Determination of the Infrared Luminosity of Active Galactic Nuclei (AGN)

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ABSTRACT

Using archival data from the *Spitzer* and GALEX Space Telescopes we have plotted a UV-IR color-magnitude diagram for AGN. The previous difficulty in determining the IR luminosity of AGN using this technique has been that AGN have varying levels of obscuration in the UV, also they are variable and previous observations were often taken at widely differing times. As a result, color-magnitude diagrams sometimes had UV and IR data points acquired decades apart. These issues were mitigated in this study i) by using data that were collected much closer in time to each other, since both telescopes were launched and carried out most of their observations within the same 5 year period and ii) by choosing Type 1 AGN, which show the least amount of obscuration.

Using *Spitzer* and GALEX to study AGN

AGN are the most continuously luminous objects in the universe; therefore, AGN can act as excellent references to study the farthest reaches of the universe. Although there exist several correations between various AGN properties and their luminosity, (e.g. optical [OIII] line vs bolometric luminosity or IR [OIV] vs Hard X-ray Luminosity) this study is an attempt to produce a much tighter correlation than those already known.

We have used newly available data from the *Spitzer* and GALEX telescopes to see if a color magnitude relation exists between the UV emission of AGN and their IR emission (Figure 1). The expectation would be that the dust would act as a calorimeter and reach a temperature dictated by the warmth of the accretion disk. The UV from GALEX would then quantify the temperature of the accretion disk while the IR from *Spitzer* would come from the surrounding dust. For a schematic see Figure 2.

An additional advantage of using these two data sets is that their data have been obtained much closer in time than previous IR and UV missions and so the variability of the sources should play a smaller role in hiding any possible correlation.

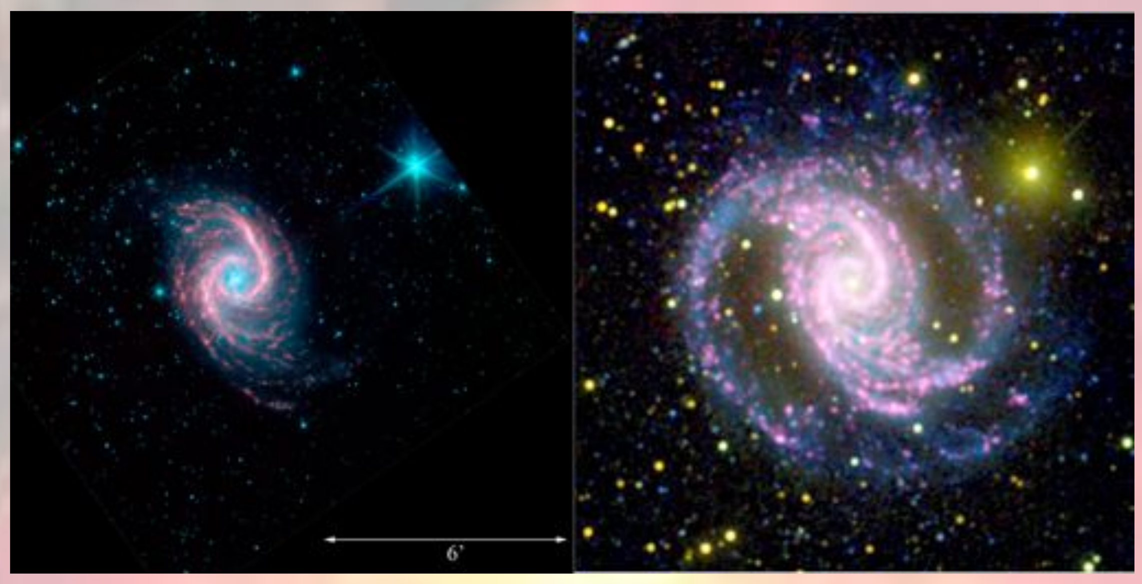

Figure 1. Left: *Spitzer Space Telescope* image of NGC 1566, a Seyfert 1.5 type AGN. The colors cover the 3.6 to 8.0μm wavelengths. Right: NGC 1566 image in the two GALEX UV bands, 0.12 and 0.23μm

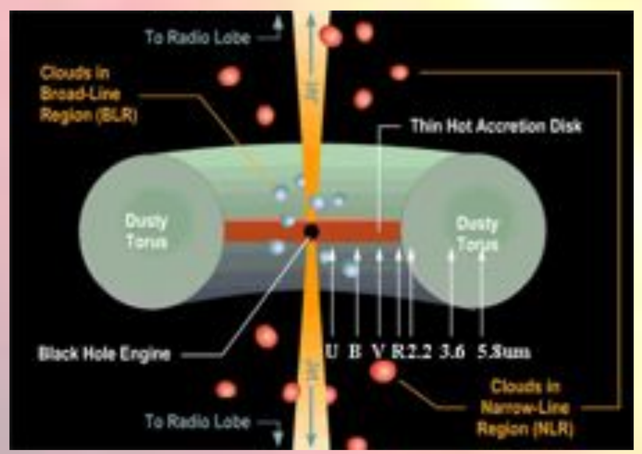

Figure 2. Schematic representation of an active galactic nucleus (AGN) accretion disk and dusty torus, not to scale.The regions of optical/UV emission from the accretion disk are noted based on their optical/UV emission bands: U, B, V, R. The expected IR emission regions are noted based on their wavelengths: 2.2 - 5.8 μm. Note that the 2.2 μm emission is expected to come from the edge of the dusty torus which is at the dust sublimation radius while the longer wavelengths detectable by *Spitzer* come from within the torus. Original Image credit: Brooks/Cole Thomson Learning.

Spitzer and GALEX AGN Sample

This sample is dictated by the availabilityAGN that are in the archives of both *Spitzer* and GALEX and have photometry in both GALEX bands and at least one of Spitzer's 4.5 or 5.8μm bands. We have chosen to use the 4.5 and 5.8μm bands since they have less contamination from the AGN host galaxy's stellar bulge and do not have Polycyclic Aromatic Hydrocarbon (PAH) emission.

Also we have chosent to use only nearby AGN ($z<0.07$) so that we do not include conitrbution of emission from star formation in the spiral arms of the host galaxies.

Finally we chose to use only those AGN calssified as type 1 Seyferts so that we would not be subject to issues of obsuration that are expected to exist in type 2 Seyferts. For this study we chose to represent Type 1 Seyferts as all those labeled as type 1, 1.2 and 1.5 in the NASA Extragalactic Database (NED).

There were 19 galaxies which met the above criteria and we have plotted their color-magnitude diagram below (Figure 3):

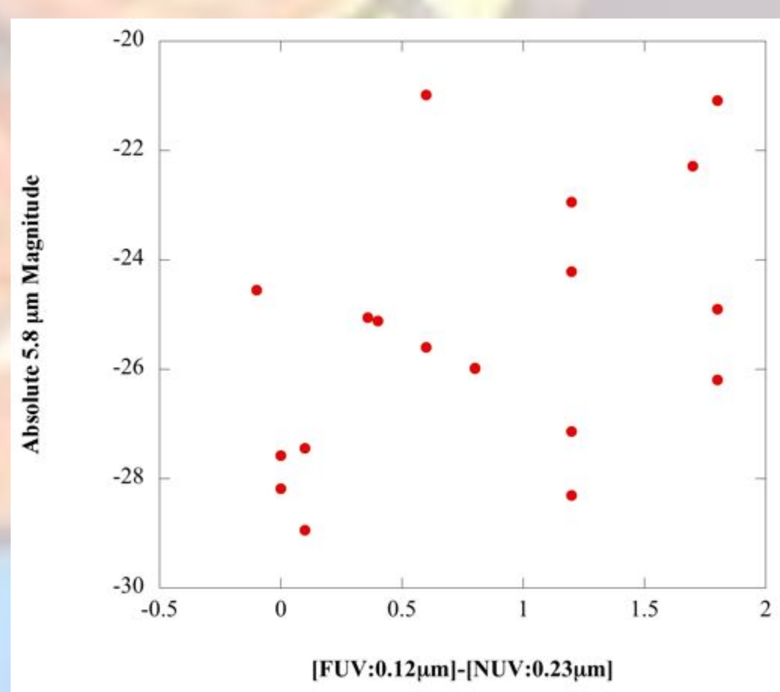

Figure 3. Color-Magnitude plot of the GALEX UV colors and the *Spitzer* 5.8μm band

Conclusions

There does not seem to be evidence of a correlation between the UV color vs the IR luminosity. A reason for this lack of correlation may be that, although we have tried to minimze the effects of variability, it is still a significant factor in hiding any correlation.

Additional factors may be that the naive expectation that the UV is heating the dust may not be correct. A more complicated process may be at work which would mask any direct color-magnitude relation.