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 ~ 3-4 × 10^{10} M_{sun}. 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 ~ 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.