Testing the Link between Star Formation and Accretion from NLS1's to LINERs: Spitzer Spectroscopic Observations of 6.2 µm PAH

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ABSTRACT: Galaxies with Low Ionization Nuclear Emission Line Regions (LINERs) are the dominant population of galaxies in our local universe. Recent studies find that 50% of LINERs show hard X-ray nuclei typical of AGN. Combining these results with the characteristics of the host galaxy, we have found an intriguing correlation between the mass accretion rate onto the central black hole (BH) and both the far-IR luminosity and the IR-brighness of the host galaxy of LINERs and of other AGN. In starburst galaxies the IR luminosity is a measure of the galaxies' star formation activity. However, in our case, the far-IR luminosities are measured in a large aperture and include the emission from the entire host galaxy, making it difficult to distinguish the nuclear emission that is powered by the central BH from the stellar emission. This complicates any simple interpretation such as: the correlation implies that accretion onto the BH is regulated by the star formation rate or vice versa. In an attempt to investigate this accretion rate/star formation rate relationship further, we have conducted a Spitzer spectroscopic analysis of the 6.2µm PAH feature in a sample of bona fide AGN. In this poster we present the preliminary results of our investigation.

GOALS: 1. To extract an uncontaminated star formation rate (SFR) from galaxies containing AGN. 2. To compare the relationship between the SFR and the black hole’s properties in a large sample of bona fide AGN with a wide range of accretion rates.

Previous Work

- We find a correlation between L/L_Edd and L_6.2µm extending over many orders of magnitude in L/L_Edd.
- The correlation varies with AGN class, which may put constraints on galaxy formation models.
- This correlation may imply a link between the growth of black holes and the build-up of galaxies where LINERs are the “missing link” between normal and active galaxies.

Is the FIR tracing Star Formation in galaxies with AGN?

NGC 2841
NGC 4579

LIKELY since FIR is SPATIALLY EXTENDED!!

Deeper Studies:
Polycyclic Aromatic Hydrocarbons (PAHs) also trace star formation!

- PAHs are normally associated with star formation
- Efficiently absorb Optical/UV radiation (from stars)
- Re-radiate efficiently in the mid-IR, displaying broad features that are easy to identify.
- Molecules can be destroyed around a hard radiation source such as an AGN.

The New Sample: 200+ galaxies from the Spitzer Archive

NGC1068 14 Mpc
NGC4314 13 Mpc

Spitzer Detects Circumnuclear Star Forming Rings

Spitzer 6.2µm PAH images of NGC 1068 & NGC4314 clearly show circumnuclear star forming rings and a PAH-free cavity where the PAH have sublimated by the AGN’s radiation field

Wu et al. 2005 find a relationship between 7.7µm PAH and SFR in Starbursts:

SFR ~ M_1.37 (17.7 µm)
1.38 x 10^7 M_⊙

The 7.7µm and 6.2µm PAH are related:

(1/7.87) = 1.86 x (16.2µm)

Star formation and accretion are related in galaxies with AGN!