*3.1.4 Hydrogen Density*

The limits for *n*H in our baseline grid are based on the low density limit (LDL) and the critical density, *n*crit, values of the emission lines we tracked. The LDL for most emission lines is ~100 cm-3, so we chose this as our lowest *n*H value. Recent observations of ultra-compact and hyper-compact H II regions (Hoare et al. 2007, Sánchez-Monge et al. 2011) provide insight for identifying a suitable *n*H upper limit. Observations of ultra-compact regions have revealed *n*H> 104 cm-3 while observations of hyper-compact H II regionshave revealed *n*H > 106 cm-3 (Wood & Churchwell 1989, Kurtz, Churchwell, & Wood 1994, Beuther et al. 2002). The *n*crit values of the higher ionization potential elements we track are about an order of magnitude or two above these deduced values, for example, log(*n*crit([Ne II] λ5755)) = 7.5 and log(*n*crit([C III λ1909)) = 9.0. With *n*H≈ 1010 cm-3 being close to our peak *n*crit, we set 1010 cm-3 to be our upper limit on *n*H. Thus, combining the atomic limits of our emission line list with previously observed *n*H values, we limit the *n*H to 0 ≤ log(*n*H) ≤ 10.

*3.1.5 Incident Ionizing Flux*

The incident ionizing flux, *φ*H, typically is not defined explicitly in photoionization simulations, but instead is indirectly incorporated by using *Q*H, the number of ionizing photons emitted by the central emitting object per second, and *r,* radius from the central emitting object, or by a version of ionization parameter, where *q = cU*, with a given density.

The first method arrives at *φ*H through the relationship,

. (2)

Stasinska and Leitherer (1996) give the theoretical range of 2.7 x 1047 < *Q*H < 7.4 x 1055, however a typical H II region simulation includes a more modest range 1048.89 s−1 < *Q*H < 1049.23 s−1 (Vacca, Garmany & Shull 1996, Hanson et al. 1997) while using *r ~* 1018 cm as in the case of Orion (Pellegrini et al. 2007). Assuming the radius from Pellegrini et al. 2007, translates to a theoretical range of 2.15 x 1010 < *φ*H  < of 5.89 x 1018, given that caveat that this range may extend even further by few orders of magnitude since H II regions are not uniform in size.

The second method for supplying *φ*H is through

.(3)

Leveque et al. (2010) adopt a range of 7 ≤ log(*q*) ≤ 8.6, which, when including their range of hydrogen density, 1 ≤ log(*n*H) ≤ 2, translates to8 ≤ log(*φ*H) ≤ 10.6. In our simulations grids, our lower limit to *φ*H is set by the lower limit of Levesque et al. (2010), while the upper limit is set by assuming the theoretical maximum *Q*H and a radius 102 closer than Orion. All together, this sets our simulation grid at 8 ≤ log(*φ*H) ≤ 22, which is much broader than any other studies, but fits within reason given our focus on high ionization emission lines.