



**FIGURE 3-7** Rutherford reasoned that each atom in the gold foil contained a small, dense, positively charged nucleus surrounded by electrons. A small number of the alpha particles directed toward the foil were deflected by the tiny nucleus (red arrows). Most of the particles passed through undisturbed (black arrows).

## Composition of the Atomic Nucleus

Except for the nucleus of the simplest type of hydrogen atom (discussed in the next section), all atomic nuclei are made of two kinds of particles, protons and neutrons. A proton has a positive charge equal in magnitude to the negative charge of an electron. Atoms are electrically neutral because they contain equal numbers of protons and electrons. A neutron is electrically neutral.

The simplest hydrogen atom consists of a single-proton nucleus with a single electron moving about it. A proton has a mass of  $1.673 \times 10^{-27}$  kg, which is 1836 times greater than the mass of an electron and  $1836/1837$ , or virtually all, of the mass of the simplest hydrogen atom. All atoms besides the simplest hydrogen atom also contain neutrons. The mass of a neutron is  $1.675 \times 10^{-27}$  kg—slightly larger than that of a proton.

The nuclei of atoms of different elements differ in the number of protons they contain and therefore in the amount of positive charge they possess. Thus, the number of protons in an atom's nucleus determines that atom's identity. Physicists have identified other subatomic particles, but particles other than electrons, protons, and neutrons have little effect on the chemical properties of matter. Table 3-1 on page 74 summarizes the properties of electrons, protons, and neutrons.

## Forces in the Nucleus

Generally, particles that have the same electric charge repel one another. Therefore, we would expect a nucleus with more than one proton to be unstable. However, when two protons are extremely close to each other, there is a strong attraction between them. In fact, more than 100