- REVIEW SYLLABUS
- KEY TAKEAWAYS FROM EACH LECTURE, AND COLD-CALL SUMMARY
- READING (BEFORE LECTURE!)
- VOCABULARY!

## BASIC IMAGING PRINCIPLES (P. 1-14)

### LOOKING AT THE HUMAN BODY:

- ORIGINALLY PEOPLE CUT IT OPEN!
- ENDOSCOPY: ENDOSCOPE IS A LIGHT TUBE THREADED THROUGH THE BODY.
- THESE ARE INVASIVE TECHNIQUES (AS OPPOSED TO NON-INVASIVE TECHNIQUES.
- DIFFERENT IMAGING TYPES ARE CALLED "MODALITIES". EACH GIVE DIFFERENT TYPES OF SIGNALS.
- WE TAKE A SIGNALS & SYSTEMS APPROACH
  - PHYSICAL PARAMETERS OF TISSUES OR FUNCTION WITHIN THE BODY ARE THE SIGNALS.
  - THE TYPE OF SIGNAL WE ATTEMPT TO OBSERVE DEPENDS ON THE MODALITY.
  - OUR MEDICAL IMAGING SYSTEM ATTEMPTS TO DISPLAY THE DESIRED SIGNAL WITH AS MUCH FIDELITY AS POSSIBLE.
- 1ST OUTPUT OF AN IMAGING SYSTEM IS BASED ON PHYSICAL MEASUREMENT
- FINAL OUTPUT IS CREATED THROUGH IMAGE RECONSTRUCTION, THE PROCESS OF CREATING AN IMAGE FROM MEASURED SIGNALS.

### ORIENTATIONS:

SAGITTAL

CORONAL

AXIAL OR TRANSVERSAL

# HISTORY OF MEDICAL IMAGING.

- IT ALL STARTED WITH WILHELM CONRAD ROENTGEN (1ST NOBEL PRIZE IN PHYSICS!) IN DECEMBER 1895.
  - EXPERIMENTING WITH A "CROOKE'S TUBE"
  - NOTICED A NEW KIND OF RAYS THAT COULD EXPOSE FILM EVEN WHEN OPTICALLY SHIELDED.
  - FIRST CLINICAL USE IN FEB. 1896.
- X-RAY USE BECAME WIDESPREAD
  - STATIC 2D TECHNIQUES
  - DYNAMIC, OR FLUOROSCOPIC, TECHNIQUES
  - "PLANAR": 2D PROJECTIONS
- FIRST TRUE CT SCANNER IN 1972 AT EMI IN ENGLAND
  - GODFREY HOUNSFIELD; } NOBEL PRIZE IN MEDICINE 1979
  - ALLAN CORMACK: (← MATH) } NOBEL PRIZE IN MEDICINE 1979

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## X-RAYS LED TO X-ray, CT.

DISCOVERY OF RADIOACTIVITY (ANTOINE HENRI BECQUERREL IN 1896) LED TO "NUCLEAR MEDICINE":

- INITIALLY RADIONUCLIDES USED IN CANCER THERAPY
- GEORGE DE HEVESY: IN 1923 INTRODUCED THE CONCEPT OF USING RADIOACTIVE TRACERS TO STUDY PHYSIOLOGY (FATHER OF NUCLEAR MEDICINE)
- RADIOTRACER: A RADIOACTIVELY LABELED DRUG THAT MIMICS A BIOLOGICAL COMPOUND OF INTEREST.
- FIRST NUCLEAR IMAGING SYSTEM (THE RECTILINEAR SCANNER) IN 1949.

ULTRASOUND:

- INTERACTION OF ACOUSTIC WAVES WITH MEDIA
  - LORD JOHN RAYLEIGH
  - MODERN ULTRASOUND HAS ROOTS IN WW II NAVY SONAR TECHNOLOGY
  - PROGRESSED FROM 1960's THROUGH TODAY

MRI:

- NMR DESCRIBED BY FELIX BLOCH AND EDWARD PURCELL
  - ← 1952 NOBEL PRIZE IN PHYSICS
- RICHARD ERNST EXTENDED WORK: 1991 NOBEL PRIZE IN CHEMISTRY
- RAYMOND DAMADIAN ⇒ 1971 NMR FOR MEDICINE
- PAUL LAUTERBUR ⇒ 1973
- SIR PETER MANSFIELD

} NOBEL PRIZE IN MEDICINE IN 2003

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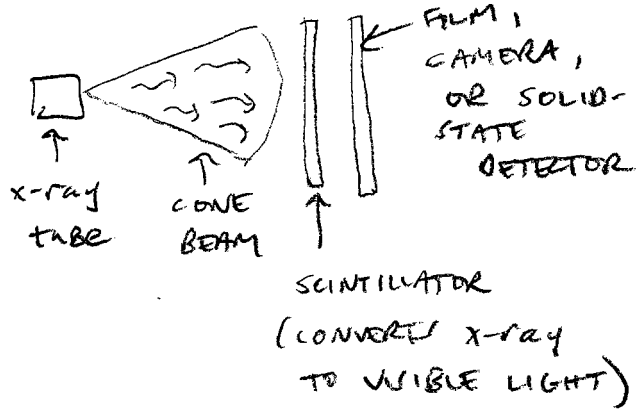
FUNCTIONAL VS. STRUCTURAL OR ANATOMICAL IMAGING.

## BRIEF REVIEW OF MODALITIES:

### PROJECTION RADIOGRAPHY:

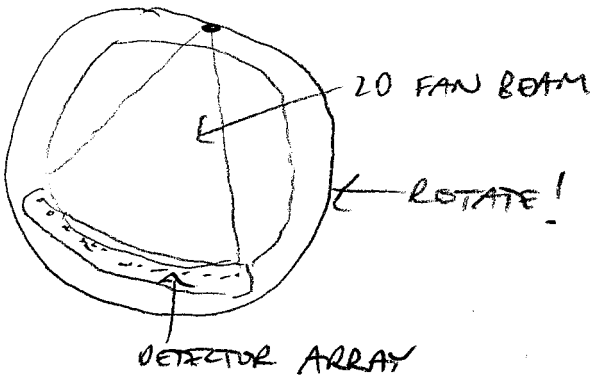
- REPRESENT A 3-D OBJECT BY A 2-D IMAGE ("PROJECTION")
- SIGNAL ARISES FROM TRANSMISSION OF X-RAYS THROUGH THE BODY.
  - X-RAYS: ELECTROMAGNETIC ENERGY (LIKE MRI AND NUCLEAR MEDICINE)




- USES "IONIZING RADIATION" & DAMAGES TISSUES
- CHEST x-rays, ANGIOGRAPHY, MUSCULOSKELETAL, NEURORADIOLOGY
- CAN BE MOBILE!

### COMPUTED TOMOGRAPHY: 3D IMAGING!

- NO CONE BEAM: COLLIMATED INTO 2D "FAN BEAMS":




- SINGLE-SLICE CT
- HELICAL CT
- MULTI-SLICE CT

## NUCLEAR MEDICINE:

- RADIOTRACERS INJECTED IN BODY
- 3 METHODS:
  - SCINTIGRAPHY
  - SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT)
  - POSITRON EMISSION TOMOGRAPHY (PET)

## ULTRASOUND:

- A-MODE IMAGING: 1-D WAVEFORM
- B-MODE: CROSS-SECTIONAL
- M-MODE: SUCCESSION OF A-MODE SIGNALS
- DOPPLER

## MRI: