Blue Compact Galaxies in the Ultra Deep Field:

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Introduction:

We surveyed the HST/ACS Ultra Deep Field (UDF) for extended disks in Luminous Compact Blue Galaxies (LCBGs) at redshifts 0.4 - 1.2. Whether LCBGs have such disks is a key constraint to their nature and evolution to the present day.

Based on narrow emission line widths, morphology and spectral properties, LCBGs are proposed progenitors of local low-mass spheroidal galaxies (e.g. Koo et al. 1995, Guzman et al. 1998). Alternatively, LCBGs were interpreted as forming bulges of interacting disks (Barton & van Zee 2001); luminous compact galaxies were suggested to be progenitors of present-day bulges of massive spirals (Hammer et al. 2001). In the two latter scenarios, the brightness of the forming bulge imprint the colors, effective size and surface brightness, and linewidths of the bulge onto the values measured for the entire distant galaxy (see Fig. 2a,b). Directly probing for extended, possibly low surface brightness disks through direct imaging is not trivial for high-redshift galaxies due to cosmological surface brightness dimming, but desirable to test the above described scenarios.

We take advantage of the exceptional depth and resolution of the UDF images (PI: S. Beckwith, STScI; 56,56,144 and 144 orbits integration time in the F435W, F606W, F775W, F850LP filters with HST/ACS). As shown in Fig. 2, these data make it possible to search even for low surface brightness (LSB) disks out to z~1.

Sample selection, surface photometry

To select objects by intrinsic rather than apparent properties, the UDF SEXtractor catalog (V1, Beckwith et al. 2004) was matched with robust published redshifts in the UDF region. After calculating rest-frame properties, objects were selected on the criteria (Garland et al. 2004)

\[ r_e < 3.5 \text{kpc}, S_B < 21 \text{B mag/arcsec}^2, \]
\[ (B-V) < 0.6, M_I < -18.5 \]

This yields 28 galaxies, mostly around z~1 (see Fig. 1). Two of these are AGN and are not further analyzed here.

Surface brightness profiles and color profiles were derived and transformed to rest-frame B band surface brightness and color profiles, using methods as detailed in Papaderos et al. (2002), Noeske et al. (2003), and Willmer et al. 2004. Some example profiles are shown in Figs. 2 and 3.

References:


Structure of the extended stellar components: compact galaxies or large disks?

Surface brightness profiles are typically exponential at larger radii (>2-4 kpc), and often show central excess emission that is accompanied by an inwards-blueing of the rest-frame color profiles. This reflecton electro in LCBGs, central starburst emission is frequently embedded in a more evolved, extended stellar component, in agreement with Guzman et al. (1998).

Exponential fits (orange lines in the surface brightness profiles) to the rest-frame B band profiles were applied only in their exponential part, where color profiles showed no strong gradients. This way, the fitted exponential scale lengths (alpha) reflect the structure of the older extended stellar components/disks in LCBGs, and are not dominated by the starburst emission.

Conclusion

(1) LCBGs at high redshifts typically show a stellar component that is more extended and probably mostly more evolved than the ongoing starburst.

(2) In most LCBGs (~80%) this extended stellar component is itself compact, with high central surface brightnesses and small scale lengths, comparable to local Blue Compact Dwarf (LCD) Galaxies, but different from normal and LSB sprays in the local Universe. We estimate that an additional large, lower surface brightness disk underlying these compact stellar components would be detectable in the present data, unless it had extremely faint central surface brightnesses (fainter than 23 B mag/arcmin^2) at z~1, see Fig. 1c-f).

(3) Only few (3/28) LCBGs show a large, low-surface brightness disk hosting a dominant central starburst. These fit the scenario of LCBGs being photometrically dominant starburst cores within large disks. However, the small number suggests that this scenario is valid for a small fraction (~10%) of LCBGs only.