

HW 2, #4

Hydrogen atoms have energy levels

$$E(n) = -13.6 \text{ eV} * \frac{1}{n^2}$$

The first 6 are

$n =$	$E_n \text{ (eV)}$
1	-13.60
2	-3.40
3	-1.51
4	-0.85
5	-0.54
6	-0.38

Transitions from higher levels to $n=2$ involve energy differences, and wavelengths

upper $n \rightarrow 2$	$E_2 - E_n$ (eV)	λ (nm)	name
3	1.89	656.5	H α
4	2.55	486.3	H β
5	2.86	434.2	H γ
6	3.02	410.3	H δ

So line near 410 nm is $n=6 \rightarrow n=2$

430	5	2
480	4	2



HW 2, #4 continued

However, the actual observed emission lines in the spectrum of NGC 40 are slightly different

observed	theoretical	$\Delta\lambda/\lambda_{\text{theory}}$
409.74	410.29	- 0.0014
433.65	434.17	- 0.0012
485.59	486.27	- 0.0014

The consistent shift $\frac{\Delta\lambda}{\lambda} \approx -0.0013$ is caused by Doppler effect. Thus,

$$\frac{v}{c} \approx -0.0013$$

$$\Rightarrow v \approx -390 \frac{\text{km}}{\text{s}}$$

coming toward us