

Sizes of Intervening C IV Absorbers from High Resolution Spectroscopy of APM 0827+5255.

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Abstract. Some intervening C IV absorbers in the Keck/HIRES spectrum of APM 0827+5255 give rise to absorption lines for which the observed optical depths for the doublet components are not in the expected 2 : 1 ratio. We model this effect as coverage of one line of sight to this gravitationally lensed quasar and perform a set of simulations to select a sample of lines for which our model provides an explanation for the effect. We use lines in this sample to obtain estimates for minimum absorber sizes from total coverage and the separations of the lines of sight for a range of lens redshifts, z_1 , and two cosmologies. We also obtain best estimates for overall sizes from a statistical “hit and miss” approach. For $z_1 = 0.7$ our results set a lower limit to sizes of C IV absorbers of $\sim 0.3 h_{72}^{-1}$ kpc ($\sim 0.5 h_{72}^{-1}$ kpc) for $\Omega_M = 1, \Omega_\Lambda = 0$ ($\Omega_M = 0.3, \Omega_\Lambda = 0.7$).

1. Anomalous Doublet Ratios

A number of intervening C IV doublets in the Keck/HIRES spectrum of quasar APM 0827+5255 (Ellison et al. 1999; Irwin et al. 1998) cannot be fitted with Voigt profiles unless the zero level is adjusted (see Figure 1).

2. Model and Results

We modelled these Anomalous Doublet Ratios (ADRs) as due to partial coverage of the multiple lines of sight to this gravitationally lensed quasar and investigated the observability, or otherwise, of an ADR. Details can be found in Tzanavaris & Carswell 2003. For the sizes of C IV absorbers, our method allowed us to obtain (1) lower limit estimates of $\sim 300 h_{72}^{-1}$ pc, and (2) most probable sizes of a few kiloparsecs.

Our results agree with estimates based on separate spectra for each sightline (Rauch et al. 2001) and for different quasars. C IV clouds may have been transported or at least metal-enriched due to galactic winds (Theuns et al. 2002). Depending on z_1 , some of our results may be supporting the picture according to which intervening C IV absorption arises in protogalactic clumps (Haehnelt

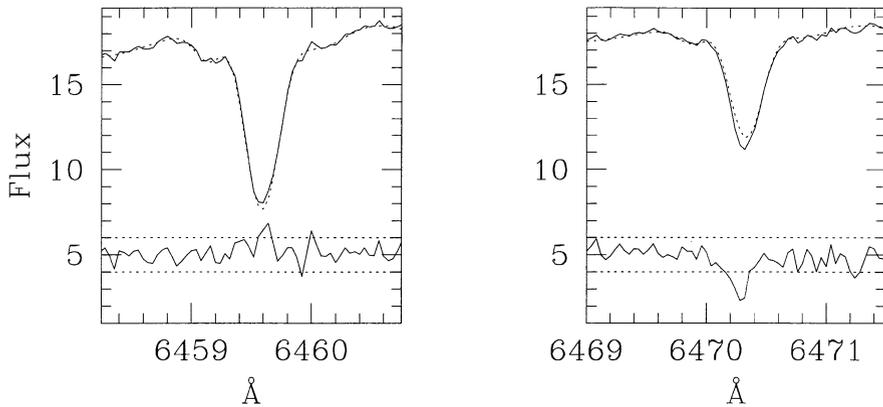


Figure 1. Example of C IV doublet showing an ADR. The *left* panel is for the 1548 Å line and the *right* panel for the 1550 Å line. In each panel from top to bottom shown are data (*solid* line) and fit (*dotted* line), and residuals (*solid* line) with $\pm 1\sigma$ level marked by two horizontal, *dotted* lines. The residuals can be eliminated by adjusting the zero level.

et al. 1996). Although our sample of observed ADRs is small and z_1 is not known, almost half of the lines for which our model establishes that ADRs are detectable, show partial coverage.

Our technique compensates, to some extent, for the lack of lensed quasars with image separations large enough to allow separate observations of individual sightlines.

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