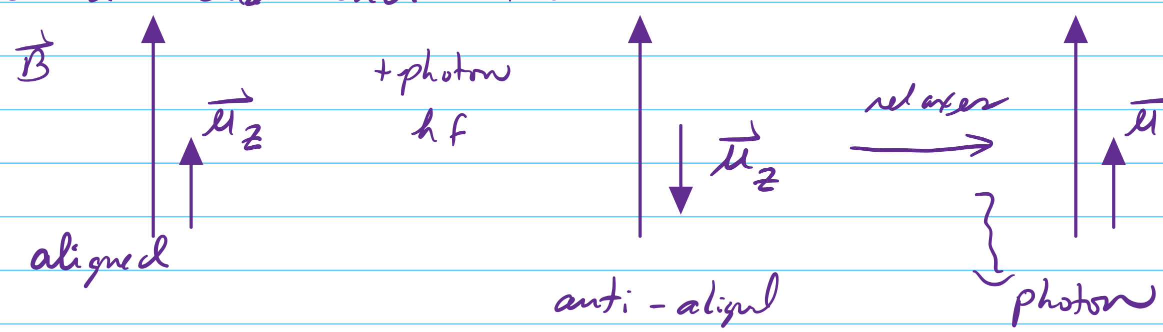
Quantum Spin Flip:

electron magnetic moment $\mu_e = \frac{1}{2} g \mu_B$

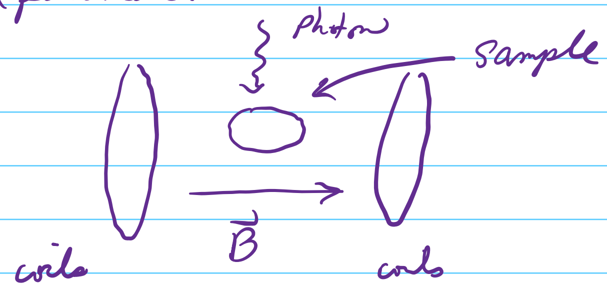
In an external B field, the potential energy is $V = -\vec{\mu} \cdot \vec{B} = -\mu_z B_z$

Spin flip: $\Delta E = 2\mu_z B_z = g \mu_B B$.

In a thermal environment ....



Experiment:



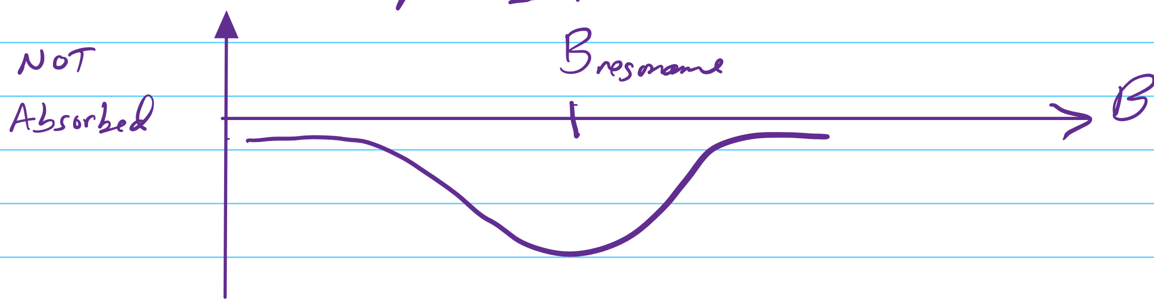
Send photons in (typically radio frequency).

when $hf = g \mu_B B$, get absorption. Measure f and B, find g.

ESR part 2

(a) Typical experiment: fix f, sweep B, measure absorption

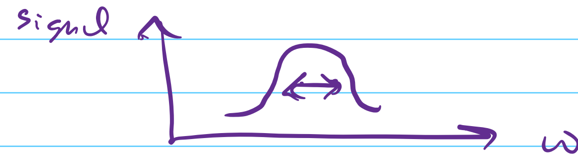
Or ... measure signal NOT absorbed



$$hf = g \mu_B B_{resonance}.$$

(b) Relaxation time τ. Eventually flips back into alignment.

Typical lifetime of the excited state $= \tau$.



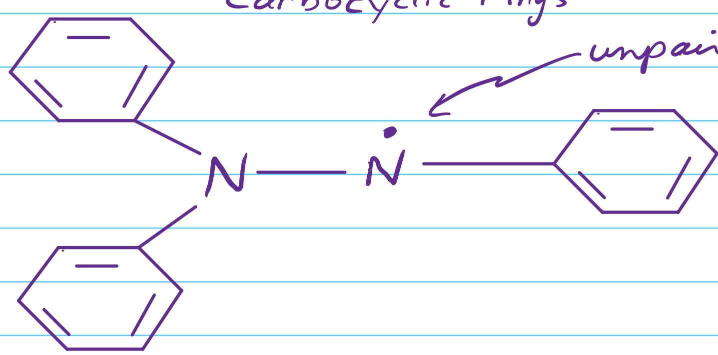
Recall for a resonance curve

$$FWHM = \Gamma = \frac{1}{\tau}$$

$$2\pi(\Delta f) = \frac{1}{\tau}$$

Sample: DPPH = diphenyl - picri -hydrazl

Carbocyclic rings



unpaired electron in an S state ($\ell = 0$)

ESR part 2

1) measuring g tells you about the electron's state

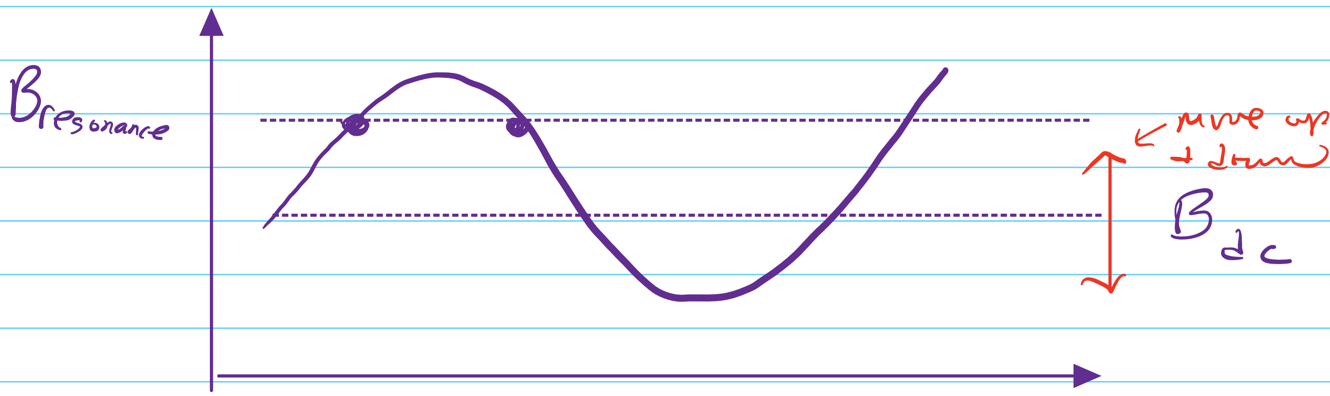
2) Measuring τ - lifetime - tells about local interactions

3) Area under absorption curve tells about amount of sample present

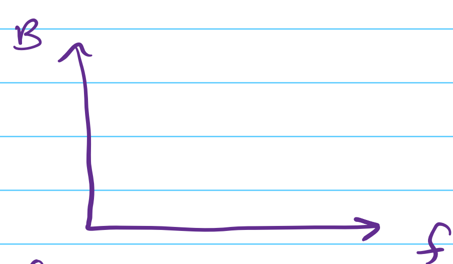
Experimental Plan:

1. Set f.
   Sweep B: $B = B_{dc} + B_{AC} \sin(2\pi f t)$

   Identify $B_{resonance}$ (details in writeup)



2. Plot



$$B = \frac{h}{g\mu_B} f$$

Why this way? Fit software assumes x is exact and all the error is in y, so put the most certain quantity on x.

ESR part 2

3. Get $g \pm \delta g$

4. Width - any plausible discussion. There is no single correct answer here.
Think very carefully about units.