Discriminating the Dependence of Galaxy Color on Luminosity & Redshift Using Updated SDSS Survey

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We revisit the previously hypothesized time-evolution of galaxies' color in the redshift ranges from 0 to 0.3, using the spectroscopic data from Sloan Digital Sky Survey (SDSS). Our samples reveal two distinct populations of galaxies, which are bluer and redder in color, and have blue-skewed and red-skewed color distribution functions towards the larger apparent magnitudes, respectively. This blue-skewed color distribution of the blue population galaxies (BPGs) was attributed to the more active star-formation at higher redshift in a previous study. Surprisingly, by directly plotting galaxies' color versus redshift, we do not find any evidence of evolution of color over cosmic time. Our hypothesis to resolve this apparent paradox is that the distributions of galaxy in the color-apparent magnitude diagram are subject to the intrinsic color-luminosity relations of galaxies. Indeed, after removing the distance modulus and the redshift effects in color, we found that our galaxy samples at all redshifts approximately follow the same trends of being bluer at the fainter end. In conclusion, we have identified two dominant competing mechanisms which affect the observed galaxy distributions in the color-apparent magnitude diagram: (1) distance modulus and redshift, and (2) the intrinsic color-luminosity relations of galaxies. For the red population galaxies (RPGs), the former mechanism has a more prominent effect, which leads to the red-skewed distribution. On the other hand, the effect of the intrinsic color-luminosity relations may be more prominent for BPGs, whose fainter part is dominated by the low-redshift faint and blue galaxies.