The Stellar Outskirts of the Disk Galaxy NGC4244

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Background: The faint outermost components of galaxies contain vital clues for understanding their formation and mass assembly histories. In particular, numerical simulations predict that stellar halos and thick disks should be generic features of disk galaxies, consisting largely of tidal debris from accreted satellite galaxies (e.g. Bullock & Johnston 2005). Our knowledge of the structure and content of the outskirts of the Milky Way and M31 has increased dramatically in the last years, with much evidence supporting the current hierarchical paradigm (e.g. Ferguson et al 2002, Ibata et al 2007, Bell et al 2008). Larger sample sizes are clearly required however, and we present here results from our ongoing study of the resolved RGB population in the outskirts of the low-mass edge-on NGC4244 (D=4.36 Mpc, Seth et al. 2005a).

Discussion: NGC4244 has been the subject of a number of previous studies. Notably, Fry et al. (1999) conducted deep R-band surface photometry (to R~27.5 magnitudes per square arcsec) and concluded that the galaxy was composed of a single disk component. More recently, Seth et al. (2005b) used HST exposures to analyse the vertical structure of the galaxy and found a scaleheight for the RGB stars similar to that of Fry. Tikhonov & Galazutdinova (2005) also present an HST analysis of NGC4244 and claim tentative evidence for a flattening to the star counts beyond ~3 kpc, similar to what we find here. A similar result was also found in preliminary work reported by Seth et al. (2007). Until now, the small FOV HST analyses have had little constraining power in distinguishing between a thick disk or stellar halo nature for NGC4244's second structural component. Our wide-field ground-based images suggest a highly-flattened nature, as expected for a thick disk. If confirmed, the existence of such multi-component structure in a bulgeless disk galaxy would be particularly interesting. Indeed, many of the most attractive scenarios for thick disk formation involve merger events, which would also be expected to lead to the formation of a bulge (e.g. Abadi et al. 2003).

The Data: Observations were taken using Suprime-Cam on Subaru under 0.7-0.9” seeing. We obtained a total of 6930s exposure in the V and 4300s in the I. Basic processing, including stacking, mosaicing, photometric and astrometric calibration, has been done using the CASU pipeline in Cambridge. Subsequent crowded-field photometry has been conducted using DAOPHOT II (Stetson 1987), using stellar PSFs defined for each of the 10 CCD chips.

Star-Galaxy Separation: The most challenging aspect of the data analysis is the task of star-galaxy separation. In Local Group galaxies, RGB stars are generally several magnitudes brighter than the bulk of the contaminating unresolved background galaxies. This is not the case in NGC4244, where the two occupy similar magnitude ranges (although generally define different colour sequences) – see Fig.2.

Star-galaxy classification has been explored using both cuts in the DAOPHOT output parameters Merr, Sharp and Chi as well as morphologies from Sextractor. In order to test the robustness of our classifications, we have analysed several public HST/ACS exposures of NGC4244, taken as part of the GHOSTS survey. Detailed comparison of ground and space-based classifications within these fields indicates that up to 80% of the point sources in the sparsest fields could be background galaxies. This means we cannot trust the morphological classifications alone, but by doing a careful background subtraction using regions at the FOV edges, we can still examine the large-scale distribution of stellar sources in and around NGC4244.