

**Conversion of Natural Background Gamma rays into short range photoelectrons by high atomic number (Z) material like Uranium.
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1. Absorption of gamma rays by materials is proportional to the Fourth power on the atomic number. Calculations show that for low energy gamma rays DU absorbs 500-1000 times the amount of energy that living tissue does. This is because of the high Z (92) and high density (9.5) of Uranium Oxide compared with water ($Z = \text{ca. } 16, d=1$)

[see e.g. Krane 1988 *Introductory Nuclear Physics*]

$$\log I/I_0 = \mu x \quad (\text{at } 100\text{keV}, \mu: \text{Uranium} = 70; \text{water} = 0.17)$$

2. About 75% of all the energy absorbed by DL from natural background is converted into photoelectrons with ranges up to 200 microns. Thus the sparsely ionising and penetrating gamma rays are converted by the DU particles inside the body into highly ionising short range photoelectrons.

3. This results in a focusing of energy from the natural background field into tissue close to the DU particles. For an annual dose of 1mSv there is a dose of 500mSv in the DU particle and this dose is redistributed into the tissue close to the DU particle with the very steep dose trend. The form of this trend depends critically on the size of the particle. As particles get larger than 10 μ diameter, the energy is increasingly absorbed in the particle.

4. For gamma energies above 100keV, secondary processes (pair production, Compton scattering) produce X-rays of lower energy so a large fraction of this component also is absorbed and converted to photoelectrons.

5. Photoelectrons generated inside the DU particles will emerge into tissue with decreased energy, and will therefore have shorter range and be more ionising close to the DU particle. These combined processes will lead to high ionisation density near the DU particles smaller than 2 μ diameter.

6. These ionisations by photoelectrons will cause high local dose due to amplification of natural background radiation and medical X-rays and will cause damage in addition to the alpha and beta activity of the DU particles. The effect is simple to investigate.