WJEC England Physics AS-level

Topic 1.7 Particles and Nuclear Structure

Flashcards

What are the main constituents of an atom?

What are the main constituents of an atom?

- Proton
- Neutron
- Electron

What is the letter associated with a proton number?

What is the letter associated with a proton number?

Z

What is a nucleon?

What is a nucleon?

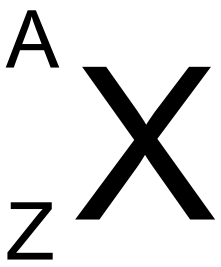
A constituent of the nucleus: a proton or a neutron.

What letter represents nucleon number?

What letter represents nucleon number?

A

Which is the correct notation?



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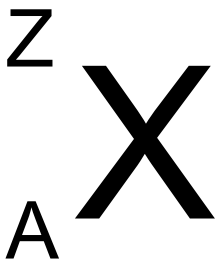

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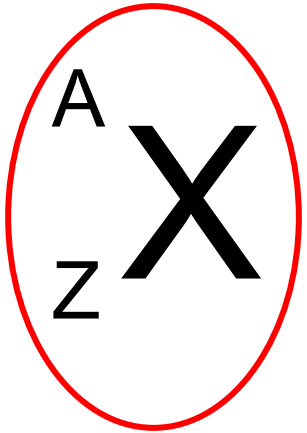

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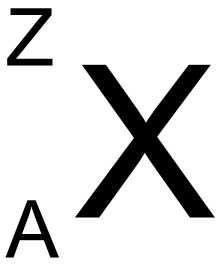

What is the strong nuclear force?

What is the strong nuclear force?

The fundamental force that keeps the nucleus stable by counteracting the electrostatic force of repulsion between protons.

Describe the range of the strong force.

Describe the range of the strong force.

Repulsive up to 0.5fm

Attractive from 0.5-3fm

Negligible past 3fm

What makes a nucleus unstable?

What makes a nucleus unstable?

- Nuclei which have too many protons, neutrons, or both.
- Too many protons means the electrostatic force is too strong and pushes them apart.
- Too many neutrons or both will make the nucleus larger than the range of the strong force, so it will no longer be held together.

What is an antiparticle?

What is an antiparticle?

For each particle there is an antiparticle which has the same rest energy and mass, the opposite charge, and will annihilate with the particle if they ever come into contact.

True or false?
‘Every fundamental particle has a antiparticle’.

True or false? ‘Every fundamental particle has a antiparticle’.

True.

What is the name of the antiparticle of an electron?

What is the name of the antiparticle of an electron?

Positron

What is the antiparticle of π^0 (pion with neutral charge)?

What is the antiparticle of π^0 (pion with neutral charge)?

π^0, its antiparticle is itself

Explain the process of annihilation.

Explain the process of annihilation.

- When a particle and its corresponding antiparticle come into contact with each other, they will annihilate.
- The mass of the particle and antiparticle is converted back to energy in the form of 2 gamma ray photons which are released in opposite directions in order to conserve momentum.

What is pair production?

What is pair production?

When a gamma photon has sufficient energy, it can be converted into a corresponding particle-antiparticle pair.

Name the 4 fundamental forces.

Name the 4 fundamental forces.

- Gravity
- Electromagnetic/electrostatic
- Weak nuclear
- Strong nuclear

The virtual photon is the exchange particle of which force?

The virtual photon is the exchange particle of which force?

The electromagnetic force.

What type of particles are affected by the strong nuclear force?

What type of particles are affected by the strong nuclear force?

Hadrons

What is the exchange particle of the weak nuclear force?

What is the exchange particle of the weak nuclear force?

The W boson (W^+ or W^-).

What does the electromagnetic force act on?

What does the electromagnetic force act on?

It acts on all charged objects.

For example: when a positively charged ball repels another positively charged ball.

When does the weak nuclear interaction occur?

When does the weak nuclear interaction occur?

When quark character changes (a quark changes into another quark). It affects all types of particles.

Which properties must be conserved in particle interactions?

Which properties must be conserved in particle interactions?

- Energy
- Charge
- Baryon number
- Lepton number (treat electrons and muons separately)
- Momentum
- Strangeness (only in strong interactions - it can change by ±1 in weak interactions.)

What is a lepton?

What is a lepton?

A fundamental particle that is not made of quarks and does not experience the strong nuclear force (electrons, neutrinos and muons).

What is a hadron?

What is a hadron?

A particle made of quarks that are held together by the strong force. Mesons and baryons are hadrons.

What are the classes of hadrons?

What are the classes of hadrons?

- Baryons (three quarks)
- Mesons (1 quark, 1 antiquark)

The pion and kaon are both examples of which class of particle?

The pion and kaon are both examples of which class of particle?

Mesons.

The pion can be an exchange particle for which force?

The pion can be an exchange particle for which force?

The strong nuclear force.

What does a kaon decay into?

What does a kaon decay into?

Pions.

Give some examples of baryons.

Give some examples of baryons.

Proton - uud quark composition

Neutron - udd quark composition

What is significant about a proton?

What is significant about a proton?

- It is the only stable baryon.
- All baryons will eventually decay into protons.

Give some example of leptons.

Give some example of leptons.

- Electron
- Muon
- Neutrino
- (the antiparticles of the above)

What does a muon decay into?

What does a muon decay into?

An electron, muon neutrino and electron antineutrino.

Lepton number for electrons is zero before and after, and the lepton number for muons is 1 before and after.

What is the strangeness value of a strange quark?

What is the strangeness value of a strange quark?

-1

True or false?

‘Strangeness is always conserved in a weak interaction.’

True or false? ‘Strangeness is always conserved in the weak interaction.’

False.

Strangeness is only conserved in the strong interaction. In weak interactions it can change by 0, -1 or +1.

Complete the sentence:
Strange particles are produced through the
____ interaction and decay through the
____ interaction.

Complete the sentence: Strange particles are produced through the _____ interaction and decay through the _____ interaction.

Strange particles are particles that are produced through the strong interaction and decay through the weak interaction.

State the relative charge for an electron, electron neutrino, an up quark and a down quark.

State the relative charge for an electron, electron neutrino, an up quark and a down quark

Electron: -1

Electron neutrino: 0

Up quark: +⅔

Down quark: -⅓

What is the symbol for a positron?

What is the symbol for a positron?

e^+ (or sometimes β^+ in the context of beta decay).

What is the symbol for an anti-up quark?

What is the symbol for an anti-up quark?

$\bar{u}$

What is the quark composition of a proton and neutron?

What is the quark composition of a proton and neutron?

Proton: uud

Neutron: udd (or ddu)