The AGN–nuclear-starburst connections in a high-luminosity AGN population

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Recent observations have shown that supermassive blackholes (SMBHs) are ubiquitously present at the center of galaxy spheroids (bulges and elliptical galaxies) and that the masses of SMBHs and galaxy spheroidal stars are correlated, suggesting that SMBHs and galaxies interact and coevolve each other.

Active Galactic Nuclei (AGNs) are the objects which convert gravitational energy generated through active mass accretion onto a SMBH, to radiative energy, and are shining very brightly. SMBHs in AGNs are in a growing-up phase, so that it is important to investigate the properties of star-formation (starburst) in AGNs, in order to understand the interplay and co-evolution of SMBHs and stars in the universe.

To observationally tackle this issue, it is indispensable to use an indicator with which to disentangle AGN and starburst activity clearly. Polycyclic Aromatic Hydrocarbons (PAH) emission features, seen in infrared 3–20 μm spectra, are detected in star-forming regions, but not in AGNs, because of the PAH destruction by strong Xrays from AGNs. Thus, PAH emission is a good probe of starburst activity. Furthermore, effects of dust extinction at infrared 3–20 μm are so small, compared to UV and optical wavelength ranges, that starburst luminosity is reasonably quantifiable from the observed PAH emission.

Previous observations have indicated that in a low- to moderate-luminosity AGN population, AGN and nuclear starburst luminosities positively correlate, namely, mass accretion onto a SMBH is higher in an AGN accompanied with more luminous nuclear starburst activity. However, it is observationally unclear whether the same relation holds in a high-luminosity AGN population. Theoretically, two contradictory scenarios were proposed.

(1) The mass accretion rate onto a central SMBH is controlled by starburst-induced viscosity, so that AGN luminosity should increase with increasing nuclear starburst luminosity. In this case, a similar luminosity correlation between AGN and nuclear starburst is expected in a high-luminosity AGN population.

(2) When nuclear starburst activity is intense, a large amount of gas is consumed for a starburst, and thus the remaining amount of gas accreted onto a SMBH decreases. In this scenario, starburst activity should be relatively weaker in a high-luminosity AGN population, compared to low- to moderate-luminosity AGNs. It was desirable to observationally distinguish between these two scenarios.

We have performed infrared 3–4 μm (L-band) slit spectroscopy of 30 PG QSOs, the representative high-luminosity AGN population in the local universe, using the IRCS infrared spectrograph attached to the Subaru 8.2 m telescope. Based on the observed luminosity of the 3.3 μm PAH emission feature, we quantitatively estimated the nuclear starburst luminosity in these objects and confirmed that the AGN – nuclear-starburst luminosity correlation holds in a wide luminosity AGN range (Figure 1)[1], supporting the scenario (1).

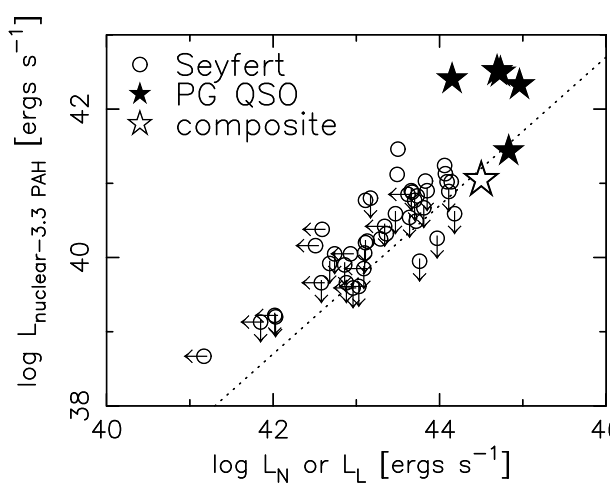

Figure 1: The abscissa and ordinate are indicators of AGN and nuclear starburst luminosities, respectively. Stars are the results for PG QSOs (= high-luminosity AGNs) obtained in this work. Filled stars are objects with detectable 3.3 μm PAH emission in individual spectra. Open star is the plot for the composite spectrum of PAH-undetected sources in individual spectra. Open circles are the plots for Seyfert galaxies (= low- to moderate-luminosity AGNs) previously studied. The nuclear starburst to AGN luminosity ratios are similar in AGNs with a wide luminosity range.

Reference

[1] Imanishi, M., et al.: 2011, *PASJ*, **63**, S447.