ABSORPTION-LINE SPECTROSCOPY OF CLOSE PAIRS OF QSOs

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Close pairs of QSOs (separations $\lesssim$1-5 arcmin) provide a powerful approach to the study of narrow absorption lines in QSO spectra. By looking for absorption in the spectrum of the higher-redshift QSO at the redshift of the other ("associated absorption"), or absorption in both spectra at the same redshift ("common absorption"), one may address several issues: the cosmological nature of QSO redshifts, the origin of the narrow absorption lines of high redshift and excitation (intrinsic or intervening), the clustering of absorbing systems (with each other, and with QSOs), the sizes of the absorbing regions (for metal absorption lines and for Lyα lines; absorption cross-sections of individual galaxies and of clusters of galaxies), and the presence and nature of gaseous halos around QSOs.

The table summarizes work that has been done to date on close pairs of QSOs. In 3 pairs out of the 4 for which appropriate data exist, absorption has been found in the spectrum of the higher-redshift QSO within 2000 km/s of the emission-line redshift of the other. This result provides strong support for the cosmological interpretation of QSO redshifts (if further support is needed), and shows directly that at least some narrow absorption lines of high z and excitation arise in intervening matter. It also demonstrates that QSOs are located in regions of high matter density - plausibly clusters of galaxies. In the Q0028+003/Q0029+003 pair the absorption may arise in an extended ($\gtrsim$400 kpc) gaseous halo associated with the lower-redshift QSO itself.

Conclusive evidence of absorption in both spectra of a pair at the same redshift has only been obtained from the gravitational lens QSO Q0957+561, for which the projected separations are very small. No coincidences (within 2000 km/s) are present in 5 CIV systems in the spectra of the Q0254-334 and Q1623+268 pairs. This suggests that typical CIV absorbing regions are not strongly clustered together and are smaller than $\sim$400 kpc. A cross-correlation study of the narrow Lyα lines in the Q1623+268 pair showed no excess at small velocity splittings, indicating that the Lyα absorbers are also not strongly clustered and probably smaller than 1 Mpc.

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QSO Pair	z_{abs}	Separation			Relevant Lines	Ref.
		ang. (')	proj. (kpc)	ΔV (km/s)		
a) Absorption at z_{em} (lower) ("associated absorption")						
0028+003/0029+003	1.7	1.0	390	190	CIV	SBR
0254-334/0254-334	(1.9)	1.0	380	$\gg$2000	CIV	WMPJ
1228+076/1228+077	1.9	3.4	1300	1400	CIV	RS
1548+114/1548+114	0.4	0.1	19	1400	MgII	BSWW
b) Absorption at Common z ("common absorption")						
0254-334/0254-334	1.7	1.0	380	$\gg$2000	CIV	WMPJ
"	0.2	1.0	140	100?	MgII?	WMPJ
0957+561/0957+561	1.4	0.1	$\leq$0.3	<10	CIV	WCW
"	1.1	0.1	$\leq$5	<10	CIV	YSBO
1623+268/1623+269	1.9-2.2	2.9	1120	>2000	CIV	SYS
"	2.2-2.5	2.9	1150	-	Lyα	SYS

(H_o=100 km $s^{-1}Mpc^{-1}$, q_o=0)

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Discussion

Braccesi: Should you not have to see reabsorption in the emission line itself of quasar 1, if this quasar is surrounded by a gas cloud able to produce an absorption line in quasar 2?

Shaver: The absence of such absorption could be explained if the "halo" is in the form of a thin disk. Alternatively, it could be an indication that the observed absorption does not arise in gas physically associated with the foreground quasar, but rather in a galaxy located in the same cluster as the quasar.

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