

# Is nature really left-handed?

## Measurement of high- $Q^2$ deep inelastic scattering cross sections with a longitudinally polarised positron beam at HERA

Elementary particles have a property known as spin. If you imagine the particle as a spinning top, then the spin is the axis around which the particle rotates. A particle whose spin points in its direction of motion is known as right-handed and one whose spin points opposite to its direction of motion left-handed. Spin plays an important role in the interactions between particles.

The Standard Model describes the interactions of sub-atomic particles. Within the Standard Model the weak interaction which describes many phenomena, such as radioactive decay, has the peculiar property that only left-handed particles (or right-handed anti-particles) may interact.

In the HERA collider at DESY, high-energy electron (or positron) and proton beams collide and the resulting interactions are analysed using the ZEUS detector. It's very difficult to measure whether an individual particle is left or right-handed, so instead we measure the polarisation of the beam of particles. This tells us the fraction of the beam that is made up of right- and left-handed particles. By measuring the rate of interactions at different values of the polarisation of the electron (or positron) beam we can test the prediction that only left-handed particles participate in the weak interaction.

The figure shows the result of this measurement, that is the rate,  $\sigma$ , of weak interactions measured using the ZEUS detector at different values of the polarisation of the incoming positron beam,  $P_e$ .

The points are the measurements and the lines show what's expected by the Standard Model. As predicted the rate of events falls towards zero as the beam becomes more and more dominated by left-handed positrons (left-handed since the positron is the anti-particle of the electron). If we fit a line to the measured data points and extrapolate this line to a completely left-handed positron beam then the answer (shown by the dotted line) is consistent with zero events.

So it seems nature really is left-handed!

