

AST 300B – Spring 2017
In-class Problem Due: Monday Mar. 6

29. Let's calculate the type of O star powering a HII region. It will be helpful in this problem to only plug in numbers at the final step.

(a) The Orion Nebula is measured to have a continuum flux density of 495 Jy at 1.4 GHz with spectral index $\alpha \sim -0.1$. The Orion Nebula has $T = 9000$ K and is located at a distance of $D = 414$ pc. Write down an expression relating the flux density F_ν from free-free emission to the emissivity coefficient j_ν , the distance to the Orion nebula (D), and the volume of the Orion nebula (V). [HINT: we've done this problem before a couple of times now.]

(b) The emissivity coefficient for free-free emission depends on $n_e n_i$. Using your expression above and what you know about the balance of ionization and recombination in HII regions, derive an expression relating Q_0 , the number of ionizing photons to the flux density from free-free emission. [HINT: the number density of protons is related to the number density of ions by $n_p = n_i/1.1$ because the number density of Helium is $n(\text{He}^+) = 0.1 n(\text{H}^+)$.]

(c) Now plug in the numbers and calculate Q_0 and determine which spectral type main sequence star dominates the ionization of the Orion Nebula.

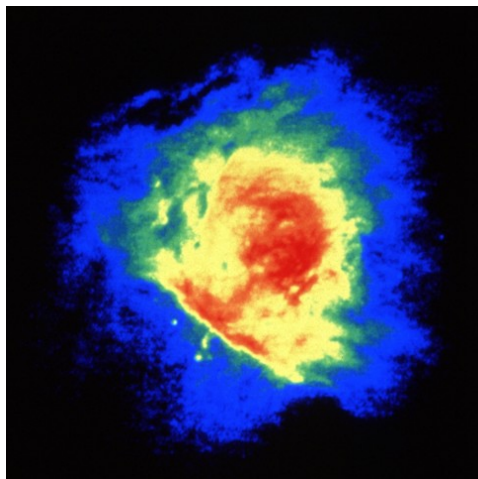


Figure 1: The Majestic Orion Nebula observed with the VLA at 1.4 GHz.