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Strong FeII emission in NLS1s: An unsolved mystery

Swayamtrupta Panda[1,2], Katarzyna Małek[3,4], Marzena Śniegowska[2] and Bożena Czerny[1]

[1]Center for Theoretical Physics — PAS, Al. Lotników 32/46, Warsaw, Poland 02—668
[2]Nicolaus Copernicus Astronomical Center, ul. Bartycka 18, Warsaw, Poland 00—716
[3]National Center for Nuclear Research, ul. Hoża 69, Warsaw, Poland 00—681
[4]Aix Marseille Univ. CNRS, CNES, LAM Marseille 13388, France

Abstract. In Panda *et al.* 2018a, we constructed a refined sample from the original Shen *et al.* (2011) QSO catalog. Based on our hypothesis — the main driver of the Quasar Main Sequence is the maximum of the accretion disk temperature (T_{BBB}) defined by the Big Blue Bump on the Spectral Energy Distribution (Panda *et al.* 2017; Panda *et al.* 2018b). We select the four extreme sources that have $R_{FeII} \geqslant 4.0$ and use CIGALE (Boquien *et al.* 2018) to fit their multi—band photometric data. We also perform detailed spectral fitting including the Fe II pseudo—continuum (based on Śniegowska *et al.* 2018) to estimate and compare the value of R_{FeII}. We show the dependence of FeII strength on changing metallicity.

Keywords. galaxies: active, (galaxies:) quasars: emission lines, accretion disks, radiative transfer, techniques: photometric

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1. CIGALE SED analysis

We use CIGALE to fit multi—wavelength photometric data (5GHz to 1344 Å) using: (a) SFH with a delayed + exponential burst; (b) SSP: Bruzual & Charlot 2003; (c) nebular emission; (d) Calzetti *et al.* 2000 dust attenuation; (e) Draine *et al.* 2014 dust emission; and (f) Fritz *et al.* 2006 AGN model. CIGALE's SED analyses shows good agreement with the T_{BBB} derived from the observations (see Table 1†).

2. Photoionisation Predictions On Metallicity

We test the behaviour of these "strong FeII" emitting NLS1s (see Fig. 1 right panel) through photoionisation code CLOUDY (Ferland *et al.* 2017) to predict the line luminosities for FeII (integrated) and Hβ using SEDs from observation. In Panda *et al.* 2018b, we found that these BLR clouds have high density ($n_H = 10^{12}\ cm^{-3}$) and characteristic FeII emission can be modelled using high column density ($N_H = 10^{24}\ cm^{-2}$) and a low value of (micro)turbulence ($v_{turb} = 10\ km/s$). FeII strength (R_{FeII}) estimates from photoionisation are further confirmed incorporating a high value of metallicity. We performed a grid simulation that gave us a linear dependence of the FeII strength on the metallicity:

$$\langle \log (R_{FeII}) \rangle = -(0.325 \pm 0.0261) + (0.519 \pm 0.008) \left\langle \log \left(\frac{Z}{Z_\odot} \right) \right\rangle ‡ \qquad (2.1)$$

† the table and the model fits for the other 3 sources can be found here
‡ average values based on the 4 sources

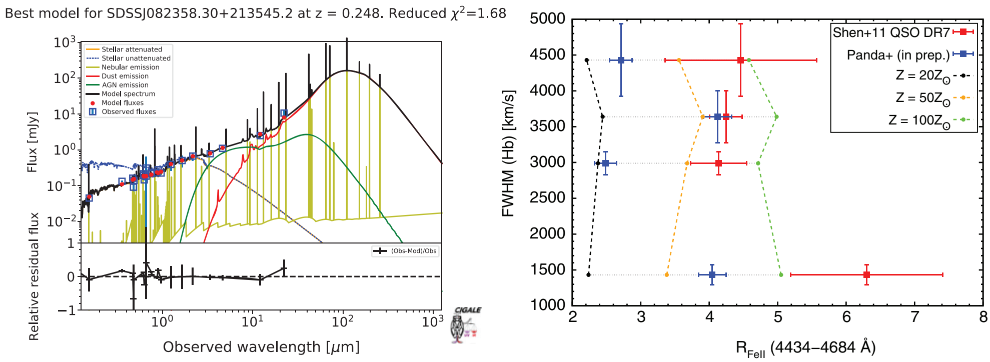

Figure 1. (a) CIGALE model fitting for SDSSJ082358.30+213545.20 — the orange line represents the stellar (attenuated) emission, the blue dashed line is for the stellar (unattenuated), the nebular, dust, AGN emission are shown in light green, red and dark green respectively. The overall model spectrum is shown in black.(b) The plot shows a comparison between values estimated by an automatic template fitting procedure (red squares) versus our semi—automatic procedure (blue squares). A subset of the photoionisation simulation results is shown in the background for varying metallicities.

The predicted average metallicities are in the range of 20—55 $Z_{\odot}$. Such high values of metallicities have been obtained for some high—redshift quasars with similar emission line features.

References

Boquien, M., Burgarella, D., Roehlly, Y., Buat, V., Ciesla, L., Corre, D., Inoue, A. K. & Salas, H. 2018. CIGALE: a python Code Investigating GALaxy Emission. *arXiv*:1811.03094

Bruzual, G. & Charlot, S. 2003. Stellar population synthesis at the resolution of 2003. *MNRAS* 344(4), 1000–1028

Calzetti, D., Armus, L., Bohlin, R. C., Kinney, A. L., Koornneef, J., & Storchi-Bergmann, T. 2000. The Dust Content and Opacity of Actively Star-forming Galaxies. *ApJ* 533(2), 682–695

Draine, B. T., Aniano, G., Krause, O., Groves, B., Sandstrom, K., Braun, R., Leroy, A., Klaas, U., *et al.* 2014. Andromeda's Dust. *ApJ* 780(2), 172–190

Ferland, G. J., Chatzikos, M., Guzmán, F., Lykins, M. L., van Hoof, P. A. M., Williams, R. J. R., Abel, N. P., *et al.* 2017. The 2017 Release Cloudy. *RMxAA* 53, 385–438

Fritz, J., Franceschini, A., & Hatziminaoglou, E. 2006. Revisiting the infrared spectra of active galactic nuclei with a new torus emission model. *MNRAS* 366(3), 767–786

Panda S., Czerny, B., & Wildy, C. 2017. The physical driver of the optical Eigenvector 1 in Quasar Main Sequence. *FrASS* 4, 33

Panda, S., Małek, K., Śniegowska, M., & Czerny, B. 2018a. Using vo tools to investigate Quasar Spectra (UNIQS). In: M. Berton, (Ed.), 2018. Revisiting narrow-line Seyfert 1 galaxies and their place in the Universe. Padova (Italy): Proceedings of Science. 50

Panda, S., Czerny, B.,, Adhikari, T. P., Hryniewicz, K., Wildy, C., Kuraszkiewicz, J., & Śniegowska, M. 2018b. Modeling of the Quasar Main Sequence in the Optical Plane. *ApJ* 866(2), 115–128

Shen, Y., Richards, G. T., Strauss, M. A., Hall, P. B., Schneider, D. P., Snedden, S., Bizyaev, D., Brewington, H., *et al.* 2011. A Catalog of Quasar Properties from Sloan Digital Sky Survey Data Release 7. *ApJS* 194(2), 45–66

Śniegowska, M., Czerny, B., You, B., Panda, S., Wang, J.-M., Hryniewicz, K., & Wildy, C. 2018. Properties of active galaxies at the extreme of Eigenvector 1. *A&A* 613, A38