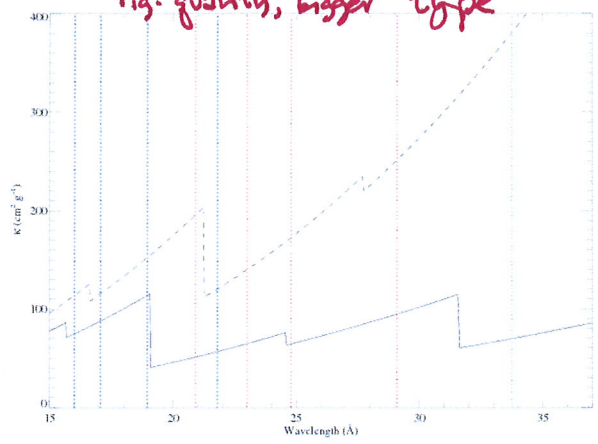

Figure 7. Comparison of opacity models assuming different ionization balances. The solid line represents a model which assumes all elements are in the +4 charge state and helium is completely ionized (high ionization limit). The dashed line represents a model which assumes all elements are in the +2 charge state and all helium is He II (low ionization limit). The latter demonstrates the worst case scenario. The blue, red, and green vertical lines indicate the location of oxygen, nitrogen, and carbon lines, respectively.

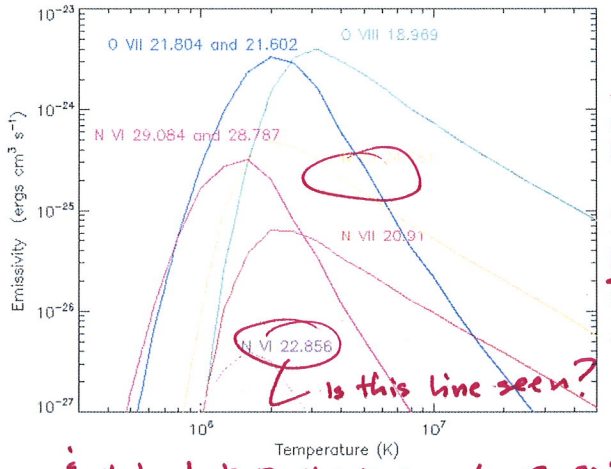

Figure 8. Emissivities of prominent nitrogen and oxygen lines.

4.3.3 *Temperature distribution*

Four and five-temperature models were used for ζ Ori and ζ Pup , respectively. One can see from the emissivities in figures ?? and ?? that our temperature components cover a range that includes the peak emissivities of all strong lines. ζ Ori is the cooler of the two stars and has weaker Fe, Ne, Mg, and Si features, hence requiring only the four lowest temperature components to fit its spectrum.

((How much should I go into the sensitivity to temperature? There isn't much sensitivity at all. Should I include plots, which might be a little overkill?))

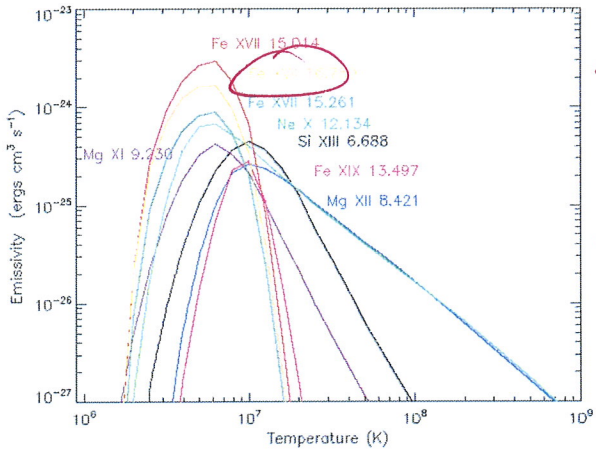

Figure 9. Emissivities of prominent iron, neon, magnesium, and silicon lines. Notice that the emissivities of these lines are heavily skewed toward hotter plasma.

5 DISCUSSION

5.1 Comparison with previous studies

Our results have ruled out the low nitrogen abundances of ζ Pup found in Zhekov & Palla (2007) and the extreme enrichment found in Bouret et al. (2012). It is likely that the slab absorption approximation for the wind in Zhekov & Palla (2007) was too weak a source of absorption and thus resulted in underestimation of the abundances. That study also used *Chandra* data, which does not detect the lowest energy He-like nitrogen line, which could result in a less than ideal constraint on the temperature distribution.

Our derived abundances for ζ Ori , which are comparable to solar, agree with most current studies, with the exception of Zhekov & Palla (2007), which found extreme depletion of both nitrogen and oxygen. This is likely the result of the effects mentioned above.

5.2 Use of this method as a benchmark

The method presented here is a systematic prescription for the determination of nitrogen and oxygen abundances in O stars using RGS spectra. This method is most effective at constraining abundance ranges determined using optical spectroscopy. Specifically, our method is capable of ruling out the extreme values in a given range of abundances. Absorption due to the partially optically thick wind is properly accounted for, and with the sensitivity of the RGS, we are able to constrain the temperature distribution and measure nitrogen and oxygen abundances simultaneously.

There are some difficulties in extending this method to other stars. Both data sets in this paper have very high S/N and the interstellar column densities are relatively low. ((Other than affecting the determinations in obvious ways, how does this particularly affect our method? Also it seems like the uncertainty in the ISM column density is more significant than the magnitude of absorption...))