Positron Emission Tomography (PET) seen in a new light

Positron Emission Tomography (PET) uses the principle of the so called annihilation of positrons with electrons while gamma-photons [γ] are released. These gamma-photons [γ] can be detected with a scanner giving information about location and appearance of specific organs.

The necessary positrons can be given by radioactive decay of certain atoms like Carbon-11 and Oxygen-15.

<u>Current insights</u>
The case Study "Positron Emission Tomography (Last updated 11:48, 12 Jun 2016)" gives the following description:
https://chem.libretexts.org/Core/Physical_and_Theoretical_Chemistry/Nuclear_Chemistry/Applications_of_Nuclear_Chemistry/Application%3A_Radiation_in_Biology_and_Medicine/Case_Study%3A_Positron_Emission_Tomography

> *The emission of a positron is represented by:*
>
> $^{1}_{1}P \rightarrow {}^{1}_{0}n + e^{+}$ *(with a small but important correction by red.)*
>
> *This shows that the positron (represented here by e^{+}) speeds out of the nucleus while the neutron stays inside the nucleus. Consider the following nuclear reaction that is common in PET scans of the brain where carbon-11 is used as the tracer molecule.*
>
> $^{11}_{6}C \rightarrow {}^{11}_{5}B + e^{+}$
>
> *Notice that in this example of positron emission, the nuclide changes into a different element and as it gives of a positron particle, the atomic number is lowered by one, but the mass of the new element stays the same as the carbon that has decayed.*

Wikipedia (https://en.wikipedia.org/wiki/Isotopes_of_carbon) says about this subject:

> *Carbon-11 or C^{11} is a radioactive isotope of carbon that decays to boron-11. This decay mainly occurs due to positron emission; however, around 0.19–0.23% of the time, it is a result of electron capture. It has a half-life of 20 minutes.*
>
> $^{11}_{6}C \rightarrow {}^{11}_{5}B + e^{+}\ \ Ve + 0.96\ MeV$
>
> $^{11}_{6}C + e^{-} \rightarrow {}^{11}_{5}B$ *+ Electron neutrino + 1.98 MeV*
>
> *Carbon-11 is commonly used as a radioisotope for the radioactive labeling of molecules in positron emission tomography. Among the many molecules used in this context is the radioligand [11 C]DASB (labeled with carbon-11).*

<u>Decay of protons</u>
Positron Emission Tomography (PET) uses –as assumed in het published articles (Case Study: Positron Emission Tomography (Last updated 11:48, 12 Jun 2016, Wikipedia)– the transition of protons to neutrons.

On Wikipedia (https://en.wikipedia.org/wiki/Proton_decay) you can find that there is currently no experimental evidence that proton decay occurs when a proton is on its own.

For neutron you can find on Wikipedia that is the decay of the free neutron is possible. (https://en.wikipedia.org/wiki/Free_neutron_decay)

Wikipedia: $n^0 \rightarrow p^+ + e^- + V_e$

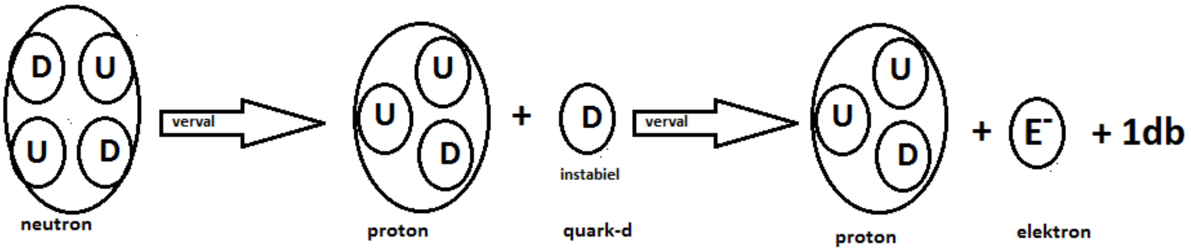
V_e hierin is circa 0.78 MeV ($1{,}25 \cdot 10^{-13}$ Joule), 1 eV ≈ $1{,}60 \cdot 10^{-19}$ Joule.

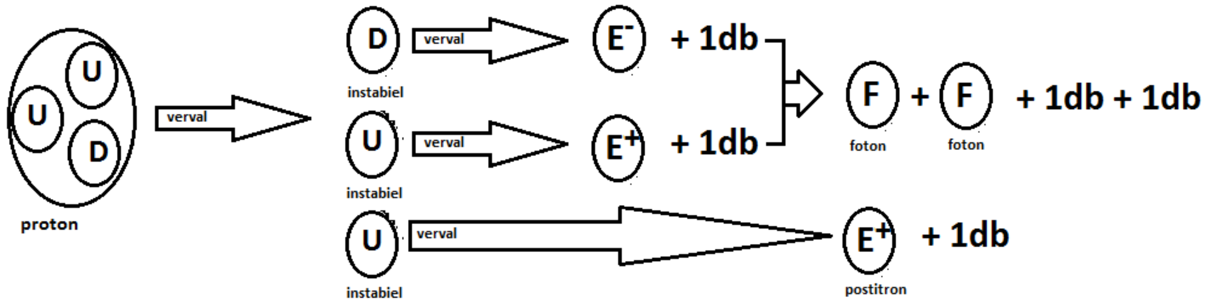
There are claims of the transition of protons to neutrons within the decay of more complex particles. In many cases there is a relation with Positron Emission Tomography. Relevant is this case is the decay of C^{11} en O^{15}.

Consideration

According to our theory the transition of a solitary proton to a neutron is complex and not to be expected. The organization of matter needed in a reverse reaction by with a proton changes into a neutron (following our equation) does not lead (in our view) to the forming of gamma-photons [⁘].

The equations are once more given:





For the db (dimensional basic) the following symbol will be used: ⅄.

According to our model only the decay of a proton can lead instantly to the appearance of gamma-photons [⁘].

Using our theory we suggest different mechanisms for Positron Emission Tomography (PET). First we give a suggestion for the decay of Carbon-11. Then we give a suggestion for the decay of Oxygen-15.

Carbon-11

Carbon-11 is an isotope of carbon, frequently used in positron emission tomography, or PET imaging. It has 6 protons, 5 neutrons, and 6 electrons. It has a half-life of 20 minutes*. (https://en.wikipedia.org/wiki/Isotopes_of_carbon#Carbon-11)

Decay C^{11} (2 atoms)

The first C^{11} gives: $${}^{11}_{6}C \rightarrow {}^{10}_{6}C + {}^{1}_{0}n \qquad (1)$$

C^{10} is not stable/half-life 20 sec*, ${}^{1}_{0}n$ is used in (3).

C^{10} out of (1) decays further as: $${}^{10}_{6}C \rightarrow {}^{10}_{5}B + {}^{1}_{1}p \nearrow \qquad (2)$$

B^{10} is stable*, possibility: [p → 2 + 3 + e^{+}], in that case the proton will not be seen, the e^{+} will follow (4) .

A second C^{11} gives: $${}^{11}_{6}C + {}^{1}_{0}n \swarrow \rightarrow {}^{11}_{5}B + 2 \nearrow + 3 \nearrow + e^{+} \qquad (3)$$

In (3): [p → 2 + 3 + e^{+}], ${}^{1}_{0}n$ is delivered by (1), B^{11} is stable*.

The e^{+} out of (3) finds an e^{-}: $$e^{+} + e^{-} \swarrow \rightarrow 2 \nearrow \qquad (4)$$

Total equation: $$2x\, {}^{11}_{6}C + e^{-} \swarrow \rightarrow {}^{10}_{5}B + {}^{11}_{5}B + 4 \nearrow + 3 \nearrow + {}^{1}_{1}p \nearrow \qquad (5)$$

Possibility: [p → 2 + 3 + e^{+}], in that case the proton will not be seen, the e^{+} will follow (4).

Oxygen-15

Oxygen-15 is an isotope of oxygen and is also frequently used in positron emission tomography, or PET imaging. It has 8 protons, 7 neutrons, and 8 electrons. It has a half-life of 122 seconds. (https://en.wikipedia.org/wiki/Isotopes_of_oxygen)

Decay O^{15} (2 atoms)

The first O^{15} gives: $${}^{15}_{8}O \rightarrow {}^{14}_{8}O + {}^{1}_{0}n \qquad (6)$$

O^{14} is not stable/half-life 70 sec*, ${}^{1}_{0}n$ is used in (8).

O^{14} decays further as: $$e^{-} \swarrow + 1 \swarrow + {}^{14}_{8}O \rightarrow {}^{14}_{7}N \qquad (7)$$

In (7) [e^{-} + 1 + p → n], N^{14} is stable*

A second O^{15} gives: $${}^{15}_{8}O + {}^{1}_{0}n \swarrow \rightarrow {}^{15}_{7}N + 2 \nearrow + 3 \nearrow + e^{+} \qquad (8)$$

In (8): [p → 2 + 3 + e^{+}], ${}^{1}_{0}n$ is delivered by (6), N^{15} is stable*

The e^{+} out of (8) finds an e^{-}: $$e^{+} + e^{-} \swarrow \rightarrow 2 \nearrow \qquad (9)$$

Total equation: $$2x\, {}^{15}_{8}O + 2e^{-} \swarrow \rightarrow {}^{14}_{7}N + {}^{15}_{7}N + 4 \nearrow + 2 \nearrow \qquad (10)$$

The given half-lives* are taken from: http://periodictable.com/Isotopes/007.15/index2.p.full.prod.html

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