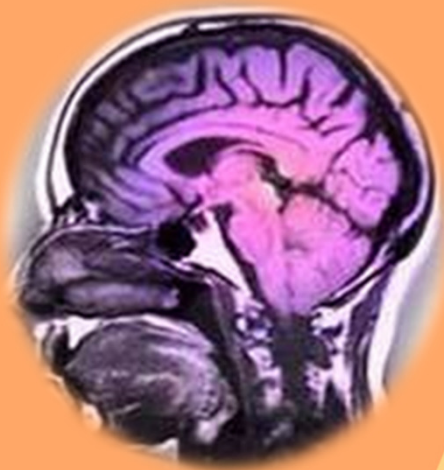


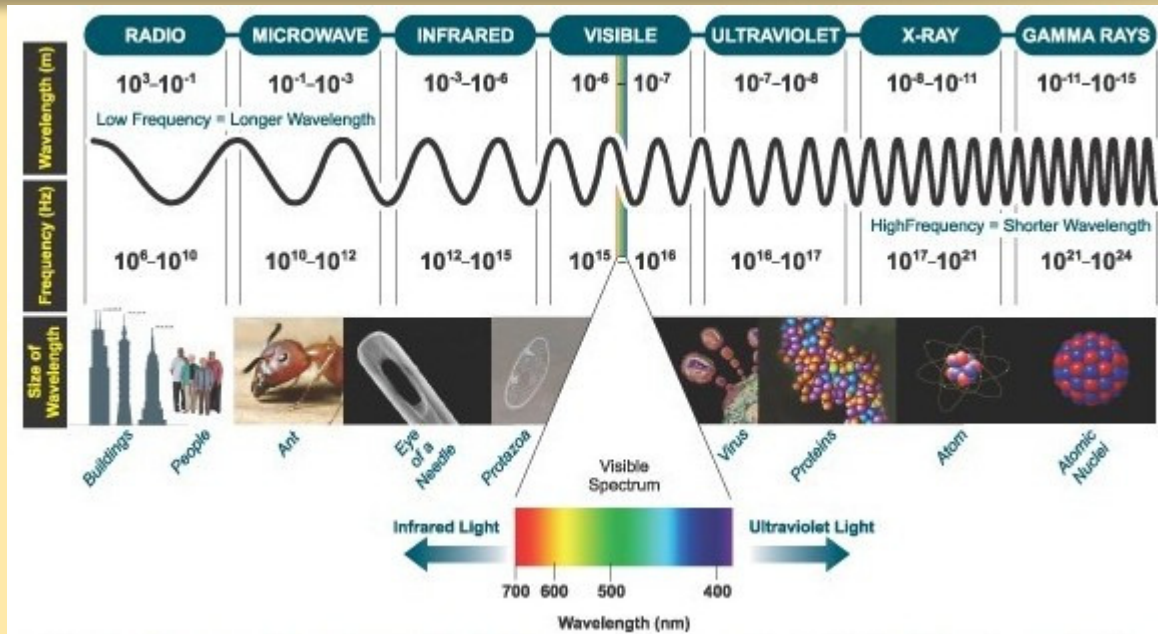
Gamma Radiation



Xue Wang
xwang040@fiu.edu



Characteristics

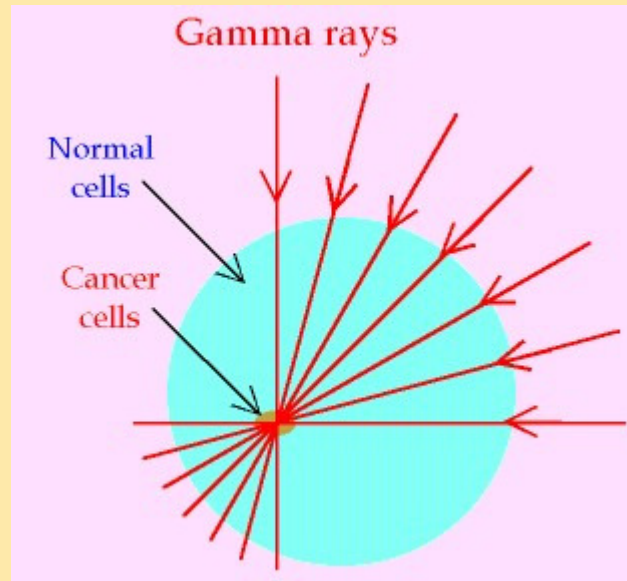


- The shortest wavelength
- The highest frequency
- The most energy



Advantages

- Kill cancerous cells



<http://www.gcscience.com/pwav53.htm>

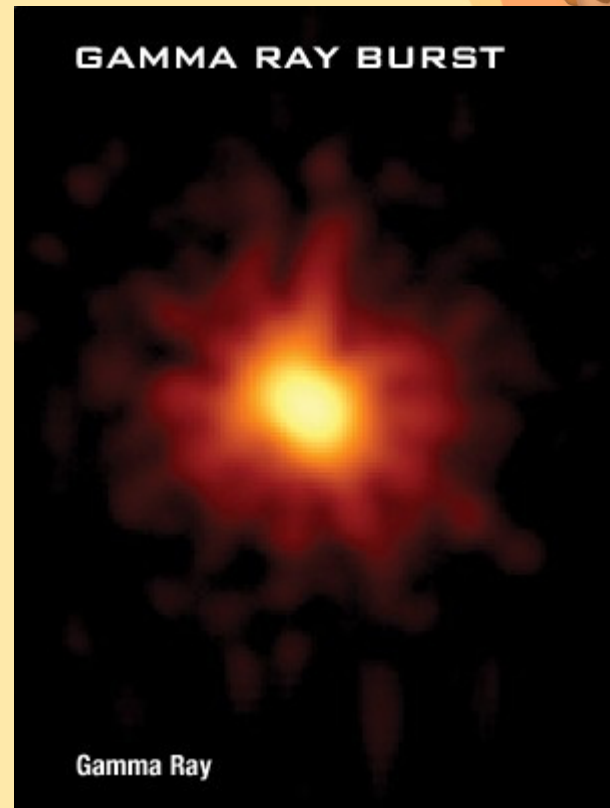
<http://www.womenhealthzone.com/tests-and-treatments/kill-your-cancer-with-radiation-therapy-through-internal-or-external-radiation/>



Advantages

- Understanding the universe by measuring gamma radiation

GAMMA RAY BURSTS



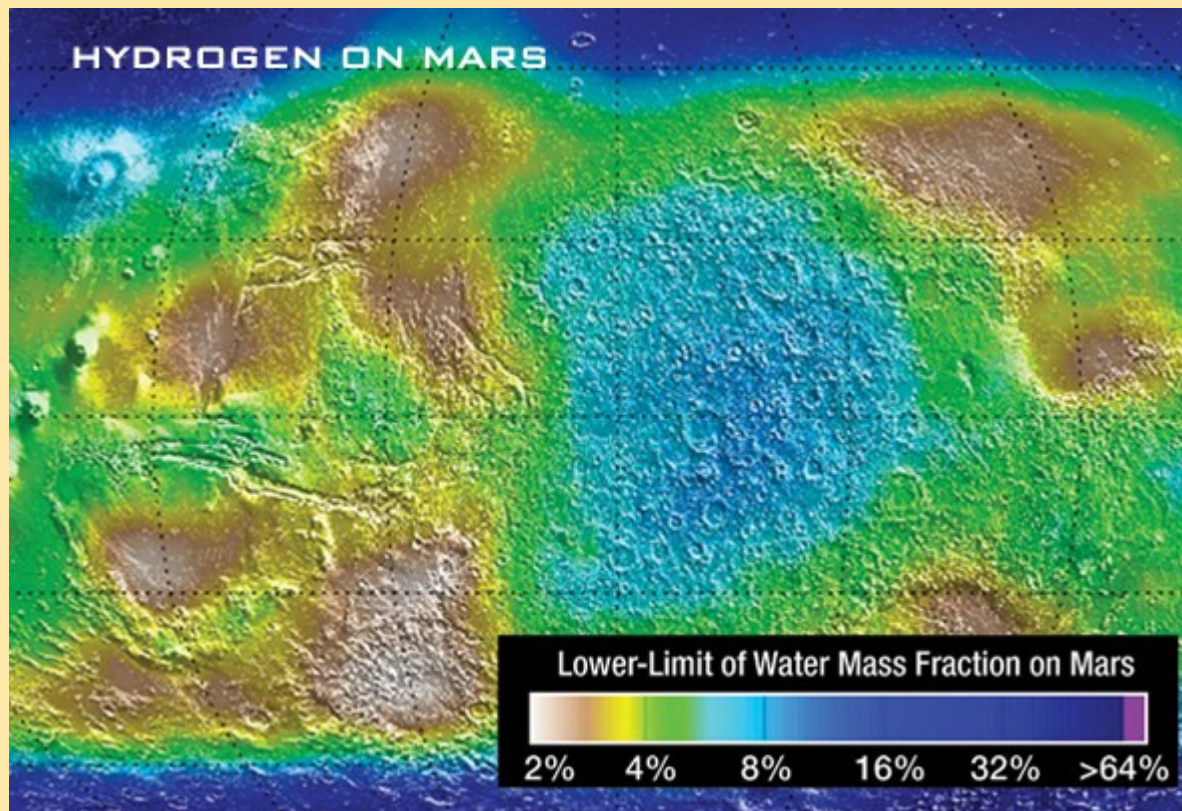
Credit: NASA/Swift/Stefan Immler, et al.

http://missionscience.nasa.gov/ems/12_gammarays.html

http://www.ehow.com/info_8567778_advantages-disadvantages-gamma-rays.html

Advantages

COMPOSITION OF PLANETS



Credit: NASA/Goddard Space Flight Center Scientific Visualization Studio



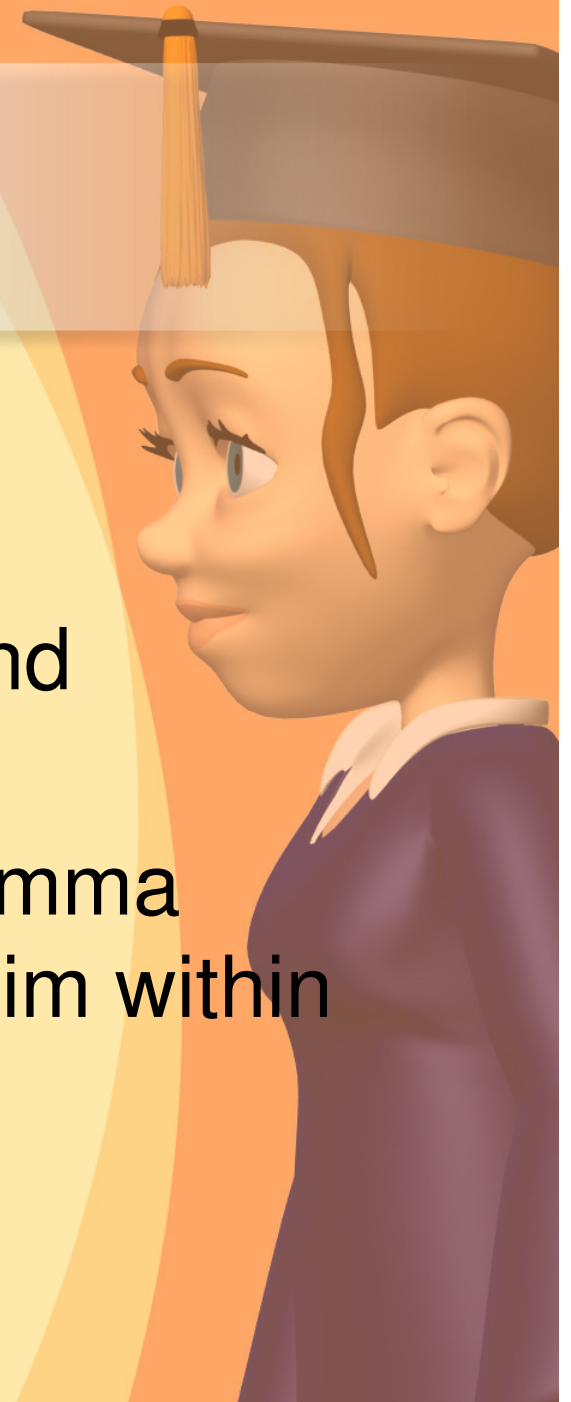
Advantages

- low cost
- small demand (only detector and computer)
- mobility
- high resolution
- high sensitivity and specificity
- possibility of early cancer detection



Disadvantages

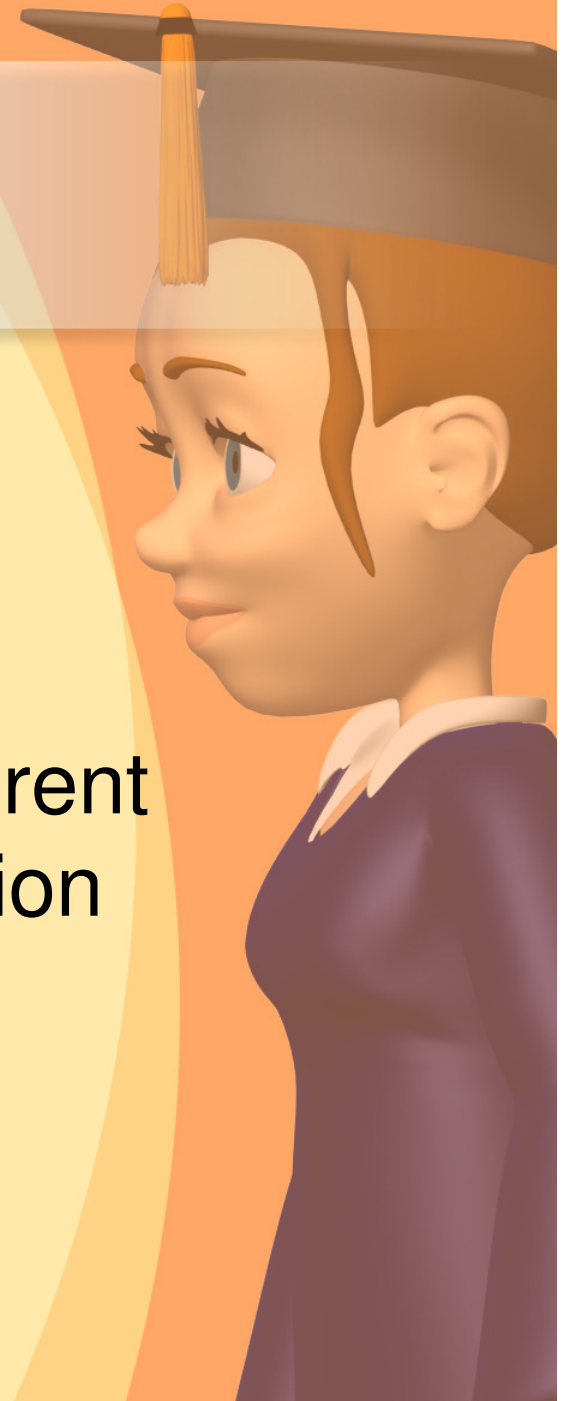
- can kill regular cells
- pregnant women and babies
- nausea, hair loss, skin burns and diminished organ function
- exposure to a lethal dose of gamma radiation will usually kill the victim within two months



Medical applications

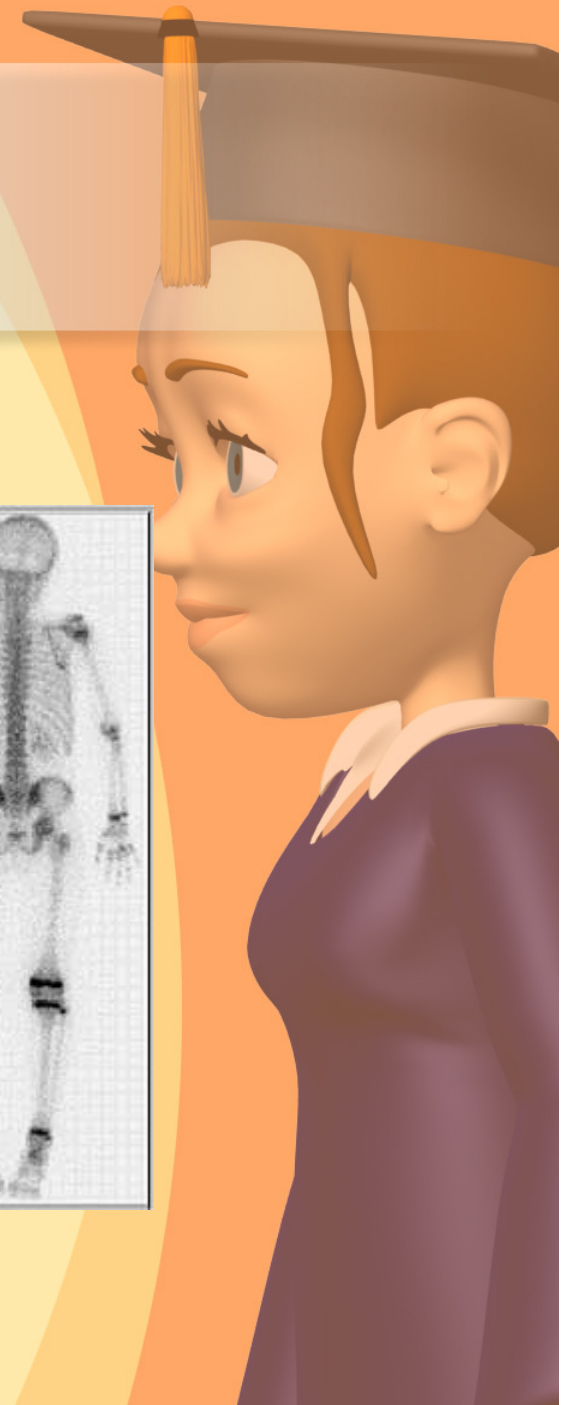
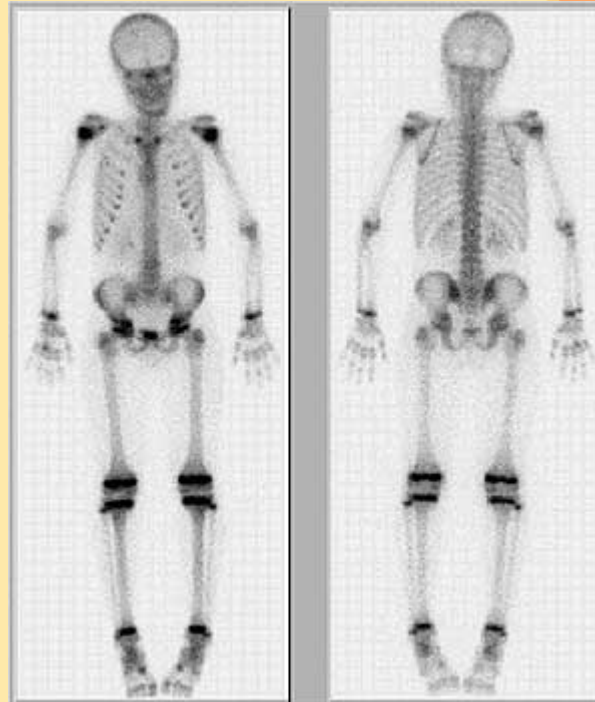
- gamma-knife surgery
treat some types of cancer
kill cancer cells

The beams are aimed from different angles to concentrate the radiation on the growth while minimizing damage to surrounding tissues.



Medical applications

- diagnostic purposes using different gamma-emitting radioisotopes e.g. the spread of cancer to the bones in a bone scan



Medical applications

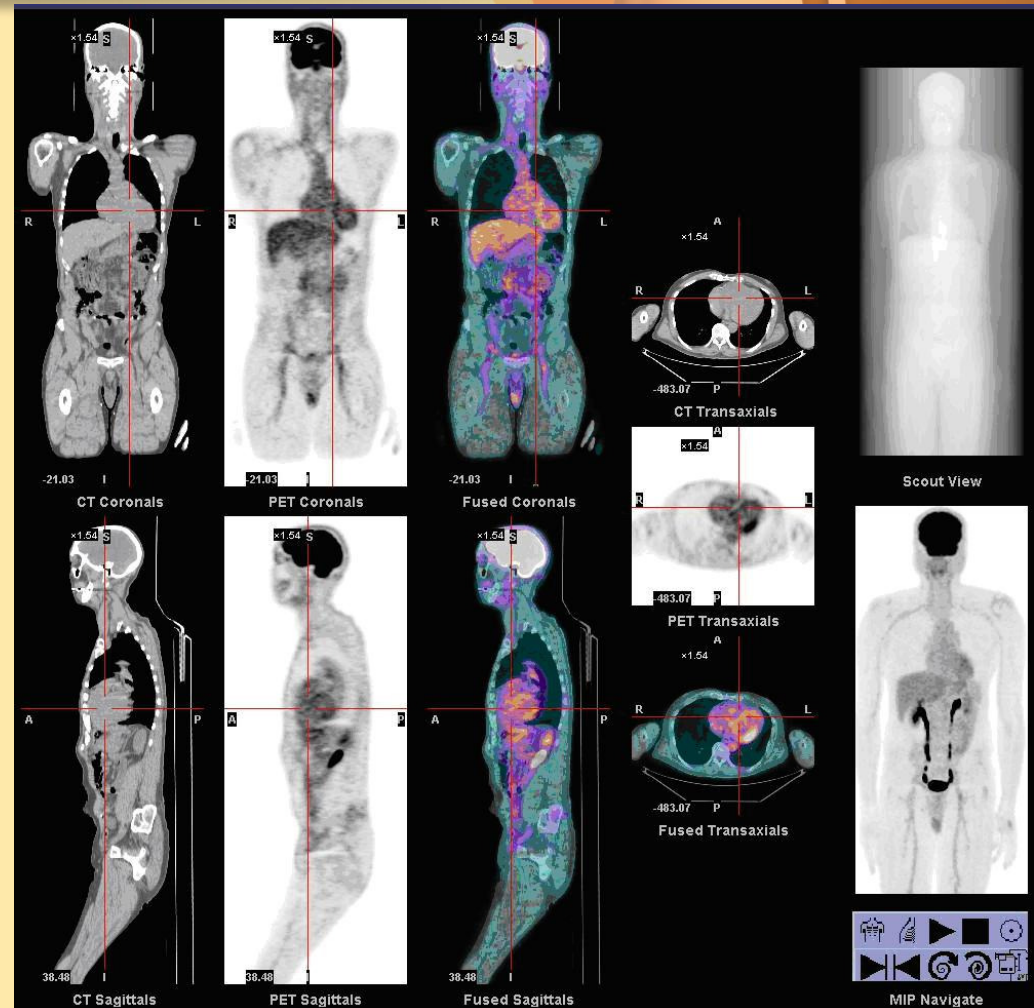
Video: Bone Gamma Imaging

<http://www.youtube.com/watch?v=WFXKNoWqux8>

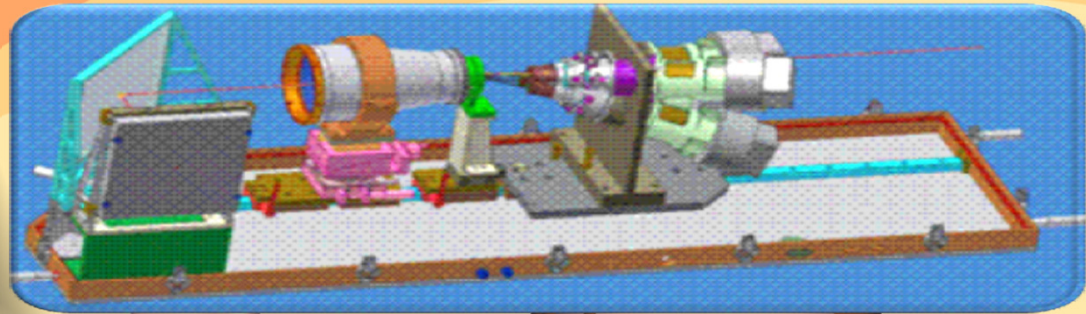


Medical applications

- The obtained “functional” image can be overlaid on an “anatomical” image from a different imaging modality (PetCT).



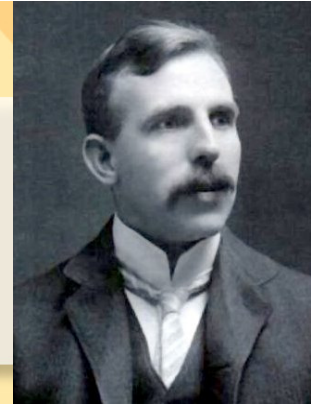
Non-medical applications



- screen merchant ship containers before they enter US ports.
- sterilizing medical equipment
- removing decay-causing bacteria from many foods



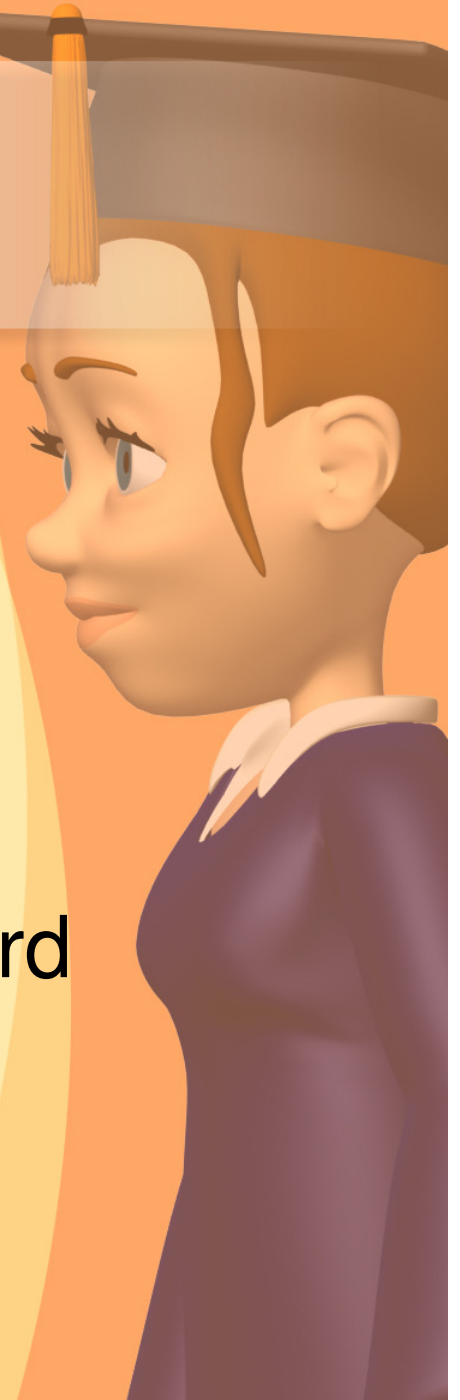
History



- Paul Villard, a French chemist and physicist, discovered gamma radiation in 1900, while studying radiation emitted from radium.
- Villard's radiation was named "gamma rays" by Ernest Rutherford in 1903.

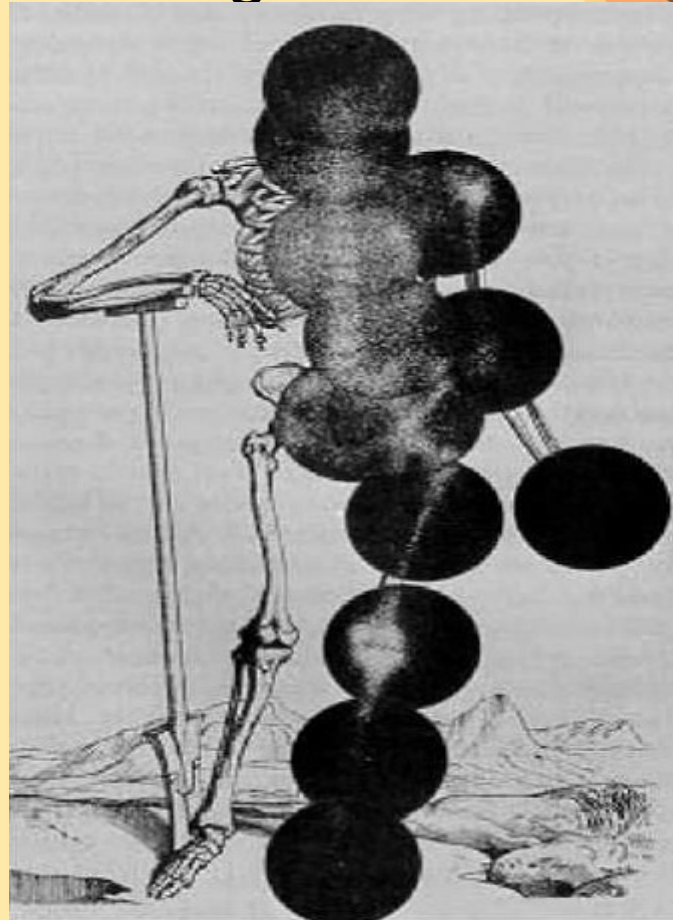
http://en.wikipedia.org/wiki/Ernest_Rutherford

http://en.wikipedia.org/wiki/Paul_Villard



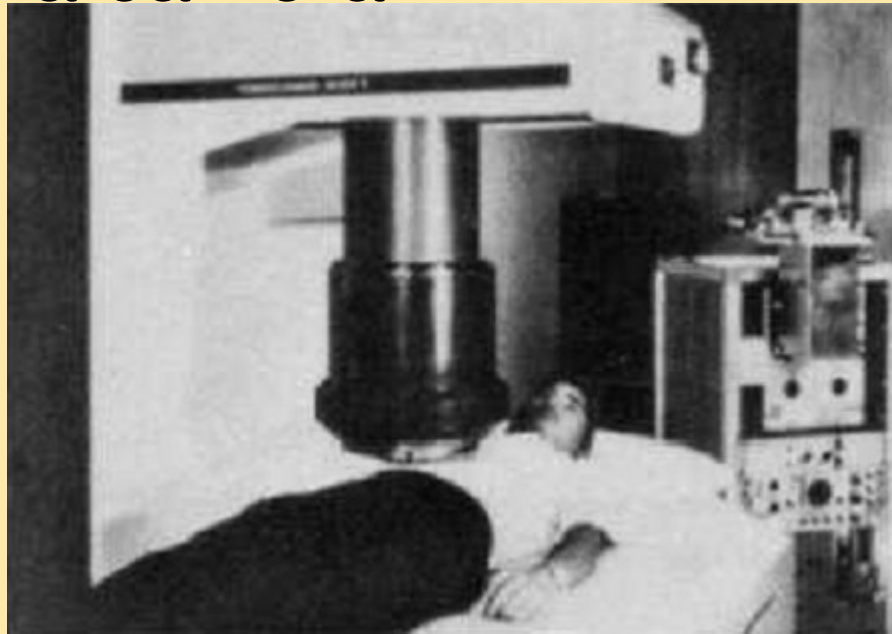
History

Hal AngerIn (1950's) the first gamma camera



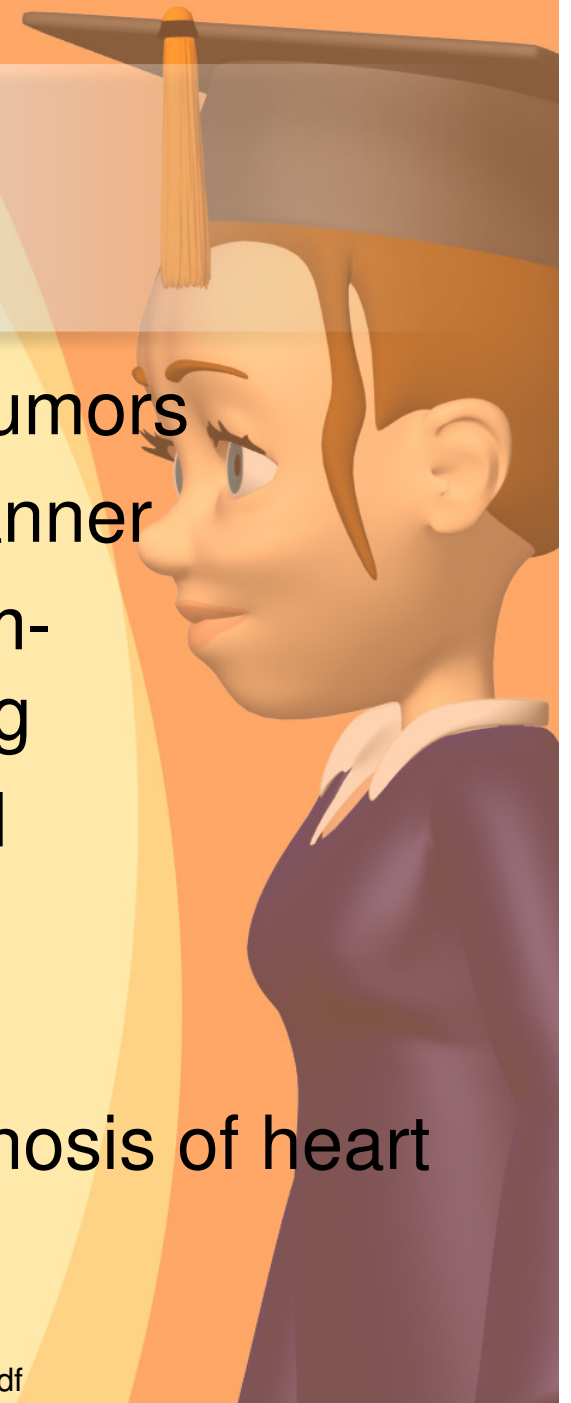
History

- 1970s, the ‘tomoscanner’ Anger
- a focused collimator was mounted onto a gamma camera .



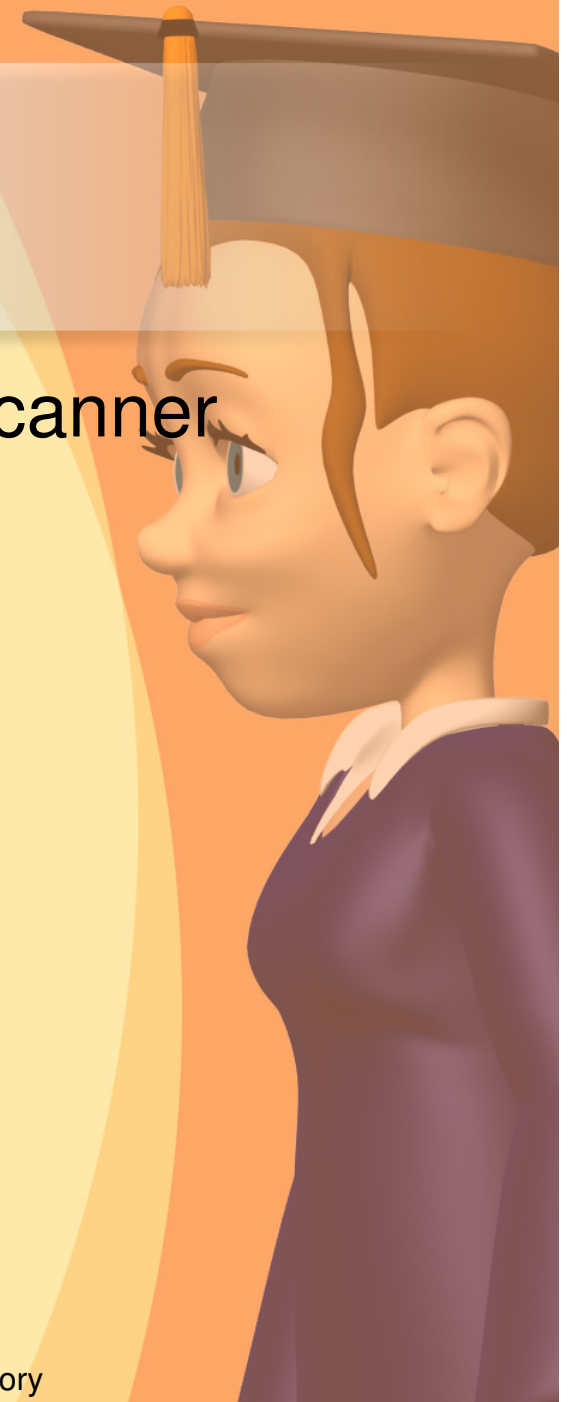
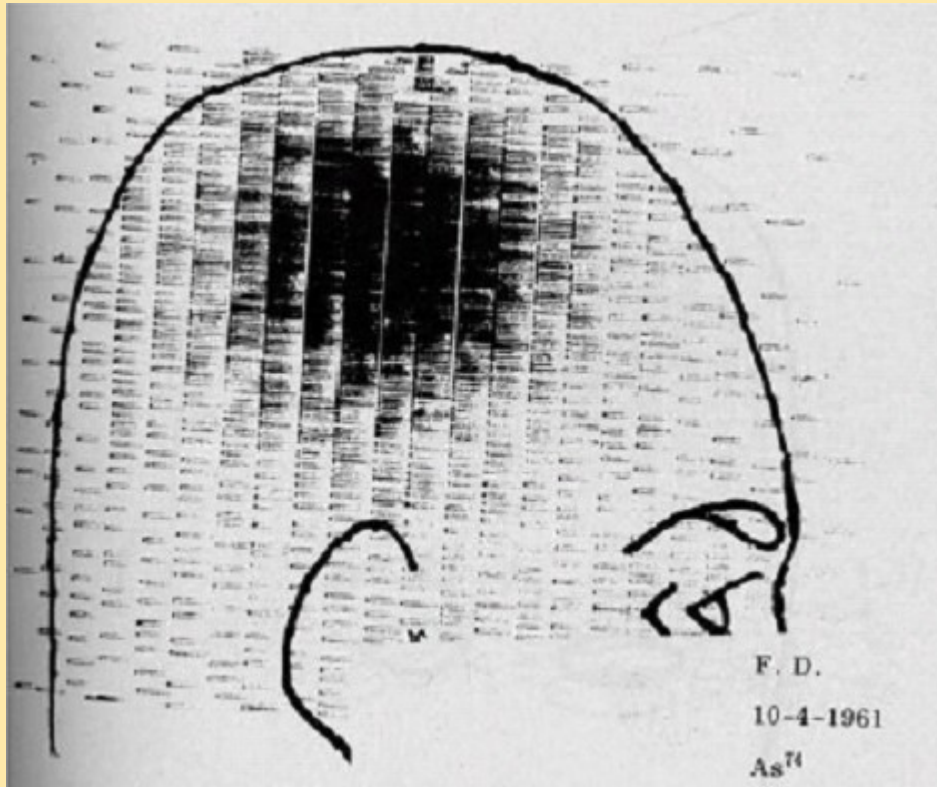
Development

- 1960s, Anger positron camera, bone tumors
- 1970, The multi-crystal whole body scanner
- 1972, Yukio Yanodevised a technetium-99m/phosphate system, bone scanning
- 1974, gated cardiac imaging appeared
- 1976, multi-headed devices
- 1978, dynamic gated PET
- 1979, rubidium-82, dynamic PET diagnosis of heart disease



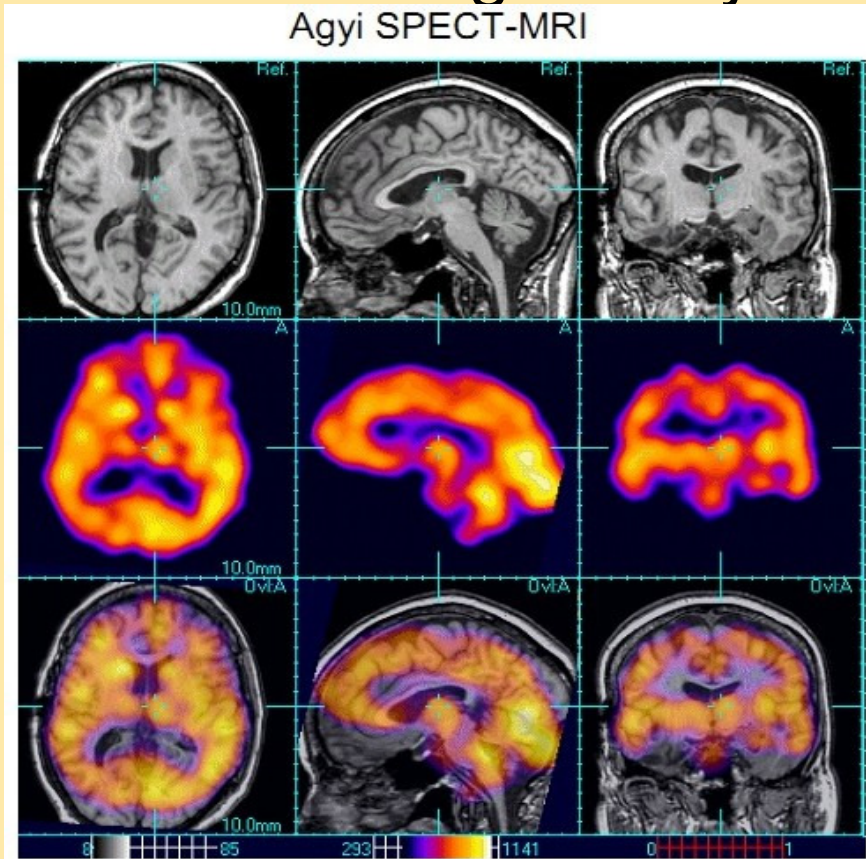
Development

Image of a brain taken in 1961 using a scanner



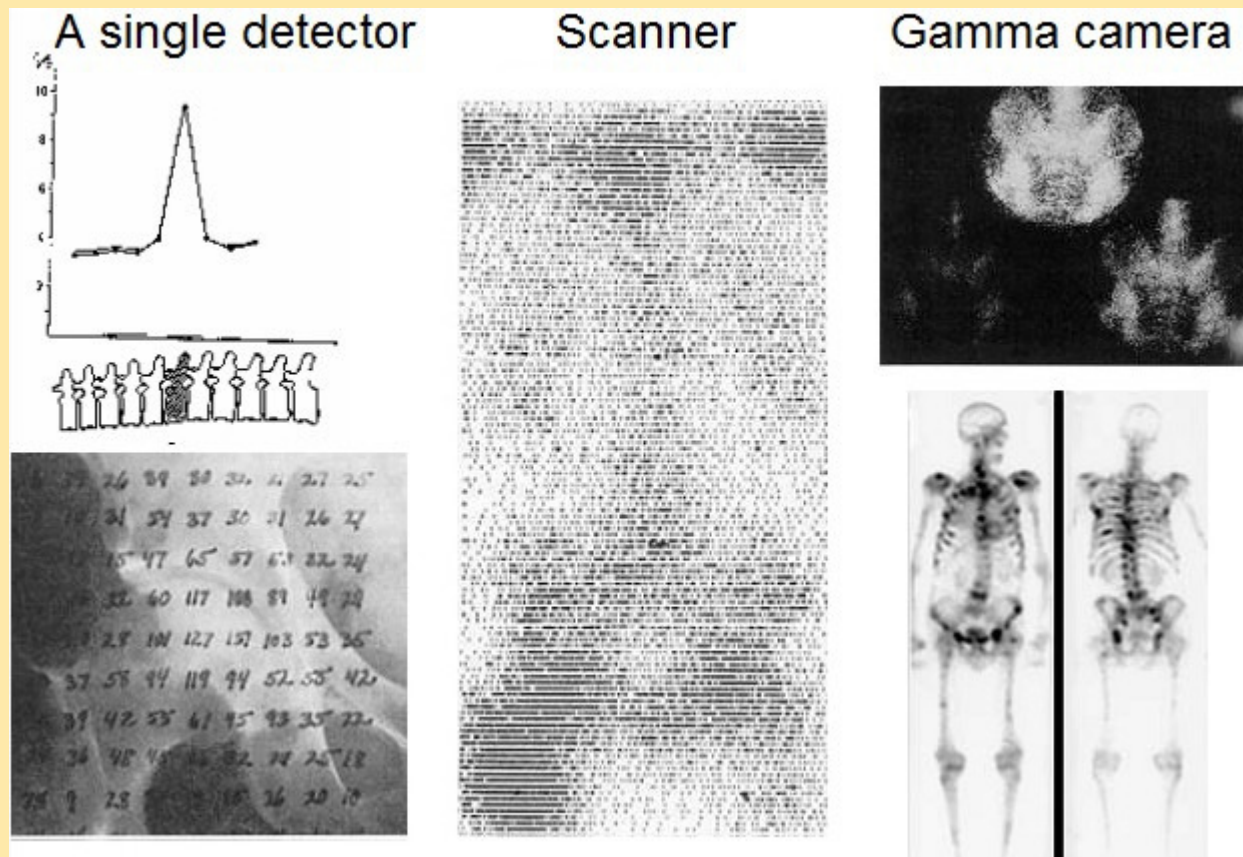
Development

PET-MRI image today



Development

Bone scan with various methods

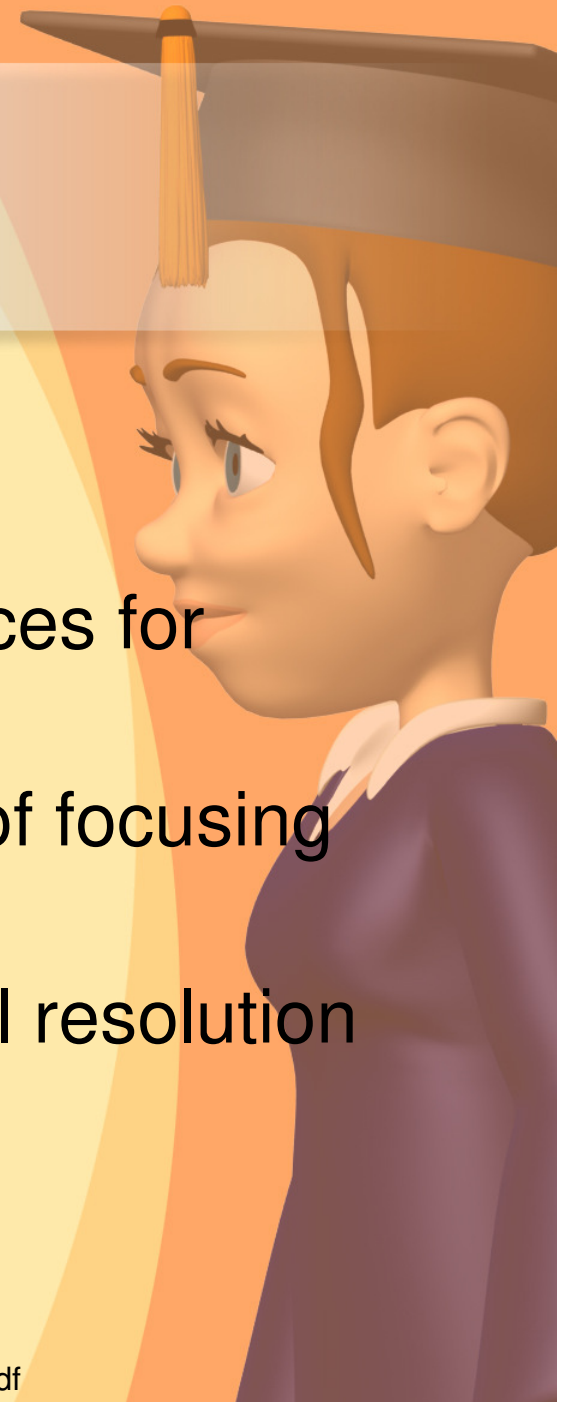


Development

University of Chicago

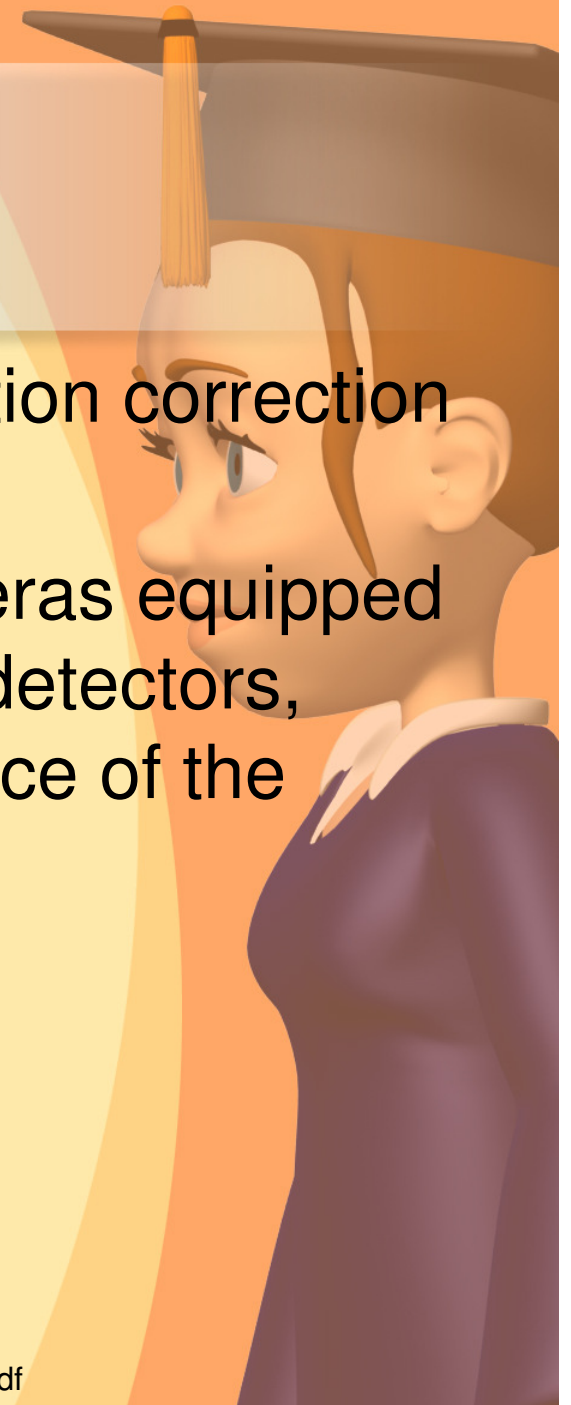
Beck: **Aebersold Award, 1991**

- the design of rectilinear scanning devices for radionuclide imaging
- theoretical analysis and optimization of focusing collimators
- studies of the trade-off between spatial resolution and sensitivity.



Development

- 1992, the first SPECT-CT, attenuation correction applied based on the CT image
- early 2000s, the first gamma cameras equipped with CZT (cadmium zinc telluride) detectors, portability, not widespread, high price of the detector



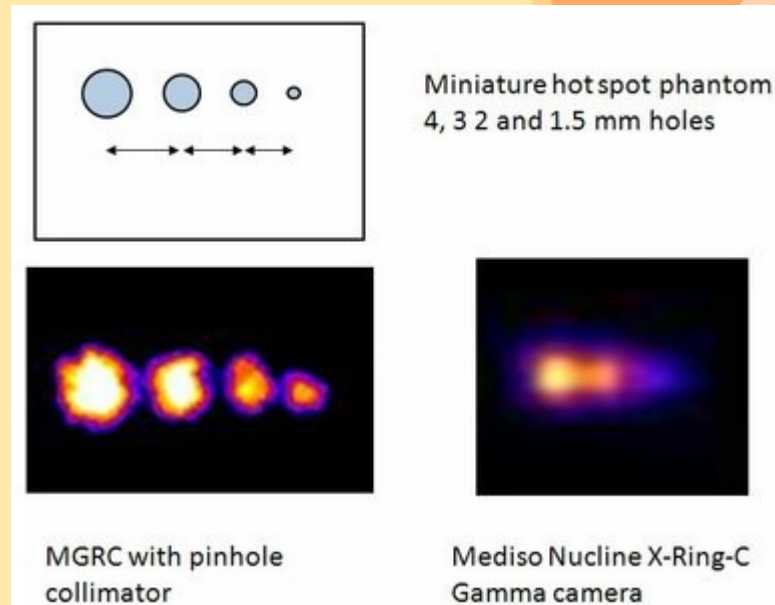
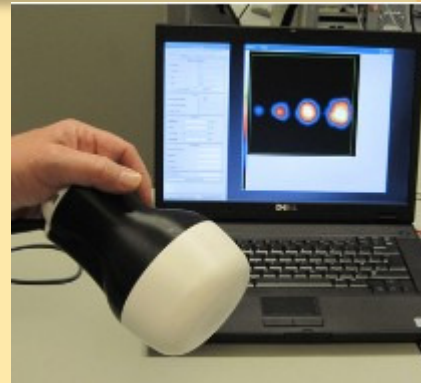
Advances have been made in:

- Development of collimator and component design
- Photomultiplier tube coupling
- Digitization of output for each multiplier
- Advent of correction maps



Mini Gamma-Ray Camera(MGRC)

Collimated
Scintillator-coated,
Low noise
Generic low cost
High performance
Hand held
Spatial resolution ~ 0.5 mm
Energy range 30 –160 keV



Dual Head Gamma Camera

Manufacturer: Toshiba

Model: GCA-7200A

Department: Nuclear
Medicine

Scan whole body
anterior and posterior
view simultaneously



Dilon 6800 Gamma Camera

- Molecular breast imaging procedure
- Compact Detector
- SmartShield



Imaging techniques using gamma cameras

- Scintigraphy
- capture emitted radiation from internal radioisotopes
- create two-dimensional images

<http://en.wikipedia.org/wiki/Scintigraphy>



Imaging techniques using gamma cameras

- SPECT
- nuclear cardiac stress testing
- usually one, two or three detectors or heads, are slowly rotated around the patient's torso



Imaging techniques using gamma cameras

- Multi-headed gamma cameras
- Positron emission tomography
- hardware and software can be configured to detect 'coincidences'



Imaging techniques using gamma cameras

- 2009- inSPira HD Portable SPECT
- runs on batteries
- 1800 pounds
- can be moved around hospital wards when needed
- spiral-rotating focused collimator.



Imaging techniques using gamma cameras

- 2011 – PosiRx Automated Radiopharmaceutical System
- manage every aspect of the compounding and dose drawing process
- high levels of accuracy and reproducibility



Cost

- SPECT Gamma Cameras cost: \$400,000 to \$600,000.
- SPECT/CT Machine: \$1.5 and \$2 million
- SPECT Scan Price: Depends on the location
 - A complete evaluation can cost up to \$3,000, not covered by most insurance plans.

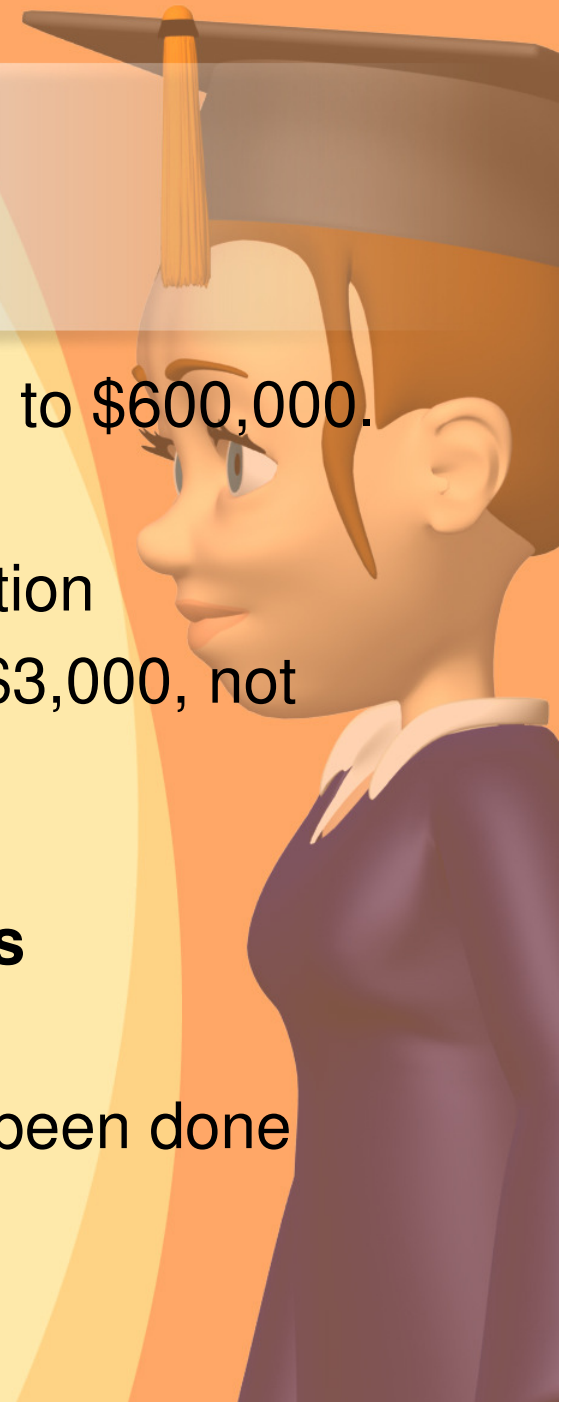
Annual SPECT Performed Procedures

- 2007 -15.9 million SPECT procedures
- 2010- 7 million SPECT procedures have been done each year (U.S.)

<http://sydney.edu.au/news/84.html?newsstoryid=760>

http://www.biotechsystems.com/breakingmarketnews/spect-ct_revitalize_nuclear_medicine.asp

http://www.imagingeconomics.com/issues/articles/2010-07_08.asp



The End



Thank You!

