Mon. Not. R. Astron. Soc. **000**, 000–000 (0000) Printed 25 November 2013 (MN LaTeX style file v2.2)

Quasar line profiles from rest-frame UV to Optical

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25 November 2013

ABSTRACT

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Key words: galaxies: AGNs, quasars, Broad line region

1 SPECTRAL MEASUREMENTS

1.1 Continuum and Spectral Indices

Our first approach to characterize the quasar continua consisted in using a single power law. ($F_\lambda \propto \lambda^\alpha$) over the entire spectra wavelenght coverage (1200-9000$\mathring{A}$) of our sample. We have found that, in general, this single power-law does not give a good representation of the overall continua and we need at least a composite of two power law with different slopes instead: a broken power law. The last result motivates us to use accretion-thin-disk models (ADMs) to characterize the quasar continua. These model are not only a more physical approach but also has intrinsic continuum slope changes. We have not taken into account the effect of galactic extinction on the spectra but it is being implemented in this moment

1.2 Small Blue Bump

The UV-optical continuum spectra of AGNs show a bump between 2000 and 4000 $\mathring{A}$ which is known as the small blue bump (SBB). The SBB consists of unresolved Fe emission and Balmer continuum. The Balmer continuum is modeled using a theoretical template provided by Hagai Netzer. We force such template to coincide in mean flux over the $3640-3650\mathring{A}$ wavelength region were the FeII emission is known to be weak (citation required). Meanwhile, the Fe emission is modeled using the FeII and FeIII template of Vestergaard & Wilkes 2001 derived from the 1Zw 1 narrow-line quasar (900km/s). We allow the template to vary in both: intensity and broadening. This template has a a cut off around 3080$\mathring{A}$ that does not let us to model the Fe emission for wavelengths between 3080 and 4000 $\mathring{A}$. However, given that the MgII line center is around 2800 $\mathring{A}$ this cutoff does not affect the fitting of this line which is the most important in the small blue bump region.

1.3 Emission Lines

We take a global continuum as the baseline for all the lines in the spectrum.This global continuum is composed by the accretion- disk-model continuum and the Balmer continuum model. Both are subtracted before proceeding with the emission line fitting. For our line fitting procedure we do not consider any additional local continuum for any emission line.

1.3.1 General procedure

For each of several emission-line regions we fit the emission line components using χ^2 minimization with the package pyspeckit (Ginsburg et al 2011).
We used a narrow ($500 <= V(km/s) <= 3000$) and a broad ($3000 <= V(km/s) <= 10000$) Gsaussian component to fit each strong, broad emission line. A velocity shift is allowed between the two components to account for the asymmetry of the line profile.
For Halpha and Hbeta, we have also included a third Gaussian component to account for the narrow-line region (NLR) emission on top of the broad-line profile. For weak emission lines only one Gaussian component is used. We used symmetric Gaussian profiles, so each profile has three parameters: flux, width, and central wavelength. We assume the same width for similar components of the same species, tie together the wavelengths of some lines based on their laboratory wavelengths, and assume line-intensity ratios for some lines based on their statistical weights to avoid too many free parameters. We list in the appended table all the free and dependent parameters in each region and how the parameters are related.

When we find obvious strong absorption around a emission line of interest we exclude the absorbed regions before fitting.

1.3.2 MgII and H beta

The MgII and H beta profile are fitted along with with the FeII templates of Vestergaard & Wilkes 2001 and Boroson & Green 1992 respectively.

Attached figures show examples of our fitting results and individual components in each region of the J0019- 1053 quasar.

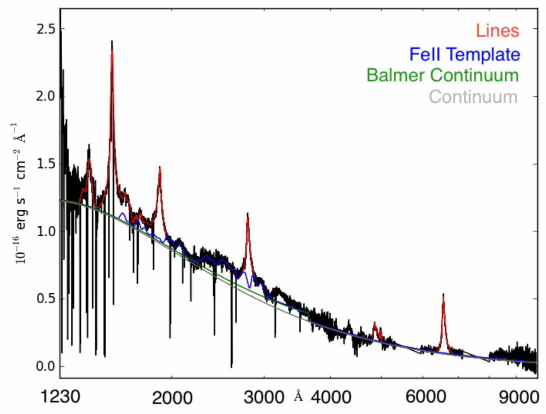

Figure 1. Componets of the spectrum

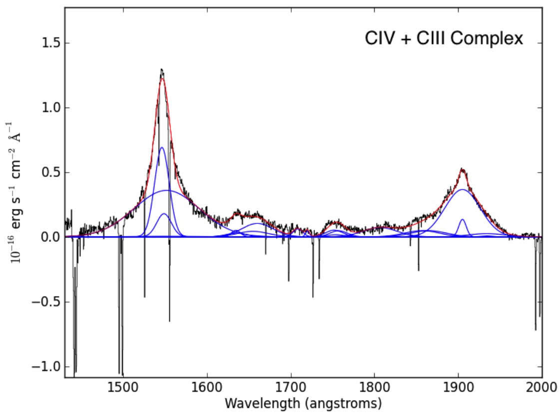

Figure 2. CIV-CIII

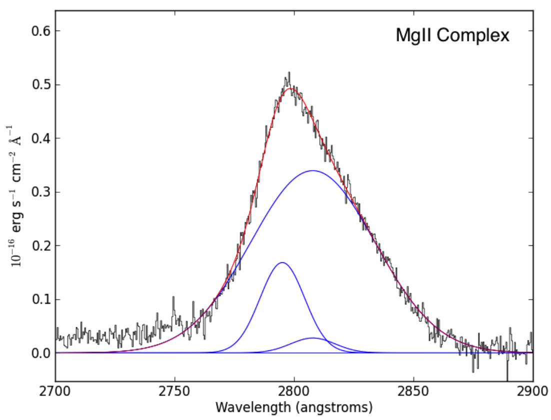

Figure 3. MgII

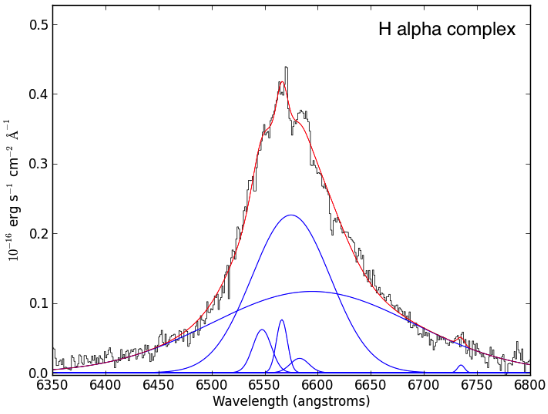

Figure 4. Halpha

We can observe from these plots that in generl we obtain good fits to the lines components using the constraints defined in the attached table. However, SiIV-OIV complex is not well reproduced by our gaussian models. The main reason for this discrepancy is that our acreation disc model does not reproduce completely well the bluer part of this spectrum and it is sligthly below the real continuum. This leads the fitting code to interprete this "overflux" as an additional gaussian component.

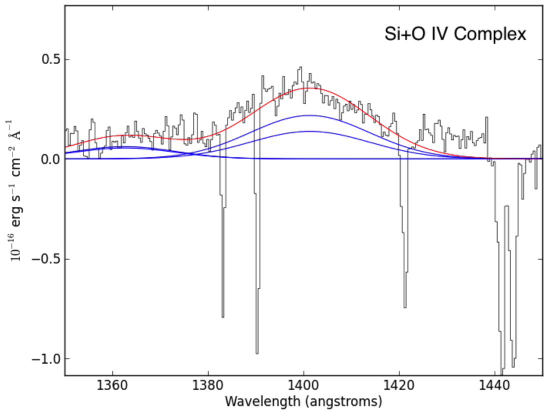

Figure 5. SiIV-OIV

ID	LINE	λa	Componet	Flux	Center	FWHM	FLUX RATIO
Si IV + O IV] 1	Si IV	1396.75	Broad	Free	Free	Free	Free
2			Narrow	Free	1	Free	Free
3	O IV]	1402.34	Broad	Free	1	Free	Free
4			Narrow	Free	2	Free	Free
C IV + CIII Region							
1	N IV]	1486.5		Free	Free	Free	
2	C IV	1548.2	Narrow	Free	Free	Free	Free
3			Broad	Free	Free	Free	Free
4	C IV	1550.77	Narrow	Free	2	2	1
5			Broad	Free	3	3	1
6	He II	1640.72	Narrow	Free	Free	Free	
7			Broad	Free	6	Free	
8	O III]	1660.8		Free	1	Free	0.29
9		1666.14		8	8	8	0.71
10	N III]	1748.65		Free	Free	Free	0.41
11		1752.16		10	10	10	0.14
12		1754		10	10	10	0.45
13	C III]	1908.73	Narrow	Free	Free	Free	
14			Broad	Free	13	Free	
15	Si III]	1892.03	Narrow	Free	Free	Free	
15			Broad	Free	15	Free	
17	Al III	1854.72		Free	Free	Free	1
18	Al III	1862.78		17	17	17	1
Mg II Region							
1	Mg II	2795.53	Narrow	Free	Free	Free	2
2			Broad	Free	1	Free	2
3	Mg II	2802.71	Narrow	1	1	1	1
4			Broad	2	2	2	1
5	Fe	Template		Free	Free	Free	
H\beta Region							
1	H\beta	4861.32	Narrow	Free	Free	Free	
2			Broad	Free	Free	Free	
3			NLR	Free	4	4	
4	[O III]	5006.84		Free	Free	Free	3
5		4958.91		4	4	4	1
6	He II	4685.65		Free	Free	Free	
7	Fe II	s		Free	...	Free	
H\alpha Region							
1	H\alpha	6562.8	Narrow	Free	Free	Free	
2			Broad	Free	Free	Free	
3			NLR	Free	Free	4	
4	[N II]	6548.06		Free	4	[O III] width	1
5		6583.39		4	4	4	3
6	[S II]	6716.47		Free	4	4	1
7		6730.85		6	6	6	1

Figure 6. Parameter definition