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PAH EMISSION IN STARBURST, SEYFERT, ULIRGS, QSOS AND QUASAR OBJECTS, AND THEIR RELATION WITH THE INFRARED, X-RAY AND RADIO CONTINUUM EMISSION

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RESUMEN

Éste es un segundo trabajo encaminado a analizar la actividad de formación estelar y su relación con las emisiones de hidrocarburos aromáticos policíclicos (PAHs). Se ha llevado a cabo un estudio alrededor de la correlación entre el flujo de la emisión en 7.7 μm de PAH y su ancho equivalente con las luminosidades y los flujos observados en las bandas fotométricas JHK, las observaciones de IRAS en 12, 25, 60 y 100 μm, la emisión en radio a 1.4GHz y la emisión en rayos X a 2–10 keV, para una muestra compuesta de galaxias Seyfert 1-2, QSOs, Quasares, Starburst y Ulirgs. Los resultados encontrados permiten discriminar entre objetos que presentan mayor actividad de formación estelar de otros con mayor influencia del núcleo activo.

ABSTRACT

This is a second study in an ongoing work aimed to analyze the star formation activity and its relation with the Polycyclic Aromatic Hydrocarbon (PAHs) emission. In this way, we have performed a study about the correlation between the flux of the 7.7 μm PAH band and its equivalent width, with the luminosities and fluxes observed in JHK photometric bands, IRAS 12, 25, 60 and 100 μm, the radio emission at 1.4GHz and X-ray at 2–10 keV, for a sample composed of Seyfert 1-2, QSOs, Quasars, Starburst, and ULIRGs. The results found let us discriminate between objects with more star formation activity from others with more AGN influence.

Key Words: galaxies: active — infrared: radiation — quasars: emission lines

1. INTRODUCTION

The relative contribution of star formation and nuclear activity to the IR continuum in starburst and AGNs remains an unsettle question. Currently, suitable indicators are based on near-infrared to far-infrared continuum ratios, polycyclic aromatic hydrocarbon (PAH) flux bands to continuum ratios, and high to low ionization forbidden lines ratios (Genzel et al. 1998; Imanishi & Wada 2004; Peeters et al. 2004; Sturm et al. 2006; Netzer et al. 2007). With the advent of observations from the Infrared Spectrograph (IRS; Houck et al. 2004, Spitzer Space Telescope) in the range of 5–37 μm for different kind of galaxies, we now have the possibility of relating previous observations based on ISO, IRAS, radio (NRAO VLA Sky Survey; Condon et al. 1998) and X-rays with these new available data.

Recently, Imanishi & Wada (2004) correlated the 3.3 μm-PAH band emission (attributed to star formation events) with IRAS 12 and 25 μm fluxes (considered as good tracers of AGN activity) for a sample of Seyfert type 1-2 galaxies. The results suggest that the power of nuclear starbursts and AGNs are closely linked. Similarly, Polletta et al. (2000) and Haas et al. (2000) found a good correlation between the infrared (3–40 μm) luminosities and soft X-ray luminosities and Alonso-Herrero et al. (2001), using hard X-ray and ISO data concluded that the 5–10 μm emission is indeed a good indicator of the AGN power. She also confirmed that in some Seyferts 2, the near-infrared nuclear continuum between 1 and 2.2 μm is dominated by stellar emission. Finally, Netzer et al. (2007) found in a sample of QSOs, correlations between L(5100 Å) and the two infrared starburst indicators L(60 μm) and L(7.7 μm-PAH).

Our main goal is to present additional suitable diagnostic diagrams to classify galaxy samples according to the degree and nature of the nuclear activity by means of IRAS fluxes, the 7.7 μm-PAH band emission and the radio emission, in a sample compose of starburst-like and AGN-like objects.

2. ARCHIVAL DATA

In this work, we use fluxes, luminosities and equivalent widths data for 153 objects published by Imanishi et al. (2007), Clavel et al. (2000), Condon et al. (1998), Brandl et al. (2006), Schweitzer et

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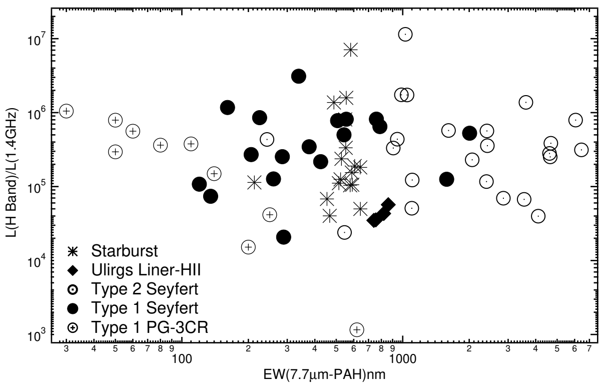

Fig. 1. [Luminosity(H-Band)/Luminosity(1.4GHz)] vs [7.7 μm-PAH equivalent width].

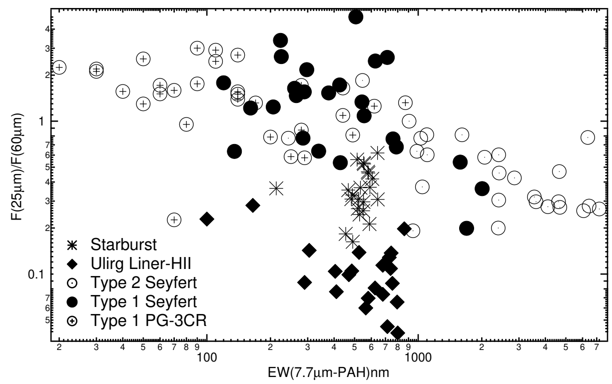

Fig. 2. Plot of the [Flux 25 μm/Flux 60 μm] vs [7.7 μm-PAH equivalent width].

al. (2006), and NED-Simbad-VizieR databases. The sample is composed of 19 Seyfert 1, 25 Seyfert 2, 78 Quasars, 22 Starburst and 9 Ulirgs. Aperture effects were not taken into account in this first approach.

3. RESULTS

Figure 1 allows us to group the sample in objects with low PAH emission (quasars, left side), objects with clear PAH emission (Seyfert 1s, starburst and ULIRGS, center) and objects with dominant 7.7 μm emission (Seyfert 2s, right side). The constant value of the H-band/1.4GHz luminosity ratio over the objects suggests that in Type 1 sources we may be looking at starburst hidden by the central source.

Additional properties between the objects involved in our analysis can be observed in Figure 2. The IRAS flux ratio 25 μm/60 μm is clearly anticorrelated with the EW of the 7.7 μm PAH feature in Type 1 and 2 galaxies. Interestingly, ULIRGS and Starburst galaxies do not follow the correlation as they occupy the lower mid-portion of the graph. This behavior is attributed to the large 60 μm flux relative to that of 25 μm: the former traces more efficiently star formation activity, dominant in the latter two classes of objects. In this sense we propose that this diagram is suitable to discriminate sources according to their degree of activity using IR continuum and PAH measurements.

4. REMARKS

Using tracers of star activity like the H-band luminosity, the 7.7 μm PAH emission and the 60 μm luminosity we present two diagnostic diagrams that allow us to classify objects according to the dominant degree of nuclear activity (AGN, Starburts or ULIRGs). We found that both, starburst and ULIRGs are clearly separated from the AGN sample when we mix AGN and star forming tracers. The diagrams are suitable to classify targets with poor emission line spectra, for example, strongly dust embedded sources or targets with low-resolution spectrum where only the 7.7 μm PAH feature has been observed at good S/N and spectral resolution.

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