For example, if $U > U_p(\mathrm{C}^{+3})$, then we expect the largest change in Al^{+3}, then Si^{+3}, and then C^{+3}, whereas N^{+4} might stay relatively constant, and O^{+5} might show changes in the opposite direction.

In figure 3-6, we show the values for a magnitude change of 0.5 in the top graph. In the lower graph, we plot the expected change in residual intensity at different values of optical depth. For a given change in fractional abundance, optical depths of $\sim$1 will yield the most visible changes. High optical depths require rather large fractional abundance changes to show a visible change, and then only if the abundance decreases.

By comparing the changes in various ions, we should be able to estimate U fairly accurately, as well as determine the true optical depth of the deeper troughs (which may be affected by scattered light filling in the bottom of the trough).

3.6 : Time-Dependent Photoionization/Recombination

3.6.1 : Recombination Time Scales

At an electron temperature of 10,000 °K, the radiative recombination rates (α_R) for H^0, C^{+3}, and Si^{+3} are 0.42, 8.5, and 7.3 $\times 10^{-12}$ cm^3 s^{-1}, respectively (see Osterbrock 1989 and Gould 1978). (Rates are always labeled by the recombined species, *i.e.* $\alpha_R(\mathrm{C}^{+3})$ is the rate for C^{+4} recombining to create C^{+3}.) At lower temperatures, the rates increase due to the contributions of higher shells; conversely at higher temperatures the rates will decrease. In general the 10^4 °K radiative recombination rates will increase as $(\mathrm{T}_e/10^4)^{-\eta}$, where $\eta \sim 0.82$ for both C^{+3} and Si^{+3} (see Aldrovandi and Pequignot 1973). The temperature as calculated by CLOUDY at $\log(U) = -1.5$ is 17,400 °K. In which case we have: $\alpha_R(\mathrm{C}^{+3}) \simeq 5.4 \times 10^{-12}$ and $\alpha_R(\mathrm{Si}^{+3}) \simeq 4.6 \times 10^{-12}$. We note that, depending on what correction factors are used for higher shells, these coefficients may differ by as much as 50% (Gould 1978).