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Optical and Near Infrared Photometry of Butcher-Oemler Clusters

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Rich clusters of galaxies at moderate redshifts (z~.3) have a larger proportion of optically blue galaxies than their low redshift counterparts. Spectroscopic examination of the blue galaxies by various authors has shown that the blue galaxies are generally Seyferts, show evidence for recent star formation, or are foreground objects. Unfortunately, spectroscopy is too time consuming to be used on large samples. Thus, we have looked for a way to separate Seyferts, starbursts, ellipticals and nonmembers using photometry alone.

Five moderate redshift clusters, Abell numbers 777, 963, 1758, 1961 and 2218, have been observed in the V, R and K bands. We model the spectral energy distributions of various kinds of galaxies found in clusters and derive observed colors.

We have modeled the spectral energy distributions (SED) of several kinds of galaxies compute their colors as a function of redshift. We expect to see ellipticals, spirals, starbursts, post-starburst and Seyfert galaxies. The SED of elliptical and Sbc galaxies was observed by Rieke and Rieke (in prep.). The SEDs for the starburst galaxies was created by adding a reddened 10^8 year old burst to a spiral galaxy SED. The post-starburst (E+A) galaxy SEDs are composed of a slightly reddened 10^9 year old burst and elliptical galaxy SED. SEDs for the Seyferts were created by adding a $\nu^{-1.1}$ power law, and a hot dust thermal spectrum to the Sbc. From the SEDs the colors of galaxies at various redshifts with assorted filters were computed.

Lilly & Gunn (1985) have optical and infrared photometry for a sample of galaxies in CL0024+1654 observed spectroscopically by Dressler, Gunn and Schneider (1985). We have used this data to choose the most appropriate SEDs for our starburst and post-starburst models. Their data and our models are shown together in figure 1.

The most likely explanation for the optically blue colors in most cluster galaxies is star formation. Very few galaxies lie in the Seyfert locus. Abell 1758, shown in figure 2, has more Seyfert candidates than the other clusters, we observed.

It seems possible to roughly sort types of galaxies in clusters by color alone. The cluster population seems to vary considerably between clusters, but our K selected sample has few Seyferts in any cluster.

References

Lilly, S. J. and Gunn, J. E. *MNRAS*, **217**, 551.
Rieke, M. J. and Rieke, G. H., in preparation.
Dressler, A., Gunn, J. E., and Schneider, D. P., 1985 *Ap. J.*, **294**, 523.

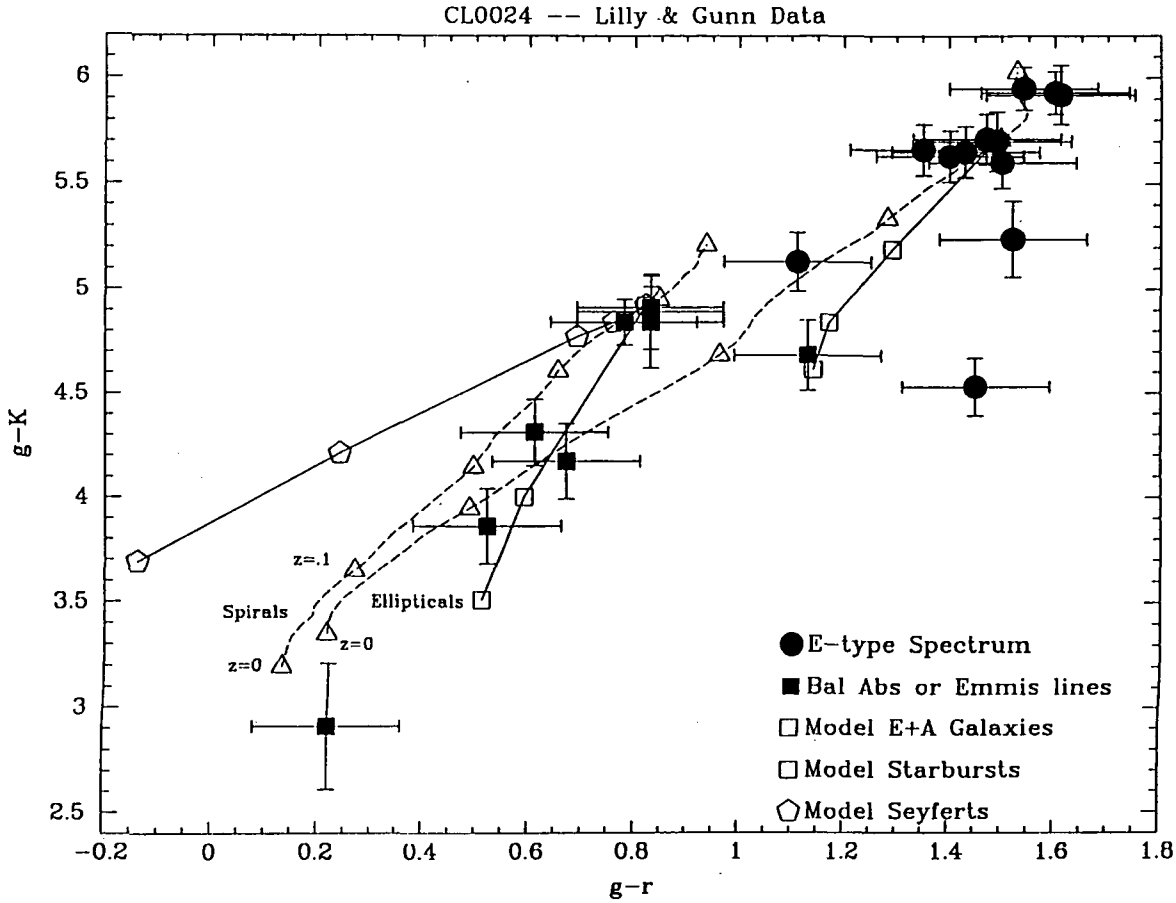

Figure 1. CL0024+17 photometry and models. Photometry taken from Lilly & Gunn (1985), spectroscopic information from Dressler, Gunn and Schneider (1985).

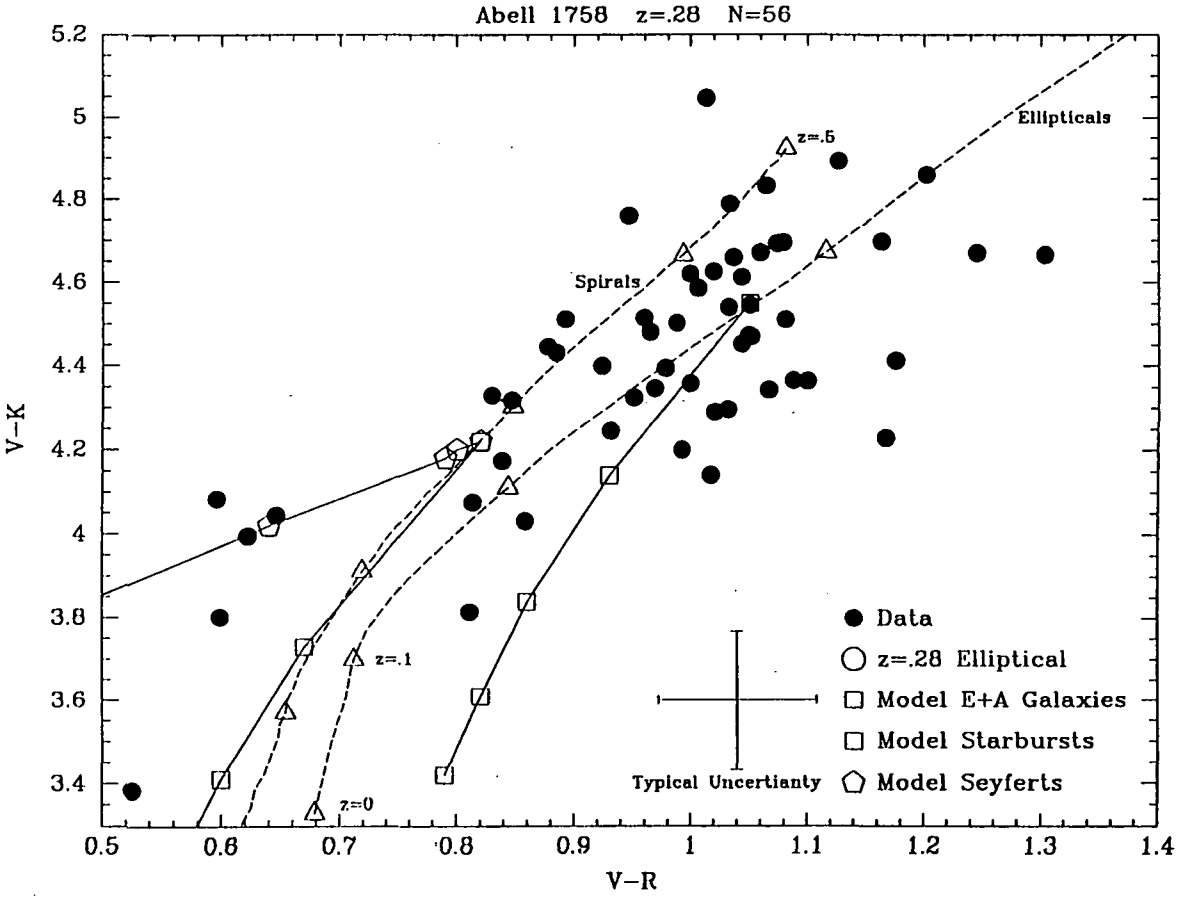

Figure 2. Abell 1758 and models at z=.28.