Near-IR Imaging of Moderate Redshift Galaxy Clusters

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Spectroscopic studies of the "blue galaxy" cluster population which first appears at $z \sim 0.2$ – the Butcher-Oemler (BO) Effect (Butcher and Oemler 1984) – have uncovered several classes of objects suggesting a wide range of evolutionary histories for cluster galaxies: star forming spirals, AGNs, and post-starburst "E+A" objects resembling early-type galaxies with a strong A-star population superimposed (but no signs of ongoing star formation). At moderate redshifts, optical imaging samples the rest-frame near-UV and tells about the recent star formation histories of the cluster galaxies. Observations at IR wavelengths are necessary to measure the luminosity and colors of the underlying cool stellar population which should dominate the galaxies' mass. Optical-to-IR photometry will provide a broader understanding of the nature of BO activity and the galaxies it affects. For example, optically-red ellipticals and S0s, the "red envelope" galaxies which had been thought to define the track of quiescent galaxy evolution, also reveal signs of spectral evolution. Lilly (1987) analyzed near-infrared photometry of galaxies in several distant galaxy clusters, and found them to be ~0.1 mag redder in their $(V-H)$ colors than predicted by models.

We have obtained near-IR imaging of 3 moderate-z clusters on the 1.3m at KPNO with SQIID, a new camera offering wide-field (5.5 arcmin) simultaneous JHK band imaging. Our photometry on a sample of ~100 likely member galaxies in one of the clusters, Abell 370 at $z = 0.37$ (K band image shown in Fig. 1), shows that we can obtain magnitudes good to 20% down to $K = 18$, considerably below the estimated K_*=16.5 at this redshift. These data indicate that there are no systematic problems in obtaining photometry at faint levels with SQIID. With the development of larger arrays, the field is open to progress. Previous near-IR imaging work on moderate redshift clusters has been hampered by the small size of the first generation arrays. Aragon-Salamanca, Ellis, and Sharples (1991) recently published the first such work on Abell 370; they find that the longer wavelength colors are redder than supposed and indicate a strong contribution by AGB stars in a post-starburst phase. They were able to mosaic a field, in only the K band using IRCAM on UKIRT, on Abell 370 with only 1/10th the area of a single SQIID frame to the same depth that we reached in similar total integration time.

The resulting J, H and K data for the three clusters are combined with previously-obtained multiband optical photometry. We present an investigation of the spectral properties and evolution of the dominant cold stellar populations by comparing optical-to-IR colors and color-magnitude diagrams to predictions from population synthesis models and galaxy spectral evolution codes.

REFERENCES

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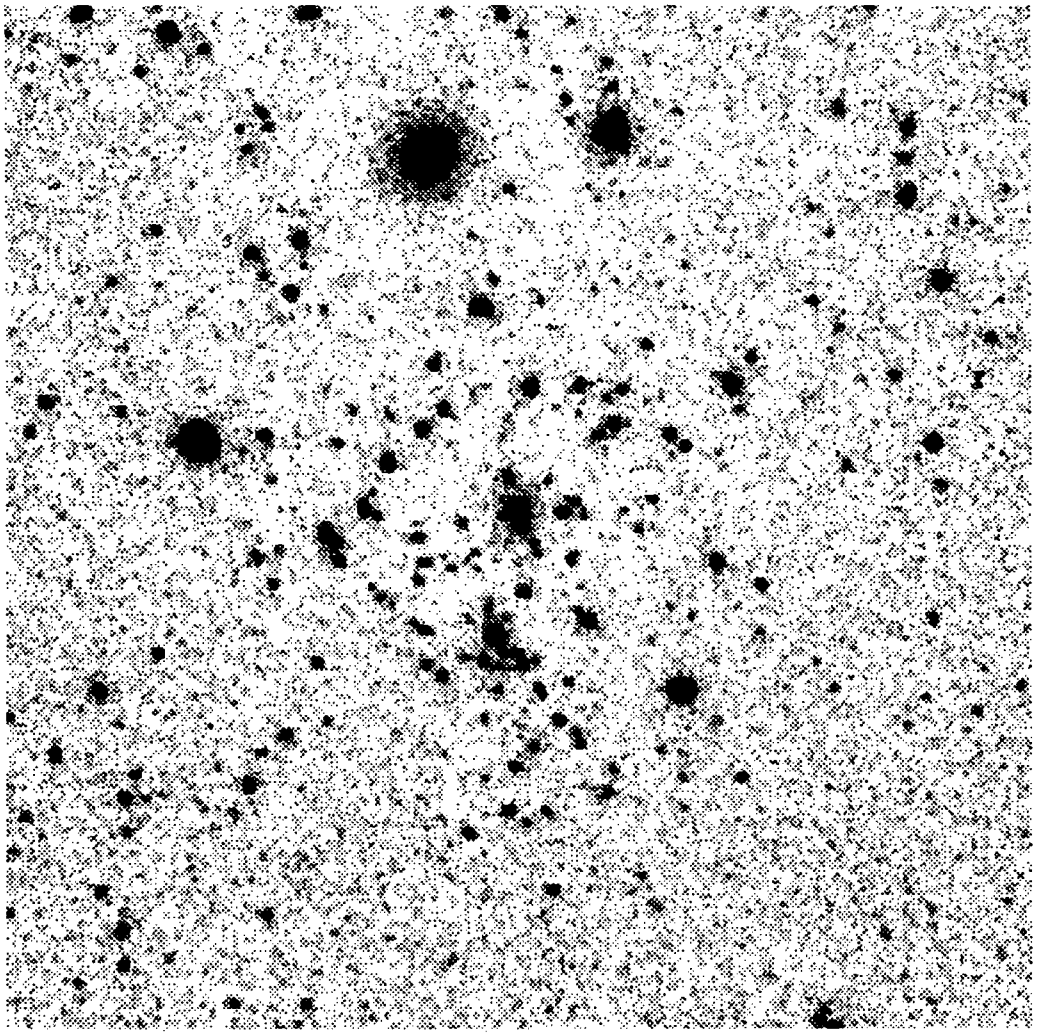

Fig. 1 – Abell 370, K band.