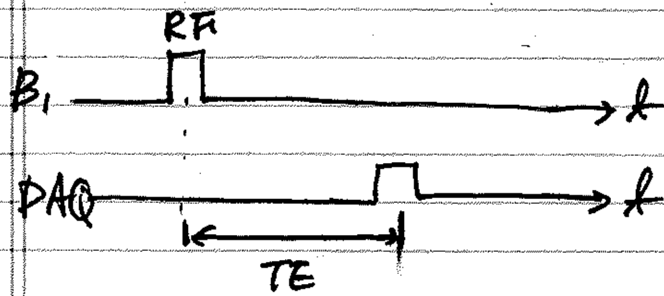
* Off-resonance effect on Imaging

$$S(t) = \iint m(x,y)\, e^{-i\omega_E(\vec{r})t}\, e^{-2\pi(k_x(t)x + k_y(t)y)}\, dx\,dy$$

① Amplitude effect - signal loss



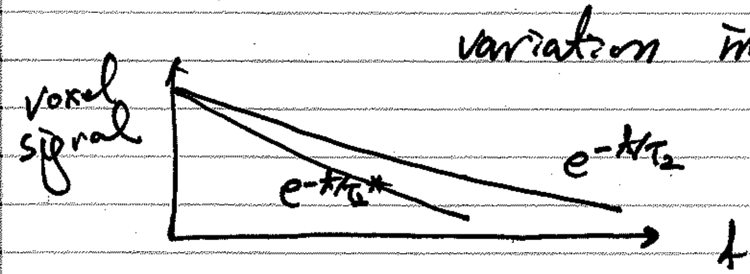
Object $\Rightarrow m(x,y)\, e^{-i\omega_E(\vec{r})TE}\, e^{-TE/T_2}$

signal over a small voxel

$$= \int_{voxel} (\text{object})$$

$$= \int_{voxel} (\quad)\, e^{-i\omega_E(\vec{r})TE}$$

$\leftarrow$ phase dispersion due to intravoxel variation in $\omega_E(\vec{r})$



T_2^* - space variant
- intra voxel inhomogeneity

② phase effect - image distortion

Assume 1D $\quad m(x) = \delta(x - x_0)$

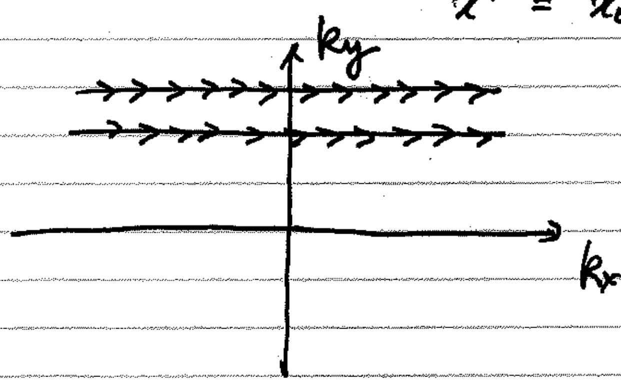
& use constant G_x

$$S(t) = \int_x m(x)\, e^{-i\omega_E(x)t}\, e^{-i\gamma G_x x t}\, dx$$

$$= \int_x \delta(x - x_0)\, e^{-i\omega_E(x)t}\, e^{-i\gamma G_x x t}\, dx$$

$$= e^{-i\omega_E(x_0)t}\, e^{-i\gamma G_x x_0 t}$$

$$= e^{-i\gamma G_x \underbrace{\left(x_0 + \frac{\omega_E(x_0)}{G_x \cdot \gamma}\right)}_{x' = x_0 + \frac{\omega_E(x_0)}{\gamma G_x}} t}$$



$e^{-i\gamma \omega_E(x_0) t}$

↑ depositing linear phase along k_x

$\Rightarrow$ shift in object domain along x

- displacement ;

$$\frac{\omega_E(\vec{r})}{\gamma G_x}$$