

X03a Morphologies of Galaxies at  $z \simeq 9 - 16$  Uncovered by JWST/NIRCam Imaging

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We present morphologies of galaxies at  $z \sim 9-16$  resolved by JWST/NIRCam  $2-5\mu\text{m}$  imaging. Our sample consists of 23 galaxy candidates identified by stringent dropout and photo- $z$  criteria in GLASS, CEERS, SMACS J0723, and Stephan's Quintet flanking fields. We perform surface brightness (SB) profile fitting with GALFIT for 6 bright galaxies with  $S/N = 10-40$  on an individual basis and for stacked faint galaxies with secure point-spread functions (PSFs) of the NIRCam real data, carefully evaluating systematics by Monte-Carlo simulations. We compare our results with previous JWST results, and confirm that the obtained effective radii  $r_e$  are consistent with the previous measurements at  $z \sim 9$ . We obtain  $r_e \simeq 200-300$  pc with the exponential-like profiles, Sérsic indexes of  $n \simeq 1-1.5$ , for galaxies at  $z \sim 12-16$ , indicating that the relation of  $r_e \propto (1+z)^s$  for  $s = -1.19_{-0.15}^{+0.16}$  explains cosmic evolution over  $z \sim 0-16$  for  $\sim L_{z=3}^*$  galaxies. One bright ( $M_{UV} = -21$  mag) galaxy at  $z \sim 12$ , GL-z12-1, has an extremely compact size with  $r_e = 61 \pm 11$  pc that is surely extended over the PSF. Even in the case that the GL-z12-1 SB is fit by AGN+galaxy composite profiles, the best-fit galaxy component is compact,  $r_e = 78_{-12}^{+30}$  pc that is significantly ( $> 5\sigma$ ) smaller than the typical  $r_e$  value at  $z \sim 12$ . Comparing with numerical simulations, we find that such a compact galaxy naturally forms at  $z \gtrsim 10$ , and that frequent mergers at the early epoch produce more extended galaxies following the  $r_e \propto (1+z)^s$  relation.