

Edexcel Physics A-Level

Topic 4.3 - Nuclear and Particle Physics

Flashcards



Explain Rutherford's experiment and how it led to Thomson's model of the atom.



Explain Rutherford's experiment and how it led to Thomson's model of the atom.

Rutherford fired alpha particles at a thin sheet of gold to test their trajectory. Most particles weren't deflected, some had a small deflective angle, while a small portion had a large deflection with obtuse angles.

This experiment suggested that the atom is mainly empty space, there is one area of highly concentrated charge, and this area is the nucleus. As well as this, the nucleus is miniscule compared to the size of the atom.



What is the proton number/nucleon number?



What is the proton number/nucleon number?

The proton number is the total number of protons in the nucleus of an atom.

The nucleon number is the total number of protons and neutrons in the nucleus, which is also the relative mass of the atom.



How does a cyclotron work?



How does a cyclotron work?

Charged particles are fired into one of 2 electrodes, each have a magnetic field perpendicular to the particle's movement so the particle follows a circular path.

An applied PD between two electrodes ('dees') accelerates the particle between the dees. $r = mv/bq$, the velocity has increased so the radius of its circular path will increase. The alternating PD means this continues to happen until it exits the cyclotron as a high speed charged particle.



Derive $r = p / Bq$



Derive $r = p / Bq$

Fleming's left hand rule: a particle with charge q , speed v , perpendicular to magnetic flux B has a centripetal force $F = Bqv$, centripetal force = $F = mv^2 / r$ so we equate these forces and rearrange to get $r = mv / Bq = p / Bq$.



Define electronvolt.



Define electronvolt.

1 eV = the kinetic energy carried by an electron after it has been increased through a PD of 1 volt.



How do linear particle accelerators work?



How do linear particle accelerators work?

They use alternating electric fields which alternate as the particle passes through each electrode, so the particle is being repelled by one electrode and attracted to the next, causing it to accelerate.



How do electron guns produce electrons?



How do electron guns produce electrons?

Via thermionic emission. A coil (cathode) is heated to emit electrons, which are attracted to the anode and accelerated to form a beam of high speed electrons.



What are hadrons?



What are hadrons?

Hadrons are particles that are made out of quarks.



What are the two common baryons and what is the only stable baryon?



What are the two common baryons and what is the only stable baryon?

Protons and neutrons are the two common baryons. There are other baryons however they don't exist in normal matter.

The proton is the only stable baryon, all other baryons will eventually decay to a proton.



What are the six types of leptons?



What are the six types of leptons?

Electron, electron neutrino, muon, muon neutrino, tau, tau neutrino.



What are antiparticles and how are they linked to their normal particles?



What are antiparticles and how are they linked to their normal particles?

Every particle has a corresponding antiparticle with the same mass but opposite charge, baryon number and lepton number.



What is the equation linking energy change and mass for the creation and annihilation of matter and antimatter particles?



What is the equation linking energy change and mass for the the creation and annihilation of matter and antimatter particles?

$$E = mc^2$$

E = change in energy, m = mass of matter and antimatter, c = speed of light (3×10^8).



What are quarks?



What are quarks?

Quarks are fundamental particles that are the building blocks for hadrons.

Protons and neutrons are made up of quarks, as well as mesons.



What are the 3 main types of quark and what are their charges?



What are the three main types of quark and what are their charges?

Up quark - $+\frac{2}{3}$

Down quark - $-\frac{1}{3}$

Strange quark - $-\frac{1}{3}$

These also have anti-quarks and are oppositely charged.



What is the quark composition of a proton, antiproton, neutron and antineutron?



What is the quark composition of a proton, antiproton, neutron and antineutron?

Proton = uud

Antiproton = $\bar{u}\bar{u}\bar{d}$

Neutron = udd

Antineutron = $\bar{u}\bar{d}\bar{d}$



What is conserved in particle interactions?



What is conserved in particle interactions?

Energy, momentum, charge, baryon number and specific lepton number are conserved.



What are the two key types of particle detection?



What are the two key types of particle detection?

CLOUD CHAMBER: there is a supercooled vapour which which causes the trail of ions to appear.

BUBBLE CHAMBER: there is hydrogen which is kept above boiling point at a high pressure. When there is a reduction in pressure, bubbles will form due to the ionisation, which means a trail of bubbles will be left.

