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ACCRETION DISK UV LUMINOSITY OF QUASARS THROUGH SED FITTING

L. SLAVCHEVA-MIHOVA and B. MIHOV

Institute of Astronomy and NAO, Bulgarian Academy of Sciences,
72 Tsarigradsko Chaussee Blvd., 1784 Sofia, Bulgaria
E-mail: lslav@astro.bas.bg, bmihov@astro.bas.bg

Abstract. Large-scale structure at high redshifts is well traced by quasars. Among the most reliable distance indicators for them is the UV vs. X-ray luminosity relation. We aim at refining this relation by precise estimation of the accretion disk emission in the UV through decomposition of the spectral energy distribution accounting both for the quasar and the host galaxy. The three basic contaminators to the accretion disk luminosity in the UV are absorption, host galaxy emission, and broad-line region emission lines. The first two are accounted for by the spectral energy distribution fitting and the third by the usage of the numerous narrow-band filters of J-PAS. We present preliminary results for a couple of objects with data in J-PAS. The above approach for the UV vs. X-ray relation construction is expected to lead to reduction in the dispersion in the Hubble-Lemaître diagram.

1. INTRODUCTION

Quasars are robust tracers of large-scale structure up to high redshifts ($z \sim 7.5$). Cosmic voids and superclusters themselves can be used as probes of the dark energy component in the Λ-Cold Dark Matter (ΛCDM) model. The long-standing issue of the Hubble tension – over 4σ discrepancy between the estimates based on cosmic microwave background (CMB) under the assumption of the ΛCDM model, on one hand, and the ones involving the cosmic distance ladder method using Cepheids and supernovae, on the other (Verde et al. 2019) – remains unraveled. Variability is the main obstacle against using quasars as standard candles. The correlation between the luminosity in the UV and X-ray, reflecting the accretion disc vs. corona interplay, deserves attention due to its non-linearity and negligible redshift dependence. These can make possible the extension of the Hubble-Lemaître diagram (HLD) of supernovae to higher redshift ranges (Lusso et al. 2020; L20). For historical reasons, the correlation links the 2500 Å and 2 keV monochromatic luminosities. The above authors applied several filtering steps to produce a final cleaned sample with a drop in the relation dispersion. Its further reduction would be of high relevance for cosmology studies, in particular concerning the issues above.

2. AIMS AND APPROACH

The purpose of this study is to build a tight UV vs. X-ray relation for a quasar sample by the precise estimation of the accretion disk emission in the UV. It is most highly influenced by absorption and the contribution from the host galaxy and emission lines. We focus on the accurate estimation of the flux at 2500 Å through decomposing the spectral energy distribution (SED).

We compiled a subsample of L20's cleaned quasar sample with available data in J-PLUS, together with the few objects already present in MiniJ-PAS, and an overall dense SED coverage allowing the proper SED decomposition. The fitting was performed with the AGNfitter code accounting for the emission of the accretion disk, torus, host galaxy stellar population (SP), and cold dust related to the star formation regions (Calistro Rivera et al. 2016).

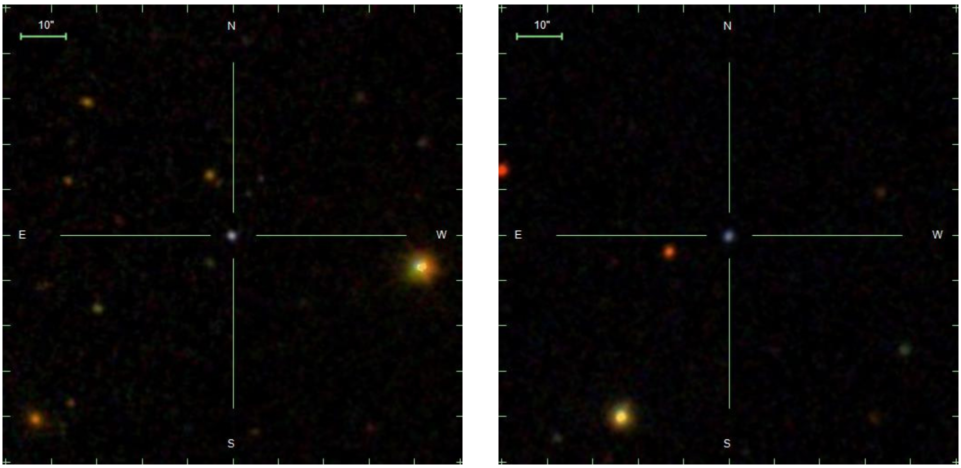

Figure 1: SDSS images of SDSS J000322.47-020051.6 (left) and WISEA J141816.23+522940.6 (right).

3. RESULTS AND DISCUSSION

As already noted, accretion disk emission in the UV is most highly influenced by three factors: absorption, host galaxy, and broad emission lines. The first two are accounted for by the SED decomposition. The usage of the numerous narrow-band filters of J-PAS enables the emission line flux specification.

We present preliminary results for a couple of objects with SDSS spectroscopic redshift estimates. The SED of the quasar SDSS J000322.47-

020051.6 (hereafter Q1; z = 2.03557 ± 0.00055) was built using data from WISE and J-PLUS. Data from WISE, MiniJ-PAS, and GALEX were used for the SED of WISEA J141816.23+522940.6 (hereafter Q2; z = 1.60524 ± 0.00021). Their SDSS images are shown in Fig. 1.

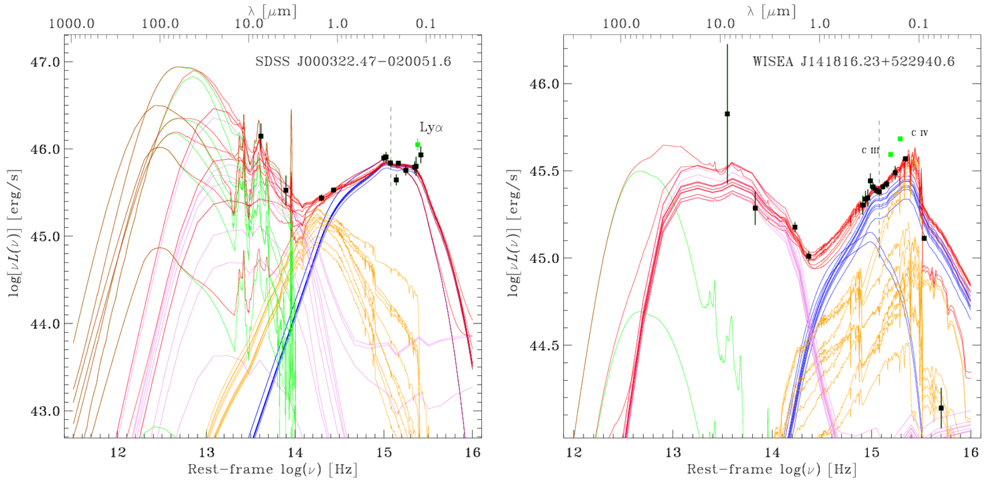

Figure 2: SED fitting with models accounting for the emission of the accretion disk (blue), torus (violet), host galaxy SP (orange), and cold dust (green). The green points correspond to the broad emission line flux mostly and were not considered in the fit. The dashed lines denote λ = 2500 Å. Left panel: SDSS J000322.47-020051.6. Right panel: WISEA J141816.23+522940.6.

Figure 2 shows the SED fitting for the two quasars. The flux data points corresponding to high contribution from the broad-line region emission (denoted) are excluded from the fit. The corresponding accretion disk flux at 2500 Å is $F_{AD,\,2500Å} = 1.7 \times 10^{-28}$ erg $sec^{-1}cm^{-2}Å^{-1}$ and $F_{AD,\,2500Å} = 8.7 \times 10^{-29}$ erg $sec^{-1}cm^{-2}Å^{-1}$ for Q1 and Q2, respectively. As can be seen from the decomposition, the bulk of the Q1 emission at 2500 Å is due to the accretion disk. Concerning Q2, the flux correction there is not negligible.

Building the UV vs. X-ray relation for a large number of quasars using accretion disk luminosities in the UV with the above corrections would result in a reduced dispersion in the HLD.

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