THE STELLAR POPULATIONS AND INTERNAL REDDENING OF SPIRAL GALAXIES

by

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ABSTRACT

In this dissertation two results are presented. The first is the calibration of a data set of optical, infrared, and spectral images of ten spiral galaxies. The data set is unique because of the combination of imaging and spectroscopy. The galaxies are imaged in the optical B, V, R, I, and near-infrared J, H, and K filters. Spatially resolved, long slit spectra are obtained at two position angles and two spectral resolutions in each galaxy. This data may be used to study surface brightness and color distributions, line strength gradients, chemical compositions (metallicities), bulge-disk decomposition, galaxy models, dust models, the Tully-Fisher relation, and stellar populations.

To understand the history and current state of a galaxy's stars, gas, and dust is to understand its evolution and the evolution of galaxies in general. In this area, spiral disks are not understood as well as ellipticals or spiral bulges. In particular whether color gradients within spiral disks are due to changes in internal reddening or changes in stellar population is an open question. Because changes in age, metallicity, and the effects of dust all make the galaxy colors redder, a reddening independent measure of the population is required to answer this question. In this work, the magnesium b triplet absorption feature is used for this purpose. The color with the largest wavelength range, $B-K$, provides sensitivity to reddening. These two quantities are measured at the same locations within the disks of a subset of the galaxies. Stellar population models are used to confirm changes in population and to estimate the amount of internal reddening. This technique has the advantage of being applied to individual galaxies and to locations within galaxies, but it is not feasible to apply it to large numbers of galaxies. Also, even though models from various authors agree to within 30%, they may contain systematic effects, the discussion of which is beyond the scope of this work.

The three disks studied are reddened by dust and have color gradients that can be due to stellar population changes or changes in reddening. The field galaxy had the least reddening and a color gradient due to population changes, becoming older and/or more metal rich toward the center. In its outer disk, the color becomes bluer outward because of a decrease in the reddening. The cluster galaxies have more reddening. One has a color gradient due mostly to an increase in reddening toward the center. Thus, the field galaxy and cluster galaxy become redder in their centers for different reasons. The internal differences between the cluster and field galaxy are likely due to their different environments. By visual inspection, the color gradients are smoother than the appearance of dust lanes in the B imagery. Comparison of the data to the models reveals that the three disks are most likely composed of a mixture of intermediate ages and metallicities. Very old metal rich populations and very metal poor populations of any age do not appear to contribute to the light observed. The technique of estimating the internal reddening by comparing data to models is successful. Thus, it will be possible to correctly interpret the colors of the unresolved disks of spiral galaxies.

Future work will include determination of the wavelength dependence of the reddening, how reddening varies from galaxy to galaxy and within a galaxy, and testing of dust models. Comparisons will also be made with the reddening in our galaxy. Distinguishing between reddening and population changes is critical to understanding the stellar content of spiral galaxies and hence the evolution of galaxies in general.