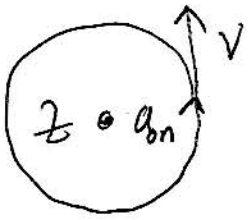
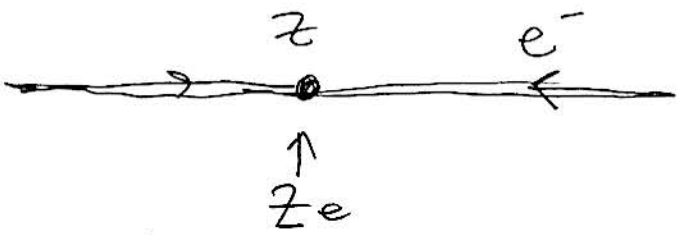
Where Bohr Picture Starts to Fail

Not all (hydrogenic) atoms have angular momentum = nħ!



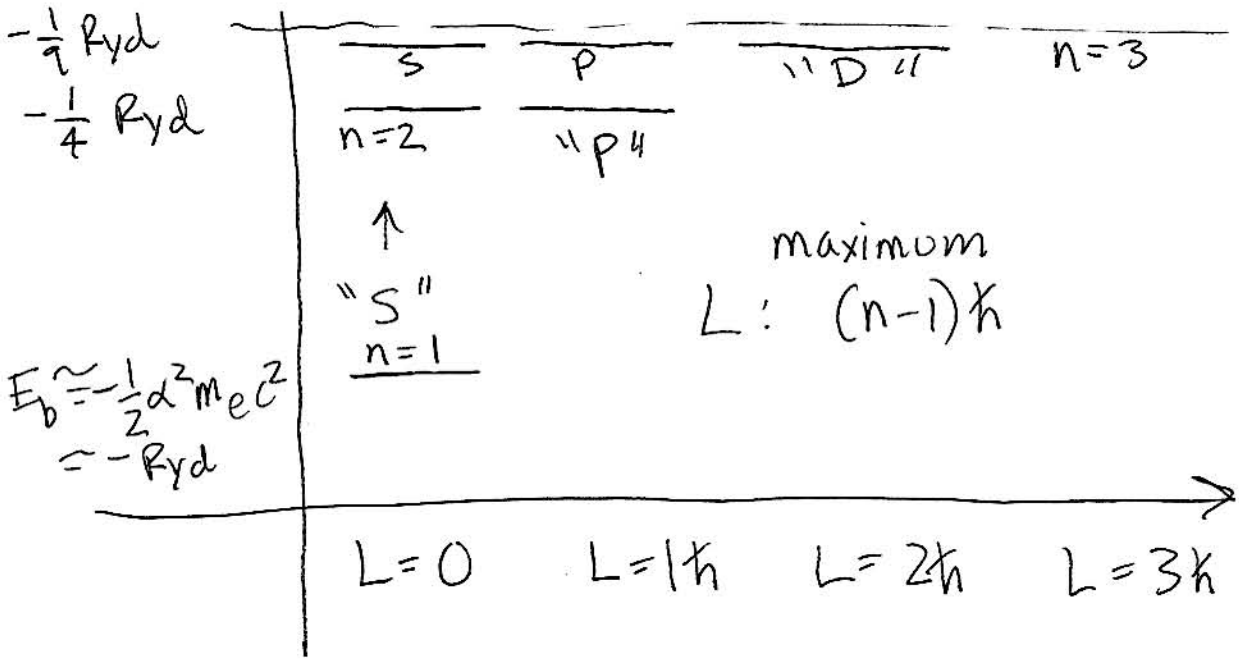
In fact, ground state (greatest binding energy) has $L = 0$!

Picture: sort of like a comet,



never "crashes"

Real Picture:

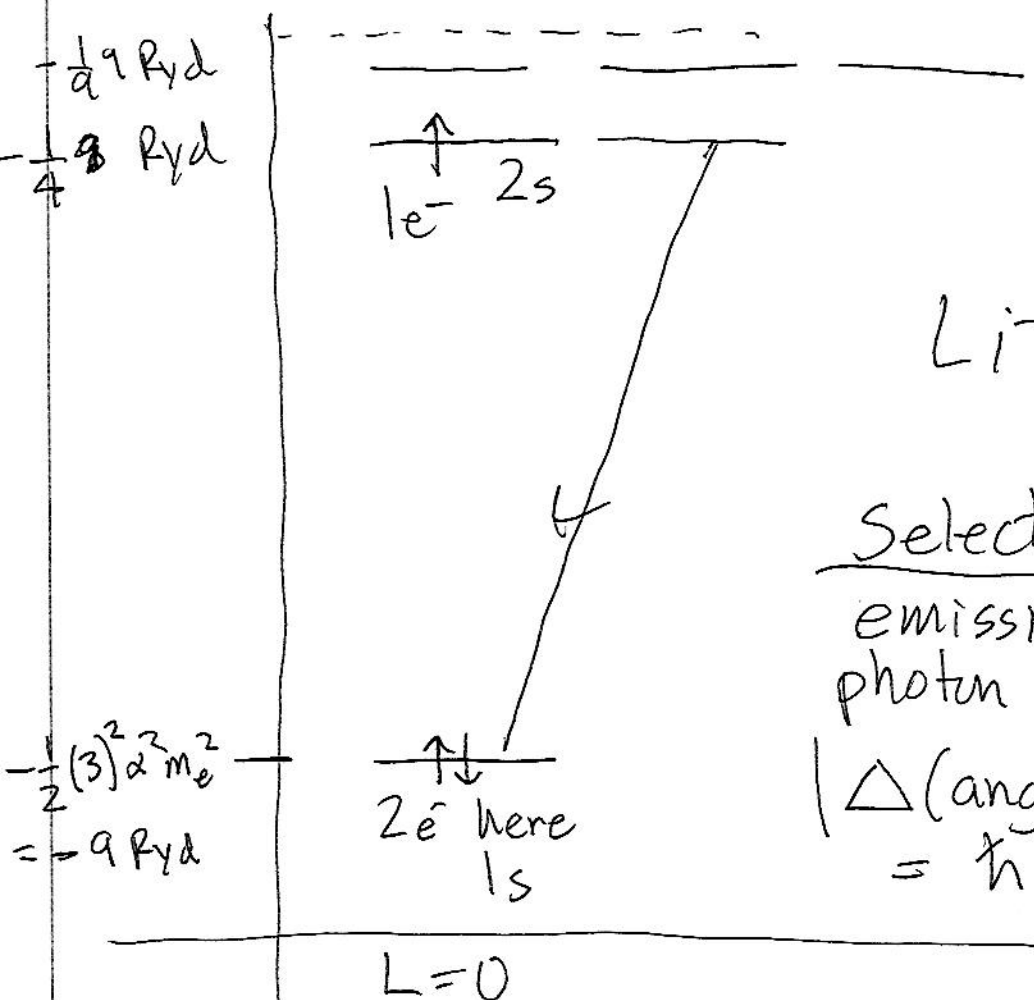


Now consider changing charge at origin: $Z = 1, 2, 3, \ldots$

$= \#$ electrons.

$\rightarrow$ 2 electrons (one spin $\uparrow$ $+\frac{\hbar}{2}$, one spin $\downarrow$ $-\frac{\hbar}{2}$) per level

$Z = 3$



Lithium.

Selection Rule

emission of 1 photon requires

$|\Delta(\text{angular momentum})| = \hbar$

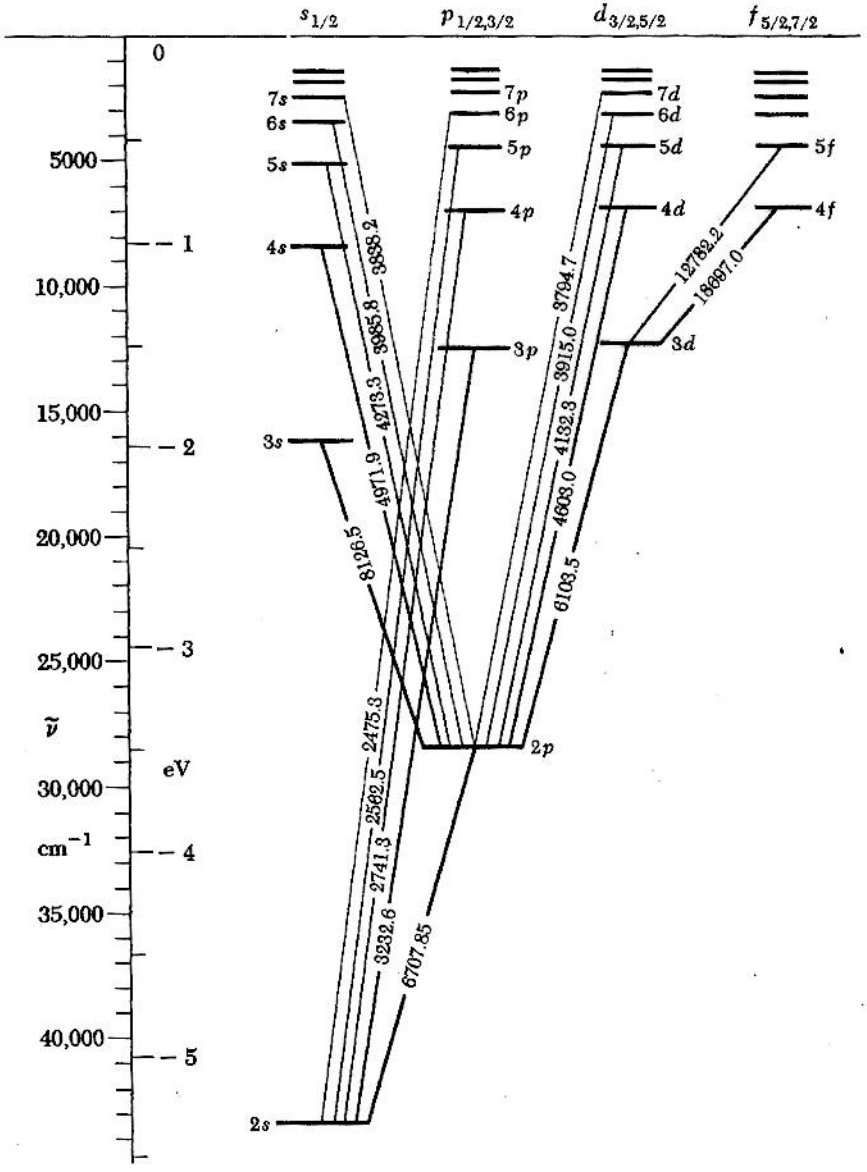
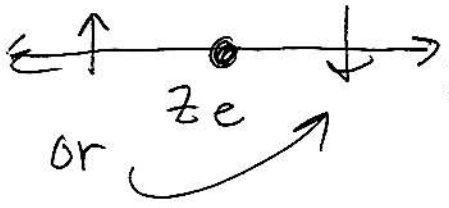


Fig. 28A Term scheme for the neutral lithium atom. The slanted lines represent observed electric dipole transitions. The numbers on these lines are the wavelengths in Ångströms. For other details, see the explanation in the text. Based on a figure in W. Grotrian, *Graphische Darstellung der Spektren von Atomen. . .*, vol. II, p. 15 (Verlag von Julius Springer, Berlin, 1928).

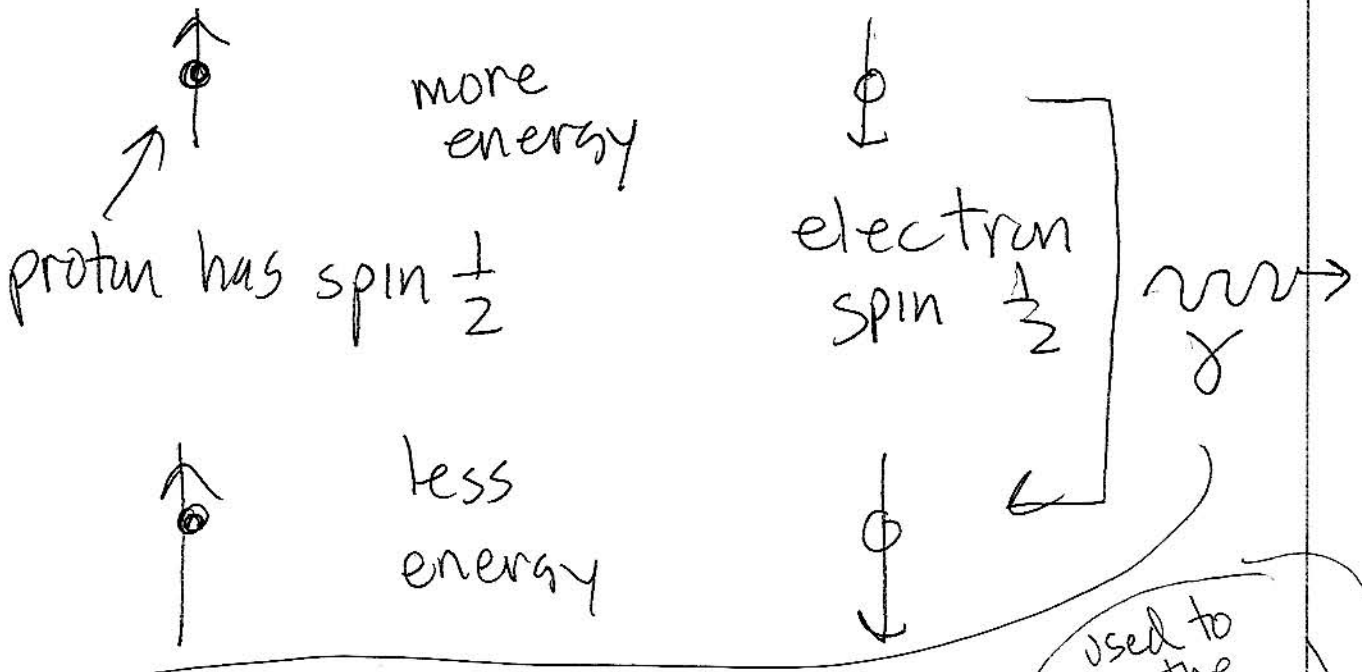
We have drawn our term schemes in the form in which the reader will find them in the literature. The drawing of such schemes, and the labeling of the different energy levels, is governed by a number of conventions of long standing. For greater realism we wanted to adhere to these conventions, even if we cannot here explain every detail of the drawings. The reader may want to object that we should not show *anything* in the diagrams that we

Complication: electron like a spinning top

so:



ground state of hydrogen



used to map the Galaxy

$\lambda_\gamma = 21$ cm

$\nu = \frac{c}{\lambda} = \frac{3 \cdot 10^{10}}{2 \cdot 10} = 1.5 \cdot 10^9$

$= 1.5$ GHz

cell phone range → penetrating