Morphological Diversities among the High Redshift Galaxies in GOODS

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Abstract

We have used the deep, multi–wavelength images obtained with the Advanced Camera for Surveys (ACS) on the *Hubble Space Telescope (HST)* by the Great Observatories Origins Deep Survey (GOODS) to identify ~ 4700 Lyman-break galaxies (LBGs) at redshifts $2.5 < z < 5$, and 292 starburst galaxies at $z \sim 1.2$. I will present the results from the morphological analysis based on modeling the surface brightness profiles using a Sérsic function, for the 1333 brightest LBGs with rest-frame $M_{1600\mathring{A}} \leq -20.5$ AB magnitudes. We distinguish the various morphological types based on the Sérsic index, n, which measures the profile shape. About 40% of LBGs at $z \sim 3$ have light profiles close to exponential, as seen for disks, and only about 30% of the galaxies have the high central concentrations seen in spheroids. We also identify a significant fraction ($\sim 30\%$) of galaxies with shallower than exponential profiles, which appear to have multiple cores or disturbed morphologies suggestive of close pairs or on-going mergers. The fraction of spheroid-like ($n > 2.5$) LBGs decreases by about 15% from $z \sim 5$ to 3. A comparison of LBGs with the starburst galaxies at $z \sim 1.2$, shows that disk-like and merger morphologies are dominant at both redshifts, but the fraction of spheroid-like profiles is about 20% higher among LBGs. The ellipticity distribution for LBGs exhibits a pronounced skew towards high ellipticities ($\epsilon > 0.5$), which cannot be explained by galaxy morphologies similar to the local disks and spheroids viewed at random orientations. The peak of the distribution evolves toward lower ellipticities, from 0.7 at $z = 4$ to ~ 0.5 at $z = 3$. The dominance of elongated morphologies among LBGs suggests that in a significant fraction of them we may be witnessing star-formation in clumps along gas-rich filaments, or the earliest gas-rich bars that encompass essentially the entire visible galaxy. Similar features are found to be ubiquitous in hydrodynamical simulations in which galaxy formation at high redshifts occurs in filamentary inflows of dynamically–cold gas within the dark matter halos, and involves gas-rich mergers.

I will also present the preliminary results from an on-going study of the morphology of high-z galaxies selected by their redder colors. Unlike the LBGs sample, this includes dusty starbursts and evolved galaxies.