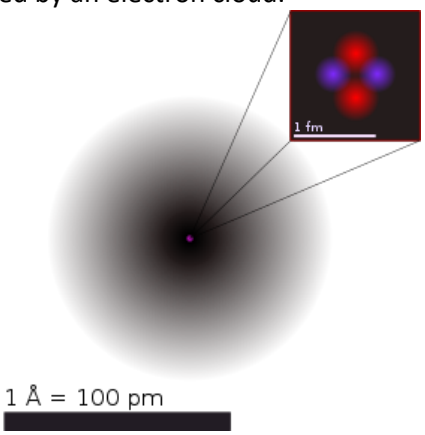
GEOGRAPHY OF THE ATOM

Structure of an atom

An atom is made of a nucleus surrounded by an electron cloud.



The nucleus of the atom, bearer of its identity

1. Structure of the nucleus

The nucleus is made of particles called nucleons. The number of nucleons, A, is called atomic mass number.
There are 2 types of nucleons:

- ***Protons***

Mass: $m_p = 1.673 \times 10^{-27}$ kg.

Electrical charge: $q_p = +1.6 \times 10^{-19}$ C = +e.

Note: *An electrical charge is measured in coulombs (C).*
e *= 1.6×10^{-19} C is the elementary charge. It is the smallest electric charge that exist by its own.*

The number of protons, Z, is called atomic number.

- ***Neutrons***

Mass: $m_n = 1.675 \times 10^{-27}$ kg.

Electrical charge: $q_n = 0$ c. The NEUTRon is NEUTRal.

Number of neutrons: $N = A - Z$.

Note: *In first approximation, it can be considered that all nucleons have the same mass: $m_{nucl} = 1.67 \times 10^{-27}$ kg.*

2. Symbolic representation of the nucleus

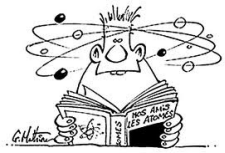
$$^{A}_{Z}X$$

X being the symbol of the corresponding element.

The electron cloud, initiator of interatomic interactions

The electron cloud is made of all electrons moving in the close surroundings of the nucleus.

1. Characteristics of the electron



Mass: $m_e = 9.1 \times 10^{-31}$ kg.

Electrical charge: $q_e = -1.6 \times 10^{-19}$ C = - e.

Note: *The mass of an electron is approximately 2000x smaller than that of a nucleon.*
We can therefore neglect the masse of the electrons compared to the mass of the nucleons.

2. Number of electrons in an atom

$$\left.\begin{array}{l}\boldsymbol{neutral\ atom} \\ \boldsymbol{Z\ protons\ of\ charge\ +e}\end{array}\right\} \Rightarrow \boldsymbol{Z\ electrons\ of\ charge\ -e.}$$

Mass of an atom

$$m_{at} = Zm_e + Zm_p + (A - Z)m_n$$

If the mass of the electrons is neglected compared to that of the nucleons, we can derive the following formula:

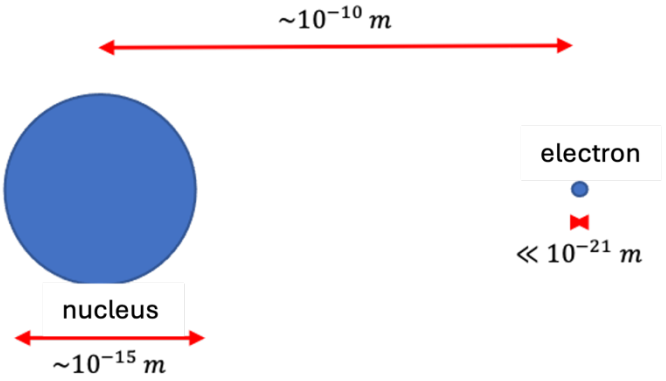
$$\boldsymbol{m_{at} = m_{noyau} = Am_{nucl}}$$

Dimensions of an atom

1. Reminder on the sub-units of the metre

metre	decimetre	centimetre	millimetre	micrometre	nanometre	picometre	femtometre	attometre
m	dm	cm	**mm**	**µm**	**nm**	**pm**	**fm**	**am**
1	10^{-1}	10^{-2}	$\mathbf{10^{-3}}$	$\mathbf{10^{-6}}$	$\mathbf{10^{-9}}$	$\mathbf{10^{-12}}$	$\mathbf{10^{-15}}$	$\mathbf{10^{-18}}$

2. Lacunar structure of the atom



The atom is mainly made of vacuum. It is said to have a lacunar structure.