Group II : β^+- Conversion

Profile : β^+-Conversion

The β^+-Conversion is a nuclear decay which always occurs when the atomic nucleus has a high number of protons and a too low number of neutrons. To achieve a stable state (stable nuclear configuration) from this **neutron deficiency**, a **Proton** is converted to a **Neutron** in the nucleus. This conversion also produces a **Positron** e^+ and a **Neutrino** ν, which are released as radiation. The neutrino can be neglected for our considerations, but the positron makes up the so-called **Beta-Plus 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 :

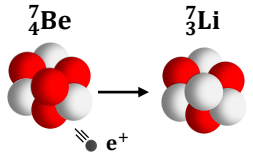
$$^1_1\mathrm{p} \rightarrow {}^1_0\mathrm{n} + {}^0_1\mathrm{e}^+ + {}^0_0\nu$$

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

For the entire nucleus, this means that a new chemical element is created (since the daughter nuclide has one less proton). The mass number remains the same during the reaction. Besides the β^+-Conversion, **Electron Capture** (ϵ) is also possible in case of neutron deficiency. Here, the same daughter nucleus is formed as in the β^+-Conversion. The only difference is that no positron is emitted, but an electron is absorbed. Electron capture is, so to speak, the alternative conversion channel of the β^+-Conversion.

$$^1_1\mathrm{p} + {}^0_1\mathrm{e}^- \rightarrow {}^1_0\mathrm{n} + {}^0_0\nu$$

Proton is converted into Neutron, with absorption of an electron



A stable lithium nucleus can be created from a beryllium nuclide with a neutron deficiency with the help of beta-plus conversion

In a Nutshell

- ✓ The overall reaction is
  β^+: $^A_Z X \rightarrow {}_{Z-1}{}^A Y + {}^0_1 e + {}^0_0 \nu$
  ϵ: $^A_Z X + {}^0_{-1} e \rightarrow {}_{Z-1}{}^A Y + {}^0_0 \nu$
- ✓ Occurs at:
  Neutron Deficiency
- ✓ Radiation released:
  Positrons

Expert Task | Stay Positive

a) Set up the reaction equation of **F-18 (Fluorine)** and find out which element is produced. Use the nuclide table and the general formula from the Nutshell box.

b) The Isotope **Potassium-40** ($^{40}_{19}$K) can transform by both electron capture and beta-plus conversion. Write the two reaction equations of K-40.

Home Group Task

What to explain:

- Pick any radioactive nuclide that undergoes beta-plus conversion or electron capture from the nuclide table and write down the two reaction equations. Using the equation, briefly summarize beta-plus conversion and electron capture and their properties.

What you have to find out:

- The Potassium-40 from task b) can undergo one more nuclear conversion. Check it in the nuclide table and note this additional nuclear transformation. Discuss the following question together:

How can it be that a nuclide can pass into several different daughter nuclei?