Analysis of Galaxy Count Variations

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We present galaxy counts to $B \sim 26$ (50% detection completeness) in two 0.023 deg^2 areas of sky: the South Galactic Pole and a field referred to as BES at $(l, b) = (21, -38)^\circ$. Our aim is to establish the veracity and cause of astrophysically induced breaks in galaxy count slopes. A critical aspect of our analysis is the comparison of counts in two fields surveyed in identical fashion over a large area and to great depth. Images were obtained for both fields in $UBVRI$ bands using a Tektronix 2048^2 CCD on the Du Pont 2.5m at Las Campanas Observatory during the same nights, and images were carefully calibrated using Landolt standards. Image processing, source detection and photometry were also conducted identically for both fields. Images of the two fields in the same bandpass have equivalent depth and seeing.

Spurious slope breaks may arise from systematic detection and photometry errors. Substantial effort has been expended to limit these problems in our analysis. Simulations were run in which libraries of stars and galaxies taken from the images are randomly reinserted at different flux scalings and then re-subjected to the detection and photometry algorithms. From these tests, various corrections to source detection and photometry are derived. We find the magnitude errors and completeness to be identical for the two fields. Special care was taken with the star/galaxy separation. A combination of techniques allowed for identification of stars past $B \sim 23.5$ where the number of stars drops to less than 10% of the number of galaxies.

The resultant slopes of the galaxy counts for both fields are within the range of values established for this magnitude regime, but there exist field-to-field variations in the normalization, slope and shape of the counts at brighter magnitudes. The mean B band slope for the SGP is $dlogA/dm = 0.52 \pm 0.05$ with a break at $B \sim 24$ where the slope changes from 0.56 to 0.47 ± 0.04. In contrast, the BES field slope is 0.40 ± 0.04 with no noticeable break. Such differences between our two fields suggest that the variance found in other recent studies of the B band count–e.g., B band slopes ranging from 0.31 (Arnouts et al. 1999, A&A, 341, 641) to 0.51 (Brunner et al. 1999, ApJ, 516, 563)– has astrophysical origin. We find that count variations correlate to clumping in color-color space along iso-redshift loci, clearly indicating large scale structure as the primary source of these variations. It is plausible that slope breaks are due primarily to this phenomenon, and not global redshift trends in volume, luminosity function shape, or evolution. We conclude that it is premature to attribute slope breaks to either the evolution of galaxy populations or cosmological effects, or to assume global galaxy count trends from studies along only a few lines of sight.

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