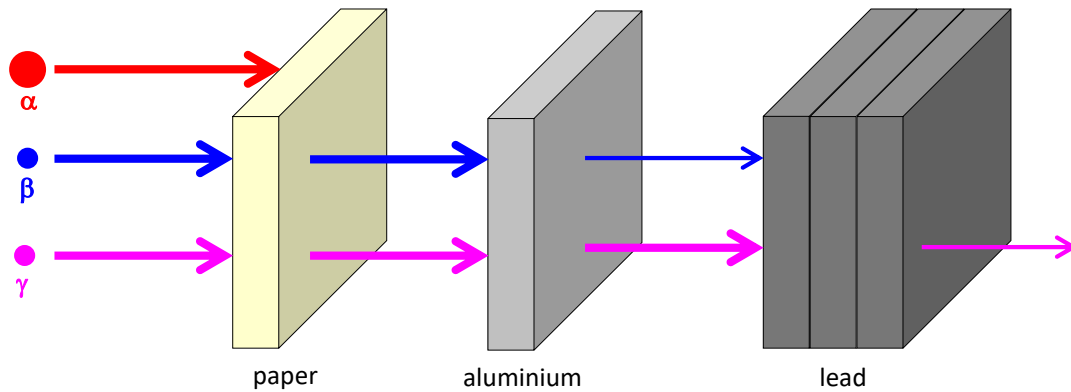


RADIATION PENETRATION POWER



Relative penetrating powers of α particles, β particles and γ rays. The greater the density of the material, then the smaller the penetration through that material.

Alpha particles are the most ionizing form of radiation because the large charge and mass of the helium nucleus. Gamma rays are the least ionizing form of radiation because the photons have zero charge. Therefore, gamma rays are the most penetrating and alpha particles the least penetrating form of radiation.

(**Ionization** – removal of a bound electron from an atom to produce a free electron and a positive ion).

All radioactive emissions are extremely dangerous to living organisms. When alpha, beta or gamma radioactive emissions hit living cells they cause ionize atoms. They can kill cells directly or cause genetic damage to the DNA molecules. High radiation doses will cause burn effects as well as kill the damaged cells. However, low doses don't kill the cells, but if the cells are genetically damaged and can still replicate, these mutations can lead to the formation of cancerous cells and tumour development later.

When alpha, beta and gamma radiation collide with neutral atoms or molecules they knock off electrons and convert them into charged or ionised particles (ions). Positive ions are formed on electron loss and negative ions are formed by electron gain. The positive ions maybe unstable and very reactive and cause other chemical changes in the cell molecules. The three radiations have different capacities to cause cell damage.

If the radioactive source gets inside the body the danger order is

alpha > beta > gamma

The bigger the mass or charge of the particle, the larger its ionising impact on atoms or molecule.

	alpha	beta	gamma
Ionizing power	10	1	1
mass	4	1/1850	0
charge	+2	± 1	0

If the radioactive source is outside the body, the order danger is reversed:

gamma > beta > alpha

because the danger order follows the pattern of penetrating power. The smaller the mass and charge the more penetrating the radiation.

Gamma and beta are the most penetrating and will reach vital organs in the body and be absorbed. Most gamma passes through soft tissue but some is inevitably absorbed by cells. Alpha radiation would not penetrate clothing and is highly unlikely to reach living cells.

Because of the dangers of this ionising or atomic radiation, all workers and medical staff who are likely to be near radioactive or ionising sources must wear lapel radiation badges containing photographic film to monitor their exposure to radiation. The film is regularly developed and the darker the film the more radiation would have impacted on the person.

Examples of precautions that can be taken include:

- Radiographers wear lead lined aprons and anyone else involved in radiotherapy cancer treatment must take particular precautions and radiation monitored.
- In nuclear fuel preparation and reprocessing, as much work is done using robotic control systems in behind steel, concrete, lead or thick lead glass panels for visual monitoring of the situation.
- In research laboratories, experiments are conducted in sealed fume cupboards at the laboratory side and technicians work through sealed whole arm gloves through a thick lead glass front. You can also reduce the pressure in the fume cupboard so there is no chance of pressure leakage out into the laboratory area.

[VISUAL PHYSICS ONLINE](#)

If you have any feedback, comments, suggestions or corrections
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