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Starburst-AGN Connections: Clues from Poststarburst Broad Line AGN in the SDSS DR2

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Abstract. A sample of 74 poststarburst broad line AGN are selected from the Sloan Digital Sky Survey Data Release 2 (SDSS DR2). Because in these so-called "Q+A"s, we can catch with a smoking gun the change of the recent star formation in the host galaxies, and in the meantime, view the nuclear activity directly, the present sample suits to address the important yet long debated issue concerning the physical link between starburst and AGN phenomena. We find that more than half of the Q+As can be classified as Narrow Line Seyfert 1 galaxies (NLS1s) and the mass accretion rate of the sample is significantly higher than that of optically-selected quasars. If these engorging objects, especially the NLS1s are indeed AGN in their early evolution stage, this result strongly suggests that the nuclear activity be driven by starburst with a time delay of ~ a few hundred Myr.

Key words. galaxies: active — galaxies: starburst — radiation: lines, continuum

Dressler & Gunn (1983) identified a class of galaxies whose spectra show strong Balmer absorption lines and deep Balmer jump indicating that an intense starburst took place within approximately 1 Gyr and was subsequently terminated almost abruptly. These galaxies are denominated as poststarburst galaxies. Observing broad line AGN in poststarburst host thus provides us an excellent opportunity to understand the starburst-AGN connection by studying the abrupt change of star formation histories and the AGN properties simultaneously. However, these objects have not been adequately explored except for a case studies of UN J1025-0040 (Brotherton et al. 1999). We set off a systematic search for such interesting objects using the recently released spectroscopic dataset of the SDSS Data Release Two (DR2, Abazajian et al. 2004) and we present the primary result in this poster.

Using our newly developed method based on Ensemble Learning Independent Component Analysis, the SDSS spectra of active galaxies can be properly decomposed into stellar and nuclear components provided that their contributions are comparable. Important parameters of the host galaxies, such as starlight reddening, stellar velocity dispersion, stellar mass, star-formation history, can be obtained simultaneously. Representative example of starlight-nucleus decomposition and emission line fitting is displayed in Figure 1. The estimated continuum of the host galaxy

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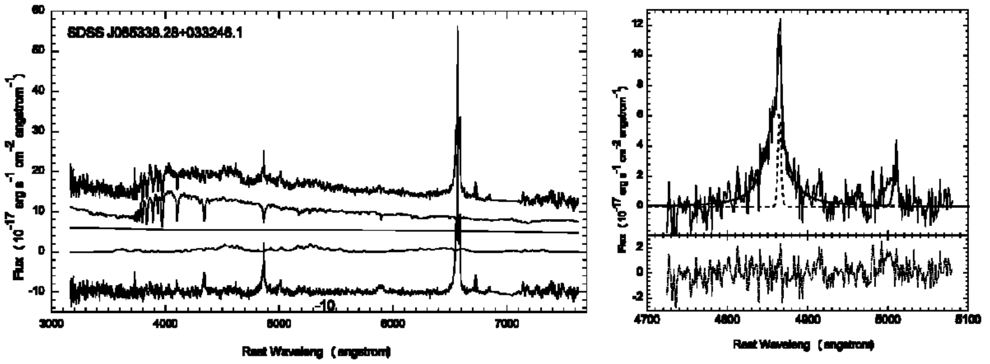

Fig. 1. Left panel: Representative example of starlight-nucleus decomposition. From top to bottom we plot the observed spectrum, the decomposed components of the host galaxy and the power law continuum of the nucleus, the FeII multiplets, and the "pure" line spectrum respectively. The observed spectra are smoothed with a boxcar of 3 pixels for illustration. Right panel: The fitting results of Hβ + [OIII] regime.

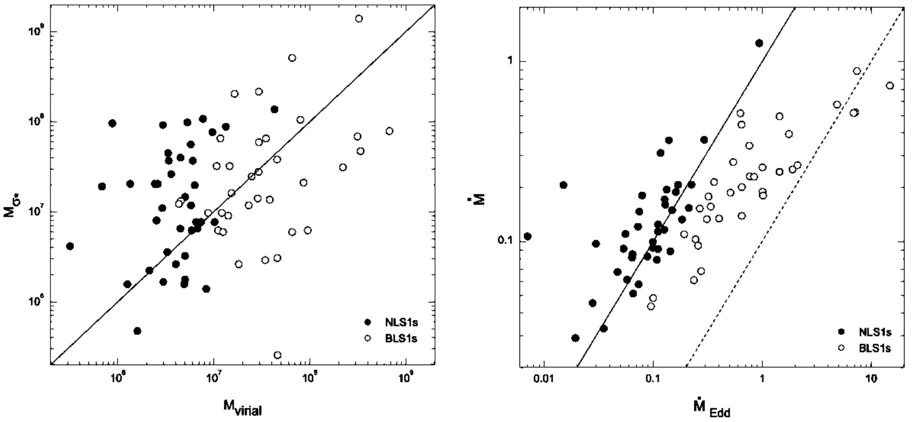

Fig. 2. Left panel: The central black hole mass (in $M_{\odot}$) estimated via the virial-mass measurements, M_{virial} against that via the $M_{BH} - \sigma_*$ relation, M_{σ_*}. The solid line denotes $M_{virial} = M_{\sigma_*}$. Right panel: The estimated mass accretion rate assuming an efficiency factor of $\eta = 0.1$ against Eddington accretion rate in $M_{\odot}\ yr^{-1}$ estimated using the mean of M_{virial} and M_{σ_*}.

was employed to calculate the equivalent width of $H\delta$ absorption line (EW($H\delta$)) and 74 poststarburst broad line AGN, or "Q+A"s, are picked out based on two criteria, 1) $EW(H\delta) > 5$ Å; and 2) at least one broad emission line detected.

We find that more than half of the Q+As have broad emission line width (Full Width at Half Maximum, FWHM) less than 2000 km s^{-1}, fulfilling the formal line width criterion for Narrow Line Seyfert 1 galaxies (NLS1s). Strong optical FeII emission is detected in objects with prominent broad component of Hβ, which is also typical of NLS1s. The high frequency of finding NLS1s in poststarburst galaxies suggests some connections between these two interesting phenomena. The central black hole mass was estimated grounded on the broad line width-luminosity-mass scaling relation and the empirical $M_{BH} - \sigma_*$ relationship. We find M_{σ_*} is significantly larger than M_{virial} for most of the NLS1s, while these two values are similar for normal broad line AGN in the Q+A sample (Figure 2, left panel). This indicates that NLS1s are AGN in their early evolution stage, in which the spheroid is already there while the bulk of black hole mass is yet to be built, and are accreting at near or super Eddington rate (Figure 2 right panel). Inspection of the SDSS image of nearby Q+As reveals that more than a dozen show signature of recent merger or strong interactions. A straightforward interpretation of the fact why the mass accretion rate of most Q+As is relatively high is that strong interaction or merger between galaxies can induce gas inflow to the nuclei, which trigers intensive starburst as well as fueling of the massive black hole in the nucleus as numerical simulations suggested. Our results suggest that the two process are not strictly simultaneous, but a time lag of the AGN to the starburst.

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