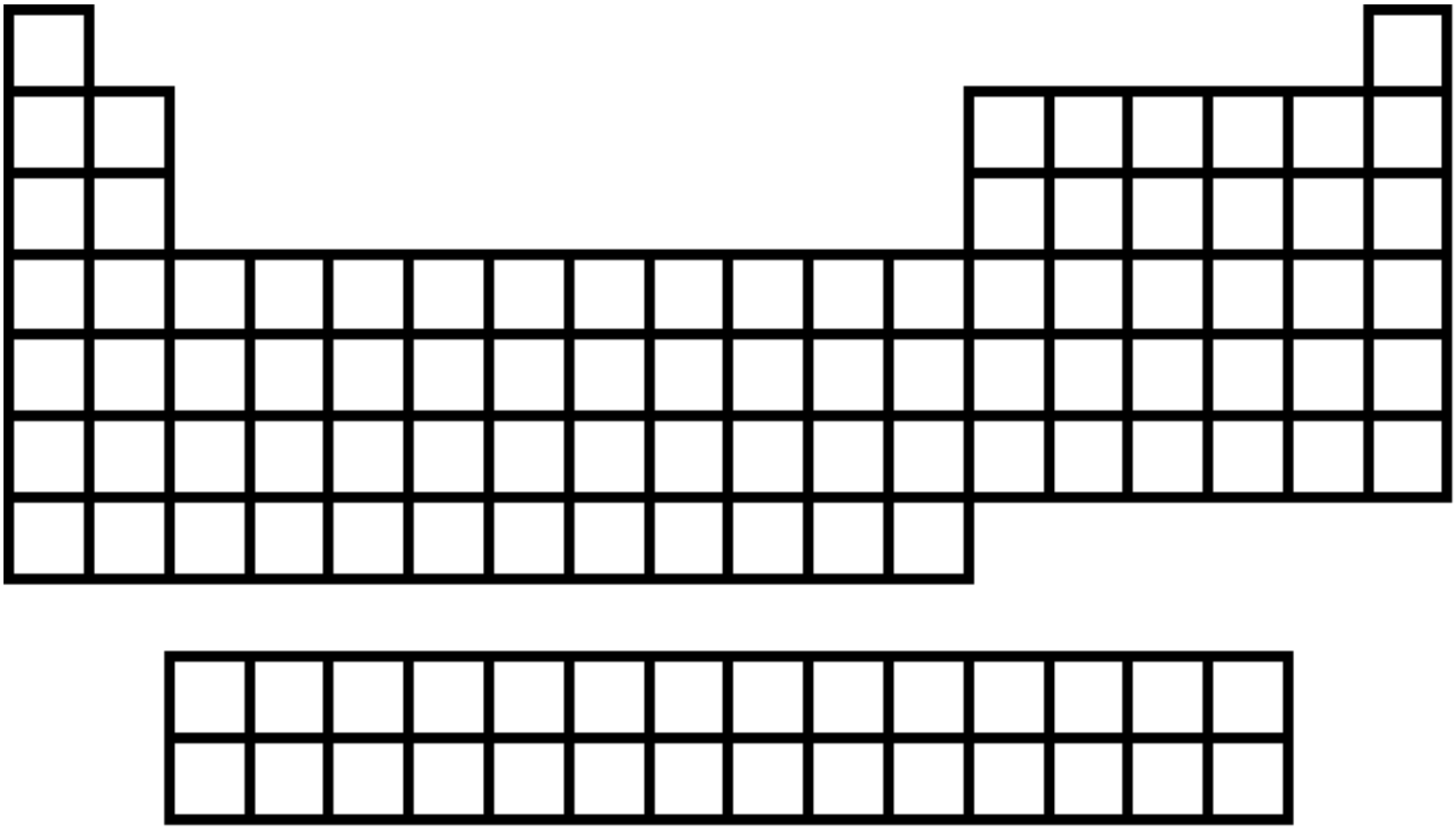
One Electron Multi-Level Atoms

Electronic structure of Alkali elements

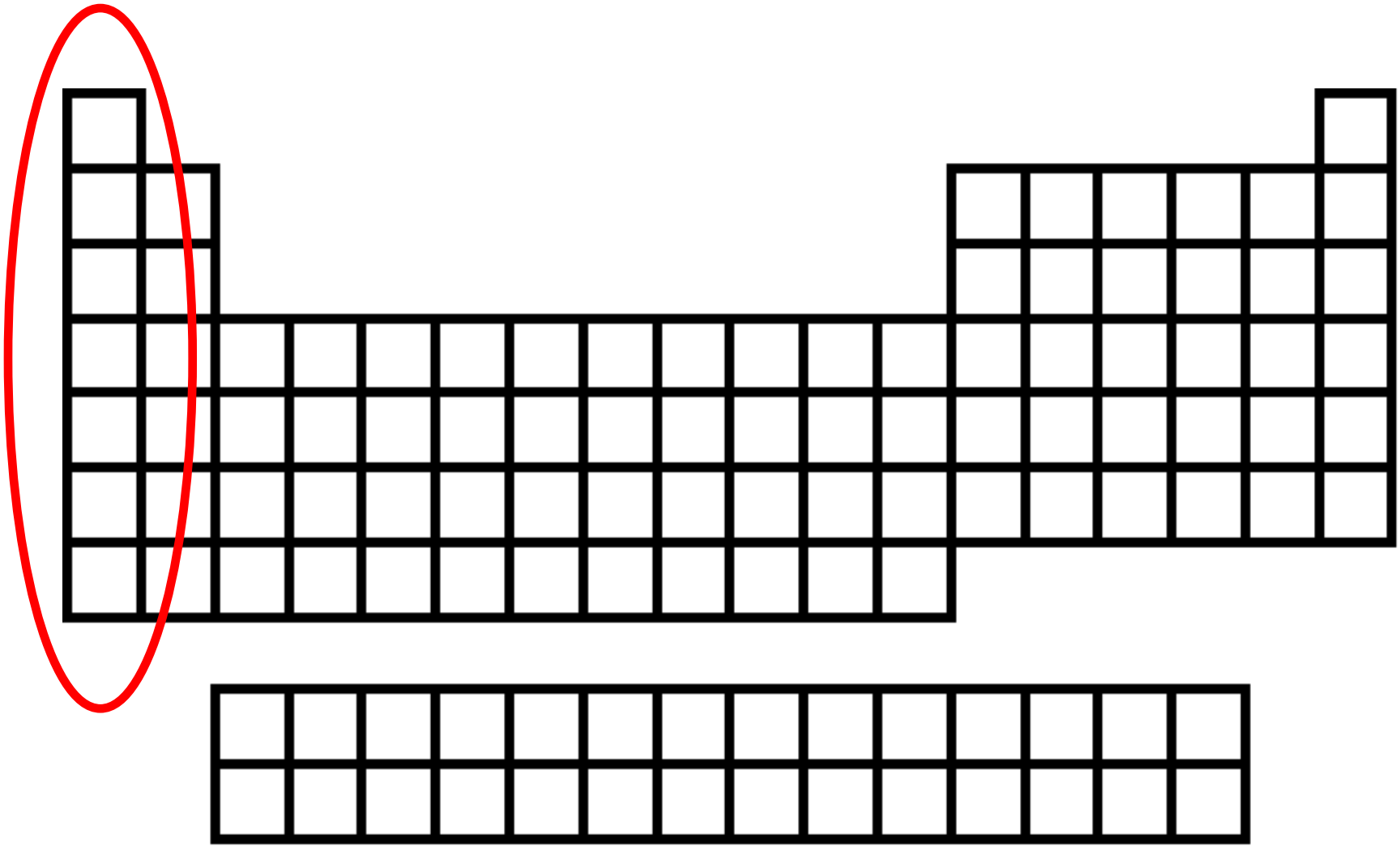
Outline

1. Basic structure
2. Fine structure
3. Hyperfine Structure
4. Zeeman splittings in a DC magnetic field.
5. Selection for rules for E-M transitions.

The Alkali Elements



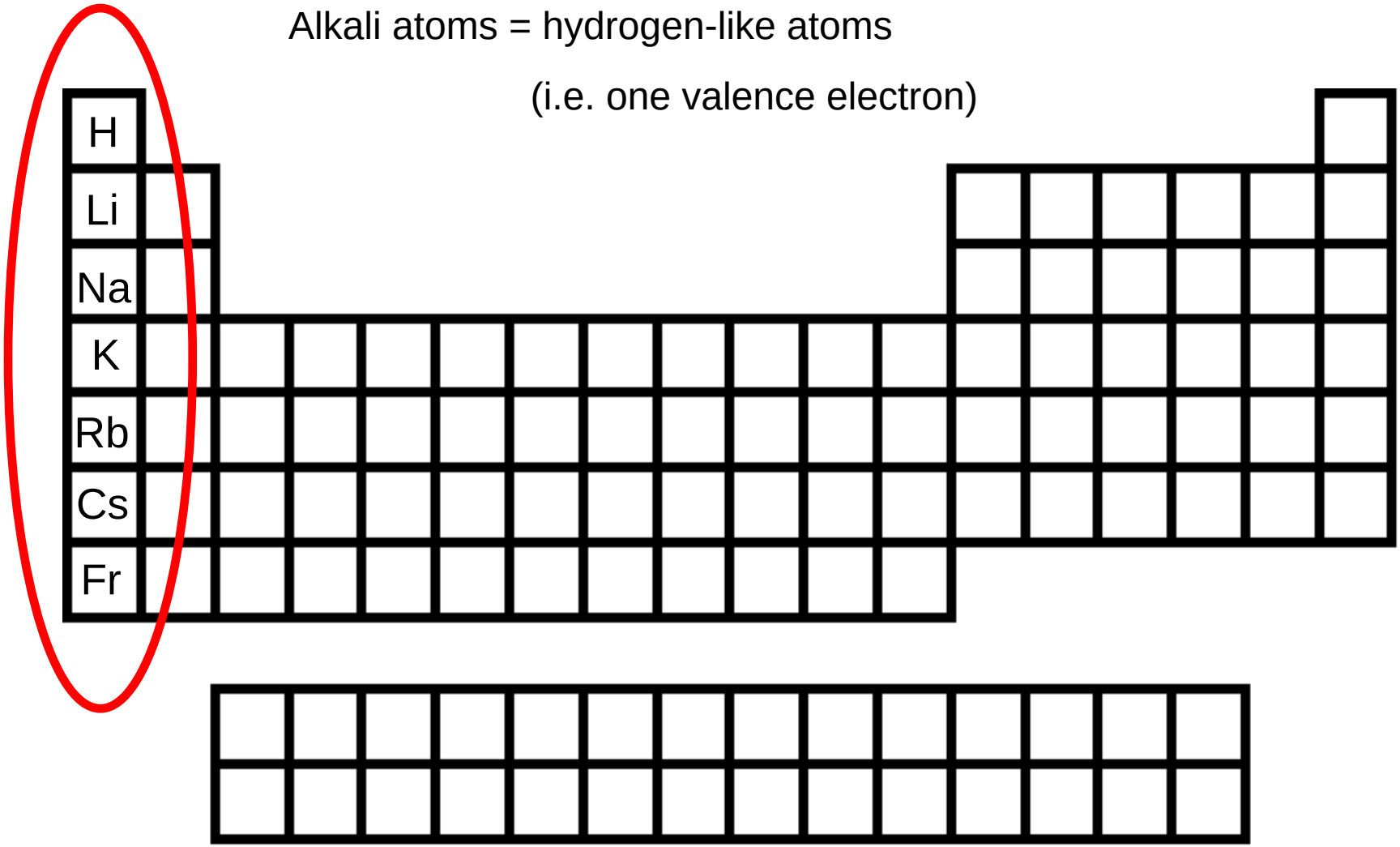
The Alkali Elements



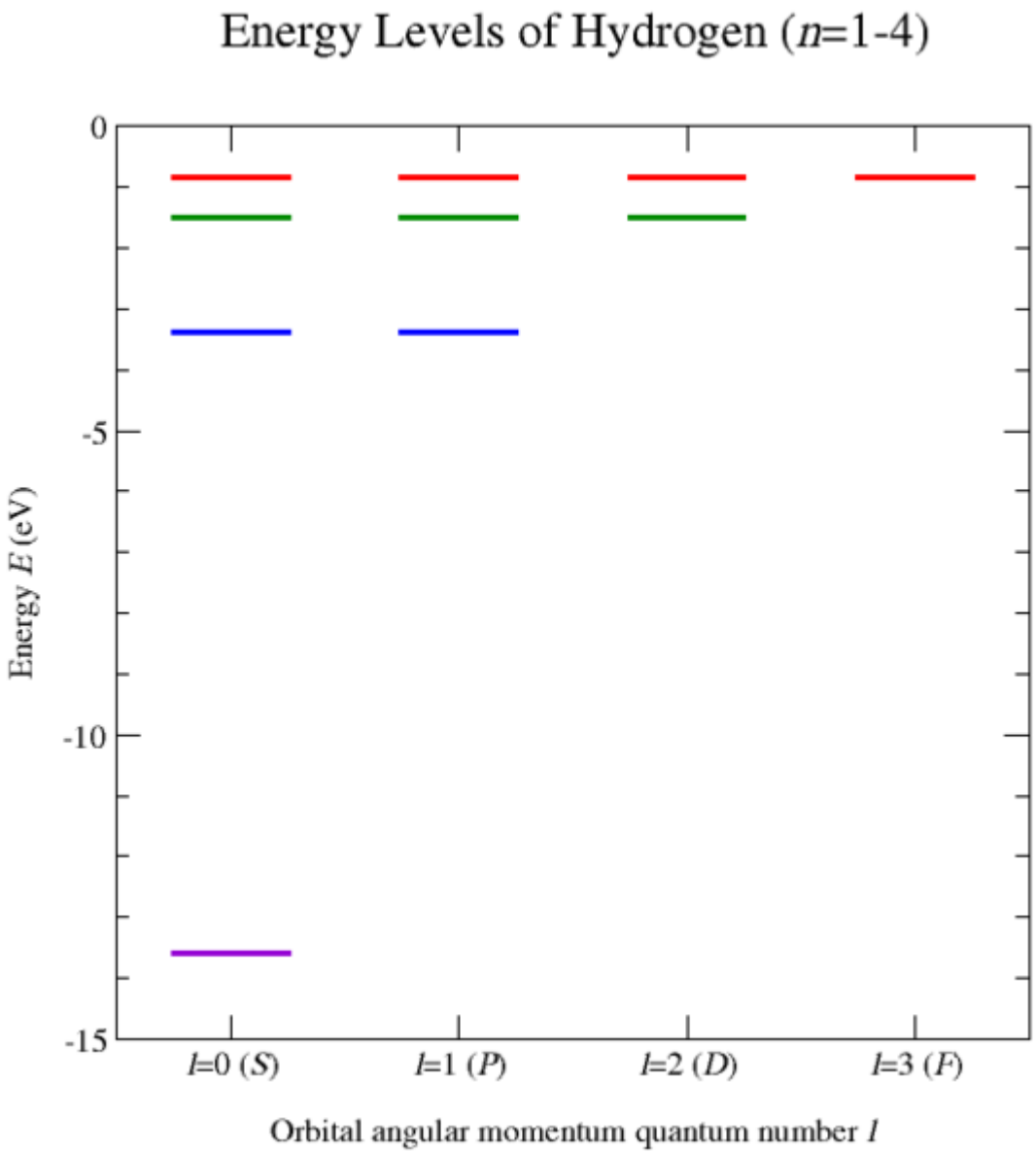
The Alkali Elements

Alkali atoms = hydrogen-like atoms

(i.e. one valence electron)



Basic Energy Levels



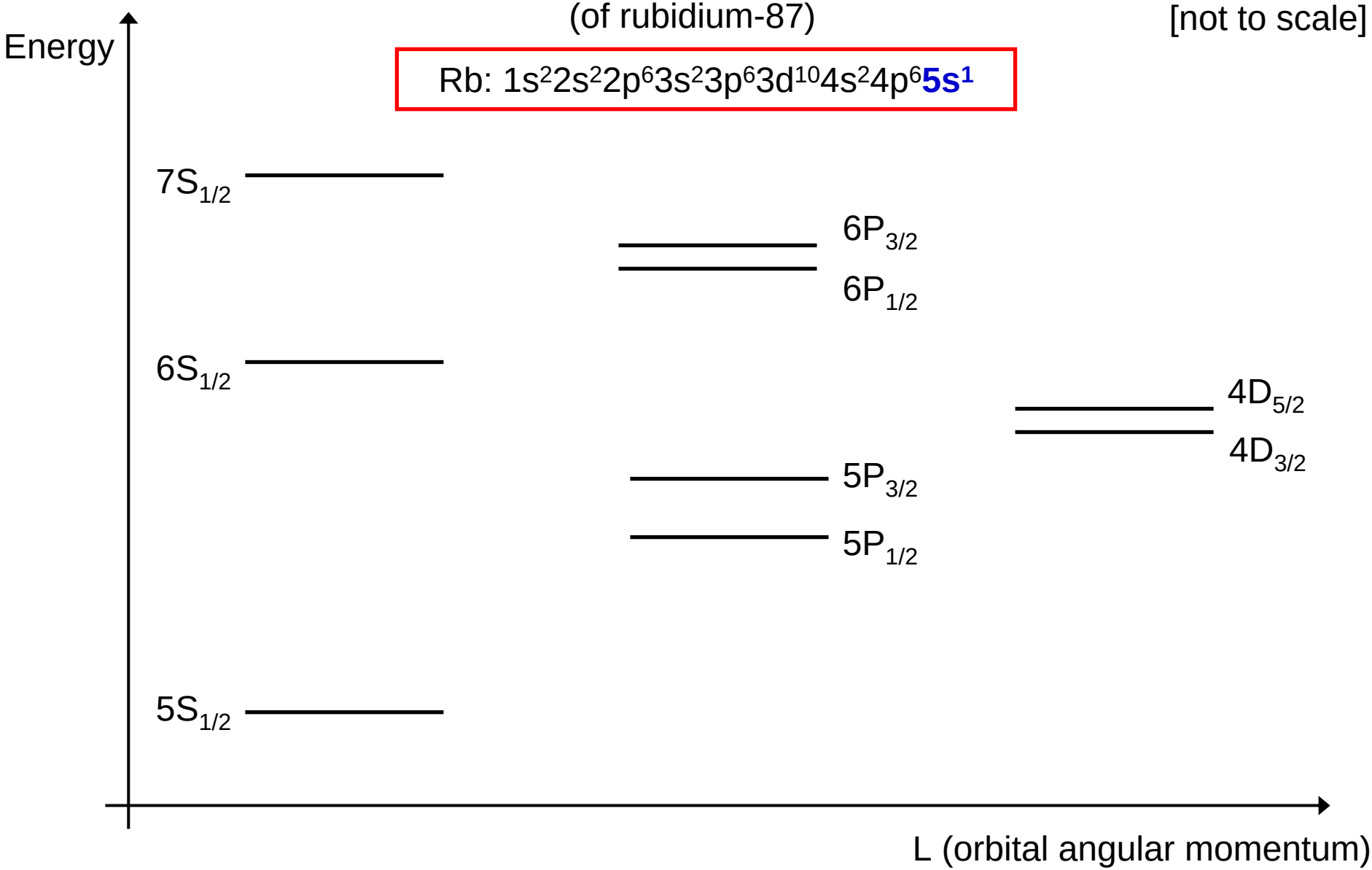
[Figure from wikimedia.org]

Fine Structure

(of rubidium-87)

[not to scale]

Rb: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 \mathbf{5s^1}$



Fine Structure: Notation

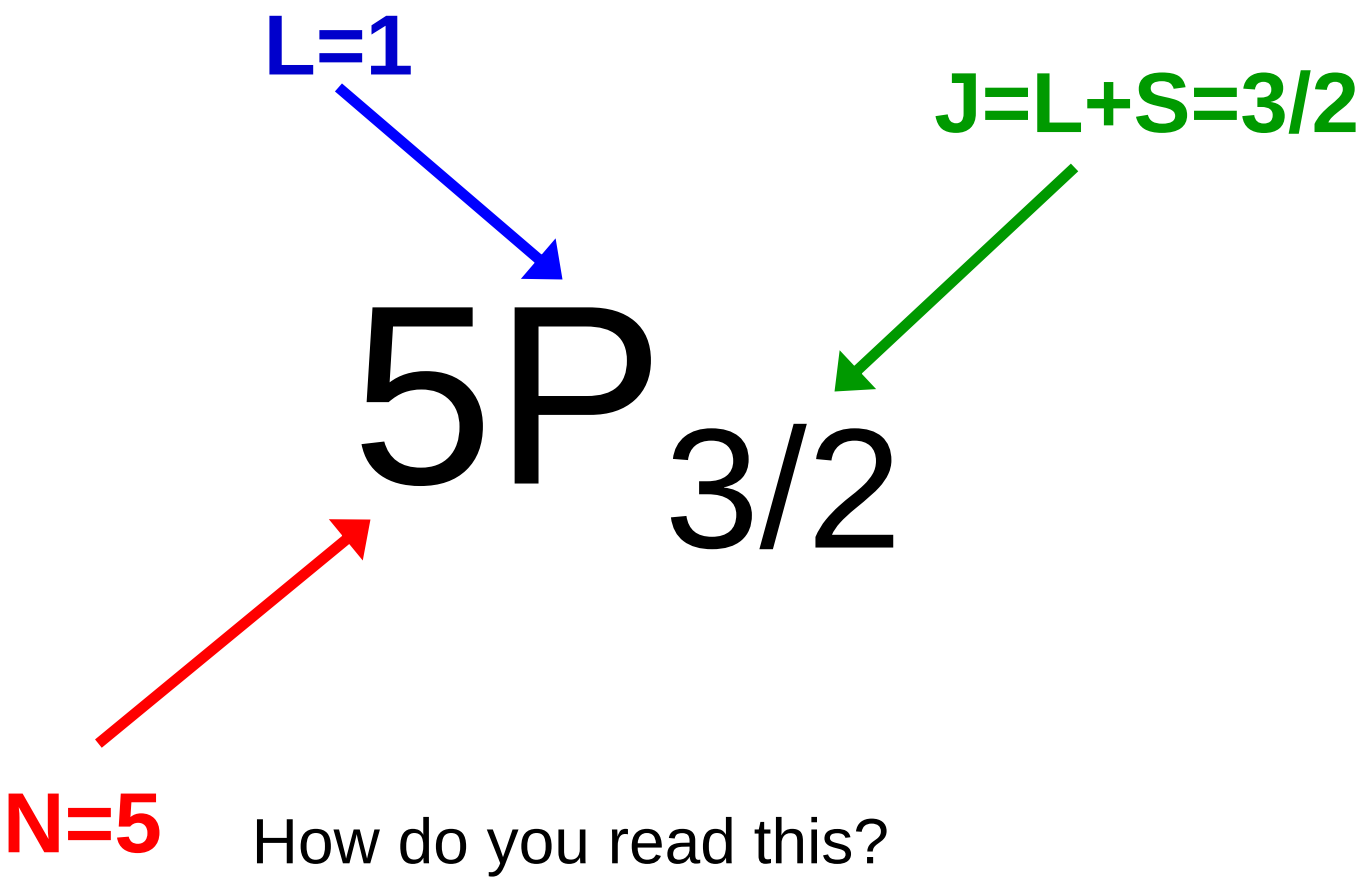
[Russell-Saunders notation]

$$5P_{3/2}$$

How do you read this?

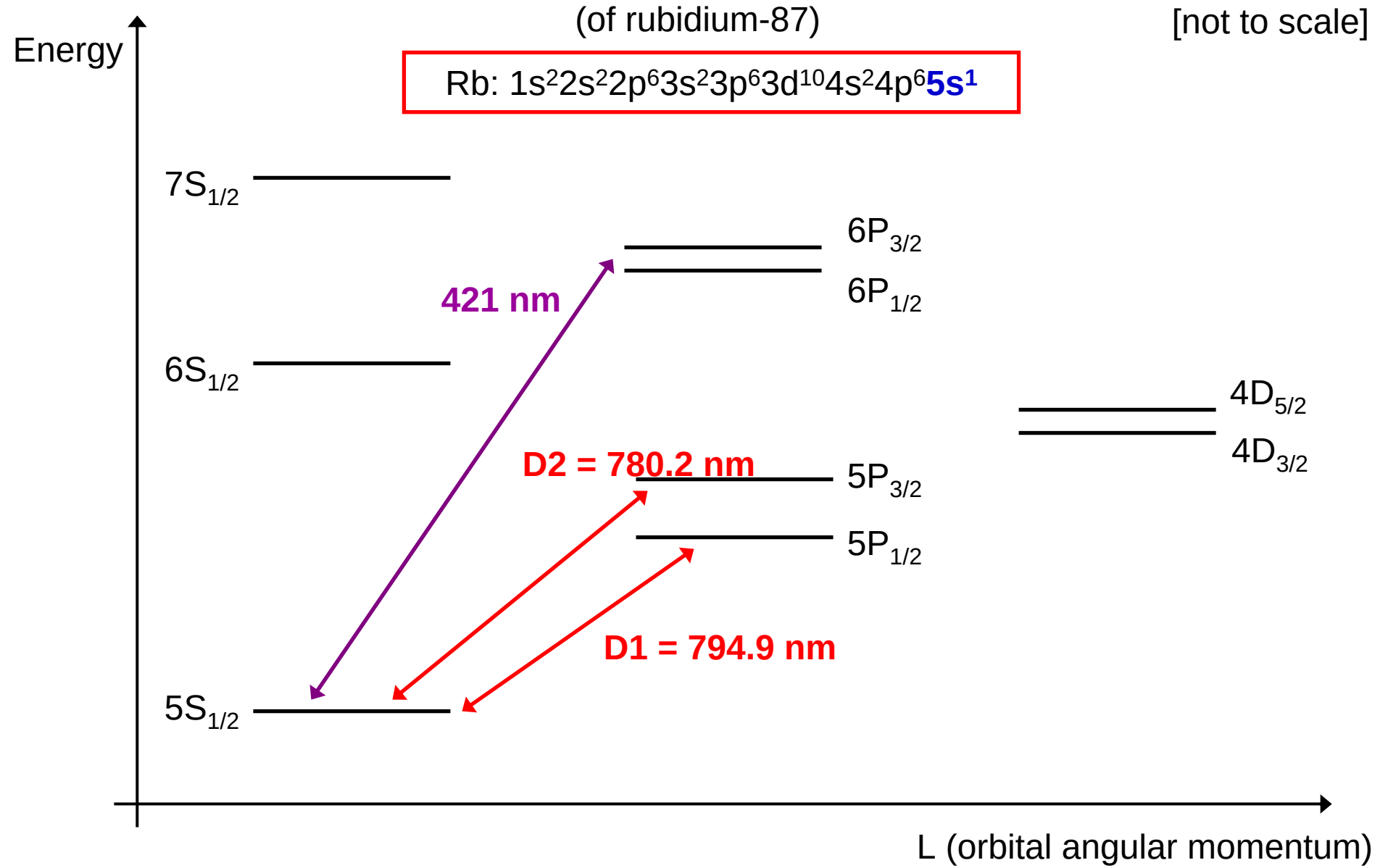
Fine Structure: Notation

[Russell-Saunders notation]



How do you read this?

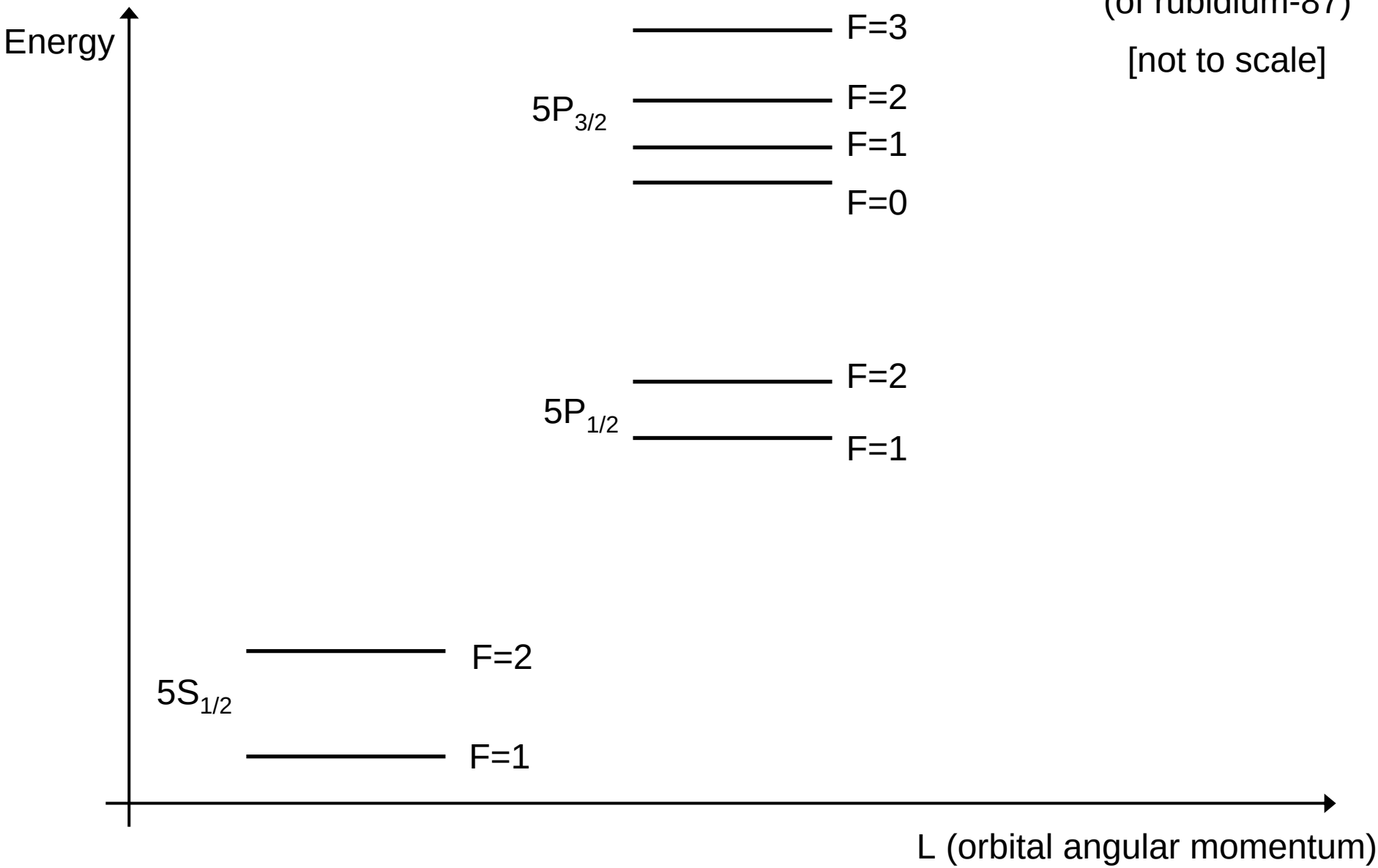
Fine Structure



Hyperfine Structure

(of rubidium-87)

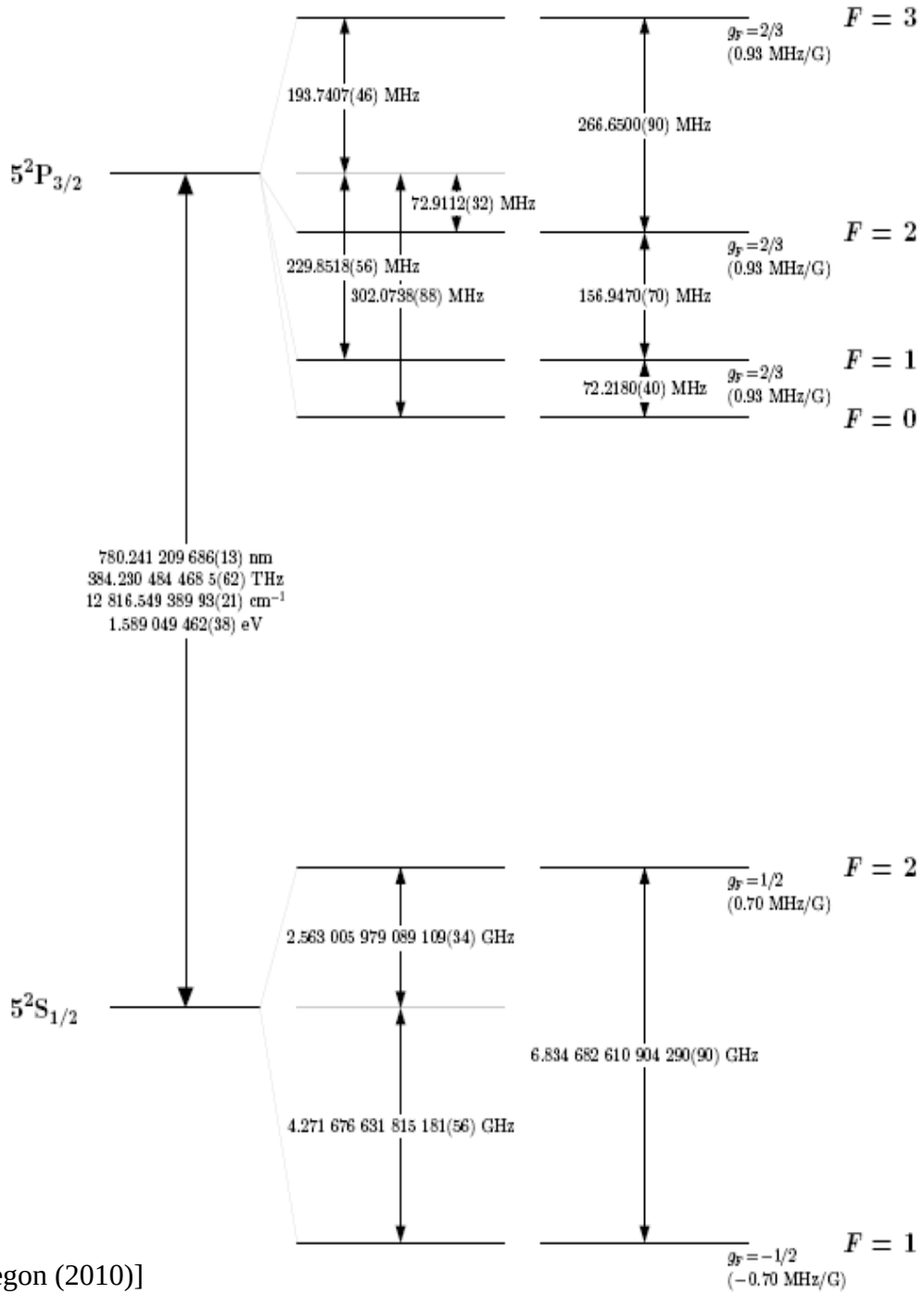
[not to scale]



Rubidium-87:

D2 line

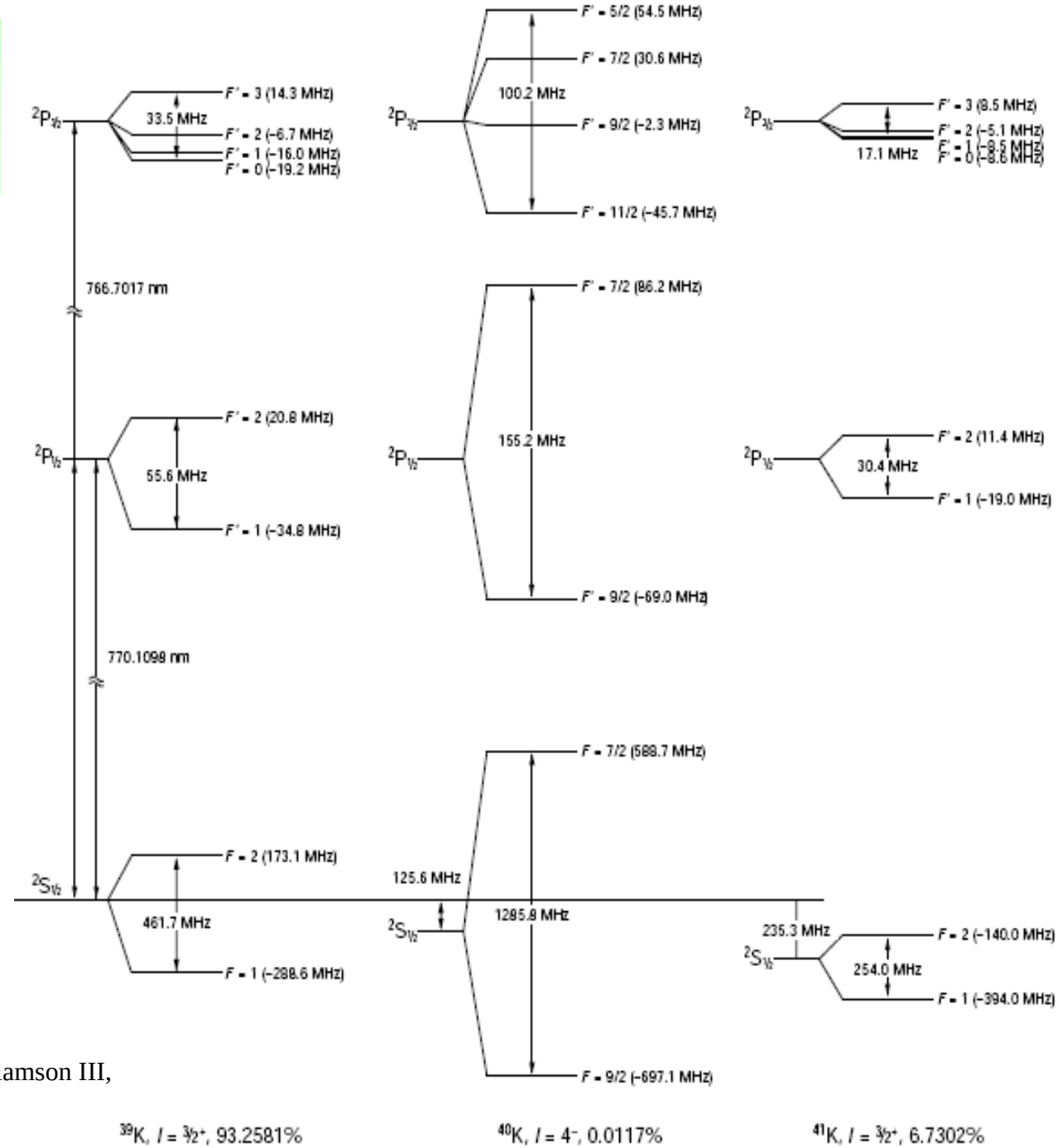
Nuclear Spin:
I=3/2



[Figure adapted from steck.us by Prof. Dan Steck, U. of Oregon (2010)]

Potassium:

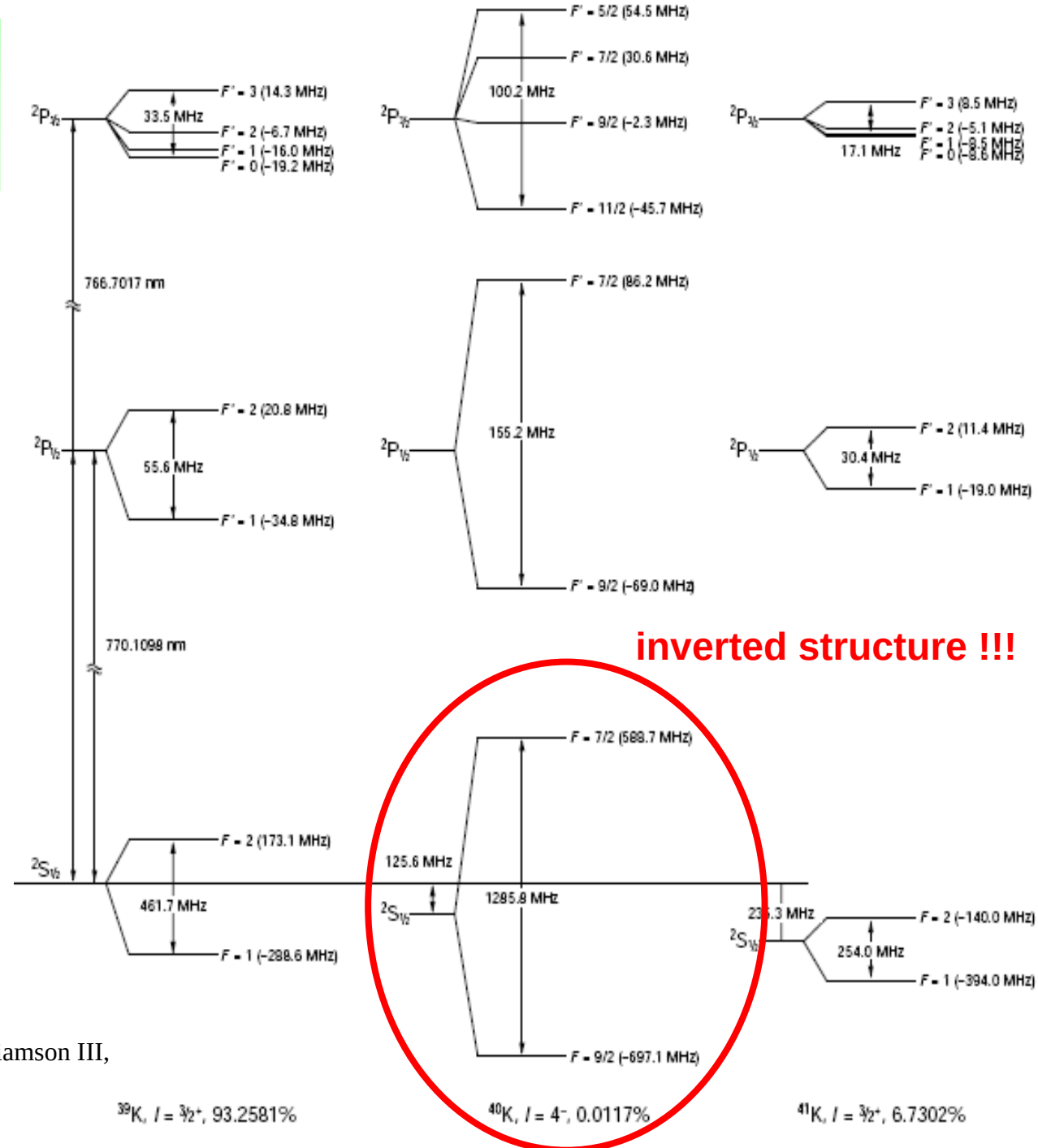
D1 and D2 lines



[Figure adapted from PhD Thesis of R. Williamson III,
U. of Wisconsin-Madison (1997)]

Potassium:

D1 and D2 lines



[Figure adapted from PhD Thesis of R. Williamson III,
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Zeeman Sub-Structure

[^{87}Rb, ^{39}K, ^{41}K]