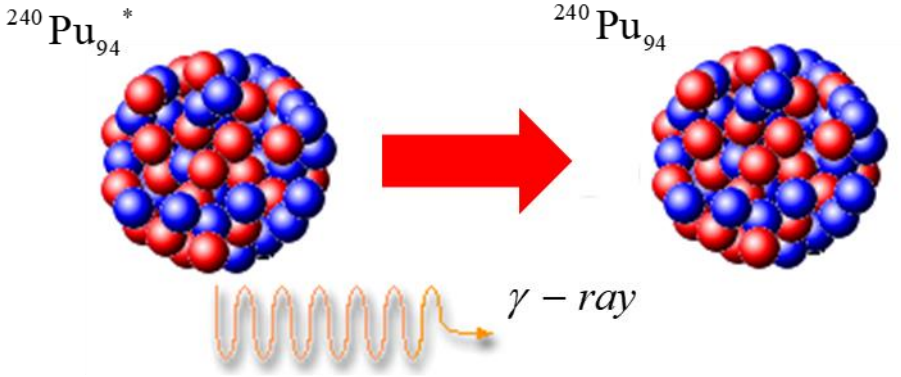
VISUAL PHYSICS ONLINE

GAMMA DECAY



high-energy (high-frequency) electromagnetic wave

Gamma rays (γ rays) are **photons** having very high energy that were emitted from excited nuclei, much like emission of photons by excited atoms. Like an atom, a nucleus itself can be in an excited state. When it jumps down to a lower energy state it emits a photon called a γ ray. The energy level separations in a nucleus (~ MeV) are much greater than the energy level differences in an atom (~ eV). For a given decay, the γ ray always has the same energy and since the photon is electrically neutral, there is no change in the element as a result of the decay.

Gamma rays are extremely high frequency (short wavelength) electromagnetic waves where the photons are emitted from excited nuclei.

- N, Z and A do not change

$$^{222}_{86}\mathrm{Rn}^{*} \rightarrow {}^{222}_{86}\mathrm{Rn} + \gamma$$

A nucleus can be in an excited state after it suffers a violent collision with another particle, or more commonly the daughter nucleus remaining after an α decay or β decay is left in an excited state.

$$^{226}Ra_{88} \rightarrow {}^{222}Rn_{86}^{*} + {}^{4}He_{2}$$

energy of α particle 4.685 MeV

$$^{222}Rn_{86}^{*} \rightarrow {}^{222}Rn_{86} + \gamma$$

energy of γ ray 0.186 MeV

What is the difference between a γ ray and an X ray?

Fundamentally there is no difference. They are both just high energy electromagnetic radiations, although γ rays usually have higher energies. We distinguish between the two on how they are created:

The source of γ rays is the nucleus.

The source of X rays electronic transition in an atom.

Gamma rays have very great penetrating power. They move at the speed of light and have a very short wavelength or high frequency. The energy of the photon of a gamma ray is

$$E = h\,f$$

Typical values (check the calculations with your calculator):

$\lambda \sim 3 \times 10^{-12}$ m $\quad f = c / \lambda \sim 10^{20}$ Hz

$E_{photon} \sim 7 \times 10^{-14}$ J ~ 0.4 MeV

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