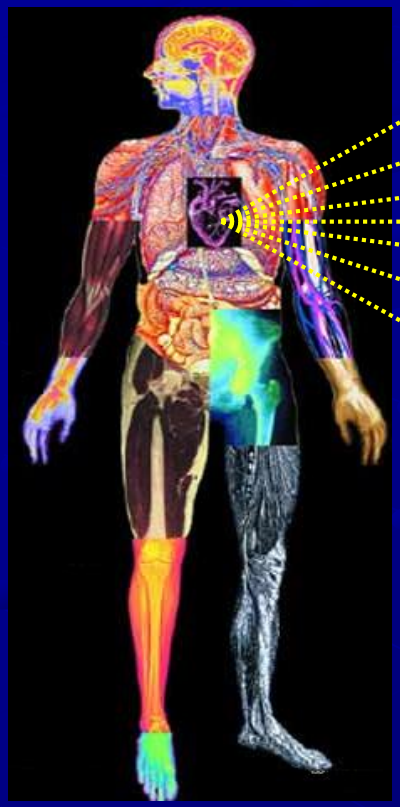
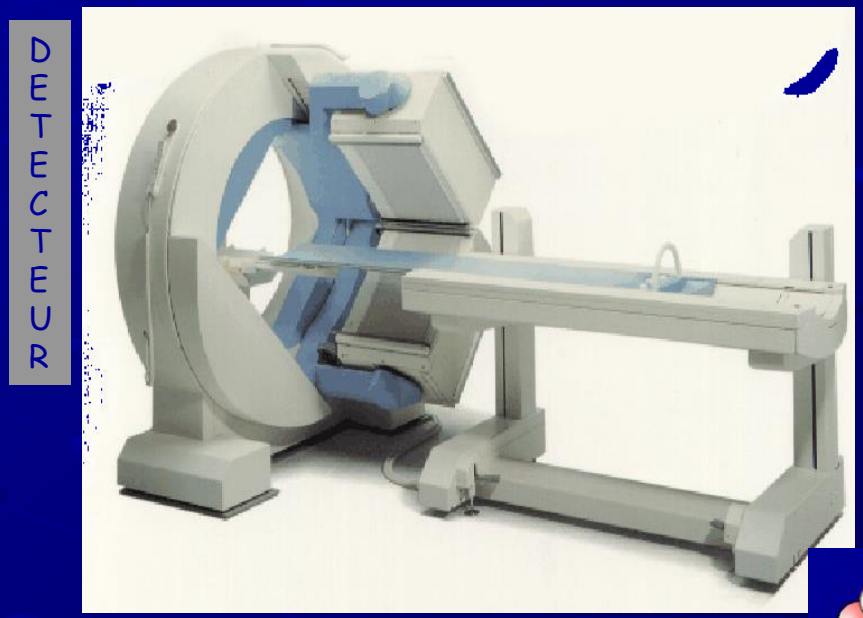
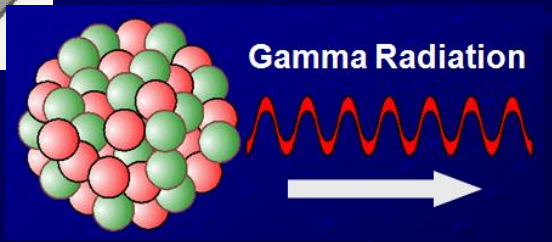
Using ionizing radiation in medical field « radioactivity »





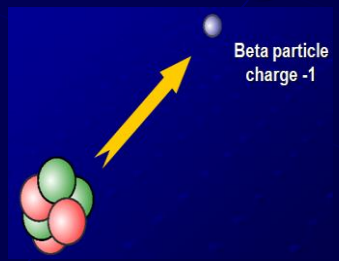


Pr R. SEBIHI

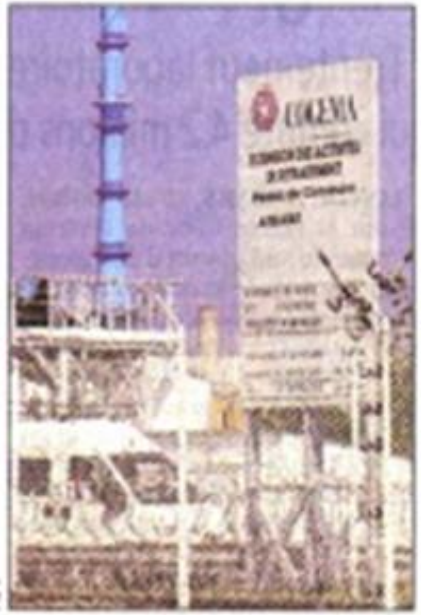
Medical Physicist

Mohamed V university,

faculty of Sciences, Rabat

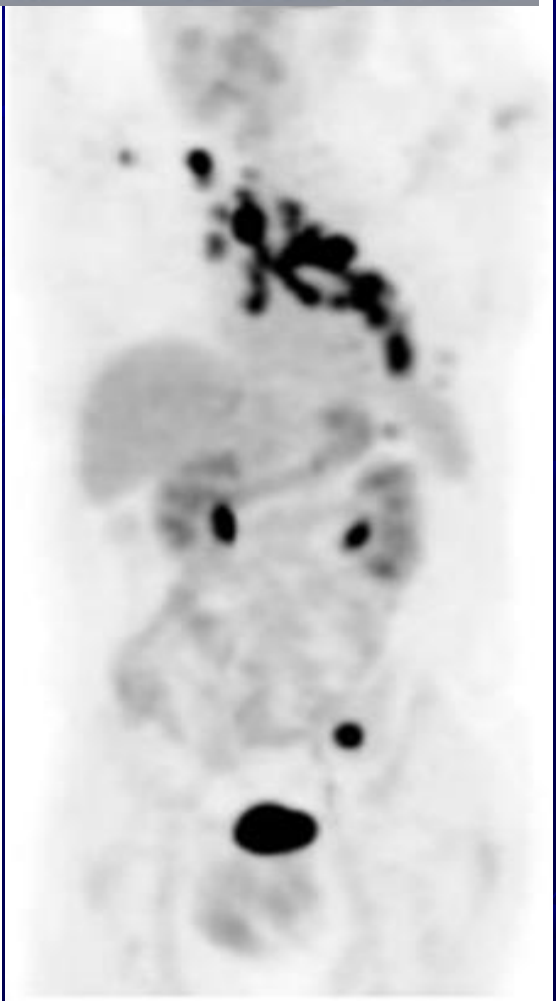


Radiation

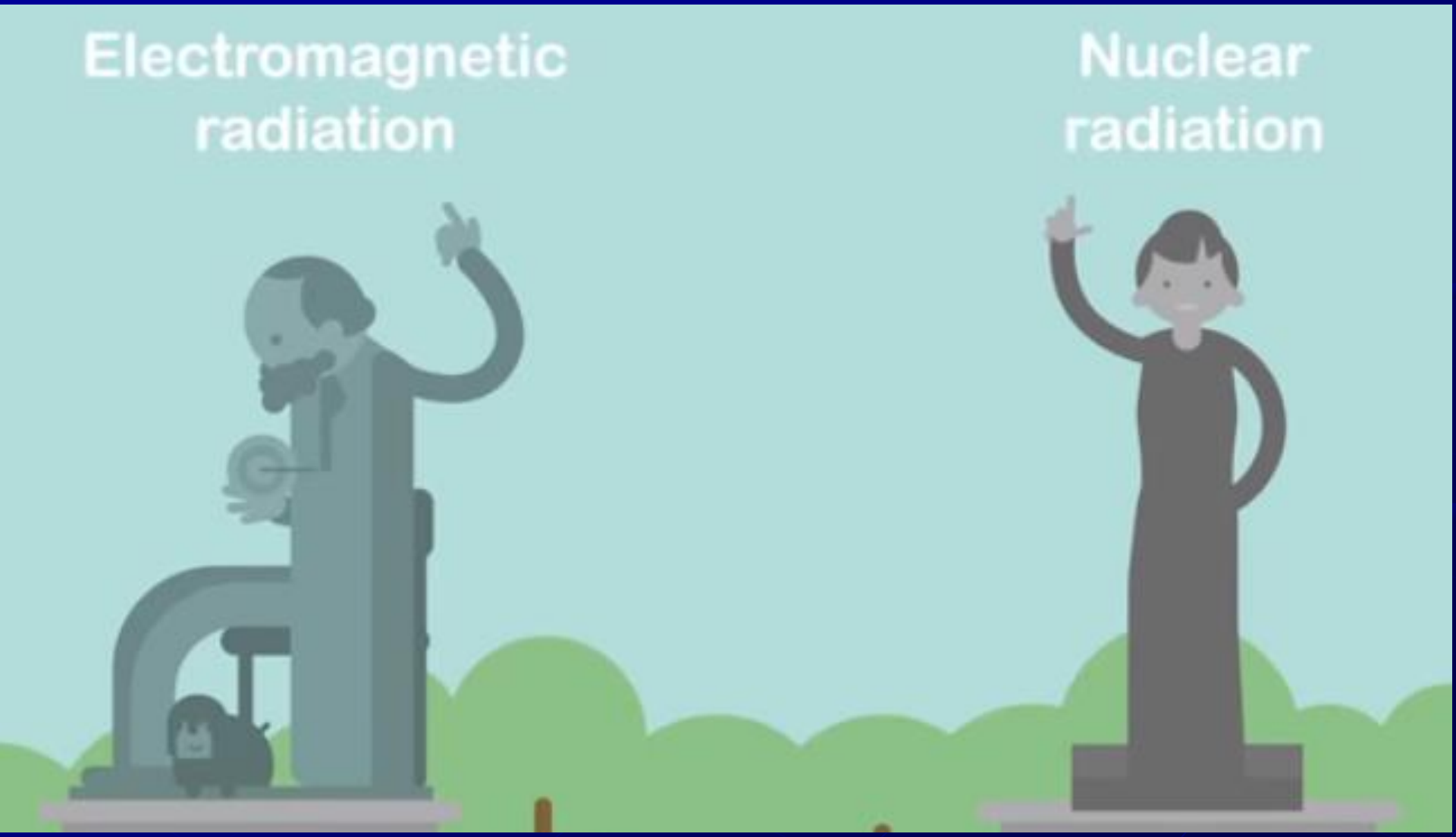


DÉCHETS NUCLÉAIRES

Le Mox caché de la Hague



Radiations

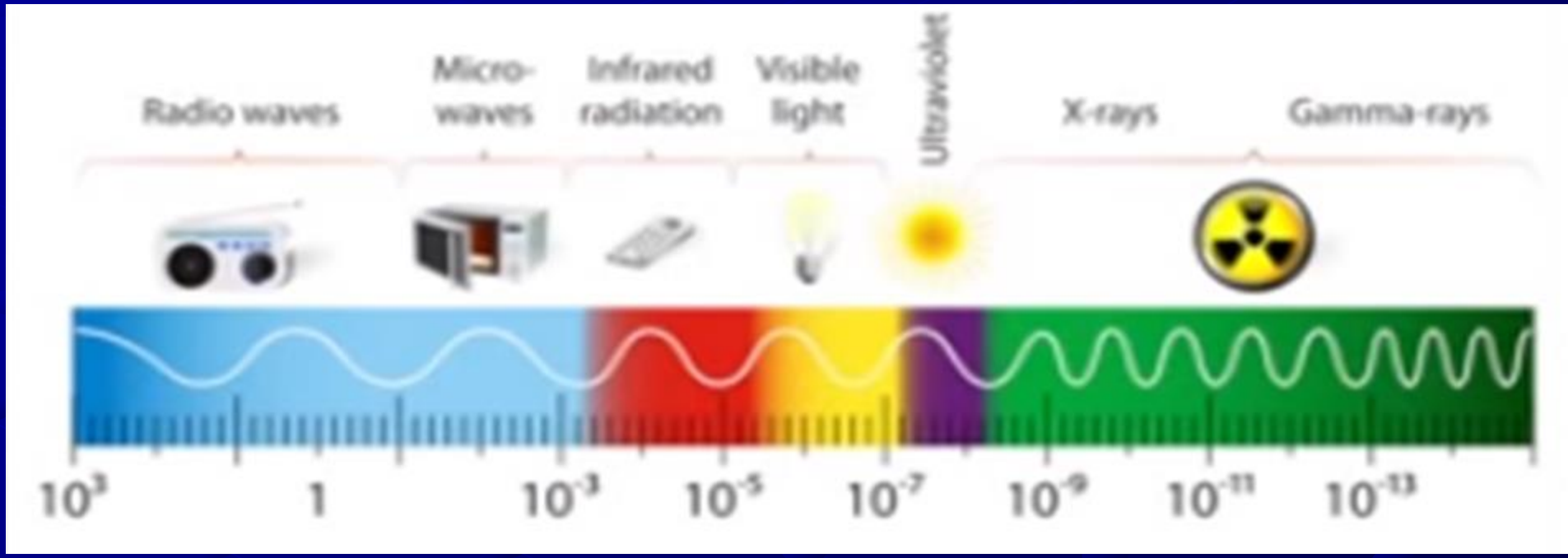


James Maxwel

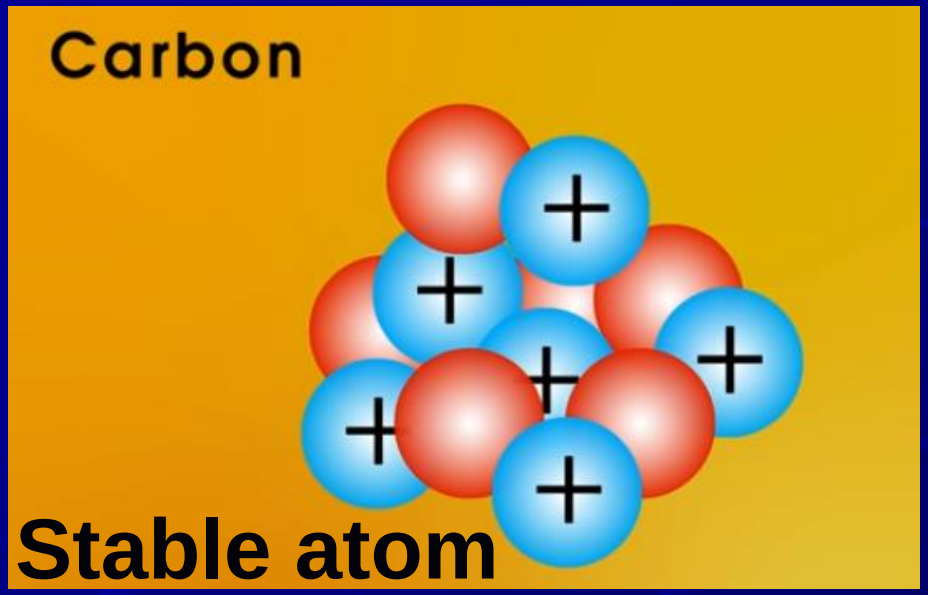
Marie Curie

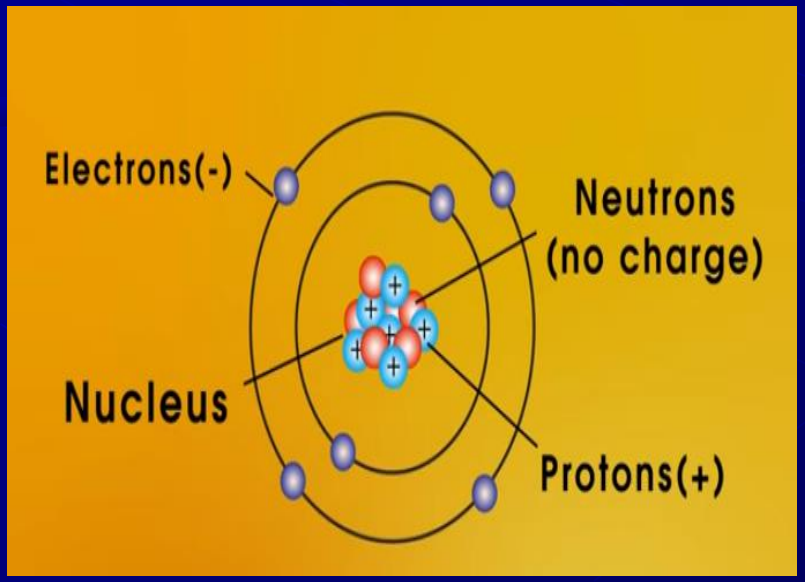
Electromagnetic radiation

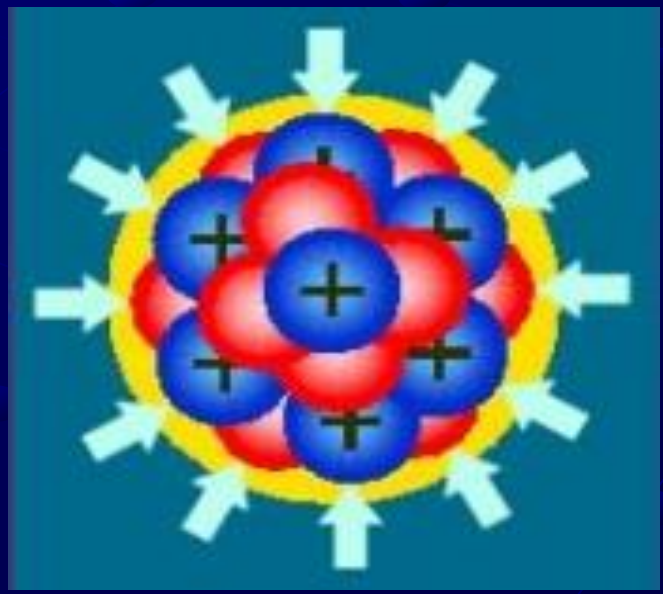
Electromagnetic radiation



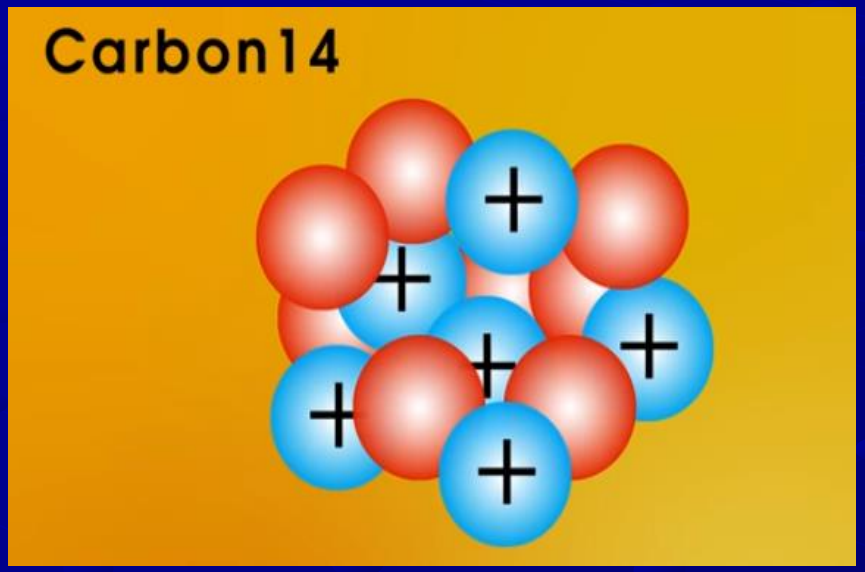
Nuclear Radiations







Nuclear radiations

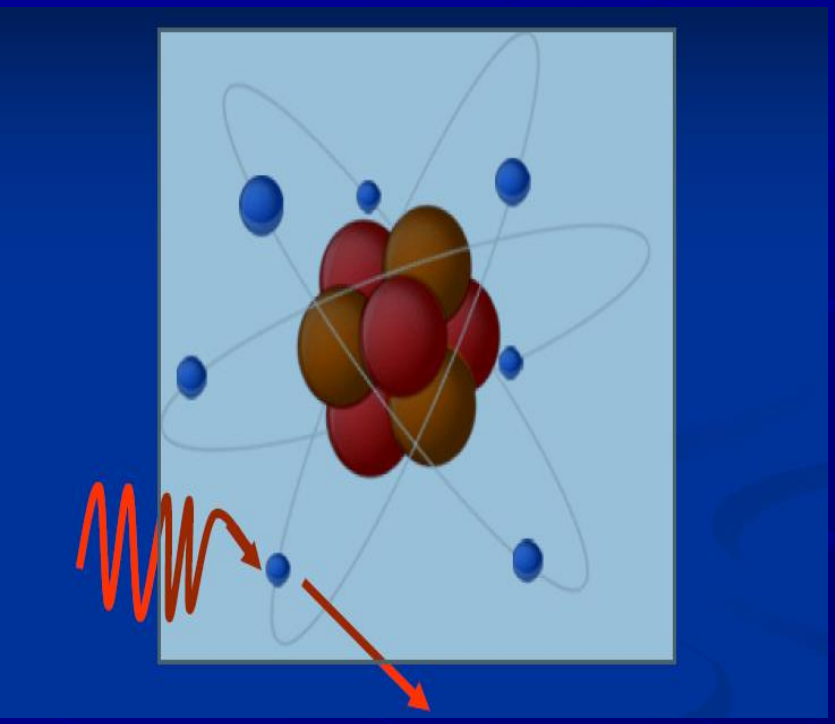


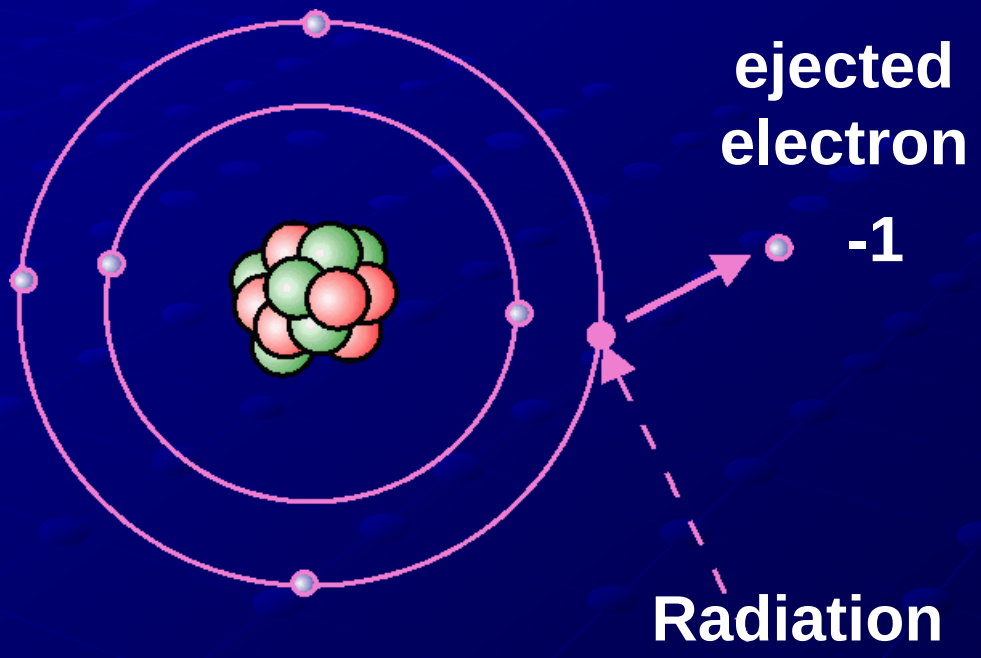
Unstable atom: radiactive

Isotope:

An atom with the same number of protons but a different number of neutrons

Ionizing radiations



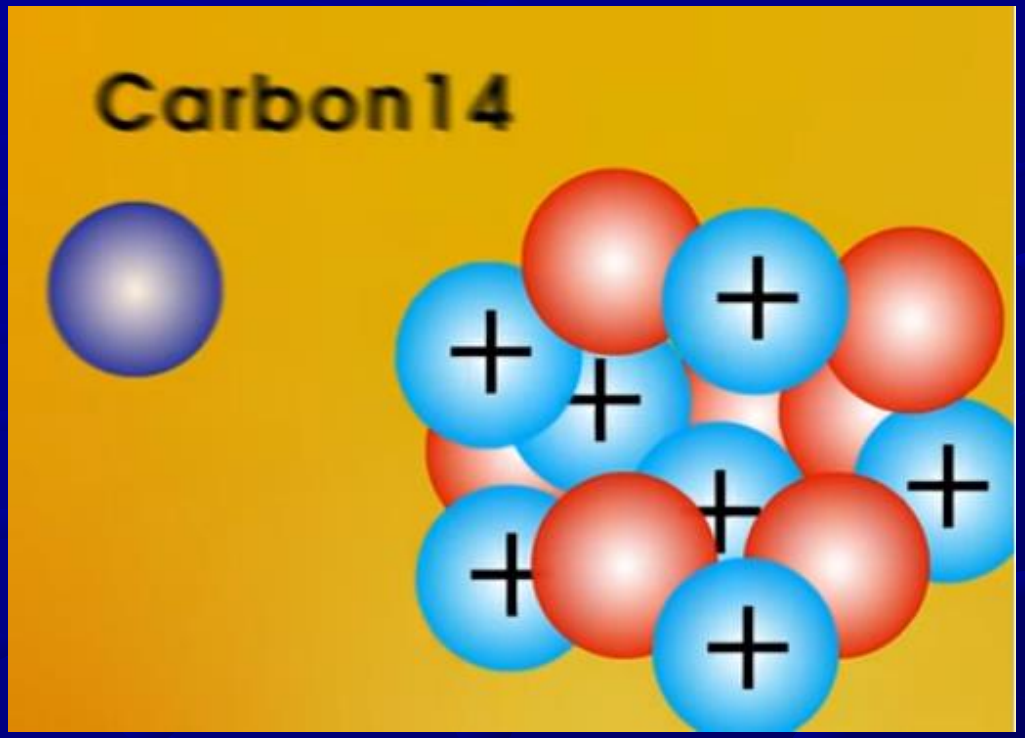


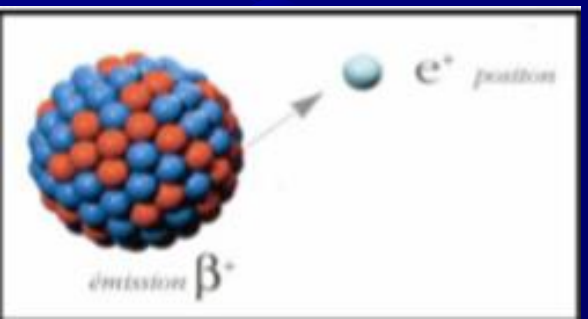
Ionization:

Turning a **neutral** atom into an ion

3 Types of Nuclear radiations

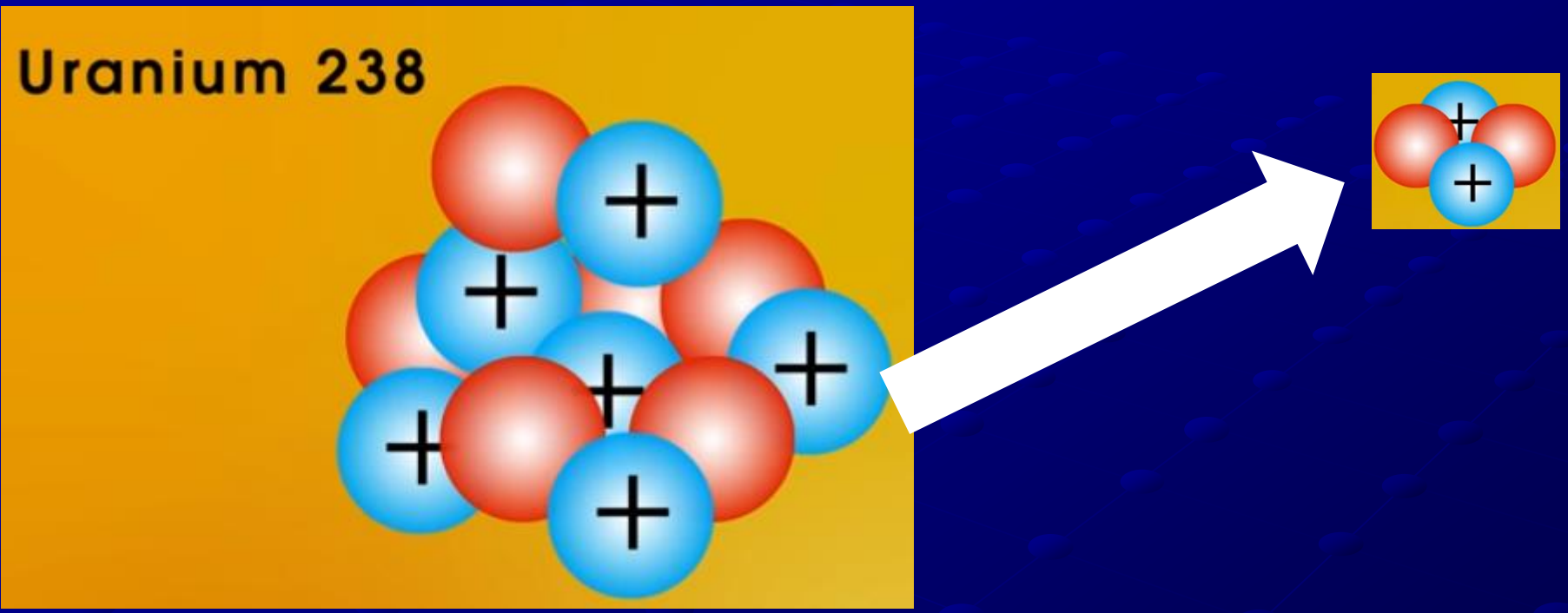
Beta decay

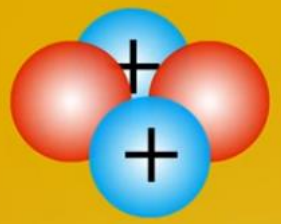




Beta
A high speed electron

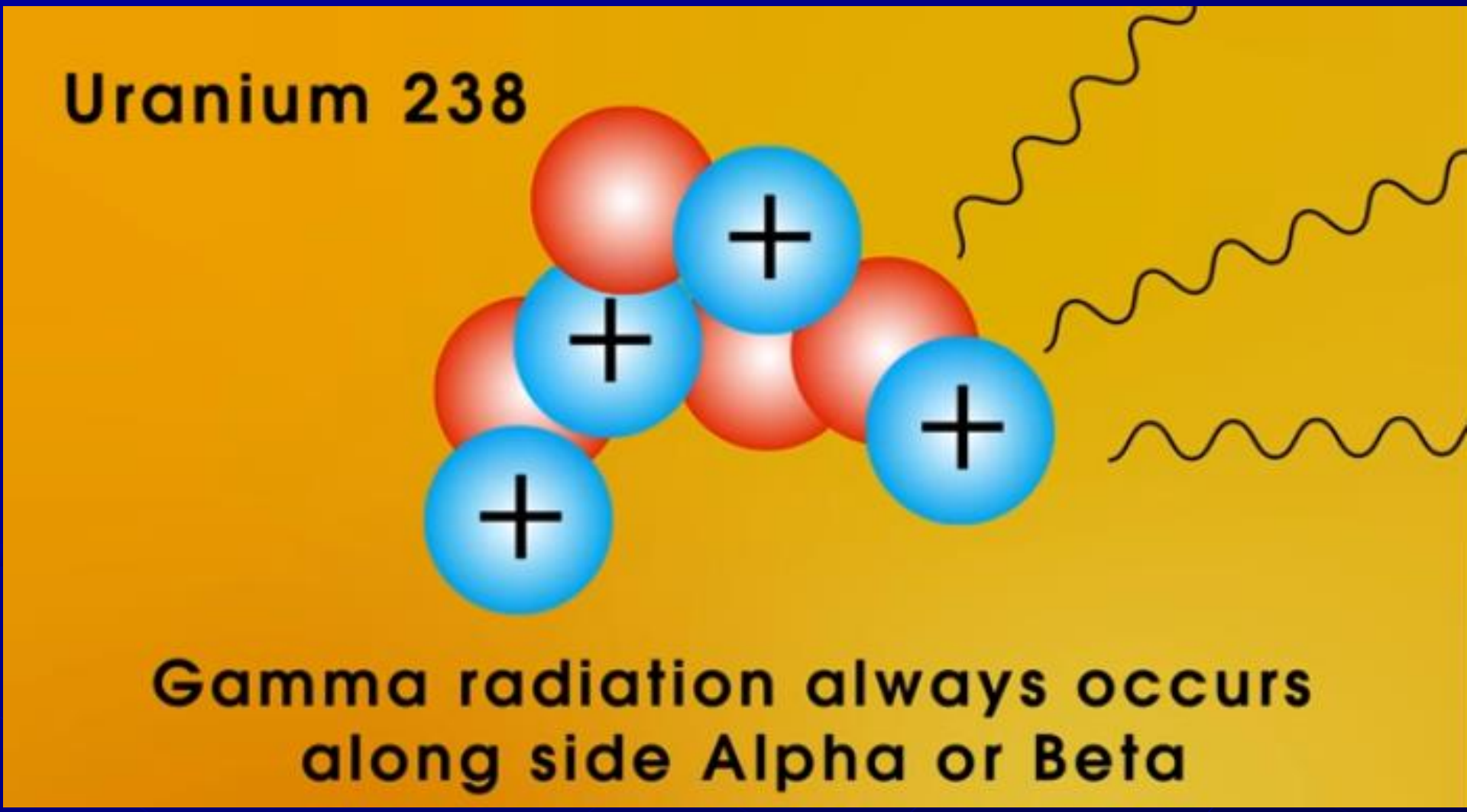
Alpha decay





Alpha
A helium nucleus

Gamma decay

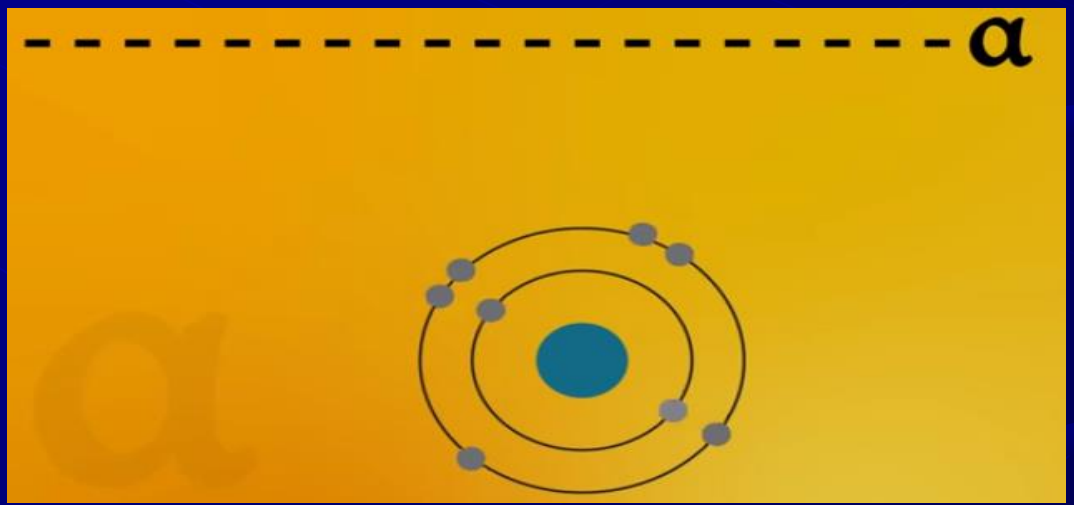

Uranium 238
Gamma radiation always occurs
along side Alpha or Beta

Ionization

Alpha rays

Alpha is the best at ionising

α +2

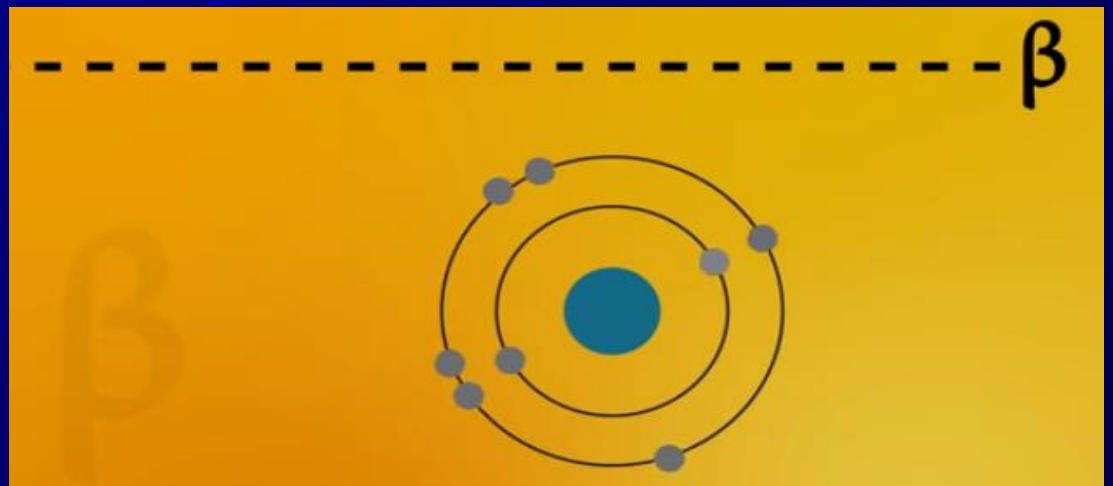


Alpha travel in the atom

Beta rays

Beta is the next best at ionising

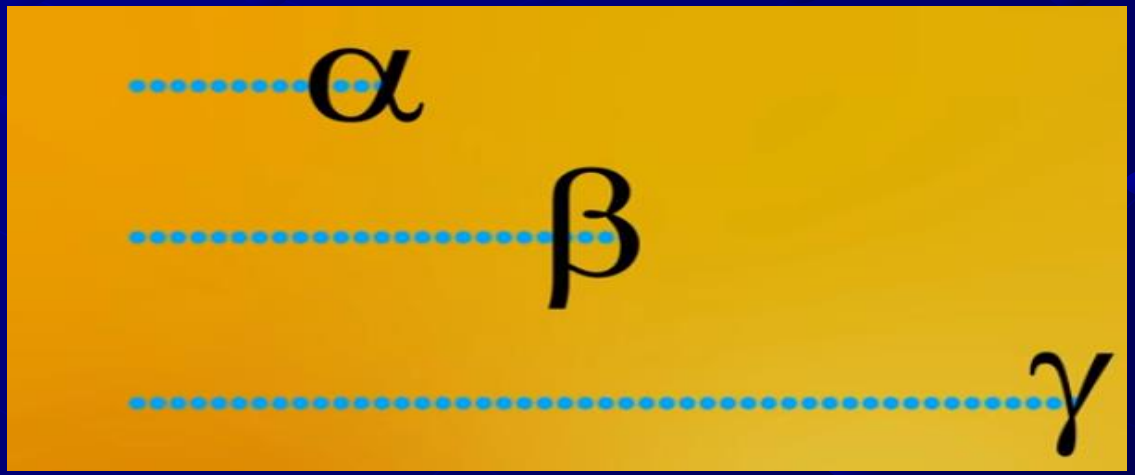
β -1



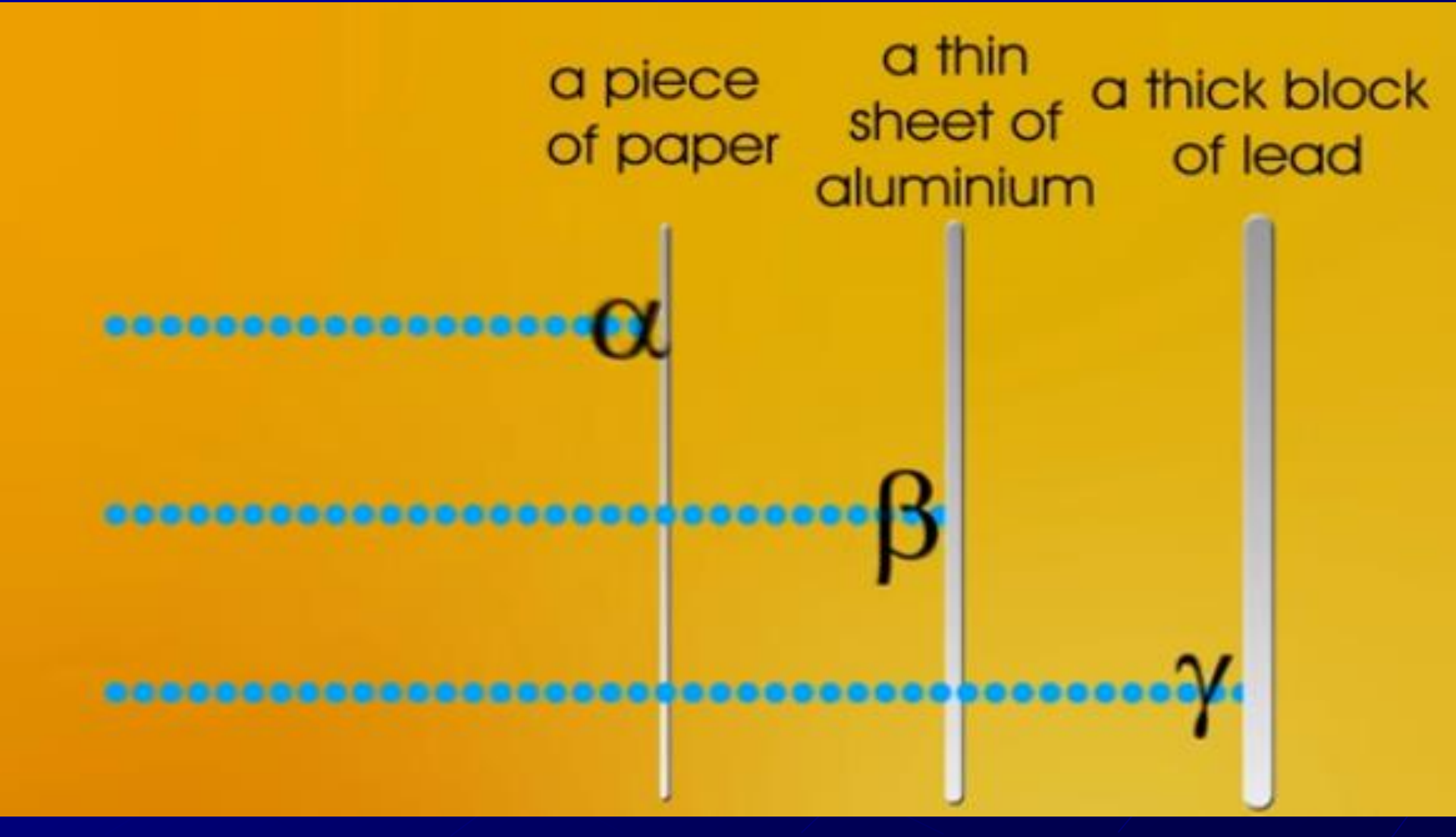
Gamma rays

Gamma no charge

Absorption

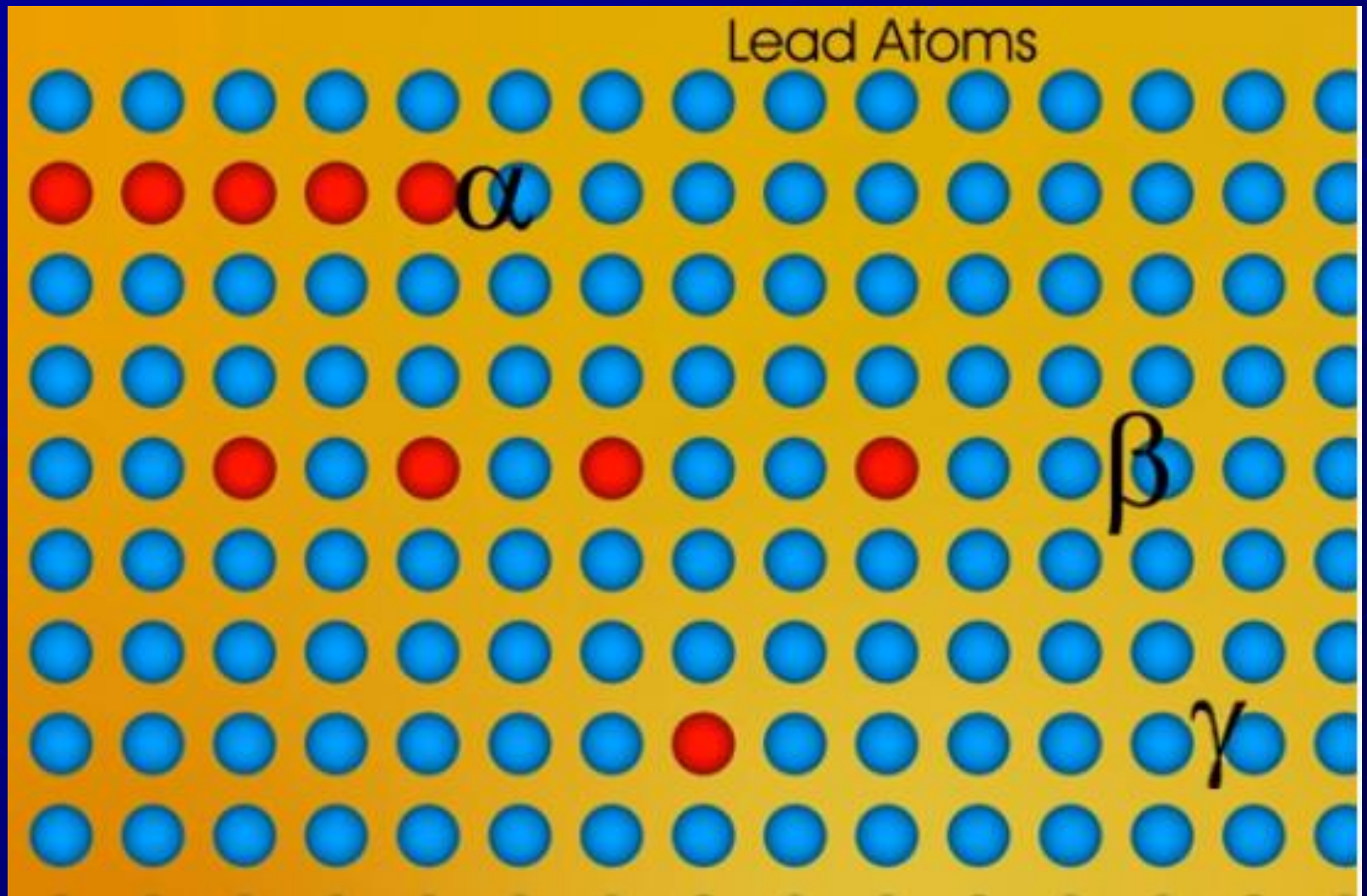


Absorption

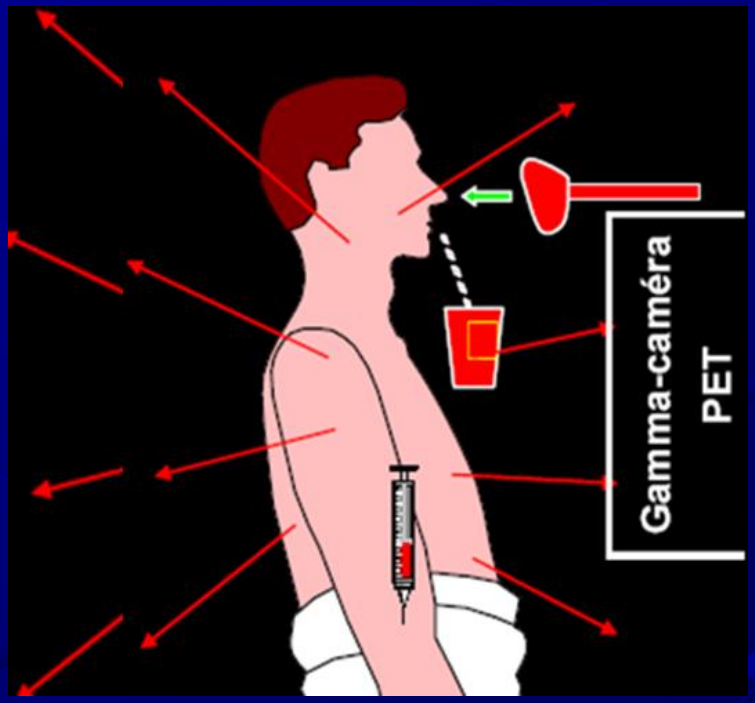

a piece of paper
a thin sheet of aluminium
a thick block of lead
α
β
γ

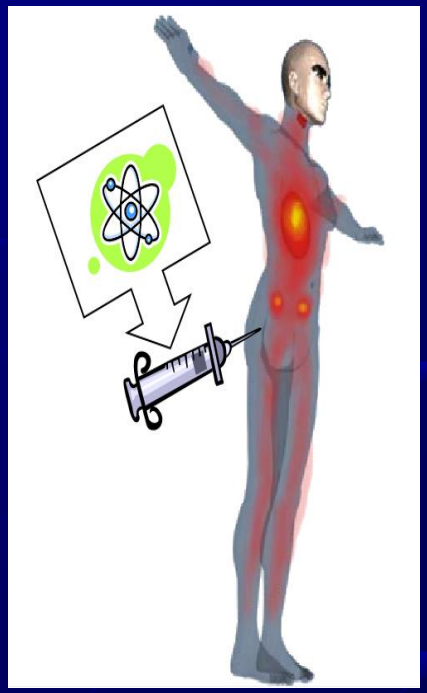
Absorption

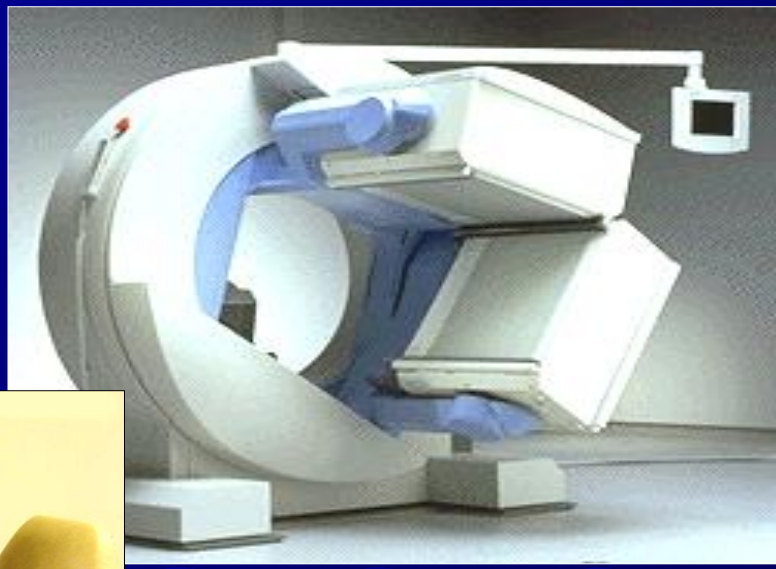
α	A few cm
β	Several metres
γ	Several km



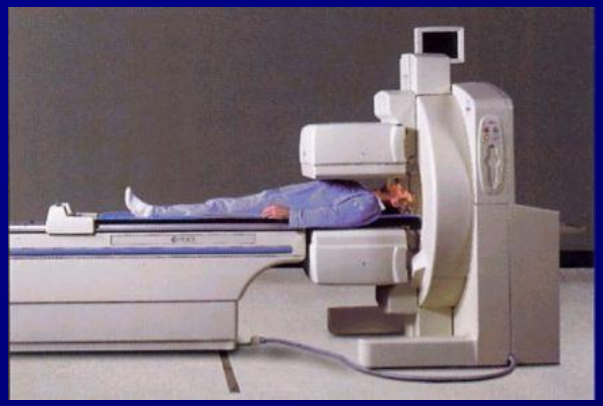
Nuclear medicine



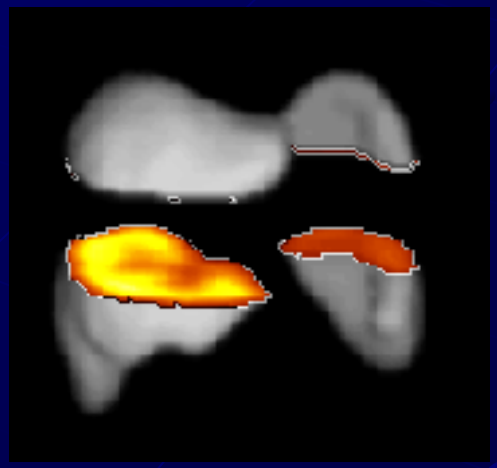




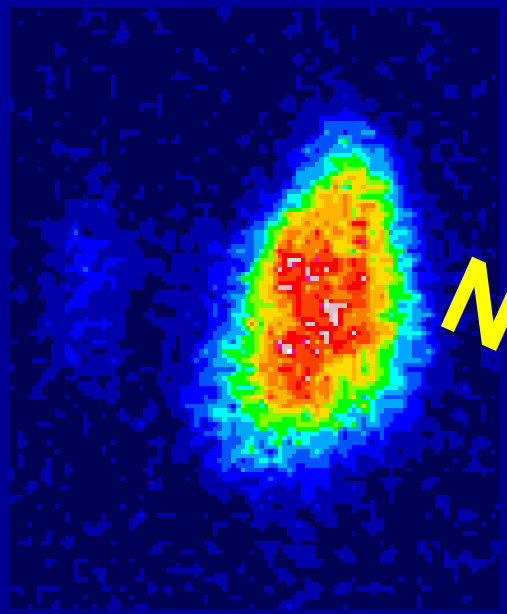
Nuclear medicine

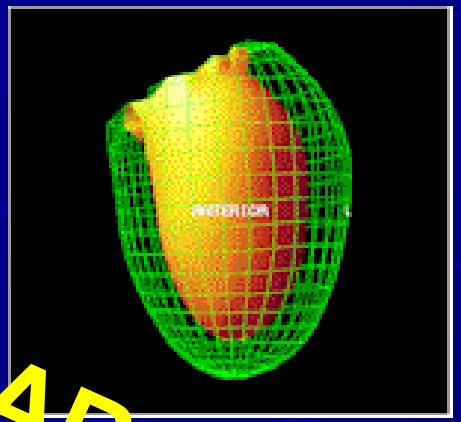


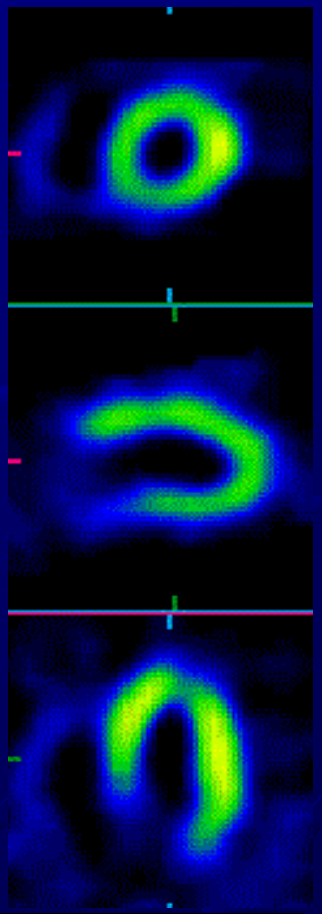
Scintigraphy

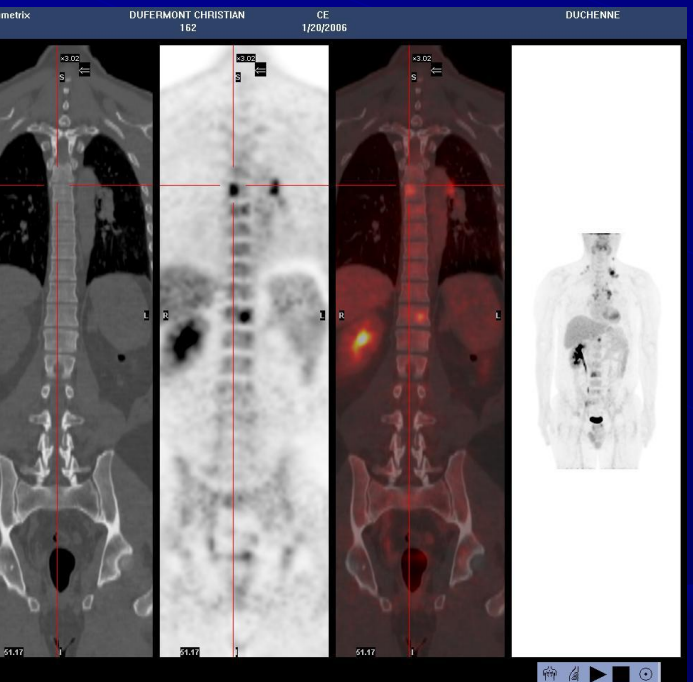


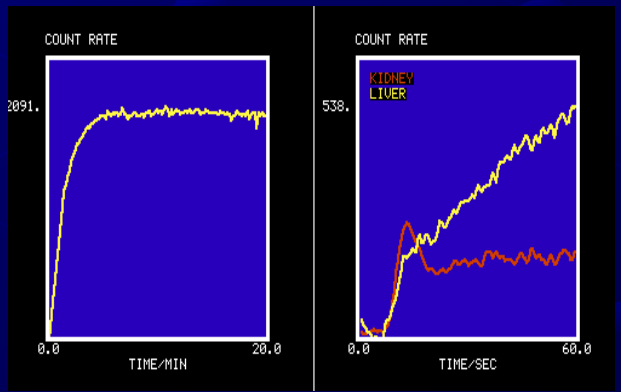
NUCLEAR MEDECINE

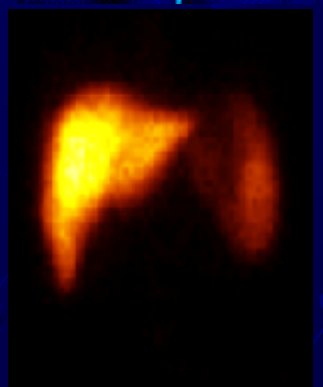












Different kind of radioisotopes produced by nuclear reactors or cyclotrons

PREPARATION

REACTOR

CYCLOTRON

DISTRIBUTION

SOLUTION

SOLID FORM

GENERATOR

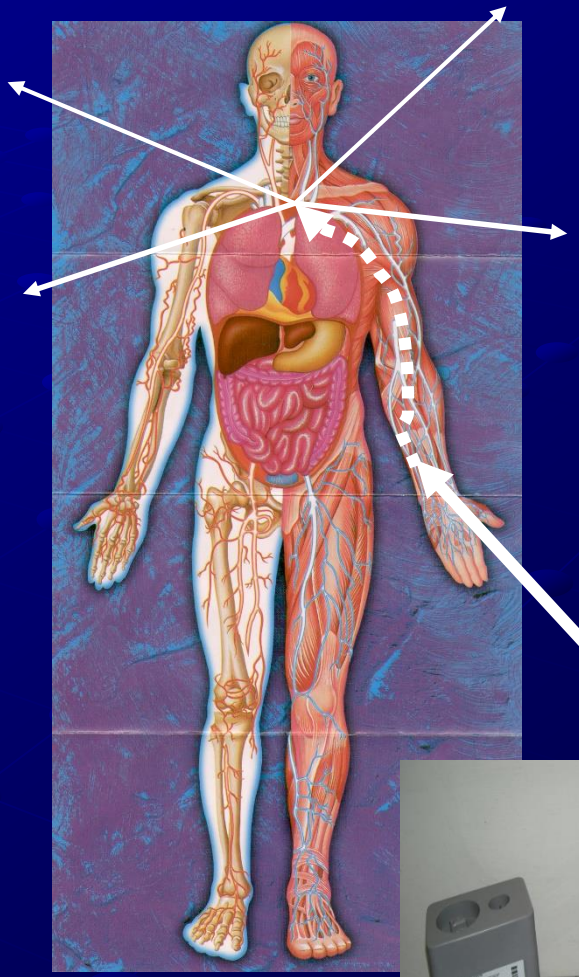
USE ON SITE

AUTHORISED USER

NUCLEAR MEDICINE DOCTOR

The main radioisotope used in NM… ^{99m}Tc

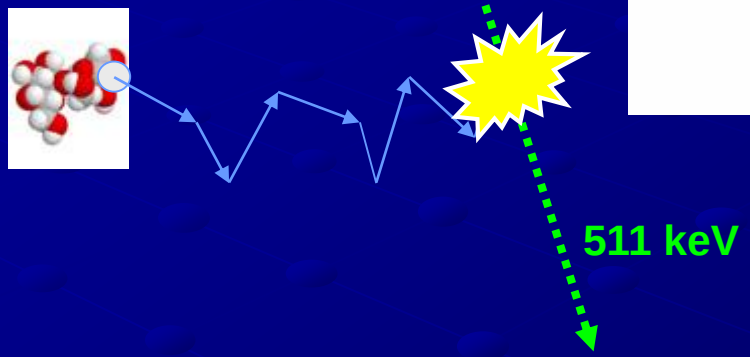
- γ Emission : 140 keV
- Short Half-life: 6 h (adapted to the kinetic for diagnostic)
- Good chemical characteristics
- Easy to prepare and to distribute
- Linked to different molecules with specific properties

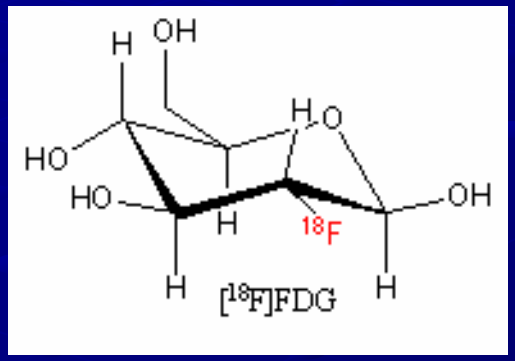


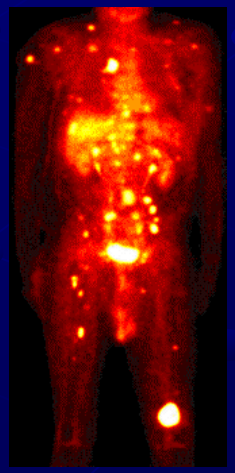
Ideal also for radioactive waste management !

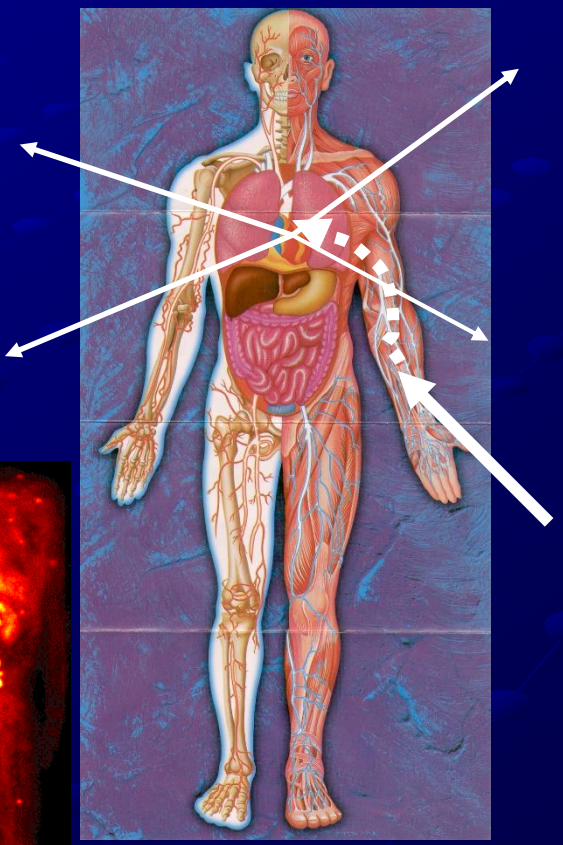
PET Traceur (^{18}F-FDG (Fluorodeoxyglucose))

- ^{18}F fixed to an organic molecule

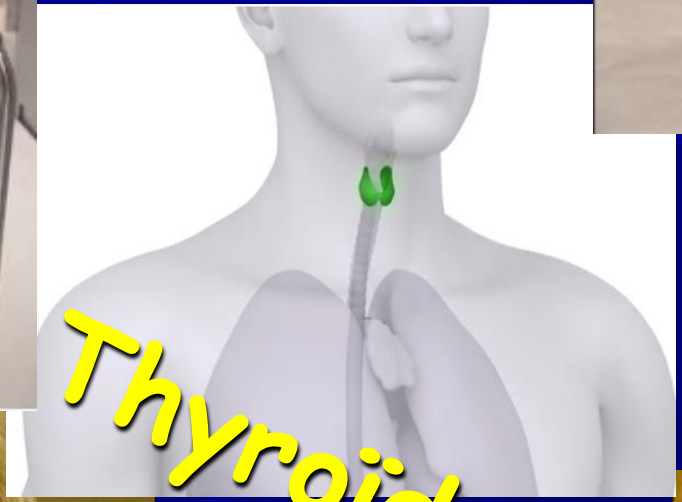








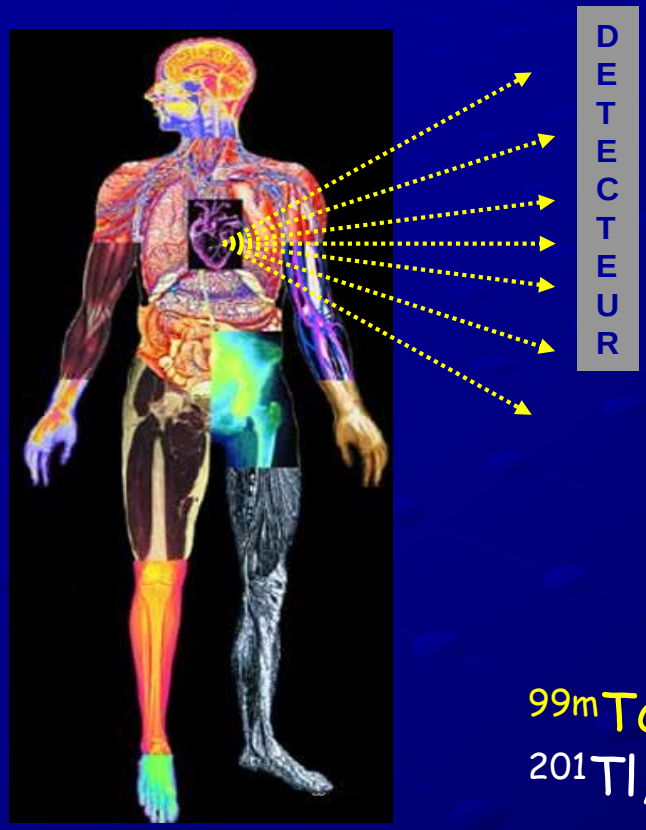
Short half-life ($T_{1/2}$ = 1,83 h),
High Energy of X-rays
→ High dose rate compared to ^{99m}Tc →
→ to be considered for waste management



Thyroid Therapy

$^{131}I \Rightarrow T_{1/2} = 8$ days !!

Nuclear medicine uses unsealed sources for diagnosis and therapy



^{99m}Tc, ^{18}F, ^{123}I, ^{131}I, ^{111}In,
^{201}Tl, ^{51}Cr, ^{153}Sm, ^{90}Y.....

The use of unsealed sources will generate radioactive waste of different kinds during many different phases

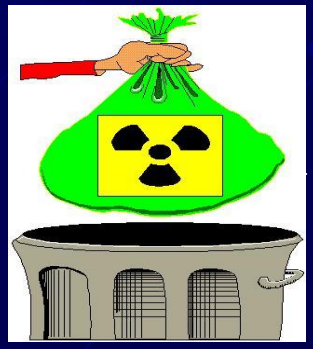
Why management of radioactive waste from nuclear medicine is so important?

- **Radioactivity**
  - is not observable…
  - has a negative image….
  - Induces some risk for the people and the environment

- Radioactive waste should be strictly managed
- **Basic principles**
  - Try to keep minimum waste
  - Try to be practicable
  - To provide an acceptable level

of protection forV

  - human health
  - Environment



Short lived radioactive waste could be managed directly in the hospital

« Nothing in life is to be feared, it’s only to be understood. Now is the time to understand more, so that we may fear less»