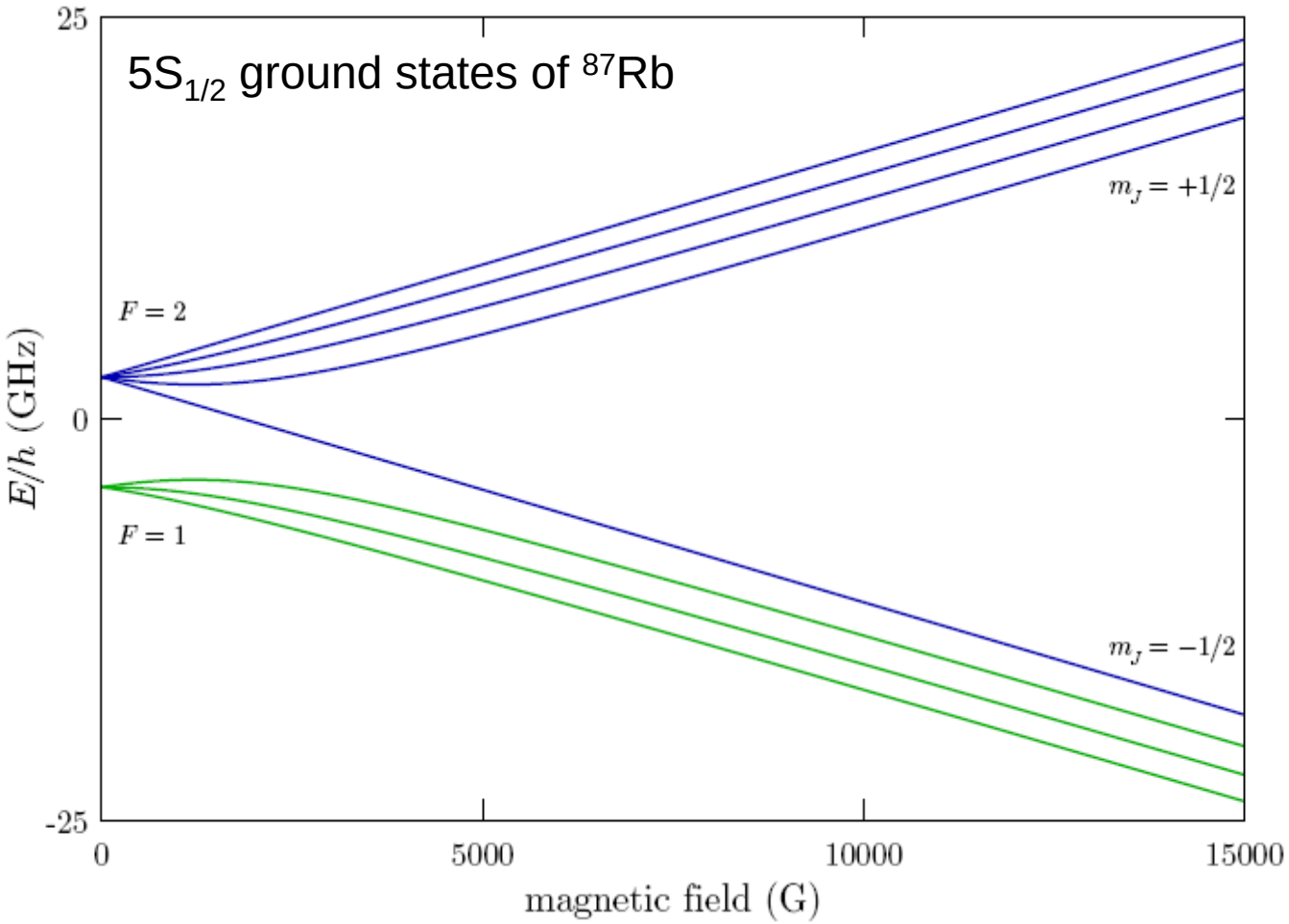
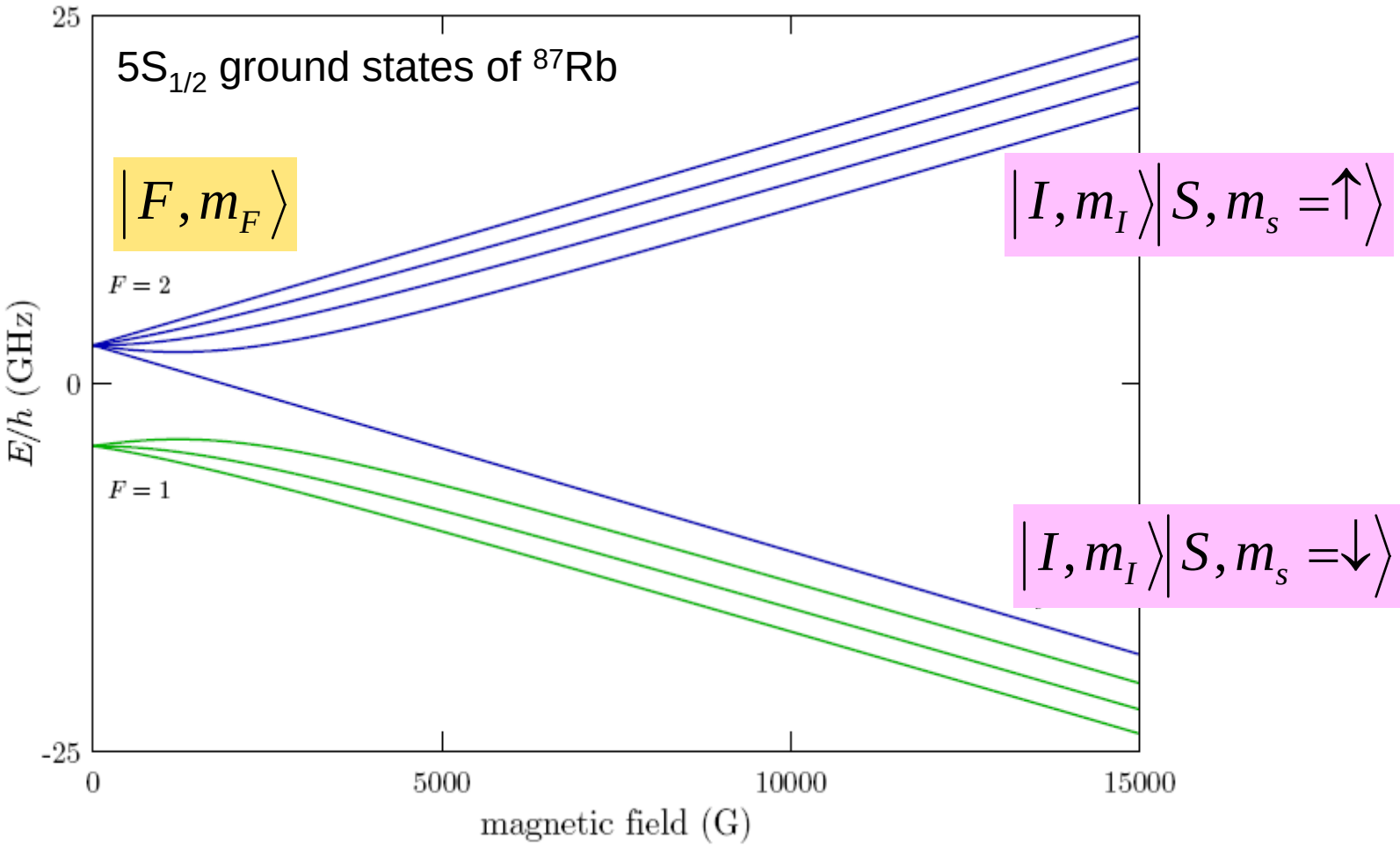
Zeeman Sub-Structure



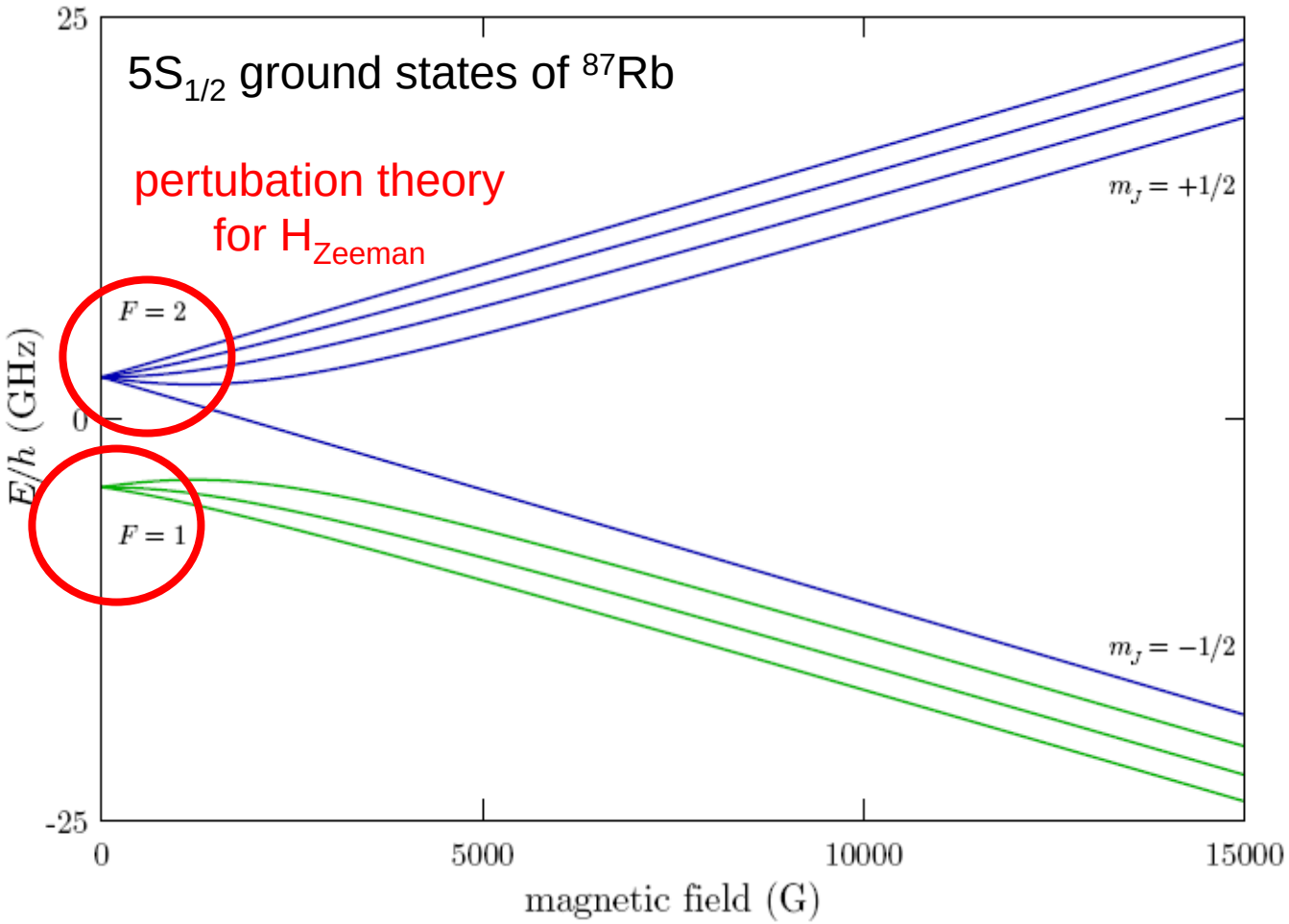
[Figure adapted from steck.us by Prof. Dan Steck, U. of Oregon (2010)]

Zeeman Sub-Structure



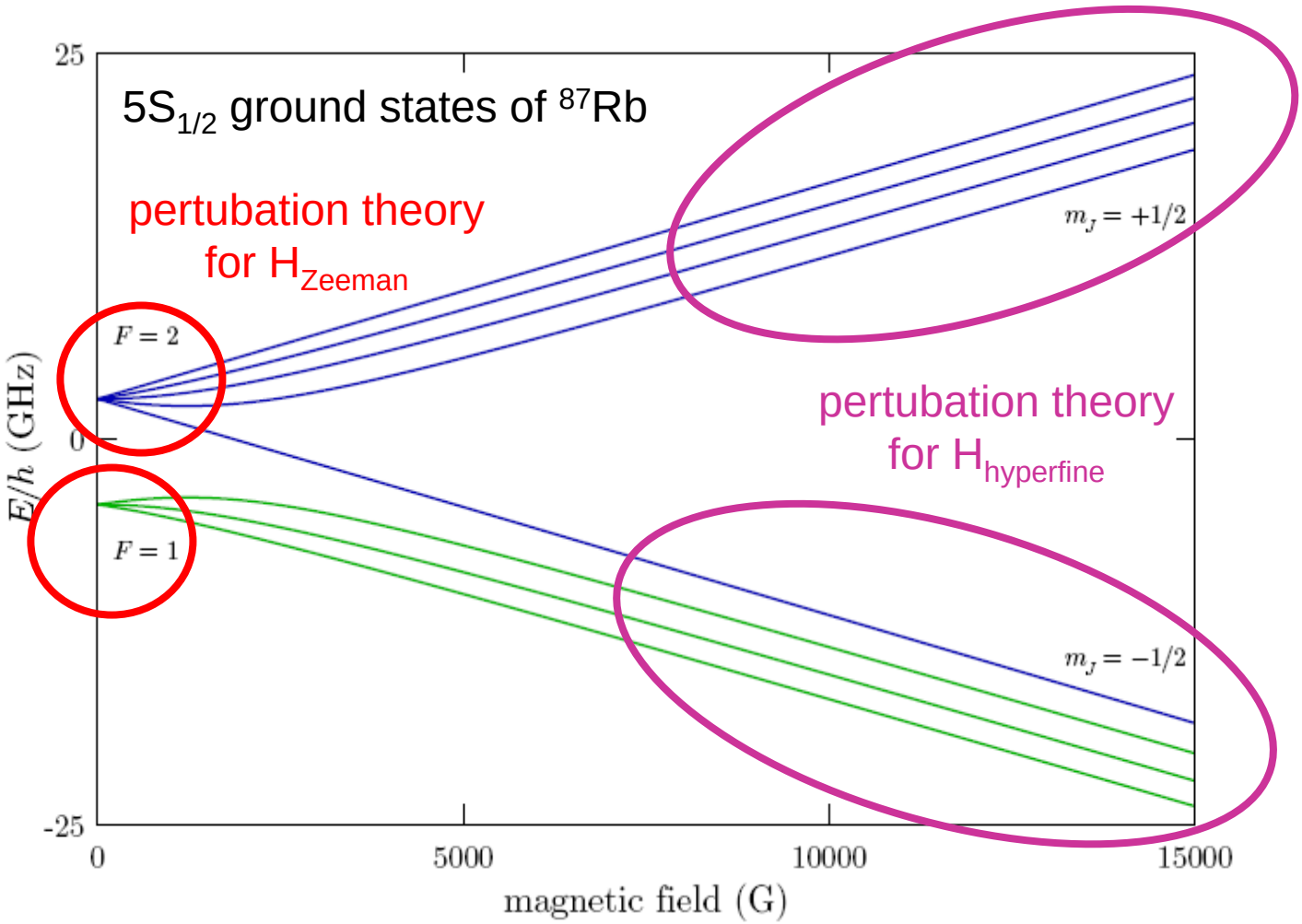
[Figure adapted from steck.us by Prof. Dan Steck, U. of Oregon (2010)]

Zeeman Sub-Structure



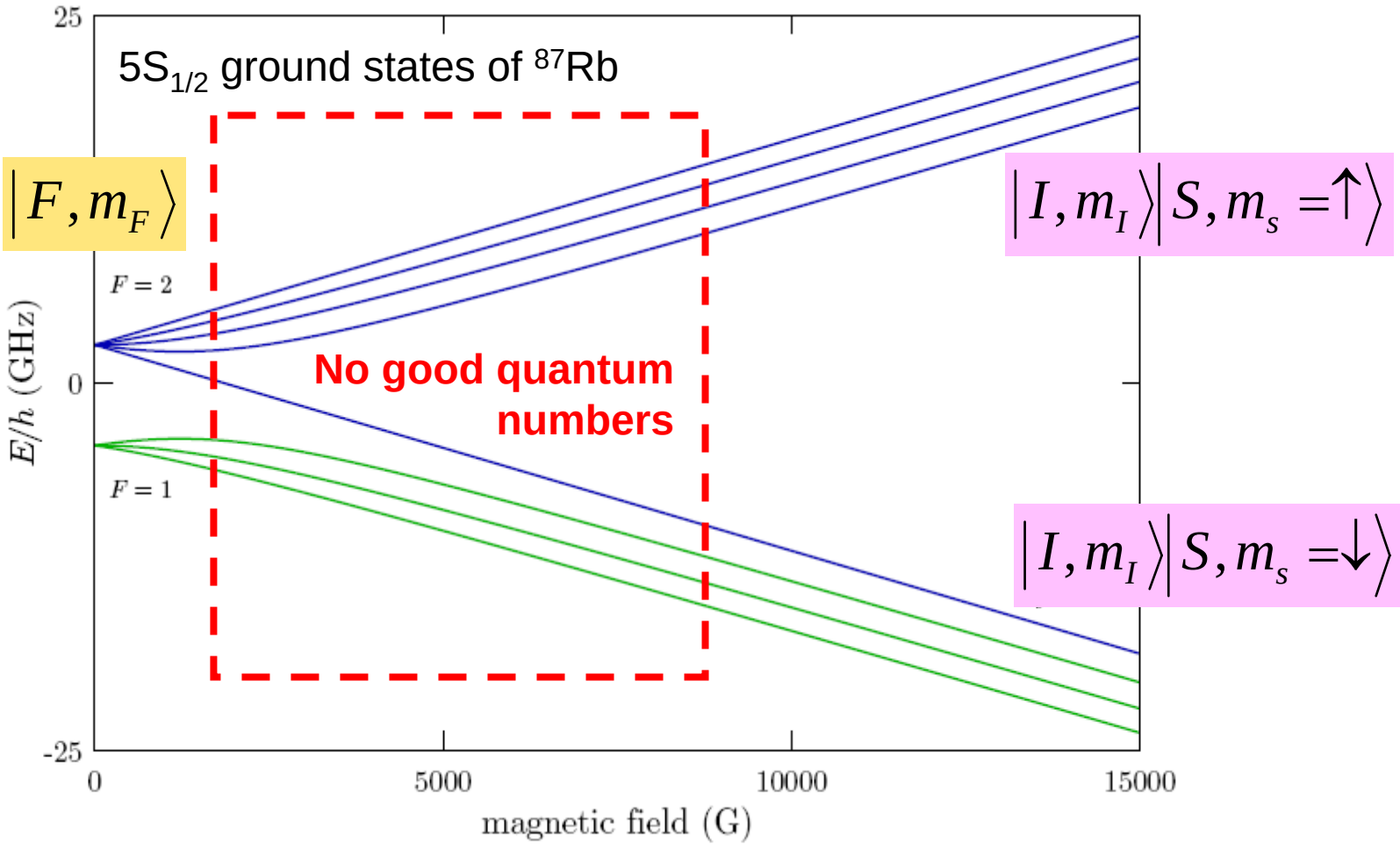
[Figure adapted from steck.us by Prof. Dan Steck, U. of Oregon (2010)]

Zeeman Sub-Structure



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

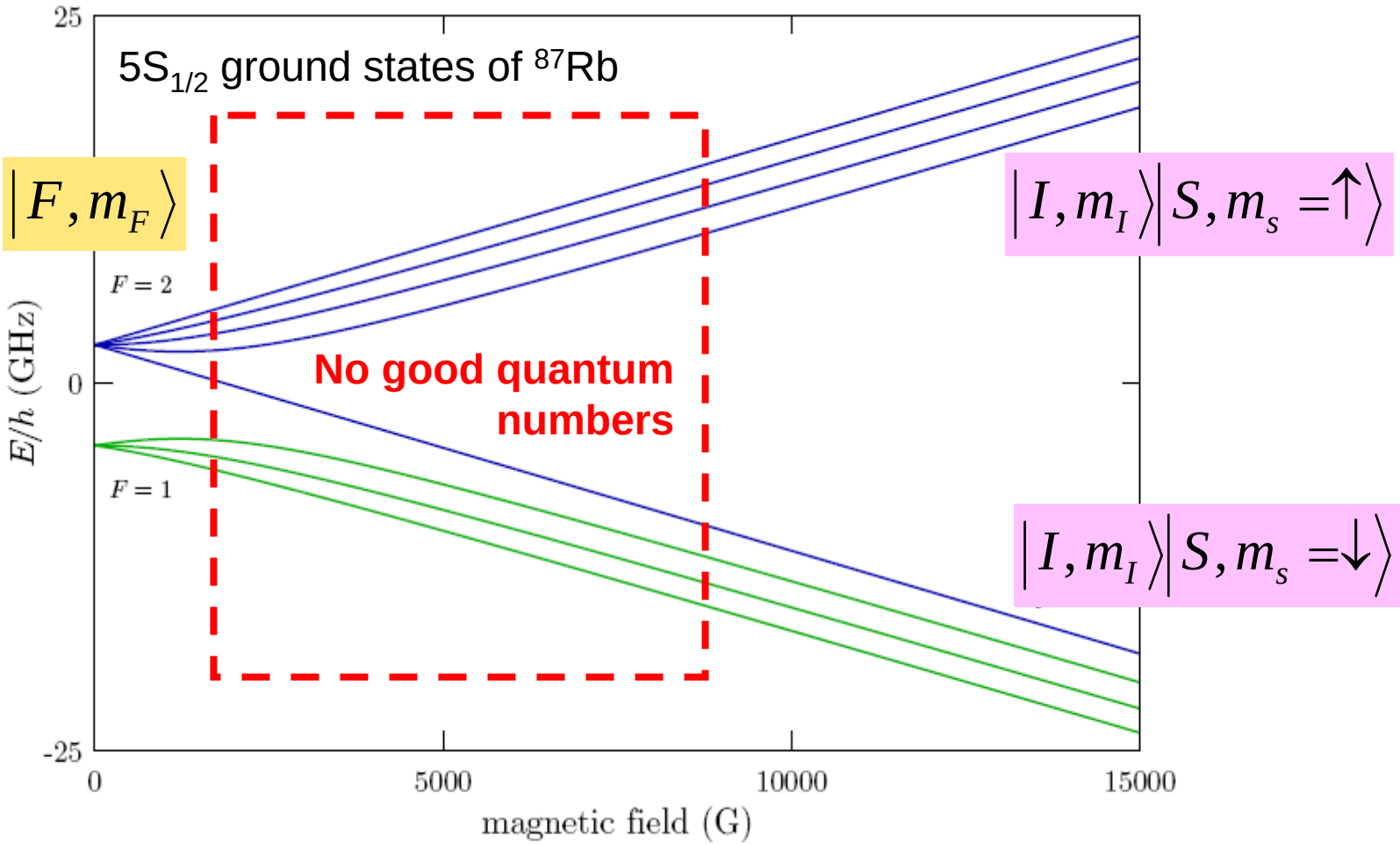
Zeeman Sub-Structure



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

Zeeman Sub-Structure

How do you calculate this entire plot?



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

Breit-Rabi Formula

The Breit-Rabi formula for the Zeeman shift of atomic ground states is given by:

$$U(m_F, B) = g_I \mu_B m_F B + \frac{E_{hfs}}{2}(\pm(1 + \frac{4m_F x}{2I+1} + x^2)^{1/2} - \frac{1}{2I+1}),$$

where the $\pm$ is used for the $F = I \pm J$ state, respectively, and

$$x \equiv \frac{(g_J - g_I)\mu_B B}{E_{hfs}}.$$

PhD Thesis of J. Obrecht, U. of Colorado (2007)]

Clebsch-Gordan Decomposition for $nS_{1/2}$ states

$$\left|F_+ = I + S, m_F\right\rangle =$$

$$\frac{\sqrt{F_+ + m_F}}{\sqrt{2I+1}}\left|m_I = m_F - 1/2\right\rangle\left|\uparrow\right\rangle + \frac{\sqrt{F_+ - m_F}}{\sqrt{2I+1}}\left|m_I = m_F + 1/2\right\rangle\left|\downarrow\right\rangle$$

$$\left|F_- = I - S, m_F\right\rangle =$$

$$-\frac{\sqrt{F_+ - m_F}}{\sqrt{2I+1}}\left|m_I = m_F - 1/2\right\rangle\left|\uparrow\right\rangle + \frac{\sqrt{F_+ + m_F}}{\sqrt{2I+1}}\left|m_I = m_F + 1/2\right\rangle\left|\downarrow\right\rangle$$