

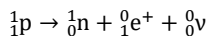
Group Puzzle | Nuclear Reactions

Group II : β^+ - Conversion

Profile : β^+ -Conversion

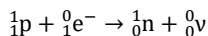
The β^+ -Conversion is a nuclear decay which always occurs when the atomic nucleus has a high number of protons and a too low number of neutrons. To achieve a stable state (stable nuclear configuration) from this **neutron deficiency**, a **Proton** is converted to a **Neutron** in the nucleus. This 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 :

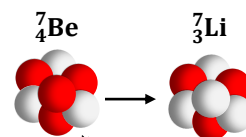


Proton is converted into Neutron, giving off an Positron and Neutrino

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.



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 beta-plus conversion

! In a Nutshell

- ✓ The overall reaction is
 $\beta^+ : {}_Z^AX \rightarrow {}_{Z-1}^AY + {}_1^0\text{e}^+ + {}_0^0\nu$
 $\epsilon : {}_Z^AX + {}_{-1}^0\text{e}^- \rightarrow {}_{Z-1}^AY + {}_0^0\nu$
- ✓ 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** (${}_{19}^{40}\text{K}$) 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?