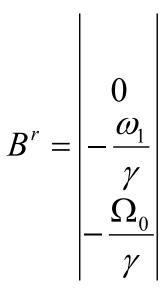
EPR Spectra

ESR Electron Spin Resonance **EPR** Electron Paramagnetic Resonance

The EPR spectra are mainly acquired in CW mode

CW (continuous wave) Signal

- The signal is observed in the presence of a low power r.f. magnetic field, B₁, as a function of the r.f. frequency
- The signal is obtained as a function of frequency
- B^r magnetic field in the rotating frame
- The y' axis is chosen for the r.f. magnetic field



For this system the Bloch equations are:

$$\frac{dM_x}{dt} = \gamma \left(M_y B_z - M_z B_y \right) - \frac{M_x}{T_2} = -\Omega M_y + \omega_1 M_z - \frac{M_x}{T_2}$$

$$\frac{dM_{y}}{dt} = \gamma \left(M_{z}B_{x} - M_{x}B_{z} \right) = \Omega M_{x} - \frac{M_{y}}{T_{2}}$$

$$\frac{dM_{z}}{dt} = \gamma \left(M_{x}B_{y} - M_{y}B_{x} \right) - \frac{M_{z} - M_{0}}{T_{1}} = -\omega_{1}M_{x} - \frac{M_{z} - M_{0}}{T_{1}}$$

The solution are looked for at the steady state

$$\frac{dM_x}{dt} = 0 \qquad \qquad \frac{dM_y}{dt} = 0 \qquad \qquad \frac{dM_z}{dt} = 0$$

Thus we must solve a systems of three equations with three unknowns

$$-\Omega M_{y} + \omega_{1}M_{z} - \frac{M_{x}}{T_{2}} = 0$$
$$\Omega M_{x} - \frac{M_{y}}{T_{2}} = 0$$
$$-\omega_{1}M_{x} - \frac{M_{z} - M_{0}}{T_{2}} = 0$$

 M_x , obtained from the second equation, is used in the third one

$$-\frac{\omega_{1}M_{y}}{\Omega T_{2}} - \frac{M_{z}}{T_{1}} + \frac{M_{0}}{T_{1}} = 0$$

$$M_z$$
 is obtained as: $M_z = M_0 - \frac{T_1 \omega_1 M_y}{\Omega T_2}$

Substituting for $M_z e M_y$ in the first equation:

$$-\Omega M_{y} + \omega_{1} M_{0} - \frac{T_{1} \omega_{1}^{2} M_{y}}{\Omega T_{2}} - \frac{M_{y}}{\Omega T_{2}} = 0 \qquad /\cdot \Omega T_{2}^{2}$$

$$-\Omega^{2}T_{2}^{2}M_{y} + \omega_{1}\Omega T_{2}^{2}M_{0} - T_{1}T_{2}\omega_{1}^{2}M_{y} - M_{y} = 0$$
$$M_{y}\left(1 + \Omega^{2}T_{2}^{2} + \omega_{1}^{2}T_{1}T_{2}\right) = \omega_{1}\Omega T_{1}T_{2}$$

$$M_{y} = \omega_{1}M_{0} \frac{\Omega T_{2}^{2}}{1 + \Omega^{2}T_{2}^{2} + \omega_{1}^{2}T_{1}T_{2}}$$

Since:
$$M_x = \frac{M_y}{\Omega T_2}$$

$$M_x = \omega_1 M_0 \frac{T_2}{1 + \Omega^2 T_2^2 + \omega_1^2 T_1 T_2}$$
 Absorption

Under non saturation conditions, that is: $\omega_1^2 T_1 T_2 \ll 1$ it can be neglected, and the lineshape is Lorentzian