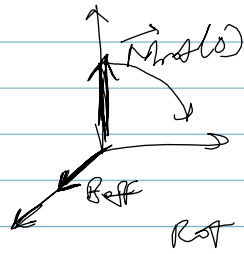
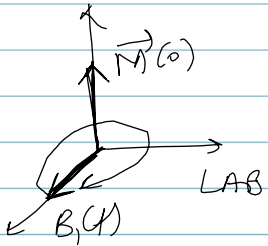


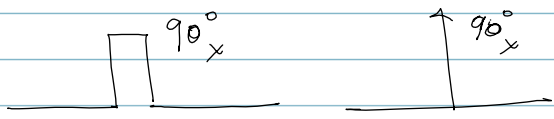
Review



- $\frac{d\vec{M}_{rot}}{dt} = \vec{M}_{rot} \times \gamma \vec{B}_{eff}$

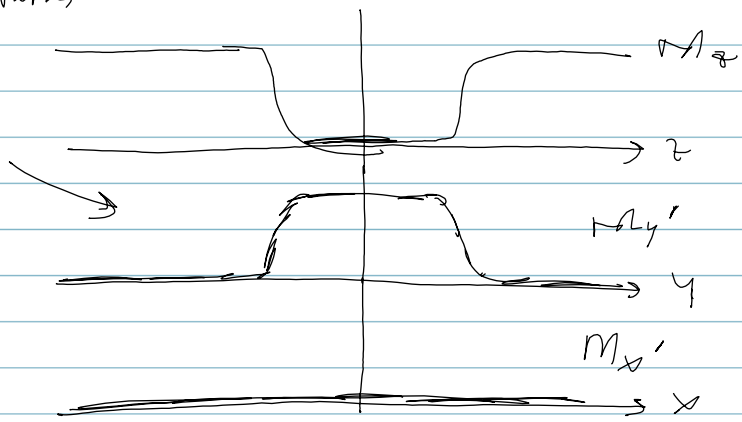
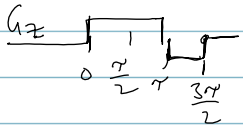
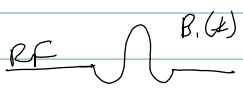
- rotation $\Theta = \int_0^{\tau} \omega(t) dt = \int_0^{\tau} \gamma B(t) dt$

- specify Θ (tip/flip angle) and axis



remember: left handed rotation!

selective excitation



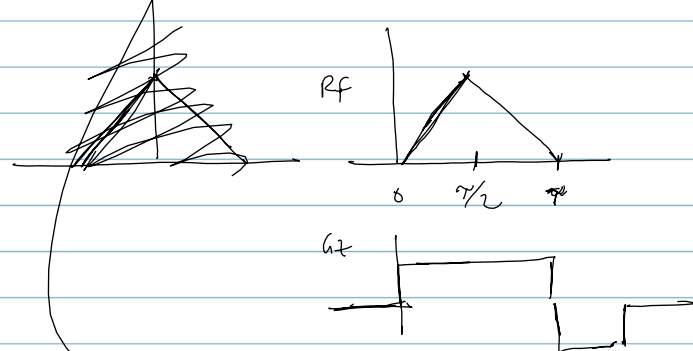
Small dip approximation, θ small, $M_z \approx M_0$

$$M_r\left(\frac{3\pi}{2}, z\right) = i M_0 \int \left\{ \underbrace{\omega_r(t + \frac{\tau}{2})}_{\text{curved } \gamma_B(t)} \right\} f = -\frac{\gamma}{2\pi} G_z z$$

↑
equilibrium magnetization
↑
curved $\gamma_B(t)$

Mish 6.11

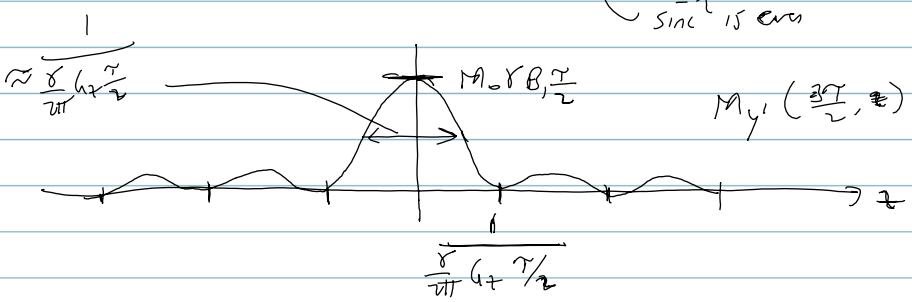
$$B_r(t) = B_1 \wedge \left(\frac{t - \frac{\tau}{2}}{\tau/2} \right)$$



$$M_r\left(\frac{3\pi}{2}, z\right) = i M_0 \int \left\{ \gamma B_1 \wedge \left(\frac{t - \frac{\tau}{2}}{\tau/2} \right) \right\} f = -\frac{\gamma}{2\pi} G_z z$$

$$= i M_0 \gamma B_1 \frac{\tau}{2} \text{sinc}^2 \left(\frac{\tau}{2} \left(+ \frac{\gamma}{2\pi} G_z z \right) \right)$$

↑
sinc² is even



Channel slices:

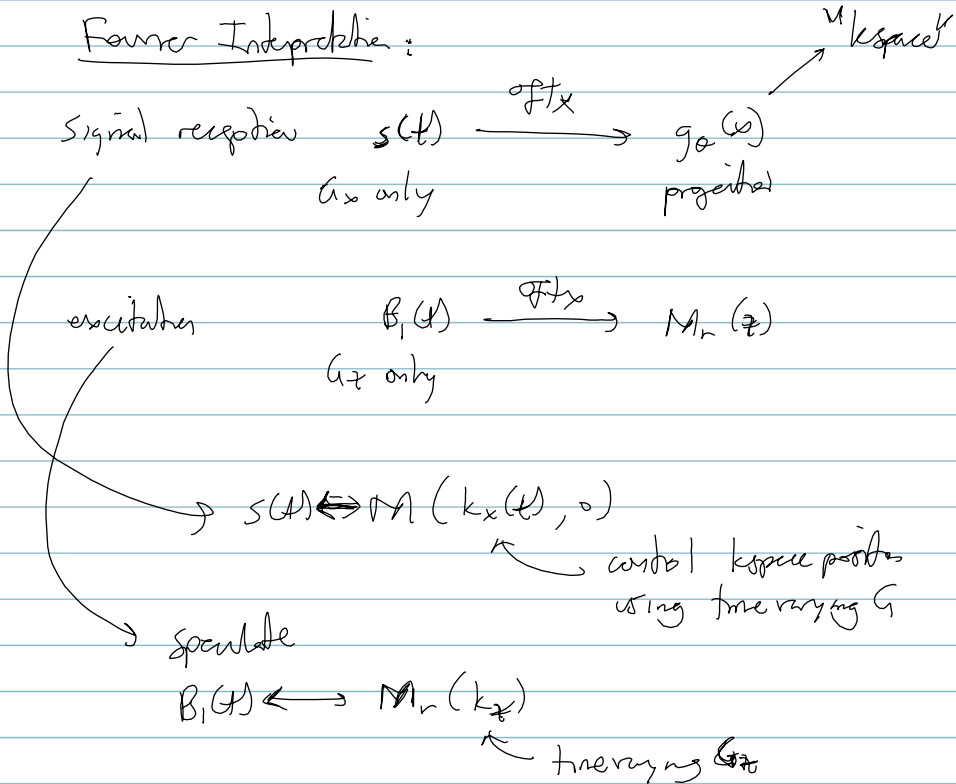
$\uparrow G_z \rightarrow$ OK, but amplitude limited
 $\uparrow T \rightarrow$ reduce BW of $B_z(t)$,
 but off resource is an issue
 \searrow consider T_z

$$G_z \approx 1 \text{ G/cm}$$

$$T \approx 1 \text{ ns}$$

$$\Delta z \approx 0.4 \text{ cm}$$

Fourier Independence:



excitation k-space

return to small hp approx

$$M_r(\tau, z) = i m_0 \int_0^{\tau} \omega_1(s) e^{+i \omega_1(s)(s-t)} ds$$

$\omega_1(s)$ constant
 $\omega_1(s) = \gamma G_2 z$

consider $B_1(t)$

& $G_2(t)$ ← can be time varying

$$M_r(\tau, z) = i m_0 \int_0^{\tau} \omega_1(s) e^{-i \left(\gamma \int_s^{\tau} G_2(t') dt' \right) z} ds$$

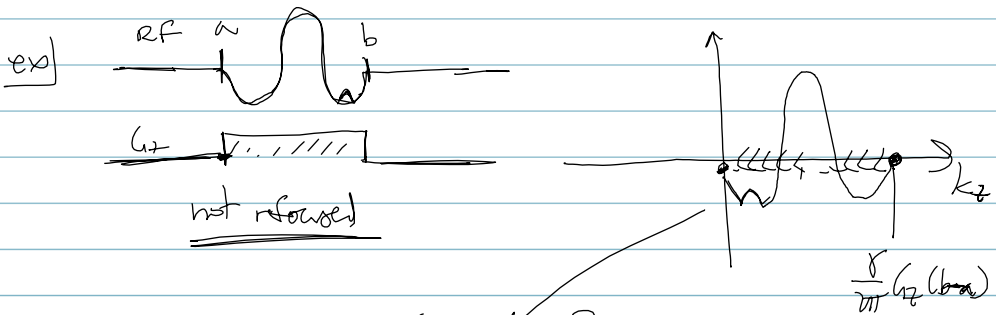
Define $k_z(s) = \frac{\gamma}{2\pi} \int_s^{\tau} G_2(t') dt'$

$$= i m_0 \int_0^{\tau} \omega_1(s) e^{-i 2\pi k_z(s) z} ds$$

⊛ $\omega_1(s)$ "depositing" weight in excitation k-space $[\gamma B_1(s)]$

⊛ trajectory in excitation k-space is controlled by gradient
Note: always end at ~~the~~ origin

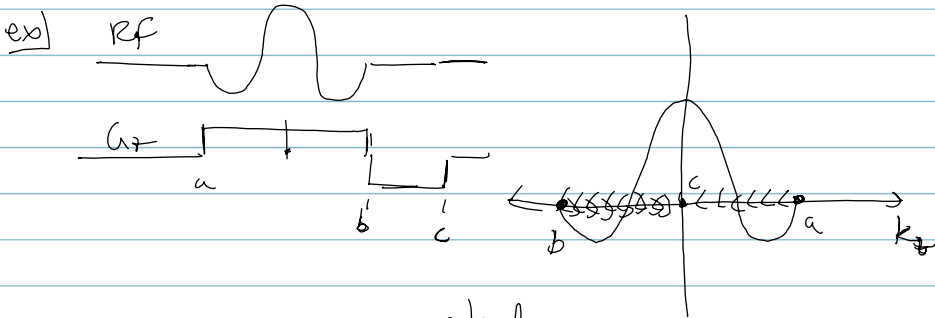
⊛ $M_r(z)$ is the same transform of the weighting



$$M_n(z) = \mathcal{F}\{T_x\} \left\{ \begin{array}{l} \text{ } \\ \text{ } \end{array} \right\}$$

$$= \text{rect} \cdot \text{phase factor}$$

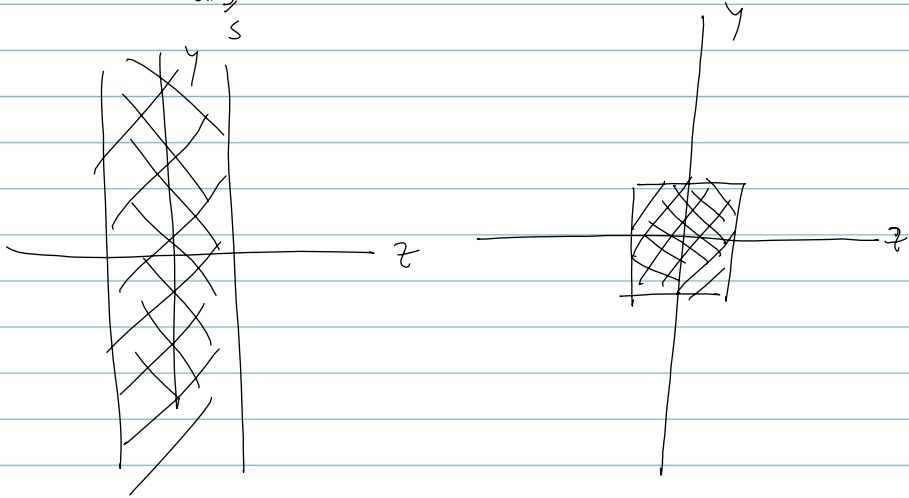
$$= e^{-i \omega(z) T_x / 2}$$



centered slice
no phase in the slice profile!

framework applies to 2D & 3D selective erasure

$$\vec{k}(s) = \frac{r}{2\pi} \int_s^{\infty} \vec{a}(t') dt'$$



see Past Projects
for examples

