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Cluster Galaxy Populations from $z = 0.33 - 0.83$: Characterizing Evolution with CL1358+62

Kim-Vy Tran and Garth D. Illingworth

Department of Astronomy and Astrophysics, University of California, Santa Cruz, CA 95064

Marijn Franx

Leiden Observatory, P.O. Box 9513, NL-2300 RA Leiden, Netherlands

Abstract. We combine HST WFPC mosaics of clusters at multiple redshifts with Keck LRIS spectroscopy to characterize different galaxy populations and how they evolve. By combining quantitative measurements of structural parameters with velocity dispersions, line indices, and morphological types, we attempt to establish links between ellipticals, S0's, E+A's, and later type galaxies. Here we focus on galaxies in CL1358+62, a massive cluster at $z = 0.33$.

1. Introduction

Using both high resolution imaging from HST WFPC2 and spectroscopy from LRIS on Keck, we study the cluster galaxy populations in CL1358+62 using 142 confirmed members. The imaging provides colors, morphological type, and quantitative structural parameters such as bulge/total fraction, bulge and disk scale lengths, half-light radius, galaxy asymmetry, and ellipticity. The spectroscopy provides membership, velocity dispersions ($\sim$masses), and line indices for measuring recent star formation, e.g. Hδ and [OII]. With our complementary approach, we can place constraints on the evolution of cluster early-type (E/S0) and post-starburst (E+A) galaxies in CL1358+62.

2. Elliptical vs. S0: A Matter of Viewing Angle?

Jorgensen & Franx (1994) suggest that elliptical and S0 galaxies ($M_B \geq -22$) are of the same galaxy class where E's are face-on members and S0's the more edge-on ones, *i.e.* these are the same galaxies where viewing angle is the primary discriminator. If the CL1358+62 sample has ellipticals that are mainly round and S0's that are elongated while both share a similar bulge fraction (B/T) distribution, this would support a common parent population for both. We show the ellipticity distributions of E's and S0's in Fig. 1 (left). Results from the Kolmogorov-Smirnov tests of the B/T and ellipticity distributions for this sample supports a common parent population for ellipticals and S0's.

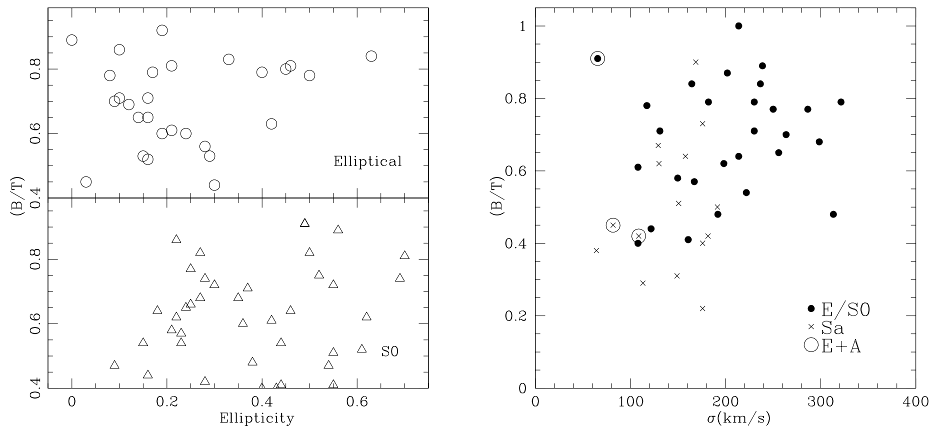

Figure 1. *Left:* Bulge fraction vs. bulge ellipticity for ellipticals and S0's; we show only the most bulge-dominated galaxies ($B/T \geq 0.4$). The B/T distributions of E's and S0's are indistinguishable while their ellipticity distributions do not share a common parent population (> 99% confidence). *Right:* Velocity dispersion (Kelson et al. 2000) vs. B/T for a subset of E/S0, Sa, and E+A members. As the E+A's in CL1358+62 do not share the same velocity dispersion distribution as the E/S0 population, they cannot evolve into massive E/S0 galaxies.

3. E+A Galaxies: What Do They Become?

E+A galaxies are still a mystery (Dressler et al. 1997). Spectroscopically defined as galaxies that formed stars within the recent past (< 1.5 Gyr; Balogh et al. 1999), they may be the transition between late type spirals and early type systems. If E+A's are a snapshot in the transformation of the former to the latter, they are a fundamental phase in galaxy evolution.

To test if E+A's can evolve into the bright, massive early type cluster galaxies observed nearby, we examine the bulge fraction, bulge scale length, and velocity dispersion of E+A's in CL1358+62. Their scale lengths and velocity dispersions (Fig. 1, right) show a population different from E/S0 galaxies. The E+A's in CL1358+62 may evolve into early type systems but they cannot become massive ones.

References

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