ENVIRONMENTAL INFLUENCES ON GALAXY EVOLUTION

Stephen E. Zepf, *University of Durham*

and

Brad Whitmore, *Space Telescope Science Institute*

Abstract

We investigate the role of mergers and interactions in the evolution of galaxies by studying galaxies in compact groups. Compact groups of galaxies have high spatial densities and low velocity dispersions making these regions ideal laboratories in which to study the effect of interactions and mergers. Based on a detailed spectroscopic and multi-color imaging study, we find that both the isophotal shapes and the stellar kinematics indicate that many of the elliptical galaxies in compact groups have been affected by tidal interactions. At the same time however, we find that the only a few elliptical galaxies in compact groups have evidence for the young stellar populations that would be expected if they are the result of recent merger of two spiral galaxies. Therefore we conclude that tidal interactions affect galaxy properties at the current epoch, but the bulk of basic galaxy formation and transformation must have occurred at much higher redshift.

1. Colors and Recent Mergers

Elliptical galaxies recently created from the mergers of spiral galaxies are expected to have relatively blue colors because of their younger stellar populations. Therefore, if mergers of spiral galaxies are common in compact groups, a population of elliptical galaxies should exist in these groups with bluer than normal colors. In order to address this question, we undertook an extensive multicolor imaging survey of 76 early-type galaxies in compact groups (Zepf *et al.* 1991). The primary result of this survey is that three of the elliptical galaxies and one of the S0 galaxies have blue colors indicative of recent interactions and mergers.

A complementary study of the number of currently interacting systems, as determined from far-infrared colors, optical morphology, and emission-line rotation curves, finds that roughly 7% of the galaxies in compact groups are currently merging (Zepf 1992). Therefore, mergers are occurring in compact groups, but the timescale for the evolution of the groups through merging is significantly longer than the observed crossing time. Moreover, these results suggest caution in attributing all of the enhanced activity observed at higher redshifts to changes in environment, as not even in compact groups is the level of starbursting and

other phenomena often associated with interactions and mergers as high as that apparently observed in samples of galaxies at moderate redshifts (e.g. Broadhurst *et al.* 1988) .

2. Structure and Dynamics

Although dramatic mergers which result in a transformation of galaxy type are rare in compact groups, the elliptical galaxies appear to be affected by tidal interactions within the groups. These tidal interactions manifest themselves as differences in both the isophotal structure and the stellar kinematics of ellipticals in compact groups compared to ellipticals in other environments. The isophotal shapes of elliptical galaxies in compact groups differ from those in other environments in several ways. They are less likely to have perfectly elliptical isophotes and more likely to have isophotes with irregular shapes than galaxies in other regions. These two differences are consistent with the more frequent encounters expected in compact groups. The third difference is that elliptical galaxies with boxy isophotes are rarer in compact groups. This result argues against a connection between interactions and mergers and boxy isophotes.

The stellar kinematics of the elliptical galaxies in compact groups also appear to be different than those of elliptical galaxies in other regions. We have obtained velocity dispersions of 20 ellipticals in compact groups and find that these galaxies have systematically lower velocity dispersions than ellipticals in other environments (Zepf & Whitmore 1992). These low velocity dispersions cause the compact group ellipticals to lie off of the "fundamental plane" defined by other ellipticals. Although the sample size is unfortunately small, there are several factors which support the hypothesis that elliptical galaxies in compact groups have low velocity dispersions. The first is that distance errors are unlikely to be a factor since the compact group ellipticals have low velocity dispersions for their colors. The second factor is that the central velocity dispersions correlate with the isophotal shape, such that disky ellipticals have lower velocity dispersions than boxy ellipticals. This trend also suggests that the same physical phenomenon may be responsible for the differences in isophotal shape and the low velocity dispersions.

References

Broadhurst, T.J., Ellis, R.S., & Shanks, T. 1988, MNRAS, 235, 827

Zepf, S.E. 1992, ApJ, submitted

Zepf, S.E., Whitmore, B.C., & Levison, H.F. 1991, ApJ, 383, 524

Zepf, S.E., & Whitmore, B.C. 1991, ApJ, 383, 542

Zepf, S.E., & Whitmore, B.C. 1992, ApJ, in preparation