The rates for C^{+3} and Si^{+3} neglect radiative dielectronic recombination effects.† The total recombination rate is the sum of the radiative and dielectronic values. Due to energy needed to excite inner electrons, dielectronic recombination is usually unimportant at $T_e < 10^4$. It is essentially negligible for C^{+3} and Si^{+3} and higher ions at $T_e \lesssim 10^5$, but raises the rates by factors of ∼2–10 for the lower ions of Carbon and Silicon at $T_e \sim 15,000$ (Shull and van Steenberg 1982, Aldrovandi and Pequignot 1973).

The characteristic timescale for recombination is $\sim 1/n_e\alpha_R$. For, C^{+3} this is ∼30 $(10^8/n_e)$ minutes, where n_e is in cm^{-3}. Neglecting recombination of other ions of carbon, *i.e.* all the carbon is either C^{+3} or C^{+4}, for BALR densities close to the estimated BELR density of 10^9 (see §2.5), equilibrium would be reached in only a few minutes. However, at lower densities of 10^6 and 10^4, the timescales would be 50 hours and 208 days, respectively. Note that at $z_e \sim 2$, time dilation, $\Delta t_{EARTH} = \Delta t_{QSO}(1+z_e)$, will increase these times by about a factor of three in the observer's frame. If we accept the limit on n_e ($\gtrsim 10^6$) based on the lack [O III] emission (see §2.4), we would conclude that recombination delays would be negligible for the variability timescales generally seen in BALQSOs (see chapter 8). However, the densities could be much lower, and densities $\lesssim 10^5$ would create noticeable delays in the observer's frame. For this reason, we consider the effects of time-dependent photoionization/recombination.

If these delays are significant, it might be possible to detect differences in the timescales of various ions. Note that $\alpha_R(Si^{+3})$ is slightly smaller than $\alpha_R(C^{+3})$, and thus would have a slightly longer timescale. However, for Silicon, recombination of other ions is probably important in determining the actual timescale (see §3.6.4). The rate for hydrogen, $\alpha_R(H)$, is ∼20 times smaller than C^{+3}, and so we would expect a much longer

† Dielectronic recombination is the process whereby a free electron recombines, and at the same time causes a bound electron to move to a higher level. The two electrons may subsequently drop back to the lower levels emitting two photons. Thus, more states in an atom are available to a free electron than just the empty levels of an unexcited atom.