functions are matched, $\Phi_g(> M_{\rm s}) = \Phi_h(> M_{\rm h})$, for finding the $M_{\rm h}$ corresponding to a given $M_{\rm s}$ (dotted arrows, for two different masses, in Figure 1), i.e., the $M_{\rm s}$–$M_{\rm h}$ or $F_s \equiv M_{\rm s}/M_{\rm h} - M_{\rm h}$ relations are inferred (solid bell-shaped curve in the inset). This method, called the abundance matching technique (AMT; e.g., Kravtsov et al. 2004; Vale & Ostriker 2004; Behroozi, Conroy & Wechsler 2010, hereafter BCW10, and references therein), makes a minimum of assumptions and has proven to be effective and practical. The halo masses of galaxies can be actually determined by direct methods as galaxy-galaxy weak lensing and satellite kinematics (e.g., Mandelbaum et al. 2006; More et al. 2011). Nevertheless, in current studies, due to the low signal-to-noise ratios, results can be obtained only by stacking a large number of galaxies; this introduces biases and significant statistical uncertainties in the inferences, and limits these inferences to relatively small mass ranges. However, in the mass ranges where comparisons are feasible, these direct methods, the model-dependent indirect methods (e.g., the Halo Occupation Model and the Conditional Luminosity Function formalism), and the AMT, give local F_s-$M_{\rm h}$ relations compatible among them within a factor of $\sim$2 (see BCW10; Moster et al. 2010; Guo et al. 2010; More et al. 2011; Rodríguez-Puebla et al. 2011).

The obtained stellar mass fractions, F_s, are very low with respect to the universal baryon fraction ($F_{b,U} \equiv \Omega_b/\Omega_M \approx 0.16$), i.e., galaxy SF inside ΛCDM halos seems to be a very inefficient process. Besides, the efficiency is strongly dependent on mass: it peaks around $M_{\rm h} = 8 \times 10^{11}\ M_\odot$, decreasing significantly towards lower ($F_s \propto {M_{\rm h}}^a, a \approx 1.25$) and higher ($F_s \propto {M_{\rm h}}^b, b \approx -0.6$) masses. The *GSMF* determinations at higher redshifts allow now to use methods like the AMT to infer the $M_{\rm s}$-$M_{\rm h}$ relation at different epochs (Moster et al. 2010; Wang & Jing 2010, BCW10). The latter authors extended the AMT out to $z \approx 4$ and found that (a) the $M_{\rm h}$ at wich F_s peaks shifts little to higher masses (by ≈ 0.6 dex out to $z \approx 4$), and (b) the peak value remains roughly constant. For masses below (above) the peak at a given epoch, F_s is smaller (slightly larger) than at earlier epochs for a given $M_{\rm h}$ (see Figure 2, dashed blue curves). This implies that galaxy SF in massive halos should have been slightly more efficient in the past, while in low-mass halos it should have been even less efficient. *This is a manifestation of the cosmic downsizing discussed above.*

(2) Individual $M_{\rm h}$ and $M_{\rm s}$ growth tracks.- In the ΛCDM scenario, the individual mass aggregation histories (MAHs) of halos are known. By using

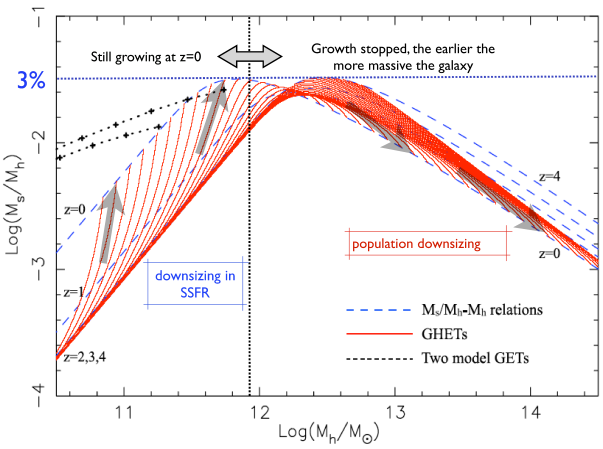

Fig. 2. The $M_{\rm s}/M_{\rm h}$-$M_{\rm h}$ functions inferred by the AMT at four z (dashed blue curves; BCW10, see FA10 for modifications). Solid red curves are the average $M_{\rm s}$ growth tracks inferred in FA10: in small halos, $M_{\rm s}$ assembles faster at late epochs as smaller is $M_{\rm h}$, while in large halos, $M_{\rm s}$ stopped its growth, the earlier the more massive the halo. The two dotted curves are tracks corresponding to two disk galaxy evolutionary models.

them in combination with the semi-empirical $M_{\rm s}$-$M_{\rm h}$ relations at different z, the corresponding $M_{\rm s}$ evolutive tracks (GHETs) can be inferred (red arrows in the inset of Figure 1; Conroy & Wechsler 2009; Firmani & Avila-Reese 2010, hereafter FA10). In FA10, average halo MAHs and a parametrization of the BCW10 $M_{\rm s}$-$M_{\rm h}$ relations up to $z = 4$ were used to infer individual *average* GHETs. The results are encouraging and show that at each epoch there is a characteristic mass that separates galaxies into two populations (Figure 2): (a) galaxies more massive than $M_{\rm s}(z=0) \approx 3 \times 10^{10}\ M_\odot$ are on average quiescent/passive (their $M_{\rm s}$ growth slowed down or stopped completely), besides the more massive is the galaxy, the earlier it has transited from the active (blue, star-forming) to the passive (red, quenched) population ('population downsizing'); (b) galaxies less massive than $M_{\rm s}(z=0) \approx 3\times10^{10}\ M_\odot$ are on average active (blue), and the less massive the galaxy, the faster its late $M_{\rm s}$ growth, driven likely by local SF ('downsizing in SSFR').

The $M_{\rm s}(z)$ average tracks (GHETs) inferred in FA10 are shown in Figure 3 (solid red curves). Their corresponding halo MAHs are also plotted (dot-dashed blue curves) but for comparative reasons, they were shifted vertically in such a way that each MAH coincides with its related GHET at $z = 0$. The shapes of the average stellar and halo mass assembling histories are quite different. For galaxies with