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DACs AND SACs PHENOMENA IN THE C IV EMITTING REGIONS OF QSOs

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Abstract. In this paper we study the C IV resonance lines in the UV spectra of 5 Broad Absorption Line Quasars (BAL QSOs). We found that the Broad Absorption Lines (BALs) that we analyzed in the spectra of some BAL QSOs, are created by a number of Satellite Absorption Components (SACs). We calculated the kinematical parameters such as the apparent rotational (V_{rot}) and radial (V_{rad}) velocities of the regions where the studied lines are created and the random velocities (V_{rand}) of the C IV ions. We also calculated the Full Width at Half Maximum (FWHM) and the column density (CD).

1. INTRODUCTION

In the spectra of Broad Absorption Line Quasars (BAL QSOs) we observe complex profiles of Broad Absorption Lines (BALs), mainly in the case of high ionization ions (e.g. C IV, Si IV, N V). Danezis et al. (2006, 2008) indicated that these complex profiles result from the fact that the BALs are composed of a number of Satellite Absorption Components (SACs). In this paper we test the idea of SACs in quasars' spectra, proposed by Danezis et al. (2006, 2008), using the GR model (Danezis et al. 2007).

Here we investigate the physical properties of Broad Absorption Line Regions (BALRs), where the C IV resonance lines ($\lambda\lambda$ 1548.187, 1550.772 Å) are created, in the case of five quasars. With this model one can accurately fit the observed complex profiles of both emission and absorption spectral lines. Generally, with this model we can calculate the apparent rotational and radial velocities, the random velocities of the ions, as well as the Full Width at Half Maximum (FWHM), the column density of the independent density regions of matter which produce the main

Name	Z	Obs. Date	Ins./grat.
PG 0946+301	1.216	Feb 16, 1992	FOS/G400,G570
PG 1700+518	0.292	Sep 12, 2000	STIS/G430L,G750L
3C 351	0.371940	Oct 22,1991	FOS/G190H
H 1413+1143	2.551	Jun 23, 1993, Dec 23,1994	FOS/G400H,G570H
PG1254+047	1.024	Feb 17,1993	FOS/G160L,G270H

Table 1: Observational Data

and the satellite components of the studied spectral lines and the respective absorbed or emitted energy. We are able to explain the observed peculiar profiles of the BALs using the DACs/SACs theory, i.e. the complex profiles of the BALs are composed by a number of DACs or SACs which are created in different regions (Danezis et al. 2006, 2008).

2. OBSERVATIONAL DATA AND METHOD OF ANALYSIS

The observational data are taken with HST and are shown in Table 1. The studied spectra have resolution between 1.2 and 3.2 Å.

In order to study the C IV regions of the above BAL QSOs, we used the model proposed by Danezis et al. (2007).

3. RESULTS AND DISCUSSION

In Figure 1 one can see the best fit of the C IV resonance lines in the spectra of PG 0946+301 (left) and PG 1700+518 (right). In the case of PG 1700+518 the complex profile of the observed C IV Broad Absorption Line (BAL) is composed by a number of Satellite Absorption Components (SACs). However, in the case of PG 0946+301 the complex profile of the C IV BAL is composed by two discrete groups of SACs. This means that we also observe the DACs phenomenon.

We point out that the C IV doublet of PG 0946+301 is one of the very few lines that present clearly the DACs phenomenon, in the case of quasars.

By applying the model proposed by Danezis et al. (2007) (GR model), we calculated the kinematical parameters such as the apparent rotational (V_{rot}) and radial (V_{rad}) velocities of the regions where the studied lines are created and the random velocities (V_{rand}) of the C IV ions. The calculated values are presented in Table 2. We also calculated the Full Width at Half Maximum (FWHM) and the column density (CD) (see Table 3). As one can see in Table 2, the C IV complex profiles are created by a number of SACs.

In some cases we observe that the calculated values of the random and/or the rotational velocities are too large (see Table 2), indicating that the region of origin of the components is close to the massive black hole. Such large rotational and random velocities are expected near the massive black hole, in difference with the large widths observed in stellar spectra (see Antoniou et al. 2008).

Object	SAC	V_{rand} (km/s)	V_{rad} (km/s)	V_{rot} (km/s)
PG0946+301	a	615	-5998	3000
	b	615	-10835	1800
	c	228	-10061	600
PG1700+518	a	5699	-19348	6500
	b	2280	-12092	3000
	c	1140	-27474	1000
	d	456	-5611	1000
	e	114	-9674	800
3C351	a	39	-1722	270
H1413+1143	a	2280	-5224	3600
PG1254+047	a	1596	-5804	1000

Table 2: Random (V_{rand}), Rotational (V_{rot}), Radial (V_{rad}) velocities (in km/s) of all the C IV SACs (a to e) of the studied quasars spectra.

Object	SAC	FWHM (km/s)	CD (cm^{-2}) λ 1548.187 Å	CD (cm^{-2}) λ 1550.772 Å
PG0946+301	a	5058	$5.84 \cdot 10^{10}$	$5.36 \cdot 10^{10}$
	b	3025	$3.60 \cdot 10^{10}$	$3.30 \cdot 10^{10}$
	c	1010	$1.00 \cdot 10^{10}$	$9.17 \cdot 10^{9}$
PG1700+518	a	15134	$2.39 \cdot 10^{11}$	$2.20 \cdot 10^{11}$
	b	6271	$7.23 \cdot 10^{10}$	$6.61 \cdot 10^{10}$
	c	2624	$1.69 \cdot 10^{10}$	$1.53 \cdot 10^{10}$
	d	1738	$1.53 \cdot 10^{10}$	$1.40 \cdot 10^{10}$
	e	1316	$7.58 \cdot 10^{9}$	$6.90 \cdot 10^{9}$
3C351	a	602	$7.27 \cdot 10^{9}$	$6.73 \cdot 10^{9}$
H1413+1143	a	7245	$1.19 \cdot 10^{11}$	$1.10 \cdot 10^{11}$
PG1254+047	a	3491	$1.73 \cdot 10^{10}$	$1.57 \cdot 10^{10}$

Table 3: Full Width at Half Maximum (FWHM) (in km/s) and Column Density (CD) (in cm^{-2}) of all the C IV SACs (a to e) of the studied quasars spectra.

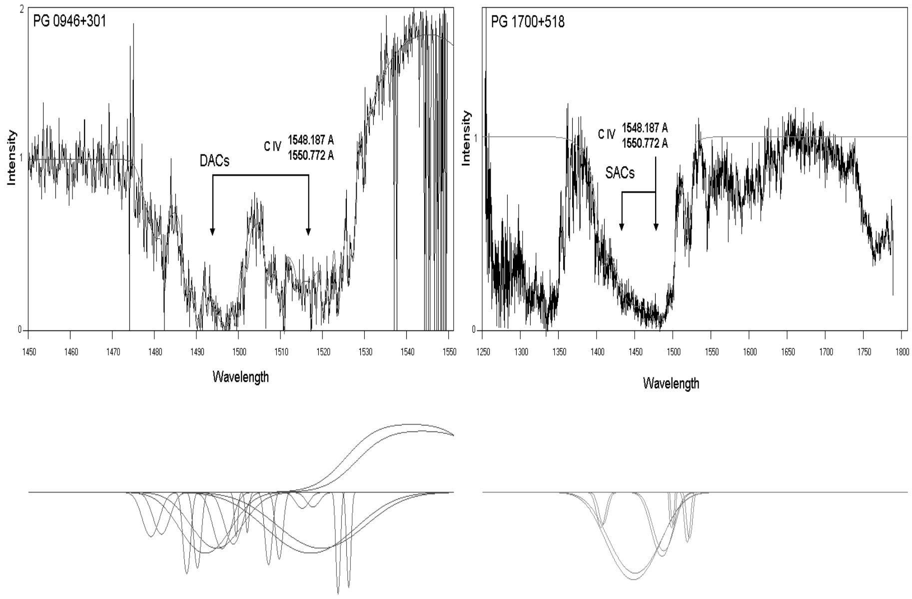

Figure 1: Best fit of the C IV resonance lines in the spectra of PG 0946+301 (left) and PG 1700+518 (right). We can explain the complex structure of these lines as a DACs or SACs phenomenon, respectively. Below the fit one can see the analysis of the observed profile to its DACs/SACs.

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