In 1911, Earnest Ruthorford performed a critical experiment that showed that Thomson's model could not be correct. In this experiment a beam of positively charged alpha particles (helium nuclei) was projected into a thin gold foil. It is observed that most of the alpha particles passed through the foil as if it were empty space. But some surprising results are also seen. Several alpha particles are deflected from their original direction by large angles. Few alpha particles are observed to be reflected back, reversing their direction of travel as shown in figure-1.2.

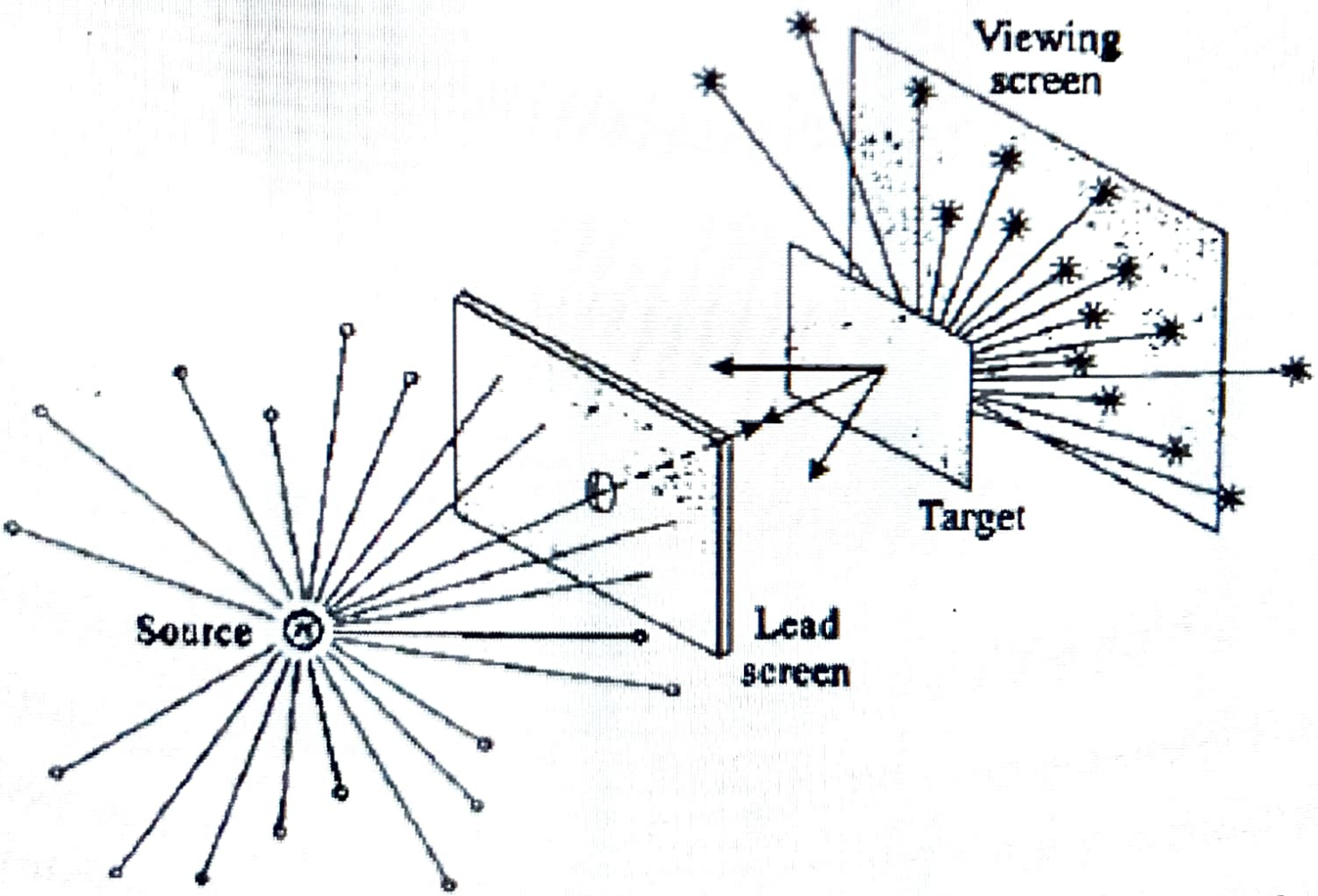

Figure 1.2

If Thomson model is assumed to be true that the positive charge is spreaded uniformly in the volume of an atom then the alpha particle can never experience such a large repulsion due to which it will be deflected by such large angles as observed in the experiment. On the basis of this experiment Ruthorford presented a new atomic model.

In this new atomic model it was assumed that the positive charge in the atom was concentrated in a region that was small relative to the size of atom. He called this concentration of positive charge, the nucleus of the atom. Electrons belonging to the atom were assumed to be moving in the large volume of atom outside the nucleus. To explain why these electrons were not pulled into the nucleus, Ruthorford said that electrons revolve around the nucleus in orbits around the positively charged nucleus in the same manner as the planets orbit the sun. The corresponding atomic model can be approximately shown in figure-1.3.

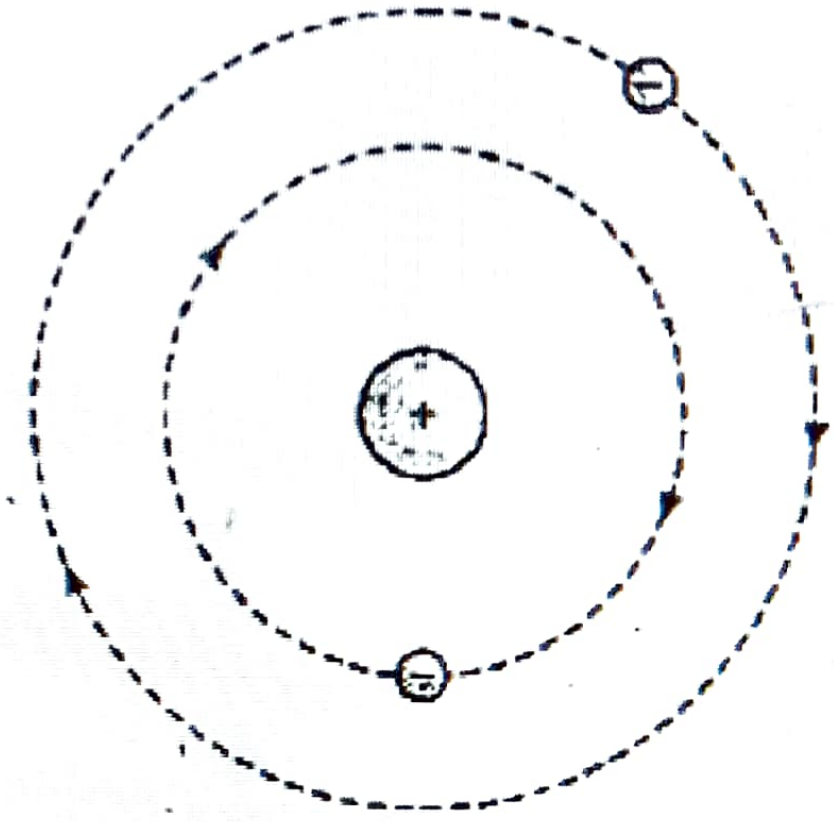

Figure 1.3

In the Ruthorford's planetary model, two basic difficulties exist. First is the emission of some characteristic frequencies of electromagnetic radiation by an atom. It is observed that every atom emits some characteristic frequencies and no other frequency is emitted. Ruthorford's model was not able to explain this phenomenon. Second difficulty was the revolution of electrons around the nucleus. These electrons undergo a centripetal acceleration. According to Maxwell's Theory of electromagnetism, a centripetally accelerated, charge particle should continuously radiate electromagnetic waves of same frequency as that of its revolution. In this model if we apply this classical theory it says that as electron radiates energy, the radius of its orbit steadily decreases and its frequency of revolution continuously increases. This would lead to an ever-increasing frequency of emitted radiation and ultimately atom will collapse as the electron plunges into the nucleus as shown in figure-1.4.

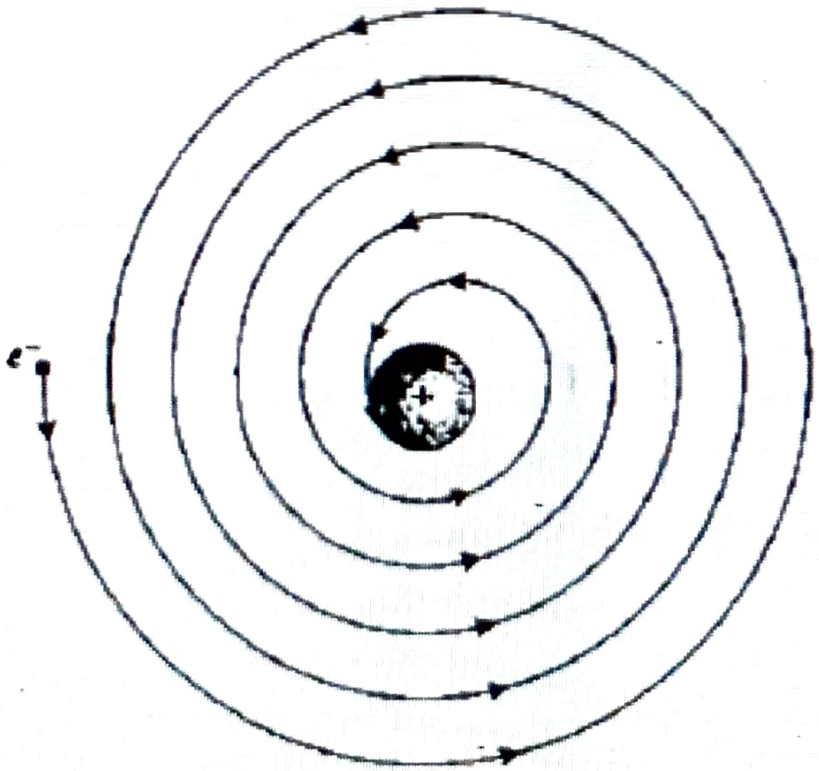

Figure 1.4