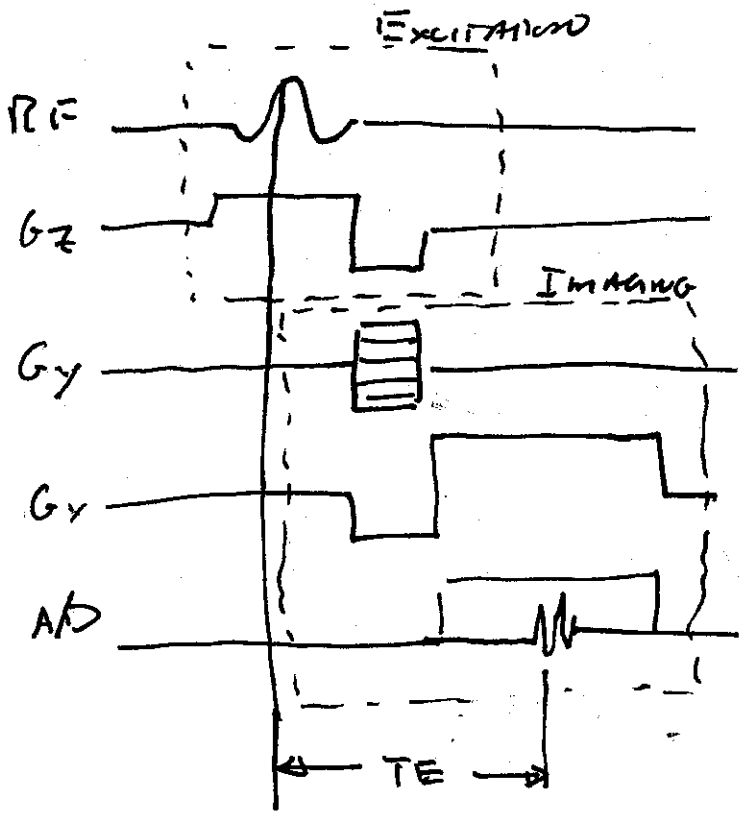
LECTURE 15 MR PULSE SEQUENCES

FROM LAST TIME, MR PULSE SEQUENCES CONSIST OF AN EXCITATION BLOCK, AND AN IMAGING BLOCK



RF

SLICE SELECT GRADIENT

PHASE ENCODE GRADIENT

READOUT GRADIENT

DATA

EXAMPLE: A TYPICAL WHOLE BODY SCANNER CAN PRODUCE GRADIENTS OF 40 mT/m. A TYPICAL READOUT GRADIENT IS 10 mT/m.

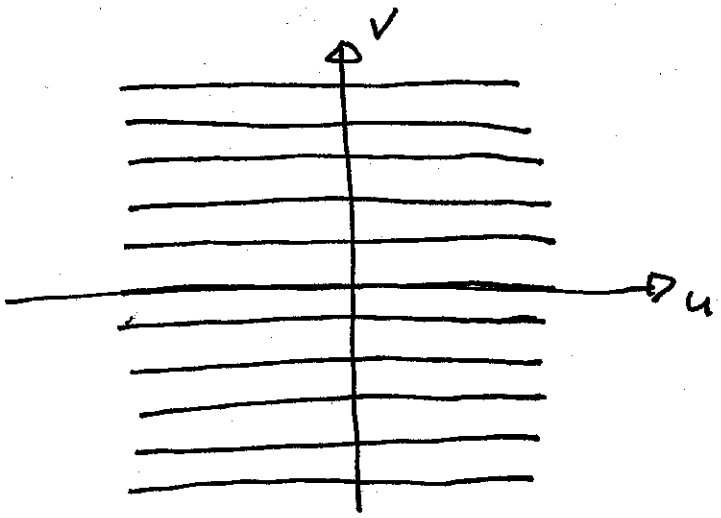
THIS CORRESPONDS TO A FREQUENCY SHIFT OF

$(10\ mT/m)(42.57\ MHz/T) = 425.7\ kHz/m$ (IMAGING VOL)

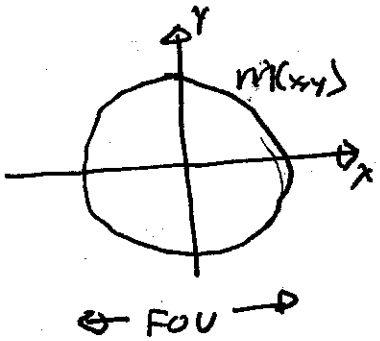
$= 425.7\ Hz/mm$ (VOXEL)

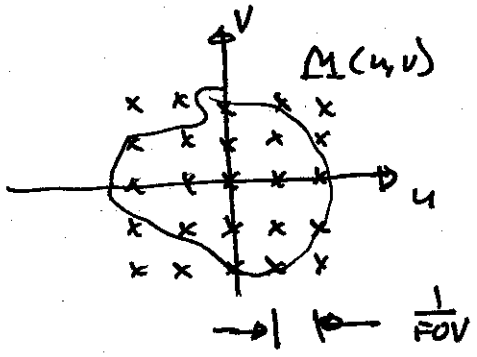
ALIASING AND FOV

THE SPIN WARP ACQUISITION COVERS SPATIAL FREQUENCY WITH A SEQUENCE OF LINES



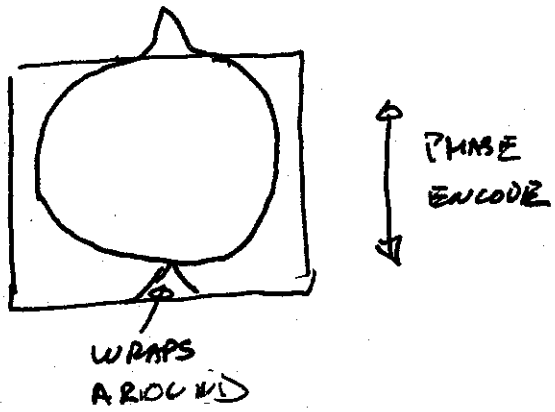
THE SIZE OF THE OBJECT IN IMAGE SPACE DETERMINES THE NYQUIST SAMPLING RATE IN SPATIAL FREQUENCY



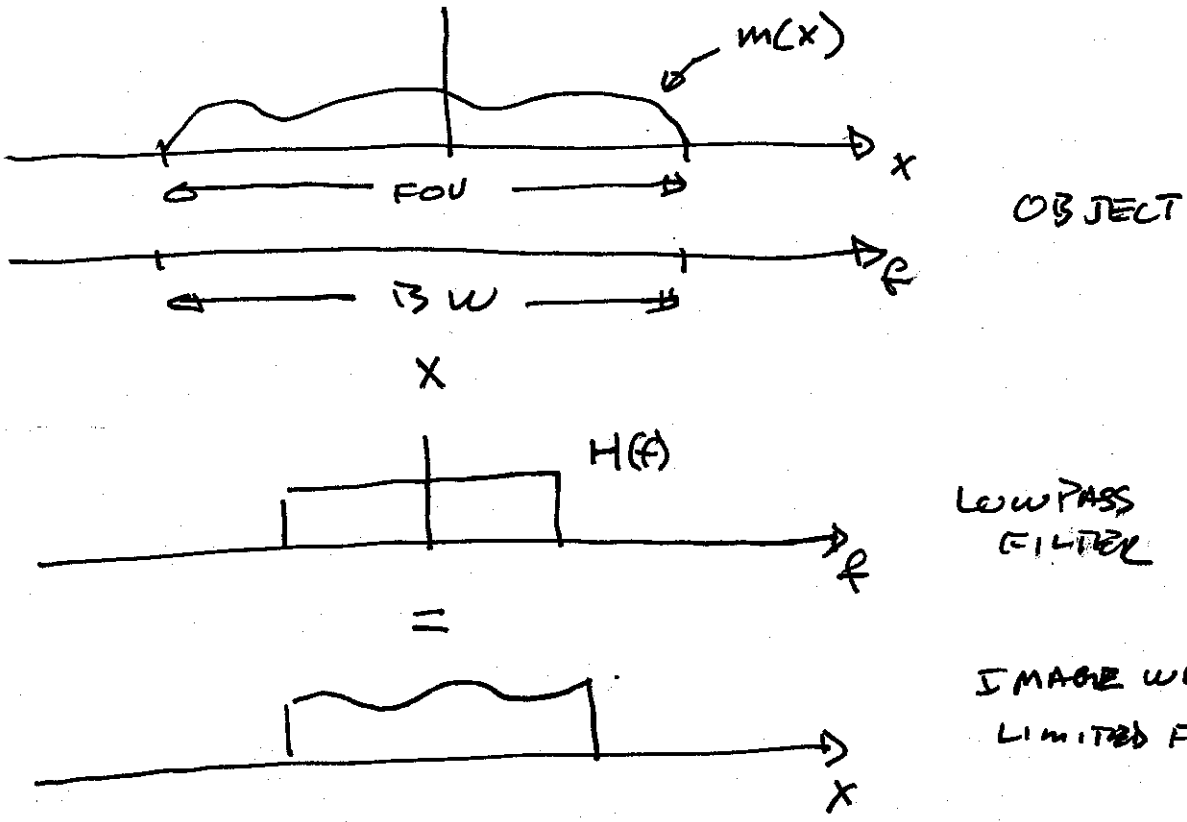


WHAT HAPPENS IF THE OBJECT IS TOO BIG FOR THE SAMPLING RATE?

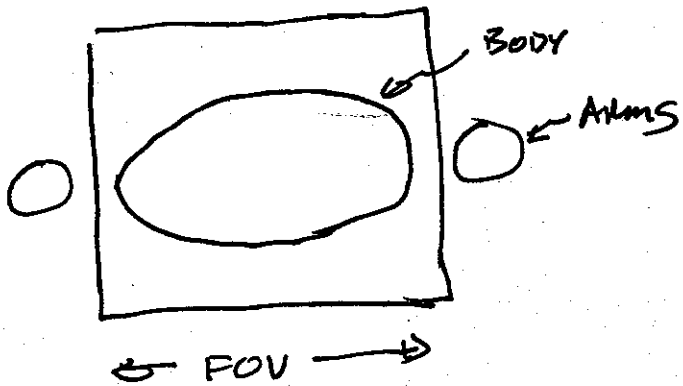
PHASE ENCODE DIRECTION: THIS IS SAMPLED DISCRETELY, SO WE GET ALIASING



READOUT DIRECTION: THE A/D HAS AN ANTI-ALIASING FILTER THAT LIMITS BANDWIDTH

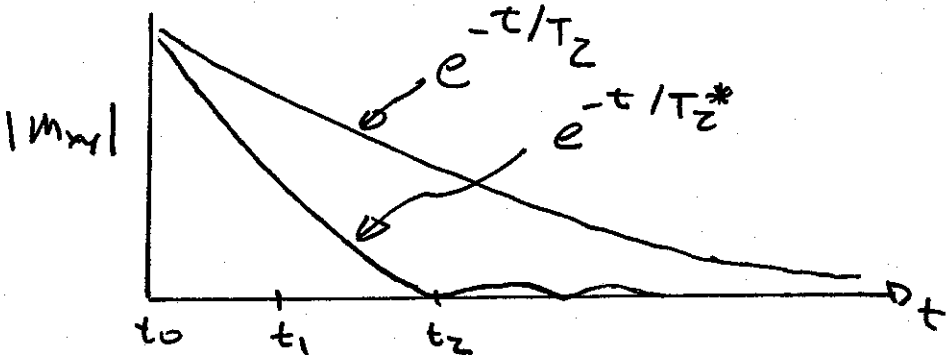


EXAMPLE: ANTI-ALIASING FILTER SUPPRESS THE ARMS

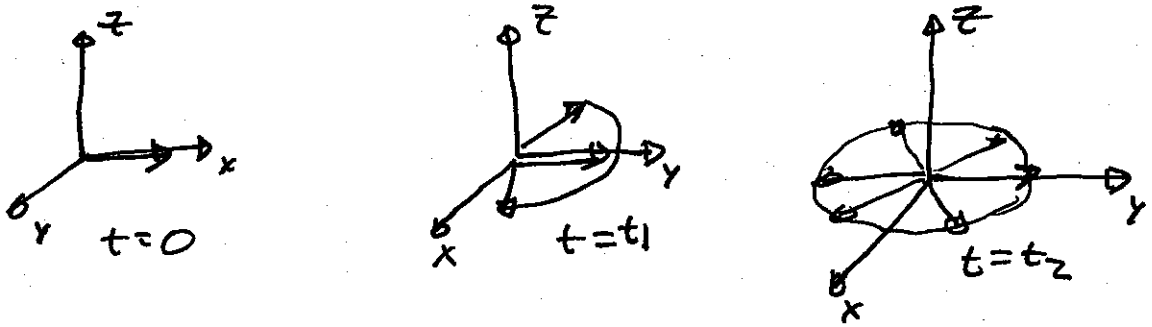


T_2 AND T_2^*

OFTEN SIGNAL DECAYS FASTER THAN T_2



THIS IS DUE TO A VOXEL CONTAINING A RANGE OF FREQUENCIES. THESE CAN DESTRUCTIVELY INTERFERE

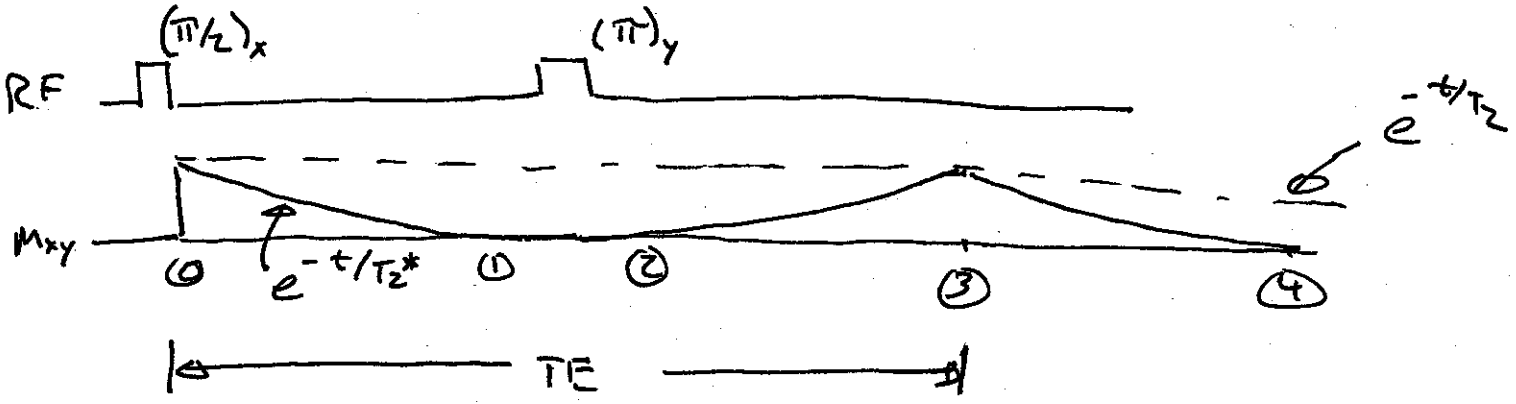


EVEN THOUGH THERE IS STILL TRANSVERSE MAGNETIZATION, IT INTEGRATES TO ZERO.

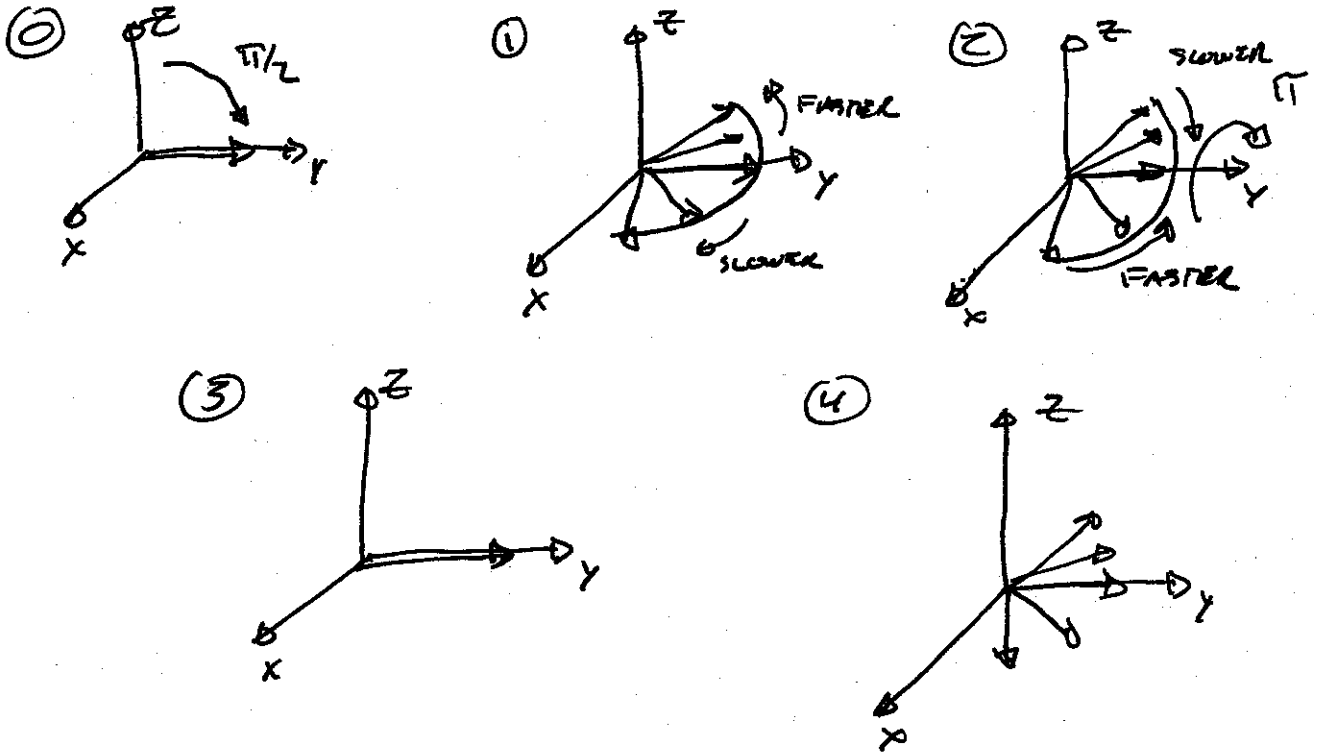
REMARKABLY, WE CAN OFTEN GET THIS SIGNAL BACK!

SPIN ECHO

WE USE A 180° ROTATION



THIS FORMS A SPIN ECHO



OFTEN USED IN PULSE SEQUENCES TO REDUCE THE EFFECT OF FIELD VARIATIONS, AND MAKE THE SIGNAL LAST LONGER