

A Comparison of the Near-Infrared Spectral Features of Early-Type Galaxies in the Coma Cluster, the Virgo Cluster and the Field

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Aaronson *et al.* (1981) derived the relative distance between the Coma and Virgo clusters from color-magnitude relations of the early-type galaxies in each cluster. They found that the derived distance was color-dependent and concluded that the galaxies of similar luminosity in the two clusters differ in their red stellar populations. More recently, the color-dependence of the Coma-Virgo distance modulus has been called into question by Bower *et al.* (1992a, 1992b). However, because these two clusters differ so dramatically in their morphologies and kinematics, it is plausible that the star formation histories of the member galaxies also differed. If the conclusions of Aaronson *et al.* are indeed correct, then some signature of the resulting stellar population differences should appear in the near-infrared and/or infrared light of the respective galaxies.

We have collected near-infrared spectra (6600 - 9200 Å) of 17 Virgo and 10 Coma early-type galaxies; this sample spans about four magnitudes in luminosity in each cluster. Seven field E/S0 galaxies have been observed for comparison. Pseudo-equivalent widths have been measured for all of the field galaxies, all but one of the Virgo members, and five of the Coma galaxies. The features examined are sensitive to the temperature, metallicity and surface gravity of the reddest stars. These include the Ca II triplet (8498, 8542 and 8662 Å) as defined by Delisle & Hardy (1992), the Na I doublet (8183 and 8195 Å) as defined by Faber & French (1980), the TiO band indices I(7100), I(7450), I(7890), I(8197) and I(8460) of Terndrup *et al.* (1990), and the TiO1 and TiO2 bands of Carter *et al.* (1986).

A preliminary analysis of these spectral features has been performed, and, with a few notable exceptions discussed below, the measured pseudo-equivalent widths agree well with previously published values. In particular, our I(8197) indices support those of Boroson & Thompson (1991) and Delisle & Hardy (1992), both of whose I(8197) strengths disagree with the Terndrup *et al.* (1990) values. However, we have had some difficulty reproducing the Na I measurements of Delisle & Hardy, and our sample of galaxies does not show the correlation between Na feature strength and luminosity which they see. This is undoubtedly due to the very narrow continuum bands used to determine the Na I width; they span only one or two pixels at our spectral resolution. We have also found some of the feature measurements to be highly sensitive to the removal of the telluric O₂ and H₂O absorption bands present in this spectral region. This is especially true of the Na doublet and I(8197) band.

The pseudo-equivalent widths of the E/S0 galaxies in the Coma cluster and in the field do not appear to be systematically different from those of the Virgo cluster members of similar luminosity and/or color. There are two significant trends evident in the Virgo data, and the field and Coma galaxies tend to scatter about the Virgo relations.

For the Virgo galaxies, the strength of the Ca II triplet weakens as the TiO band at 7890 Å gets stronger. This trend is shown in Figure 1; it is consistent with the inverse correlation between the widths of the TiO band at 8145 Å and the Ca II 8662 Å line seen in Galactic bulge stars and solar neighborhood M giants by Sharples *et al.* (1990). However, due to the measurement uncertainties in our data and the fact that our observed trend greatly depends upon the two or three galaxies with the strongest Ca lines, the Ca II strengths are also consistent with the galaxies having an intrinsically small spread in Ca II width, as predicted by Terlevich *et al.* (1990) for a metal-rich, giant-dominated stellar population.

Figure 2 illustrates that the indices of the two most prominent TiO bands in the near-IR, I(7100) and I(7890), tend to be stronger in redder galaxies, with their strengths becoming constant for the reddest galaxies. Since the color of an early-type galaxy is known to be a function of metallicity, this would indicate that, at least for the bluest galaxies in our sample, the TiO band strengths trace the average metallicity of the underlying late-type stellar population.

Reduction of the remaining near-IR spectra is in progress, and this project will soon move on to an analysis of infrared (K band) and optical (4300 - 7000 Å) spectra which have already been obtained.

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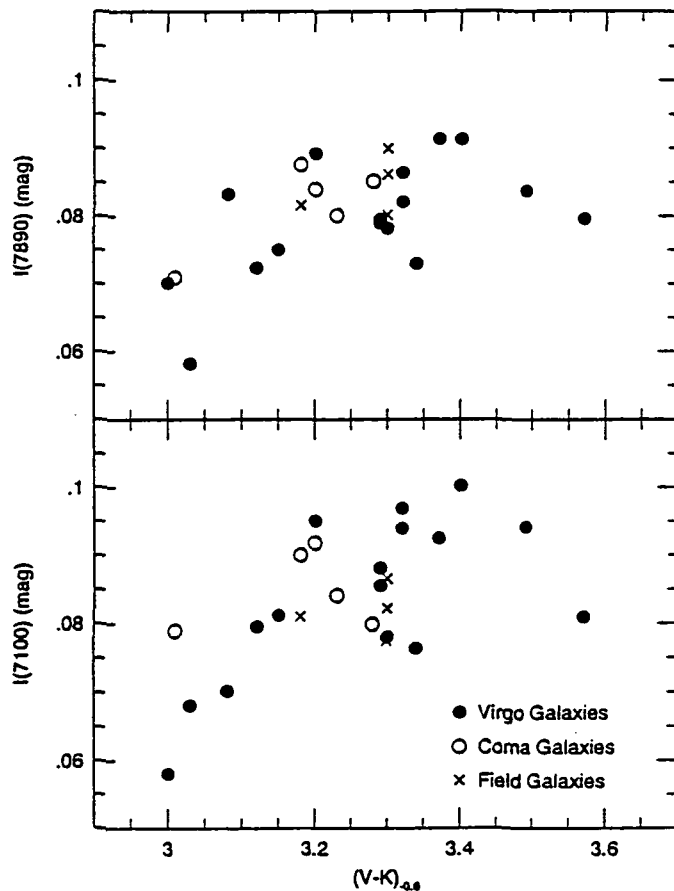


Fig. 1. - The correlation of the strength of the TiO band index I(7890) with the pseudo-equivalent width of the Ca II triplet. $(V-K)_{0.6}$ is the $V-K$ color at $\log(A/D_0) = -0.6$ taken from Aaronson *et al.* (1981).

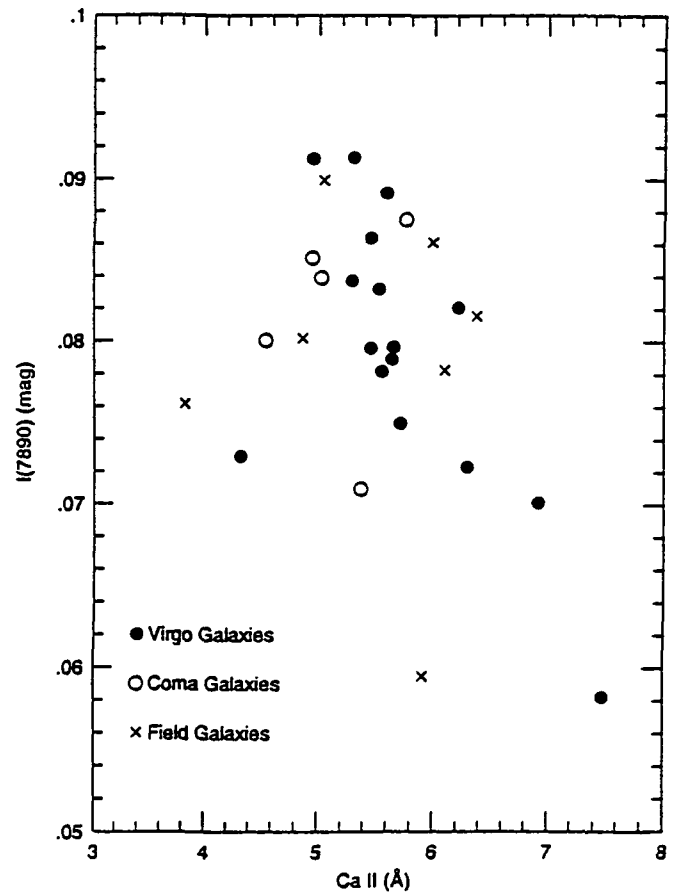


Fig. 2. - The strengths of the TiO band indices I(7100) and I(7890) as a function of galaxy color. $(V-K)_{0.6}$ is the $V-K$ color at $\log(A/D_0) = -0.6$ taken from Aaronson *et al.* (1981).