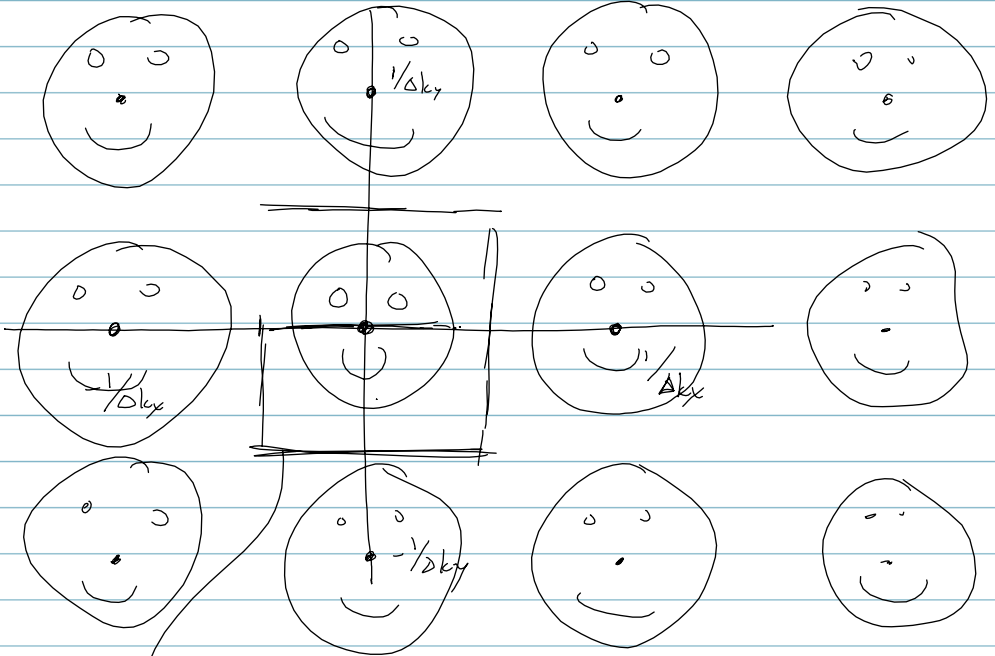


# Effects of Sampling in k-space

## ① Replication

$$m(x,y) ** \sum \sum (\Delta k_x, \Delta k_y)$$



unaliased field of view

$$FOV_x = \frac{1}{\Delta k_x}$$

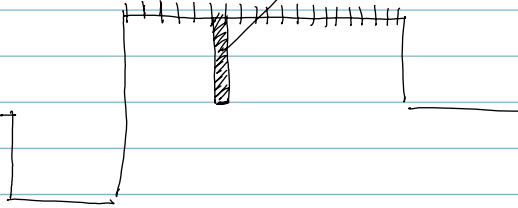
to avoid aliasing  
→ width<sub>x</sub>

$$FOV_y = \frac{1}{\Delta k_y}$$

> height<sub>y</sub>

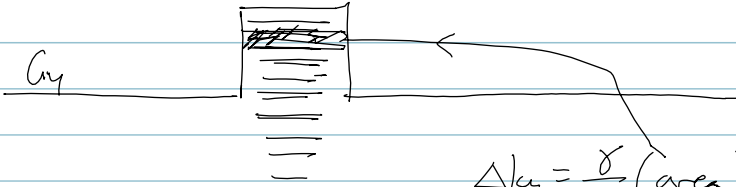
consider ZFFT

$G_x$



$$\Delta k_x = \frac{\delta}{2\pi} (\text{area})$$

$G_y$



$$\Delta k_y = \frac{\delta}{2\pi} (\text{area})$$

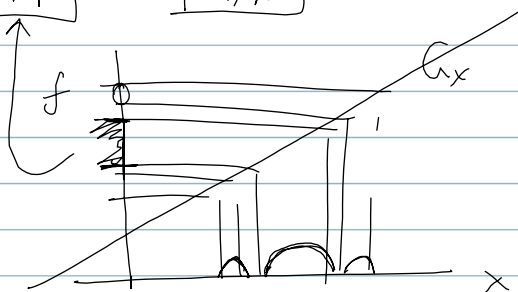
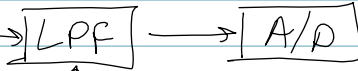
$$\Delta k_x$$

$$\Delta k_y$$

Avoiding aliasing in the x direction

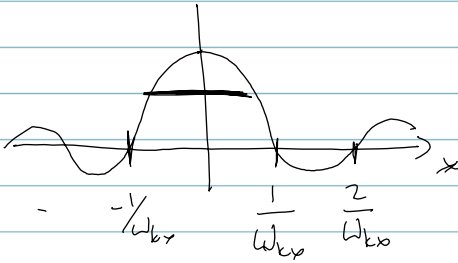
$s(t)$

after  
demod



## ② Blurring

$$m(x,y) \approx \text{sinc}(\omega_{kx} x) \text{sinc}(\omega_{ky} y)$$



impacts spatial resolution

"convolution"

$$\text{main lobe width} \approx \frac{1}{\omega_{kx}}, \frac{1}{\omega_{ky}}$$

spatial resolution

$$\delta_x \triangleq \frac{1}{\omega_{kx}} \quad \delta_y \triangleq \frac{1}{\omega_{ky}}$$

---

Limits to Resolution

$T_2$  decay, gradient  $\propto G/cm$

↑  
limit-resolution

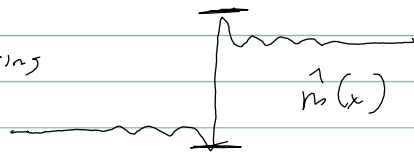
- Fundamental limits:
- 1)  $SNR \propto \text{voxel size}$
  - 2) diffusion of spins

# Truncation artifacts

\* sinc




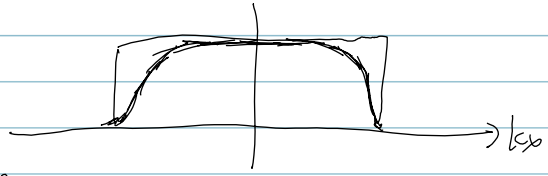
Gibbs ringing



avoid

- 1) improve resolution
- 2) apply a window

  $\left( \frac{kx}{W_{kx}} \right) \rightarrow$  hamming  
hanning  
kaiser bessel  $\left( \frac{x}{W_{kx}} \right)$



tradeoff  
lose spatial resolution