Beta Particle Encyclopedia Article

Beta Particle

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Henri Becquerel discovered the ability of certain materials to give off radiation spontaneously (radioactivity) in 1896. The logical follow-up question to this discovery was what the nature of that radiation was. At first, Becquerel thought the radiation was X-rays. Indeed, his research had originally been inspired by Wilhelm Röntgen 's recent (1895) discovery of X-rays.

It soon became obvious that this interpretation was incorrect. Research conducted by Ernest Rutherford in England, by Meyer, von Schweidler, and Giesel in Germany, and by Becquerel himself all showed that nuclear radiation can be deflected by a magnetic field. Since X-rays and other forms of electromagnetic waves are not deflected by magnetic fields, these results showed that nuclear radiation must consist of some kind of charged particles.

Early on, Rutherford showed that nuclear radiation consists of at least two kinds of rays. When forced to pass perpendicular to a magnetic field, the radiation separated into two distinct streams. One was bent in a clockwise direction, and the other in a counter-clockwise direction. Rutherford suggested calling the two forms of radiation alpha rays and beta rays.

Beta rays are more easily deflected than are alpha rays and were, therefore, studied first. Becquerel as well as Irène Joliot-Curie and Frédéric Joliot-Curie carried out a number of studies aimed at identifying the particles of which beta rays consist. The key measurement they made was that of the charge-to-mass ratio of particles in the beta rays. They were able to show that this ratio is the same as the charge-to-mass ratio of the particles that make up the cathode rays discovered by Plücker in 1858. Since Joseph J. Thomson had demonstrated in 1897 that cathode rays are a stream of electrons, the identity of the beta rays was also apparent. They, too, are streams of electrons.

Beta particles are produced within the atomic nucleus when a neutron decays to produce an electron, a proton, and a neutrino. The electron is ejected from the nucleus with a high velocity. The energies of beta particles differ depending on the nucleus from which they are emitted. On average, they travel with a velocity of about 1.6×10^{10} cm/sec, roughly half that of the speed of light. Beta particles travel easily through air and can be stopped by thin sheets of aluminum metal.