Group I : β⁻-Conversion

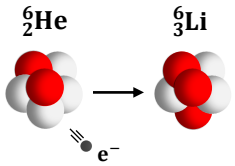
Profile: β⁻-Conversion

The β⁻-Conversion is a nuclear conversion which occurs when the atomic nucleus has a low number of protons and a higher number of neutrons. In order to achieve a **stable state** (stable nuclear configuration) from this **neutron excess**, a neutron is converted into a proton in the nucleus. This conversion also produces an **Electron** e^- and a **Neutrino** ν, which are released as radiation. The neutrino can be neglected for our considerations, but the electron makes up the so-called **Beta-Minus Radiation**. Although this has a low penetration power, it is harmful to the human body in high doses.
In summary, the following reaction takes place in the core :

$$^{1}_{0}n \rightarrow {}^{1}_{1}p + {}^{0}_{-1}e^- + {}^{0}_{0}\nu$$

Neutron is converted into Proton, giving off an Electron and Neutrino

For the entire nucleus, this means that a new chemical element is created (since the daughter nuclide has one more proton). The mass number remains the same during the reaction.



A stable lithium nucleus can be created from a helium nucleus with neutron excess with the help of beta-minus conversion

In a Nutshell

- ✓ The overall reaction is generally $^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e + {}^{0}_{0}\nu$
- ✓ Occurs at: **Neutron excess**
- ✓ Radiation released: **Electrons**

Expert Task | Nuclear Medicine

In medicine, radioactive nuclides are often used for radionuclide therapy. For example, beta-minus emitters are introduced into the organism, where they decay and release radiation. A typical example **is I-131** (iodine), which accumulates in the thyroid gland and undergoes beta-minus decay there.

a) Set up the reaction equation of I-131 and find out which element is produced. Use the nuclide table and the general formula from the Nutshell box.

b) It may actually be medically useful to introduce a radioactive material such as I-131 into the human body. Make assumptions to answer the following question:

What medical purpose could radioactive iodine 131 have?

Home Group Task

What to explain:

- Pick any radioactive beta-minus nuclide from the nuclide chart and write down the reaction equation. Using the equation, briefly summarize the beta-minus conversion and its properties.
- Briefly describe the principle of radionuclide therapy. Discuss your assumptions about b) with your group members and, if necessary, check your ideas with an Internet search on radionuclide therapy.

What you have to find out:

- With the help of group 2, compare the beta-minus conversion with beta-plus and electron capture. Consider the three reaction equations and describe the relationship between the three reactions.