

# Early and Late Life - Bulge-Dominated Galaxies over the Last 8-9 Gyr

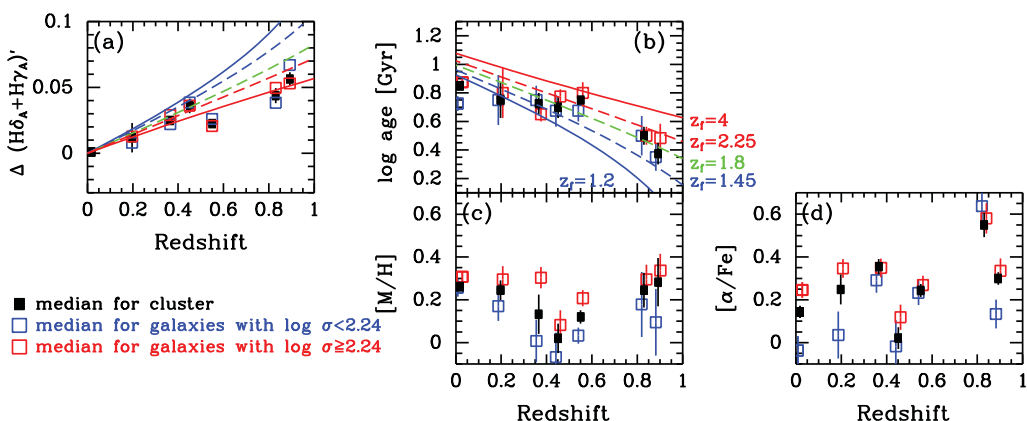
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**Abstract.** We present results from our investigation of galaxy evolution in dense cluster environments up to redshift  $z=1.3$  based on high S/N ground-based spectroscopy and HST imaging of bulge-dominated galaxies: (1) An analysis of sizes, M/L ratios and line indices of galaxies in massive clusters out to  $z=1.3$ . The results are published in Jørgensen & Chiboucas (2013) and Jørgensen *et al.* (2014). (2) A preliminary analysis (Fig. 1) of absorption line indices, ages, metallicities and abundance ratios for galaxies in nine massive clusters out to  $z=0.9$ . New data cover three clusters at  $z=0.2-0.5$ .

**Keywords.** Galaxies: evolution, galaxies: elliptical and lenticular



**Figure 1.** The figure shows, as a function of redshift for the clusters, (a) zero point offsets relative to  $z \approx 0$  for the relation between Balmer line strengths and velocity dispersions, (b) mean ages, (c) metallicity [M/H], and (d) abundance ratios [α/Fe]. We have used single stellar population models (Maraston & Strömbäck (2011), Thomas *et al.* (2011)) to derive ages, [M/H], and [α/Fe] and to make the predictions for the passive evolution models shown on panels (a) and (b). The Balmer lines strengths and the ages are in agreement with passive evolution with a formation redshift  $z_f \approx 2$ . However, the cluster-to-cluster variations in [M/H] and [α/Fe] are inconsistent with this simple model.

## References

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