



THE ORIGIN OF SOLAR SYSTEM “THE NEBULAR MODEL”

PRIYA¹, Inamul Haq Wani²

Department of Physics, Govt. Maulana Azad Memorial College Jammu, Jammu and Kashmir,
India

ABSTRACT: The Nebular Hypothesis is a widely accepted theory and explains the formation of the Solar System, Sun, Stars, and Planets. The Nebular Hypothesis gives the idea that a spinning cloud of dust made of mostly light elements called a nebula fattened into a planetary disk and became a Solar System with orbiting planets. The model suggests that the rotating solar nebular ultimately evolves into a disk shape due to gravitational contraction and conservation of angular momentum. The group of gas dust starts to collect together and form heavy areas in the cloud the matter starts to spin as the clumps gather more and more dust, forming a flat rotating disk and these clumps became planets with the planets formed they provide heat and light to the solar system in complete the Nebular Hypothesis explains the most of solar system.

KEYWORDS: Formation of Solar System Solar Nebular Disk, Angular Momentum, Evolution of Planets.

INTRODUCTION

The theory was developed by German philosopher “Immanuel Kant” and later on by a mathematician. named "Laplace" in 1796. The nebular hypothesis is the most widely accepted model to explain the formation and evolution of the solar system, as well as other planetary

Systems. According to this Hypothesis the origin of Earth, the Solar System, the Sun as well as planets formed from the interstellar cloud of dust and gas. The model based on this hypothesis is called a nebular model. The Basic Principle of Physics underlying the nebular Model is Newton's law of Gravitation. To understand this theory everything is made with NEBULA CLOUD OR SOLAR NERULA. A solar nebula is an interstellar cloud of dust and gas that began with the star formation. According to the Nebular model, the formation of stars including the sun takes place with an interstellar cloud with enough mass and low internal pressure and gravity. Eventually, a region within the solar nebula forms a core made up mostly of hydrogen and helium which begins to heat up with due to gravitational internal friction and rotation. This phase in Star's life cycle is called Protostar. The stars were found a way before planets and Asteroids came into existence Planets are formed 4.5 billion years ago and most of the stars were between 1-10 Billion years ago and the sun is the biggest Star in the Universe. The theory explains what happened initially was there is Nebular Cloud which is made from Hydrogen. Helium and other dust particles. The cloud started rotating very heavily and due to that most of the helium and hydrogen atoms came to the centre and started colliding with each other due to refraction and Collision of particles. Fusion reaction took place and pure energy started generating. When its internal temperature is high enough to initiate thermonuclear reactions a full-fledged star sun is born. Our solar system formed at the same time as our Sun as described in the Nebular Hypothesis. The nebular Hypothesis is the idea that a Spinning cloud of dust made mostly of light elements called a Nebula flattened into a Protoplanetary disk, and became a solar system consisting of a star with orbiting planets. According to the nebular model, our solar system formed due to the gravitational contraction of rotating interstellar cloud called solar nebula. Due to rotation, the solar nebular takes form of disc. Due to rotation, the solar nebula takes form of a disc. When the sun formed at the centre of the disc and became luminous enough, the remaining gas and dust was pushed away due to sun radiation pressure.

The blown away gas and dust condensed into various planets orbiting the sun one of the natural consequences of solar nebula model is that most stars in the galaxy should have planetary systems.

FORMATION OF THE SOLAR SYSTEM

There are several theories that attempt to explain how the solar system began but the most widely accepted one is nebular theory. Astronomers believe the solar system started at large, shapeless cloud of gas, dust and ice. but something disrupts the mass and set things in motion and the explosion of nearby star. Our solar system formed about 4.5 billion years ago from a dense cloud of interstellar gas and dust. The cloud collapsed; possibly due to the shockwave nearby exploding star called Super Nova. When this dust cloud collapsed, it formed a solar Nebula spinning of material. Due to rotation solar nebula takes form of disc. At the centre when gravity pulled more and more material in the pressure in core is so great that hydrogen atom began to combine and helium, releasing a amount of energy with that our sun was born when the sun formed at the centre of this disc and became luminous enough the remaining gas and dust was pushed away due to the Radiation pressure of sun and eventually 99% of the matter is available the matter further out in the disk was so clumping together that these clumps are smashed into one another forming larger and larger objects. The blown away, dust and gas condensed into various planets orbiting the sun some of them becoming dwarf planets and large moons. The asteroid belt is made of pieces of early solar system that never come into a planet and other leftover pieces became asteroids, comets meteoroids and small irregular moons. There are nine planets in our solar system. The first four planets of the solar system is nearest the sun, Mercury, Venus, Earth and Mars are Terrestrial planets. They are small and have rocky surfaces. The other leftover planets are called Jovian Planets namely Jupiter Saturn, Uranus and Neptune. The Jupiter and Saturn are gas giants and Uranus and Neptune are Ice giants. Our

solar system extends much farther than the eight planets that orbit the sun. It includes the Kuiper belt that lies in past Neptune orbit the most popular Kuiper belt object dwarf planet Pluto.

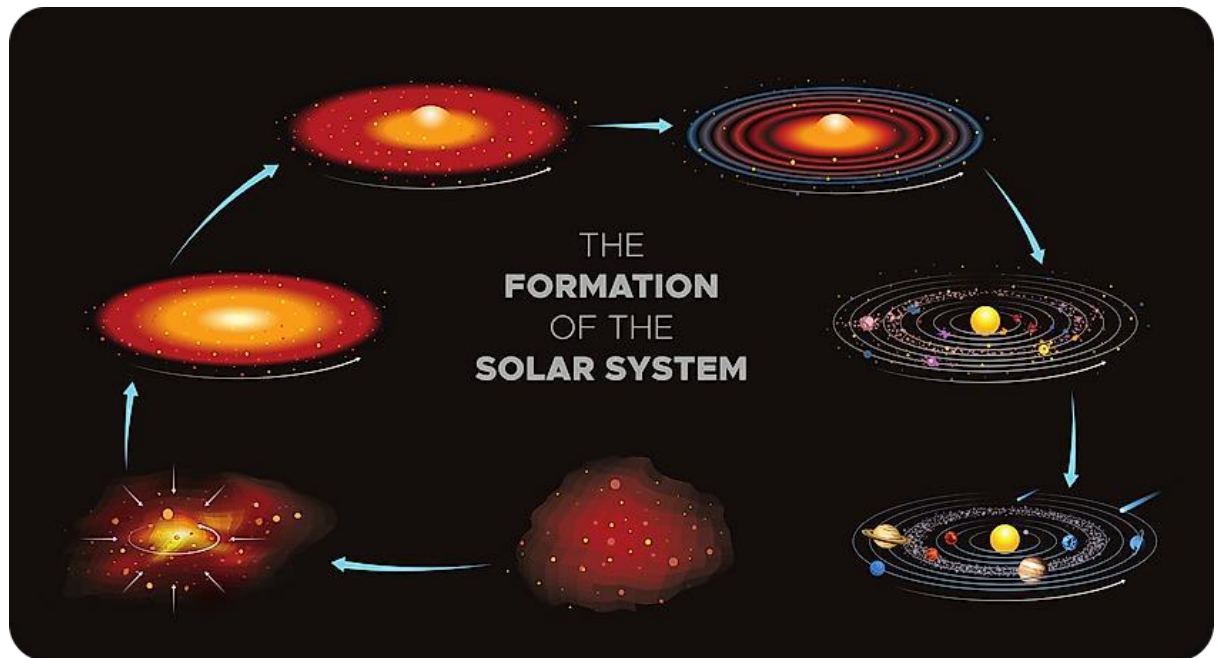


Fig. Formation of Solar System

ANGULAR MOMENTUM OF THE SOLAR SYSTEM

The present distribution of angular momentum in the solar system seems inconsistent with the basic of the nebular model. The argument goes Since the Sun and the planets, are formed the same cloud, the angular momentum per unit mass must be same. The facts is the sun posses app. 99.9% of the total mass of the Solar system but only 1% is angular momentum Jupiter exceeds the rotational angular momentum factor of 20 among all 99% total angular momentum of the Solar system. Jupiter possesses the most of it. In the formation of the Solar System the angular momentum is transported from the central part of the nebula to the outer regions. There are two possible mechanism. According to the first mechanism, the interaction of the charged particles and the magnetic field of the evolving Sun causes transfer of angulated by momentum. The charged particles created by ionisation of solar nebule by the Sun are dragged along by the magnetic field. As a result nebular material in the outer region gains angular momentum. The

other mechanism suggested for transfer of angular momentum is based on viscosity. Due to viscosity motion of fluid in one part is affected by the motion of the fluid in the adjoining part. Thus the slow moving particles located at outer edges of the nebula gain in velocity due to their interactions with the fast moving particles in the smaller orbits of the nebula and vice versa. This may cause transfer of angular momentum from the "Sun to the outer planets of the Solar System. The angular momentum problem is addressed by proposing that there is a transfer the of angular momentum from the inner to outer regions of the solar system during its evolution.

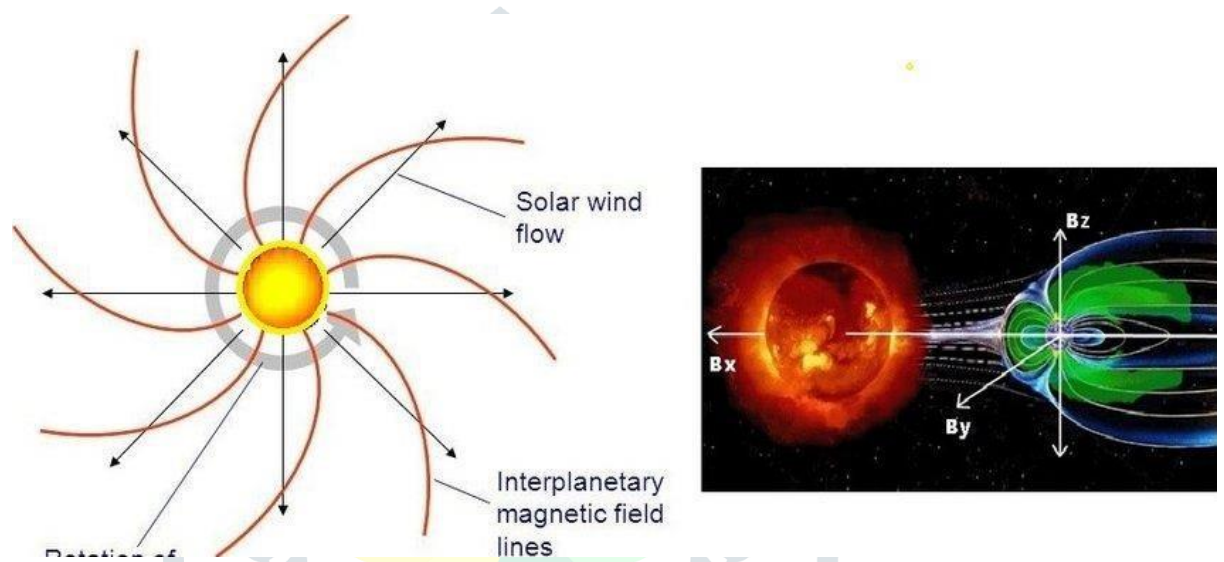


Fig. Magnetic lines of force of the rotating Sun

EVOLUTION OF PLANETS

It involves 3 stages.

- (i) formation of planetesimals,
- (ii) formation of protoplanets, and (ii) Stabilisation of the planet.

A) The first stages involves the growth of macroscopic grains of solid matter from the Interstellar cloud. The size of these grains range from a few cm to a few km and they are called planetesimals. Planetesimals can grow through two processes condensation and accretion. In the condensation process, grains grow by adding one atom at a time to a nucleus atom from the surrounding gaseous cloud. This is Similar to the growth of

snowflakes in the Earth's atmosphere. In the accretion process, solid particles stick together. Further, the planetesimals would tend to rotate in the plane of the solar nebula.

B) In the second stage, planetesimals coalesce and protoplanets - objects having planetary sizes and masses. Since all the planetesimals are moving along the same direction in the nebula, they collide with each other at a low relative velocity and stick together to form protoplanets, further, growth of protoplanets is helped by gravity because the nebular matter is attracted by the protoplanets.

C) At the third stage, when a protoplanet grows into a Stable planet, a large amount of heat is generated in its core due to the decay of short lived radioactive elements. Heat is also generated due to collision of these planets with other objects. Due to high temperature, the planets melt and facilitates the process of gravitational separation in which material in the planet, segregate themselves according to their density. Therefore, the inner regions of planets hold heavier elements and compounds and lighter elements are pushed to the surface.



CONCLUSION

From this theory it is concluded that it explains most solar system from this theory we know about all the planets revolve, clockwise like sun's rotation. Most of the planets rotates clockwise/ except Venus and Uranus. The most of the planets are in the same plane as the sun and there is pattern in spacing of the planets. The Nebular Model explains that each planets and moon in solar system has unique structure and properties from this theory we known about the angular momentum of all the planets is more than the Angular momentum of Sun. Nebular Hypothesis widely explains the formation of Sun, Stars, the planetary disk, in the solar and the formation and evolution system of planets in the solar system.

REFERENCE

Astronomy and Astrophysics by Mohit Kumar Sharma, Suresh Chandra.

Space Encyclopedia our Universe.

Modern Astrophysics, B.W. Carroll & D.A. Ostle, Addison-Wesley Publishing Co.

Introductory Astronomy and Astrophysics.