Feeding Compact Objects: Accretion on All Scales
Proceedings IAU Symposium No. 290, 2012
C. M. Zhang, T. Belloni, M. Méndez & S. N. Zhang, eds.

doi:10.1017/S1743921312019473

Spectral Variability of Active Galactic Nuclei

Y. L. Ai[1], W. Yuan[2], H. Y. Zhou[3]

[1]National Astronomical Observatories/Yunnan Observatory, Chinese Academy of Sciences, Kunming, 650011, China
email: *ayl@ynao.ac.cn*

[2]National Astronomical Observatories, Chinese Academy of Sciences, Beijing, 100012, China

[3]Polar Research Institute of China, 451 Jinqiao Road, Pudong, Shanghai 200136, China

Abstract. With SDSS multi-bands photometric data we propose that the variation of the nuclear continuum emission mostly accounts for the observed wavelength-dependent variability of active galactic nuclei.

Keywords. Active galaxies, quasars, photometric

1. Introduction

Variations of optical/ultraviolet (UV) luminosity on timescales from weeks to years are characteristics of active galactic nuclei (AGNs). Extensive observational investigations have revealed dependence of the variability amplitude on various quantities such as wavelength, time-lag, luminosity, and Eddington ratio (Ai *et al.* 2010, Vanden Berk *et al.* 2004, and Zuo & Wu 2012). The study of these relations is a powerful too for constraining the variability mechanism of AGNs. There are many possibilities accounting for the wavelength-dependent variability. Here we mainly discuss the influences from the starlight contamination and/or variation of nuclear continuum emission.

2. Overview

In our previous paper (Ai *et al.* 2010), the multi-epoch repeated photometric scanning data in the Stripe-82 region of the Sloan Digital Sky Survey (SDSS) are exploited for two comparative AGN samples (mostly quasars) selected therein, a broad-line Seyfert 1 (BLS1) type sample and a narrow-line Seyfert 1 (NLS1) type AGN sample within redshifts 0.3–0.8. It is deserving to investigate the underlying factor for our observed variability dependence on rest wavelength. For each source in our sample, we first fit the brightest and faintest photometric data separately incorporating all of the three possible components,

$$f(\lambda) = A\lambda^{-\alpha_\lambda} + Bl(\lambda) + Cs(\lambda), \tag{2.1}$$

where $\lambda^{-\alpha_\lambda}$ representing the nuclei continuum; the emission-line spectrum $l(\lambda)$ is derived from the SDSS composite spectrum after removal of the nuclei power-law continuum (Vanden Berk *et al.* 2001), the starlight component s(λ) is approximated by the composite spectrum of elliptical galaxies presented by Mannucci *et al.*(2001). By convolving with the SDSS *ugriz* filter transmission curves we can get the model-flux at the effective wavelength. The fitting is performed by minimizing the χ^2 with A, B, C, and α_λ as non-negative parameters.

First we estimate the relative starlight contribution from the best fitted parameters with the integrated flux ratio of Cs(λ) to f(λ). For the majority the starlight component is negligible in the total luminosity with the contribution less than a few percent. This is

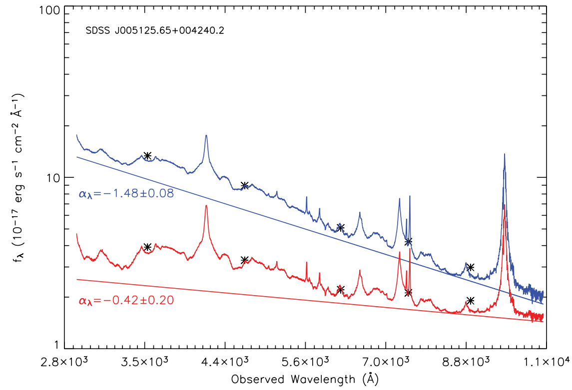

Figure 1. Representative examples of the procedure of the fitting (blue: bright state, red: faint state). The observed flux (black asterisk), the combination of the model (solid), and the power-law continuum of the nucleus are shown. (dotted).

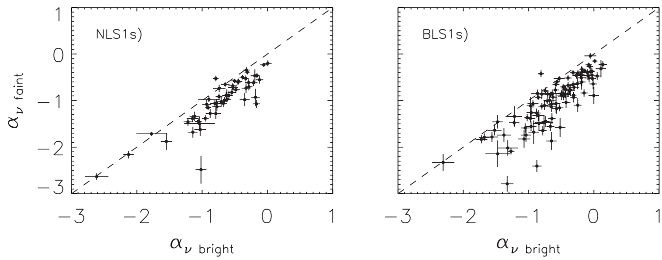

Figure 2. Spectral index of NLS1s and BLS1s in bright and faint state.

expected, since all of the sources in our sample are high luminosity quasars, and all are unresolved sources in the SDSS image. The possibility of color variability from starlight contamination is thus excluded. Neglecting host galaxy component, $s(\lambda)$, in equation 2.1, we can reproduce the observed photometric data very well for most sources in the sample. A Representative example of the fitting is shown in Figure 1. And we derive a stringent constraint on the variability of continuum slope, characterized by spectral index α_ν. It is evident in Figure 2 that, for all sources, both NLS1s and BLS1s, the continuum slope flattens when brightening.

3. Implications

Our result strongly supports that an accretion disk is likely to play a major role in producing the opitcal/UV variability. *This work is supported by Chinese NSF grants NSF-11103071, NSF-10973012.*

References

Ai, Y. L., Yuan, W., Zhou, H. Y., Wang, T. G., Dong, X.-B., Wang, J. G., & Lu, H. L. 2010, *ApJ*, 716, 31
Mannucci, F., *et al.* 2001, *MNRAS*, 326, 745
Vanden Berk, D. E., *et al.* 2001, *AJ*, 122, 549
Vanden Berk, D. E., *et al.* 2004, *ApJ*, 601, 692
Zuo, Wenwen, Wu, Xue-Bing, Liu, Yi-Qing, Jiao, & Cheng-Liang 2012, arXiv:1209.0524