LECTURE 12

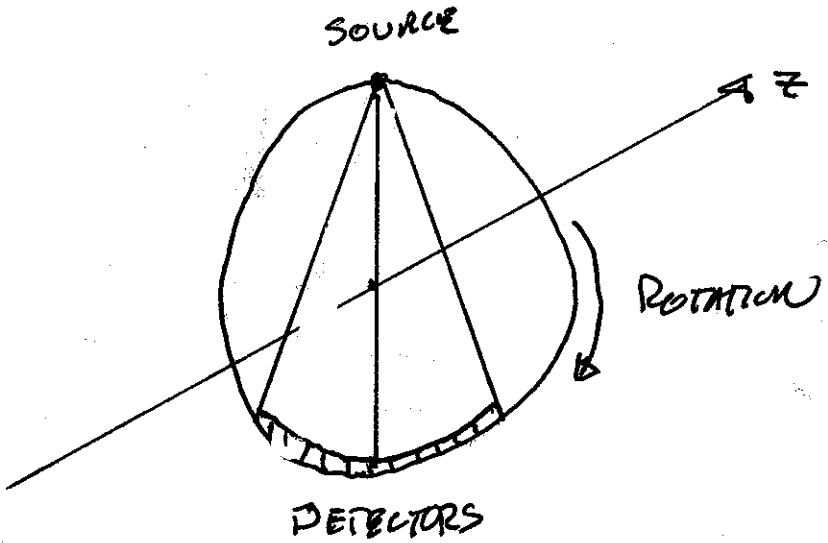
3D COMPUTED TOMOGRAPHY

HELICAL CT

MULTIDETECTOR CT
CONE BEAM CT
MULTIPLE SOURCE CT

CONVENTIONAL FAN BEAM CT

ONE SOURCE
ONE ROW OF DETECTORS
ONE SLICE PER ROTATION



VOLUMETRIC IMAGING

STEP AND SHOOT: IMAGE SLICE THEN TRANSLATE PATIENT

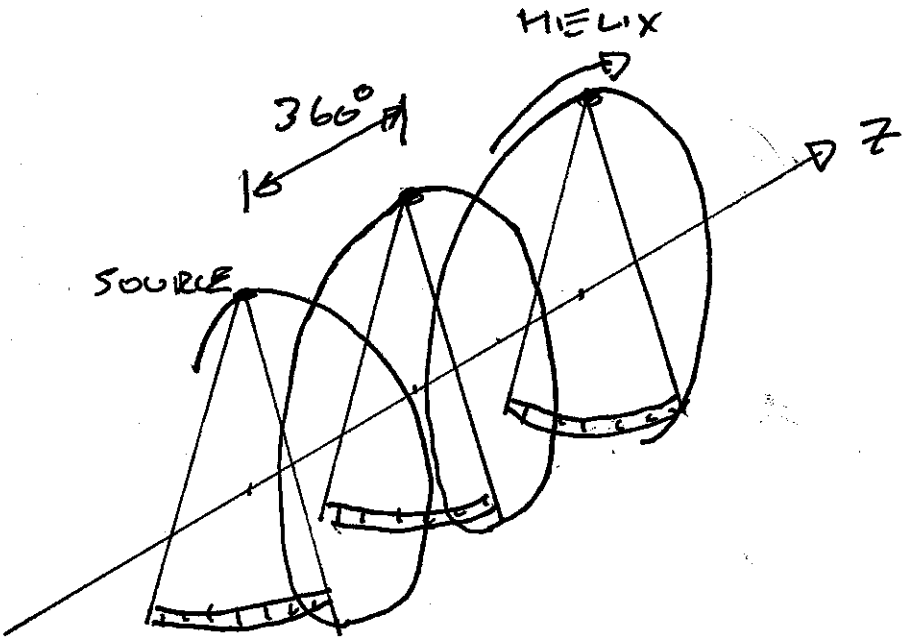
UNWIND CABLES

LIZ

HELICAL CT

CONTINUOUS PATIENT TRANSLATION

SLIP RINGS FOR DATA + POWER

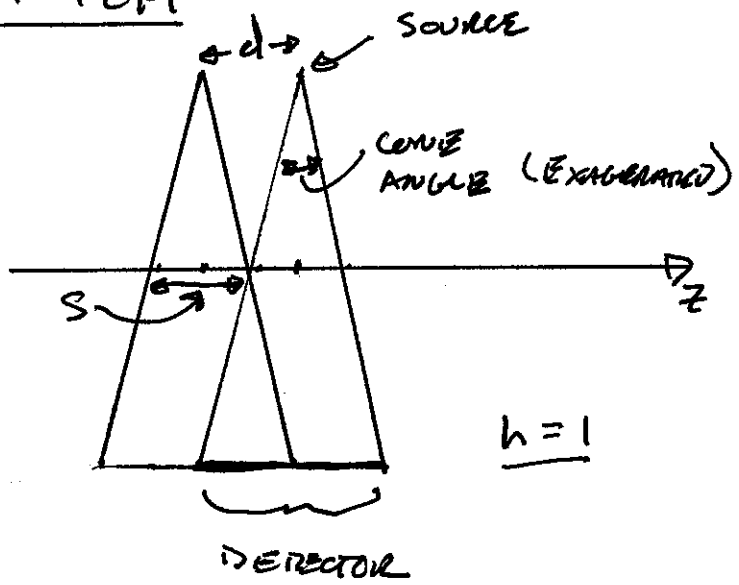


FROM THE PATIENT PERSPECTIVE, SOURCE TRACES OUT A HELIX

PROBLEM: EACH VIEW IS A SLIGHTLY DIFFERENT SLICE

⇒ INCONSISTANT DATA AND ARTIFACTS

HELIX PITCH



$$h = \frac{d}{s} = \frac{vt}{s}$$

h - PITCH

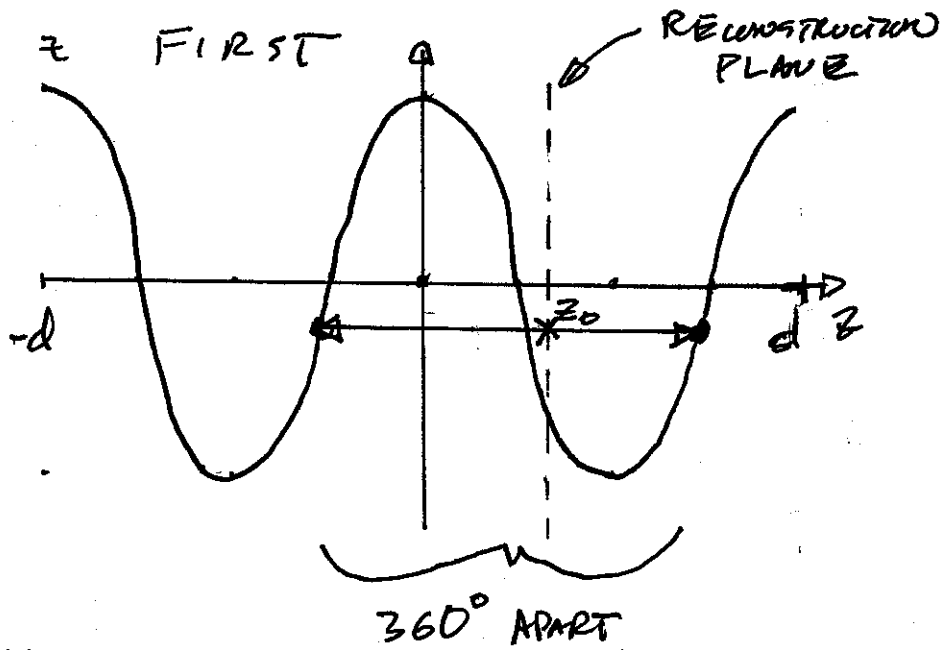
d - TRANSLATION PER SLICE

s - SLICE WIDTH AT ISOCENTER

HIGHER PITCH ⇒ FASTER SCAN, MORE ARTIFACTS (LESS CONSISTANT DATA)

Z INTERPOLATION

RECONSTRUCTION IS IMPROVED BY INTERPOLATING IN z FIRST

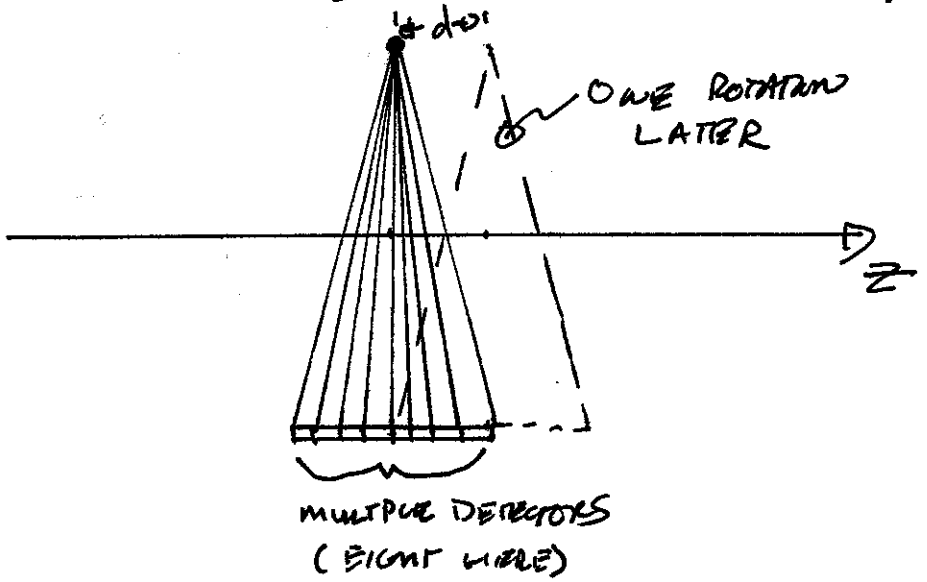


360 LI: LINEAR INTERPOLATION OVER 360°. ALSO 180 LI USING OPPOSING RAYS

LIZ

MULTIDETECTOR CT

ADD MULTIPLE ROWS OF DETECTORS



MORE COVERAGE IN z PER ROTATION $(h > 1)$

FASTER SCANS

BETTER TUBE UTILIZATION

HISTORY: 2, 4, 8, .. 64, 128, 320

PROBLEMS

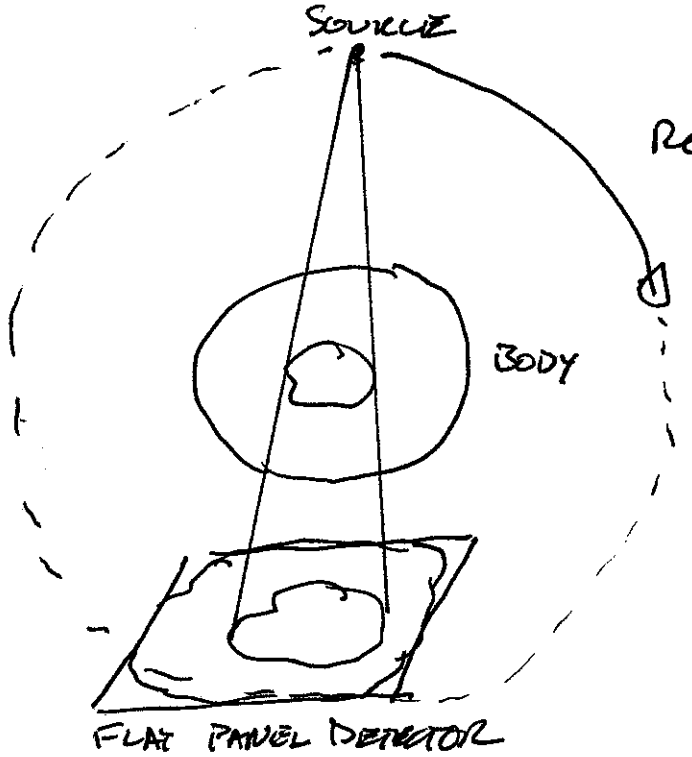
SCATTER

RAYS ARE IN DIFFERENT PLANES

CONE BEAM ARTIFACTS

CONE BEAM CT

AREA DETECTORS COLLECT 2D PROJECTIONS



DIGITAL X-RAY FLUORO SYSTEM

ROTATE, COLLECT 2D PROJECTIONS OVER 360°.

INTERESTING RECONSTRUCTION PROBLEM

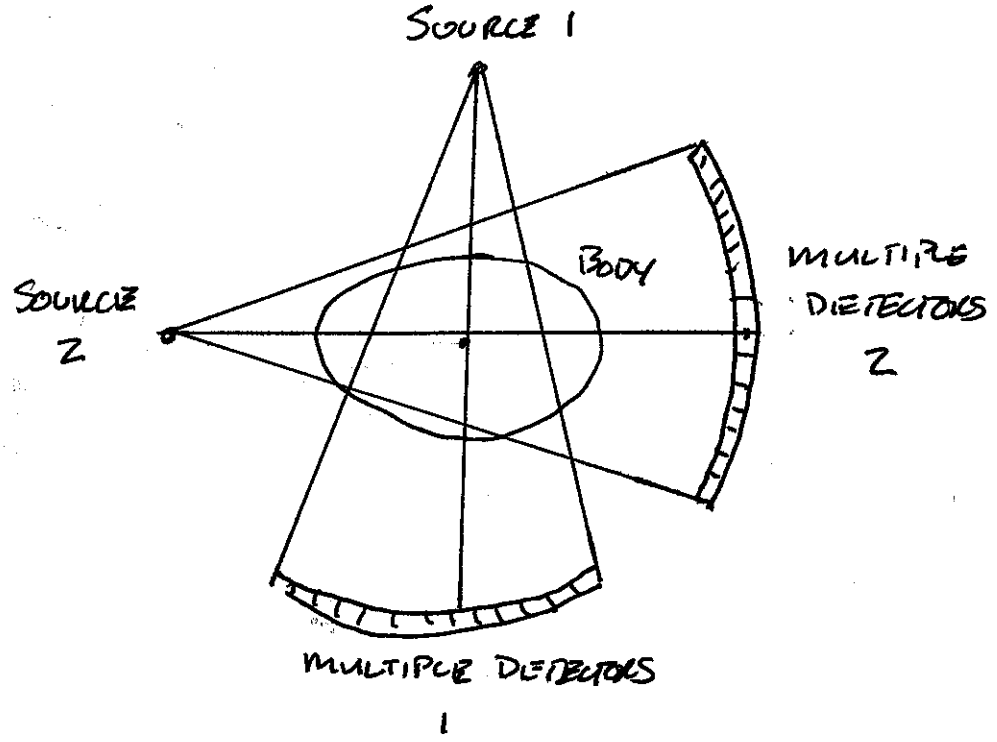
3D EXTENSION OF 2D FAN BEAM FILTERED BACKPROJECTION

FUNDAMENTALLY AN INCOMPLETE DATA SET

STILL PRODUCES NICE IMAGES

MULTIPLE SOURCE CT

ADD AN ADDITIONAL SOURCE (AND DETECTOR ARRAY)



BOTH SOURCES USED AT SAME TIME

TWICE THE DATA RATE

HALF AS MANY ROTATION ANGLES REQUIRED

DIFFERENT SOURCES CAN HAVE DIFFERENT ENERGIES

DUAL ENERGY CT