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A QUANTITATIVE STUDY OF THE EVOLUTION OF PECULIARITIES IN GALAXY MORPHOLOGY OUT TO $Z \sim 3$

K. L. Wu,[1] S. M. Faber[2] and T. R. Lauer[3]

Peculiarities in galaxy morphology are generally accepted to be indications of galaxy interactions and mergers. A study of such peculiarities, therefore, will provide valuable clues to the formation and evolution of galaxies. I have developed a pair of indices, Rotational Asymmetry and Concentration, based on the work of Abraham et al. (1996), to identify galaxies with peculiar morphology. These indices are applied to a large sample of galaxies in the Hubble Deep Field - North for which photometric redshifts have been determined by A. J. Connolly. This powerful combination of deep, high resolution HST data and photometric redshifts allows investigation of trends at redshifts which have been largely inaccessible until now.

The Rotational Asymmetry, A_W, and Concentration, C_W, indices in this work are defined as follows:

$$A_W \equiv \frac{1}{2}\ \frac{\sum |I - I^{180}|}{\sum I} - \ < \frac{1}{2}\frac{\sum |B - B^{180}|}{\sum I} >, \tag{1}$$

where I is the intensity at a given galaxy pixel, I^{180} is the intensity at the corresponding 180°-rotated pixel, and B and B^{180} are the corresponding background pixel values; and

$$C_W \equiv \frac{r_{80}}{r_{20}}, \tag{2}$$

where r_{80} and r_{20} are the radii enclosing 80% and 20% of the total galaxy light, respectively. For details, please see Wu et al. (2002).

Figure 1 shows the Rotational Asymmetry - Concentration relation for galaxies in the Hubble Deep Field - North, divided into five redshift bins. Three trends can be seen in this figure: (1) The observed range of galaxy morphology has not changed significantly between $z \sim 1$ and today. This is consistent with the findings of several other groups (*e.g.*, Driver et al. 1998, Abraham et al. 1996). (2) Beyond $z \sim 1.2$, few high-concentration (early-type) galaxies are observed. Simulations indicate, however, that

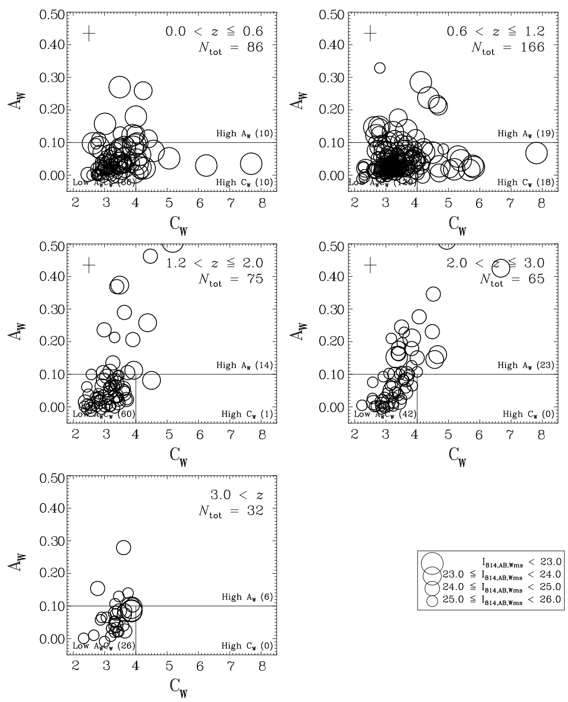

Fig. 1. The Rotational Asymmetry - Concentration relation for galaxies in the Hubble Deep Field - North, divided into five redshift bins. Photometric redshifts for these objects were determined by A. J. Connolly.

this apparent "disappearance" of this class of galaxies may be strongly influenced by observational selection effects. (3) Beyond $z \sim 1.2$, both the measured degree of peculiarity and the percentage of peculiar objects increases. Although bandpass effects are present, they cannot fully account for the new population of highly asymmetric objects that is observed. The increase in the percentage of peculiar objects may, however, be a result of sampling to different depths in the luminosity function at different redshifts.

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[1]Department of Astronomy, University of Florida, 211 BSSC, Gainesville, FL 32611-2055, USA; *klwu@astro.ufl.edu*.
[2]UCO/Lick Observatory, Santa Cruz, CA 95064, USA.
[3]KPNO/NOAO, Tucson, AZ 85721, USA.