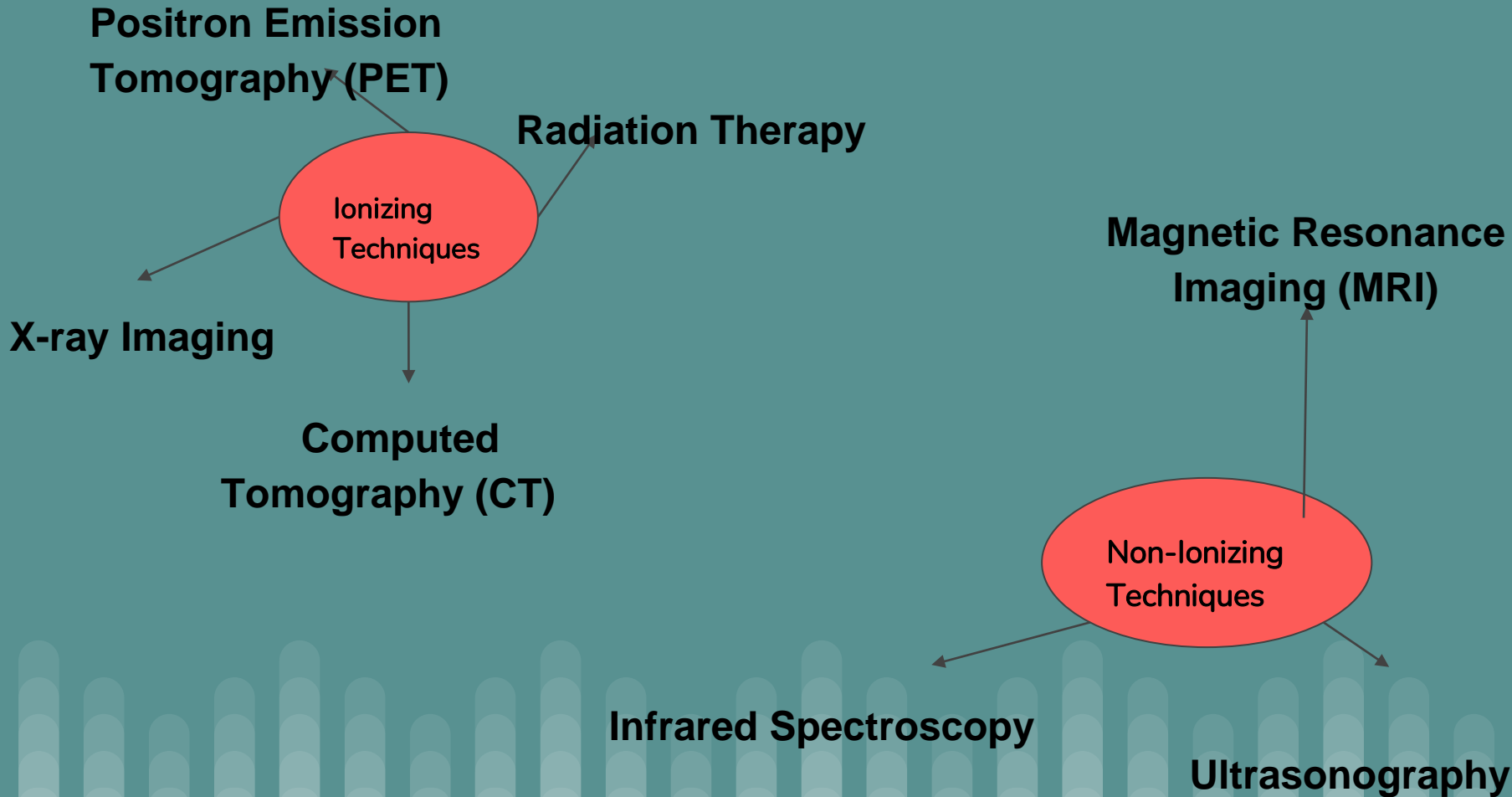


Applications of fundamental particles in medical imaging

students : Ana Andrei & Georgescu Daria

coordinated by Joni Pham



Non-ionization imaging methods

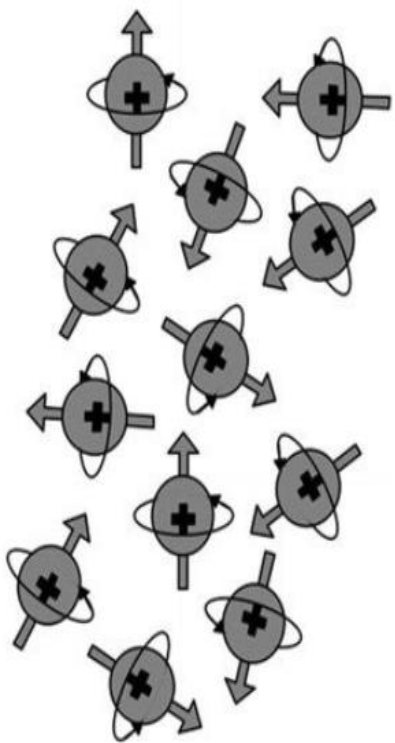
A photograph of a clinical MRI scanner room. The scanner is a large, white, cylindrical machine with a patient lying on a table inside the bore. The room has a white ceiling with recessed lights and a light-colored floor. There are shelves with medical equipment on the right and a trash can on the left.

MRI - Magnetic Resonance Imaging

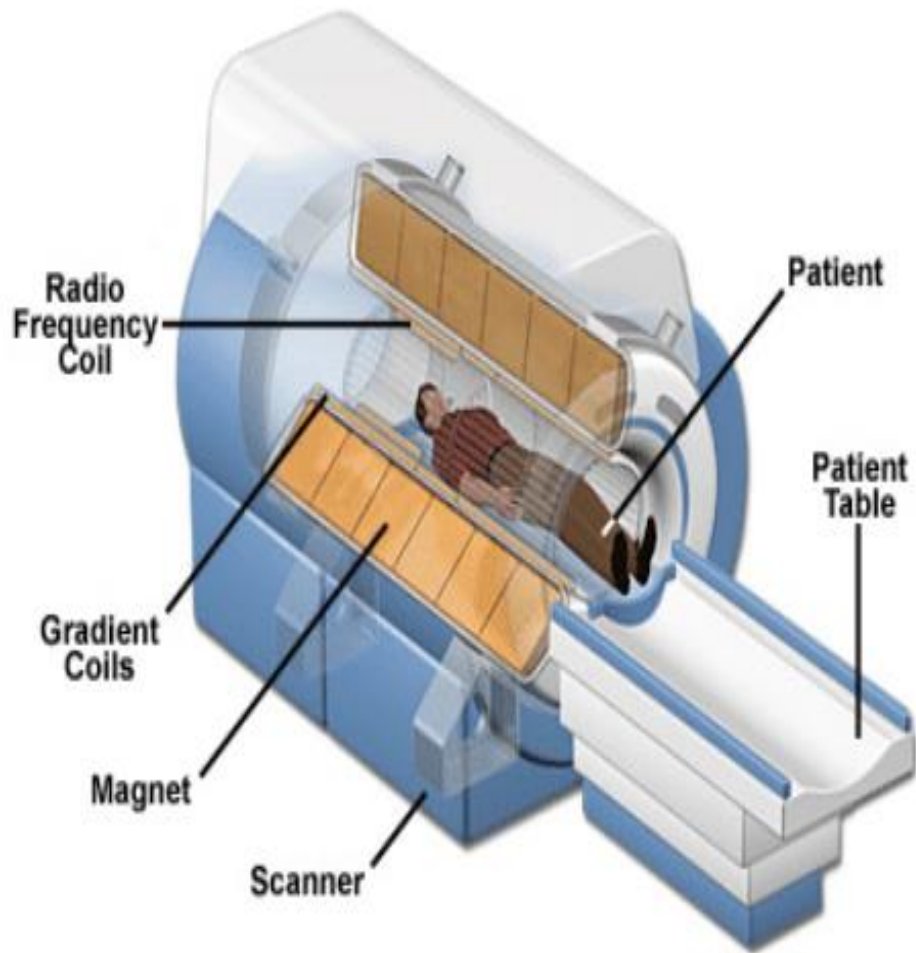
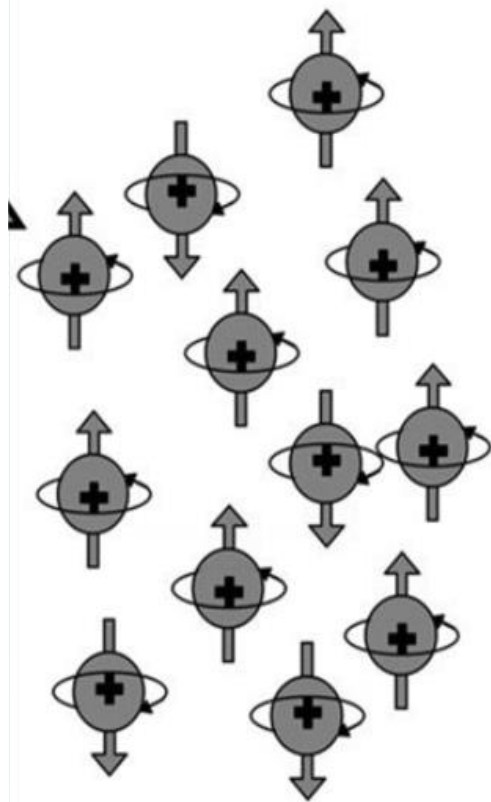
**HOW DOES IT
WORK?**




No External Magnetic Field



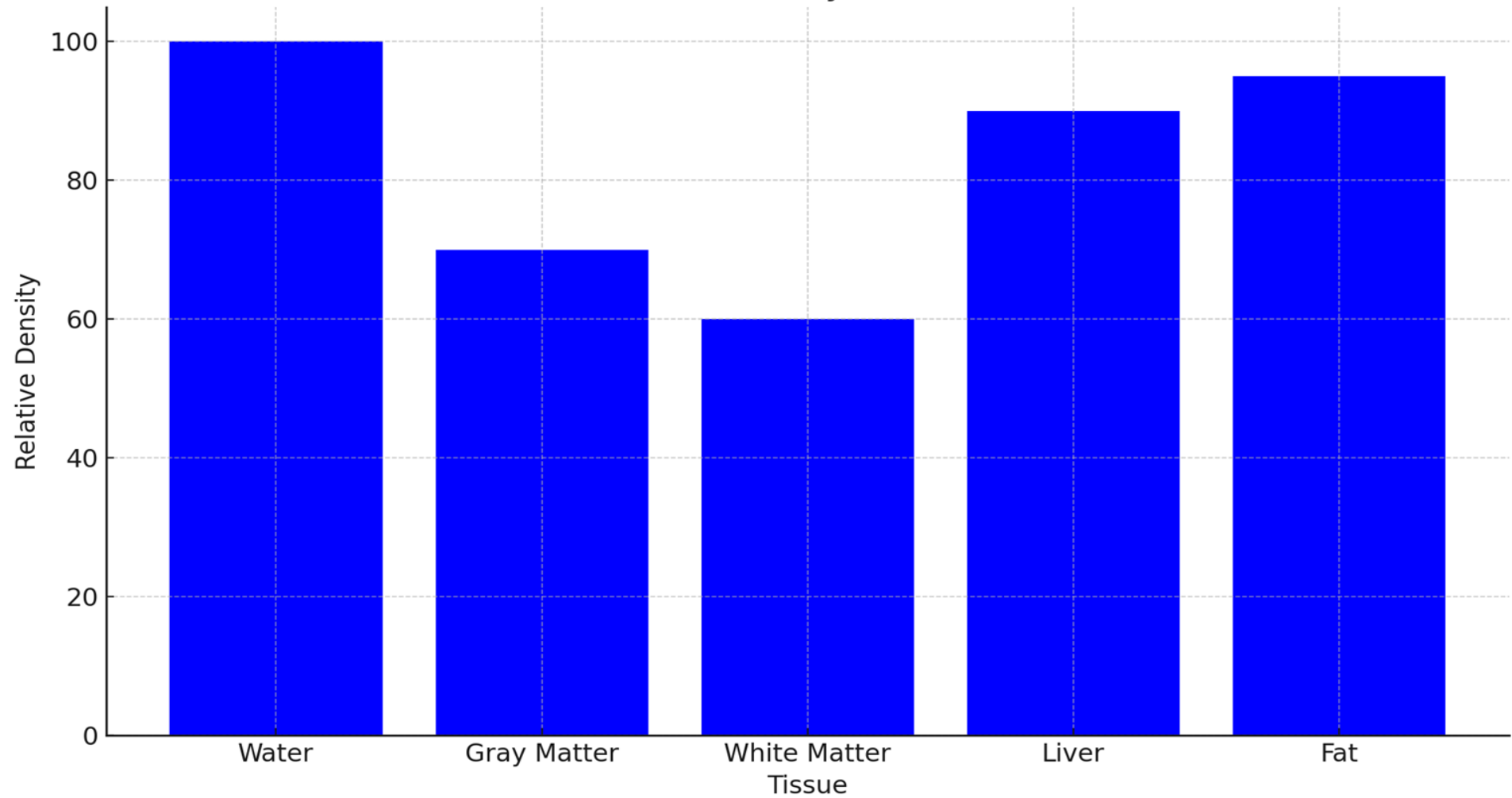
Applied External Magnetic Field



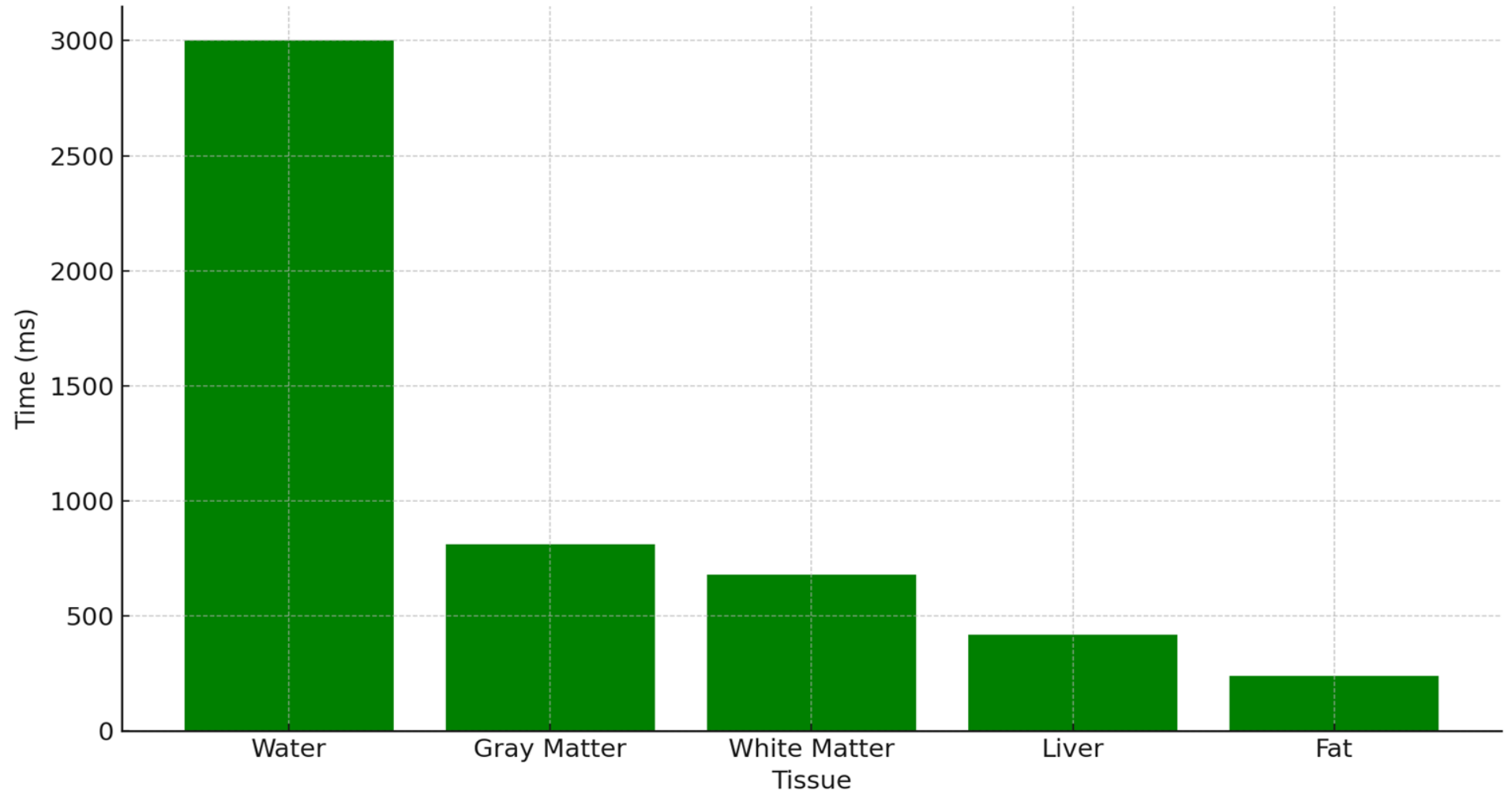
**But how do
we create
these images?**

A decorative pattern of vertical bars of varying heights and shades of teal, located at the bottom of the slide.

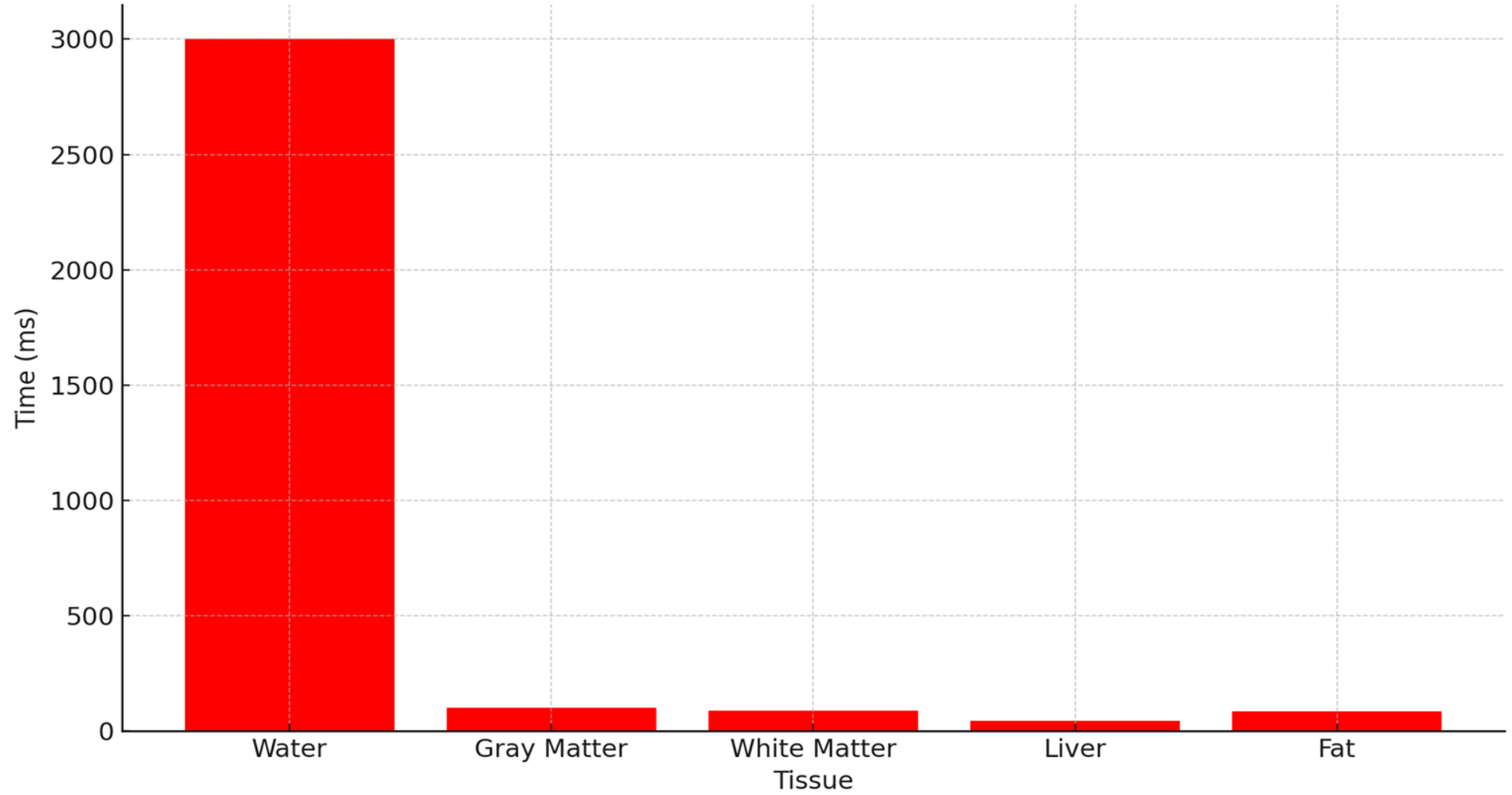
Proton Density (Relative)

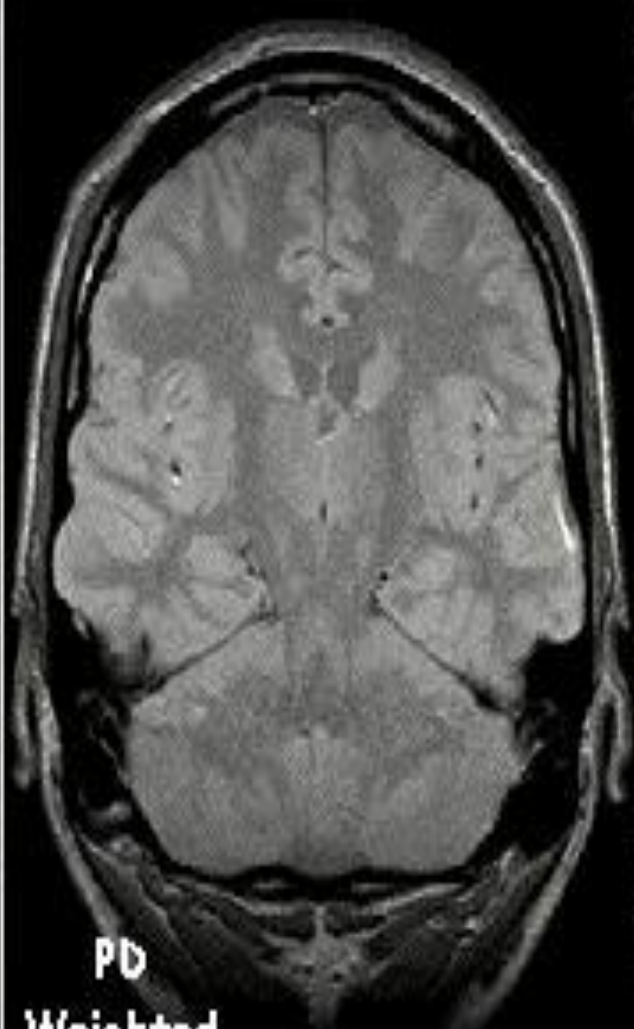
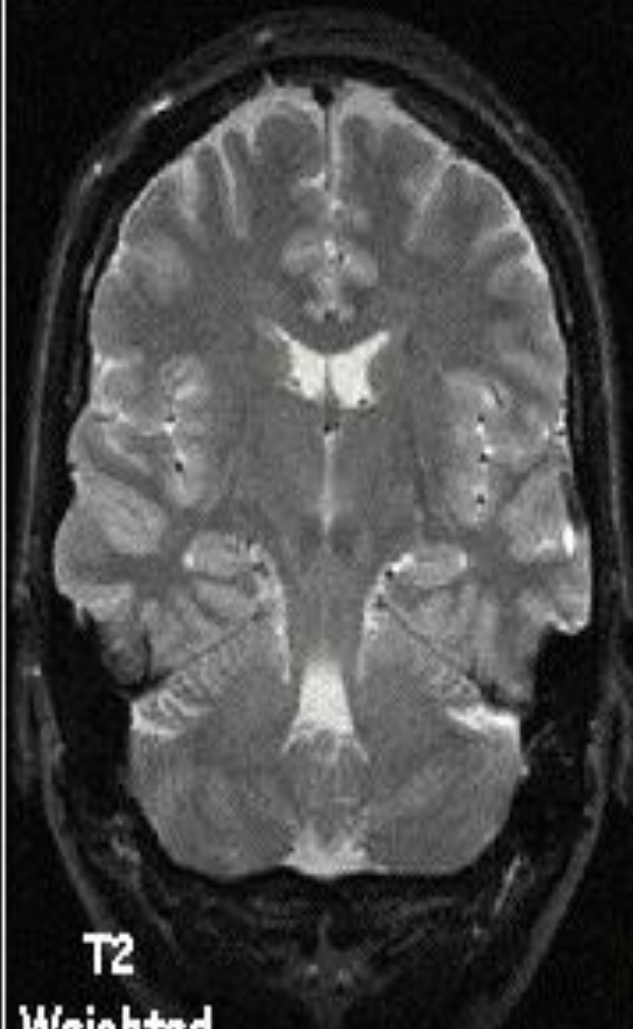
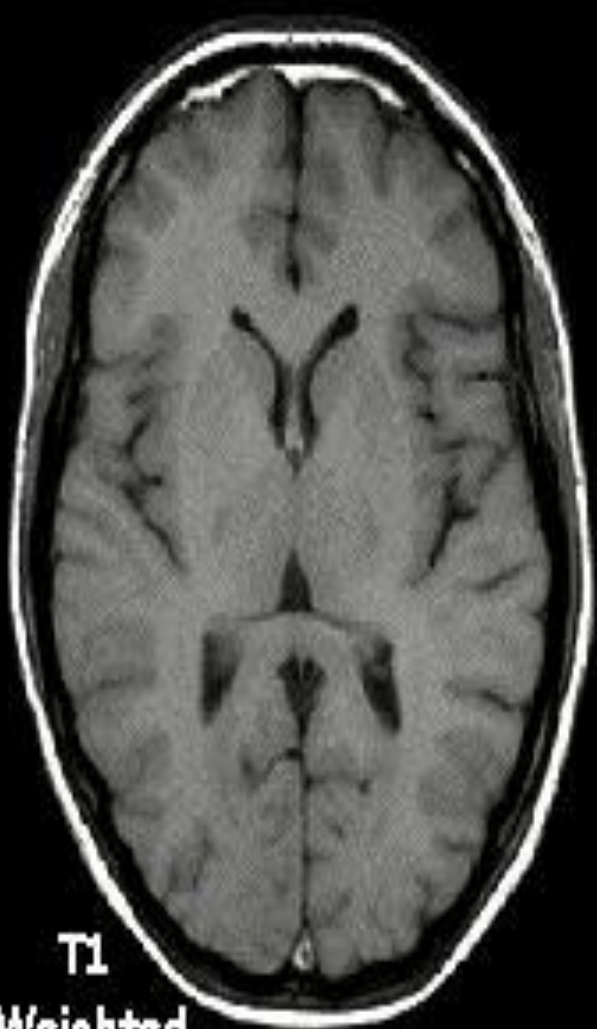


T1 Relaxation Time (ms)



T2 Relaxation Time (ms)





MRI

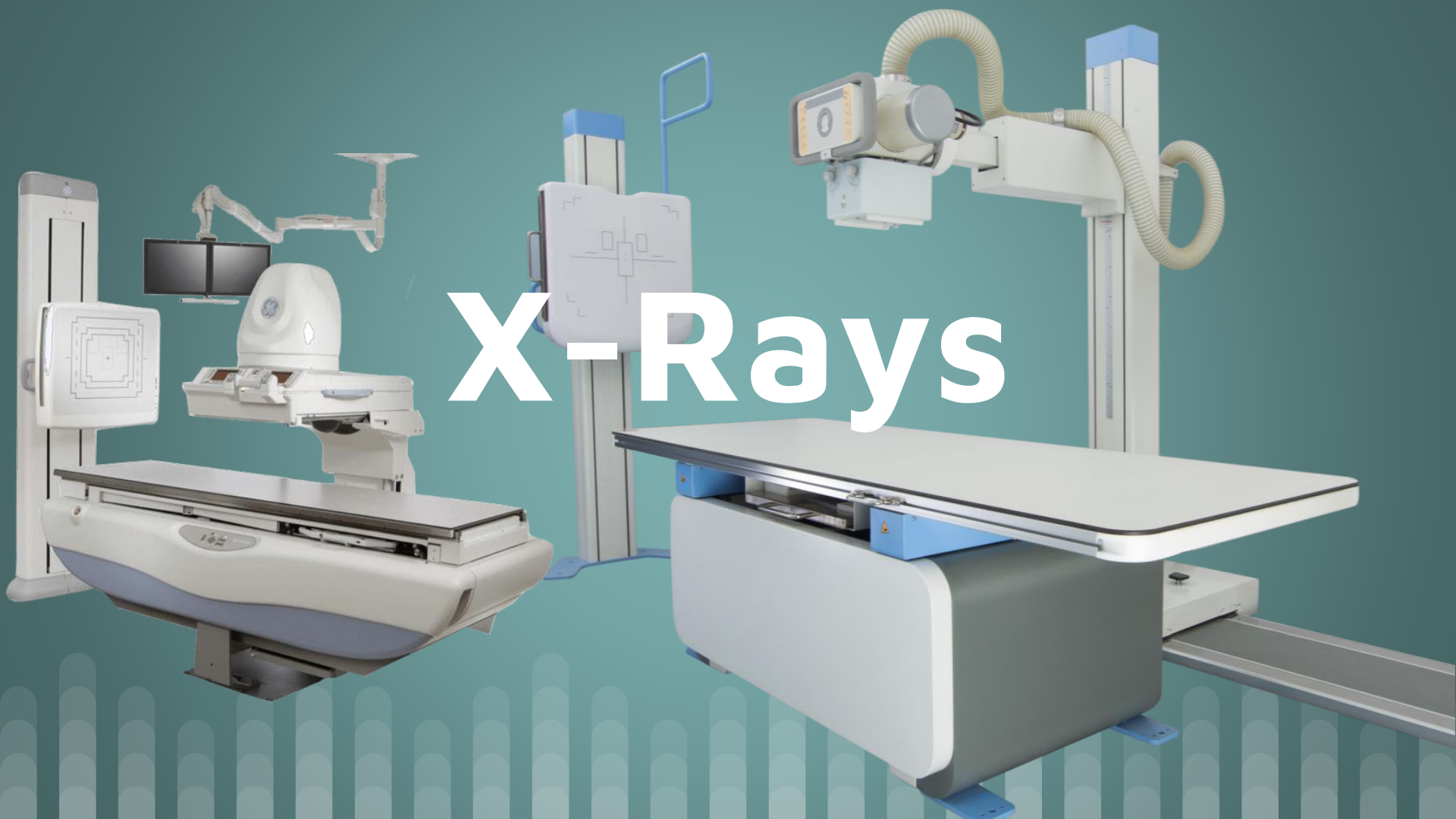


X-ray

Advantages & Risks



**Why does the MRI
have this funny-
looking shape?**



X-Rays

USES

ANGIOGRAPHY & VASC INTERVENTION(3%)

GASTROINTESTINAL AND
UROGENITAL TRACT (2%)

MAMOGRAPHY (7%)

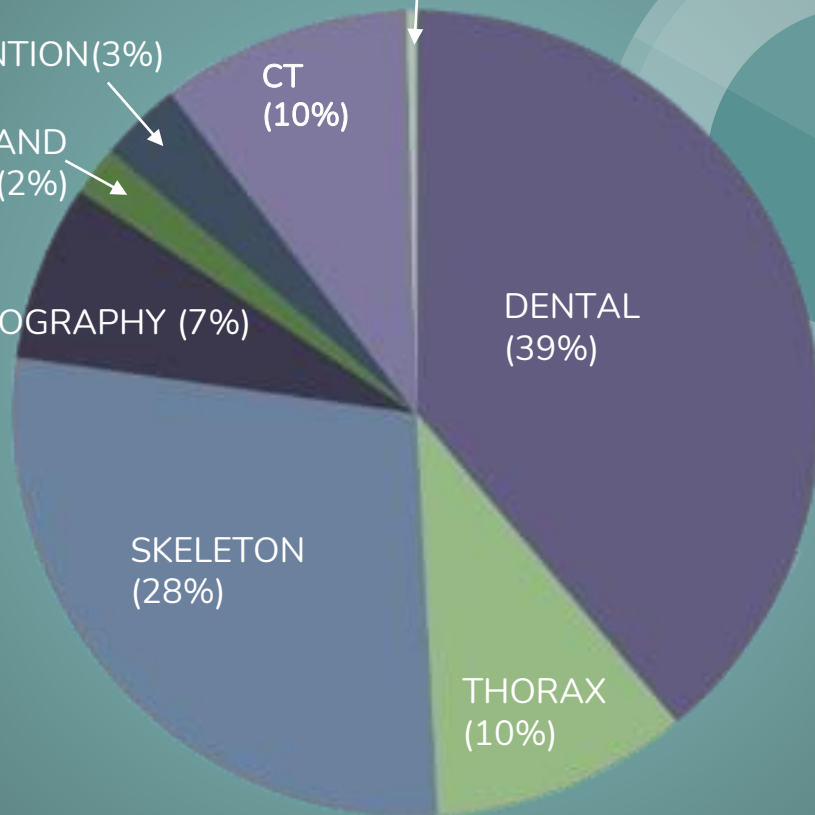
SKELETON
(28%)

THORAX
(10%)

CT
(10%)

DENTAL
(39%)

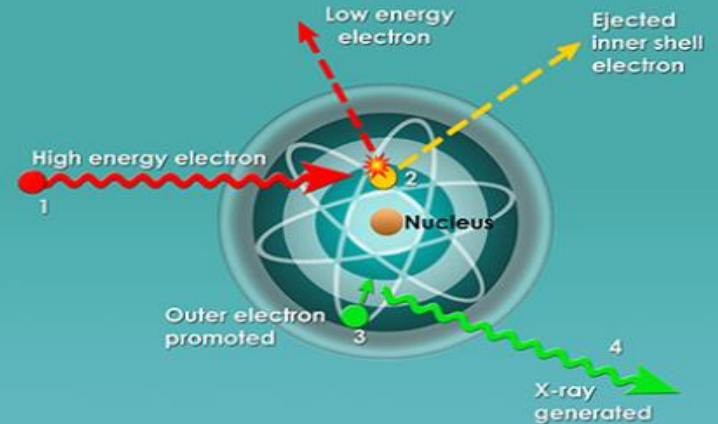
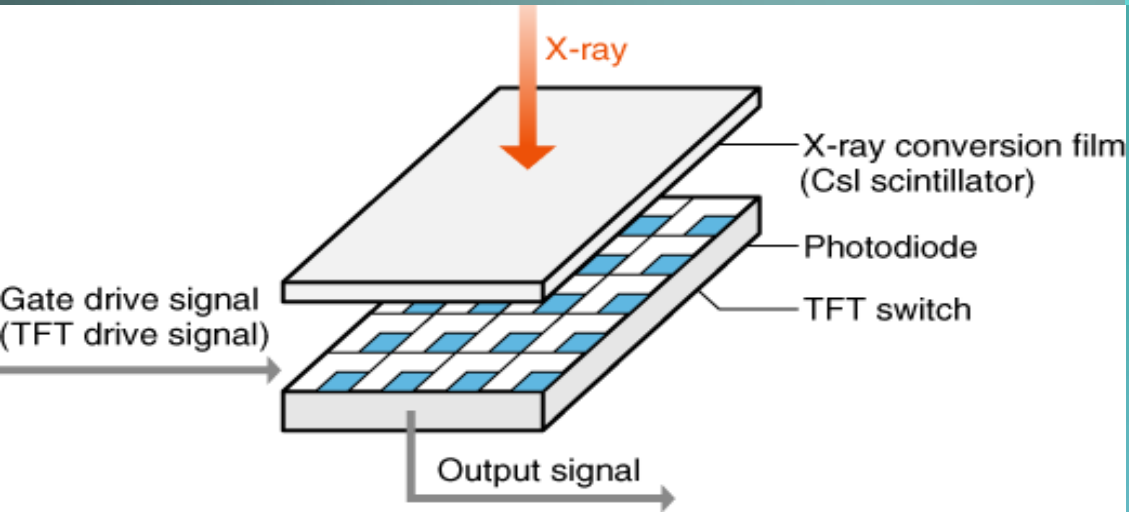
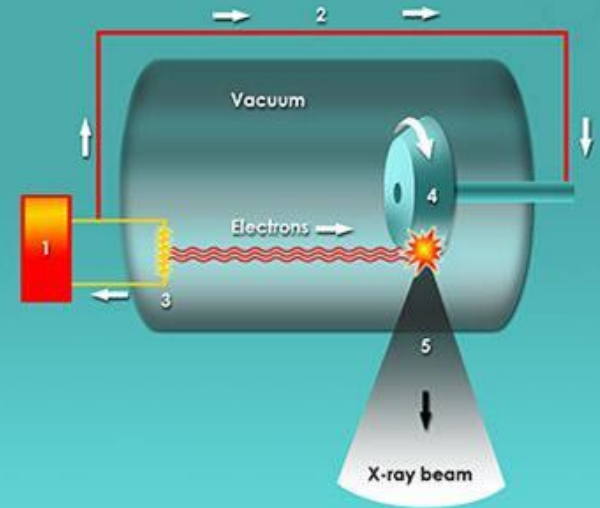
REMAINDER(0,4%)



COMPONENTS AND FUNCTIONING

Main components :

- X-Ray generator
- Image detection system





applications & shortcomings



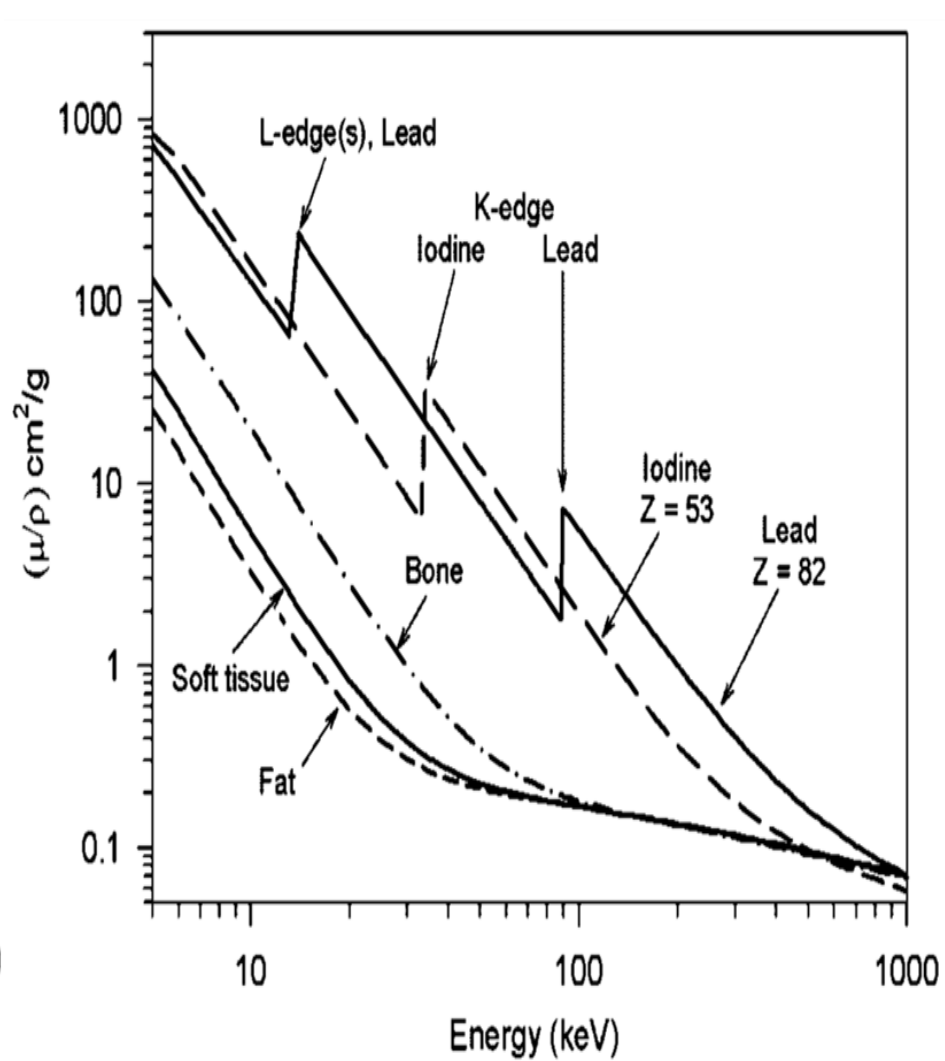
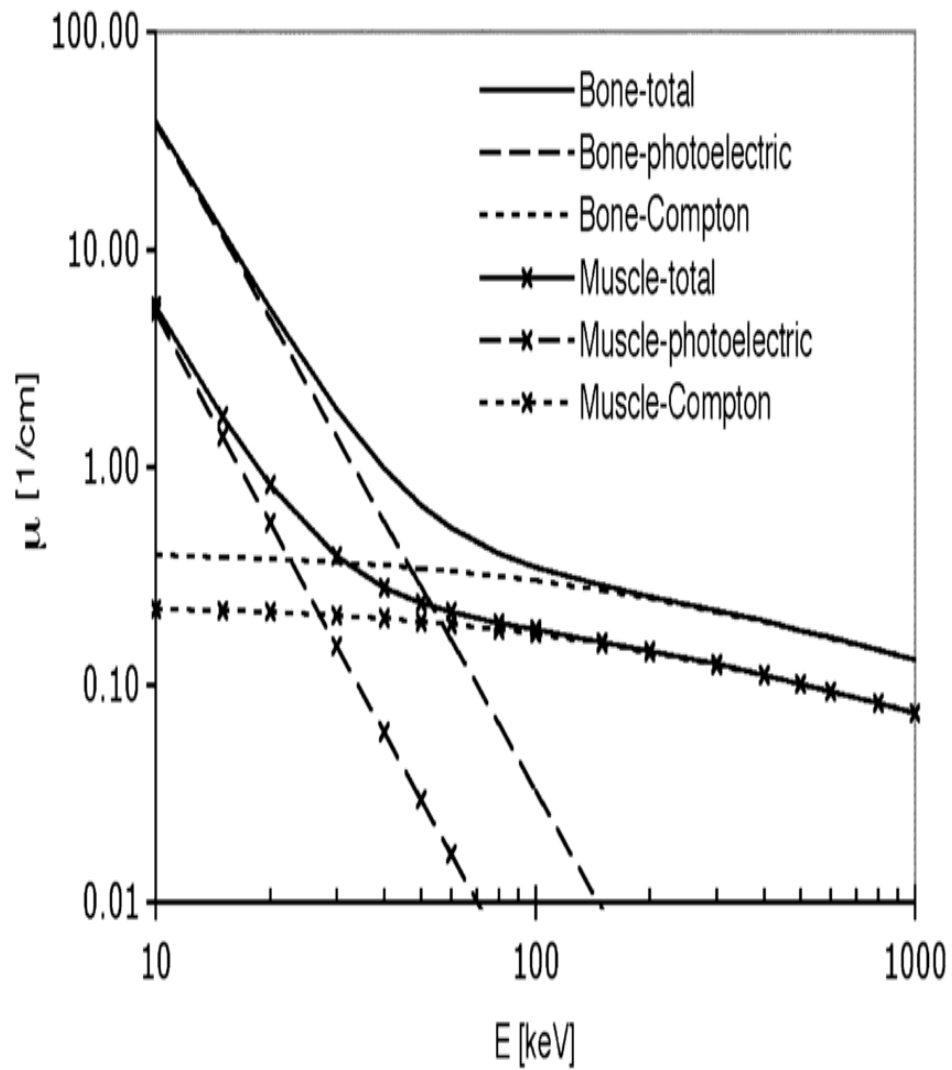


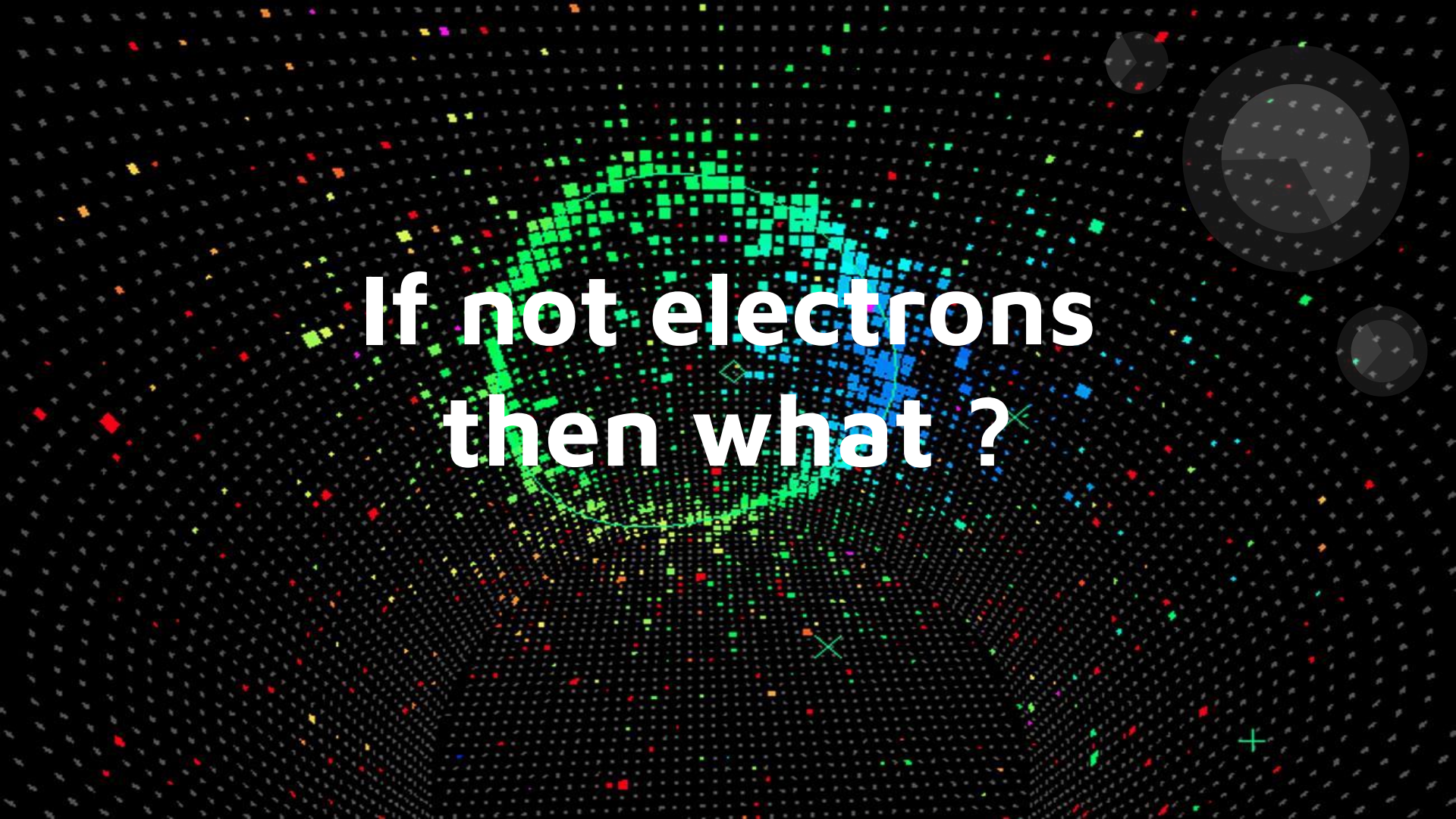
wavelengths : 0.01 to 10 nanometers,

frequency : 30 petahertz to 30 exahertz (31016 Hz to 31019 Hz)

energy: 100 eV to 150 keV.

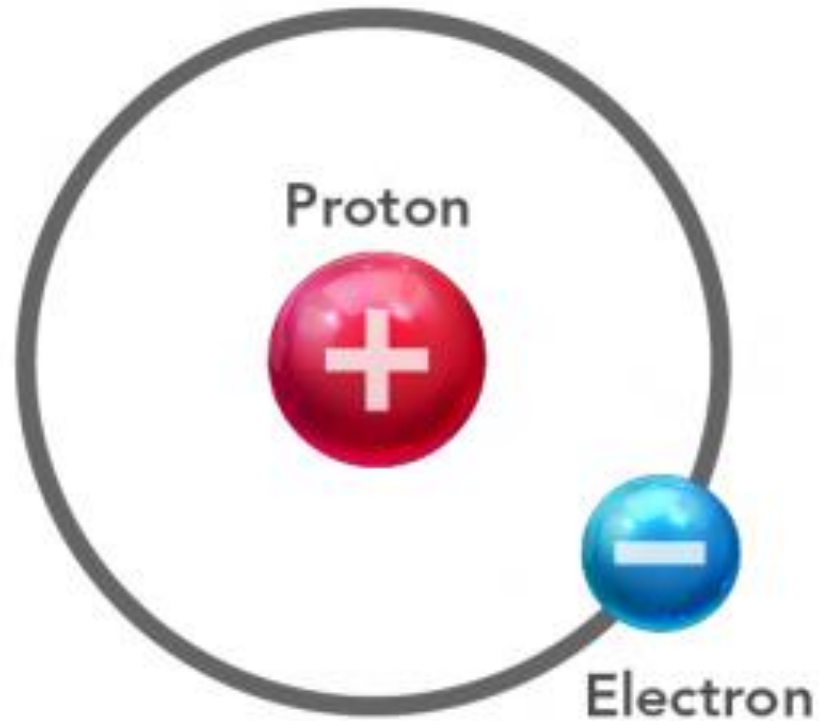






**If not electrons
then what ?**

MATTER

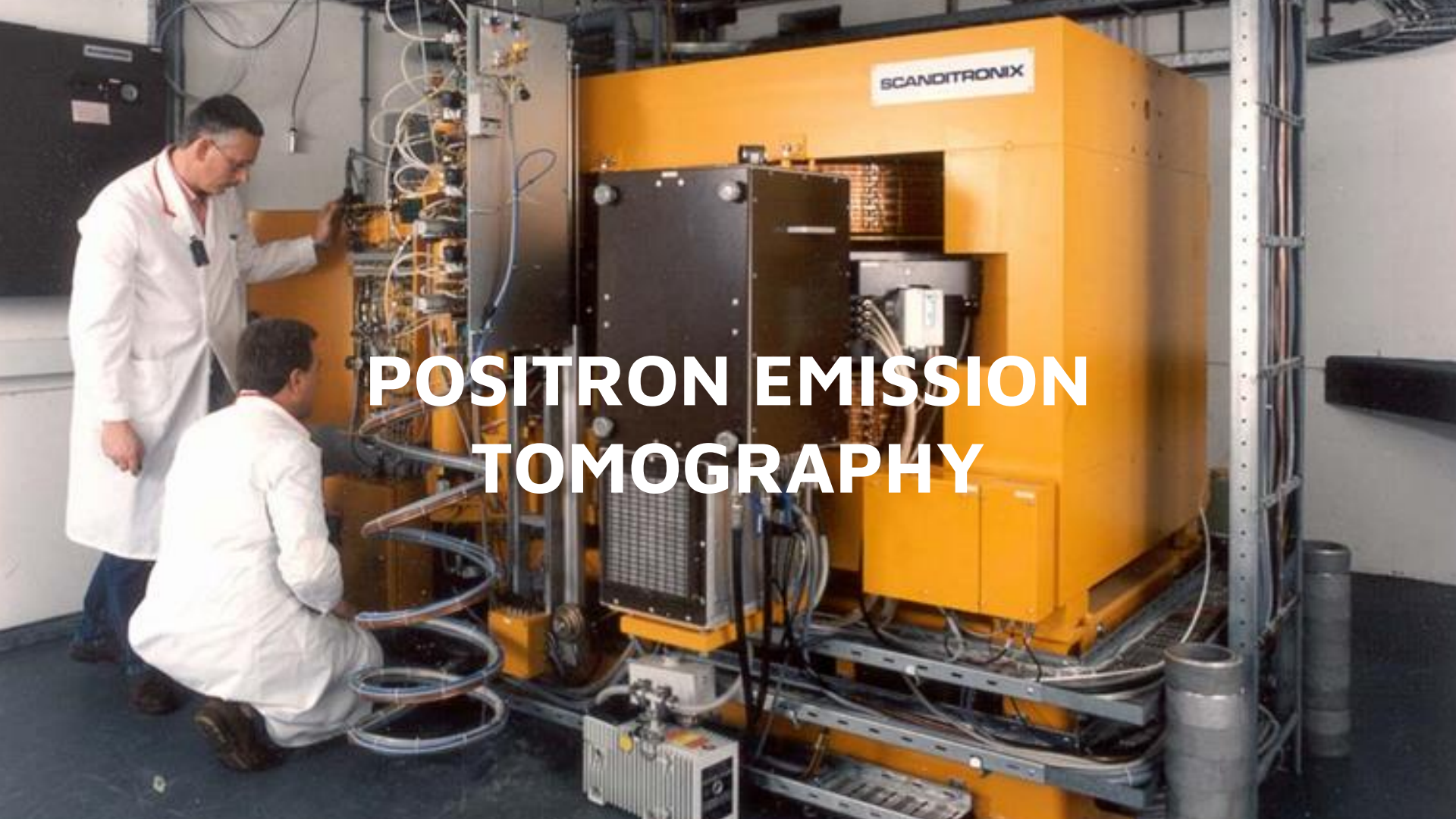


HYDROGEN

ANTIMATTER

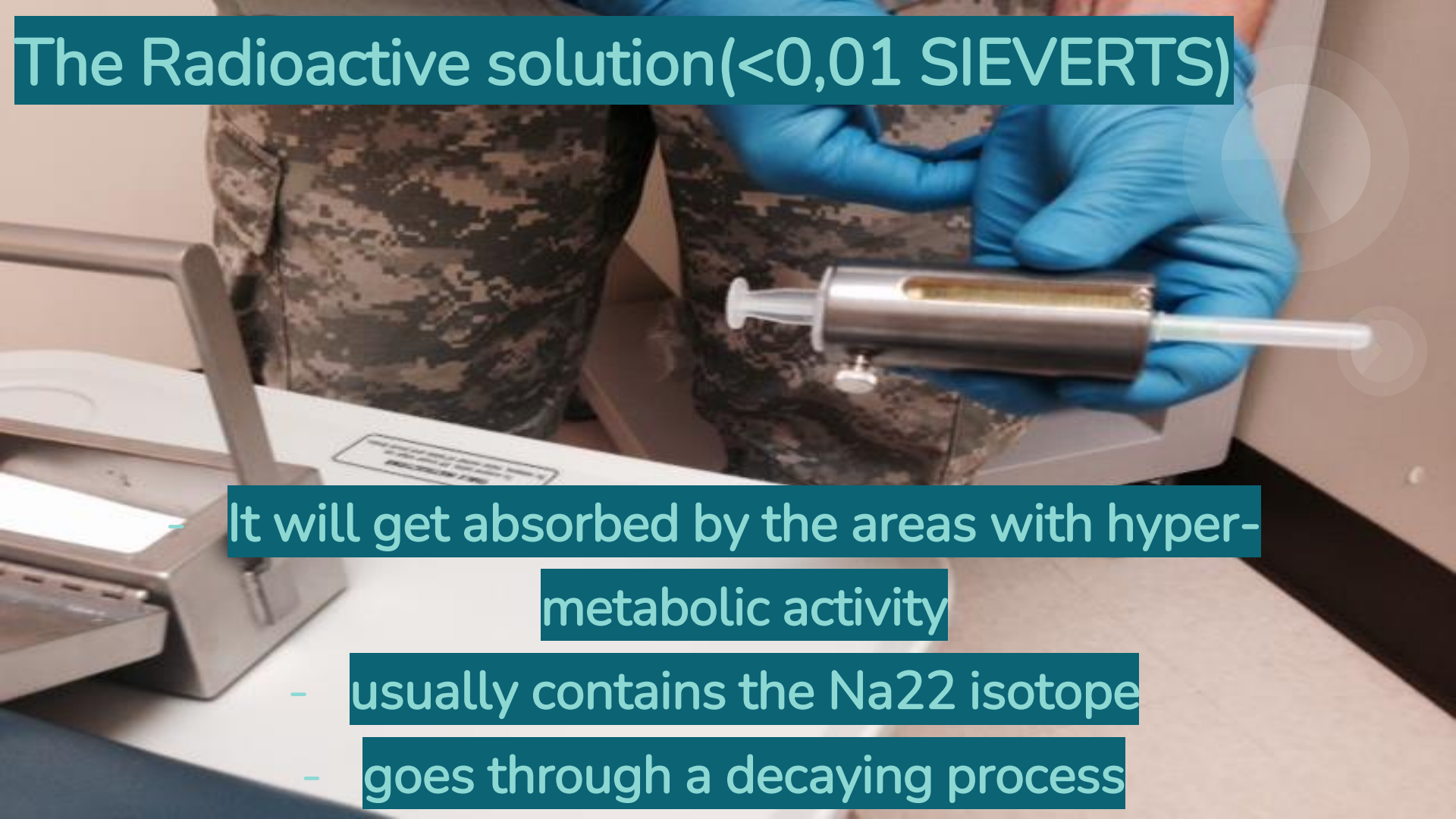


ANTIHYDROGEN

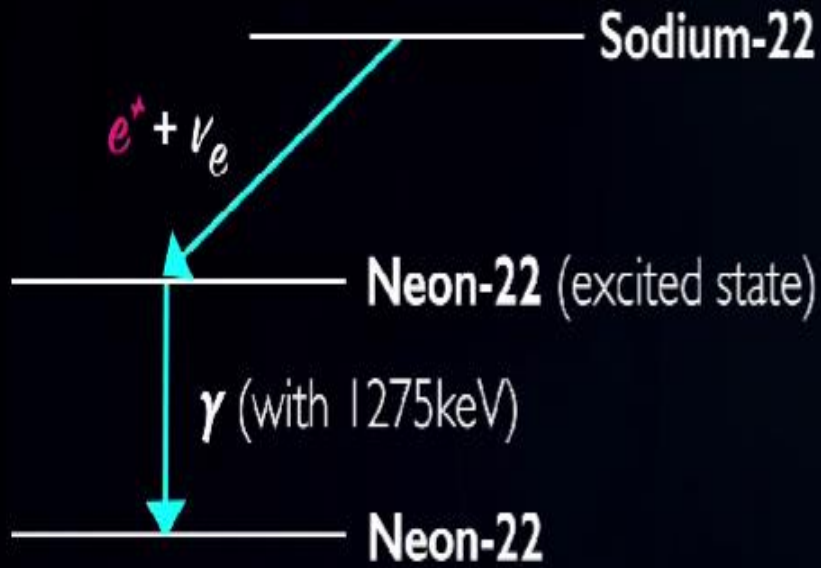


POSITRON EMISSION TOMOGRAPHY

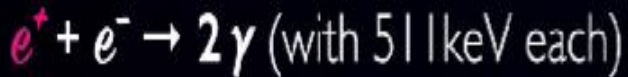
The Radioactive solution (<0,01 SIEVERTS)



- It will get absorbed by the areas with hyper-metabolic activity
- usually contains the Na22 isotope
- goes through a decaying process



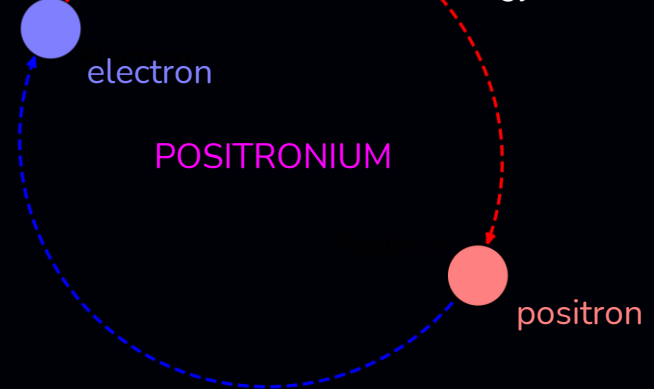
THE DECAYING PROCESS



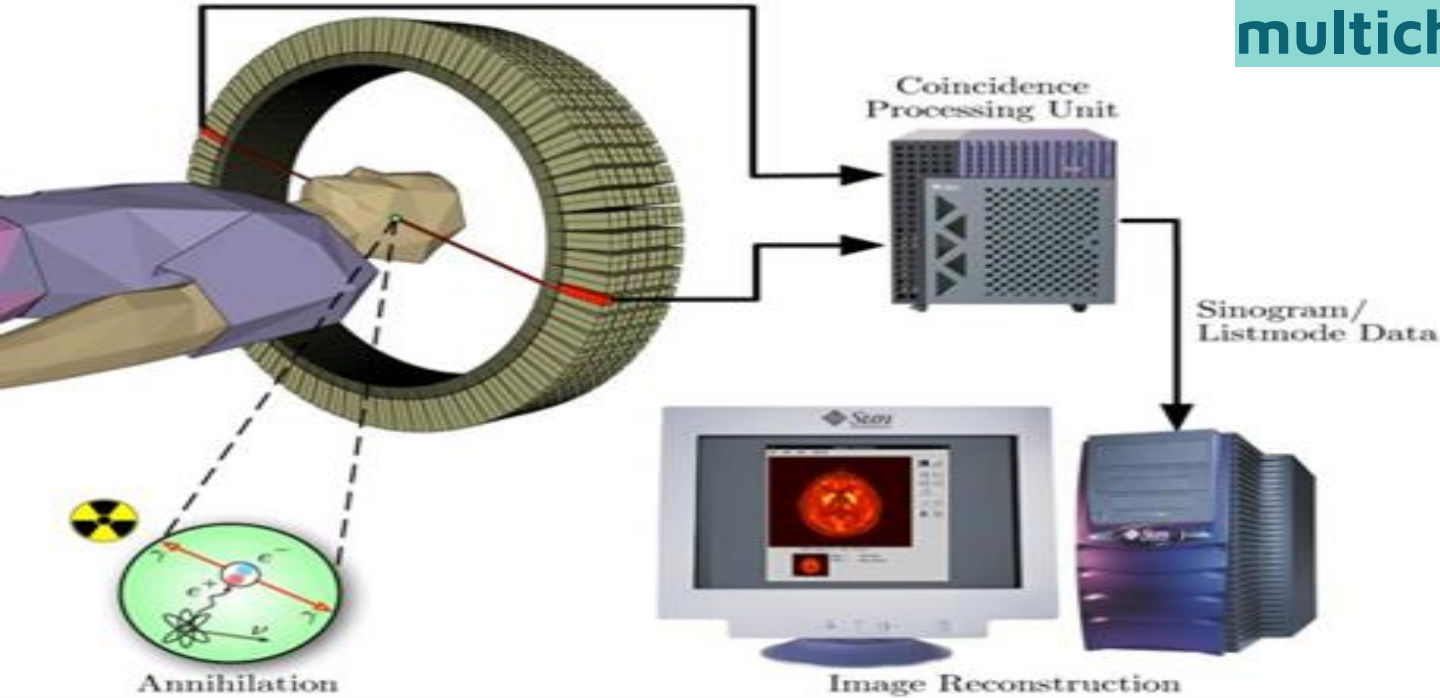
The positron is slowed down in the tissue (collisions) => positronium, (atom formed by the positron and an electron).

Anti particles => annihilation => 2 photons of 511 keV back to-back or co-linear are generated.

CONSERVATION LAWS: cons. energy / momentum

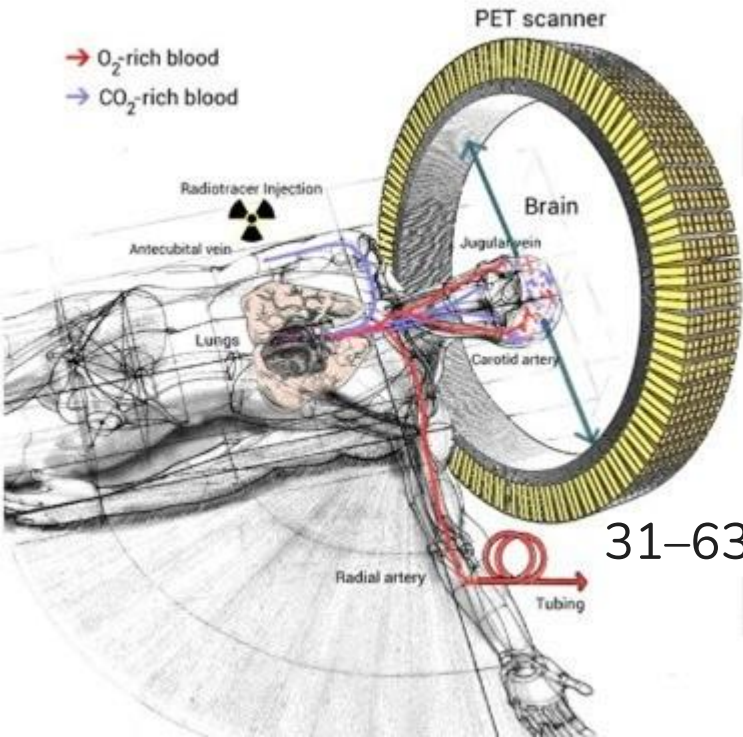


Coincidence measurements : energetic photons → scintillator crystals → photomultiplier → electric current → multichannel analyzer



Coincidence
2 signals with
maximum $4\mu\text{s}$
between them

THE SCINTILLATION DETECTORS / POSITRON CAMERA



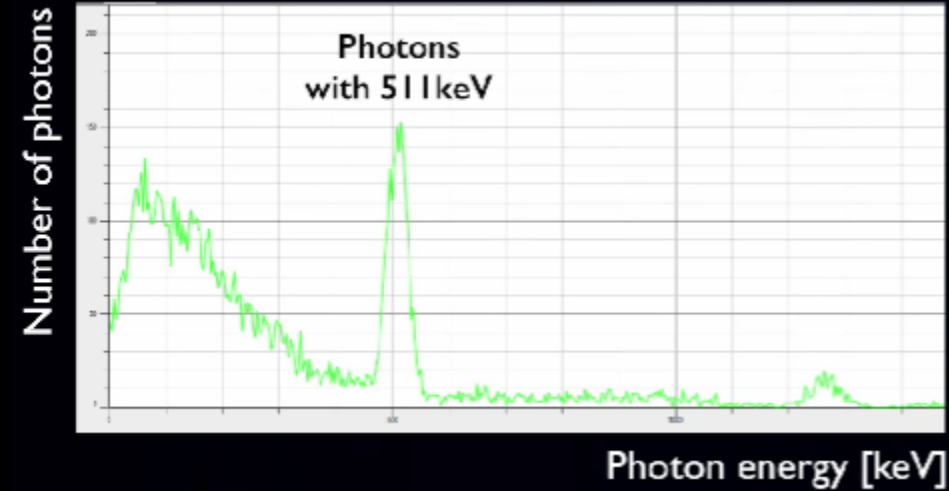
Ring formed from $\cong 70$ blocks

4 rings added \Rightarrow axial field of view (15–16 cm)

31–63 planes are imaged simultaneously with a spatial resolution of 4–7 mm FWHM

(full width at half maximum)

THE ENERGETIC SPECTRE

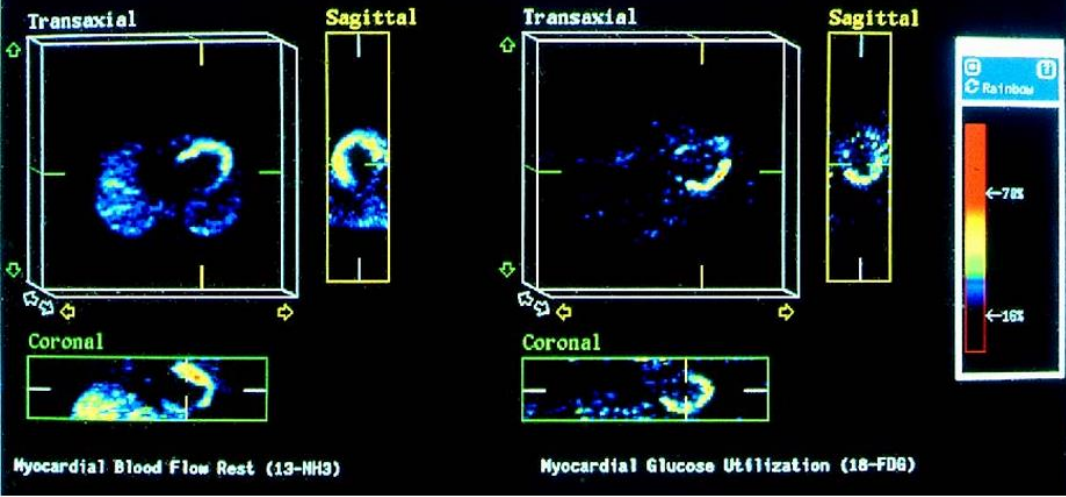


PEAK : 511 KeV
(ANIHILTION)

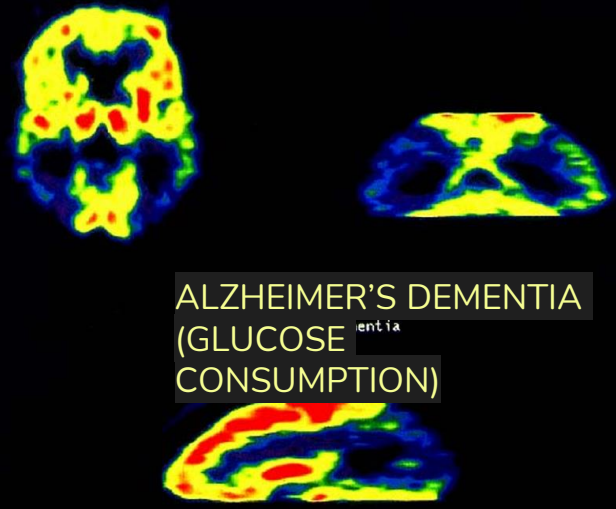
SMALL PEAK : 1275 KeV
(Na22 excited \rightarrow Na22 + γ)

Study 1

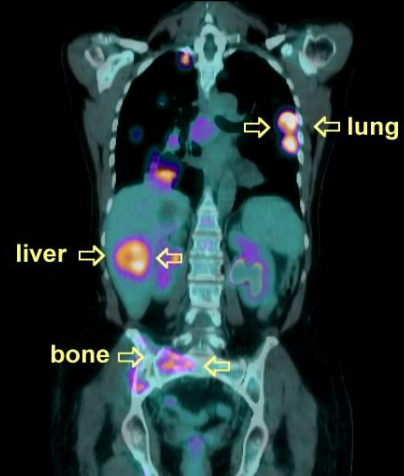
Study 2



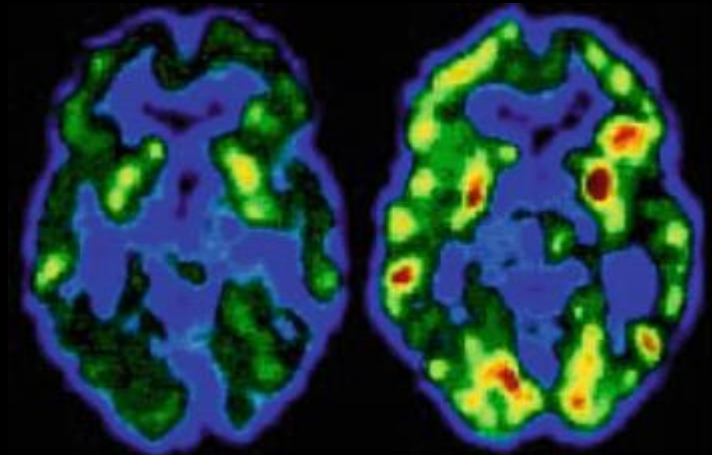
USE IN MEDICAL FIELD



Pet Scan - Metastatic Cancer



ALCOHOLISM - ABSTINENCE CURE



ADVANTAGES AND SHORTCOMINGS

ACCURACY



RISKY

EFFICIENT

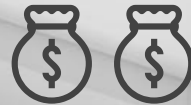


LIMITED

HIGH PRECISION



SLOW



EXPENSIVE

bibliography

<https://www.nibib.nih.gov/science-education/science-topics/magnetic-resonance-imaging-mri#pid-946>

<https://www.mayoclinic.org/tests-procedures/mri/about/pac-20384768>

<https://www.youtube.com/watch?v=HUUvBICd6QI>

<https://www.youtube.com/watch?v=Ok9ILlYzmaY>

<https://www.imaios.com/en/e-mri/nmr-signal-and-mri-contrast/signal-weighting-and-sequences-parameters>

https://www.researchgate.net/figure/Alignment-of-protons-due-to-an-external-magnetic-field_fig3_299512554

<https://www.healthline.com/health/mri-vs-xray#pros>

**Thank you for
your
attention !**

A decorative pattern at the bottom of the slide consisting of numerous vertical bars of varying heights and shades of teal, creating a stylized, rhythmic border.