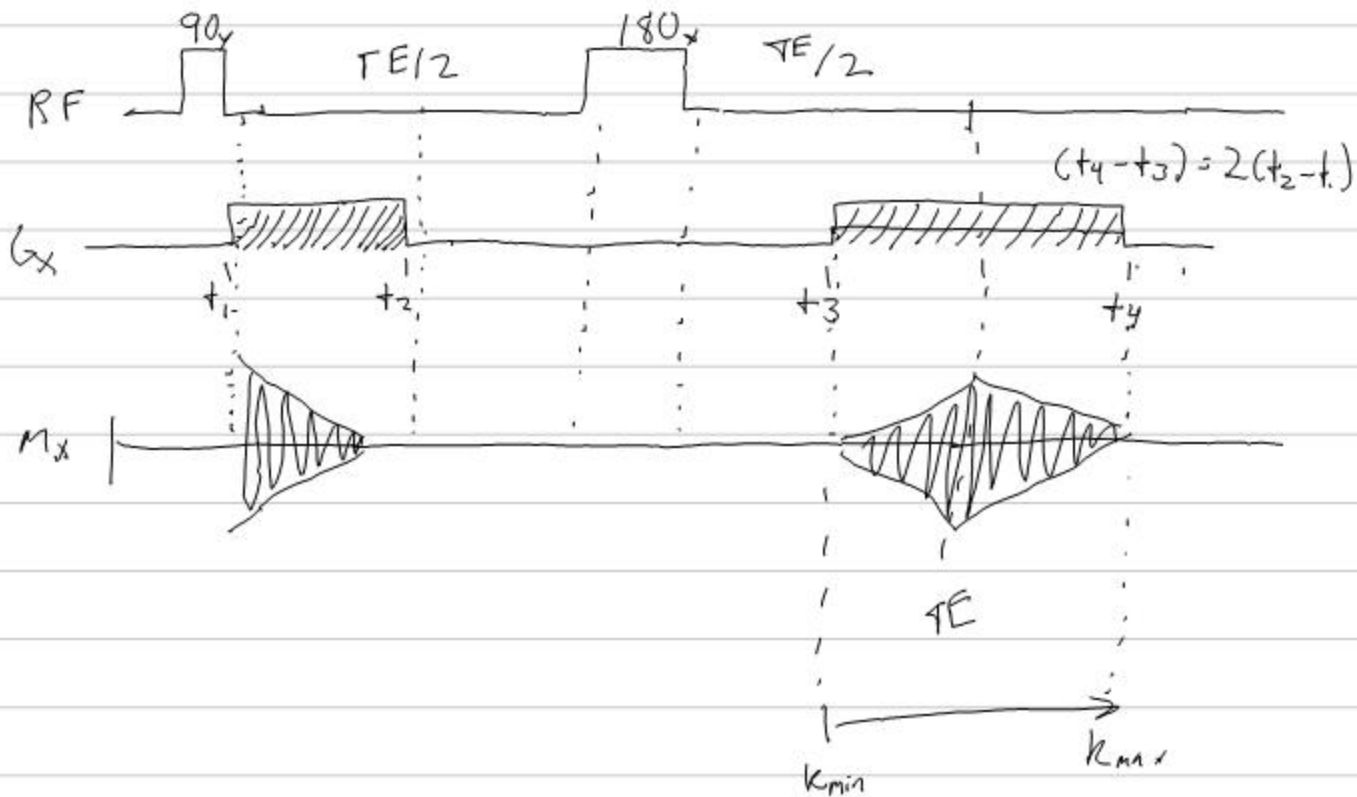


ΔB_z not under our control \rightarrow δ_{ij} chem shift
 \rightarrow J_{ij} J-coupling
 Δx

bad shimming

static affects, can be ameliorated with a spin echo

Spin Echo MRI (One dimension)



The 180_x is in essence equivalent to gradient reversal

$$G_x \rightarrow -G_x ; k \rightarrow -k$$



π pulses are imperfect, especially with imaging gear

suppose the flip angle is $\pi \pm \Delta\alpha$

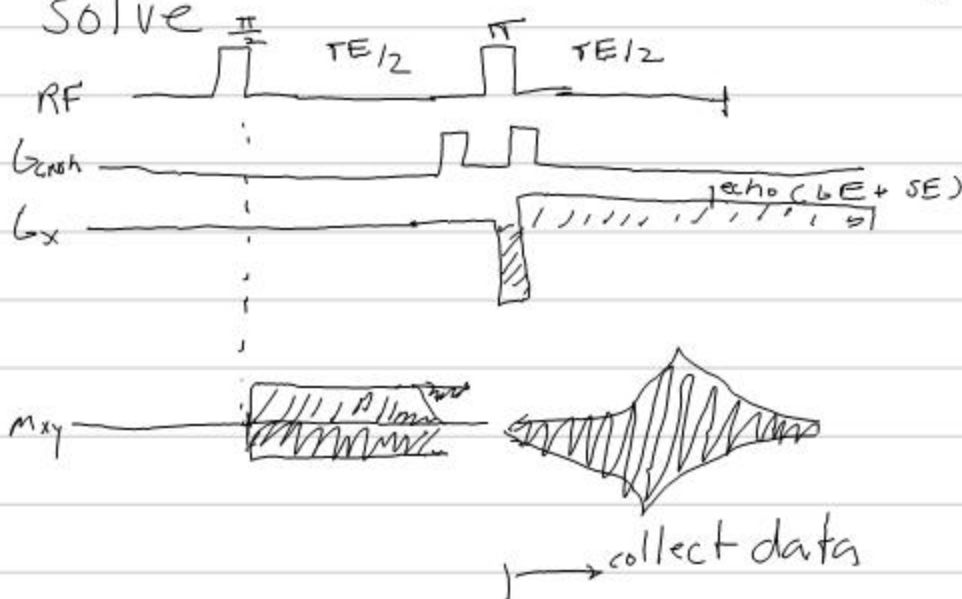
A FID will follow this pulse that barely decays before the gradient, and runs in to the echo.

To correct this you can follow the 180° pulse with a small gradient. These gradients are called "crushers."

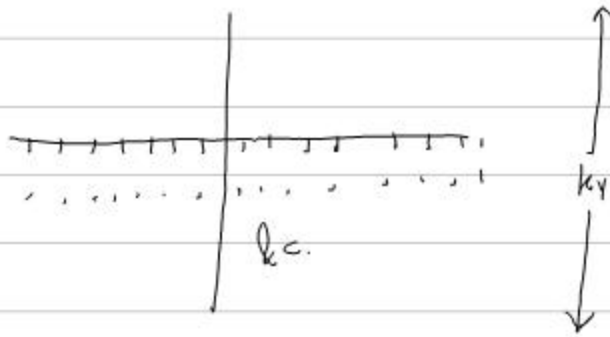
The π pulse can be flanked by crushers to cancel out any crusher caused encoding.

Motion Problems

• leave no space without a gradient to solve



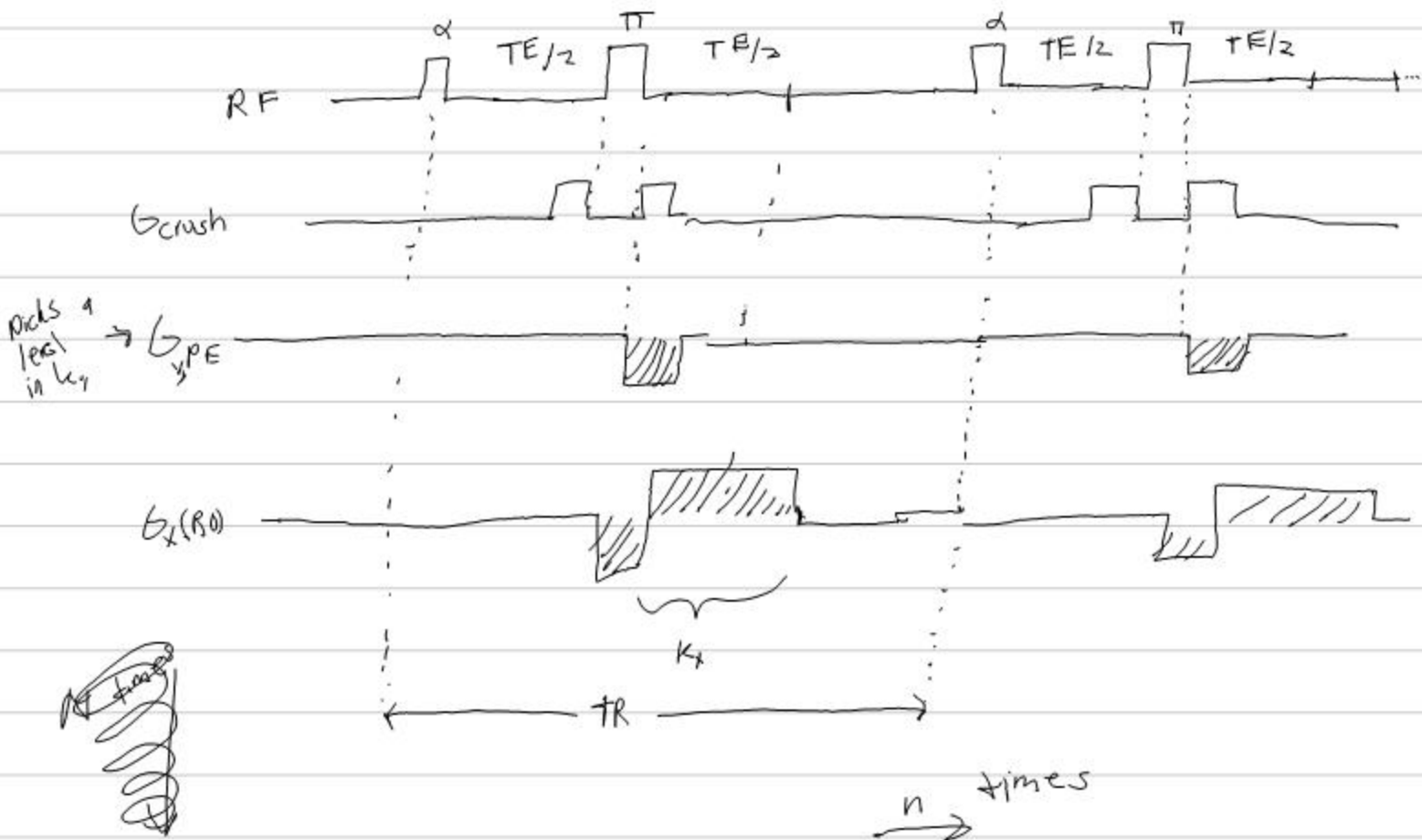
2-D Imaging



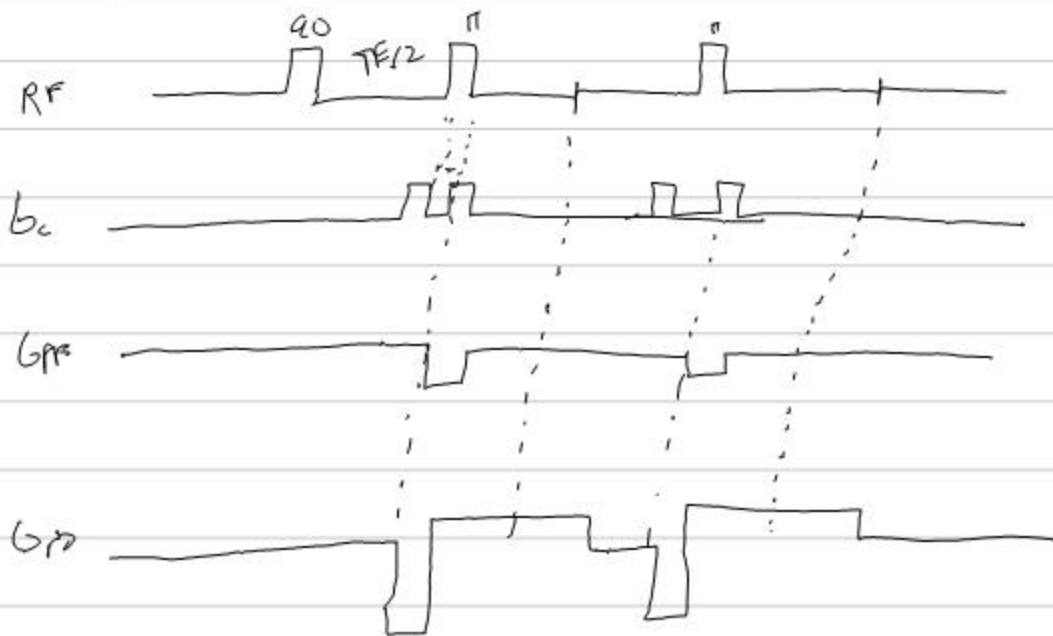
$n \times n$ data points
 $n \approx 16$ to 1024

$\leftarrow k_x \rightarrow$

Classical SE Sequence



We could speed this up by instead using something like a CPM6 multi-echo sequence



This is T_2 limited.