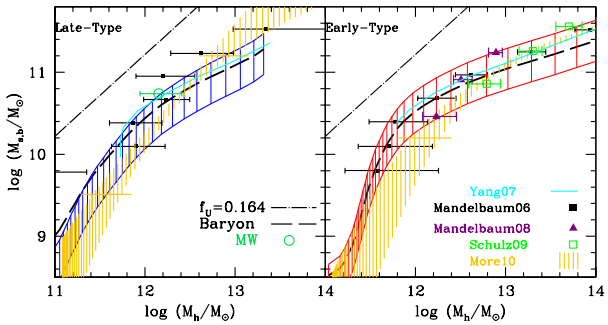

Fig. 1. The $\pm 1\sigma$ interval of the determined $M_{\rm s} - M_{\rm h}$ relations for blue (left panel, blue curves connected by vertical) and red (right panel, red curves connected by vertical lines) galaxies. Thick dashed lines are the means of the corresponding blue and red $M_{\rm b} - M_{\rm h}$ relations. Symbols with error bars correspond to weak lensing inferences, while the orange dashed regions are from satellite kinematics inferences.

3. THE SCALING LAWS OF DISK GALAXIES

According to our semi-empirical determination, blue galaxies have very low ($\ll f_U$) and strongly dependent on mass (bell-shaped function) baryon fractions. *Are consistent these fractions (given by the blue $f_{\rm b} - M_{\rm h}$ relation) with the structural and dynamical scaling laws of disk galaxies?* Following Mo et al. (1998) and Dutton et al. (2007), we implemented a model in which an exponential baryonic disk of mass $M_{\rm b} = f_{\rm b} M_{\rm h}$ is self-consistently loaded (gravitational drag is taken into account) in a dark matter halo with a NFW mass density profile characterized by the concentration parameter c and the spin parameter λ_h. A simple disk instability criterion is applied to estimate $M_{\rm s}$. The distributions of c and λ_h as a function of $M_{\rm h}$ are taken from results of cosmological simulations. For $f_{\rm b}(M_{\rm h})$ and its scatter, we use our semi-empirical inference.

The population of $z = 0$ disk galaxies generated with our model is in excellent agreement with the slope, zero-point, and intrinsic scatter of the observed stellar Tully-Fisher relation (upper panel of Figure 2). This relation is indeed very robust to changes in $f_{\rm b}$ (and λ_h, Firmani & Avila-Reese 2000; Dutton et al. 2007); our bell-shaped $f_{\rm b}(M_{\rm h})$ function just produces a slight bend at the faint end. Instead, the radius-$M_{\rm s}$ relation is much more sensitive to $f_{\rm b}(M_{\rm h})$: our peculiar $f_{\rm b}(M_{\rm h})$ produces a strong bend of this relation at low and high masses (Figure2, middle panel). The results plotted here are in fact by using a disk spin parameter $\lambda_d < \lambda_h$ and decreasing with $M_{\rm h}$ according to a law given by semi-empirical determinations (Berta et al. 2008);

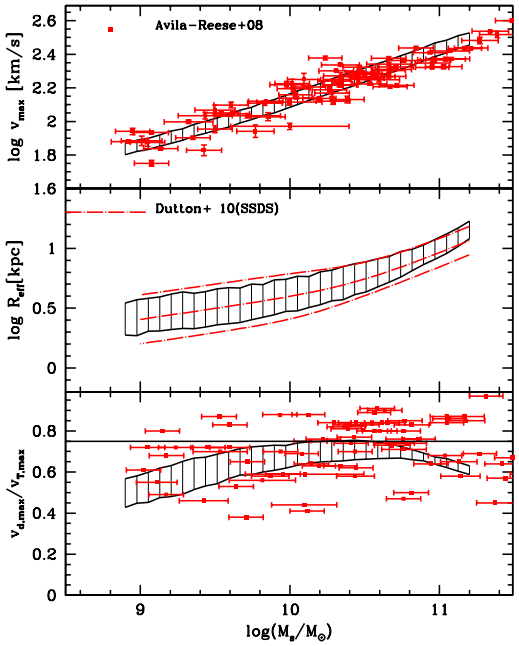

Fig. 2. Predicted dependences of $V_{\rm max}$, $R_{\rm eff}$, and the $V_{\rm d}$-to-$V_{\rm tot}$ ratio at 2.2 $R_{\rm d}$ on $M_{\rm s}$ by using the $f_{\rm b}(M_{\rm h})$ function inferred here for blue galaxies (the 1σ of the population distributions is plotted, vertical lines regions). The observational data are from Avila-Reese et al. (2008) and Dutton et al. (2011).

otherwise the radii are on average larger than observations, specially at high masses. The low values and peculiar dependence of $f_{\rm b}$ on $M_{\rm h}$ produce in average (sub-maximum) low disk-to-total circular velocity ratios at 2.2 $R_{\rm d}$, that even decreases with mass for large masses (bottom panel of Figure 2). This result seems to be at odds with observational determinations, though more accurate determinations are required before claiming for a potential inconsistency of the ΛCMD-based models.

REFERENCES

Avila-Reese, V., et al. 2008, AJ, 136, 1340
Behroozi, P. S., Conroy, C., & Wechsler, R. H. 2010, ApJ, 717, 379
Dutton, A. A., et al. 2007, ApJ, 654, 27
Dutton, A. A., et al. 2011, MNRAS, 410, 1660
Firmani, C., & Avila-Reese, V. 2000, MNRAS, 315, 457
Mandelbaum, R., et al. 2006, MNRAS, 368, 715
Berta, Z. K., et al. 2008, MNRAS, 391, 197
Mo, H. J., Mao, S., & White, S. D. M. 1998, MNRAS, 295, 319
More, S., et al. 2011, MNRAS, 410, 210
Rodríguez-Puebla, A., et al. 2011, RevMexAA, 47, 235
Yang, X., Mo, H. J., & van den Bosch, F. C. 2009, ApJ, 695, 900