

# Introduction to atomic nucleus philosophy essay



**ASSIGN  
BUSTER**

Atomic nuclei are built up of two elementary particles: proton and neutron. Proton is known as hydrogen nuclei, i.e. a hydrogen atom from which single outermost electron can be removed. It carries only one positive charge particle whose mass is 1836 times greater than mass of electron. While neutron is electrically neutral particle whose mass is approximately equal to the mass of proton. Proton and neutron are held together in the nucleus by strong force which is known as nuclear force which is greater than other forces such as gravitational force or electrical force. The two different types of elementary particles, proton and neutron, are jointly known as nucleons. The sum of proton and neutron inside the nucleus is known as mass number  $A$  where  $A = N + Z$  where  $Z$  is known as atomic number or number of protons present in the nucleus or number of electrons revolving around the nucleus. Nuclei of same atomic number  $Z$  but different mass number  $A$  are known as isotopes. These nuclei contain equal number of protons but different number of neutrons [1].

## **DISCOVERY OF NUCLEUS**

In the discovery of nucleus J.J. Thomson and Rutherford made a main contribution.

### Thomson model

According to Thomson the discovery of radioactivity proves the independent existence of electron which gave base to the theories of atomic structure.

Due to radioactive nature of atom the atom transferred to another element by emitting positively or negatively charged particles. As a whole atom is electrically neutral whose number of protons and electrons are equal at normal condition. The positively and negatively charged particles must be numerically

equal [2]. In accordance to the atomic model of Thomson he conceived that atomic sphere is of the order  $(10)^{-10}$  and of positively charged matter in which electron are embedded but Thomson model is not enough to explain the properties of nucleus that is it could not explain the feature of optical spectra of hydrogen and other element.

## **Rutherford atomic model**

After JJ Thomson in 1911 Rutherford performed a number of experiment on scattering of alpha particle by the thin gold foil. In his experiment a collimated beam of alpha particle hitting the gold foil from which the scattering occur through large angle. Most of the alpha particle is undeflected and some of them are turn back with an angle of  $180^\circ$ .

Rutherford present that there is a massive nucleus in the centre of an atom in which proton is embedded. According to Rutherford the dimension of nucleus is of the order  $10^{-14}$ m. the negatively charge electron are revolve around the nucleus in closed orbit. The dimension of the nucleus is  $10^{-10}$  and most of the space within the atom is empty. Rutherford suggest that the deflection of alpha particle through greater angle is due to the atomic nucleus which repel the alpha particle. As most of the alpha particle is undeflected because most of the space inside the nucleus is empty and those rays which are turn back make a head on collision with the nucleus. As nucleus is too heavy so it cannot displace from by alpha particle the Thomson model failed to explain the experimental result therefore Rutherford pictured as follow

The atom has small positively charged nucleus in which all the positively charges of an atom and most of the mass of the atom concentrated in the

<https://assignbuster.com/introduction-to-atomic-nucleus-philosophy-essay/>

nucleus. Electron have no place inside the nucleus are revolves around the in closed path at some distance. The dimension of the nucleus and of the electron are negligible small as compared to size of the atom. Also that most of the volume occupied by an atom is empty space. Thus the discovery of nucleus of the is due to Rutherford.

Since the distribution of electron give stability to the neuleus so electron is not in a stationary state it revolve around the nucleus in closed orbit and so that centrifugal force produced due to rotation of electron was balanced by electrostatic attraction between the nucleus and the electron. Thus Rutherford present a dynamical model of atom in which nucleus act the role of sun and electron act a role of planets revolve around the sun [3].

## **THE PROTON ELECTRON HYPOTHESIS OF THE CONSTITUTION OF THE NUCLEUS**

As radioactive atom emit alpha and beta ray which show corpuscular nature of both alpha and beta ray. Which built an idea that atom is made of elementary constitute. In 1816 Prout suggest that all the atomic weight is a whole number and atomic weight might be integral multiple of atomic weight of hydrogen atom. Prout suggested wrong when it is found that the atomic weight of some element are fractional for example the atomic weight of chlorine is 35. 46 and copper has 63. 54. In the 20th century the discovery of isotopes occure from the study of radioactive element. The discovery of isotopes occure from the idea that all the element are built up from one basic substance. Due to the existence of mixture of isotopes of an ordinary element. As ordinary element is a mixture of isotopes so that atomic weight of isotopes is close to the whole number. As isotopes having atomic weight

close to the whole number led Aston to formulate his whole number rule which is the modified form of Prout hypothesis. According to Aston whole number rule that all the element has atomic weight close to whole number and having fractional value is due to the existence of its isotopes and these isotopes has integral atomic weight. From experimental work on isotopes the positive rays come from different substance which show that these positive rays has same mass as that of hydrogen atom which has only one proton and the positive charge is equal in magnitude to electronic charge but opposite in sign. As mass of hydrogen is very closed to unity. So from the combination of both whole number rule and special properties of hydrogen nuclei led to the assumption that all the element are built up hydrogen nuclei which has mass equal to unity and named it proton.

The electron proton hypothesis of nucleus seems to the emission of alpha and beta rays from radioactive element. The emission of alpha and beta particle is ejected from the nucleus of an atom and is possible if proton and electron are present in the nucleus of an atom. This seems reasonable that electron present inside the nucleus by emitting beta rays. The hypothesis of electron and proton has some useful aspect but it failed to describe the angular momentum of nucleus and this led to the failure of electron proton hypothesis.

## **DISCOVERY OF NEUTRON**

Neutron was discover by Chadwick in 1932. The existence of neutron occur due the transmutation or disintegration of nuclei by alpha particle. According to Chadwick neutron has no charge and whose mass is approximately equal to mass of proton.

## NEUTRON PROTON HYPOTHESIS

As the discovery of neutron led to the assumption that atomic nuclei are made of neutron and proton. The sum of both proton and neutron is known as atomic mass which is denoted by  $A$  and the no of proton in the nucleus is known as atomic no which is denoted by  $Z$ . The atomic weight is very close to the whole. The number of neutron inside the nucleus is equal to  $A-Z$ . The neutron proton hypothesis explain the angular momentum of nucleus which is failed to explain by proton electron hypothesis. According to the hypothesis that proton and neutron both having half integral spin ( $1/2$ ). The spin of neutron is  $\frac{1}{2}(h/2\pi)$ . The spin of neutron and proton depend on mass no  $A$ . If the mass no is even than the resultant spin would be integral multiple of spin ( $h/2\pi$ ) and if mass no is odd than the resultant spin would be half integral multiple of spin ( $h/2\pi$ ). Since the mass of proton is very close to the mass of neutron so it conclude that proton is present inside the nucleus [4].

## CLASSIFICATION OF NUCLEI

Nuclei of different element are classified as follow

Nuclei of same atomic no but different mass no are known as isotopes. For example  $^{14}\text{Si}_{28}$ ,  $^{14}\text{Si}_{29}$ ,  $^{14}\text{Si}_{30}$ ,  $^{14}\text{Si}_{32}$  are isotopes of silicon.

Nuclei having same mass no but different atomic no is known as isobars of each other. For example  $^{80}\text{O}_{16}$  and  $^{7}\text{N}_{16}$  both the element have same mass no 16 but different atomic no  $Z$ . so both the element are isobar of each other.

Those element whose no of neutron is equal then such element are isotones of each other. For example  ${}^6\text{C}14$ ,  ${}^7\text{N}15$ ,  ${}^8\text{O}16$  ( $N= 8$  in each case) these element are isotones of each other.

Those element whose mass no as well as atomic no is same and the difference comes into the nuclear energy and in the internal structure. These nuclei are distinguish from each other by their different life times. Such a nuclei are known as isomeric nuclei or isomer.

Nuclei whose mass no is same but the number of proton and neutron are interchangeable that is number of proton of one element is equal to number of neutron of other element and number of neutron is equal to number of proton. For example  ${}^4\text{Be}7$  ( $Z= 4$  and  $N= 3$ ) and  ${}^3\text{Li}7$  ( $Z= 3$  and  $N= 4$ ). Such a nuclei is called mirror nuclei.