

DECAY MECHANISMS

OCR A LEVEL PHYSICS H556

Module 6: Particles and medical physics

6.4 Nuclear and particle physics

6.4.3 Radioactivity

c) nuclear decay equations for alpha, beta-minus and beta-plus decays; balancing nuclear transformation equations

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Outline = what happens during nuclear decay?

Text book reference = pages 223-226

Independent study = page 226 questions

What is this lesson about?

- What are the four mechanisms for radioactive decay?
- Why do radioisotopes decay this way?*
- How do we decay processes through nuclear equations?
- What is the particle process involved in alpha decay?
- What is the particle process involved in beta- decay?
- What is the particle process involved in beta+ decay?

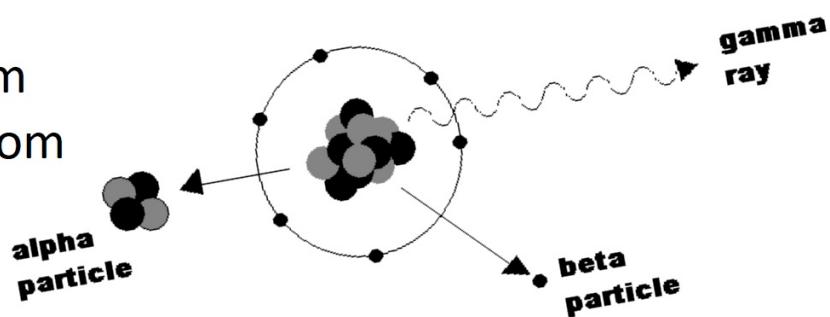
*possibly beyond the course, but interesting!

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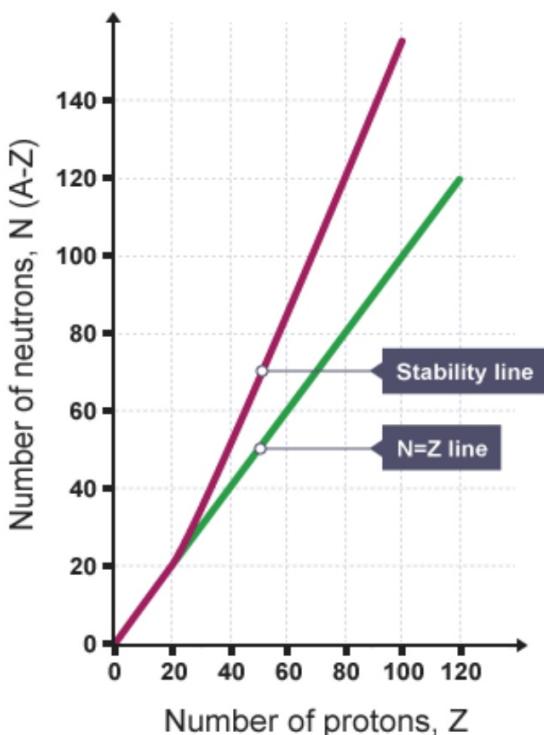
The four mechanisms for radioactive decay

- Alpha decay = emission of alpha particle (2p & 2n)
- Beta- decay = emission of an electron (beta- particle)
- Beta+ decay = emission of a positron (beta+ particle)
- Gamma decay = emission of a photon (of energy)

All of this happens from the nucleus (but not from the same one at the same time)

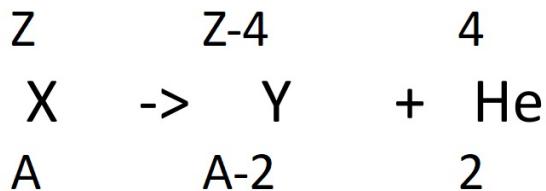


Why decay this way ... ?



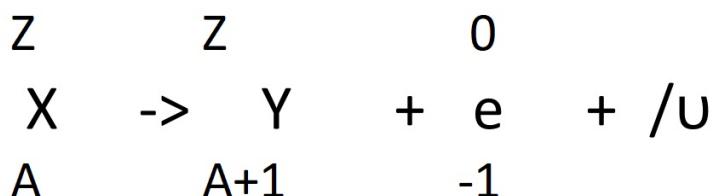
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Alpha decay



- Alpha particle = **two protons and two neutrons**
- Alpha particle = helium nucleus
- Alpha particle = very stable
- Alpha particle forms in the **nucleus** and is then ejected some time later ...

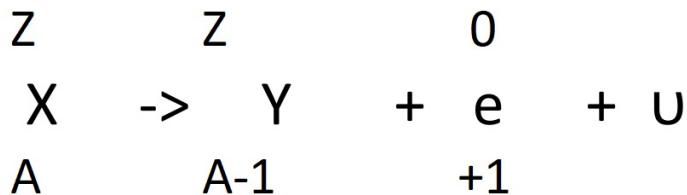
Beta- decay



- Beta- particle = **electron**
- Neutron decays to proton, electron and anti-neutrino
- Electron (and anti-neutrino) emitted
- Range of energies
- This neutron decay process can happen in isolation

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Beta+ decay



- Beta+ particle = electron
- Proton decays to neutron, positron and neutrino
- Positron (and neutrino) emitted
- Range of energies
- This proton decay process cannot happen in isolation

Examples

Write nuclear equations for the following ...

- Rn-219 decays via alpha
- C-14 decays via beta-
- F-18 decays via beta+
- Ra-226 decays via alpha
- I-131 decays via beta-
- N-13 decays via beta+

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Further thoughts ...

- Do we need this language?
- 'Parent nucleus decays to daughter nucleus'
- 'Sometimes this continues to granddaughter'
- If A decays to B and B decays to C this is a decay chain
- Stability of C > B > A in example above
- Why?

Independent study

- Page 226 questions from your text book