Department of Astronomy and Physics

Kaitlin Kratter

Mentor: Charles Liu and Laura Kay

Spectroscopic Analysis of Nearby Active Galaxies

The objective of this research was to determine the age of stellar populations in nearby active galaxies. The term active is used to describe two general classes of galaxies: those undergoing a surge of star formation (starburst galaxies) and those with an active galactic nucleus, or AGN, called seyfert galaxies. Such age-dating has been the subject of recent research as it is believed that accurate determinations of age dispersion in galaxies will enable us to better determine galaxy formation models, and place constraints on the causes of starbursts and the relationship between AGN and starbursts.

Stellar ages are estimated by examining specific emission and absorption lines in spectra of the galaxies. However, this process is complicated by a phenomena known as age-metallicity degeneracy. Many of the spectral lines used to determine stellar age are both indicative of metal content (where metal is any element heavier than helium) and age. There is an indirect correlation between the age of a star and its metal content: in general, younger stars tend to be metal rich because they were formed more recently from a more metal enriched media. This relation, however, does not consistently hold true because the material from which stars form is not uniform from galaxy to galaxy or even within a single galaxy. Thus it is often difficult to separate a metal rich population from a young population, or a metal poor population from an old one.

The optical spectral data used for this project was collected from Kitt Peak National Observatory in 1996 and 1997 by Charles Liu. The data was processed and analyzed using the software package IRAF (Image Reduction and Analysis Facility). Once the data was reduced and ready for analysis, measurements of the relevant line widths and and heights were made. Comparing this data to the Lick Index System, a defined set of spectral lines which are well calibrated for particular features (such as age and metallicity) to known stellar sources, yielded inconclusive results. Because the line diagnostics were based on non-active galactic sources, the two data sets did not match well. A comparison between different oxygen lines was then used to attempt to place constraints on the temperature of the gas and dust surrounding the active regions in the galaxies, which would provide a means to account for the alteration of the spectra due to the activity in the galaxy. Although a clear trend between the lines was established, the resolution of the spectral lines in the data was ultimately to low to adequately distinguish the necessary features.

In addition to this analysis, new data of nearby seyfert galaxies was collected using the MDM telescope at Kitt Peak in October 2003, and February 2004 for another research project which will commence later this year.