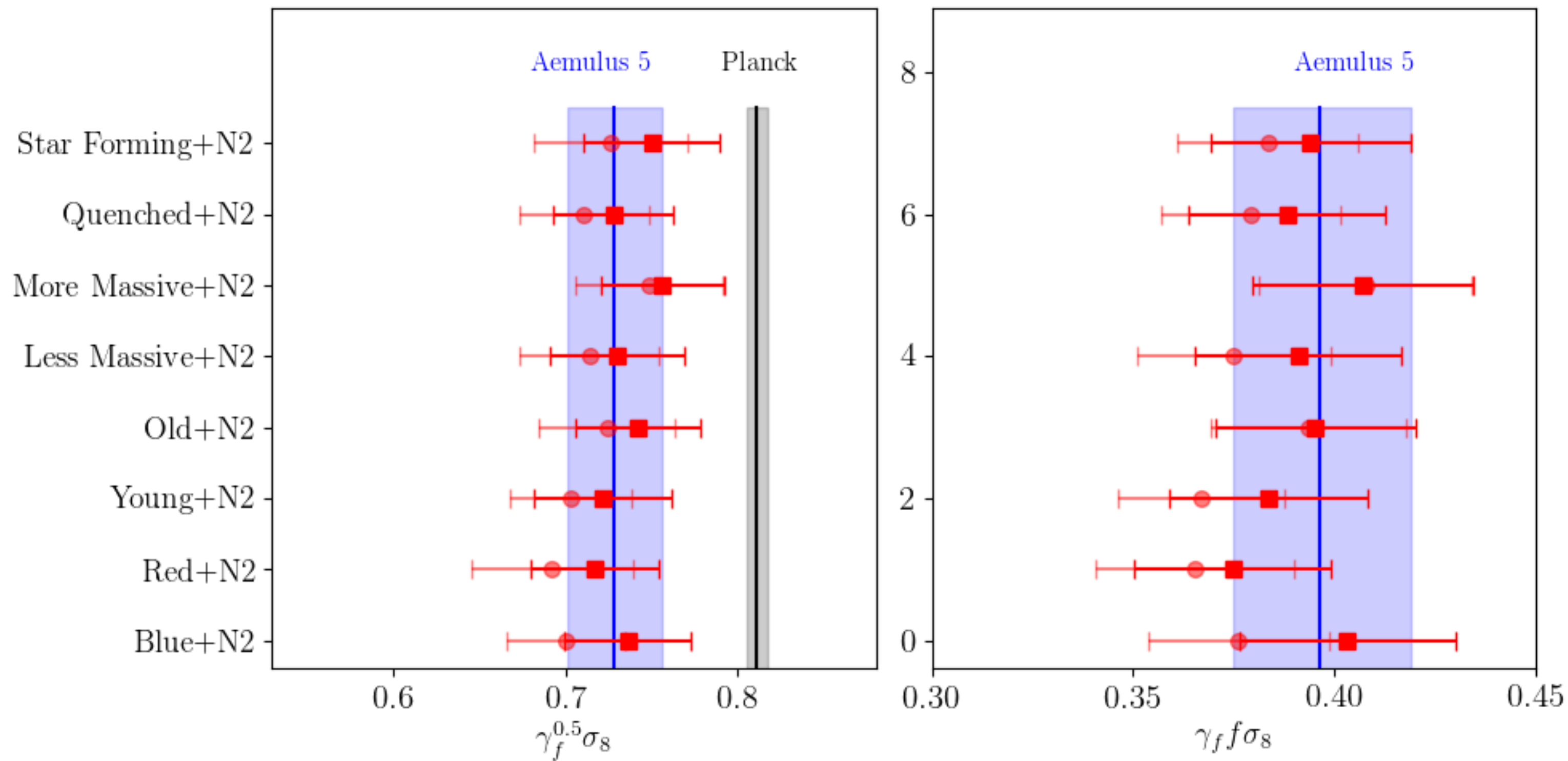
Measurement of structure growth



The Aemulus nu Project

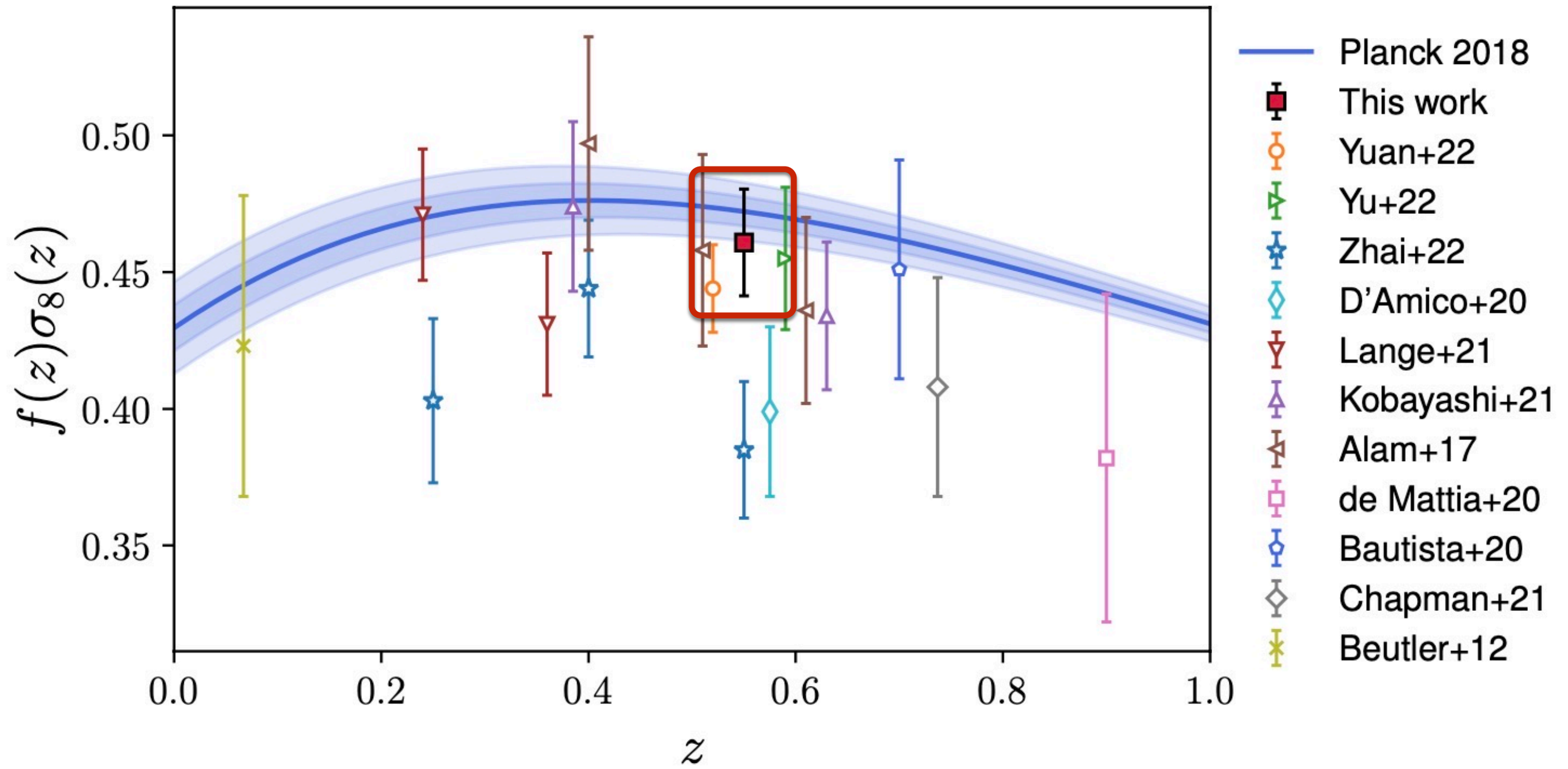


Re-analysis with massive neutrinos



Preliminary

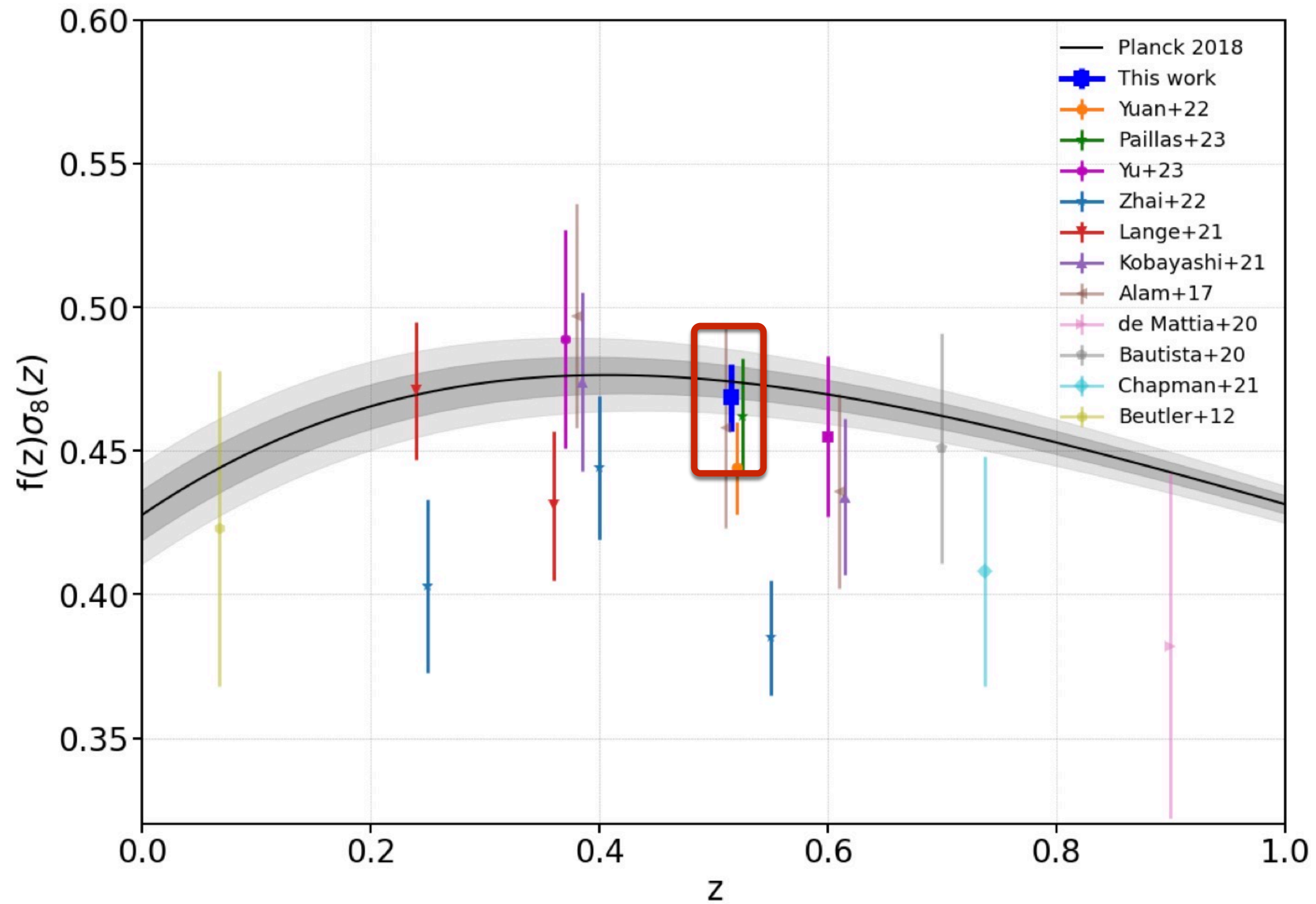
On the tensions



Density split analysis

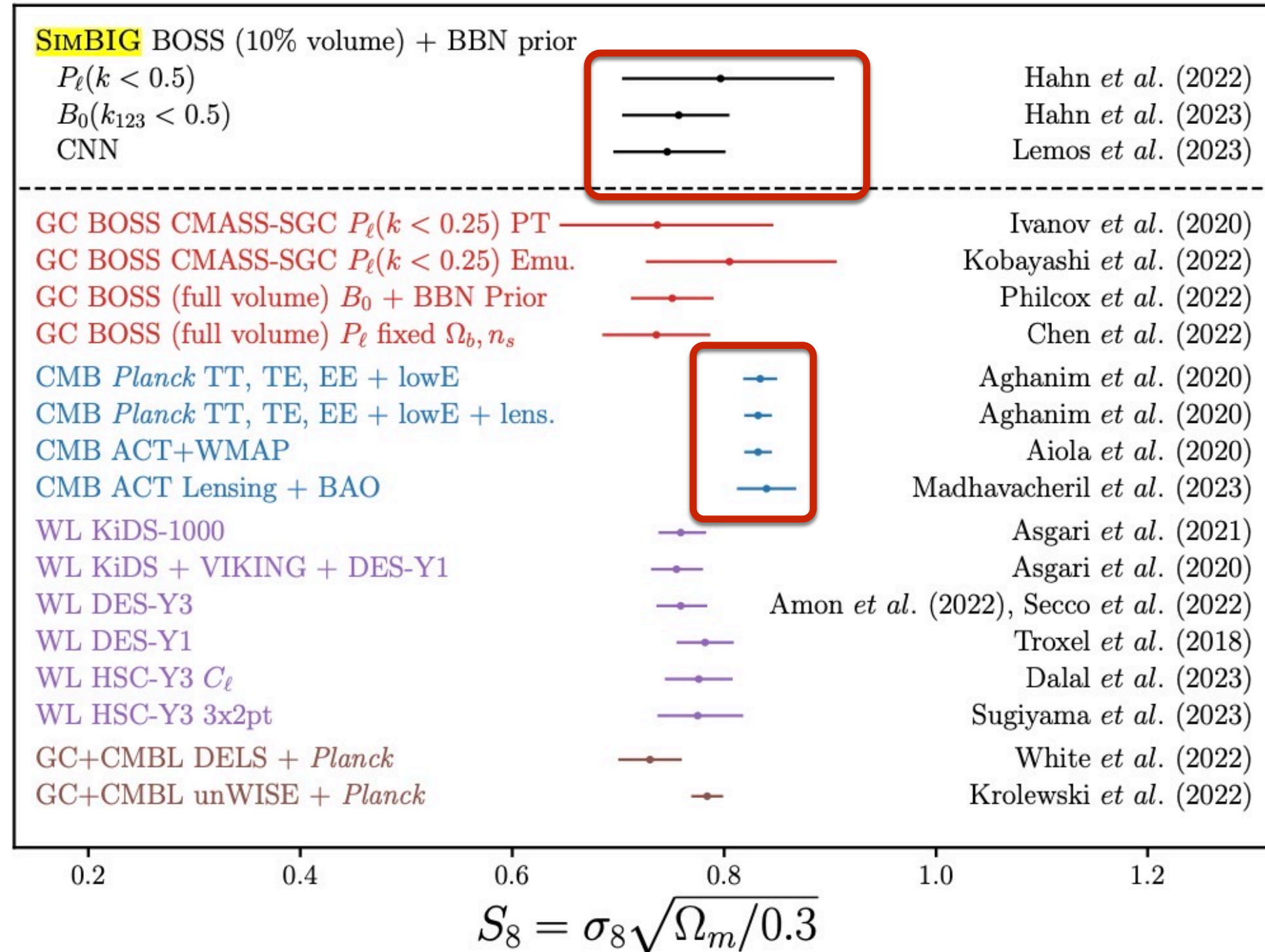
Paillas+2023

On the tensions



Wavelet scattering transform Valogiannis+2023

On the tensions



SIMBIG analysis Hahn+2023

Thanks