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Jain Philosophy in Modern Scientific Perspective

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1.0 Introduction

Jain philosophy is unique in the sense that it does not accept any Creator or Supernatural God like many other philosophies. It explains the phenomena of both the living and the non-living worlds by propounding the existence of real substances that are independent and distinct; every one of them functions by its own set of rules. All real substances are eternal, powerful in their own right and cannot be destroyed by one another. The real are not absolutely permanent but are transitory-permanent that is they undergo transformation, according to the set of rules, maintaining their essential characteristics. This special feature of the substances gives rise to creation of the world as we know without intervention of any other Creator power. The transformations in the substances are based on the principle of causality, an approach which is also the foundation of modern science. From this perspective the Jain philosophy is rightly called a scientific philosophy.

Modern Science has proceeded on experimental verification of its laws and theories, but such verification is often difficult in case of real substances which are metaphysical in their scope. But the Jaina tenets being facts, as pronounced by omniscient Lord, compare well with scientific findings where ever science has reached a conclusive stage. In other matters in which the scientific findings are still in initial stages and no concluding opinion has been reached the Jaina tenets, particularly in the living world, provide truths that can be torch-bearer to science. But there is a need to reinterpret the Jaina texts in scientific perspective so that they are accepted by the scientific community as a source of truths that are convincing, logical and scientific

My paper shall elucidate the above proposition by citing examples from both the living and the non-living worlds and present an overall scenario of comparison between Jain philosophy and science. Such a comparison many a times needs extension and

projection of established form of Jaina tenets to suit the format of modern science and also to fill up the explanatory gap found in the Jaina texts and the detailed scientific knowledge now available.

2.0 The Non-tangible Substances

Akasastikaya is a real substance. It is the container of all other substances, stationary or moving. It is boundless / infinite, eternal and one indivisible unit. It is non material and so does not possess the qualities of touch, taste, smell and colour. The part of *akasa* which is occupied by other substances is called *loka* (cosmos). *Loka* is finite and is surrounded in all direction by a*loka* which is inert, empty pure boundless space. Beyond *loka* there is no object – animate or inanimate. No *paramanu* or *Jiva* can cross the boundary and go beyond the limit of *loka*. The *dharma* and *adharma* determine the boundary of the *lokaakasa* by their own finiteness and thus divided *akasastikaya* in two parts *loka* and *aloka*.

Kala possesses the characteristic of 'persistence – through – change' and, therefore, is a substance. Its existence is necessary to define the duration (continuity), change (modification), motion, newness and oldness of substances. Time by itself cannot cause a substance to exist, but continuity of existence implies duration in terms of time. Mutation or change or modes also cannot be conceived without time, because change implies temporal succession in which modification takes place. Similarly, motion implies different positions of an object in space in temporal succession. *kala* is not *astikaya* i.e. it does not have spatial extension. Only the 'present' mode of *kala* is in existence, the 'past' has expired and the 'future' is yet to come. The singular present' *kala* cannot have spatial extension.

Kala is of two types – the absolute *kala* and conventional *kala*. The absolute *kala* assist modification/ change in substance and the conventional *kala* measures the duration of change. The Swetambara and Digambara traditions differ in the interpretation of absolute *kala*. According to Swetambara view since the absolute *kala* assists the substances like *jiva* – and *pudgala* in their modification it should be an attribute of the substance it is assisting. Thus the need of a separate substance like absolute *kala* is dispensed with. The Digambara concept of absolute *kala* is very

different. According to this view the absolute *kala* is in the form of *kalanus* (*paramanus* of *kala*) which are placed one each on each *pradesa* of *loka*. The *kalanus* are separated from each other and therefore there is no spatial extension. The number of *kalanus* is equal to the number of *pradesa* (innumerable) in the *loka*. A *kalanu* assists the substances present on its *pradesa* in their modification. *kalanu* itself being a substance follows the rule of origination – cessation - permanence.

The concept of conventional *kala* is same in the two traditions. The smallest indivisible unit of conventional *Kala* is '*samaya*'. One '*samaya*' is the time taken by a *paramanu* moving at a medium pace to go from one *akasa pradesa* to the adjoining *pradesa*. All other units of conventional *kala* are multiples of '*samaya*'. These practical units of conventional *kala* are based on the movement of sun and moon.

In physics, the concepts of space and time are so basic for the description of natural phenomena that their modification entail an alternation of the whole frame work we use in physics to describe nature. The concepts of space and time underwent radical modification from the Aristotle to the present time.

In Newtonian physics, matter particles moved in a three dimensional absolute space, filled with ether (medium of motion). It was an absolute space, always at rest and unchangeable. All changes in the physical world were described in terms of a separate entity called time, which again was absolute having no connection with the material world and flowing smoothly from the past through the present to the future. These concepts of space, time and ether were the basis of physics for almost three centuries.

Both Aristotle and Newton believed in absolute time. That is, one could always measure the interval of time between two events and that it would be the same whoever measured it. Time was completely separate from and independent of space. This commonsense view worked well when dealing with apples or planets that move slowly but they don't work at all for things moving at or near the speed of light.

According to Einstein's relativity theory, space was not three dimensional and time was not a separate entity. Both were intimately connected and formed a four-dimensional continuum- "space – time". Furthermore, there was no universal flow of

time. Concepts of an absolute space and an absolute time were, thus abandoned and became merely elements of language for describing observed phenomena.

Einstein's earlier theory of time and space, special relativity, proposed that distance and time are not absolute. The ticking rate of a clock depends on the motion of the observer of that clock, likewise for the length of a "yardstick". Published in 1915, general relativity proposed that gravity, as well as motion, can affect the intervals of time and of space. The key idea of general relativity, called the equivalence principle, is that gravity pulling in one direction is completely equivalent to acceleration in the opposite direction. A car accelerating forward feels just like sideways gravity pushing your back against your seat. An elevator accelerating upward feels just like gravity pushing you into the floor.

If gravity is equivalent to acceleration, and motion affects measurements of time and space, then it follows that gravity does so as well. In particular, the gravity of any mass, such as our sun, has the effect of warping the space and time around it. For example, the angles of a triangle no longer add up to 180 degrees, and clocks tick more slowly the closer they are to a gravitational mass like the sun.

Dharmastikaya is helpful in the motion of active substances. It is a single individual and homogenous continuum pervading the entire *loka*, but does not extend beyond it. In fact, it is a cause of finiteness of the *loka*. Temporally, *dharma* is beginning less and eternal. Being non-physical and non-corporeal (*amurta*), it is devoid of sense-qualities of smell, taste, touch and colour, and, therefore, imperceptible to the sense – organs and physical instruments. Immobile itself, it passively assists the motion of mobile objects like *jiva* and matter and micro movements in all realities. Not even the minutest vibration is possible without the assistance of *dharma*. Hence, where there is no *dharma*, there is neither psychical activity nor physical activity like functioning of nerves, beating of heart, winking of eyelids, propagation of light waves, vibrations of any kind etc. *Dharma* passively assists the *jiva* and *pudgal* but does not actively help in their movement.

Adharmastikaya assists *jiva* and *pudgala* to assume rest position. Its other characteristics are similar to dharma. It is also a single, indivisible and homogeneous

continuum pervading the entire *loka* but does not extend beyond it (it is also a cause for finiteness of *loka*). It is *beginning less*, eternal, devoid of sense qualities and imperceptible to the sense organs and physical instruments. It is immobile and assists *jiva* and *pudgala* passively in assuming rest position. It does not stop moving *jiva* and *pudgala* but becomes a passive agent in retarding and stopping their movement just like a shade of tree prompts a traveling passenger to stop. An object reversing its direction stops momentarily before changing the direction and such turn is also assisted by *adharma*. The still positions of body concentration of mind, silence, staying motionless and all steady postures etc., are due to passive action of *adharma*.

There are two main reasons for assuming the existence of *Dharma* and *adharma*

1. Assist *jiva* and *pudgala* in the act of motion and rest.
2. Division of *akasa* into *lokakasa*, cosmic space, and *alokakasa,* trans-cosmic space

Science has presented the concept of ether which, in due course of time, has been assigned different kinds of functions including propogation of light. Some authors assume that *dharmastikaya* is the medium of motion and *adharmastikaya* is the medium of rest. To me these propositions require a close examination and scrutiny.

Scientists hypothesized luminiferous ether mainly for two reasons.

1. To have a medium of propagation for light waves.
2. To satisfy the requirements of some equations like Maxwell's equations and Einstein's general relativity.

The *dharma* is not a medium of motion like ether. According to Jain philosophy the medium of motion is *akasa.* The Jaina concepts of *dharma* and *adharma* are more comprehensive and broad based. The scientific concepts are related to the physical world, for obvious reasons, but Jaina concepts fulfill the needs of both the *Jiva* and material world. According to Jaina philosophy a *Jiva* having *Karman* body and *tejas* body migrates through space from one life to another. The soul in pure form is non-material but *karman* body and *tejas* body are made up of *varganas* which are supposed to be plasma like. A liberated pure soul travels from this land to end of *loka* in one *'samaya'*. The *dharma* and *adharma* assist this kind of journey of *Jiva* besides helping *paramanu,*

vargana and aggregate matter in their motion and rest. Such comprehensive view is a specialty of Jain philosophy and is missing in scientific thinking

Akasa of Jains is a substance which accommodations all other substances stationary or moving. So all objects, including light particles, move in it, *Akasa* is non material, one indivisible unit having infinite *pradesa*. Its *pradesa* do not move like the particles of fluids and therefore, *akasa* provides a solid like continuum (at least for *paramanus*& *varganas*) in which transverse waves can travel. Thus *akasa* is the medium of propagation for light, were it photons or waves. The travel of light, however, like any other movement, requires the passive assistance of dharma. The *akasa* does not become an effective medium of propagation in the absence of dharma. The presence of any other substance like ether is not necessary in Jain scheme. The *akasa* serves the purpose of ether the scientists talk of. The akasa, *dharma* and *adharma* being non-material fulfill the needs of travel of both *jiva* and *pudgala*. *Dharma* and *adharma* must also be solid like substances so that their *pradesa* do not move, they superimpose on *akasa pradesa* in one-to-one manner. Both are present in *loka* and have the same shape as *lokakasa*.

The space of Newton is similar to *akasa* in some respects. Both are independent objective realities which are immobile and indivisibly whole entities. The Newton's space is void and requires the presence of ether but *akasa* does not need it to be a medium for propagation of light.

The time defined by Newton appears to be a fact rather than a substance. It measures the intervals of time like the conventional *kala* of Jains. Newton did not accept any limit on the velocity of light thus denying an inter relationship between space and time. According to the Jain philosophy also speeds higher than velocity of light are possible as happens in the case of *paramanu* and some *varganas*.

The Einstein's theory of relativity surmises that all speeds are relative and that the absolute velocity of any object can not be determined by any means. This generally is interpreted to mean that absolute space does not exist. If this is true then the Jaina concept of *akasa* does not agree with the theory of relativity. But before coming to such a conclusion we must ascertain that the impossibility of determining the absolute

velocity is due to subjective limitation of the observer or it is a real impossibility. If it is by limitation of the observer then existence of the absolute speed can not be denied. In view of Jain philosophy such a limitation is indeed due to the observer. An omniscient observer perceives the substances in their absolute state as he does not face the limitations imposed by material sense organs. He can perceive the absolute velocity and the absolute space.

The 'time' defined on the basis of movement of sun and moon or some event of matter is meaningful only for *pudgala* that is the physical world. It has no relevance to non-corporal substances like dharma, *adharma, akasa* and liberated soul. Consider now the connection between spaces (perceptual) and time as suggested by general theory of relativity. The perceptual space (finite) is influenced by matter. The time defined by events of matter must also be a property of *pudgala.* Since both space ant time are related to *pudgala* an interconnection between them is indicated. Jain philosophy has therefore no objection to the concept of four dimensional continuums of space and time and the relationship between space, time and matter as provided by general theory of relativity in that specific context.

3.0 *Pudgala*: Matter and Energy

The characteristic attribute of *pudgala* is that it possesses the properties, which can be perceived by sense organs viz. colour, smell, taste and touch. Concomitance of all the four is emphasized by the Jains. In other words, if a thing is perceived by the sense of touch, it must also necessarily possess smell, taste and colour. The *paramanu* structure of *pudgala* is, as its name implies, absent in other *astikayas*. Whereas the other four *astikayas* are indivisible i.e. not disintegrable, *pudgala* is divisible. The ultimate indivisible unit of *pudgala* is called *paramanu*. *Paramanu* is the pure form of *pudgala* and all matter and energy are modes (impure) of *paramanu pudgala*. The *paramanu* can neither be created nor can it be destroyed. It is eternal. Although it possesses sense – qualities, it cannot be an object of sense – perception. It is the subtle most physical entity. By itself it transcends the sense experience, though it is basic constituent of all perceivable objects.

Based on touch the *pudgala* is of three types

(i) Two touch (primary) *paramanu*.

(ii) Four touch (primary) subtle (*suksma*) aggregates (*skandha*) -energy.

(iii) Eight touch gross (*badara*) aggregates-energy and matter.

Cold, hot, smooth and rough are primary touch qualities of *pudgala*. The smooth touch is also regarded as positive charge and the rough touch is regarded as negative charge. We shall use these equivalence properties in our study. The other four touch qualities viz. light, heavy, soft and hard are secondary touch qualities. These touch qualities develop when bonding between infinite *paramanus* produces a gross aggregate. If number of negative *paramanus* is more in the bonding process the aggregate contains light touch quality and if positive *paramanus* are more then heavy touch is produced in the aggregate. When positive *paramanus* are in majority and they bond in cold condition soft touch is produced and when a majority of negative *paramanus* bond in hot condition hard touch is produced in the aggregate. The mass (or weight) of the aggregate is said to relate to the light and heavy touch qualities. These two qualities always co-exist, they are not found separately in aggregate. The four touch aggregates and *paramanu* are *agurulaghu* and mass less. The mass is a property of gross aggregates having eight- touch.

3.1 *Paramanu*

Paramanu is capable of being dynamically active (*kriyavan*). When mobile, it may have vibratory as well as migratory motions. The activity of a *paramanu* is not continuous but rather in the form of quanta. When dynamic, it can assume a very high velocity, since it is completely mass less, there is no upper limit to its speed, and it can travel from one end of *loka* to the other in one *samaya*. The motion and dynamics of *paramanu* in some respect follow certain rules. On the other hand the *paramanu* also follows some rules of uncertainty. *Paramanu* generally cannot be stopped or hindered by any object (*apratighati*) and at the same time it does not cause hindrance to others

Some intrinsic qualities of *paramanu* are also factors in determining its velocity. When the intensity of negative charge of *paramanu* becomes a maximum, the velocity of *paramanu* reduces without any external influence. A *paramanu* with higher negative charge moves at a lower velocity then a *paramanu* with lower negative charge. The

velocity is lowest for a *paramanu* with maximum negative charge. A *paramanu* having positive charge favours rest position. Both negative and positive charge may vary due to self-modification process (*sadgun- hani-vridhi*) and the velocity of *paramanu* would change accordingly.

3.2 *Vargana*

Acharya Malayagiri has defined *vargana* as a group of similar things of the same kind. Acharya Mahaprajna says that a pudgala aggregate made up of similar *paramanus* is a *vargana*. According to Acharya Kanaknandhi a *vargana* is a cluster of *paramanus*, which are in unbound state. It will be seen later that all these definitions appear to be true under different conditions.

Gommatsara Jivakanda provides a classification of *varganas*. According to it there are 23 types of main *varganas* found all over *loka*. These *varganas* are classified on the basis of number of *paramanus* present in the cluster. The *varganas* fall into two broad categories, one has four- touch and the other having eight-touch. The 2nd to 14th order *varganas* are four-touch type and mass less. The 16th to 23rd order *varganas* are eight- touch type and are supposed to have weight. The first *anu vargana* consisting of a single *paramanu* has two-touch. The 15th intermittent regular *vargana* is perhaps a mixed type. The four-touch and the eight- touch *varganas* have separate existence and inter conversion among them are limited.

Lord Mahavira said that *paramanu* might exist either as a particle or as a wave. It is astonishing to find such a statement in Jain philosophy, a fact that was discovered in science by Loeus de Broglie as late as 1924. The *paramanu* is so small, and invisible to common man, that it can be detected only by omniscient and persons having high power of clairvoyance (*parmavadhi jnan*). It is also known that infinite number of *paramanus* can occupy one space point. This shows that a *paramanu* is bosonic in character and mass less. This establishes the energy characteristic of *paramanu*. Further, a *paramanu* occupies only one space point; it does not extend to other space points. From this consideration it would be logical to assume the *paramanu* as an energy point. Though the energy in a *paramanu* exists as potential energy or kinetic energy or both but such fractions of energy are not realized outside *paramanu* as the

paramanu is indivisible. So the energy of a *paramanu* is the smallest amount of energy that can exist in Free State and therefore can be regarded as a quantum of energy

A *vargana* has both positive and negative *paramanus.* In a *vargana* having infinite number of *paramanus* the number of positive and negative *paramanus* is not likely to be equal. Therefore, a *vargana* has a net charge either positive or negative. This charge produces an electric field. A moving *vargana* with an electric charge also produces a magnetic field. So a moving *vargana* is an electromagnetic field. Variation in the speed of *vargana* produces electromagnetic waves, which travel through the space.

A *vargana* is a bundle or packet of energy. The energy density or energy intensity increases with the order of *vargana*. *Varganas* of varying energy intensity have different application. Soul makes suitable use of different intensity *varganas*. The *ahara vargana*, luminous *vargana*, sound *vargana*, *mano vargana* and *karman vargana* fulfill different needs of soul. The non-associable *varganas* although not directly useful to soul, are source of *varganas* useful to soul besides taking part in other natural processes.

Varganas of 15th and higher order are supposed to have eight- touch. So in addition to four basic touches, namely cold, hot, positive and negative charge, other four secondary touches - light, heavy, soft and hard are also present. We have seen that the lower order *varganas* have the four basic touches. How the higher order *varganas* acquire the other four touches? One plausible explanation is that this happens due to bonding of *paramanus*. We know that the energy intensity increases with the order of *vargana*. The energy intensity in the 15th order *vargana* reaches a critical level which perhaps is enough to cause condensation of energy to corpuscular form or in other words, the energy converts to matter form and this happens because of bonding between *paramanus*. It may be noted that according to present scientific concept also the elementary particles of matter are, in their essence, nothing else then, condensation of the electromagnetic field. The *paramanus* bond according to the rules given in Jaina texts. Bonding between two negative *paramanus* produces light touch and bonding between two positive *paramanus* produces heavy touch. Bonding also takes place between positive and negative *paramanu*. The bonding may take place between two *paramanus* or between an aggregate of *paramanus* and a *paramanu*. The existence of

light and heavy touch produces another property called mass. The act of bonding requires energy. When two *pramanus* bond a good part of their energy (potential energy) is used up in bonding reducing the free energy of the *vargana*, this free energy exists as kinetic energy of motion and vibration. This shows that the maximum velocity a two *paramanu-bonded vargana* will be less than the maximum velocity of a *paramanu* or a two *paramanu* unbound *vargana*. We therefore can see that lower order *varganas* having four- touch must have higher maximum velocity than eight touch *varganas* of higher order. The *paramanu* having two- touch has the highest maximum velocity.

A question may be raised why the energy of lower order *varganas* does not exist as mass (corpuscular form). The Einstein equation giving relation between energy and mass does not say anything about the condition required for conversion of energy to mass. It appears that if the energy intensity is less than critical value energy always exists in that form. The lower order *vargana*, though have a mass equivalent, are free of gravitational effect and are said to be weightless. The higher order *vargana* in which a good part of total energy exists as mass have gravitational property. Thus the total matter in the universe (*loka*) exists in three forms (1) *paramanu* having two- touch, (ii) mass less low order *vargana* having four touches and (iii) higher order *vargana* having eight touches and mass.

The bonding between *paramanus* also produces the other two secondary touches, soft and hard. We know that abundance of cold and positive charge produces the soft touch and the hard touch is produced by abundance of hot and negative charge. This shows that bonding between similar charges paramanus produces soft and hard touches. Both heat and charge are forms of potential energy of *paramanu*. A high positive charge and cold state means high electric energy and low heat energy. In this case the kinetic energy i.e. velocity of the *paramanu* can be comparatively high for a given quantum energy of *paramanu*. A high negative charge in hot state implies that both the electric energy and heat energy are high and therefore the velocity of the *paramanu* should be comparatively low. When the *paramanus* belonging to former case bond together, soft touch is produced and when *paramanus* corresponding to second case combine a hard touch is produced. What do soft touch and hard touch mean in

scientific terms? Perhaps this refers to the strength of the bond. A soft touch may signify high bonding strength. It means that once bonded it would be relatively difficult to disintegrate the positive aggregates than the negative aggregates. In a *vargana* of infinite *paramanus* bonding of some *paramanus* may produce soft touch and the others may produce hard touch. Similarly, the light and heavy touch is produced and the *vargana* has all the eight touch. This is true for all higher order *varganas*

3.3 Luminous Matter

All matter (visible or invisible) is made up of the 23rd Gross Matter Vargana (GMV) according to Jain philosophy. Science has discovered various kinds of sub atomic particles, which, according to present knowledge, are the smallest constituents of matter. We examine how these sub atomic particles are produced from GMV. Consider the case of leptons first. The neutrino is the smallest lepton having negligible mass and no charge. If neutrino is made of GMV then it must be a combination of at least two GMV, one having positive charge and the other a negative charge. This will be the case when the two GMV have equal and opposite charge. As *varganas* exist with differing charges it is very likely that more than two GMV combine to produce a neutral charge in neutrino. So a neutrino of negligible mass should be made up of more than two GMV. There are three types of neutrinos. The mass of all three types is negligible but still there is a minor difference between them. Such minor variation in mass is obtained by variation in number of GMV in the three types of neutrinos. This indicates that the neutrino must contain a large number of *vargana*. It may be noted that when the mass of a neutrino is considered to be negligible, the mass of GMV is truly negligible.

We now consider another lepton, the electron. The mass of electron is 0.511 MeV, which is millions of times greater than the mass of a neutrino. This means that an electron is made of millions of GMV. Some of these GMV may have negative charge and others positive charge. In an electron the number of negative charge GMV exceeds the positive charge GMVs giving a net negative charge (-1). This also shows that the charge of one GMV is millions of times smaller the charge of an electron. And since a GMV contains infinite *paramanus*, the quantum charge of a *paramanu* is really unimaginable. The lepton muon is more than 200 times heavier, and tau is about 3500 times heavier

than electron and therefore, they must contain more GMV in the same proportion. These particles are unstable and so the GMVs shed off till a stable configuration is obtained.

Next consider the stable baryon particles proton and neutron. These particles are supposed to be made up of quarks. The mass of a proton is 1836.12 times greater them that of the electron and neutron is very slightly heavier than proton. The mass of a quark is uncertain but it is many times more than that of the electron. So a quark is made from that many times more GMV than an electron. There are six types of quarks having fractional charges, both positive and negative, and masses ranging from 2 MeV to 18000 MeV. According to Jain philosophy the fractional charges of quarks are possible by appropriate combination of positive and negative GMV comprising them. Another thing we observe is that the charges of up quark, charm quark and top quark are same but their masses vary considerably. Similar is the case with down quark, strangeness quark and bottom quark. Synthesis of these quarks is clearly possible with suitable combination of GMV. Many more types of particles can be formed, including about 200 discovered so far.

We know that fission of uranium nucleus produces enormous amount of energy. This energy is mainly obtained by conversion of a fraction of nucleus mass into energy in the fission reaction. The fission process releases only about one percent of energy equivalent to the mass of nucleus. One hundred percent conversion of mass into energy takes place where a particle meets its antiparticle and the two annihilate each other. For this to happen all bonds between the *paramanus* must be broken so that the *paramanus* are restored to their free state producing almost infinite amount of energy. The process of synthesis of a particle from GMV is a fusion process. Here energy of infinite number of *paramanus* combines to produce a sub atomic particle. This is truly the statement of Einstein equation. Jain philosophy can, therefore, claim that the energy - mass relationship was known to the omniscient and this was later derived mathematically by Einstein in 20^{th} century.

There are four fundamental forces in nature. The strong nuclear force binds quarks in protons and neutrons and holds protons and neutrons together. The weak

nuclear force is responsible for radioactivity and in a way holds the particles with negative charge together. The electromagnetic force holds oppositely changed particles together. Scientists assume the existence of imaginary particles like gluon, boson and photon for the operation of these three types of forces respectively. Jain philosophy has described attributes of touch qualities for similar functions. We know that bonding between positive *paramanu* produces heavy touch and bonding between negative *paramanus* produces light touch. This means that heavy touch holds positive *paramanus* together and light touch holds negative *paramanus* together. Thus there is a clear similarity between strong nuclear force and heavy touch and between weak nuclear force and light touch. The bonding between positive and negative *paramanus* is similar to electromagnetic force. We see that the three types of bonding described in Jain philosophy are equivalent to the three kinds of basic forces known to science.

The soft and hard touch offer possible explanation to some observed behaviour of sub atomic particles. The protons carry a majority of positive *paramanus* held together by soft touch signifying high bonding strength. The electrons carry a majority of negative *paramanus* held together by hard touches signifying low bonding strength. Thus protons are strongly bonded and electrons are loosely bonded particles. This is the reason why proton decay is not observed in practice. Neutron bond is not as strong and so neutrons decay. The electrons can easily disintegrate and integrate.

4.0 Soul and Biology

Jain philosophy describes *jiva* (soul) as a substance. According to one classification there are six classes of souls– earth body soul, water body soul, fire body soul, air body soul, plant body soul and mobile souls. This kind of classification of souls is unique to Jain philosophy. Lord Mahavira gave this classification from his "direct" observation of nature by his power of omniscience. He could see the minutest form of life. He could see that there are innumerable numbers of lives in a tiny particle of earth or a drop of water, that they all breathe, take food and have a life span. He offered a detailed description as to their birth, life after death, cognizance power, passions, etc.

The plant and vegetation are bodies of plant body souls. Plant body souls are of two kinds' solitary body soul (*pratyeka vanaspati*) and common body soul (*sadharana*

vanaspati). The soul who is the sole owner of the body is called solitary plant body soul. When more than one soul has a common physical body, the plant is called common body soul. In such cases the breathing process, food, age and body are common to all souls living in that body. It may be noted that there may also be many souls who depend on the body of a solitary body soul but in that case they enjoy individual independent lives and have no body in common

Plants are subtle and gross type. The above are all gross plants. The subtle plants called *nigod* are minutest form of microorganisms, we call them nano organisms. Microbiology also regards some types of virus as plant life. This finding of science is in agreement with the Jain belief. According to Jain philosophy infinite numbers of nano organisms, called *nigod,* live in a micro body. For instance, the tip of a needle is supposed to accommodate infinite divisions of a body and one division has infinite parts. Each part has infinite living places and each place contains infinite micro bodies. Each micro body has infinite nano organisms. All these nano organisms are born together, die together, breathe together and eat together. Their physical body is common but the subtle bodies, *tejas* and *karman*, are individual. When an inactive nano organism comes out of *nitya nigod* it is first born as a gross plant and becomes an active soul. The minimum life span of a plant body soul is less than one Indian hour and the maximum span is ten thousand years. All plant body souls have consciousness before processing.

All mobile beings with two to five senses are *trasakaya*. Mobile beings can move forward and backward, contract and expand, produce sound, move around and run in defense, get frightened, etc. All infernal beings, celestial beings, animals and humans are mobile beings. Mobile beings are found only in the *trasnadi,* the central region of *loka*.

Mobile beings having two to four senses are classed as deficient creatures.

Two- sense creatures – have the senses of touch and taste. Small insects, shell, conch shell, earthworm and other worms are some examples of two sense creatures.

Three- sense creatures – have the senses of touch, taste and smell. Ants, bed bugs, scorpions, pests, louse, etc. are some three-sense creatures.

Four sense creatures – have the senses of touch, taste, smell and vision. Flies, mosquitoes, black beetle, bee, locust etc. are four sense creatures.

Five sense beings. These beings are born either by womb or agglutination. Both of these kinds are aquatic, terrestrial, or aerial creatures. Fish, turtle, crocodile, etc. are aquatic

All creatures having one to four senses, five sense beings without mind and infernal beings are necessarily hermaphrodites. Celestial beings have male and female category (and no hermaphrodites). The human beings and animals have all three categories i.e. male, female and hermaphrodite.

In a land of action (*karma bhoomi*) the five sense animals have birth by womb as well as agglutination but in a land of enjoyment (*bhog bhoomi*) the birth takes place by womb only. The beings having non-fetus or fetus birth are matured but those having agglutination birth are non-matured (*aparyapta*).

4.1 Embryology

The species of a soul is pre decided. This means that the kind of body a soul is going to get is decided in his previous life. The *naam* karma of the soul bonded in the previous life determines the *gati*, the class of life viz., infernal, celestial, animal or human, *jati viz*. number of senses, the type of body that is species, and the structure of body in this life. In the transit period between two lives the soul is equipped with psychical sense though it does not have sense organs. So, the soul has sense perceptions right from the time of conception when the physical organs are not formed.

The first nourishment of soul consists of the seed cell produced by the union of sperm and egg cells of parents. The life begins from this seed cell. The first nourishment is, in fact, considered to be a luminous type. The skin nourishment starts right in the womb when the body parts of the fetus are formed and afterwards it continues throughout the life. The fetus does not take in alimentary food; it depends for nourishments on mother for its growth. The fetus draws only the essential elements from the diet of mother and does not share food as such. The internal parts like stomach etc do not come in contact with air and so stool, urine and gas, are not produced (or produced in a negligible amount) in the body of a fetus. The breathing by

fetus is connected to breathing of mother. The food elements and oxygen from mother's body are transported through placenta. The carbon dioxide, urea etc. produced in fetus are transported back to mother's body in the same way. The food and breathing activities of fetus are thus not independent, they are related to food intake and breathing by the mother.

Besides the process of natural conception Jain philosophy also describes methods of artificial conception. The Sthananga canon describes five such methods. All these methods essentially involve artificial means of transplanting sperm cells in the womb. It is said that up to nine hundred thousand souls can take birth at a time in the womb of a female. Most of them die before conception. The pregnancy period in human females varies from less than an Indian hour to a maximum of twelve years. The maximum period of pregnancy in animals is eight years.

5.0 Evolution of Life

In biology, evolution is the process by which populations of organisms acquire and pass on novel traits from generation to generation. Its action over large stretches of time explains the origin of new species and ultimately the vast diversity of the biological world. The living species of today are related to each other through common descent, products of evolution and speciation over billions of years. The modern theory of evolution is based on the concept of natural selection proposed by Charles Darwin in 1859. Natural selection is the idea that individuals who possess advantageous heritable traits are more likely to survive and reproduce. In doing so, they increase the frequency of such traits in subsequent generations.

In the 1930 scientists combined Darwinian natural selection with the theory of Mendelian heredity to create the modern evolutionary synthesis. The modern synthesis understands evolution to be a change in the frequency of alleles within a population from one generation to the next. The mechanisms that produce these changes are the basic mechanisms of population genetics: natural selection and genetic drift acting on genetic variations created by mutation, sex, and gene flow. This theory has become the central organizing principle of modern biology. It helps biologists understand topics as diverse as the origin of antibiotic resistance in bacteria, eusociality in insects, and the

staggering biodiversity of the living world. Because of its potential implications for the origin of humankind, the theory of evolution has been at the center of many social and religious controversies since it was first introduced.

Biodiversity found on Earth today is the result of 4 billion years of evolution. The origin of life is not well known to science, though limited evidence suggests that life may already have been well - established a few 100 million years after the formation of the Earth. Until approximately 600 million years ago, all life consisted of bacteria and similar single- celled organisms.

The emergence of oxygenic photosynthesis (around 3 billion years ago) and the subsequent emergence of oxygen rich, non-reducing atmosphere can be traced through the formation of banded iron deposits, and later red beds of iron oxides. This was a necessary prerequisite for the development of aerobic cellular respiration, believed to have emerged around 2 billion years ago. In the last billion years, simple multi cellular plants and animals began to appear in the oceans. Soon after the emergence of the first animals, the Cambrian explosion (a period of unrivaled and remarkable, but brief, organism diversity) saw the creation of all the major body plans, or phyla, of modern animals. This event is now believed to have been triggered by the development of the Hox genes. About 500 million years ago, plants and fungi colonized the land, and were soon followed by arthropods and other animals, leading to the development of land ecosystems with which we are familiar.

Religious beliefs have always held that there is an intelligent cause for origin of life. The arguments put forward by proponents of religion have reason and logic, though they may not qualify to be scientific in the strict sense

The design argument assumes that the order we see in the world around us bears an analogy to the kind of order exhibited by human artifacts. Since the two kinds of order are similar, the cause of one must be similar to the cause of the other. The order in human artifacts is the result of human intelligence. Therefore, the order in the world must be the result of an intelligent being (creator). DNA is considered the identifying mark of a living system. In recent years, scientists have applied information theory to biology, and in particular to the genetic code. The amount of information in

the DNA of even the single – celled bacterium, E. coli, is vast indeed. It is greater than the information contained in the books in any of world's largest libraries. A DNA code is a very special kind of order. The sequence of nucleotides in DNA or amino acids in a protein is like the letters in a written language. There is no detectable difference between the sequence of nucleotides in E. Coli DNA and a random sequence of nucleotides. Yet within the E. Coli cells, the sequence of "letters" of its DNA is very specific. Only that particular sequence is capable of biological function.

The discovery that life in its essence is information inscribed on DNA has greatly narrowed the question of life's origin. With the insights from information theory we need no longer argue from order in a general sense. Order with low information content does arise by natural processes. However, there is no convincing experimental evidence that order with high information content can arise by natural process. Indeed, the only evidence we have is that it takes intelligence to produce the second kind of order. If we want to speculate on how the first informational molecules came into being, the most reasonable speculation is there was some form of intelligence around at that time. Even the simplest form of life, with their store of DNA, is characterized by specified complexity. Therefore life itself is prima facie evidence that some form of intelligence was in existence at the origin of DNA code. The claim that DNA arose by material forces is to say that information can arise by material forces. However, the material base of a message is completely independent of the information transmitted. The material base could not have anything to do with the messages' origin. The information within the genetic code is entirely independent of the chemical makeup of the DNA molecule. To accept a material cause for the origin of life actually runs counter to the principle of uniformity

Russian discoveries have shown that DNA can be influenced and reprogrammed by words and frequencies. Only 10 percent of our DNA is being used for building proteins, the other 90 percent are considered junk DNA. The Russian linguists found that the genetic code, especially in the apparently useless 90 percent, follows the same rules as all our human languages. The Russian biophysicist and molecular biologist Pjotr Garjajov and his colleagues explored the vibration behaviour of the DNA. They found

that living chromosomes function just like solitonic / holographic computers using the endogenous DNA laser radiation. They worked on devices that can influence the cellular metabolism through suitable modulated radio and light frequencies and thus repair genetic defects. They even captured information patterns of a particular DNA and transmitted it onto another, thus reprogramming cells to another genome. So they successfully transformed, for example, frog embryos to salamander embryos simply by transmitting the DNA information patterns.

Jain philosophy believes in dualism, the body is different from the soul. The soul is eternal; it can neither be created nor destroyed. The corollary of this rule is that the total number of souls in *loka* is fixed and it is infinitely infinite. The soul taking birth in *loka* is an active soul; birth only means acquisition of a new body by the soul. Science, while talking of origin of life, is referring to formation of a new body. The soul in essence is non corporeal and the body is made of matter. The characteristics of soul and matter are different but they unite to produce life. In order to appreciate life we must understand both the soul and the body forming matter.

The question to be answered is how life began on Earth? Before answering this question we clarify our view on origin of Earth. Jain philosophy supports the quasi steady state theory of finite universe where events like mini Big Bang, implying local and not overall, changes in the structure of the universe, are permissible. Such changes are in accordance with the rule of permanent existence through change of reality. So stars are destroyed and new stars and star systems are formed. Although life always exists in *loka*, the life on a new planet must begin in the sense that biodiversity must evolve. According to Jain philosophy small nano organisms found everywhere in *loka* are also present on the new planet. These small nano organisms must contain a primitive gene like structure. Small nano organisms do not need oxygen so they survived in the oxygen deficient atmosphere of early Earth. Evolution starts from this organism when conditions on the planet are appropriate to sustain other forms of life.

As the life is a union of soul and matter, the role of both must be considered in evolution. Science, not recognizing the soul, focuses on the formation of material body through genes, DNA and other environmental factors. This is an incomplete view of

evolution of life as has been aptly accepted by Stephen J. Gould. The soul is the source of intelligence; the high information content in life cannot arise by natural forces. Darwin's theory based on fossil records misses this subtler aspect of life that is so crucial to its growth and development. The soul is characterized by consciousness and without consideration of consciousness evolution can never be fully explained.

Jain philosophy lays focus on evolution of soul and shows how a soul climbs the ladder from lowest level to highest level of existence. This journey of progress is mainly determined by karma. As mentioned earlier there is an inexhaustible stock of inactive nano organisms in the bottomland of lower *loka*. When a soul in middle *loka* is liberated and occupies a place in the abode of emancipated souls at the top of upper *loka* a vacancy is created in the mobile zone and so a nano organism migrates from its abode to the mobile zone. This is the beginning of evolution. At this stage only a minutest fraction of consciousness of the soul is explicit, the rest of consciousness is covered by karma and is in the latent state. A soul with latent consciousness feels deficient and incomplete. By natural instinct the soul wants to be pure and so tries to overcome the forces, which are shielding his consciousness. This provides a motivating force to soul to act and annihilate the karmas, which are hindering his progress. This struggle against karma is the journey to progress and is evolution.

The form and complexity of the gross body of an organism is compatible with his explicit consciousness. The complexity of the body increases with consciousness. With minimum consciousness the organisms has only one explicit sense and needs the simplest kind of body. Here we should be clear about the meaning of sense of an organism. The organism, in fact, has all the five senses; the gross body has the facility to use only the sense of touch, which is explicit. We know that the subtle body, mainly the luminous body, carries out the management and regulation of the gross body. At the minimum level of consciousness the ability of the luminous body is also at its lowest level and it cannot support a complex body. So the soul has the simplest kind of body in which only the touch sense exists, no parts are formed in the body that is sensitive to other sense stimuli.

In order that the soul achieves perfection, all the five senses must be operational. So the first priority of soul is to develop the remaining four senses. This needs higher consciousness, which can be achieved by reducing karma. The easiest and possible way of doing so, at that stage of development, is to enjoy (bhog) the karma. So soul spends time in one-sense bodies, which could be millions of years, till his consciousness is sufficient to assume a more complex body having two senses. In this phase of life over a long period of millions of years the karmas reduce by way of emissions and consciousness increases. We have classified the one-sense small nano organisms as earth body, water body, air body and fire body and also plant body souls. In the initial phase of evolution the soul occupies the four kinds of nano or micro bodies and then enters a plant body. This order of evolution is also accepted by science. The unicellular bodies prevailed on Earth in its earlier life and then came vegetation and plants. The question how the first cell was created is not important in Jain philosophy. The small nano organisms present on Earth in its early life provide the primitive cell having some kind of gene structure. The evolution starts from this basic stage and a cell suitable for higher organisms is developed in due course of time. The small nano organism can be considered to be the common ancestor of all organisms including bacteria and archaea. Further refinement of cell takes place and prokaryotes cells are evolved which prepare ground for vegetation and plants.

It has been discovered that different class of bacteria existed on early Earth. Photosynthesizing bacteria evolved in volcanic eruptions where hydrogen was found. Such bacteria can still be found in volcano areas like Yellowstone in Wyoming (these could be fire beings). Other bacteria forms eventually arose, which were able to extract hydrogen from a much more widespread source, water (these may be water beings). When hydrogen is removed from water, free oxygen remains. The oxygen so accumulated through millions of years provided environment for oxygen-based life to evolve. These organisms, which are complex only as compared with bacteria, are found where there is constant moisture and are close relative of green algae. Some of these algae, which are blue green, have developed a strange lime oozing form. The blue-green pillars of Hamelin Pool are living stromolites. They are living organisms that secrete lime,

producing skeletons of stone and live in an environment where deposits of ooze and sand are being laid down (these may be earth beings). The most primitive life forms that share plant characteristics are smallest viruses and algae (these could be plant beings). Thus various forms of immobile organisms evolved from nano organisms on early Earth.

In the next phase of development the soul acquires a plant body (having one sense of touch). This is also a long phase of millions of years. Vegetation and plants produce oxygen and make the atmosphere suitable for other forms of life. The soul with increased consciousness is now capable of having a two-sense body. Darwin has rightly called the transition from plant body to two-sense body as natural selection. But in a deeper sense natural selection means struggle by the soul to reduce his karma and improve the quality of genes so that a higher form of body can be assumed. The mutation of genes, which is supposed to be the main force behind evolution and natural selection, is the result of will power of the soul to improve his consciousness and not just chance as is generally assumed. It is known that genes can be changed by frequencies. Such frequencies must be generated internally by the soul with his consciousness so that gene mutation takes place. Psychologists also believe that consciousness can alter the hologram that is karma.

We have some knowledge about how karma operates. According to Jain Philosophy the decision of species in the next life is made in the present life. This decision is made by the soul based on the level of consciousness and the merit and demerits an individual has earned in this life. This decision and all other information are stored in the karma body. The karma body is attached to the soul, which after death starts a new life in the next body. The next life begins from a cell. As per scriptures the first food of life is called *ohja ahara* or luminous food. This implies that the soul owns the cell and receives its bioelectricity as the first food. Jain philosophy also provides that the six bio potentials are accomplished within one Indian hour of conception. It means that all the information regarding formation of six important systems in the body is recorded on the DNA in few minutes after conception. We know that only 10 percent of DNA contain protein-making instructions and the remaining 90 percent part has regulatory function. Russian research indicates that this major part of DNA acts like a

language. The information from the karma body is perhaps transferred to this part of DNA, which appears like a language. So, the DNA now contains a blue print of the body to be constructed. If the complete information on all the six bio potentials is not correctly transferred, the body shall be underdeveloped having deficiency in parts or organs corresponding to the missing information.

6.0 Karma and Genes

An important scientific discovery from the point of view of physiological karma is that of bio photons. It is now well established that all living systems emit a weak light current of some photons Popp found that a living organism in fact possesses a living aura, a virtual electromagnetic field that pervades the entire organism with a virtual photonic flux. In this field, virtual photons are stored. The field continually receives inputs (virtual) from the environment and is continually outputting bio photons, particularly in the near ultraviolet. This field, in which all cells are bathed and with which they all continually intercommunicate, tends to stabilize and cohere the organism. All this has been established by laboratory experiments.

Practically all organisms emit light at a steady rate. An increasing number of observations from different laboratories all over the world suggest that bio photons are emitted from a coherent photon field within the living system. Organisms are thus emitters and most probably, also receiver of coherent electromagnetic signals which may be essential for their functioning. The bio photon is trapped and remitted by DNA, which undergoes physical resonance, resulting in light emission with at least some coherence. Biological process may be integrated by the endogenous bio electromagnetic field that has a primary organizational and informational role. Conformational states of DNA may serve as the photon storage of the coherent modes of the electromagnetic field within the cell. From the bio physical point of view bio photons are regulating the body in its rather complex functions.

The bio photons appear to have many features common to *adhyavasaya*, there is a great similarity between *adhyvasaya* and bio photons. It can therefore be assumed that the coherent magnetic field emitting bio photon is also similar to the karma field. The *adhyvasaya* waves therefore always have a constant phase relationship and are

coherent. The scientists are perhaps not sure why the bio photon light is coherent but the Jaina doctrine clearly explains the reasons for this coherence. It is now easy to understand that what the source of intelligence in bio photons is. The intelligence comes from the soul which is the ultimate source of *adhyavasaya*. Being coherent electromagnetic the karma field is very powerful and can store a very large amount of information, almost infinite, for thousands of years or more.

We now compare the functions of physiological karma and genes. A close examination shows that the genes are performing almost the same functions which are assigned to physiological karma. For example, the decisions like type of body of the organisms, making of body components, organs and parts, form of body, skeleton structure, pigment of body skin, fully developed or deficient body, morphology of body, etc are common features to both. In fact, the physiological karma gives a comprehensive account of how different species having varying personal body features and traits are formed. The genetic science on the other hand offers only a limited view of body formation but it is hoped that with the advancement in genetic science more and more knowledge regarding body functions shall be gained and then perhaps it will be discovered that what the modern science with the help of large fleet of highly qualified scientists and most sophisticated technology has found is already available in Jaina scriptures. The only difference is that what exists in the scriptures is in the form of decision formulae and the findings of science offers a detailed description answering questions like what, when, how the processes occur. This is indeed a great credit to science but it should not be construed that it has discovered something new; in fact it is only reconfirming what was said by omniscient Tirthankaras.

The genes carry all the instructions for making proteins. Only a part of the total instructions are used at any particular location of the body and a cell suitable to that location is made by the genes. Who makes this selection of the set of instructions to be employed? According to Jaina doctrine such decisions are assigned to the karma body. The morphological karma contains the information required for constructing a body for

any particular species and all the body parts of that species. The bliss -obscuring karma are perhaps instrumental in producing faulty genes which develop various disease and pain in the body. Thus it is obvious that all physiological karmas operate at the level of genes and take part in the construction, maintenance, operation and control of body parts and body functions. As noted earlier these karma form the coherent electromagnetic field which emit bio photon of different frequency and the bio photons control the chemical and biological activities of the cell and the body functions.

The karma body continuously emits *adhyavasaya* waves, which are electromagnetic. The *adhyavasaya* from psychical karma, representing our psychical personality, interact with the conscious mind part of the luminous body and produce lesya waves. Lesya radiations interact with the endocrine glands which secrete hormones that mix with the blood and control the chemical activity in the cells. Some adhyavasaya from the psychical karma directly interact with the brain and produce citta, which is the physical imprint of our past memories and impressions. The psychical adhyavasaya impart the features of non-righteousness, non-restraint, violence and passions to the conscious mind and these are reflected in our thoughts and actions. The lesya waves bearing these features represent the state of our conscious mind. Lesyas reflect our psychical personality; the colour of *lesya* represents our thoughts, emotions and feelings and is closely related to our qualities.

The *adhyavasaya* emitted by physiological karma determine our physical personality. The emissions from morphological karma and bliss-obscuring karma, most likely as bio photons, are supposed to directly interact with the cells in the body and control the physiological activity through the operations of the genes as described above. The age determining karma is supposed to operate the *tejas* body, draw *prana* (*tejas vargana*) from the cosmos and supply *prana* energy to various body systems and cells for their functioning.

An average grown up human body contains about 60 trillion cells. The DNA in each cell has 30000-40000 genes and one gene has about 3000 bases. The Human

Genome thus has about 3 billion bases. This gives about $180x10^{21}$ bases in the human body. The atman is also supposed to contain innumerable parts mathematically (otherwise it is an indivisible unit). Each part of atman contains total and identical karma. The value of the innumerable is supposed to be more than 10^{140} according to Acharya Kanaknandhi. We see that the number of atman divisions out numbers heavily the number of genes and the number of bases. Let there be 10^n atman divisions per base of the gene. As all divisions of atman are identical we may think of one- to - one correspondence between genes and karma divisions. So the karma and genes are locally related, each gene is interacting with karma individually. The bio photons emitted by karma field control and regulate the activity of the gene on an individual basis. The activities in different cells are also related and connected. As a result of coherence of karma field fast communication takes place at all levels within cells and between cells and a complete and perfect coordination is established in the activities of all cells, so that the body behaves as a single unit performing goal- oriented functions. The DNA in every cell is identical but each cell performs differently and produces a variety of proteins in different parts of the body. This kind of selective function of DNA is possible due to karma.

Guenter Albrecht-Buehler, a German Biologist, claims that 30 years of his research on cell has shown that mammalian cells possess intelligence. If cells were intelligent, molecules and their genes would be the 'collaborators' or even 'slaves', but not the 'masters' of the life functions of cells. If cells were intelligent we would have to rethink all the cause-and-effect chains from genes to molecules to cell functions that we believe today to be true. If the cells were intelligent, an organism would be ecology of a huge population of intelligent individuals and we would have to look at the structures and functions of our bodies as the result of the interaction of a huge population, 1000 times the population on Earth, of intelligent individuals.

The intelligence, according to Jain philosophy, means presence of atman pradesa in the cell. The physiological karma, particularly the morphological and feeling

producing karma, exercise control through radiations on the working of the genes and the cell functions. The control is local through karma of that cell but at the same time it is also global as the same atman and identical karma are present in all cells; there is a central authority that monitors, coordinates and controls the activities of individual cells as well as of a group of cells like tissue or organ or part, so that each cell, group of cells and organs perform according to plan contained in the karma body. It is clear that the intelligence of atman constructs the body according to the blue print contained in the karma body and the cell received from parents.

The atman divisions are not expected to be uniformly distributed over the body, the distribution must match with the functions performed by organs and parts. The population of divisions may be highest in the brain, less in other parts of nervous system and major charkas, still less at minor charkas and least in other parts of the body. The regions of high concentration of atman divisions are the consciousness centers.

It is known that the karma body and luminous body remain attached to atman, during migration from one life to another. There is one-to-one relationship between the atman division and karma body parts and so the karma body is also supposed to migrate to the next body without any loss of parts. The migration of karma body from one life to another maintains continuity of history and the past performances become a factor in the next life.

7.0 Jain Cosmology and Universe

Comparison of *loka* and universe is comparing the facts told by an omniscient and the observations made by human beings with the help of scientific instruments. The observations of scientists bear the constraints imposed by physical instruments and the intelligence of the observer. Large amount of piece meal information gathered by separate individuals is put together to figure out the reality just like the parts of a jig saw puzzle are assembled to obtain the whole. An omniscient on the other hand sees the full reality as it exists and describes it in parts. An omniscient has the power to see a *paramanu* as well as the entire *loka*.

The description of *loka* given by lord Mahavira was mainly in the form of answers to queries made by his disciples. To describe the structure of *loka* to people,

who did not have scientific knowledge of modern era, should obviously entail use of examples and simplifications for presenting the subject in a comprehensible form. The description is largely qualitative because a quantitative description is neither possible nor required for broad understanding of the *loka*. Terms like countable, countless, infinite were good enough to offer description of many of the features of *loka*.

The information given by lord Mahavira was passed on orally and committed to writing after many centuries. In the intervening period to what extent the information was preserved in its original form is not known. During this period the other philosophies developed in India perhaps influenced the writings of Jain Acharyas. So the description of *loka* as available in Jaina canons may be considered to be a mix of concepts and descriptions given by lord Mahavira, the contributions of the writer himself may be as exaggerations and imaginations, and the influence of other philosophies.

Our scientific knowledge of universe comes from observations as well as mathematical theories developed to explain the observations and the reality. Both these methods suffer from human limitations and so are expected to reveal some aspect and not the whole reality. It is possible to combine both the canonical and scientific information to arrive at a more realistic picture of *loka*. We make such an attempt here.

While interpreting distances given in Jaina canons the unit yojana must be carefully used. Term yojana has been used to measure distances on land as well as in space. A space yojana is 1000 times the land yojana in Swetambara canons and 500 times the land yojana in Digambara canons. Thus the meaning of the same term yojana changes with context in which it is used.

The first question that can be asked is where is Jambudweep? Most people assume Earth to be the Jambudweep. We know that Jambudweep is disk shaped and the Earth is spherical. Where is mount Sumeru? Again people assume some mountain on Earth as Sumeru. If it were so then the Sun and Moon would orbit it. Similarly, attempts to locate Haimvat, Harivarsh, Videh regions on Earth have failed. Besides geography the other features of Jambudweep like presence of omniscient in Videh etc,

are also not found on Earth. In no way the Earth can be Jambudweep. Let us broaden our vision and compare Jambudweep with the Milky Way.

Jambudweep and Milky Way both is disk shaped. Jambudweep has diameter of 100000 yojana and Milky Way has diameter of 100000 light years. The periphery of Jambudweep is 300000 yojana and the periphery of Milky Way is 250-300 thousand light years. 13th Sthanak (Chapter) of Samavayang Sutra mentions that the expansion of the solar system is equal to 48/61 yojana. According to science the Oort cloud is considered to be the outer edge of the solar system where the Sun's orb of physical and gravitational influence ends. The Oort cloud is an immense spherical cloud surrounding the solar system and extending about 30 trillion kilometers from the Sun. Comparing yojana to a light year the expansion of the solar system according to Jain philosophy is (48/61 x 9.46 trillion =) 7.44 trillion kilometers. Though the agreement is not good, but knowing the approximations involved in defining and measuring the size of the solar system, comparison of yojana and light year for celestial measurements appears to be a reasonable choice.

Mount Sumeru is located in the center of Jambudweep and the center of Milky Way is dense and bulging out. Mount Sumeru is 10000 yojana wide at base and the dense center of Milky Way is 1-2 thousand light years wide. The Sun and Moon orbit Mount Sumeru in Jambudweep and the Sun and Moon in Milky Way orbit the center. The Jambudweep is surrounded by Lavana Ocean, which has 48 small islands, the Milky Way is surrounded by a halo containing 146 star clusters and many dwarf galaxies. The Bharat region is located on one side of Jambudweep and our Sun is situated away from the galactic center. Thus we see many features common to Jambudweep and Milky Way.

We extend our analogy further. Countless circular oceans and islands surround Jambudweep. No such island or ocean has ever been seen. This kind of description appears to be a symbolic representation of the reality. A circular island perhaps represents the orbital path of a galaxy. That is, there is a galaxy at a distance from Jambudweep, which has an orbital motion. The countless islands signify that there are countless galaxies all having orbital motions. The oceans are intergalactic spaces, which

contain many star clusters and small and dwarf galaxies. By this analogy the Andromeda Galaxy is the Dhatikikhand Island and perhaps the Triangulum Galaxy is the Pushkarvara Island. Dhatikikhand has two mount Meru and Andromeda has two separate concentrations P_1 and P_2 in its nucleus. Andromeda has more than 14 dwarf galaxies in its hello and the Kalodaka Ocean surrounding the Dhatikikhand has 48 small islands. The number of dwarf galaxies orbiting Milky Way and Dhatikikhand is not final and more are likely to be discovered in future.

According to Jain Philosophy the *loka* is beginning less but all matter follows the basic rule of origination-cessation-permanence. This means that any aggregate like star and planet can disintegrate into particles and *paramanus* and such particles and *paramanus* can reassemble and aggregate to form new stars and planets. In the same way islands are also not permanent, they may disintegrate and loose their identity. Astronomical observations confirm that this is a regular process in space, old galaxies are destroyed and new galaxies are formed. This must be the reason that the number of islands in middle *loka* is said to be countless, as their number is not fixed and keeps on changing over time. But the overall structure of the middle *loka* is invariant; no event like Big Bang is permissible in Jain philosophy.

Space scientists have detected microwave radiations coming from distances as far as 11-15 billion light years. According to them these microwave radiations may have originated 300000 years after the Big Bang, which may mean that we have reached near the edge of the universe, about 93 billion light years (commoving distance) away. Based on this the universe may be assumed roughly to be 200 billion light years across, approximately equal to $2x10^{22}$ kilometers.

On the basis of above comparison we may infer that Milky Way may be the Jambudweep, at least from cosmic considerations. The middle *loka* and Jambudweep as depicted in Jain texts appear more like artist's conception then actual maps, the kind of symmetry shown in these figures can not be realistic. But even disregarding symmetry we admit that it is difficult to find exact correspondence between Milky Way and Jambudweep. We cannot easily identify the Haimvat, Harivarsh, Videha etc. regions of Jambudweep in the Milky Way in the manner described in Jaina scriptures.

Nevertheless, we note that Milky Way contains seven major regions – four major arms, two smaller arms and a nucleus (see fig 6.9) like seven regions, Bharat, etc, in Jambudweep. Our Sun is situated in the smaller arm Orion, like Bharat region, which is only 526 6/19 yojana wide in the Jambudweep of 100000 yojana. The common features between Jambudweep and Milky Way do tempt us to believe that Milky Way galaxy is like Jambudweep. Mount Sumeru in the center of Jambudweep is signified by a dense nucleus in the Milky Way.

The middle *loka* is one raju wide and flat. The universe is also flat according to astronomical observations. The middle *loka* contains all the islands, which have been compared with galaxies. The universe is estimated to be nearly $2x10^{22}$ kilometers wide, which is roughly of the same order as one raju distance proposed by some scholars. According to Jain philosophy the stellar celestial beings are found only in middle *loka.* Thus the universe known to science is comparable with middle *loka*. This is a very significant derivation as it means that the science does not know about upper *loka* and lower *loka*. This indeed may be the case because the lands in there two *loka* are of different kind.

Scientists have been trying to find intelligent life on other planets in space. According to Jain philosophy life exists all over Jambudweep. The Bharat, Airavat, and east and west Videha regions are lands of actions and the other regions are lands of enjoyment. The scientific advancements are expected only in lands of action. Thus intelligent life and scientifically advanced civilizations may be expected in Orion arm, the nucleic center of Milky Way, which must be the Videha region, and one more region corresponding to the Airavat region. The Videh region is also supposed to be spiritually advanced. Intelligent life must also exist on other spiral arms of the Milky Way but these being lands of enjoyment, scientific advancement may not be expected there.

According to Jaina scriptures human beings are found in the Two and Half Islands only. It means that life and civilizations similar to that in Milky Way are also expected in the Andromeda Galaxy and perhaps also in the Triangulum Galaxy. The other Galaxies must have animals but not human beings.

The above comparison of middle *loka* and universe opens up a new area of study both for Jain philosophy and science. It is hoped that with further research and study both these branches of knowledge would have much to exchange and gain.

7.1 Is Universe Expanding?

The Big Bang theory, which is widely accepted by scientists, is based on the red shift observed by astronomical measurements. The red shift is supposed to occur mainly due to expansion of space, which causes emitted photons to stretch to longer wavelengths and lower frequency during their journey of millions and billions of light years. The Jain philosophy offers an alternative explanation for stretching of photons in such long journeys.

It can be shown that a photon is Individual Body Vargana (IBV) of eight-touch category. A photon is supposed to be charge less and so must be an aggregate of two or more IBV. In fact the photons of different frequency must contain differing number of IBV. These and other kinds of *varganas* of both four- touch and eight- touch category are found all over middle *loka*. These *varganas* travel in all directions at any given location. A photon traveling in space may encounter and collide with other photons or *varganas* traveling in different directions. The possibility of collision will certainly exist when the travel is on galactic scale involving millions of light years. As a result of such collisions it is expected that some of the *varganas* or *paramanus* will be knocked off reducing the number of *paramanus* and hence the energy of the photon. A photon with less number of *varganas* or *paramanus* also becomes less dense and shall occupy more space than before. Consequently, the frequency of photon shall decrease and the wavelength shall increase, when considering travel of photon on galactic scale. The frequency decrease can be expected to increase with the distance of travel and hence with number of collisions, of the photon. Thus there is no need to make the assumption of expansion of space to explain the Hubble's law. Jain philosophy supports a steady state universe; the concept of expanding universe is not acceptable

Akasa in Jain philosophy is real, infinite, eternal and one indivisible unit and it cannot have any expansion. The expansion of space, assumed by scientists obviously raises the question; it is expanding in what? There can be no expansion without the

presence of space and if the space is already present what is the meaning of expansion of space. Jain philosophy offers a way out for all such unrealistic assumptions. The Big Bang inferred by extrapolation of Hubble's observations is seen to be unnecessary.

8.0 Bibliography

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