Asst.let Alaa Aziz **Asst.let Murtadha A. Hamoozi** **Asst.let Ali H. Shomran** **Asst.let Ali Saeed Jassim**

The Islamic University, Najaf

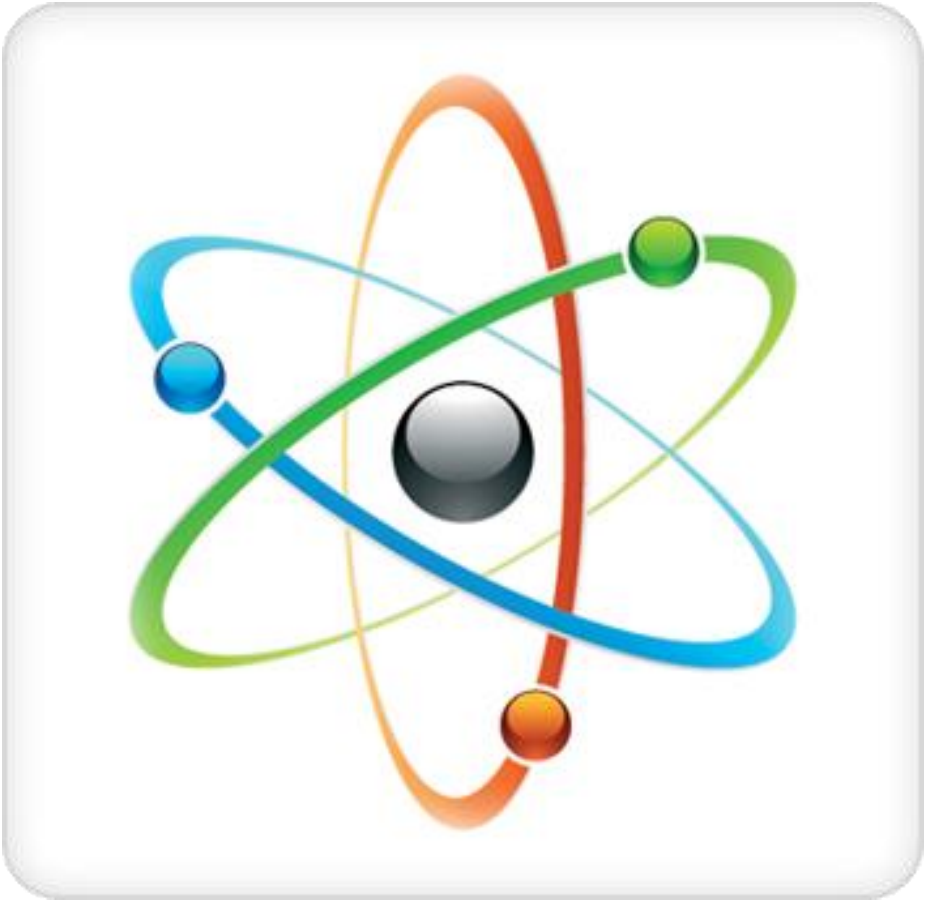
College of Medical Techniques

Department of Radiology Techniques

ATOMIC PHYSICS

2022-2023

LECTURE (1) : ATOMIC AND NUCLEAR STRUCTURE



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Atomic structure

Atom, smallest unit into which matter can be divided without the release of electrically charged particles. It also is the smallest unit of matter that has the characteristic properties of a chemical element. As such, the atom is the basic building block of chemistry.

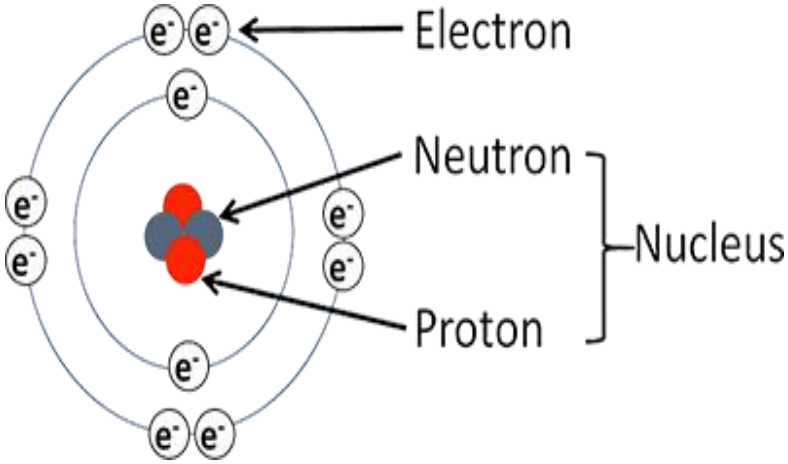

Fig (1): structure of an atom

The nucleus of an atom consists of neutrons and protons, which in turn are the manifestation of more elementary particles, called quarks, that are held in association by the nuclear strong force in certain stable combinations of hadrons, called baryons

Atoms are made up of a positively charged nucleus surrounded by a cloud of negatively charged electrons. Nuclei are very dense and extremely small, they contains more that 99.9% of the mass of an atom and are ten thousand times smaller than an atom!

The chemical element of an atom is determined by the number of protons, or the atomic number, Z, of the nucleus. The element oxygen has an atomic

number Z=8, while carbon has Z=6. The atomic mass of the nucleus is given by, A=Z+N, where, N, is the number of neutrons in the nucleus.

Atomic Number (Z)

The atomic number, frequently written as Z, is the number of protons in the atom. It is written at the bottom left of the atomic symbol. The atomic number determines the element of the atom.

Atomic number (Z) = Number of protons in the nucleus of an atom or number of electrons in shells of a neutral atom.

Mass Number (A)

The total number of nucleons (Proton and Neutron) is termed as mass number (A) of the atom.

mass number (A) = number of protons (Z) + number of neutrons (n)Isotope.

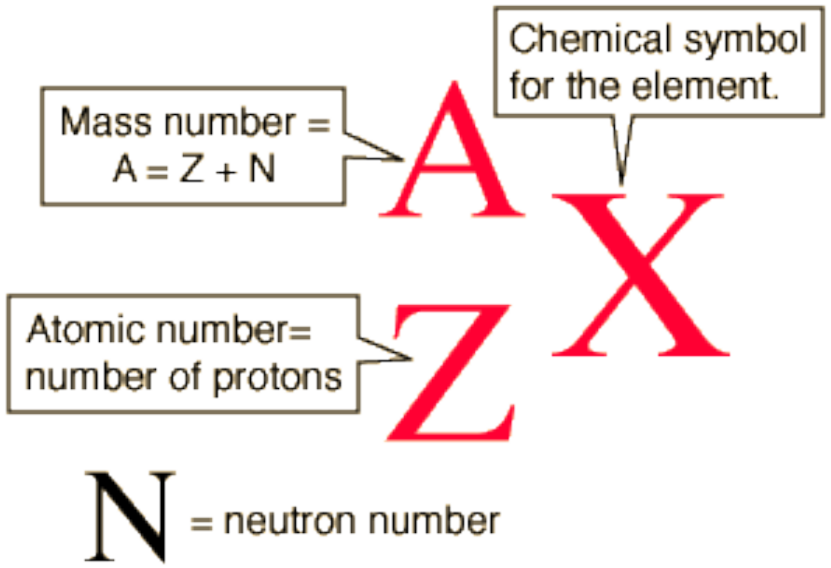

Fig (2): Atomic Number Mass Number.

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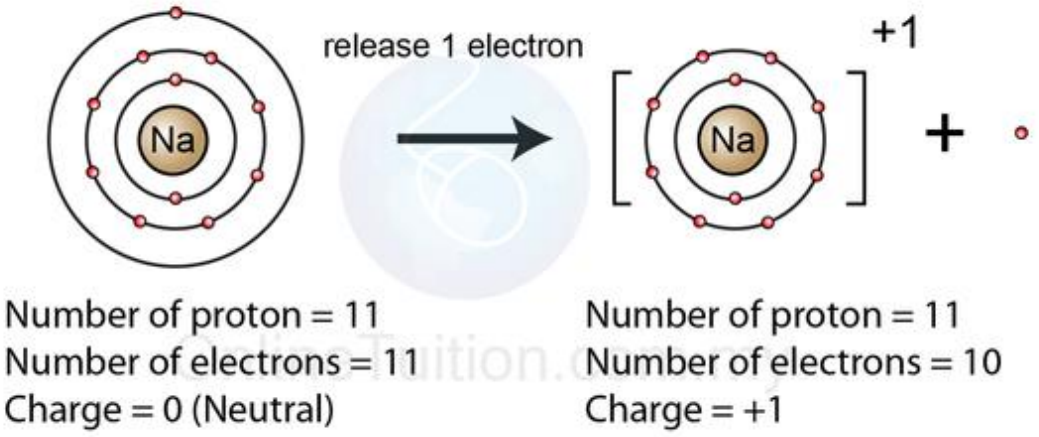
Ions

Ion is a charged atom. When the number of electrons are equal to the number of protons,that atom is called ion. An atom can acquire a positive charge or a negative charge depending on whether the number of electrons in an atom is decreased or increase.

Negatively charged ions are called anions, and positively charged ions are called cations.



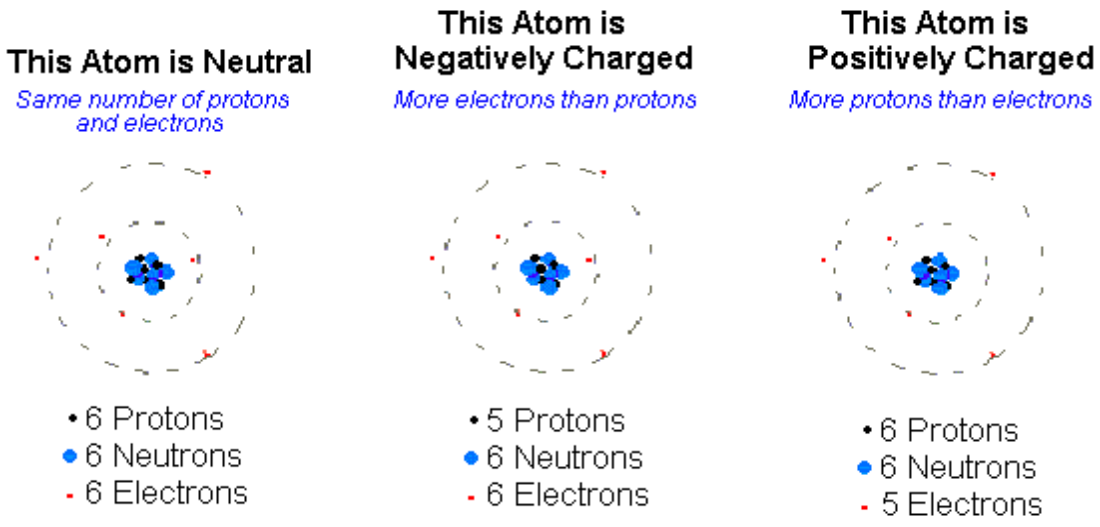


Fig (3): positive and negative ions.

Isotopes have the same atomic number (Z) but differing atomic weights (A). Isotopes may be stable or unstable. Unstable isotopes are radioactive.

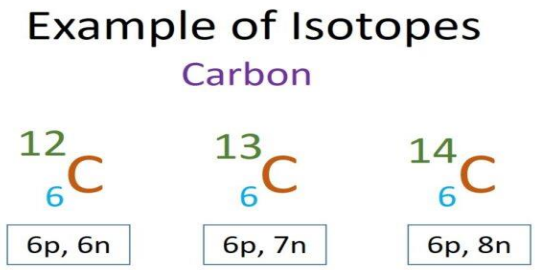


Fig (4): Example of Isotopes.

Isobars: are atoms of different chemical elements that have different atomic numbers but the same mass number i.e. the same number of total nucleons.

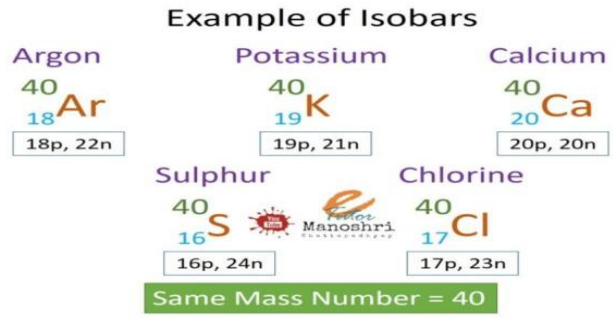


Fig (5): Example of Isobars.

Isotone: any of two or more species of atoms or nuclei that have the same number of neutrons.

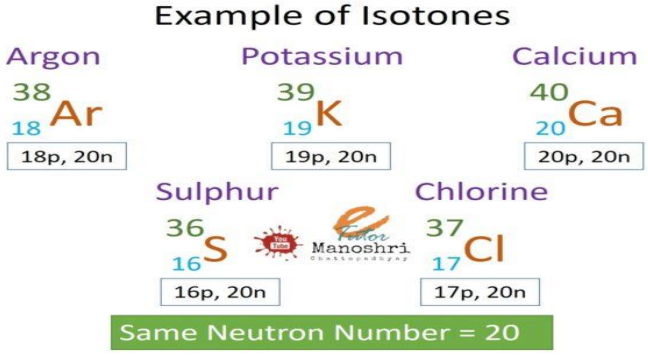


Fig (6): Example of Isotone.

Isomer : are compounds with identical molecular formulas but distinct arrangements of atoms. The physical properties of each molecule may differ for isomers.

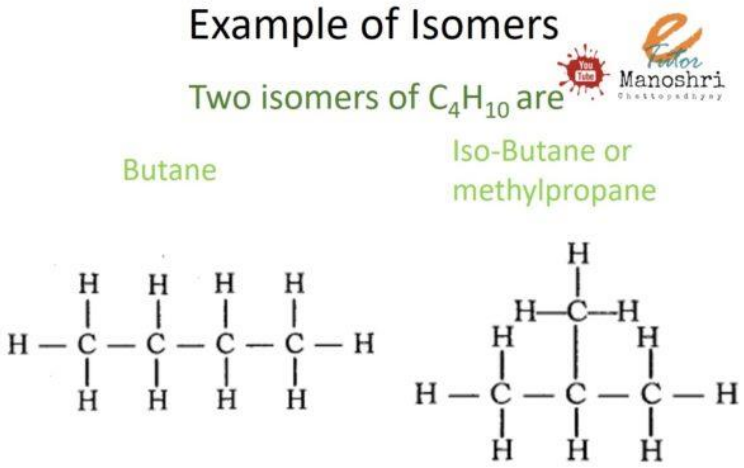


Fig (7): Example of Isomer.