Larmor precession

Angular momentum of a spin in a magnetic field (in the z-direction), equation of motion is

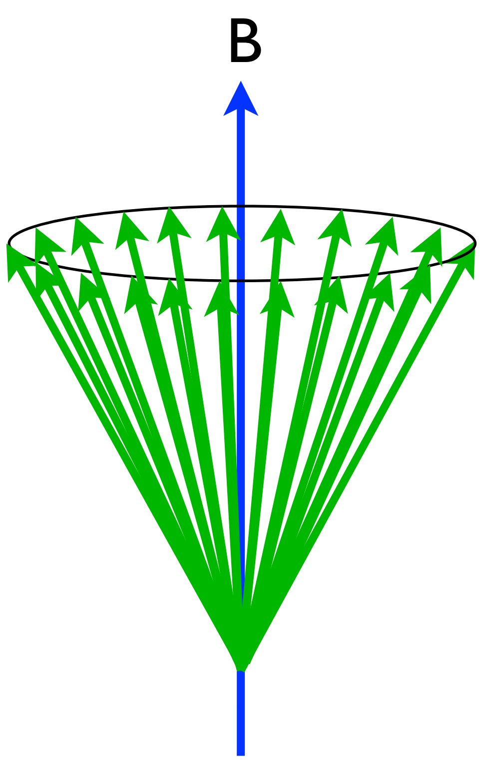
$$\frac{\hbar d\mathbf{I}}{dt} = \mu \times \mathbf{B} \qquad \text{or} \qquad \frac{d\mu}{dt} = \gamma_n \mu \times \mathbf{B}$$

Where the gyromagnetic ratio, γ_n, is the ratio of the magnetic moment to the angular momentum

This gives oscillatory solutions of the form

$$\mu_x = |\mu| \cos \omega_L t \qquad \mu_y = -|\mu| \sin \omega_L t$$

describing a precession of the spin around the field direction, with an angular frequency of ω_L, the **Larmor precession frequency**



$$\omega_L = \gamma_n B$$

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Adiabatic rotation

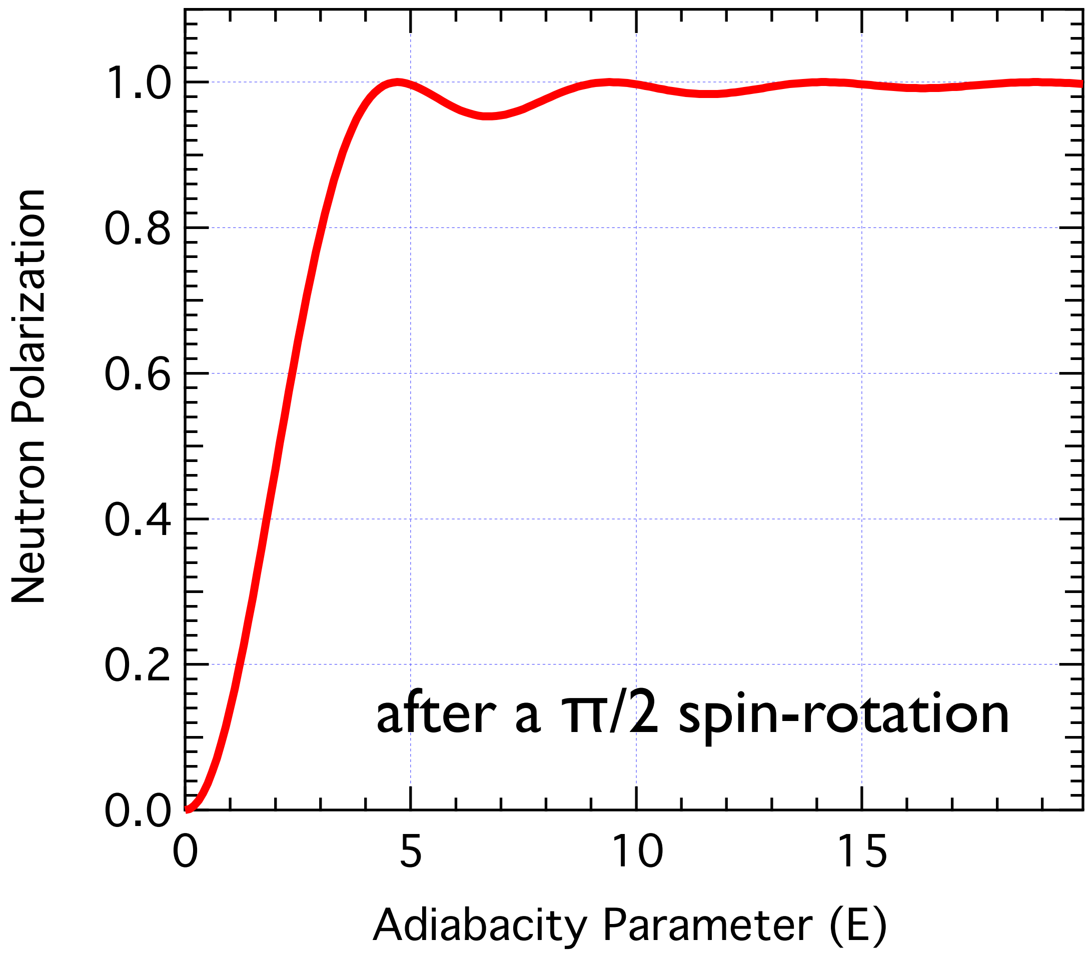
The rate of angular rotation, ω_B, of the field along the y-axis in the rest frame of the neutron is:

$$\omega_B = \frac{d\theta_B}{dt} = \frac{d\theta_B}{dy} . \frac{dy}{dt} = \frac{d\theta_B}{dy} v$$

where v is the neutron velocity

We can therefore define an adiabaticity parameter, E, where

$$E = \frac{\omega_L}{\omega_B} = \frac{|\gamma_n| B}{\frac{d\theta_B}{dy} v}$$



For an adiabatic rotation without loss of polarization we require E>10 (by bitter experience)

This inequality corresponds to $\frac{d\theta_B}{dy} < 2.65 B\lambda$ degrees/cm

with B in mT, θ in degrees, distance y in cm and neutron wavelength, λ in Å

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