Quasar Characteristics and the Effects of Double-Peaked Emission Lines

Laura VanEpps[1,2], R. Scott Barrows[2], Amanda Schilling[3], Julia Kennefick[2,3]

[1]Hastings College, 710 N. Turner Ave., Hastings, NE 68901

[2]Arkansas Center for Space and Planetary Science, University of Arkansas, FELD 202, Fayetteville, AR 72701

[3]Physics Department, University of Arkansas, 825 W. Dickson St., Fayetteville, AR 72701

Introduction

Quasars are luminous and energetic objects at the centers of galaxies that are detected by the radiation emitted and are powered by supermassive black holes. The goal of this REU was to identify quasars with asymmetric Magnesium-II ion emission lines. The emission lines give information about the broad line region of the active galactic nucleus. In order to recognize those, we intended to create a composite fit, which can help compare qualities of all the appropriate spectra available from the Sloan Digital Sky Survey. We had to isolate the Mg-II from the power-law continuum and iron emissions in order to work with the best data.

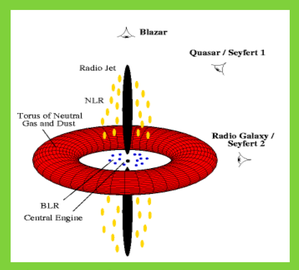

Figure 1: Active Galactic Nucleus structure
~Note the Broad Line Region

Data Sample

- Sloan Digital Sky Survey – Data Release 7
- Analyze patterns within Power-Law versus Redshift plots
  - ~ Hα, Hβ, MgII, and CIV
- Parent sample contained 40,000 quasars
- Correct for redshift

$$\lambda_{rest} = \lambda_{observed}/(1+z)$$

- Subtract power-law and Fe-II templates
- Normalize spectra for the flux that corresponded with 3000Å

$$F = k\lambda^{-\alpha}$$

- Average flux values
- Eliminate plots that were over-subtracted
- Create composite

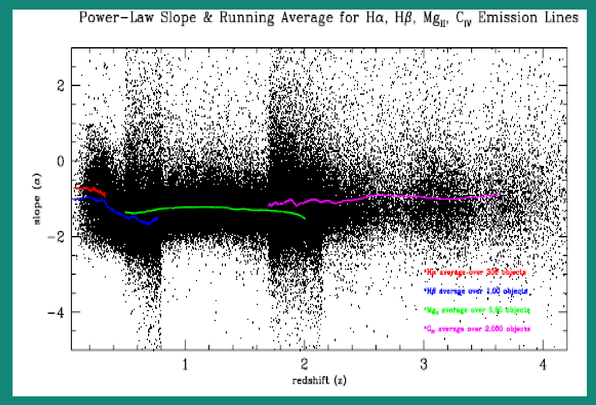

Figure 2: Redshift versus Power-Law Slope for H-α, H-β, Mg-II, and C-IV
The data had caps at α=3 and -5, so we eliminated those values. Additionally the points at very high or low redshifts for each ion contributed to the error. Ultimately, the typical values are between α=0 and α=-2.

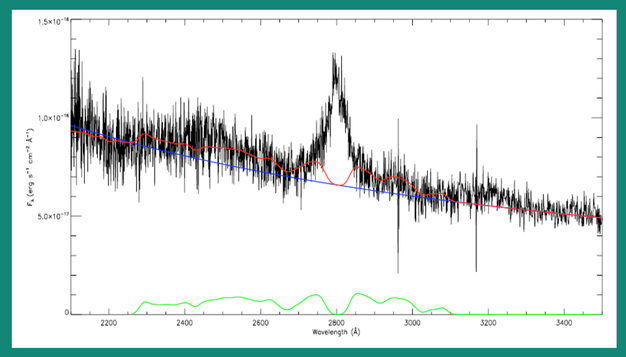

Figure 3: Wavelength versus Flux, where green is the Fe-II emission template, blue is the power-law slope, and red is the sum of both components.
These are the elements that are subtracted before we determine the average and composite.

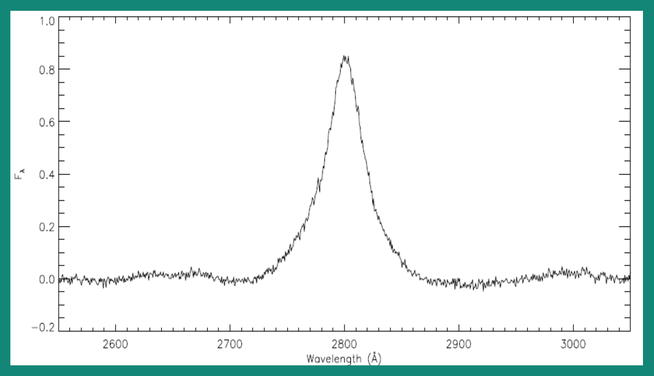

Figure 4: Wavelength versus Flux
The final composite will be used in cross-correlations with other spectra to determine the quality of the fit. Some spectra will actually fit twice, which will create a wider and shorter peak. This is an indicator of accretion disk emissions.

Results

- Power-law slope is more likely -1, not the assumed -0.5
- Slope is not exactly constant or continuous
- Quasar sample for Mg-II lines was sorted and condensed into best fits
- Spectra were averaged, so composite is ready to go

Discussion

Throughout this project, we have worked with data from SDSS DR7 to create a sample of the best spectrum fits to the Mg-II emission lines. a lot of time was spent improving the data set for the Mg-II spectra. We took note of which images were not fitting the expected trend and adjusted the programs accordingly. When we had a satisfactory sample, we managed to average the flux values and create a composite that will be used for several cross-correlations and other analysis.

The ultimate goal is to gain insight into the behavior and structure of accretion disks at the center of galaxies. This group wants to see how accurately they can fit a model of the emission line to actual spectra. We hope to identify spectra that exhibit a double peaked emission line. This would potentially indicate radiation being emitted from the accretion disk instead of the broad line region of the AGN.

References:

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