Virilization of the broad line region in the SDSS sample of type 1 AGNs

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Introduction

Determination of the mas of the supermassive black holes (SMBH) is very important and complex task (e.g. see: Popović 2020). Some methods, using the emission lines, are based on assumption that emitting gas, surrounding the SMBH is virialized. Here we investigated virialization of the Hα and Hβ line in the sample of 925 AGNs, taken from the SDSS.

Data & Fitting

We downloaded AGN spectra from the SDSS DR 16 with S/N $>$ 30 and z $<$ 0.4.

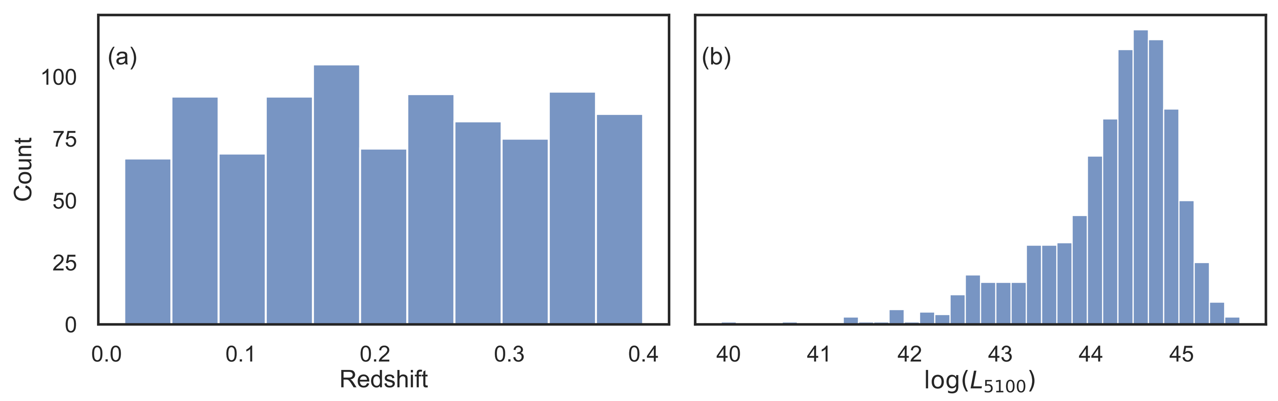


Figure 1: Histograms of z (a) and luminosity at 5100 Å (b)

For spectral analysis we used **FANTASY** (Fully Automated pythoN Tool for AGN Spectra analYsis) (Ilić et al. 2020). Host contribution was determined using the linear combination of both host and qso eigenspectra (Vanden Berk et al. 2006).

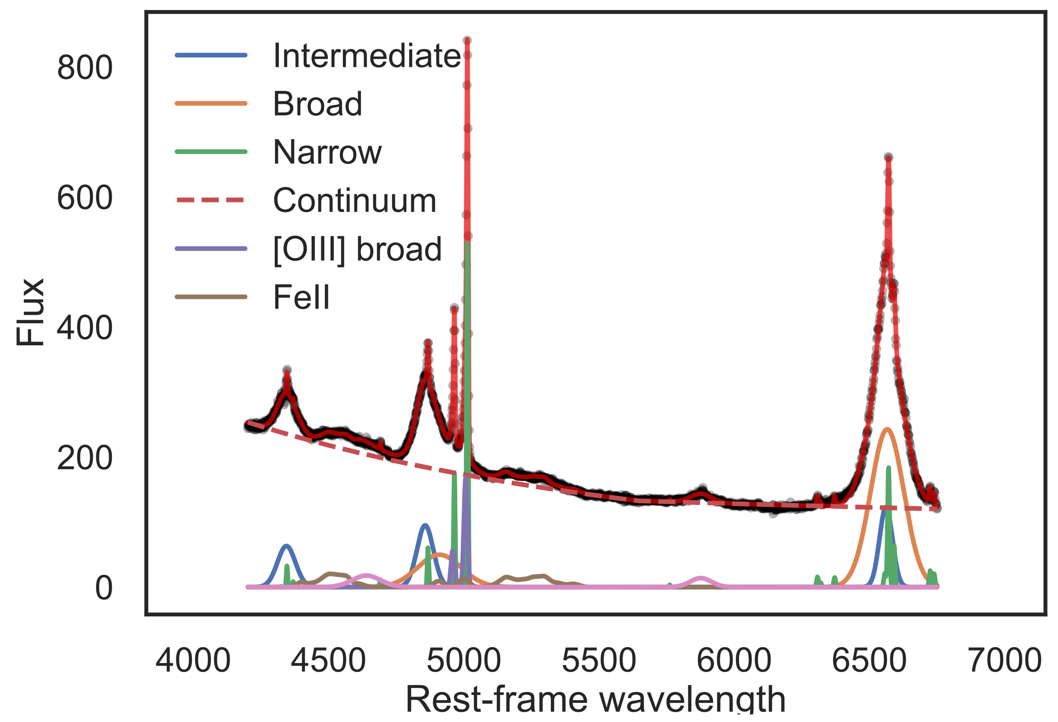
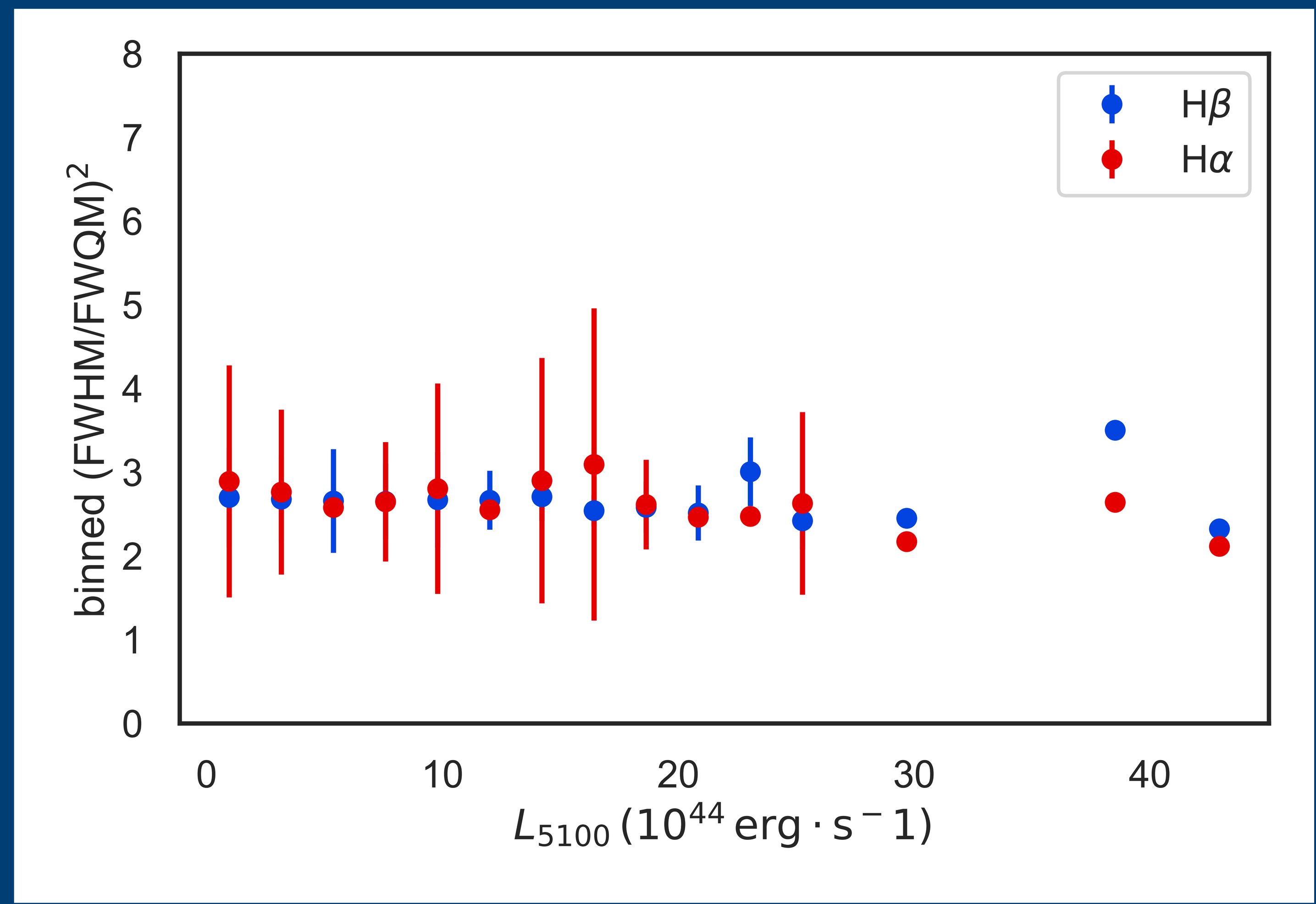


Figure 2: Example of the fully automatic multi-component fit.

This analysis on 925 AGNs indicate that the kinematics of the broad line regions is on average in good agreement with the virial theorem assumption.



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Fully Automated pythoN Tool for AGN Spectra analYsis

Methods & Results

According to the virial theory we have (e.g. see: Popović 2020):

$$M_{BH} \sim f_{\text{line}} \frac{\text{FWHM}^2 R_{line,1/2}}{G},$$

where M_{BH} is mass of black hole, f_{line} is virial factor, that takes in account inclination and geometry of the BLR, $R_{\text{line},1/2}$ is the distance of emitting region and G is gravitational constant. If we assume that the f-factor corresponding to the emission line profile measured at the half and quarter maximal intensity are equal, then we have:

$$\frac{\text{FWQM}^2}{\text{FWHM}^2} = \frac{R_{line,1/2}}{R_{line,1/4}}.$$

where FWQM is full width at 25% of the line intensity. If one assume the same luminosity dependence of the R_{line} on the half and quarter of the maximum , then, $\frac{\text{FWQM}^2}{\text{FWHM}^2}$ should be constant across the continuum luminosity range. To see change in the above-mentioned ratios we have split continuum luminosity into the equal bins, and for each bin we have calculated average of the ratios (see Figure 3 for full data and only binned in the Figure in the middle of the poster).

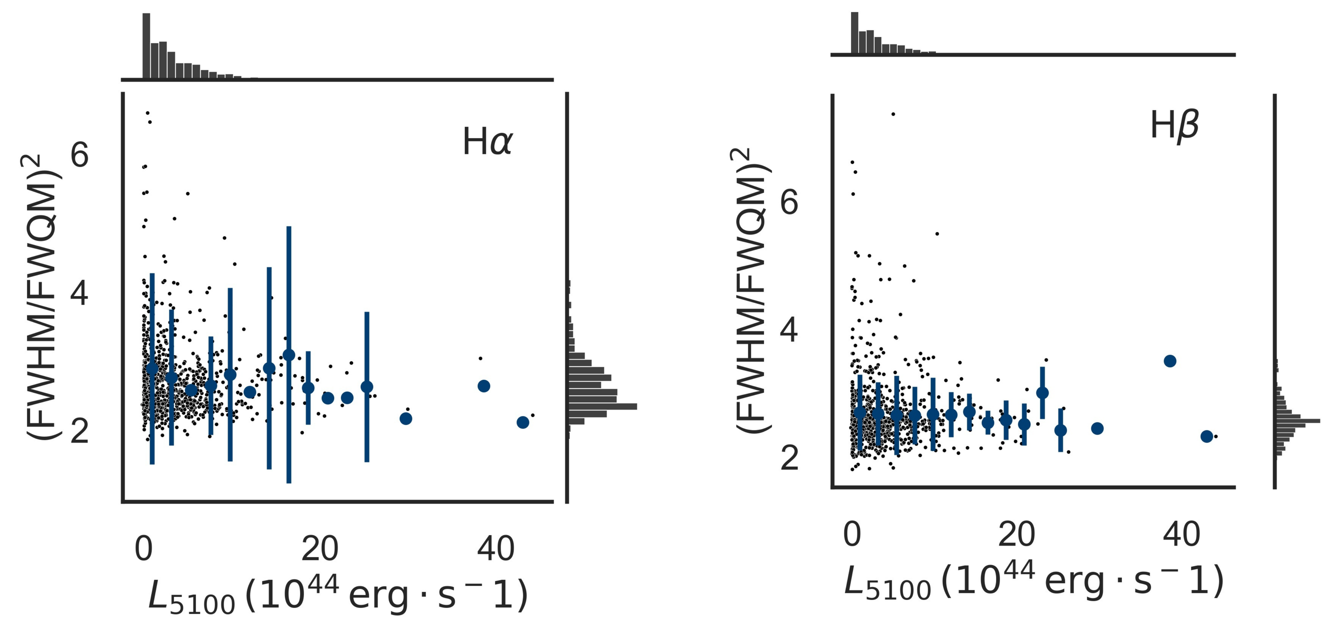

Figure 3: L$_{cnt}$ at 5100 Å vs. square ratio of $\frac{\text{FWQM}^2}{\text{FWHM}^2}$ Black dots are representing values for each of 925 objects, while blue dots are representing averaged ratio of full widths in binned L_{cnt}.

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References

Ilić, D., Oknyansky, V., Popović, L. Č., et al. 2020, A&A, 638, A13

Popović, L. Č. 2020, Open Astronomy, 29, 1

Vanden Berk, D. E., Shen, J., Yip, C.-W., et al. 2006, AJ, 131, 84