LINE-STRENGTH GRADIENTS IN ELLIPTICAL GALAXIES

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ABSTRACT. We have measured line-strength indices as a function of radius in several elliptical galaxies. All of them show strong radial gradients in Mg, but much weaker gradients in Fe and Hβ. The isophotes and contours of constant line-strength have the same flattening. More luminous galaxies have shallower gradients, contrary to the prediction of models of dissipative collapse. Most of the galaxies observed show weak central emission which can partially fill the Balmer absorption lines.

Line-strength gradients in elliptical galaxies have long been proposed as a diagnostic of the processes at work during galaxy formation. Larson (1975) and more recently Carlberg (1984) have shown that an elliptical galaxy which forms by the dissipative collapse of a gas cloud should exhibit a metallicity gradient.

We have measured Hβ, Mg_2, Fe1 (5270 Å) and Fe2 (5335 Å) indices (Burstein et al. 1984) from spectra taken by Davies and Birkinshaw (1986) in their study of the kinematics of ellipticals. Each galaxy was observed at four position angles. We find that:

(1) Typical changes in Mg_2 over the range 0.1 to 1.0 r_e are -0.03 to -0.10 which correspond to changes in [Fe/H] of -0.11 to -0.39 using the calibration given by Terlevich et al. (1981). Line-strength gradients scale with the galaxy light (i.e. isophotes and contours of constant line-strength have the same flattening).

(2) In this small sample, the brightest galaxies have shallower gradients than fainter ones. This is contrary to the prediction of Carlberg's (1984) dissipative models, and suggests that dissipation was less important in the formation of more luminous galaxies. This is consistent with the formation of giant ellipticals from mergers of low-luminosity ones, as mergers decrease abundance gradients (White 1978).

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(3) Many galaxies have weak LINER emission. The suggestion that the excess blue light in ellipticals comes from young stars rests in part on the anomalously strong Hβ absorption and correcting for the presence of emission increases this anomaly.

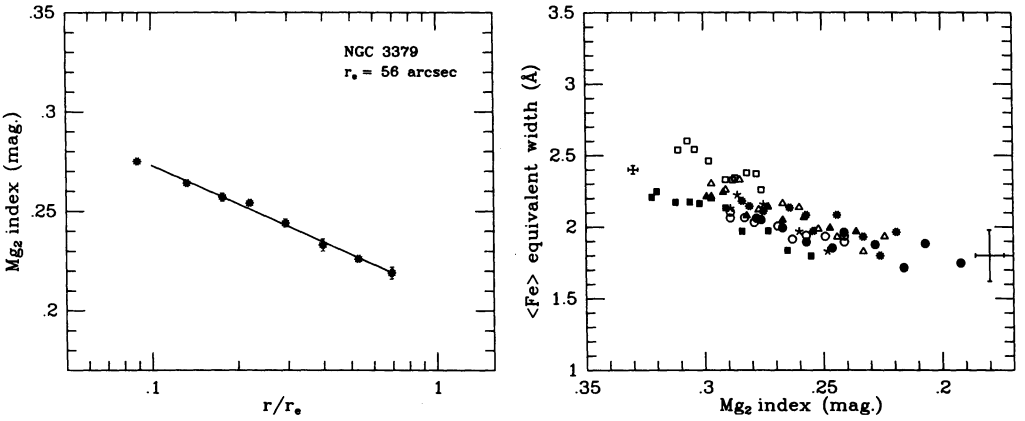

Fig. 1: (a) Mg_2 gradient in NGC 3379 (averaged over four position angles). The line is a least-squares fit from 0.1 to 0.7 r_e. (b) Radial variation of <Fe> with Mg_2 for eight bright ellipticals, each shown by a different symbol. Typical error bars are marked. Note that Mg_2 as defined by Burstein et al. is on a logarithmic scale, while <Fe> is defined as an equivalent width. Our values of Mg_2 and <Fe> may have a small zero-point offset from the Burstein et al. scale.

REFERENCES

Burstein, D., Faber, S.M., Gaskell, C.M. and Krumm, N. 1984, Ap. J., 287, 586.
Carlberg, R. 1984, Ap. J., 286, 404.
Davies, R.L. and Birkinshaw, M. 1986, in preparation.
Larson, R.B. 1975, M.N.R.A.S., 173, 671.
Terlevich, R., Davies, R.L., Faber, S.M. and Burstein, D. 1981, M.N.R.A.S., 196, 381.
White, S.D.M. 1978, M.N.R.A.S., 184, 185.