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On the galaxy stellar & baryon mass fraction of blue galaxies and its implications for the disk galaxy populations

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1. Introduction

Recently, by mean of direct methods (such as, weak lensing & satellite kinematics, e.g. [1],[2]) and indirect techniques (abundace matching technique, AMT, and halo occupation distribution model HOD) have made posible the determination of the stellar-halo connection, M_s-M_h, in most of the cases with similar results. Here, we apply the AMT to infer the stellar mass fraction, f_s $(M_h)=M_s/M_h$, for blue and red galaxies separately. Adding information of gas mass, M_g (M_s), the baryonic mass fraction, f_b $(M_h)=M_b/M_h$, is also inferred. The analysis is carried out for local and high redshift (up to z~1) galaxy samples. Then, we use the infered f_b (M_h,z) relations for blue galaxies as input in disk galaxy models to study its implications in disk galaxy scaling relations within the context of the LCDM scenario.

2. The abundance matching technique extended for blue galaxies.

(1) AMT used to infer the f_s-M_h relation, for all and blue galaxies, from the observed GSMF.

(2) Observed $M_{\rm gas}$-M_s relation to infer the f_b-M_h relation

(3) Extention of the AMT for blue central galaxies:

- Observational input (Fig.1):
  - z~0: GSMF from [4] for all, blue & red central galaxies.
    Mg-Ms for blue and red galaxies from [5] and [6].
  - z<1: A proposed general blue/red GSMF as a function of z consistent with most of the current observational inferences.
    $M_{\rm gas}$-M_s relation as a function of z for blue galaxies from [7].
- Assumptions for halos hosting blue galaxies (Fig. 1):
  - z~0: Those halos that suffered major mergers since z~0.8 are excluded.
    The observed halo mass function (HMF) group [8] is substracted from the distinct HMF (blue galaxies are not central galaxies in groups and clusters).
  - z~1: The blue to total ratio of number of galaxies in the sample is rough estimator for major mergers.
    Evolution of the HMF groups.

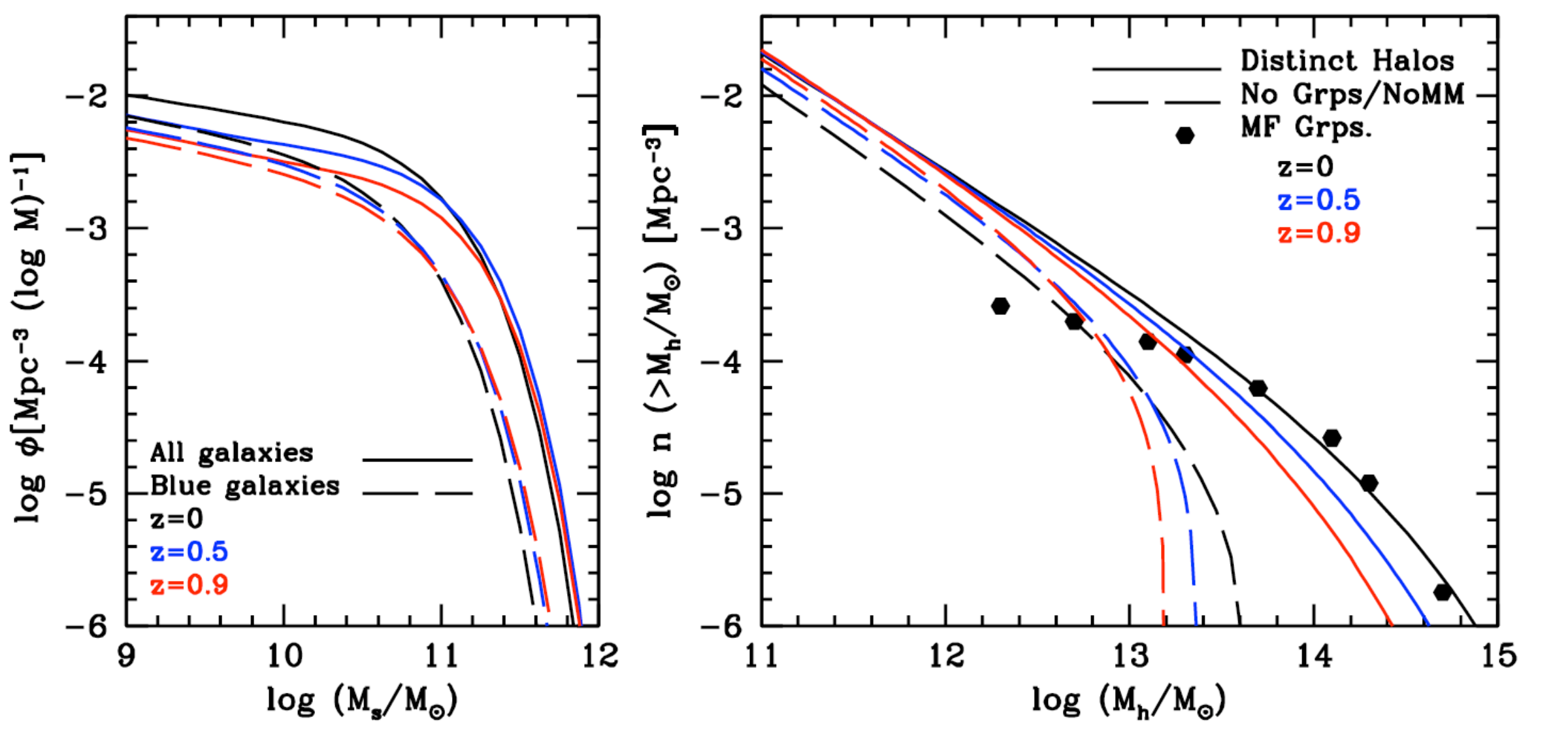

Figure 1. Left panel: The GSMF for all & blue galaxies at z~0, 0.5 & 0.9. Right panel: HMF for distinct halos & halos hosting blue galaxies at z~0, 0.5 & 0.9.

3. The stellar/baryon fraction up z~1

z~0:

(1) The M_s-M_h relations for blue & red central galaxies are consistent with direct inferences (e.g., weak-lensing [1] & satellite-kinematics [2], Fig 2).

(2) The f_s-M_h relations of blue & red central galaxies do not differ significantly.

(3) Differences in the f_b-M_h relation are even smallers than f_s for blue & red central galaxies.

(4) The peak for blue & red central galaxies is f_b=0.028 & 0.034, respectively.

z<1:

(1) Galaxy downsizing evidence for blue galaxies.

(2) Peak evolution at approximately constant f_s.

(3) No evindence for galaxy downsizing in f_b.

(4) $f_b(M_h)$-cte at high redshifts.

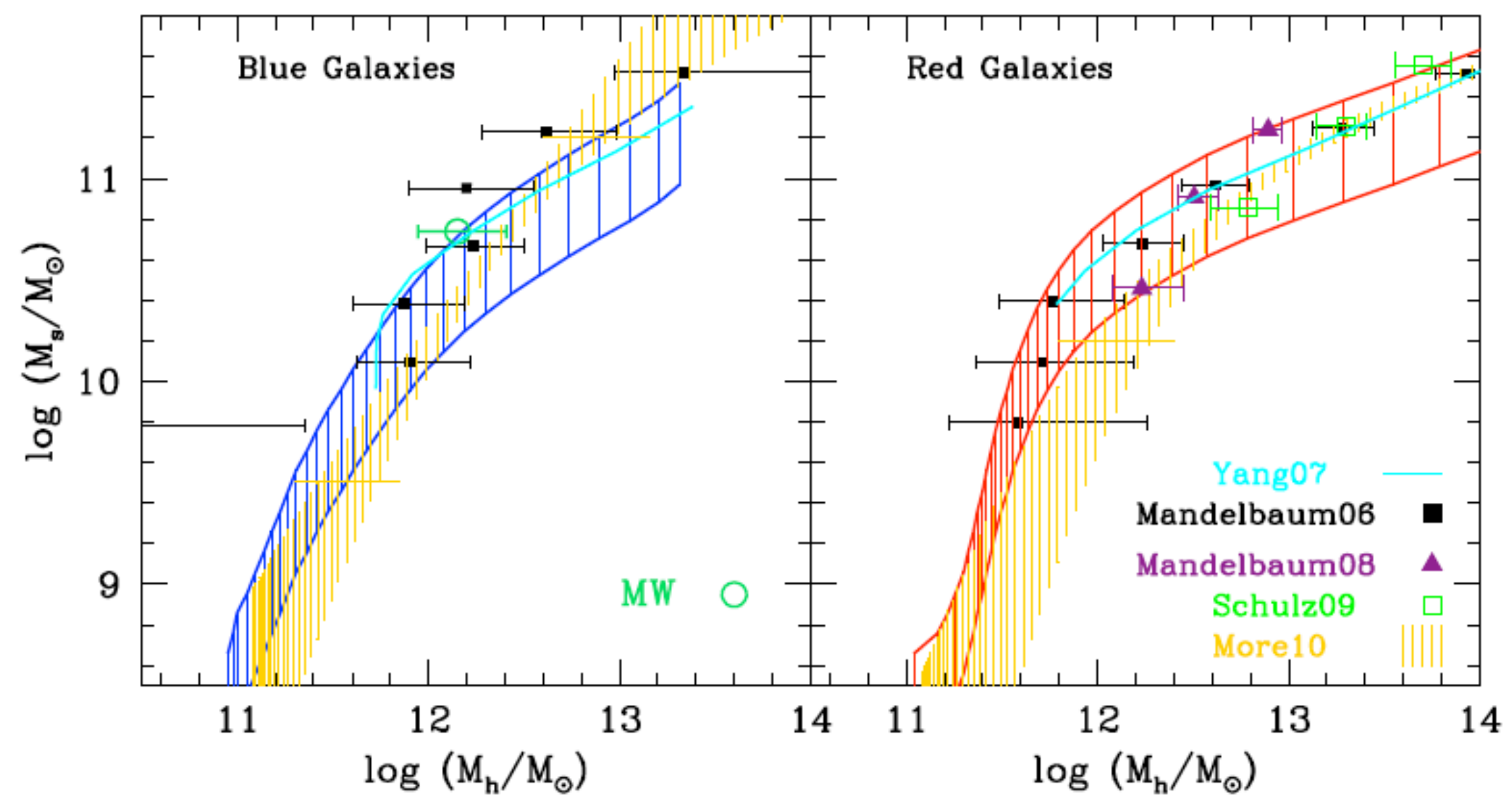

Figure 2. The Ms-Mh relations for blue (left panel) & red (right panel) central galaxies, at redshift z~0.

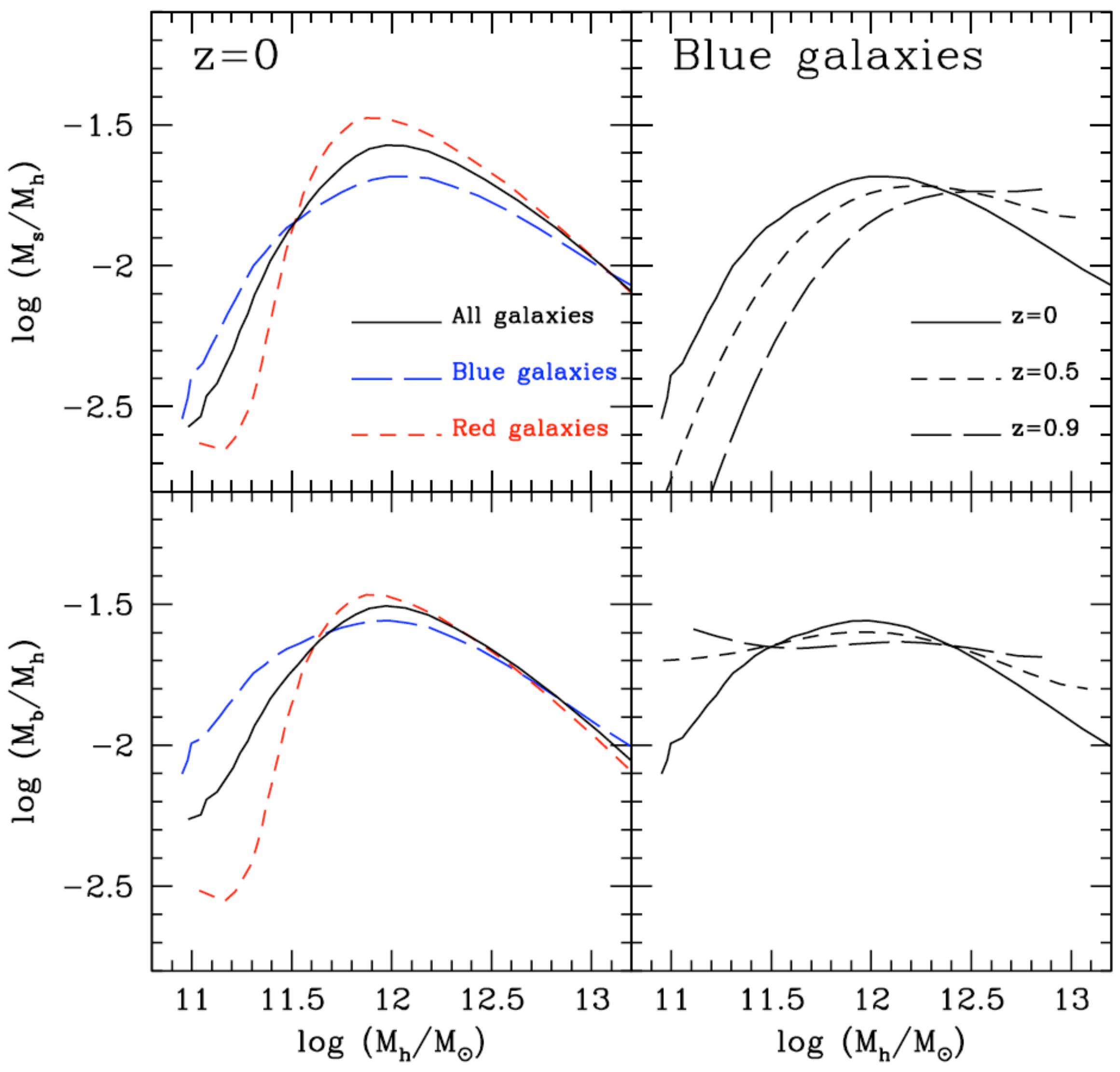

Figure 3. Left panels: fs (upper) & fb (bottom) -Mh relations for all, blue & red central local galaxies. Right panels: Evolution of the fs (upper) & fb (bottom) -Mh relations for blue galaxies.

By means of a HOD lately implemented, we predict correlations functions for blue/red galaxies under assumptions for the HMF in 2. The greement with observational (from [9]), even binned by mass, is amazing (Fig. 4).

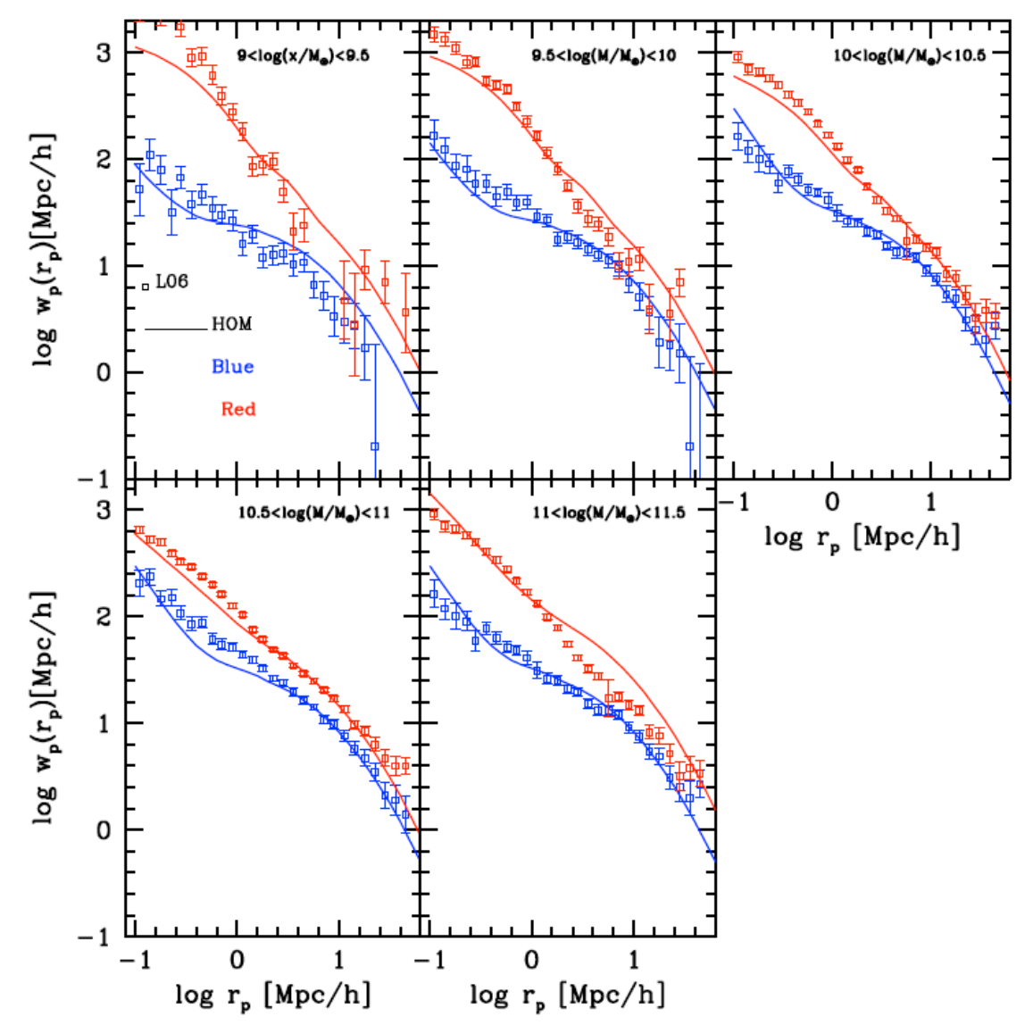

Figure 4. The proyected correlation function for blue & red galaxies.

4. Scalling Relations

The disk galaxy populations are modeled by means of a non-evolutive models close to [10], including adiabatic contraction [11], and by using our inferred f_b-M_h relations for blue galaxies.

- Inputs:

Mean values and scatters of the halo concentration parameter c and spin parameter l_h.

- Disk instability criterion to estimate M_s.

Predictions for z~0:

- We use a spin parameter $l_d<l_h$ and decreasing with M_h according empirical inferences [12], in order to reproduce the observed R_d-M_b(& M_s) relation.
- Excellent agreement with the slope, zero-point, and intrinsic scatter of the observed stellar & baryon Tully-Fisher relation (TFR)
- A slightly bend at faint end produced by the shape of $f_b(M_h)$
- TFR is robust to changes in $f_b(M_h)$
- R_d-M_b(& M_s) relation is much more sensitive to f_b
- Low values and the bell shaped of f_b-M_h produce a peak in the disk-to-total rotation velocity ratio as a function of mass, galaxies are submaximum.

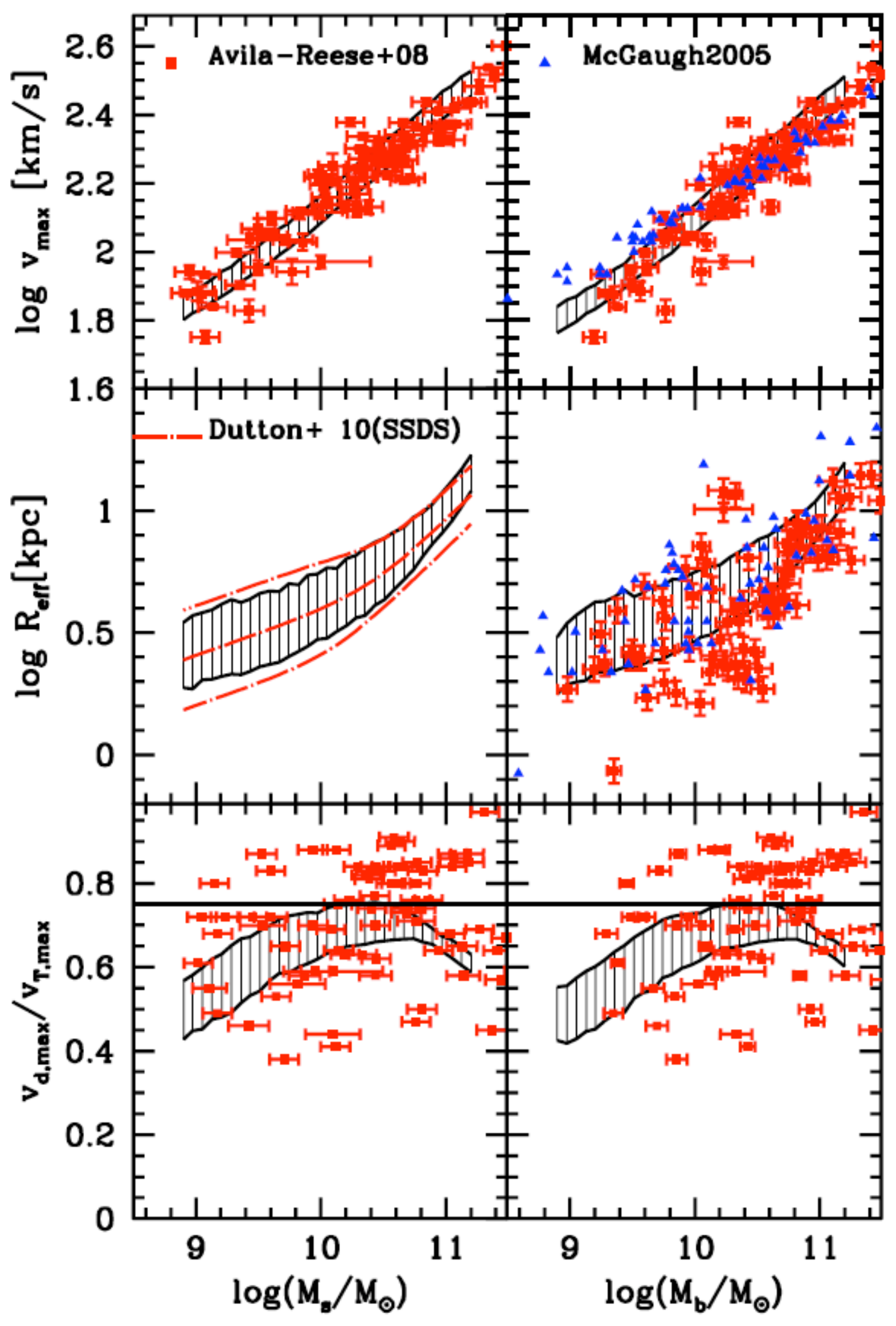

Figure 6. The predictions of the scalling relations for disk galaxies from our model with observational inferences.

Case for z<1:

- Our model predict the evolution of the slope and zero point in the stellar TFR, but not in the baryonic TFR.
- The R_d-M_s(& M_b) relation show a significant evolution at the high mass-end; the zero-point at lower masses does not evolve.
- Values for $f_b(M_h)$ results in more maximum disks at the high mass-end.

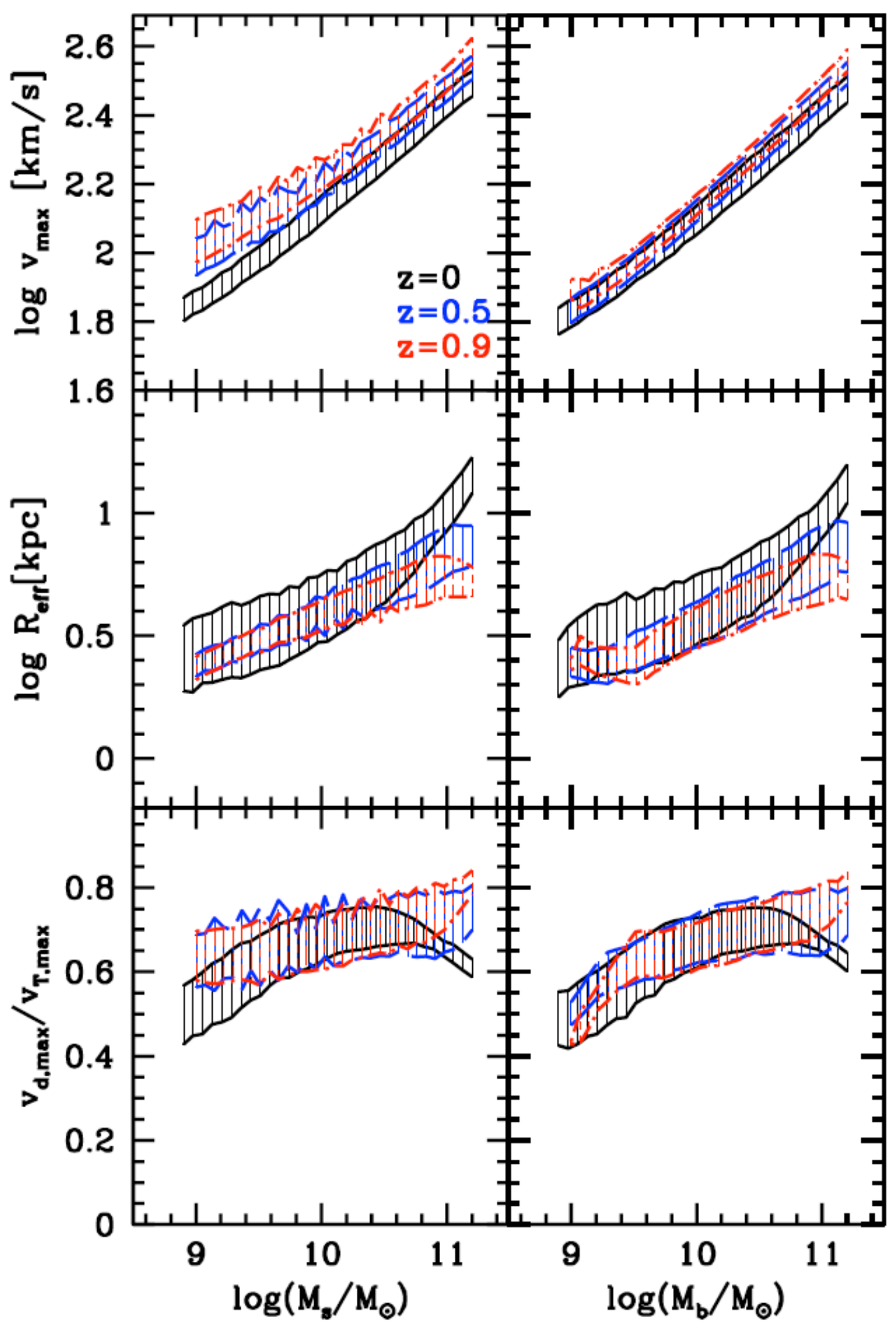

Figure 6. The predictions of the scalling relations for disk galaxies for z~0, 0.5 & 0.9

5. Concluding Remarks

- For local galaxies, our f_s is consistent with direct inferences and in good agreement with the proyected correlation function.
- Our f_b is in excellent agreement with structural and dynamical scaling relations.
- For z<1, there is a significant difference on the evolution of f_b (M_h) & $f_b(M_h)$.
- Galaxy downsizing in $f_s(M_h,z)$ but not in $f_b(M_h,z)$.

6. References

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