Connection of SuperMassive Black Hole and galaxy in Active galaxy

OI, Nagisa, IMANISHI, Masatoshi, IMASE, Keisuke
(The Graduate University for Advanced Studies/NAOJ)

Active Galactic Nuclei (AGNs) emit the bulk of their large luminosity ($>10^{10}L_{\odot}$). An engine of AGN is believed the release of gravitational energy generated by a mass-accreting onto SuperMassive Black Hole (SMBH) and conversion to radiative energy. Recent observations have revealed that formation of galaxies and SMBHs are related to each other. Since a tight correlation between masses of bulges (stellar masses) and SMBHs has been found, understanding the mechanism of connection between AGN and host galaxy is important to uncover the histories of SMBH and galaxy formations. However since size of host galaxy is more than 1000 times larger than that of AGN, it is difficult to connect them directly. It is more likely that kinematics and/or energy is interact with each material locally, then the relationship between AGN and galaxy might be made, so that understanding of relationship of them at a galaxy center continues to play an important role. Some theories of the physical mechanism at a galaxy center predict different relationships between AGN and nuclear starburst activities. To distinguish these theories, it is necessary to study AGNs over a wide AGN luminosity range including lowluminosity AGNs.

Infrared (IR) spectroscopy at $\lambda = 2$–$4\,\mu$m is effective to investigate the nuclear starbursts, because effects of dust extinction are small. Furthermore, Polycyclic Aromatic Hydrocarbons (PAH) emission feature, found in this IR wavelength range, can be used to distinguish between an emission of starbursts and AGN, because the feature are seen only in a starburst, but not in an AGN (due to PAH destruction by AGN's strong X-ray radiation). Moreover, the CO absorption features in this IR wavelength range can be used to estimate contributions an emission of stellar and AGN. These features enable us to discriminate an emission of starbursts and of AGN spectroscopically in an unresolved central region with spatially existing observing facilities.

Narrow slit spectroscopy using IR spectrographs attached to ground-based telescopes has applied to prevent an emission of galaxy central from an contamination by stars in an extended galaxy, and to investigate activities of nuclear starbursts. We have performed IR 2–4 μm spectroscopy of 22 low-luminosity nearby AGNs using the SpeX IR instrument attached to the IRTF telescope, and estimated nuclear starburst activities quantitatively (Fig. 1). We combined our sample with previous highluminosity AGNs[1], and then compared the activities of nuclear starbursts with those of AGN. As a result, we found the positive correlation between them over a wide AGN luminosity range (Fig. 2).

The result strongly supports the theory that nuclear starbursts remove much more angular momentum from materials and encourage an AGN activity, that is "nuclear starbursts control the activity of AGN"[2].

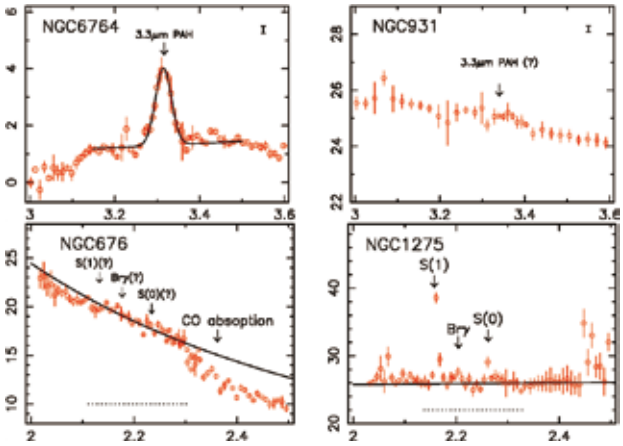

Figure 1: (left): Near infrared spectrum of a starburst dominated active galaxy. PAH emission (top) and CO absorption (bottom) features are strong. (right): Spectrum of an AGN dominated galaxy. Both of PAH emission and CO absorption features are very weak.

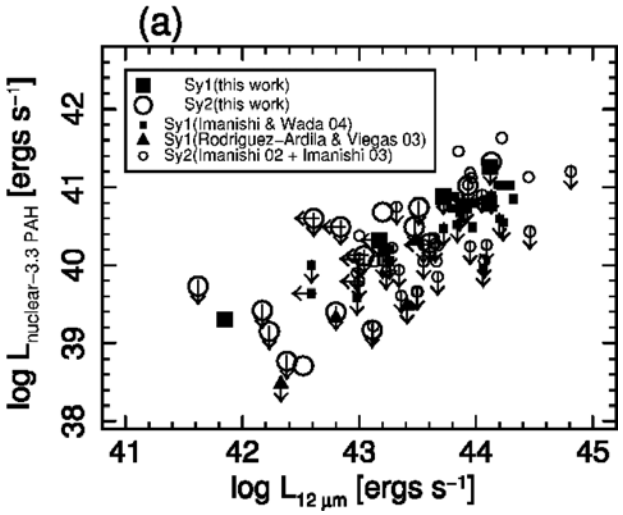

Figure 2: Nuclear starburst activities (ordinate) versus AGN activities (abscissa). The more active the nuclear starbursts activities are, the more active the AGN activities are.

References

[1] Imanishi, M., Wada, K.: 2004, *ApJ*, **617**, 214.
[2] Oi, N., et al.: 2010, *PASJ*, **62**, 1509.