

AST 300B – Spring 2018

In-class/Take-home Problems Due: Wednesday Mar. 21

29. An electron recombines into a ($nl = 4d$) state of Hydrogen. What are the probabilities for the allowed electric dipole radiative transitions starting from the 4d level? Continue the allowed radiative cascade until you are stuck (cannot radiate via electric dipole rules) or are in the ground state. Give the names (i.e Ly γ) for each of the allowed transitions in the radiative cascade and the probability that you will get a photon through that transition. This is a “branching ratio” calculation.

Redraw this diagram on the board:

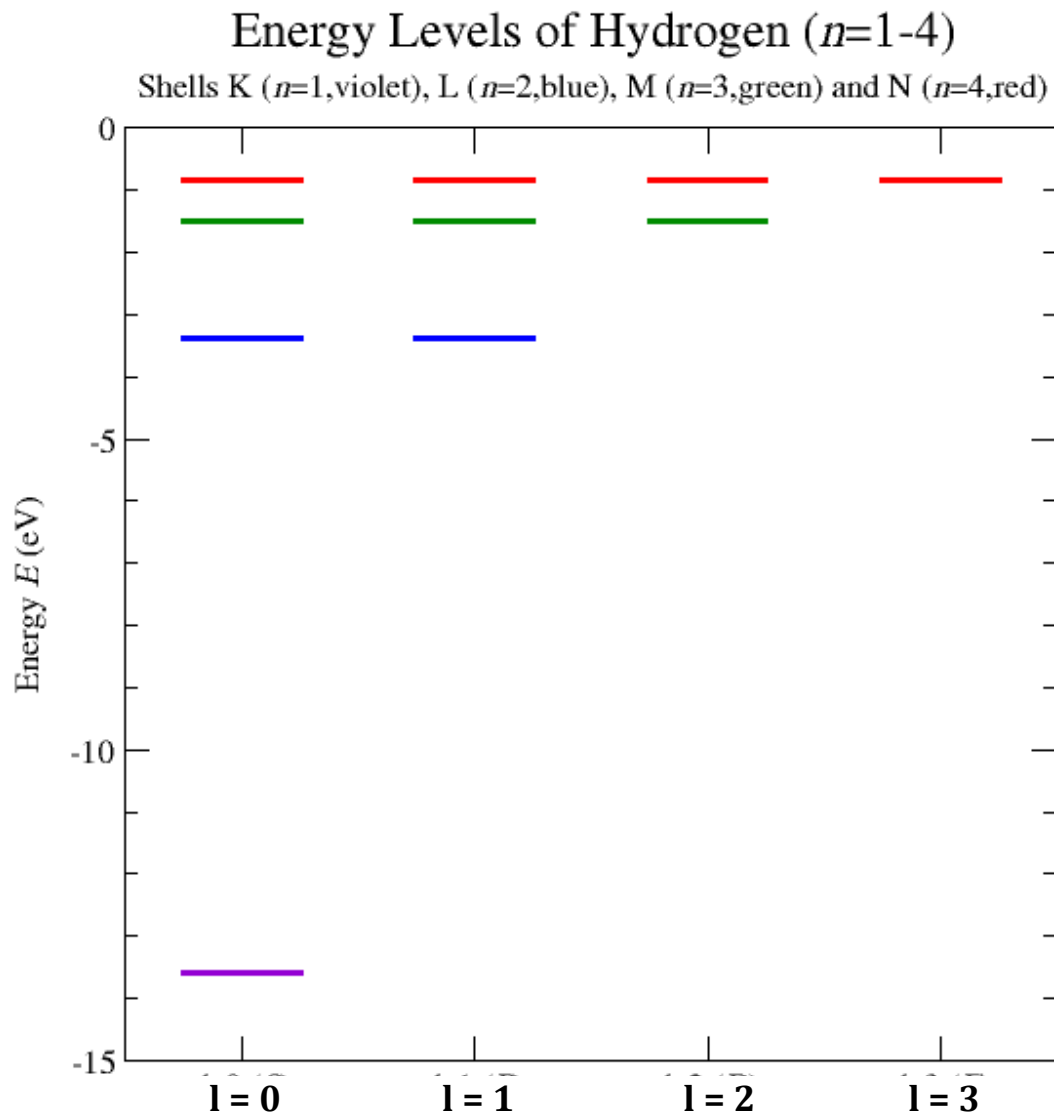


Table C.1. Line data for the hydrogen atom^a

Designation	Transition ^b $i-j$	λ_{ij} (nm) ^e	$f_{i,j}$ ^c	$A_{j,i}$ ^d (s ⁻¹)
Ly α^f	1-2	121.567	0.4162	4.699×10^8
Ly β	1-3	102.572	0.07910	5.575×10^7
Ly γ	1-4	97.254	0.02899	1.278×10^7
Ly _{limit}	1- ∞	91.18		
H α	2-3	656.280	0.6407	4.410×10^7
H β	2-4	486.132	0.1193	8.419×10^6
H γ	2-5	434.046	0.04467	2.530×10^6
H δ	2-6	410.173	0.02209	9.732×10^5
H ϵ	2-7	397.007	0.01270	4.389×10^5
H ₈	2-8	388.905	0.008036	2.215×10^5
H _{limit}	2- ∞	364.6		
P α	3-4	1875.10	0.8421	8.986×10^6
P β	3-5	1281.81	0.1506	2.201×10^6
P γ	3-6	1093.81	0.05584	7.783×10^5
P _{limit}	3- ∞	820.4		
B α	4-5	4051.20	1.038	2.699×10^6
B β	4-6	2625.20	0.1793	7.711×10^5
B γ	4-7	2165.50	0.06549	3.041×10^5
B _{limit}	4- ∞	1458.4		
H109 α^g	110-109	5.985 cm		7.0×10^{-4}
HI	1-1 ^h	21.106114 cm		2.876×10^{-15}
Deuterium I	1-1 ^h	91.5720 cm		4.65×10^{-17}

^aFrom Ref. [44] unless otherwise indicated.

^bThe upper level is j and the lower level is i , where i and j are indices representing the principal quantum numbers, unless otherwise indicated.

^cAbsorption oscillator strengths (see Appendix D.1.3) for transitions from lower level i to upper level j .

^dAverage Einstein A coefficient for transitions from upper level j to lower level i . The average value means that the particles are assumed distributed in their substates (determined by the orbital angular momentum quantum number, l) according to the statistical weights of those substates.