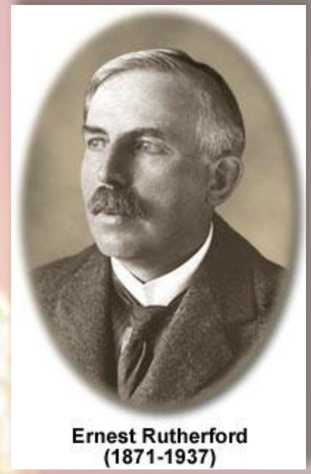
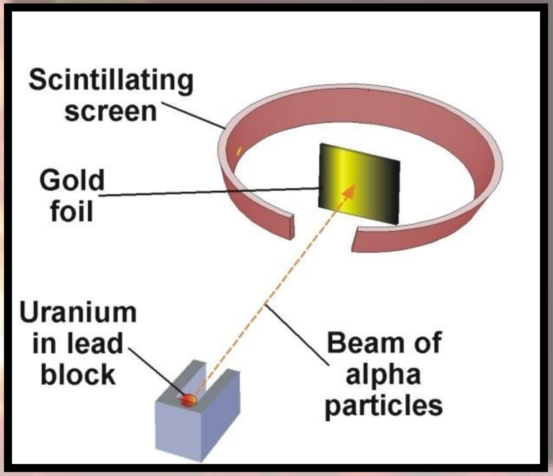
DISCOVERY OF THE ATOMIC NUCLEUS

The Alpha Scattering Experiment

The Alpha Scattering Experiment

- Ernest Rutherford performed an experiment in 1911 that helped him develop a model of the atom.
- He probed the inside of the atom by aiming a beam of positively charged particles called alpha particles at gold foil.





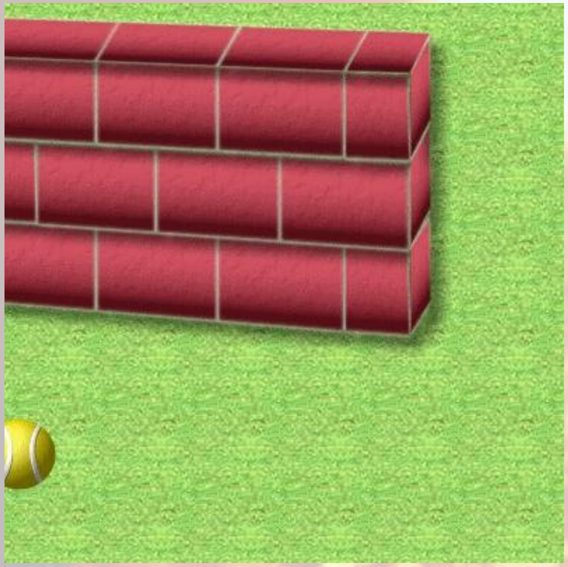
ALPHA PARTICLES

- Alpha particles are a type of radioactivity. They are given off when radioactive substances, such as uranium, decay.
- Alpha particles are small.
  - Alpha particles have a mass of 4 amu, the same as an atom of helium.
  - Gold atoms have a mass of about 197 amu, almost 50 times greater than the mass of an alpha particle.
- Alpha particles are positively charged.

Alpha Particle Analogy

Aiming a beam of alpha particles is like throwing a tennis ball. What happens next depends on what you aim it at.

- Throwing a tennis ball at a wall



. . . It bounces back.

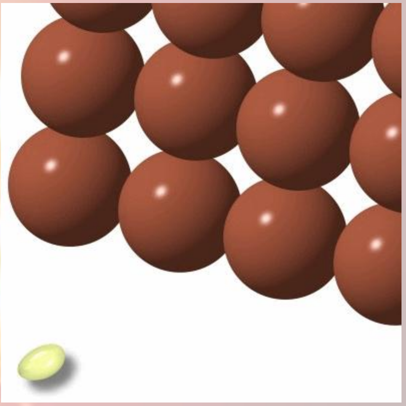
- Throwing a tennis ball at a puff of smoke

. . . It goes straight through.

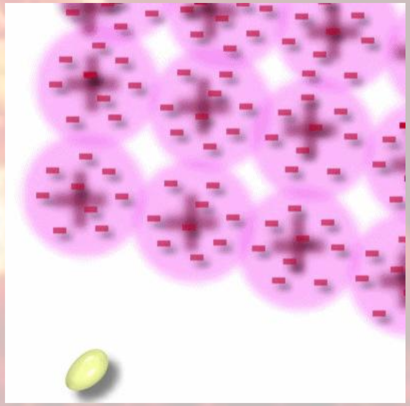
Alpha Scattering Expectations

The results of the Alpha Scattering Experiment depend upon which model of the atom is correct.

- If the Dalton model is correct, the alpha particles should bounce back.

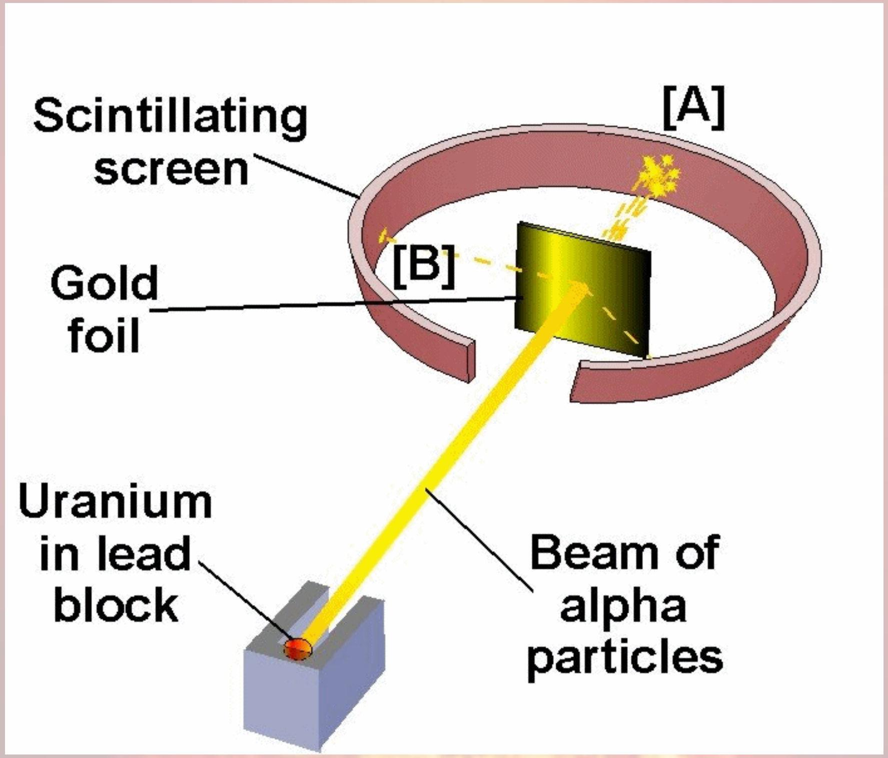


- If the Thomson model is correct, the alpha particles should go right through.



ALPHA SCATTERING RESULTS

- Results did not support either model



[A] Particles going through the foil [B] particles scattering

- Most alpha particles went straight through the foil, but 1 in 8,000 scattered at angles greater than 90°.

Interpreting the Results

- Based on the results, is the probability of an alpha particle hitting something in the gold foil high or low?

  Very low. $p < 0.00013$

- What does this show about the size of what is hit?

  It is very small. The probability of hitting a small target is low compared to the probability of hitting a larger target.

- What does this show about the charge of what is hit?

  It is positive. That is why it repelled the positive alpha particles.

- What does this show about the mass of what is hit?

  It is massive compared to an alpha particle, otherwise *it* would have moved away instead of deflecting the alpha particles.

Rutherford's Model

- There is a small, massive, positively charged ***nucleus*** at the center of an atom.
- The electrons are far from the nucleus. The atom is mostly space.
- The electrons revolve around the nucleus like planets around the sun.

- **We know this because alpha particles bounce off it, but only very few.**
- **We know this because most of the alpha particles pass straight through the foil.**
- **We assume this because the electrons are not pulled into the nucleus.**