

$|\psi\rangle$
 $|n, l, m_l, m_s\rangle$
 Principal Q. # $\rightarrow e(l+\frac{1}{2})\hbar^2$

Ground State $n=1: E_n = -13.6 \text{ eV} \cdot \frac{Z^2}{n^2}$
 $l=0, m=0, m_s = \pm \frac{1}{2}$

1st excited state $n=2: E_2 = \frac{1}{2^2} E_1 = -3.4 \text{ eV}$
 $l=0, m=0$
 $l=1, m=0$
 $l=1, m=1$

of states $= n^2 \cdot 2$

$\text{Prob}(r, \Delta r) \sim |\psi|^2 \cdot \Delta r$
 $\frac{1}{\pi a_0^3} e^{-2r/a_0}$
 $\Delta \tau = r^2 dr \sin\theta d\theta d\phi$
 $\text{Prob}(r \dots r+\Delta r) = |\psi|^2 r^2 \Delta r \int_{\phi=0}^{2\pi} \int_{\theta=0}^{\pi} \sin\theta d\theta d\phi$
 $= \frac{4r^2}{a_0^3} e^{-2r/a_0} \Delta r \cdot 4\pi$

XC HW #1: Prove that $\int_0^{\infty} \frac{4r^2}{a_0^3} e^{-2r/a_0} dr = 1$
 XC HW #2: Web page #4

$\vec{L} = m \vec{r} \times \vec{v}$ Orbital Angular Momentum
 $\vec{S} [I\vec{\omega}]$ Spin
 \rightarrow all particles

$l = 0, 1, 2, \dots$
 $m_l = 0, \pm 1, \dots, \pm l$

$s = 0, \frac{1}{2}, 1, \frac{3}{2}, 2, \frac{5}{2}$
 $m_s = \pm \text{steps of } \frac{1}{2} \rightarrow \pm s$

$s=0 \quad m_s = 0$
 $\frac{1}{2} \quad m_s = \pm \frac{1}{2}$
 $1 \quad m_s = -1, 0, +1$
 $\frac{3}{2} \quad m_s = -\frac{3}{2}, -\frac{1}{2}, +\frac{1}{2}, +\frac{3}{2}$

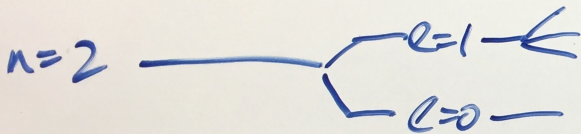
\vec{S}^2 : eigenvalue is $s(s+1)\hbar^2$
 S_z : eigenvalues are $m_s \hbar$

E_n

Relativity
+ Spin
Fine structure

Hyper
fine
structure

$n=3$ _____



$S_p = \frac{1}{2}$

$n=1$ _____

Bigger atoms?

$Z > 1$

Neutral atom $\rightarrow n_{elec} = Z$

Pauli Principle!

Spin $-\frac{1}{2}$ particles are anti social
= Fermions

H	•	$Z=1$
He	••	2
Li	•••	3
Be	••••	4
B	•••••	5
C	••••••	6
N	•••••••	7
O	••••••••	8

