The process is called **thermionic emission**. Early in the twentieth century, physicists were able to show that these particles came from the atoms of the metal filament. Thomson called them **electrons**. Their attraction to the positive plate showed clearly that they were negatively charged.

Since these electrons were so easily deflected by a magnet, Thomson knew that they were very, very light compared to the atoms that emitted them. He also realised that since atoms themselves are electrically neutral, there had to be some part of the atom that had a positive charge.

How were the electrons arranged in atoms? One of the earliest models was the 'plum pudding' or 'currant bun' model in which electrons were dotted throughout the atom like currants in a bun. The positive charge was thought to spread throughout the volume like the dough of the bun.

Evidence for the existence of nuclei

Partly to test Thomson's theory, Rutherford suggested that the recently discovered positively-charged α-particles might be fired at a thin gold foil. Most of the α-particles went straight through the foil with little or no deflection. But what really shocked the Rutherford team was that some α-particles were deflected through very large angles and a few even came straight back at them. Rutherford then realised that there had to be something 'hard' inside the atom to cause this strange 'back scattering'. He called it the atomic **nucleus**.

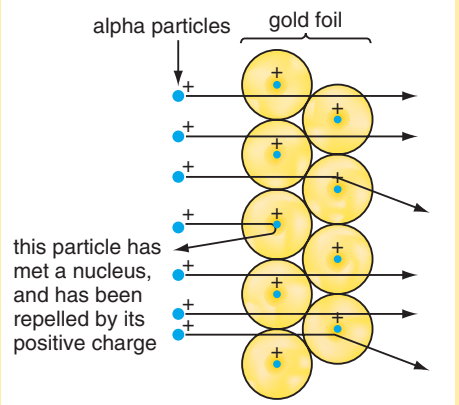

Figure 2 Most of the alpha particles pass straight through the gold foil or are slightly deflected. A very few make a 'direct hit' on the nucleus and bounce back

Rutherford argued that since most of the α-particles missed the nucleus it had to be very small. Since it appeared to repel the positively-charged α-particles, the nucleus had to be positively charged. Why did most of the α-particles pass straight through the atom? Rutherford correctly argued that most of the atom was really just empty space.

Finally, he realised that since the electron was so light, most of the atom's mass was contained within the nucleus itself

Later, in order to explain how certain elements gave out light, Rutherford was to suggest that the electrons orbited the nucleus in circular paths. So the plum pudding model gave way to the planetary model, with the orbiting electrons pictured like planets orbiting the Sun.

Rutherford's gold foil experiment took place around 1909–10. It was not until 1933 that convincing evidence was presented by James Chadwick that there were two different types of particle in the nucleus – uncharged neutrons as well as positively-charged protons.

Did you know?

The nucleus of almost every atom contains protons and neutrons. At one time it was thought that protons and neutrons had no structure., but we now know that both are made of mysterious particles called **quarks**.