An atomic bomb explodes and generates a huge mushroom cloud. The tremendous energy released when the bomb explodes is incredibly destructive. Where does all the energy come from? The answer is the nucleus of the atom.

At the Heart of It All

The **nucleus** (plural, nuclei) is a positively charged region at the center of the atom. It consists of two types of subatomic particles packed tightly together. The particles are protons, which have a positive electric charge, and neutrons, which are neutral in electric charge. Outside of the nucleus, an atom is mostly empty space, with orbiting negative particles called electrons whizzing through it. The figure below shows these parts of the atom.

![Figure 1: The nuclear atom](image)

**Size and Mass of the Nucleus**

The nucleus of the atom is extremely small. Its radius is only about 1/100,000 of the total radius of the atom. If an atom were the size of a football stadium, the nucleus would be about the size of a pea! Electrons have virtually no mass, but protons and neutrons have a lot of mass for their size. As a result, the nucleus has virtually all the mass of an atom. Given its great mass and tiny size, the nucleus is very dense. If an object the size of a penny had the same density as the nucleus of an atom, its mass would be greater than 30 million tons!

**Holding It All Together**

Particles with opposite electric charges attract each other. This explains why negative electrons orbit the positive nucleus. Particles with the same electric charge repel each other. This means that the positive protons in the nucleus push apart from one another. So why doesn't the nucleus fly apart? An even stronger force - called the strong nuclear force - holds protons and neutrons together in the nucleus.
Summary

The nucleus is a small, dense region at the center of the atom. It consists of positive protons and neutral neutrons, so it has an overall positive charge. The nucleus is just a tiny part of the atom, but it contains virtually all of the atom's mass. The strong nuclear force holds together protons and neutrons in the nucleus and overcomes the electric force of repulsion between protons.

Explore More

Watch this short video about how the nucleus was discovered, and then answer the questions below.

1. Describe the scientific procedure that was used to discover the nucleus.
2. What evidence led scientists to conclude that atoms consist mostly of empty space with a very small, positively charged mass at the center?
3. Reflect on the method used in the experiment. Why was it important to send positive - as opposed to neutral or negative - particles toward the gold foil?

Contributors

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