A Report on Nuclear Physics

Decay

Radicative decay is a process that unstable atoms (particularly nuclei) undergo to achieve a more stable stable (lower energy). Within Nuclear Physics, this is catogorside into three large types: Alpha (α) decay, beta (β) decay, and gamma (γ) decay. What decides what form of decay is undergoene depends on which way the nucleus is unstable.

Alpha Decay

Alpha decay is the first form of decay we will look at. Alpha decay releases an alpha particle from the nucleus of the atom; the particle consists of 2 neutrons and 2 protons, identical to a helium nucleus. It is denoted as: ${}^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}\alpha$.

Although alpha decay has an incredibly high ionisation power due to its strong charge, it does not travel far and has little penetration (explained later). Alpha emitters are safe out of the body as alpha particles are unable to penetrate skin. However, once inside the body, its high ionising power can wreck havoc against cells.

Beta Decay

Beta decay comes in two forms: beta positive (β^+) decay and beta negative (β^-) decay. Beta negative decay is far more common, involving a neutron decaying into a proton, releasing a beta particle (electron) and an antineutrino. It is denoted as: ${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}\beta + \overline{v}$.

There also exists beta positive decay, which is the opposite process, a protons decaying into a neutron, releasing a positron and a neutrino, denoted as ${}^{A}_{Z}X \rightarrow {}^{A}_{Z-1}Y + {}^{0}_{+1}\beta + v$. This is rarer on the account that a proton is lighter than a neutron, meaning that it would require some input energy to transmute.

Beta particles are moderatly ionsing, moderatly penetrative, and travel moderatly fast. Much like alpha emitters, beta emmiters are much more dangerous within the body, but external beta emmiters are also capable of causing "beta burns".

Gamma Decay

Gamma decay occurs when an excited atom reaches its ground state, releasing a small photon (a small packet of energy): the gamma ray. It is identical to an X-ray, except for the place of origin[1]. It is denoted as ${}^{Am}_{Z}X \rightarrow {}^{A}_{Z}X + {}^{0}_{0}\gamma$. Gamma decay often accompanies the other forms of decay.

Gamma particles are extremely penetrating and can travel long distances, but they have a small ionsiation ability.

Relation between ionsiation, particle size, and ionsiaton ability

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Bibliography:

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1. X-rays originate from the electron cloud, whereas the gamma ray originates from the nucleus.↩