INVESTIGATING THE SCATTER IN THE $V_{26} - \log \sigma$ RELATION

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ABSTRACT. The nature and existence of a second parameter needed to characterize the family of normal elliptical galaxies has been much discussed. The need for a second parameter has been demonstrated by the correlation of the residuals from the well–known magnitude–velocity dispersion relation for ellipticals with other observables such as ellipticity, mass–to–light ratio and Mg line strength or metallicity. Here, evidence for a correlation between residuals in the $V_{26} - \log \sigma$ relation and the strength of $H\beta$ is presented, suggesting that variations in the stellar populations in Virgo elliptical cores may be an important secondary parameter.

Dressler (1984) measured velocity dispersions for Virgo and Coma galaxy cluster members from reticon spectra taken through 16″ and 4″ apertures, respectively. The Virgo objects were also measured through a 4″ aperture, and velocity dispersions determined, though never published. As part of a detailed analysis of the absorption line strengths of Dressler's (1984) data, the strength of $H\beta$ has been measured for all objects in the sample, including the unpublished 4″ Virgo spectra.

Residuals from linear least–squares fits to the $V_{26} - \log \sigma$ relations for the three data sets are plotted against $\log(H\beta)$ in Figure 1. Galaxies lying far from the mean $\log \sigma$ relations were not included in the fits. A weak anti–correlation exists in the large aperture Virgo data. A much stronger trend is present in the small aperture data. Coma exhibits no such relation. In Figure 2, residuals from the tighter $\log D_\Sigma - \log \sigma$ relation are plotted against $H\beta$. $\log D_\Sigma$ is a quantity defined by Dressler et al. (1986) to be the log of the radius in arcseconds at which the surface brightness drops to 20.75 mag/arcsec^2. The tight correlation of $\log D_\Sigma$ with $\log \sigma$ is attributed to $\log D_\Sigma$ being dependent upon both core surface brightness and size, quantities more directly linked to the central potential than V_{26} (Dressler et al. 1986). The same trends are seen in Figure 1.

These relations cannot be interpreted in any precise way, though they suggest variations of the stellar population in the cores of the Virgo galaxies. The addition of a stellar component with a blue continuum and enhanced $H\beta$ would cause the velocity dispersion to be measured too low for its V_{26} or $\log D_\Sigma$ as well as enhancing the central surface brightness of the parent galaxy. Both effects would contribute to the anti–correlations seen here. This is demonstrated qualitatively by the location of NGC 4742 in the large aperture Virgo data and D107 in the Coma sample. Both galaxies have very strong Balmer lines and low $\log \sigma$. Such an effect could in

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principle be caused by young, intermediate age, or metal poor populations as well as variations in M/L (or equivalently, the slope of the IMF). That the correlation of $\log(H\beta)$ with $\delta \log \sigma$ is stronger in the Virgo 4×4 data than in the 16×16 data indicates that the population is concentrated at the centers of the galaxies. This would seem to favor the young population, as recent star formation in normal ellipticals is expected to occur where mass loss from stars would concentrate.

Whatever it is that drives the relation in Virgo is absent in the Coma cluster. If it is recent star formation that produces the Virgo correlation, then perhaps the Coma galaxies are kept clean by some gas evacuation mechanism such as ram presure from intracluster gas. It is also possible that the relation is suppressed by the somewhat lower signal–to–noise data for Coma as well as the larger effective size of the 4×4 aperture at the distance of Coma compared the the 16×16 aperture at Virgo. 0.7 arcsecond aperture measurements of Coma galaxies would be needed to obtain data equivalent to the Virgo 4×4 data.

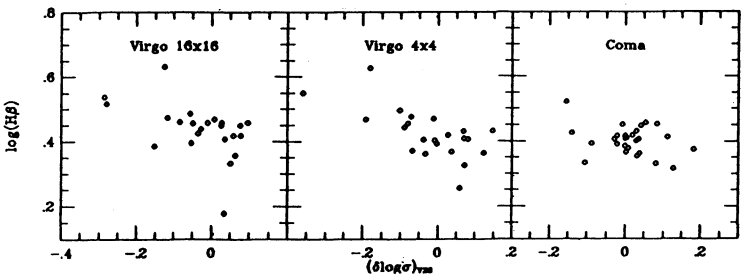

Figure 1. δlogσ - log(Hβ) correlations as measured from the V_{26} - logσ relation. Note the clear trend in the small aperture Virgo data and lack of same in the Coma sample.

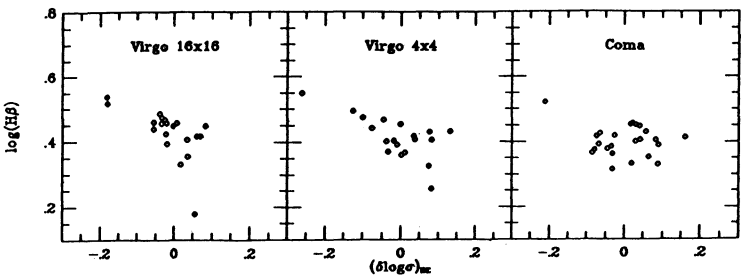

Figure 2. δlogσ - log(Hβ) correlations as measured from the $LogD_L$ - logσ relation.

REFERENCES

Dressler, A., 1984. *Ap. J.*, **281**, 512.

Dressler, A., Lynden–Bell, D., Burstein, D., Davies, R.L., Faber, S.M., Wegner, G., & Terlevich, R., 1986. "Spectroscopy and Photometry of Elliptical Galaxies. I. New Distance Estimator", preprint.

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