Atomic structure

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The basic structure of an atom is a small central nucleus composed of protons and neutrons surrounded by electrons. Most of the atom is empty space.

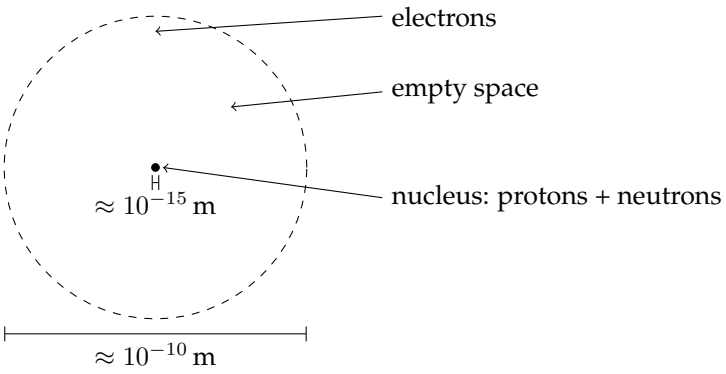

Figure 1: A representation—not to scale—of an atom, showing that almost of its mass is concentrated at the centre in the very tiny, very dense nucleus. The electrons, too small to be seen, are able to move around in the empty space which makes up most of the atom.

Sub-atomic particle	*Relative* mass	*Relative* charge
Proton	1	+1
Neutron	1	0
Electron	1/2000	-1

Table 1: The particles which make up atoms and their properties.

In a neutral atom the number of protons in the nucleus also tells us the number of electrons there must be; such an atom is electrically uncharged, so the negatively charged electrons have to be equal in number to the protons so that the atom has no charge overall.

Atoms may however gain or lose electrons, meaning that they become *ions* which are charged particles. A good example of this is where a ionic bonds are formed in chemistry, such as in common salt or sodium chloride, where the sodium atoms each lose an electron to the chlorine atoms, making positive sodium ions of (relative) charge $+1$ and chloride ions each having charge -1.

Nucleus

The nucleus contains protons and neutrons, the total number of which is called the *mass number*. The number of protons on their own is called the *atomic number*.

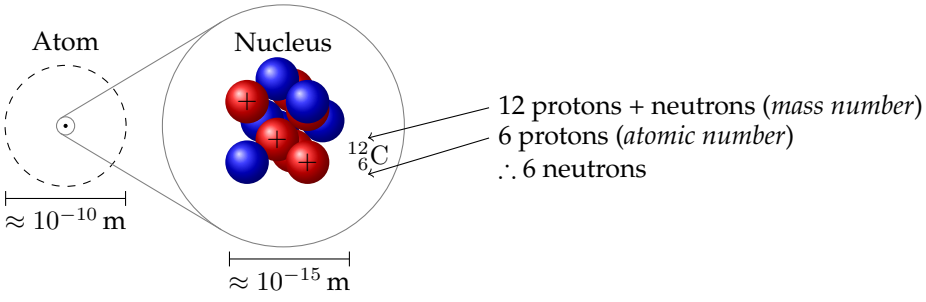

Figure 2: A carbon-12 nucleus.

In physics we are particularly interested in the nucleus, which is of no concern to chemists.[1] We find that the atoms of a particular element always have the same number of protons in the nucleus. We have already seen that the number of electrons may vary: a neutral atom of chlorine has 17 electrons, but it is prone to gaining an extra one to form a chloride *ion* with 18 electrons in total. It turns out that the number of neutrons can also differ between atoms of the same element, and these alternative varieties of an element with differing numbers of neutrons are called *isotopes*.

[1] The entire subject of chemistry is all to do with the electrons which are right at the edge of the atom.

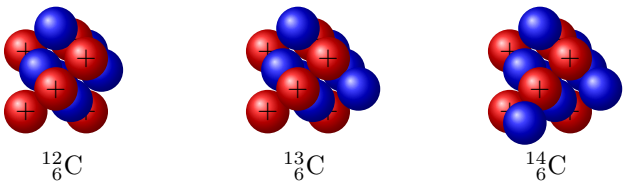

Figure 3: This represents the nuclei of the three naturally occurring isotopes of carbon. Carbon-14 is radioactive.

Each of the isotopes of carbon has 6 protons (this is what makes it carbon) but they have differing numbers of neutrons. Carbon-12 has $(12 - 6 =)$ 6 neutrons, carbon-13 has $(13 - 6 =)$ 7 neutrons, and carbon-14 has 8 neutrons in its nucleus.

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