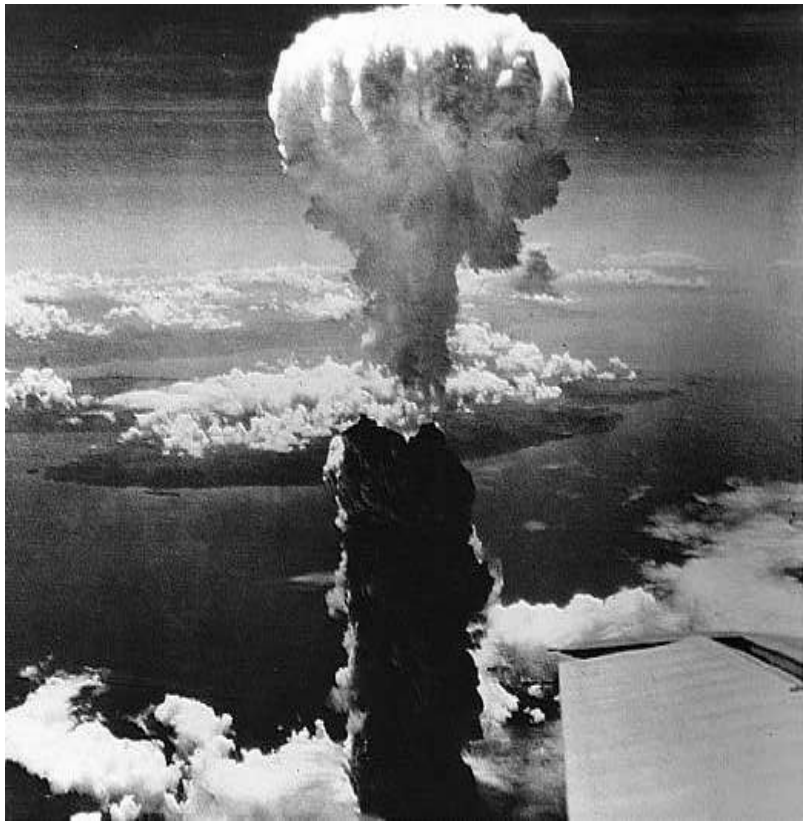
charles lowe

Chapter 2

What is Radiation?



Preface

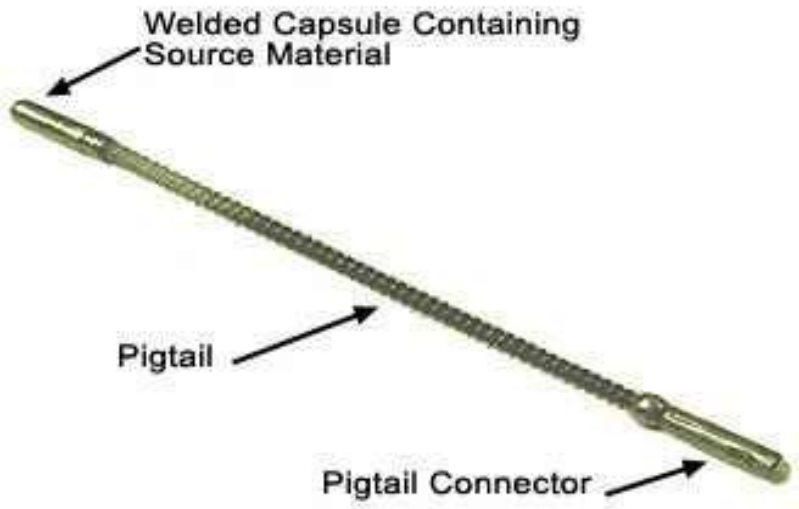
- Deadly.
- Useful.
- What is Radiation?

Preface

- Deadly.
- Useful.
- What is Radiation?

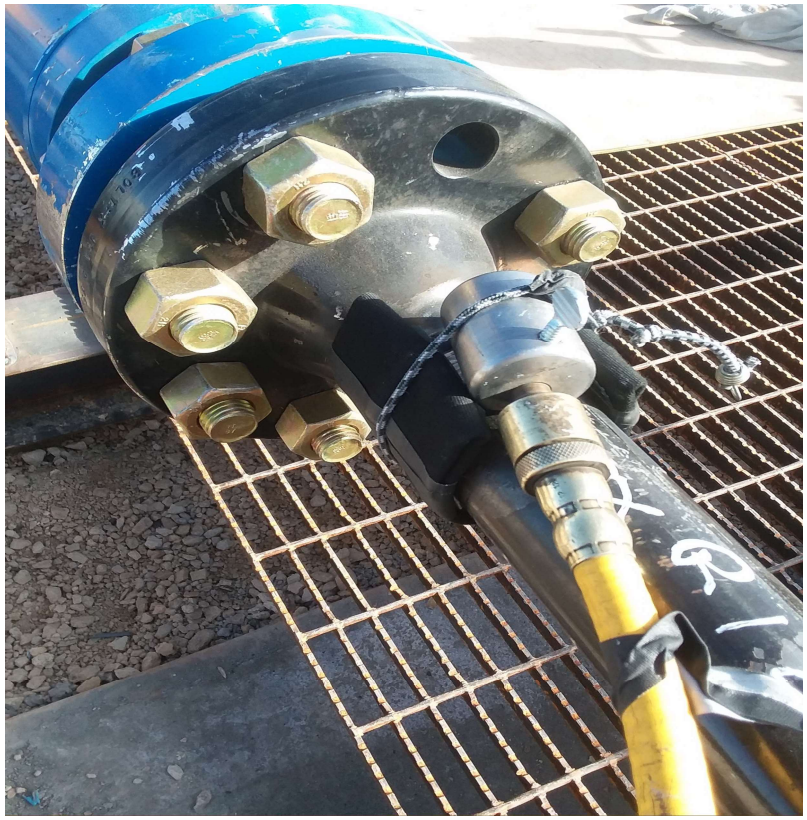
Preface

- Deadly.
- Useful.
- What is Radiation?



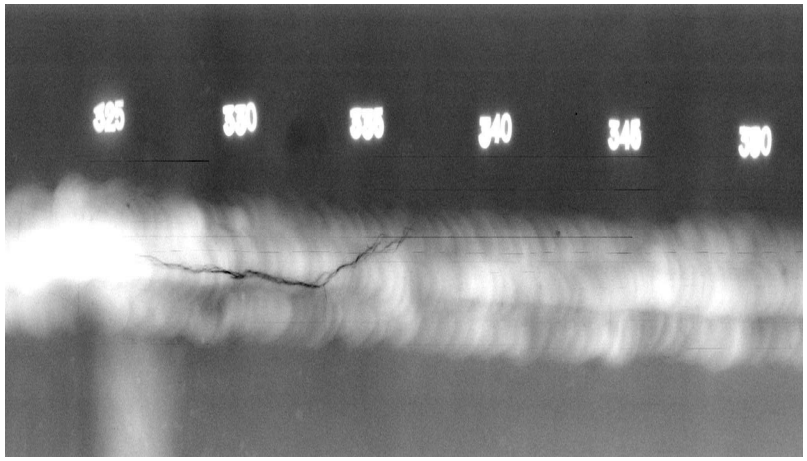
Preface

- Deadly.
- Useful.
- What is Radiation?



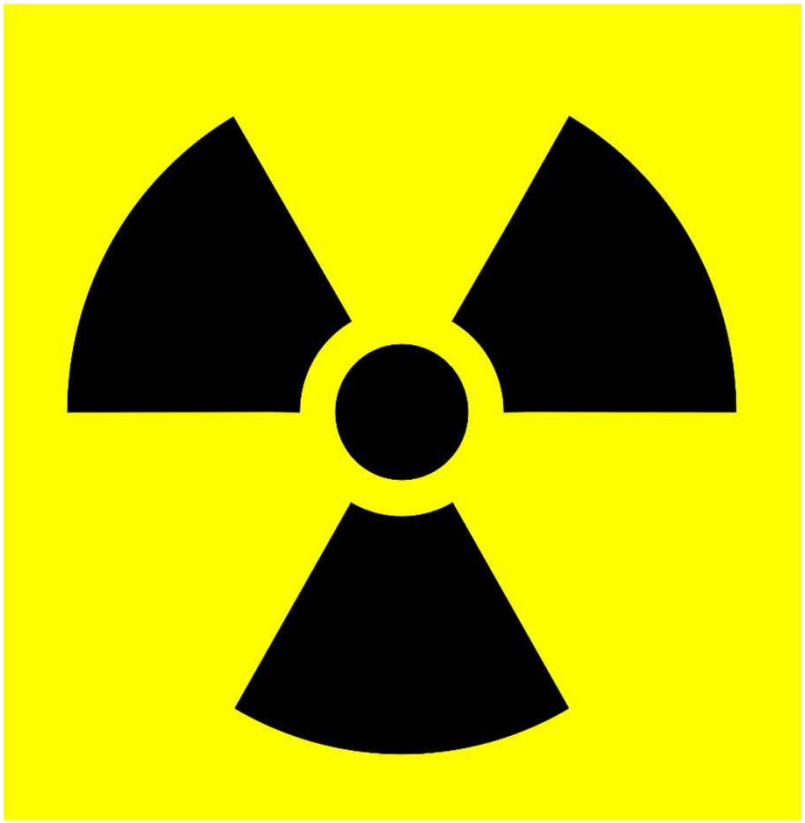
Preface

- Deadly.
- Useful.
- What is Radiation?



Preface

- Deadly.
- Useful.
- What is Radiation?

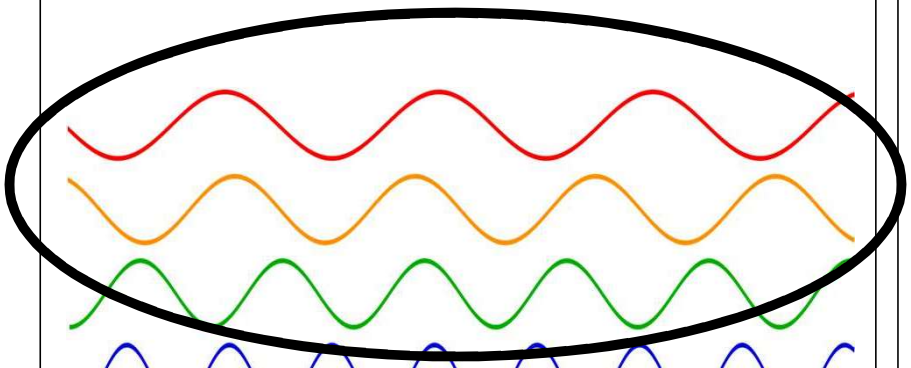


A Form of Energy

- Non-Ionizing Radiation (less harmful).
- Ionizing Radiation (harmful).

Non-Ionizing Radiation

- Visible light.
- Radio waves.
- Microwaves.



Non-Ionizing Radiation

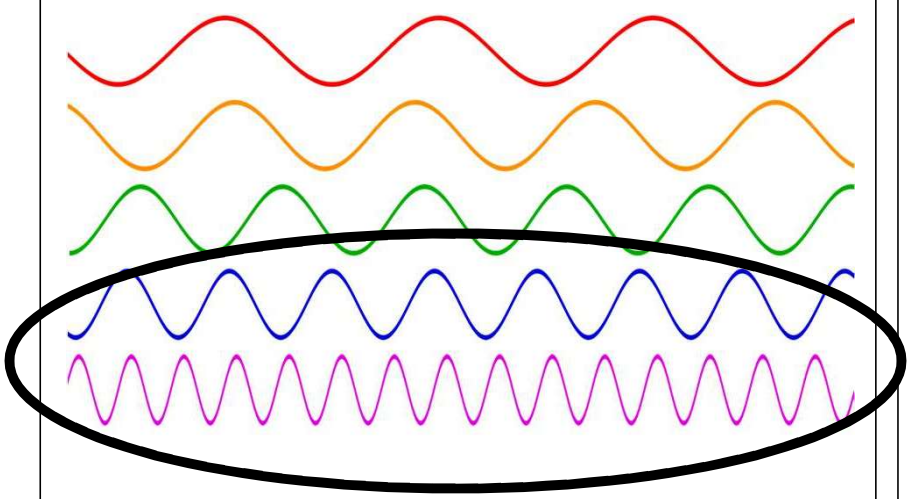
- Long wavelengths.
- Low frequency of waves between crests and troughs.
- = Little to no penetration.

Ionizing Radiation

- Gamma rays.
- X-rays.

Ionizing Radiation

- Adding or removing (ripping) electrons from atoms or molecules.
- (CAN NOT be detected by the human senses)…must use detection equipment.



Ionizing Radiation

- Short wavelengths.
- High frequency of waves between crests and troughs.
- = Penetration.

Sources of Radiation

- Radioactive Materials (radioisotopes)

- Iridium 192
- Cobalt 60
- Cesium 137
- Selenium 75
- More…

Sources of Radiation

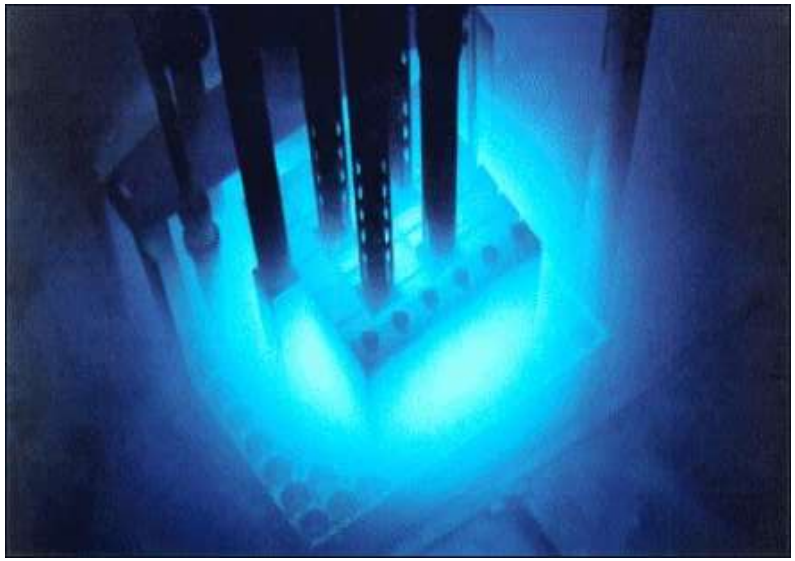
- X-rays
- X-ray producing machines.

Sources of Radiation

- Radioactive Materials
- Emit gamma rays.
- Decays, can not manipulate.

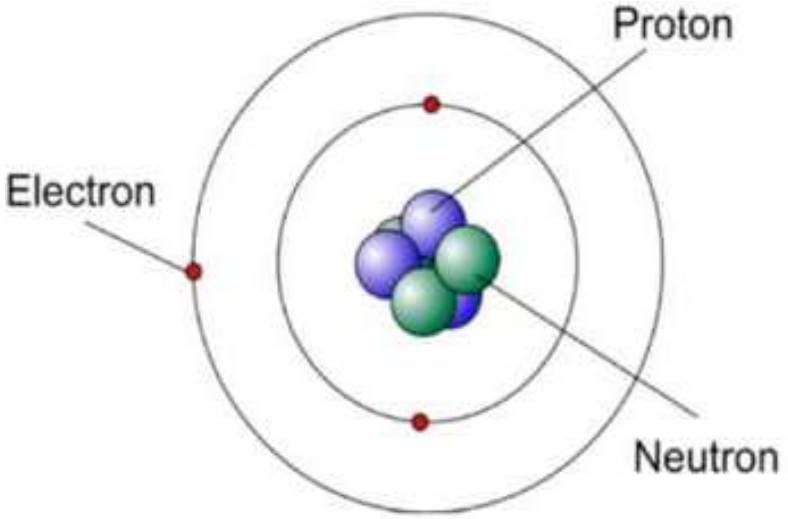
Sources of Radiation

- X-ray Machines
- Emit X-rays
- Machine can be turned off, can be manipulated.



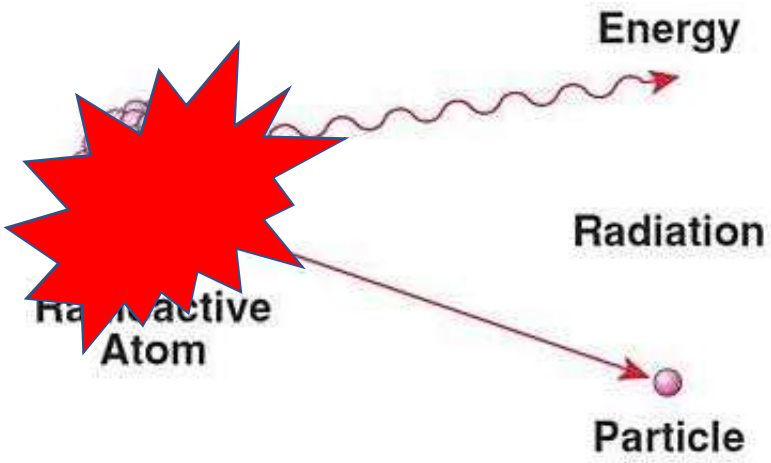
How Iridium 192 is made?

- Irradiating natural iridium in a reactor.
- Iridium 191 undergoes neutron bombardment creating Iridium 192.
- Useful properties for Industrial Radiography.



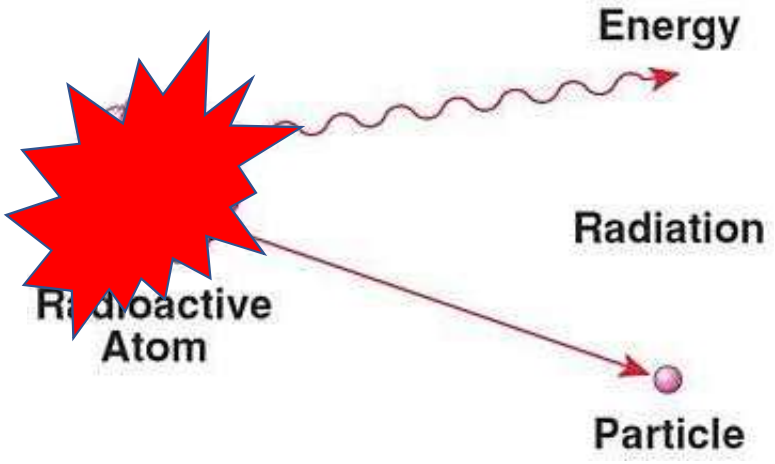
Structure of an Atom

- Protons (+)
- Neutrons (+/-)
- Electrons (-)



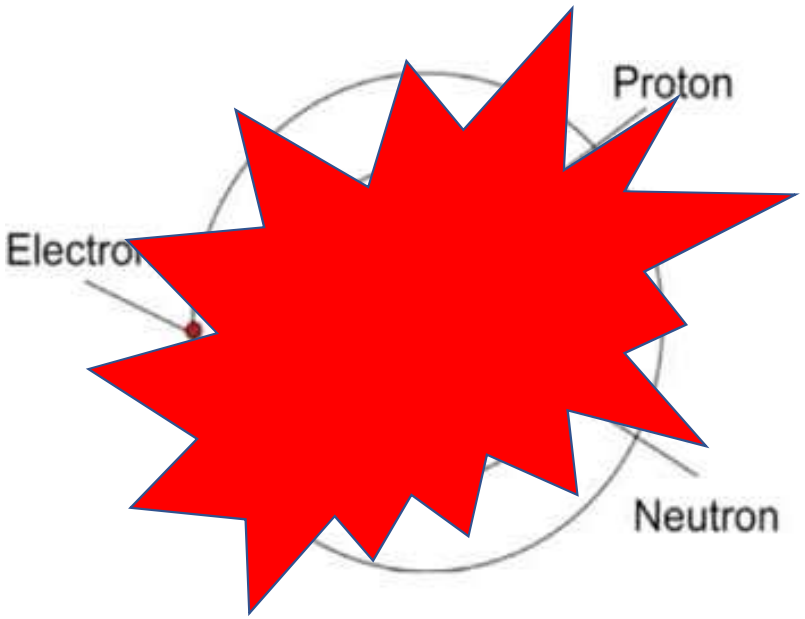
Gamma Ray Radiation

- Unstable atoms with too much energy.
- Shaking and snap releasing energy.
- Gamma ray and particle radiation released.
- Penetrating, harmful.



Two Basic Kinds of Radiation

- Particle Radiation
  Alpha (+) (in some RAM)
  Beta (-).
- Pure energy. i.e. gamma rays.

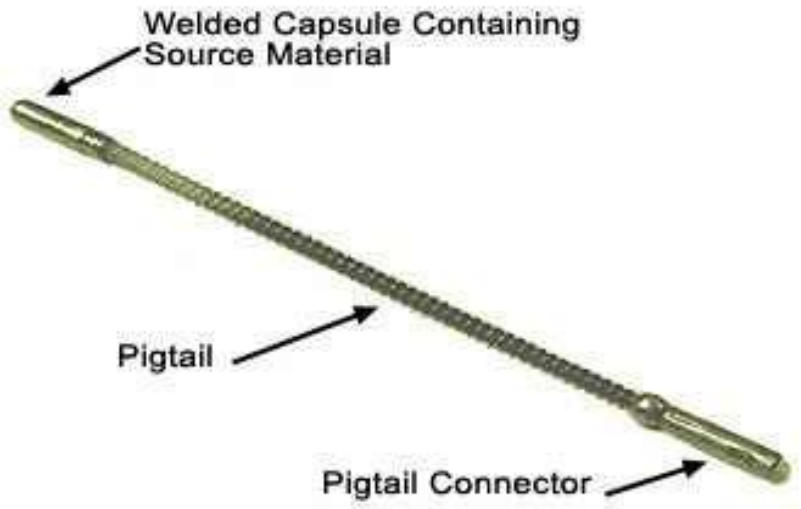


Decay

- The atom has decayed.
- The atom no longer has energy to expend.
- The environment is stable.

Unstable vs. Stable

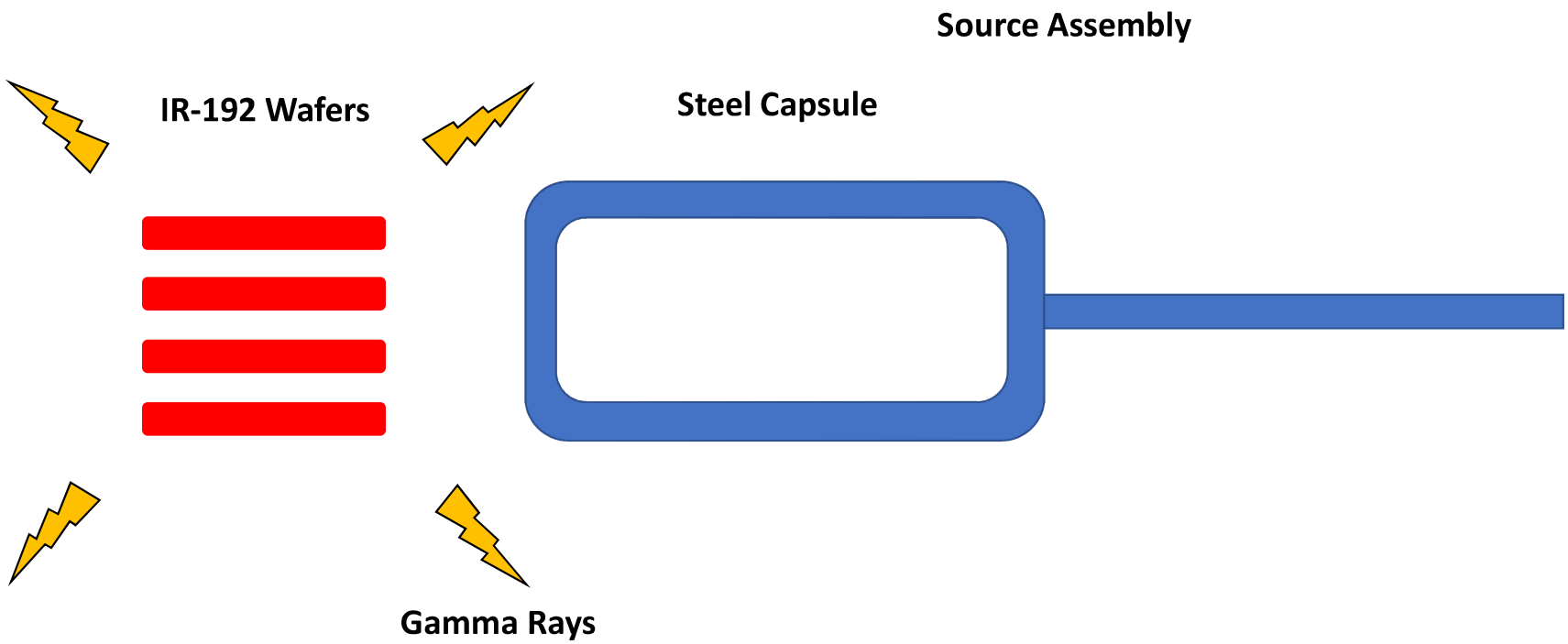
- An unstable, radioactive atom will explode and release its byproducts.
- Once byproducts are released, the environment is stable.
- The atom has decayed.



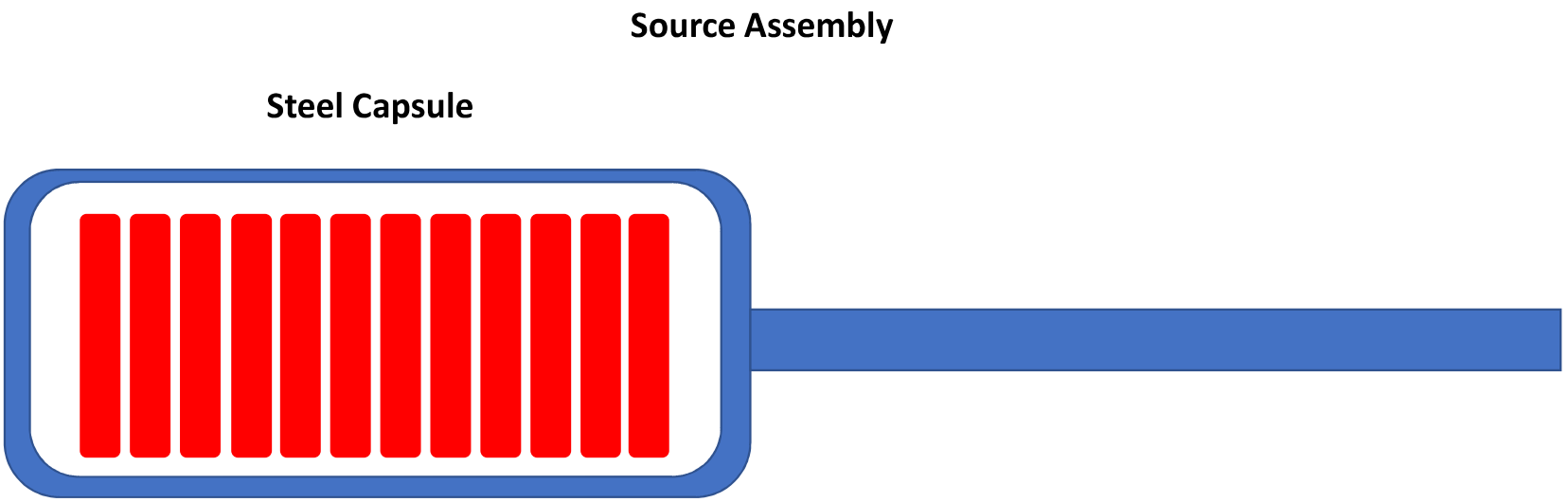
Steel Capsule

- Wafers of RAM are placed into the steel capsule.
- A cap is welded shut to seal the capsule.

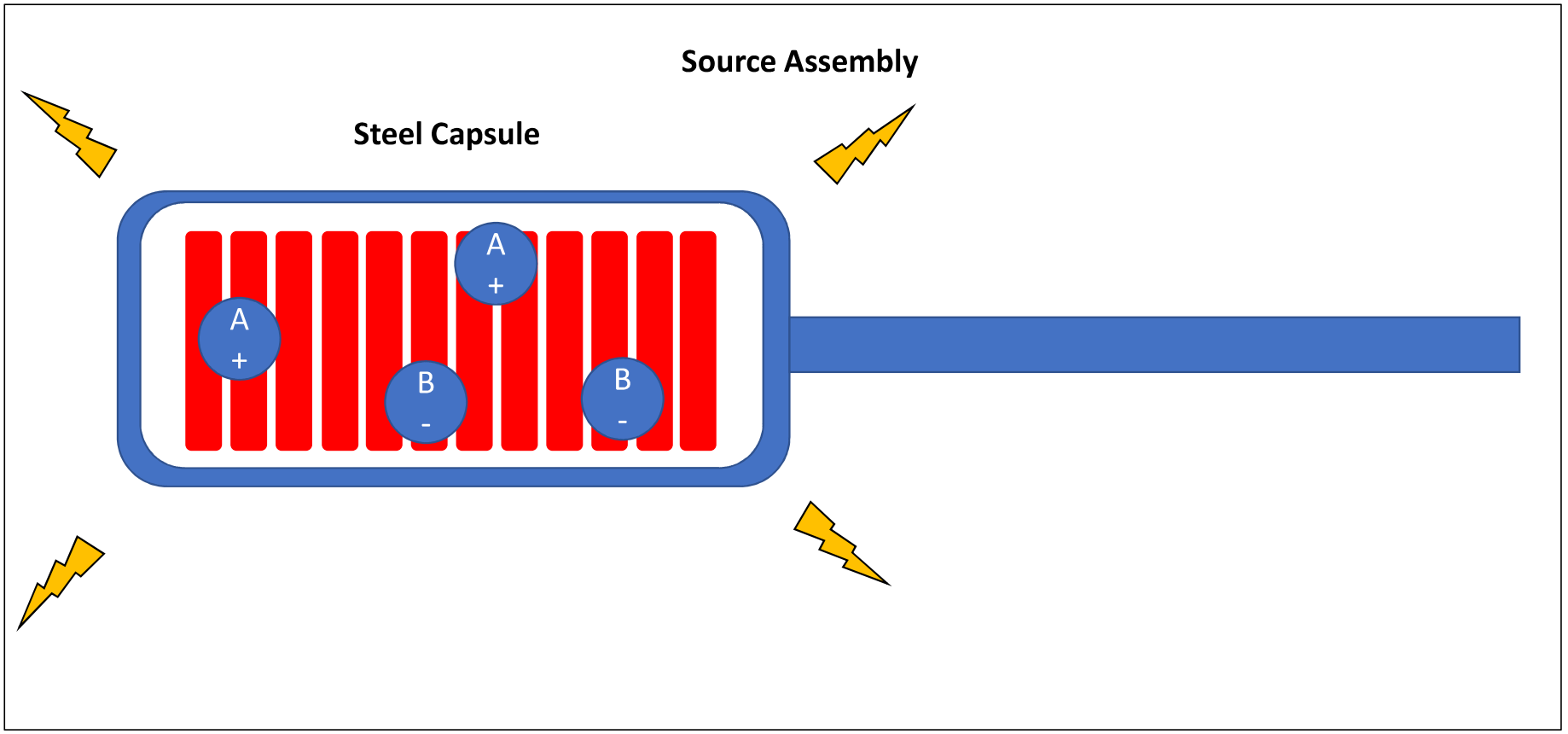
Chapter 2: What is Radiation?



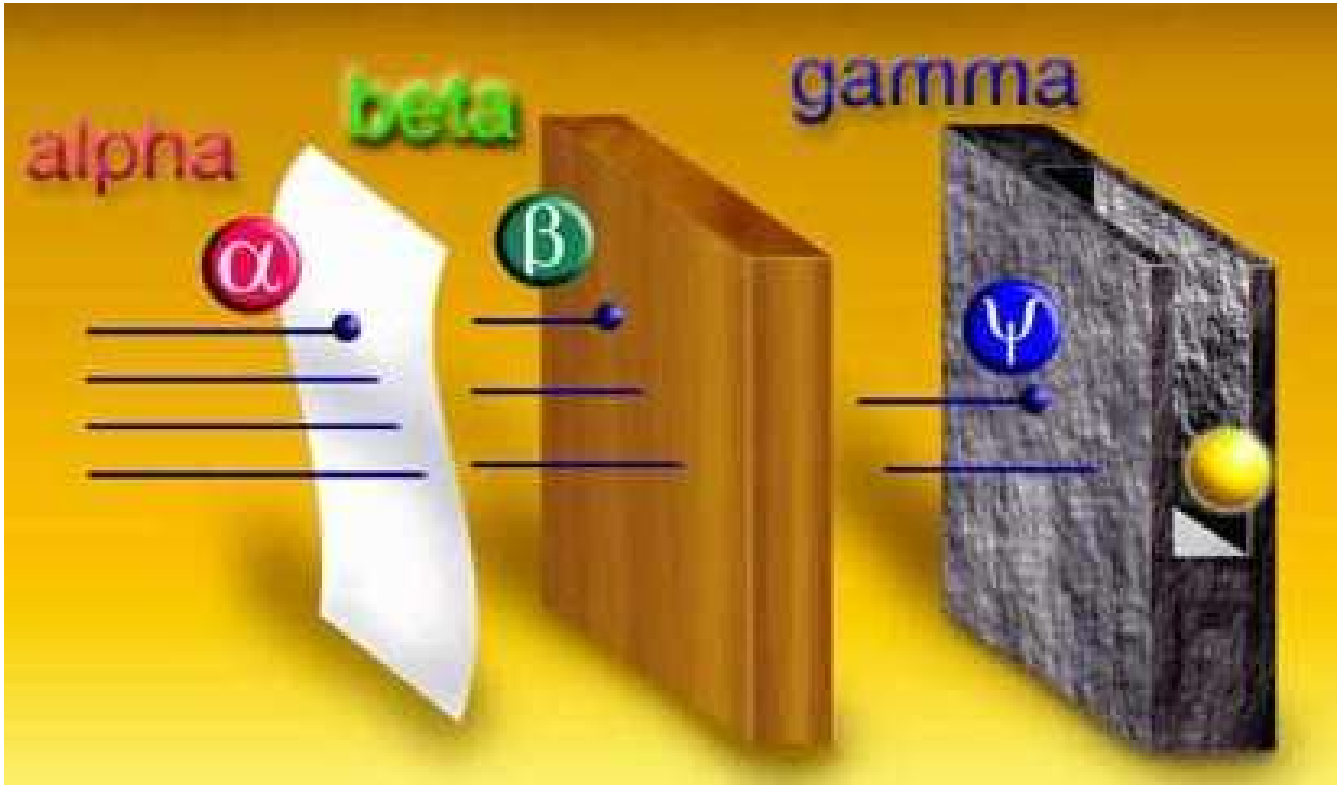
Chapter 2: What is Radiation?

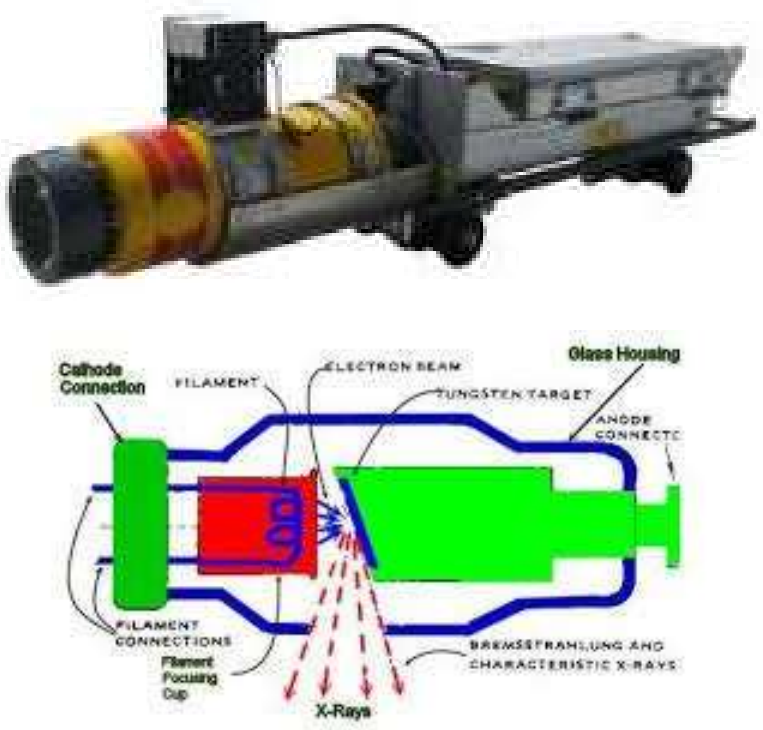


Chapter 2: What is Radiation?



Chapter 2: What is Radiation?

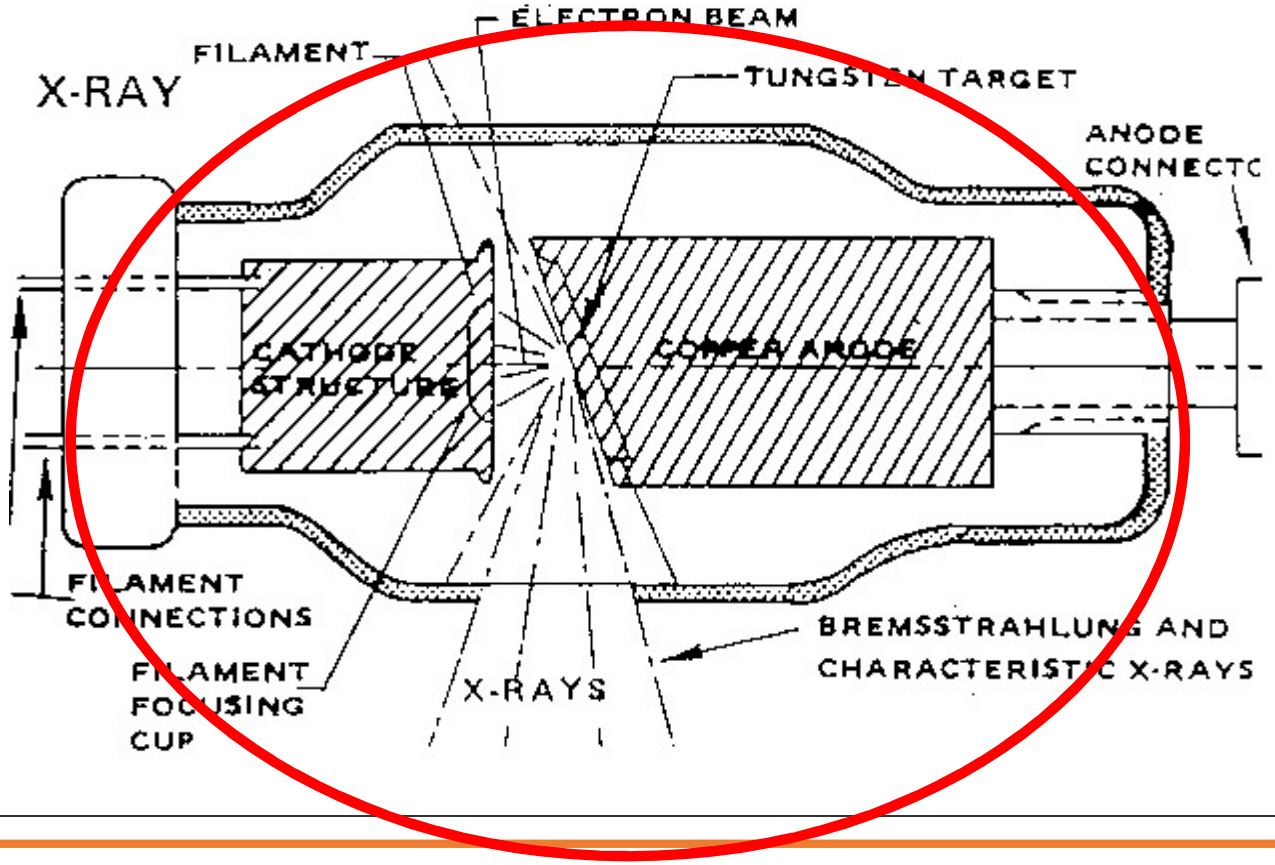




X-radiation

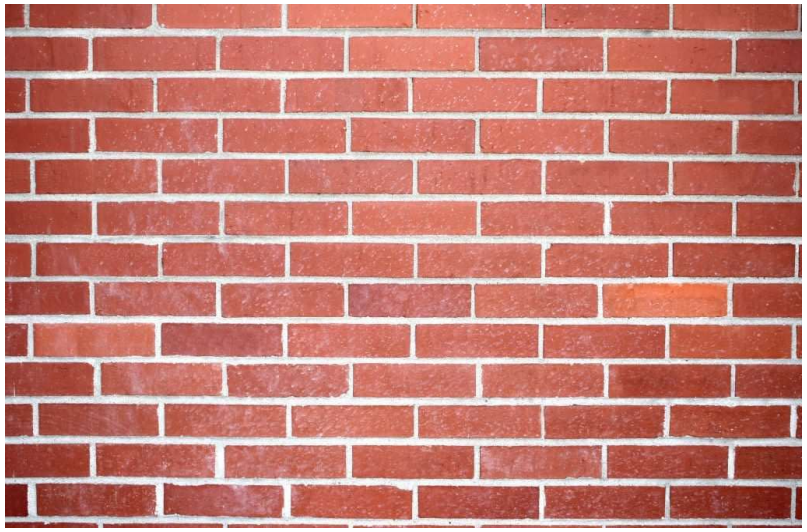
- FREE Electrons forming an electron beam, bombardment.
- Control panel.
- Power source.

Chapter 2: What is Radiation?



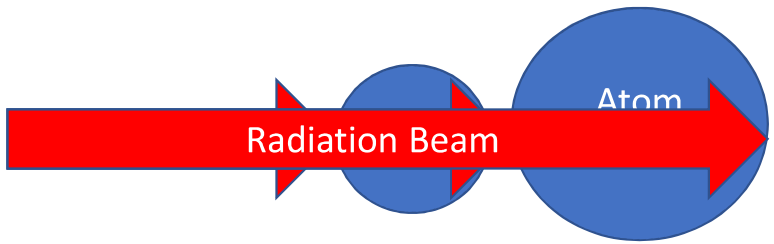
CONTROL PANEL

POWER



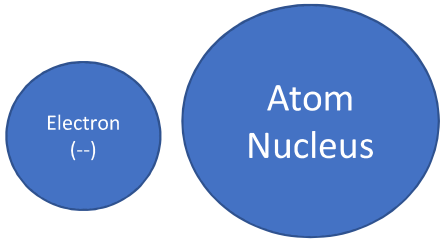
Collisions and Ionization

- Radiation beam strikes and interacts with atoms of objects.
- Ejected electron becomes a particle of radiation.
- No residual radiation.



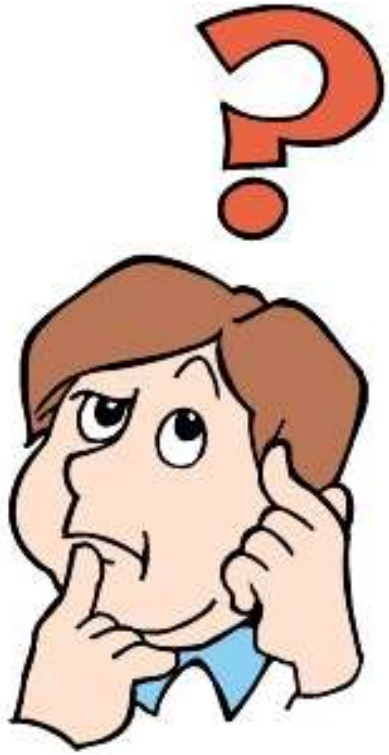
Collisions and Ionization

- Radiation beam strikes and interacts with atoms of objects.
- Ejected electron becomes a particle of radiation.
- No residual radiation.



Collisions and Ionization

- Radiation beam strikes and interacts with atoms of objects.
- Ejected electron becomes a particle of radiation.
- No residual radiation.



Collisions and Ionization

- Walls?
- Pipe?
- Trees?
- Food?
- Water?
- Humans?

Basics of Radiation

- Energy moves at speed of light.
- Penetrating.
- Harmful yet useful.
- Humans can not sense radiation.
- Travels in straight lines.

Basics of Radiation

- RAM is regulated by the United States Nuclear Regulatory Commission and Agreement States.
- X-ray Machines are regulated by the state in which they're used.

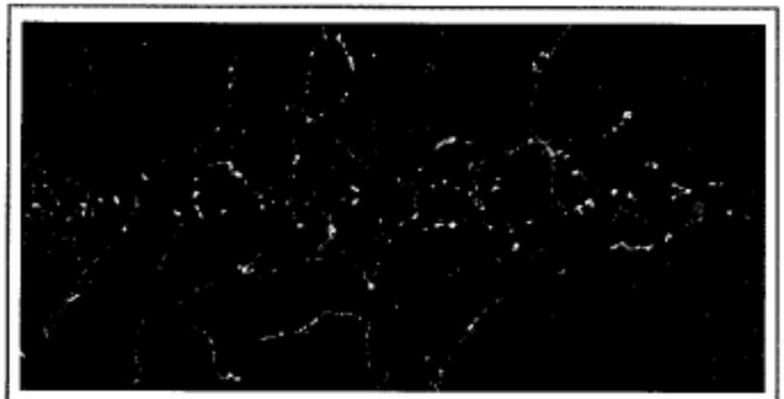


Figure 2.2: This historical photograph, published in 1923, shows the tracks made by electrons that have been hit by a narrow beam of X-rays. The X–rays pass through very moist air striking electrons in their path. These electrons speed off leaving a trail of electrically charged particles. Each particle becomes a center for the condensation of a visible droplet of water. The water droplets that are formed are photographed. C.T.R. Wilson, the scientist who took this photograph, won the Nobel Prize in physics for this work.

Exposure

- Measure of X-radiation or gamma radiation based on the ionization produced in air by X-rays or gamma rays.

Totally Rad!

Absorbed Dose

- The radiation dose or amount of radiation that has been absorbed by some substance.
- Radiation Absorbed Dose (RAD).

Dose Equivalent

- (H) is a quantity used for radiation protection that expresses on a common scale for all irradiation incurred by exposed persons.
- Reported dose.

Compound Units

- Roentgen per hour (R/h).
- Milliroentgen per hour (mR/h).

Compound Units

- Example: Your survey meter reads 8 mR/h. If you stood in the same area for an entire hour, what is your radiation dose?

8 mR

Compound Units

- Example: Your survey meter reads 8 mR/h. If you stood in the same area for 3 minutes, what is your radiation dose?

We will get there!

A.L.A.R.A.

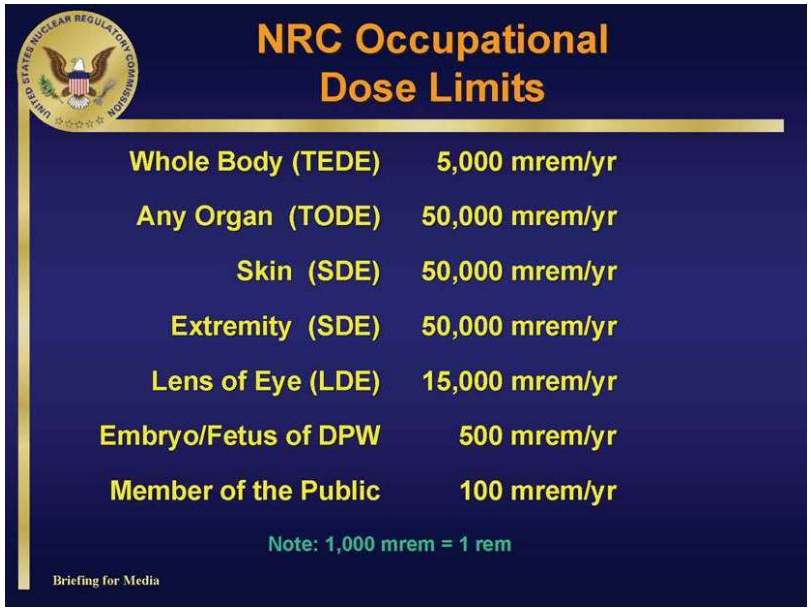
- As Low As Reasonably Achievable.
- Required programming.
- Time, Distance, Shielding.

A.L.A.R.A.

- Spend less time in radiation field.
- Increase your distance from source of radiation.
- Use available shielding.

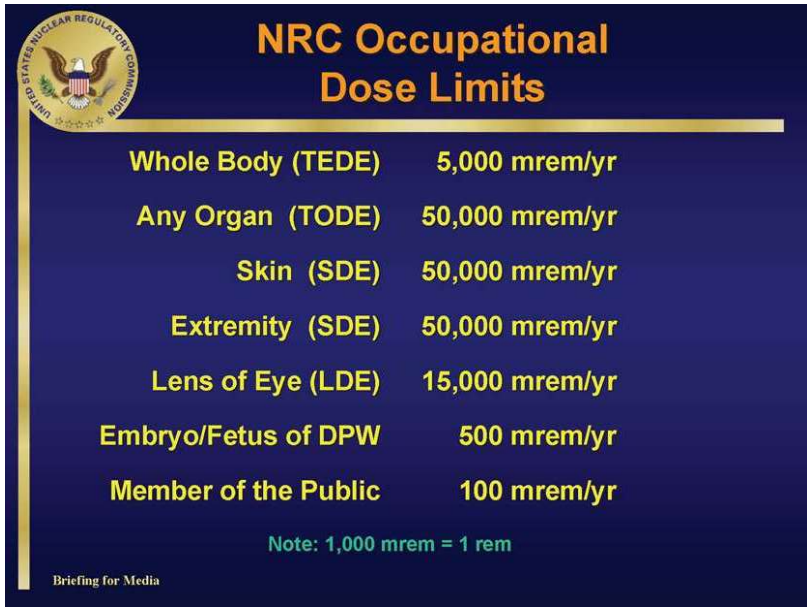
A.L.A.R.A.

- Longer crank controls.
- Sharing dosage.
- Increased collimation.
- Additional training.



Prospective Annual Limit for Occupationally Exposed Personnel

- 5 rem in any 1 year.
- Lesser limits discussed.
- Exceed limit?



Prospective Annual Limit for Occupationally Exposed Personnel

- Please be advised you have exceeded the yearly dose limit. You are hereby restricted to performing licensed ac..

Permissible Levels of Radiation in Unrestricted Areas

- All personnel in unrestricted areas shall not receive more than 2 mrem in any hour…

Permissible Levels of Radiation in Unrestricted Areas

- …or 0.1 rem to the whole body in any person of one calendar year.

Restricted Areas

- Area that protects individuals against undue risks from exposure to sources of radiation.
- Constant surveillance of established area.

Exposure of Minors

- A person under the age of 18 must not be exposed to more than 10% of the annual limits for industrial radiographers…

Exposure of Minors

- …or 10% of 5 rem per calendar year to the whole body or 50 rem to the extremities.

Exposure of Females

- More females working in the industry than ever before.
- Declared Pregnancy.

Exposure of Females

- Fetus from occupational exposure shall not exceed 0.5 rem (or 500 mrem) evenly distributed over the entire pregnancy.

Declared Pregnant Workers

- Available for those radiation workers who are pregnant or planning a pregnancy.
- Purely VOLUNTARY!
- To be apart of the program, you must DECLARE your pregnancy in writing to your supervisor and provide the estimated date of conception. The RSO must be notified immediately upon declaration.
- The declared pregnant worker may be provided with a dosimeter that will be worn at the waist level. If lead is worn, the "fetal badge" shall always be worn under the lead.

Making Sense of It All

- What is radiation?
- Gamma ray radiation.
- X-ray radiation.
- Collisions and ionization.
- Units of measure.
- Regulations.
- Sources of radiation.

Quiz 1 of 8:

Beta particles carry a _____ charge.

Negative (-)

Quiz 2 of 8:

“Ripping” the electron from its atomic shell or adding an electron is called _____.

Ionization.

Quiz 3 of 8:

The prospective annual limit for occupationally exposed personnel, for whole body, is _____ rem in any 1 year.

5

Quiz 4 of 8:

Discussing regulations, what is meant by a “Declared Pregnant Woman”?

A female Radiographer who is pregnant and declares the pregnancy to the RSO.

Quiz 5 of 8:

Describe what is radiation?

An unstable atom finally reaches a volatile point then explodes. The atom will expend a gamma ray and particle(s) of radiation. The atom no longer has energy to expend. The atom has decayed and there is no longer a threat of radiation from the atom.

Quiz 6 of 8:

Discussing collisions, a radiation beam strikes an object interacting with the electrons in the material. When a perfect strike of the beam occurs onto the electron, what happens next?

The electron is “ripped” from its shell and becomes a radioactive particle itself and may hit other electrons.

Quiz 7 of 8:

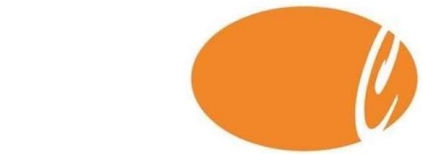
Gamma and X-rays are considered what type of radiation?

Ionizing radiation.

Quiz 8 of 8:

Describe the wavelengths and frequency of ionizing radiation.

Short wavelengths and high frequency.



End of Chapter 2

What Is Radiation?