

Clebsch-Gordan Coefficients: $I=3/2, S=1/2$

$F=2$ with $I=3/2, S=1/2$

$$|F = 2, m_F = +2\rangle = |I = 3/2, m_I = +3/2\rangle|\uparrow\rangle$$

$$|F = 2, m_F = +1\rangle = \frac{1}{2}|m_I = +3/2\rangle|\downarrow\rangle + \frac{\sqrt{3}}{2}|m_I = +1/2\rangle|\uparrow\rangle$$

$$|F = 2, m_F = 0\rangle = \frac{1}{\sqrt{2}}|m_I = +1/2\rangle|\downarrow\rangle + \frac{1}{\sqrt{2}}|m_I = -1/2\rangle|\uparrow\rangle$$

$$|F = 2, m_F = -1\rangle = \frac{1}{2}|m_I = -3/2\rangle|\uparrow\rangle + \frac{\sqrt{3}}{2}|m_I = -1/2\rangle|\downarrow\rangle$$

$$|F = 2, m_F = -2\rangle = |m_I = -3/2\rangle|\downarrow\rangle$$

Clebsch-Gordan Coefficients: $I=3/2, S=1/2$

$F=1$ with $I=3/2, S=1/2$

$$|F=1, m_F=+1\rangle = \frac{\sqrt{3}}{2} |m_I=+3/2\rangle |\downarrow\rangle - \frac{1}{2} |m_I=+1/2\rangle |\uparrow\rangle$$

$$|F=1, m_F=0\rangle = \frac{1}{\sqrt{2}} |m_I=+1/2\rangle |\downarrow\rangle - \frac{1}{\sqrt{2}} |m_I=-1/2\rangle |\uparrow\rangle$$

$$|F=2, m_F=-1\rangle = -\frac{\sqrt{3}}{2} |m_I=-3/2\rangle |\uparrow\rangle + \frac{1}{2} |m_I=-1/2\rangle |\downarrow\rangle$$

General Formula...

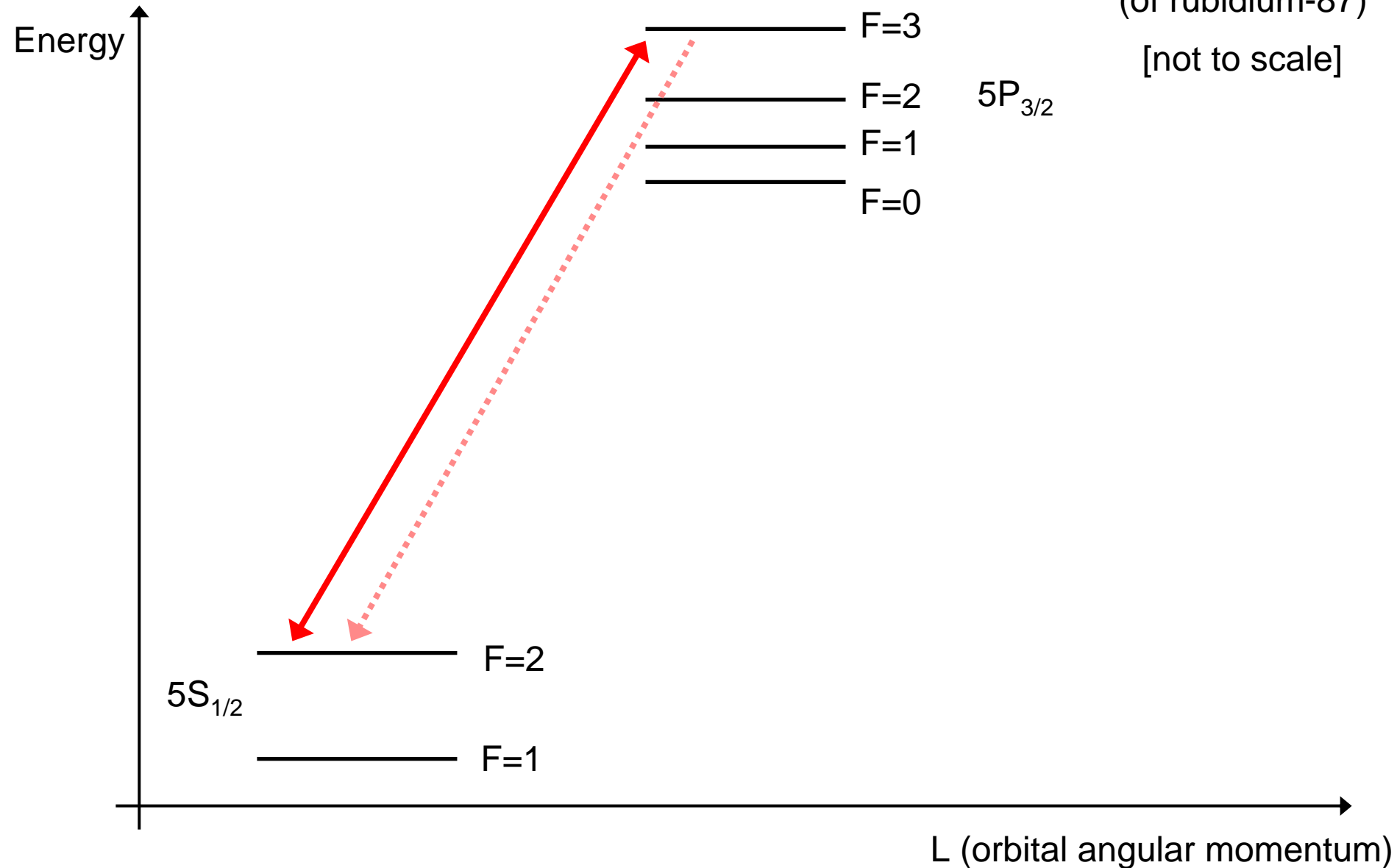
$$\begin{aligned} |F_+ = I + S, m_F\rangle = \\ \frac{\sqrt{F_+ + m_F}}{\sqrt{2I + 1}} |m_I = m_F - 1/2\rangle |\uparrow\rangle + \frac{\sqrt{F_+ - m_F}}{\sqrt{2I + 1}} |m_I = m_F + 1/2\rangle |\downarrow\rangle \end{aligned}$$

$$\begin{aligned} |F_- = I - S, m_F\rangle = \\ -\frac{\sqrt{F_+ - m_F}}{\sqrt{2I + 1}} |m_I = m_F - 1/2\rangle |\uparrow\rangle + \frac{\sqrt{F_+ + m_F}}{\sqrt{2I + 1}} |m_I = m_F + 1/2\rangle |\downarrow\rangle \end{aligned}$$

Why are Alkalis “2-level atoms” ?

(of rubidium-87)

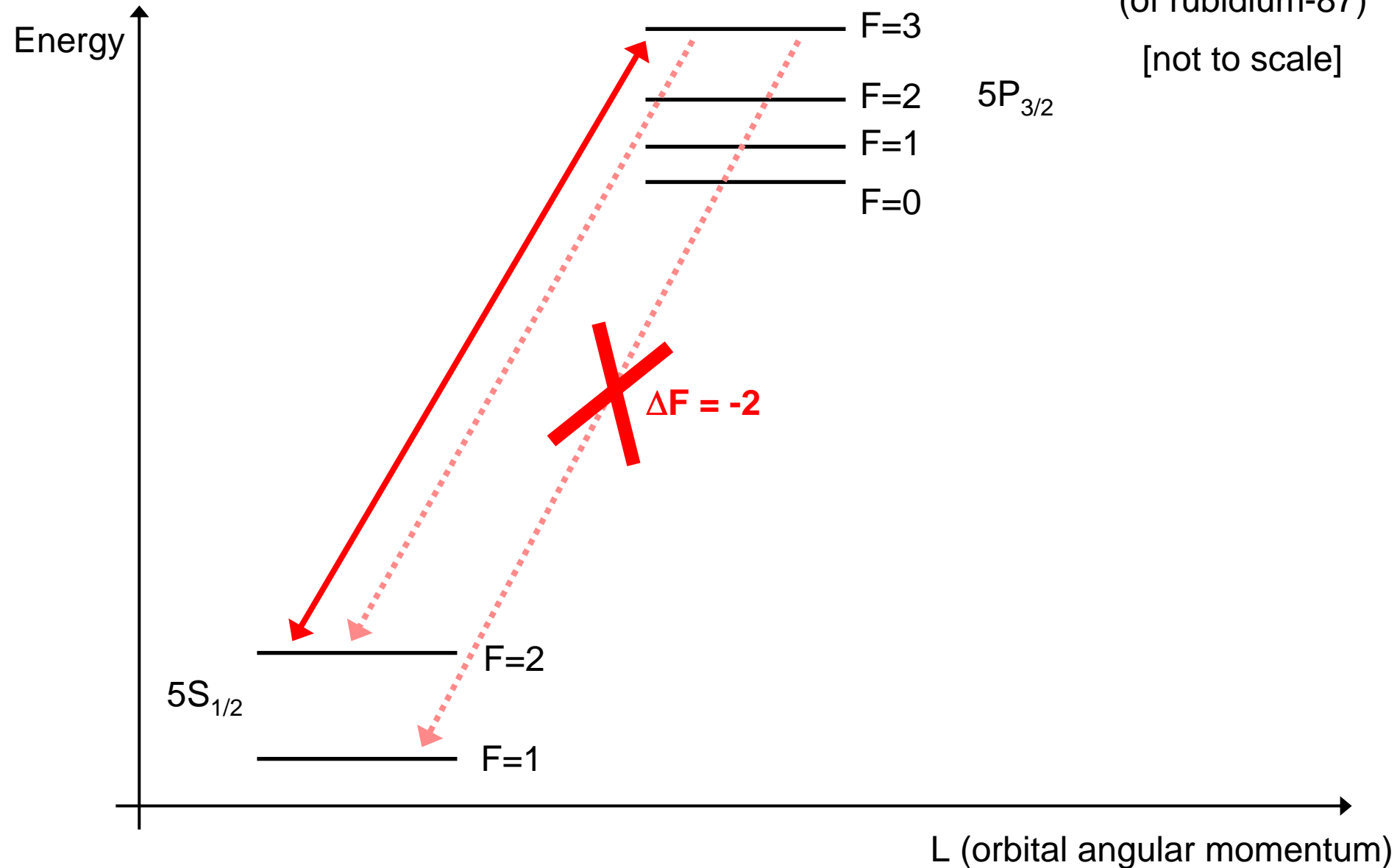
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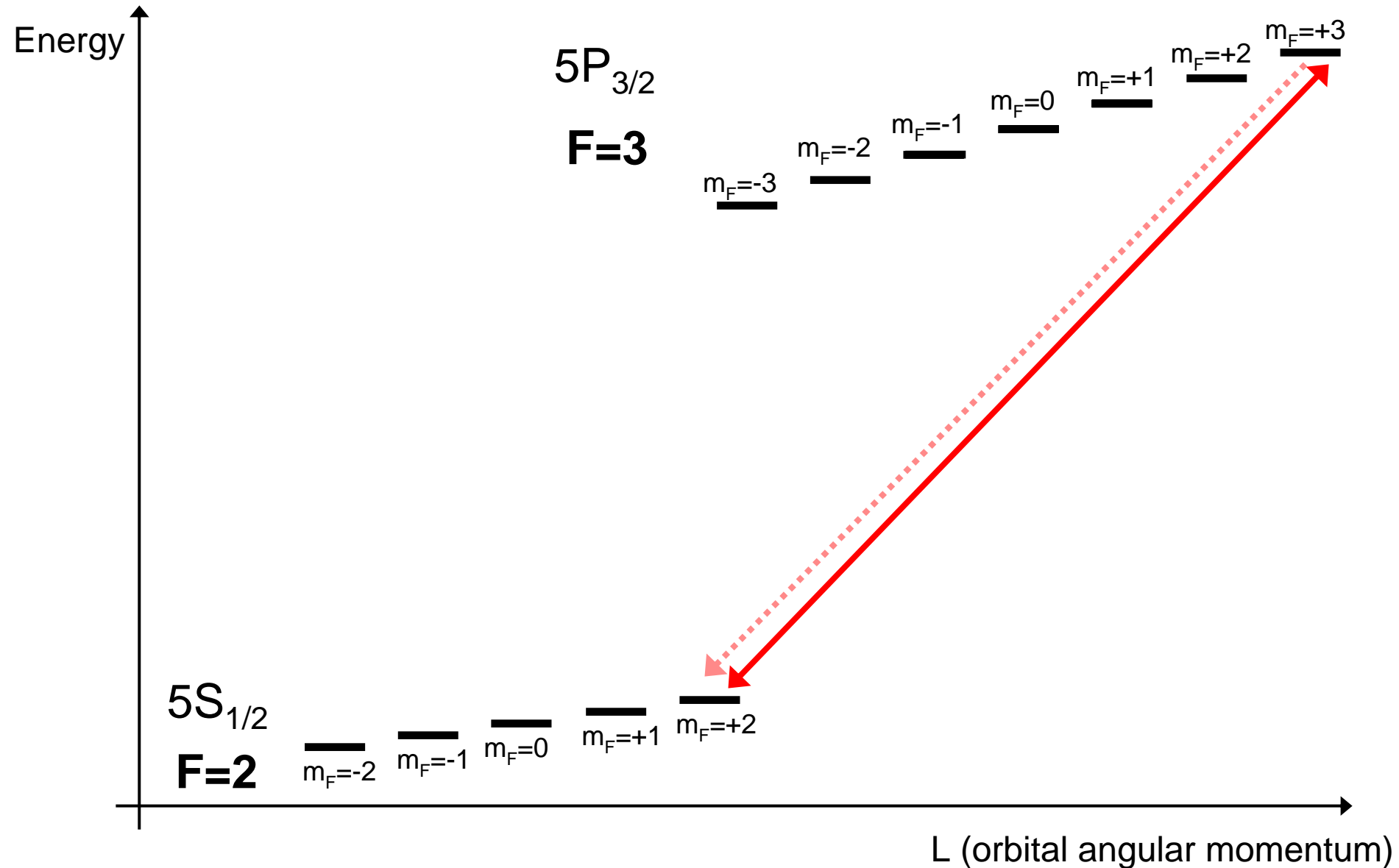
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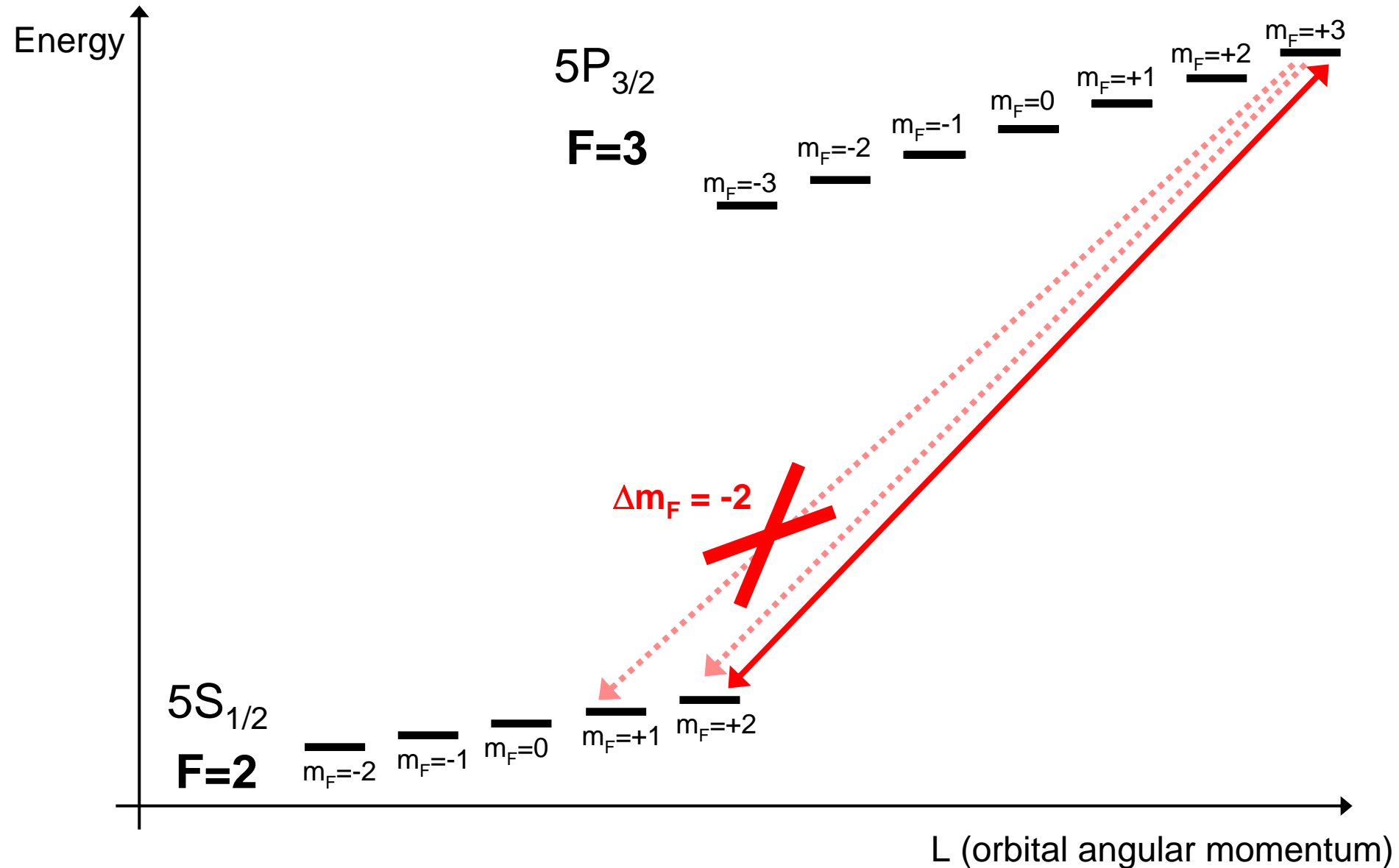
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The D2 line Cycling Transition



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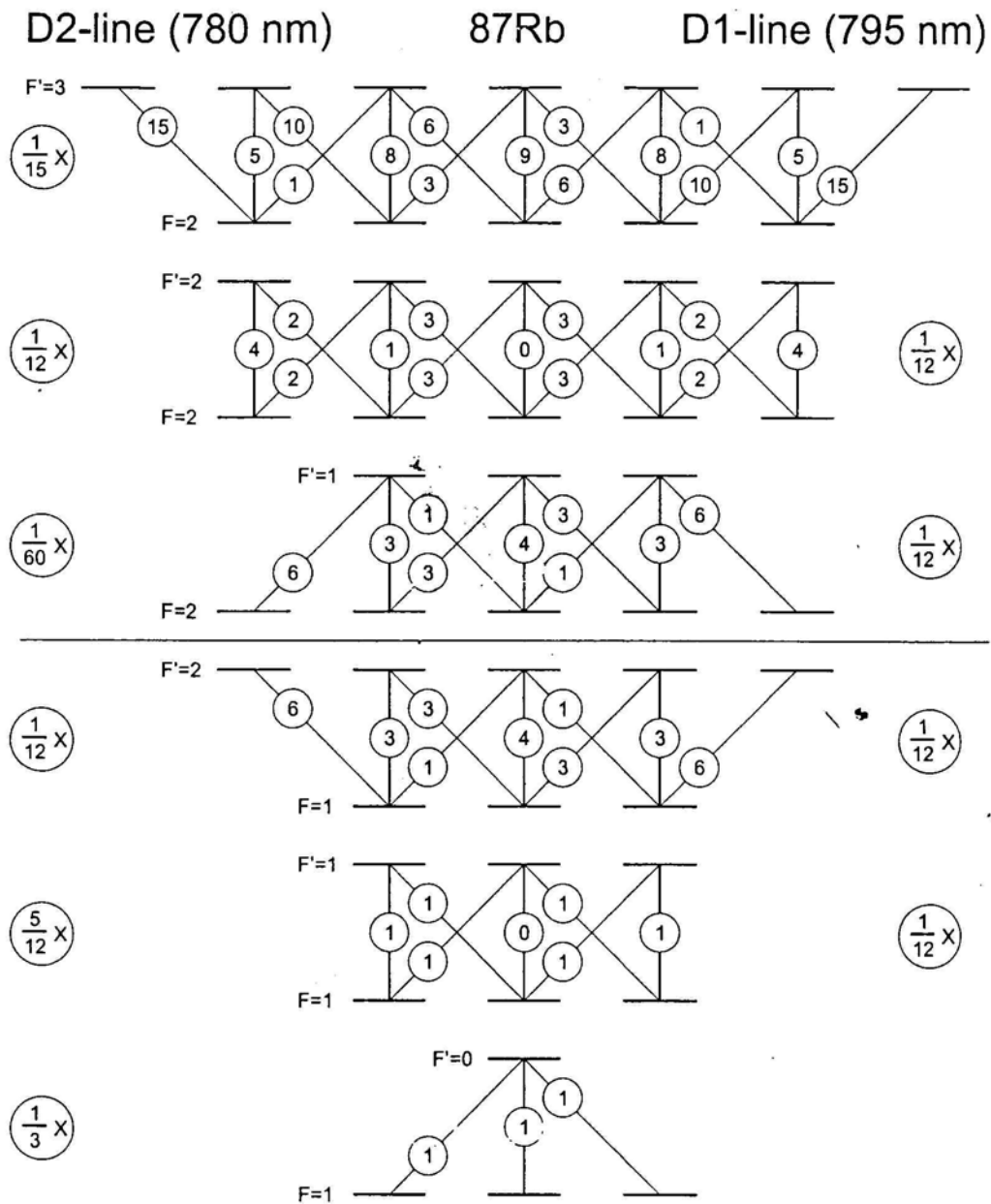


Figure A.2: Branching ratios for ⁸⁷Rb. Multiply by the circled number in the left(right) column to get the branching ratio for the D2(D1) line.