On The Robustness of $z = 0$-1 Galaxy Size Measurements Through Model and Non-Parametric Fits

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Abstract

We present the size-stellar mass relations of nearby ($z=0.01$-$0.02$) Sloan Digital Sky Survey galaxies, for samples selected by color, morphology, Sérsic index $n$, and specific star formation rate. Several commonly employed size measurement techniques are used, including single Sérsic fits, two-component Sérsic models, and a non-parametric method. Through simple simulations, we show that the non-parametric and two-component Sérsic methods provide the most robust effective radius measurements, while those based on single Sérsic profiles are often overestimates, especially for massive red/early-type galaxies. Using our robust sizes, we show for all sub-samples that the mass-size relations are shallow at low stellar masses and steepen above $\sim 3-4 \times 10^{10} M_{\odot}$. The mass-size relations for galaxies classified as late-type, low-$n$, and star-forming are consistent with each other, while blue galaxies follow a somewhat steeper relation. The mass-size relations of early-type, high-$n$, red, and quiescent galaxies all agree with each other but are somewhat steeper at the high-mass end than previous results. To test potential systematics at high redshift, we artificially redshifted our sample (including surface brightness dimming and degraded resolution) to $z=1$ and re-fit the galaxies using single Sérsic profiles. The sizes of these galaxies before and after redshifting are consistent and we conclude that systematic effects in sizes and the size-mass relation at $z \sim 1$ are negligible. Interestingly, since the poorer physical resolution at high redshift washes out bright galaxy substructures, single-Sérsic fitting appears to provide more reliable and unbiased effective radius measurements at high $z$ than for nearby, well-resolved galaxies.