Discovery Of The Electron Essay, Research Paper

The Discovery Of The Electron

The electron was discovered in 1895 by J.J. Thomson in the

form of cathode rays, and was the first elementary particle to be

identified. The electron is the lightest known particle which

possesses an electric charge. Its rest mass is Me equal> 9.1 x 10 -28 g, about 1/1836 of the mass of the proton or

neutron.

The charge of the electron is -e = -4.8 x 10^-10 esu trostatic unit). The sign of the electron’s charge is negative by

convention, and that of the equally charged proton is positive.

This is somewhat a unfortunate convention, because the flow of

electrons in a conductor is opposite to the conventional direc

tion of the current.

The most accurate direct measurement of e is the oil drop

experiment conducted by R.A. Milikan in 1909. In this experiment,

the charges of droplets of oil in air are measured by finding the

electric field which balances each drop against its weight. The

weight of each drop is determined by observing its rate of free

fall through the air, and using Stokes’ formula for the viscous

drag on a slowly moving sphere. The charges thus measured are

integral multiples of e.

Electrons are emitted in radioactivity and in

many other decay processes. The electron itself is completely

stable. Electrons contribute the bulk to ordinary matter; the

volume of an atom is nearly all occupied by the cloud of elec

trons surrounding the nucleus, which occupies only about 10^-13

of the atom’s volume. The chemical properties of ordinary matter are

determined by the electron cloud.

The electron obeys the Fermi-Dirac statistics, and for this

reason is often called a fermion. One of the primary attributes

of matter, impenetrability, results from the fact that the elec

tron, being a fermion, obeys the Pauli exclusion principle.

The electron is the lightest of a family of elementary

particles, the leptons. The other known charged leptons are the

muon and the tau. These three particles differ only in mass;

they have the same spin, charge, strong interactions, and weak

interactions. In a weak interaction a charged lepton is either

unchanged or changed into and uncharged lepton, that is a neutri

no. In the latter case, each charged lepton is seen to change

only into the corresponding neutrino.

The electron has magnetic properties by virtue of (1) its

orbital motion about the nucleus of its parent atom and (2) its

rotation about its own axis. The magnetic properties are best

described through the magnetic dipole movement associated with 1

and 2. The classical analog of the orbital magnetic dipole moment

of a small current-carrying circuit. The electron spin magnetic

dipole moment may be thought of as arising from the circulation

of charge, that is, a current, about the electron axis; but a

classical analog to this moment has much less meaning than that

to the orbital magnetic dipole moment. The magnetic moments of

the electrons in the atoms that make up a solid give rise to the

bulk magnetism of the solid.