Formation and Evolution of Galaxy Outskirts
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Galaxies Unveiled: Rest-frame UV Clumps at 0.5<z<1.5

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Abstract. Studies of high redshift galaxies reveal compact sub-galactic regions of star formation, known as 'clumps'. These 'clumpy' galaxies are useful for the study of galactic outskirts by enabling us to examine the radial progression of clumps over large time scales. We use the first deep high resolution NUV image from the Hubble Space Telescope covering intermediate redshifts to explore the implications this radial progression may have on galaxy evolution. From the analysis of 209 clumpy galaxies, we find that higher redshift clumps dominate the outer regions of galactic outskirts. This indicates that clumps may be migrating from the outskirts inward toward their galactic centers.

Keywords. galactocentric radius, galaxies: evolution, clump migration

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Having obtained NUV observations with the Ultraviolet Ultra Deep Field (UVUDF; Teplitz *et al.* 2013) we can now properly explore $0.5 \leqslant z \leqslant 1.5$: an important stage in galaxy evolution which has not been studied in the past in the rest-frame far-ultraviolet (FUV). A fraction of galaxies in this redshift range exhibit irregular and asymmetric morphologies with features such as clumps. We refer to these as 'clumpy' galaxies, which are similar to galaxies at $z > 2$ (Elmegreen *et al.* 2004). By sampling clumpy galaxies at these redshifts we can form a more cohesive picture of the evolutionary history of this sub-population of galaxies.

Light attributed to the hottest and brightest OB stars is emitted in the FUV and is sampled by the F225W, F275W, and F336W filters of the WFC3 UVIS detector on HST at 0.5<z<1.5. We explore the intrinsic properties of UV clumps detected at rest-frame 1500Å at this redshift range in the UVUDF and provide preliminary results on the FUV flux ratios, clump sizes, and galactocentric radii of the host galaxies.

Our sample of 209 clumpy galaxies shows average clump sizes of ∼0.9 kpc, consistent with previous studies at high redshift (Förster Schreiber *et al.* 2009). We find that all clumps within a galaxy typically supply an average of 19% of the total rest-frame FUV flux, while each clump individually contributes about 5% to their host galaxy flux. We also find a correlation between redshift and galactocentric radius, where higher redshift clumps ($1.0 < z < 1.5$) are located in the galaxy outskirts (up to 5 kpc), while lower redshift clumps are predominantly at smaller radii.

These preliminary results reveal that ∼20% of the star formation is occurring directly in the clumps. The dominance of $1.0 < z < 1.5$ clumps in the outskirts, compared to $0.5 < z < 1.0$ clumps, demonstrates the existence of clumps farther out in the earlier evolutionary stages of galaxies. This radius dependence on redshift suggests that gravitational instabilities, which occur over time, may cause clumps to migrate inward toward the gravitational potential well of the galaxy and eventually coalesce to form a bulge, supporting clump migration theories (Bournaud *et al.* 2007).

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