PHYS420 (Spring 2002)
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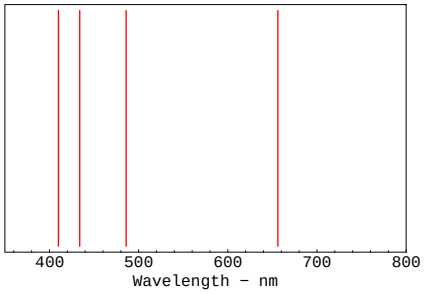
Homework # 6
(due Monday, March 18th, 2002)

Problems

1. The following is a plot showing the location of the first four lines of the Balmer series (i.e. 656, 486, 434 and 410 nm corresponding to $n_f = 2$ and $n_i = 3$, 4, 5 and 6). Using the Balmer – Rydberg formula, compute the location of the first four lines of the Lyman and Paschen series as well as their convergence limit. Make a similar graph showing all three series. Offset them vertically for clarity.



2. Another interesting property of the hydrogen wavelengths is known as the *Ritz combination principle*. If we convert the hydrogen emission wavelengths to frequencies, we find the curious property that certain pairs of frequencies added together give other frequencies that appear in the spectrum! Show that the longest wavelength of the Balmer series and the longest two wavelengths of the Lyman series satisfy the Ritz combination principle.

3. **SMM, Chapter 3, Problem 3.**

4. **SMM, Chapter 3, Problem 4 (10 points).**

5. *Extra credit problem.* Show that **Wien's law**, $u(f,T) = Af^3 e^{-Bf/T}$ where A and B are empirical constants, and the **Rayleigh – Jeans law**, $u(f,T) = \frac{8\pi f^2}{c^3} k_b T$, are special cases of the **Planck radiation formula**, $u(f,T) = \frac{8\pi h f^3}{c^3} \frac{1}{(e^{hf/k_b T} - 1)}$. What are the empirical A and B in terms of fundamental constants?