Radiation Safety – Health Physics

Neutron Spectroscopy Summer School

What is Radiation?

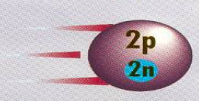
Radiation

- Energy moving through space as invisible waves

Non-ionizing Radiation

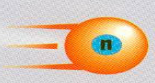
- Light, sound, heat or infrared waves, microwaves, radio waves, low frequency power line radiation

Ionizing Radiation



Alpha particles
(Fast moving helium nucleus)

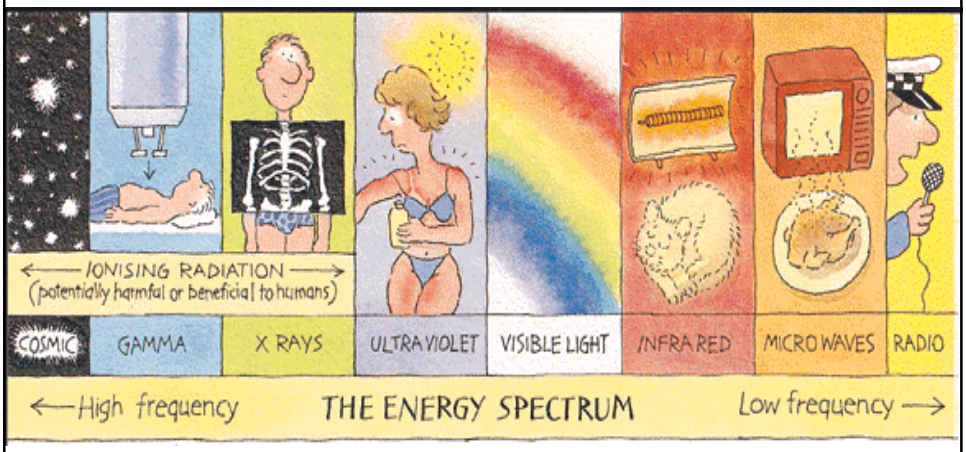
Beta particles
(Fast moving electron)



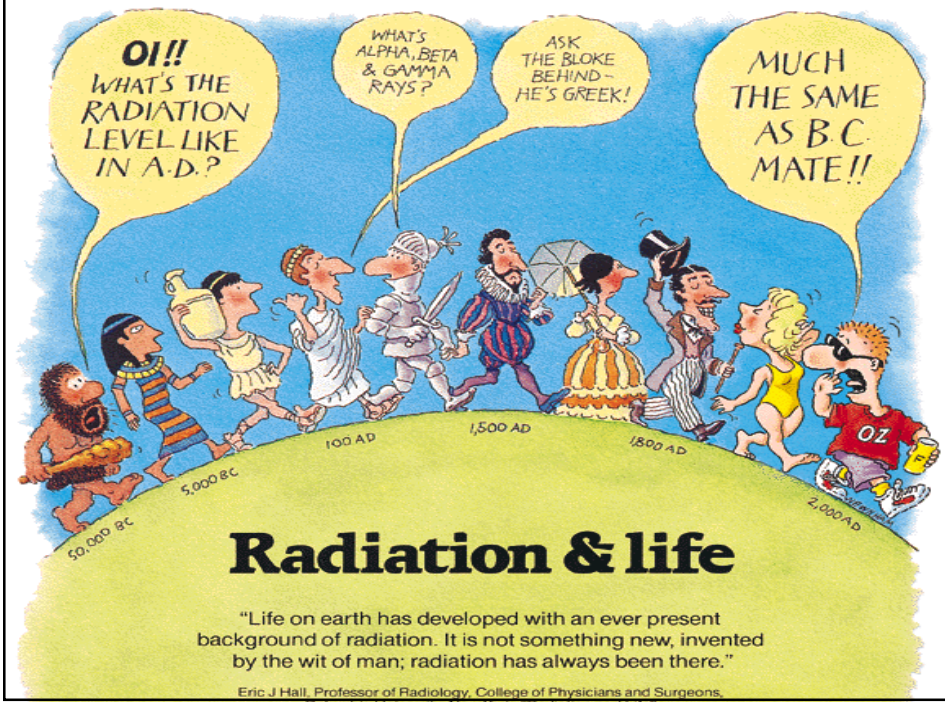
Neutrons

Gamma, X-ray

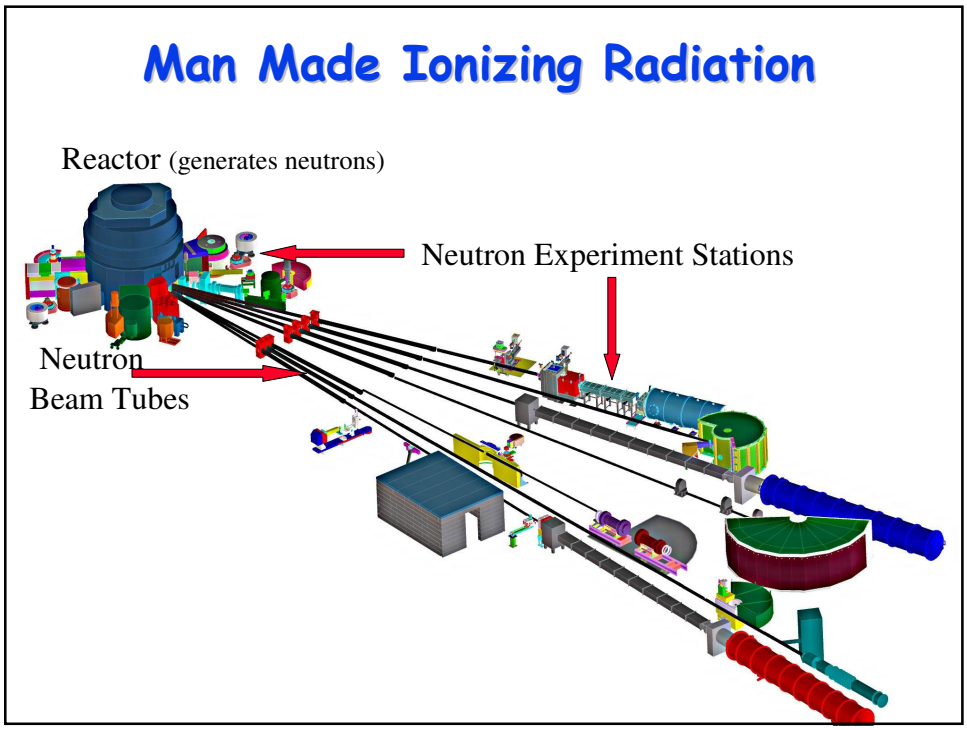
Electromagnetic Radiation: Gammas and X-Rays



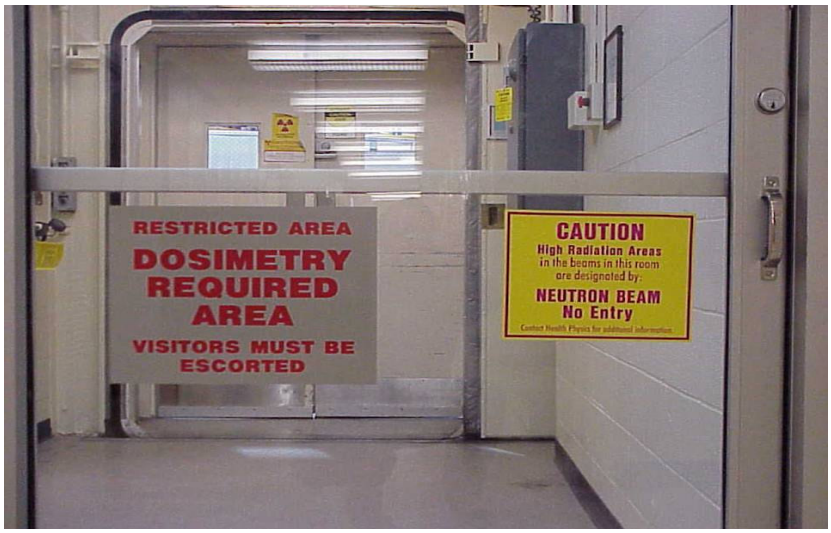
THE ELECTROMAGNETIC SPECTRUM




How Do We Quantify Radioactivity?
Disintegrations Per Second (d/s)
• The number of atomic nuclei that decay each second
Radioactivity of Some Natural and Man-Made Materials
Where Does Radiation Come From?
Cosmic Radiation 28
Consumer Products 10
Other Residual Fallout <2
Terrestrial 28
Medical Isotopes 14
Internal 40
Man Made Radiation
Medical X-rays 40
Radon 198
Natural Radiation
Millirem per year
Total Average Yearly Radiation Dose is 360 Millirem
Coal Ash 1 ton 2 million d/s
ACME Fertilizer Super Phosphate
Fertilizer-super phosphate 25kg. 125,000 d/s
Uranium 1 ton 10,000 million d/s
1 Human adult 3000 d/s
Banana small 9 d/s
Low-level nuclear waste 1kg. 1 million d/s
Hot Chocolate 1 packet 6 d/s
Hamburger 4 oz. 29 d/s


Man Made Ionizing Radiation
Reactor (generates neutrons)
Neutron Experiment Stations
Neutron Beam Tubes

Radiation Exposure



Radiation Dosimetry

Real-Time Dose Readout

Occupational Dose Limit = 5,000 mrem/yr

General Public Dose Limit = 100 mrem/yr

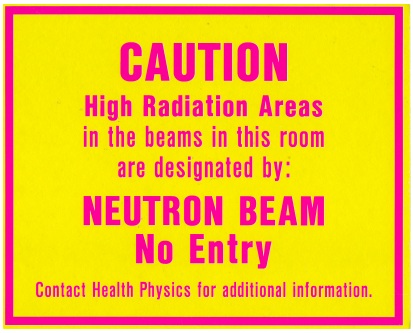
Average Dose to US Public = 360 mrem/yr

Average Dose to NIST Researcher ~ 50 mrem/yr

Health Physics Labels/Signs

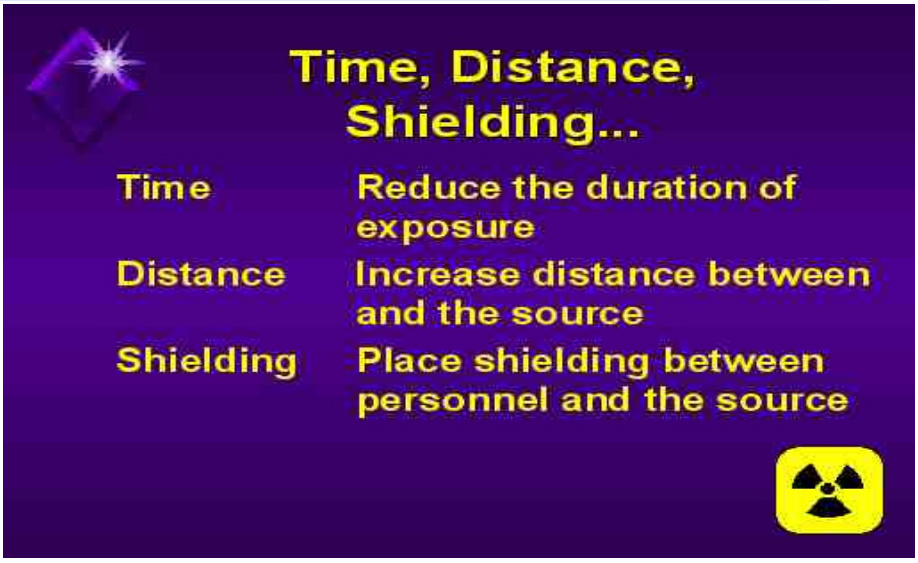
>5 mrem/hr
(whole body dose rate)

>100 mrem/hr
(whole body dose rate)

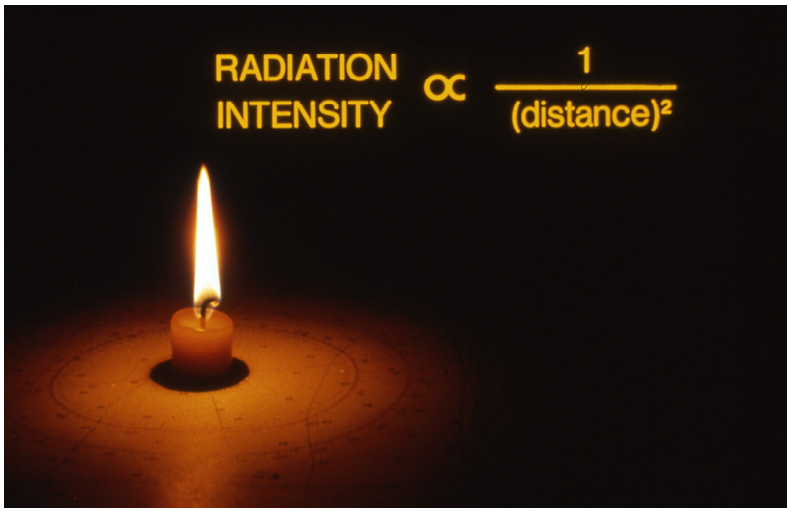


~100,000 mrem/hr
(localized dose rate)

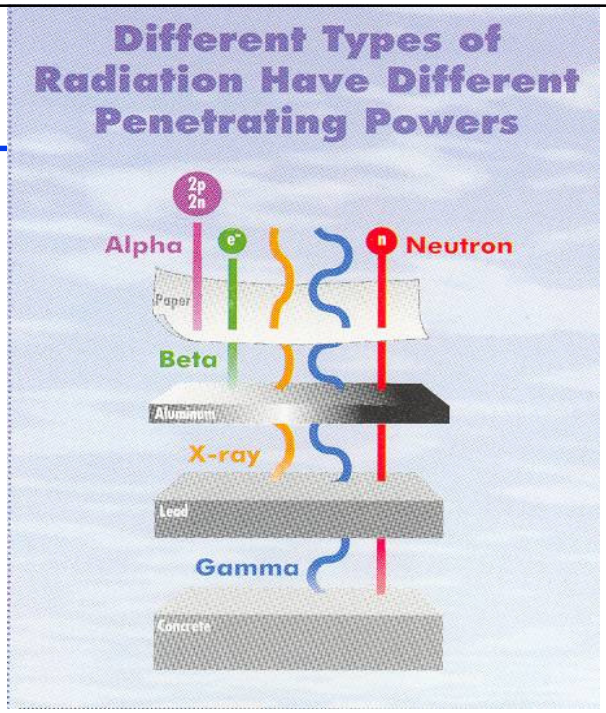
Time, Distance, and Shielding



Distance – Inverse Square Law



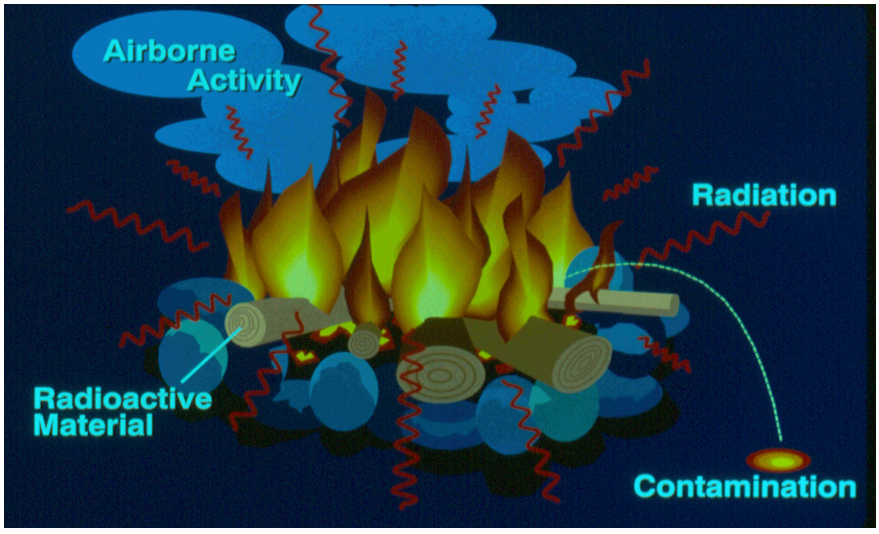
Shielding



Internal Exposure

- **External exposure**
  Exposure to radiation outside body.
- **Internal exposure**
  Exposure to radiation emitted from radioactive material taken into the body by inhalation, ingestion, absorption through skin, or through an open wound.

Campfire Analogy



Contamination Control

Always monitor yourself and items you have with you when leaving a controlled area.

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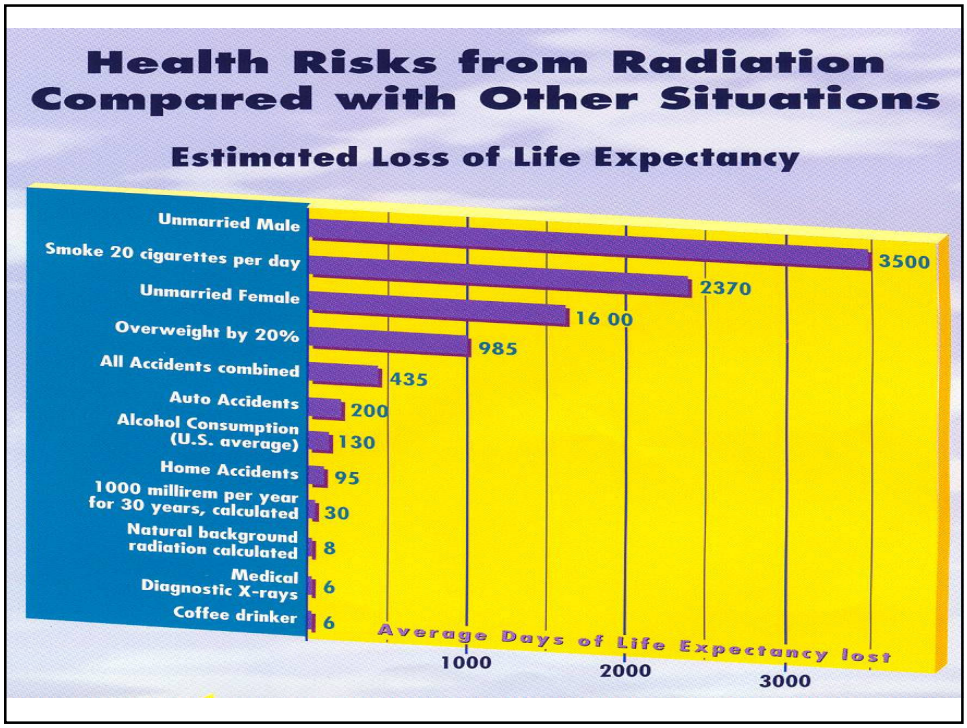

Ionizing Radiation - Overview

Can not see it, feel it, or smell it

- we must rely on training and equipment to protect ourselves

Relatively simple to detect and measure

- unlike chemical and biological hazards
- we can quickly assess and take action

Biological effects have been intensely studied for 50 years