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RESEARCH ARTICLE

THE UNEXPLAINED SIMILARITY BETWEEN THE ATOMIC AND GRAVITATIONAL MODELS

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Abstract

The undermentioned theory states the resemblance between the stable and unreactive model of atom with the stable model of solar system. The theory gives the strong significance about the atomic models to be true and applicable on gravitational and macroscopic models.The similarity is defined by using pre-existing theories from chemistry and physics like but not limited to Dalton's theory, Quantum theory and Kepler'stheory.

Introduction:-

There exists many similarities between atomic models and the solar system. The atom has a positively charged centre and the solar system also has a positively charged centre called the sun. Electrons revolve around a positively charged centre in the case of atoms, Same is true for solar systems as well. The angular velocity of electrons is conserved in the case of atoms given by Bohr's theory of atoms. Similarly angular velocity is conserved in the case of planetary motion given by Kepler's theory of planetary motion. Electron exhibit electrostatic forces, similarly planets exhibits gravitational forces, so based on these facts and observation the undermentioned theories try to elaborate the strong resemblance between these two models

Results and Discussion:-

Dalton's Atomic Theory:
All matter consists of indivisible particles called atoms.

1. The arrangement of all the atoms in an element are the same.
2. Atoms of different elements are different in terms of size.

Dalton's Theory in the Gravitational Model:
The universe consists of indestructible substances called Solar Systems.

1. The Arrangement of all Solar Systems are the same in a galaxy in terms of stars, planets etc.
2. The Solar System of different galaxies are different.

Drawbacks of Dalton's Atomic Theory

The indivisibility of an atom was proved wrong: an atom can be further subdivided into protons, neutrons and electrons. However an atom is the smallest particle that takes part in chemical reactions. Similarly the solar system can be further subdivided into Sun and Planet, However a solar system is the smallest thing that takes part in formation of galaxies.

According to Dalton, the atoms of the same element are similar in all respects. However, atoms of some elements vary in their masses and densities.

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Similarly the solar systems of the same galaxies are similar in all respects. However, the solar system of some galaxies vary in their masses, sizes and gravitational pull.

JJ Thomson Model Of Atom:
Negatively charged electrons orbited a central region of positive energy having the same magnitude as the total charge of all the electrons. Therefore the atom is neutral.

JJ Thomson Theory in Gravitational Model :
Since the charge corresponds to mass in the gravitational model so this will be proved by an experiment:
Consider that there is Planet which posses energy = X joules collapses into asteroids and comets:
Now the K.E of a Comet formed by that planet = Y_1 joules + P.E of an asteroid = Y_2 joules.
Considering that on collapsing it breaks down to (n) asteroids and (z) comets
So the total energy of the fragments = $zY_1+nY_2=X$ joules……....(Work Energy theorem)

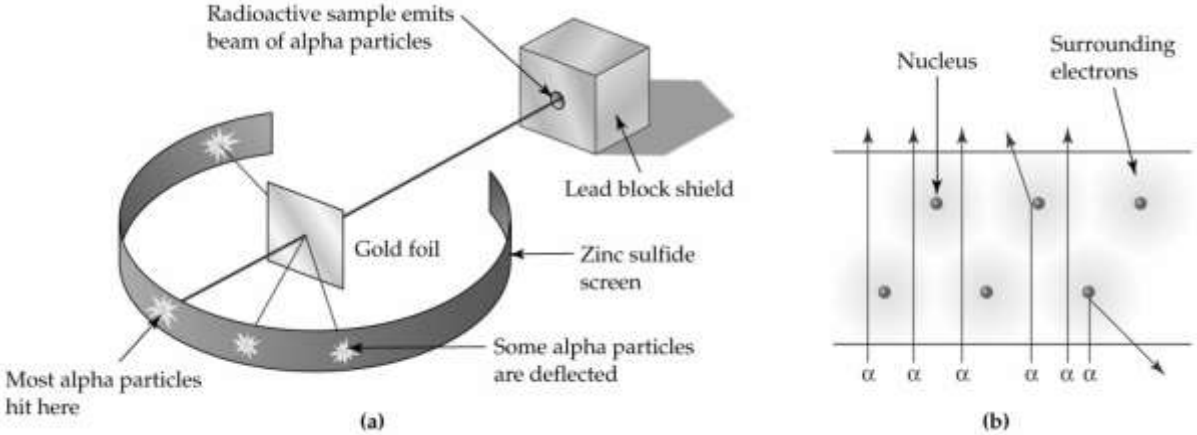
With this we conclude:
Energy of n asteroid = P.E of the planet
Energy z comet = K.E of the planet
Therefore, The Energy mass remains constant.

Rutherford's Model of Atom
Rutherford conducted an experiment by bombarding a thin sheet of gold with α-particles and then studied the trajectory of these particles after their interaction with the gold foil. Rutherford, in his experiment, directed high energy streams of α-particles from a radioactive source at a thin sheet (100 nm thickness) of gold. In order to study the deflection caused by the α-particles, he placed a fluorescent zinc sulphide screen around the thin gold foil. Rutherford made certain observations that contradicted Thomson's atomic model.

Observations of Rutherford's Alpha Scattering Experiment
The observations made by Rutherford led him to conclude that:
A major fraction of the α-particles bombarded towards the gold sheet passed through it without any deflection, and hence most of the space in an atom is empty.

Some of the α-particles were deflected by the gold sheet by very small angles, and hence the positive charge in an atom is not uniformly distributed. The positive charge in an atom is concentrated in a very small volume.

Very few of the α-particles were deflected back, that is only a few α-particles had nearly 180^o angle of deflection. So the volume occupied by the positively charged particles in an atom is very small as compared to the total volume of an atom.



Rutherford Atomic Model Postulates.

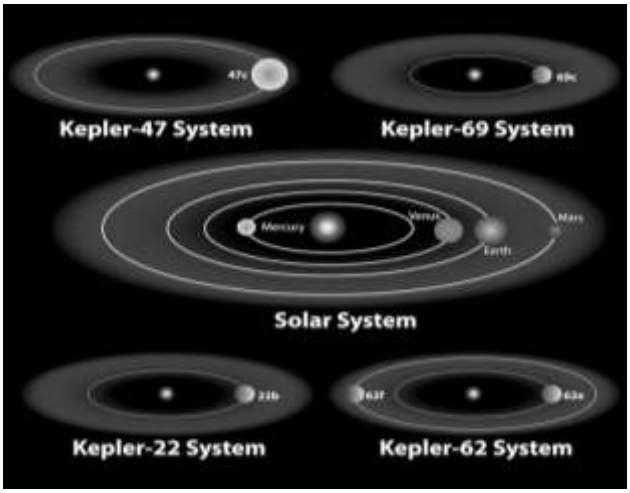
Based on the above observations and conclusions, Rutherford proposed the atomic structure of elements. According to the Rutherford atomic model:

The positively charged particles of an atom were concentrated in an extremely small volume. He called this region of the atom as a nucleus.

Rutherford model proposed that the negatively charged electrons surround the nucleus of an atom. He also claimed that the electrons surrounding the nucleus revolve around it with very high speed in circular paths. He named these circular paths as orbits.

Electrons being negatively charged and nucleus being a densely concentrated mass of positively charged particles are held together by a strong electrostatic force of attraction.

Rutherford Theory in gravitational Model:



1. The positively charged particles of the solar system are concentrated in an extremely small volume.This region in the solar system is called the Sun.
2. The planets surround the nucleus of the sun. We also claimed that the planets surrounding the sun revolve around it with very high speed in paths. We named these paths as orbits.
3. The Sun and the planets are held together by a strong gravitational force of attraction.

Planck Quantum theory in Atomic Model:
Max Planck postulated that energy was quantized and could be emitted or absorbed only in integral multiples of a small unit of energy, known as a quantum.
$E=hc/\lambda$
The nature of emission of radiation from hot bodies (Black Body Radiation).
Ejection of electron from metal surface when radiation strikes it (Photoelectric Effect)

$$E = W + K.E$$

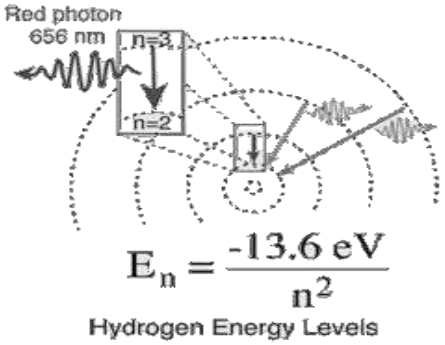
E - energy supplied to the particle
W- Work function of the atom
K.E- Kinetic Energy of the particle

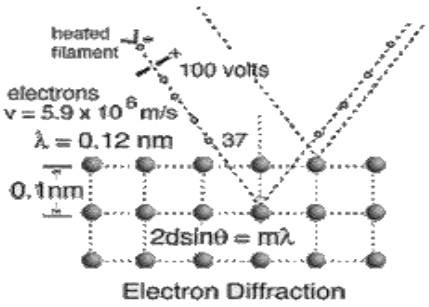
Planck Quantum Theory in Gravitational Model:
The black body present in the space is the sun besides that the ideal black body is the black hole which is present in the universe which can absorb and emit all kinds of radiation which was proved by Stephan Hawkings.
Max Planck postulated that energy was quantized and could be emitted or absorbed only in integral multiples of a small unit of energy, known as a quantum. $E=hc/\lambda$
Einstein's famous photoelectric effect can be explained by a gravitational model by an example:
Consider that a planet which is revolving around a star is struck by an asteroid
The asteroid since after collision exerts some force to the planet

If the force exerted cancels out the force of attraction between the star and the planet. Then the planet moves out of the gravitational influence of the star.

Bohr's Atomic Model of atom:
The Electrons can move around the nucleus in a circular path of fixed radius and energy. These paths are called orbits , stationary states or allowed energy states. These orbits are arranged concentrically around the nucleus.
$r_n = [5.29 \times 10^{-11} \text{ m}] n^2/z$ Å

The Energy of an electron in orbit does not change with time because the angular velocity is conserved.

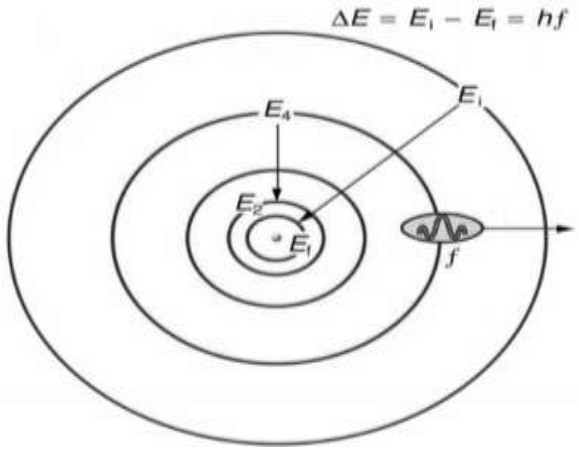




$mvr = nh/2\pi$ $E = -13.6 / n^2 eV$

The frequency of radiation absorbed or emitted when transition occurs between 2 stationary states that differ in the energy by ΔE

$f = \Delta E/h = Ef - Ei/h$



In Order to jump from lower energy level to higher energy level the electron absorbs energy.

Ef – Ei= Positive

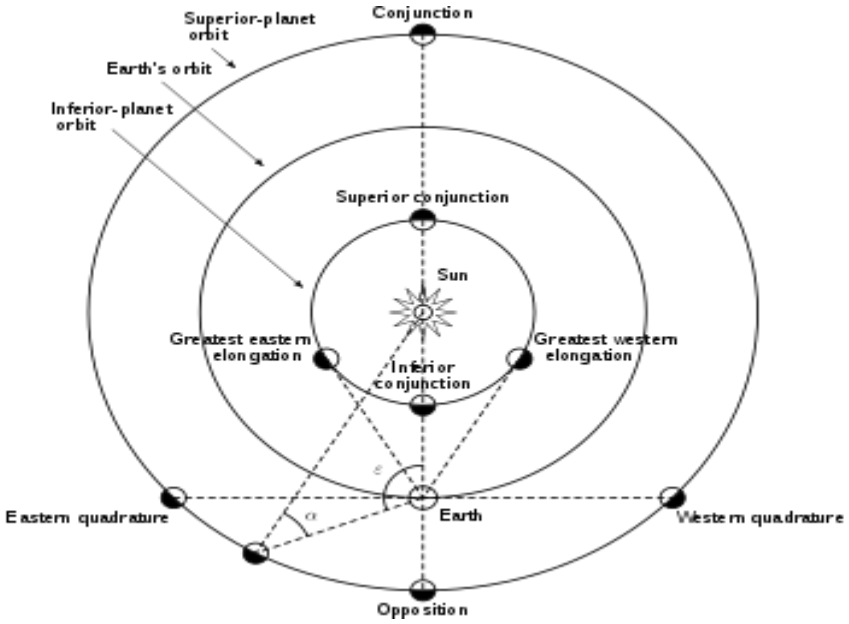
In Order to jump from higher energy to lower energy level the electron releases energy.

Ef – Ei= Negative

Drawbacks of Bohr Atomic Model

1. It was primarily for hydrogen atoms.
2. It couldn't elaborate the spectra of multi-electron atoms.
3. Wave nature of electron was not justified by the model (inconsistent with the de Broglie's hypothesis of dual nature of matter)
4. It didn't illustrate molecules making the process of chemical reactions.
5. It claimed that the electrons orbited around the nucleus in the circular orbits but it was proved by Sommerfeld's atomic model that electrons orbit in elliptical orbits around the nucleus.

Bohr-Sommerfeld Theory in Gravitational Model:



The planets move around the sun in elliptical orbits . These orbits are concentrical around the sun.
The energy of the planet in orbit does not change with time because the angular velocity is conserved as mentioned by kepler's theory.
The frequency of radiation absorbed or emitted when transition occurs between 2 stationary states that differ in the energy by ΔE_g.

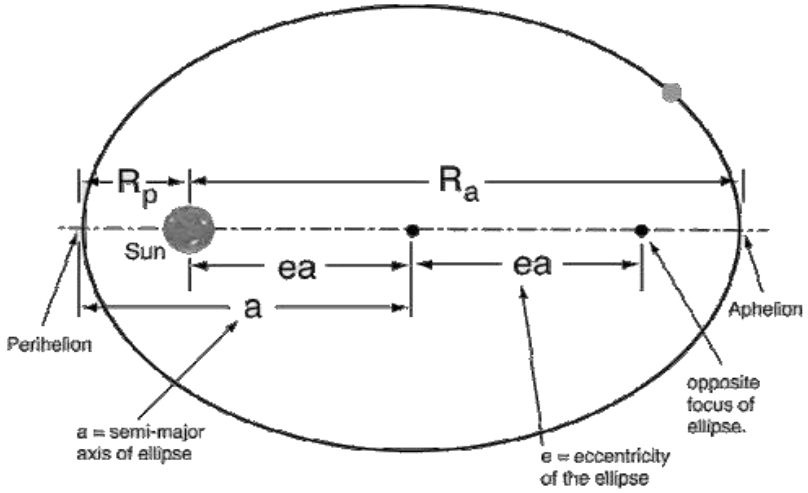
$$f= \Delta E_g/h = E_gf-E_gi/ h$$

In order to move from lower to higher energy level , energy is absorbed by the planet.

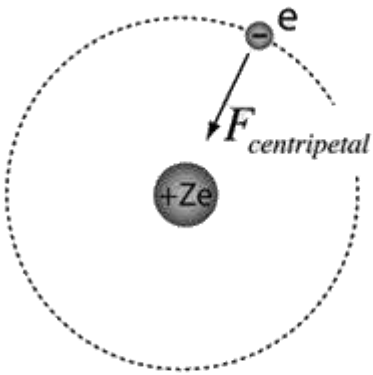
$$E_gf – E_gi= \text{Positive}$$

In order to move from higher to lower energy levels , energy is released by the planet.

$$E_gf – E_gi= \text{Negative}$$



$$R_a = a(1+e) \quad R_p = a(1- e)$$



Newton's Second Law

$$\frac{mv^2}{r} = \frac{Ze^2}{4\pi\varepsilon_0 r^2}$$ so $$T = \frac{mv^2}{2} = \frac{Ze^2}{8\pi\varepsilon_0 r}$$

Kinetic Energy T

Potential Energy

$$U = \frac{-Ze^2}{4\pi\varepsilon_0 r}$$

Total Energy

$$T + U = \frac{-Ze^2}{8\pi\varepsilon_0 r}$$

The orbit energy is negative because this is a bound state.

This is the energy of a single electron in orbit around a bare nucleus.

De Broglie Wavelength

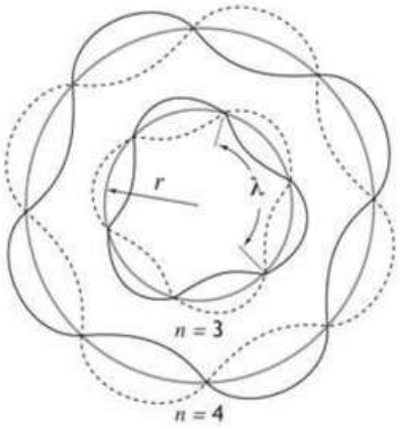
He proposed that matter , like radiation , should also exhibit dual nature i.e both particle and wavelike properties. The de Broglie equation is an equation used to describe the wave properties of matter, specifically, the wave nature of the electron:

$\lambda = h/mv$,

where λ is wavelength, h is Planck's constant, m is the mass of a particle, moving at a velocity v. de Broglie suggested that particles can exhibit properties of waves.

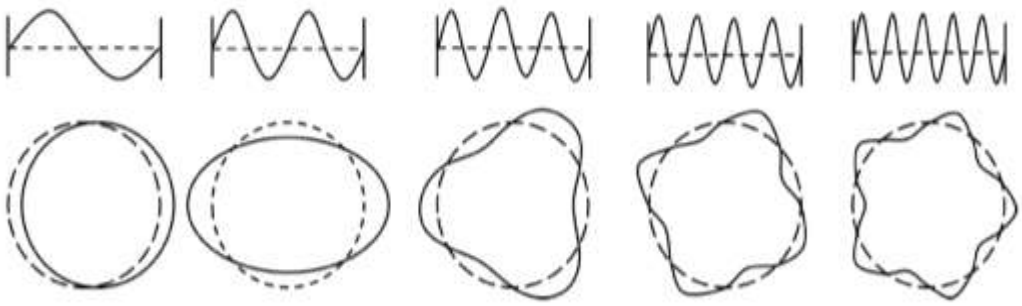
$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

λ = wavelength
h = Planck's constant (6.63×10^{-34} J · s)
p = momentum
m = mass
v = speed



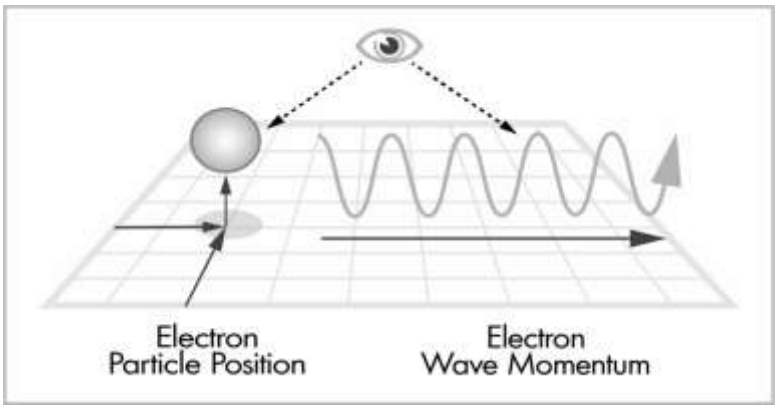
De Broglie wavelength in gravitational model

As given by the equation $\lambda = h/mv$, as the mass increases the wavelength Decreases due to the inverse relation between them so the value of wavelength is very small therefore it cannot be detected.



Heisenberg's Uncertainty principle in Atomic Model

The Heisenberg uncertainty principle is a law in quantum mechanics that limits how accurately you can measure two related variables. Specifically, it says that the more accurately you measure the momentum (or velocity) of a particle, the less accurately you can know its position, and vice versa.



Heisenberg's Uncertainty Principle in Gravitational Model:
As the equation states that the product of change in position and momentum is constant, so as the value of change in momentum increases the value of position becomes undetermined and vica versa.

$$\Delta x.\Delta p \geq h/4\pi$$

Schrödinger Atomic model:
The Schrödinger model assumes that the electron is a wave and tries to describe the regions in space, or orbitals, where electrons are most likely to be found.

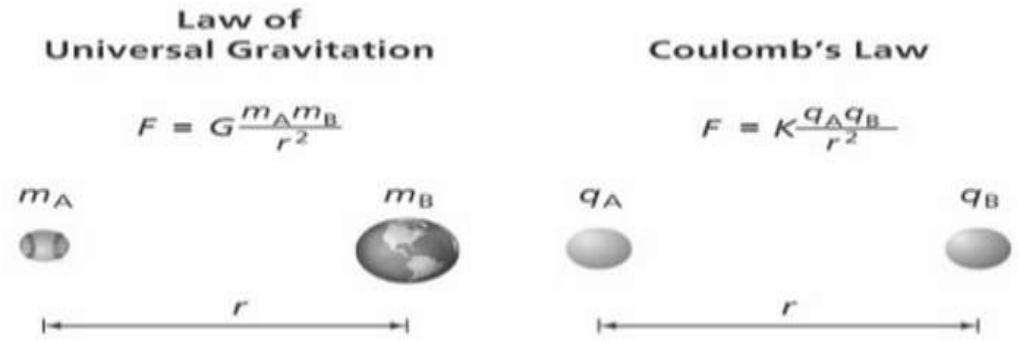
Schrödinger in Gravitational model:
The Schrödinger model assumes that the planet has a certain wave called gravitational waves and tries to describe the regions in space, or orbitals, where the centre of those waves called planets are most likely to be found.

Similarity between Coulomb's law and Universal Gravitational law:
Both laws define forces. Coulomb's law defines force between charges whereas Newton's law of gravitation defines force between masses.

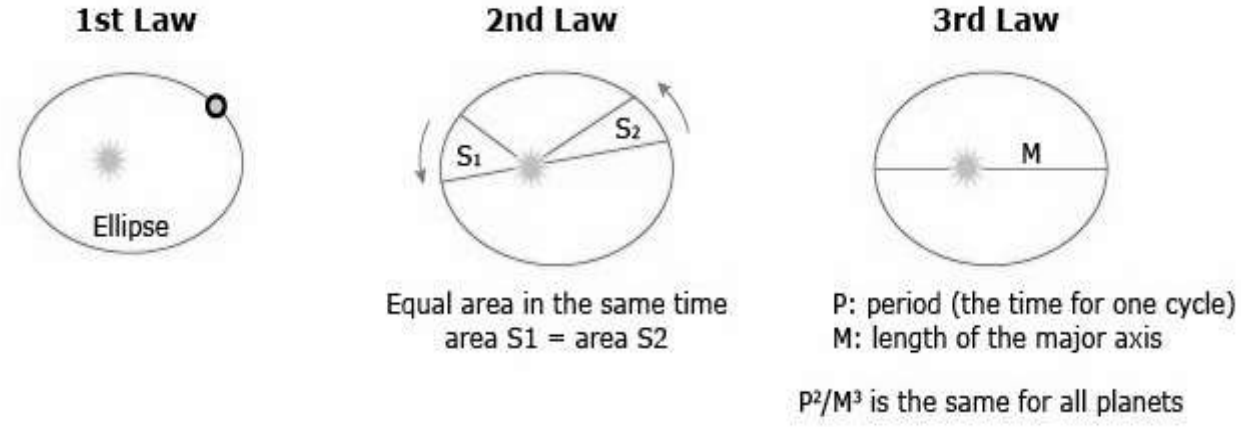
Both are inverse square laws i.e. the forces are inversely proportional to the square of the distances between charges in case of Coulomb's law and between masses in case of Newton's law of Gravitation.

The forces defined by both laws are central forces i.e. the forces act along the line joining the two charges in case of Coulomb's law and the two masses in case of Newton's law of gravitation.

The forces defined by both laws are conservative forces i.e. the work done by these forces on any object is independent of the path followed by the objects. It only depends on initial and final positions of the object on which these forces act.

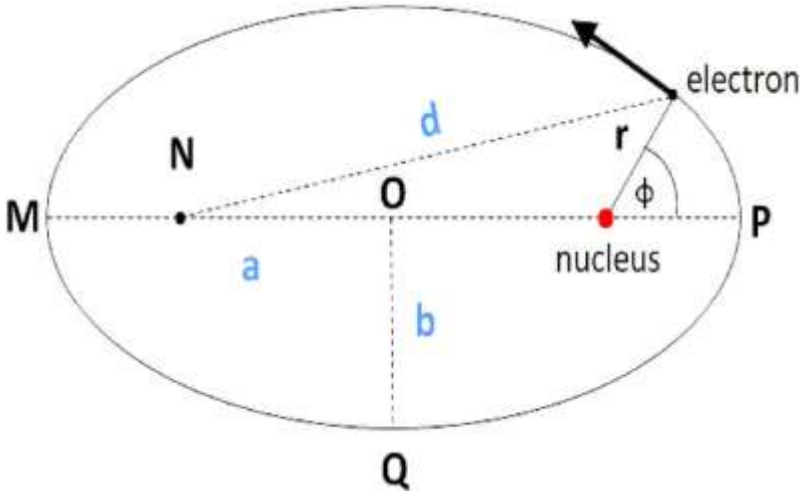


Kepler law of Gravitation:



1. Planetary orbits are elliptical with the sun at a focus.
2. The radius vector from the sun to a planet sweeps equal areas in equal times.
3. The ratio of the square of the period of revolution and the cube of the ellipse semi major axis is the same for all planets.

Kepler's law in atomic model:



1. As the planets revolve in elliptical orbits similarly electrons revolve in elliptical orbits around the nucleus with the nucleus at one of the foci.
2. The radius vector from the proton to an electron sweeps equal areas in equal times.
3. The ratio of the square of the period of revolution and the cube of the ellipse semi major axis is the same for all electrons.

Consider a hydrogen atom;The electrostatic force is given by:

$F_E = ke^2/r^2$

Since the electron is experiencing centripetal force :

$F=mr\omega^2$

$mr\omega^2 = ke^2/r^2$…….(Equating the above two above equations)

Since $\omega = 2\pi/T$ => $mr4\pi^2/T^2=ke^2/r^2$

So, $T^2 \propto R^3$

Conclusions:-

The similarity is defined by using pre-existing theories from chemistry and physics like but not limited to Dalton's theory, Quantum theory and Kepler's theory.

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