The Fate of the Universe: Argument from Jain Philosophy

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1. Introduction

The creation of the universe has always been a point of human inquisitiveness and various theories have been proposed for it. Some Indian philosophies advocate that Bhahmā is the Creator, but scientific view does not agree with this theory. Jain Philosophy also does not accept any Creator; according to it the universe (loka) is beginningless and endless. The most widely accepted theory of science is the Big Bang theory which states that the universe came in existence with an explosion. According to this theory the universe is expanding continuously. A theory of oscillating universe has been proposed which anticipates a Big Crunch in which the universe reduces to a dense mass from which the Big Bang takes place. This theory supports a beginningless and endless universe, Big Bang and Big Crunch would repeat in a cyclic manner. The second law of thermodynamics predicts a heat death of universe.

This paper examines the fate of the universe in the light of scientific knowledge and Jain philosophy. Scientific enquiry has, as far as the theories of the universe are concerned, focused more on matter and less on living systems. The performance of living systems is still a mystery to science, because the mainstream of science has not accepted the existence of a soul [or soul substance], the real force behind the life of organisms. Without including soul the fate of organisms and hence the fate of the universe cannot successfully be predicted. We make an attempt in this paper to examine the fate of the universe considering both matter and soul in scientific and logical way.

2. Cosmology and life in Jain Philosophy

According to Jain philosophy there are six (and only six) kinds of substances in the universe: *jīva*, *pudgala* (matter and energy), an agent for motion (*dharmāstikāya*), and an agent for rest (*adharmāstikāya*), *ākāśa* (space) and *kala* (time). All the substances are eternal, without beginning and end; none of them can be created or destroyed by any means or power. The *jīva* substance is infinite in number and each individual *jiva* has a separate independent existence. The smallest constituent of *pudgala* is *parāmāṇu* which are infinitely infinite. The *parāmāṇus* combine in an

appropriate way to give all the energy and matter, visible and invisible, in the universe. *Ākāśa* is infinite, but a limited part of it contains all the other five substances and this part is called *loka*, the universe of our interest. The five substances cannot cross the boundary of *loka* and therefore scientifically the universe is an isolated system. The two agents of motion and rest (i.e. *dharma* and *adharma*), *ākāśa* and *kala* are passive substances; they do not interact directly with any other substance. *Jīva* and *pudgala* interact with each other and give rise to life as we know. *Pudgala* constitutes the body occupied by *jiva*, which is the source of intelligence and life force in organisms. Merely a body made up of *pudgala* (say a dead body) has no 'life'; it misses all the attributes typical of life.

Jain philosophy describes the life cycle of a *jiva* in detail. A *jīva* exists initially in an impure state and is laden with karma in the form of a karma-body. The life journey of a *jīva* starts from this stage. The *jīva* occupies a body according to its karma. The kind of body is specified by the number of senses it has; the senses vary from one to five. The *jīva* first assumes a body with one sense, namely touch (e.g. plants, viruses, bacteria) and then subsequently according to his karma it transcends to two senses (e.g. worms), three senses (e.g. ants), four sense (e.g. most other insects) and five senses (higher organisms) body forms. In the last the *jīva* occupies a five-sensed body and mind, like mammals and other higher animals. The human body is the last stage from where the *jīva* can attain salvation by means of spiritual pursuits. Salvation is the pure state of *jīva* having no karma. Thus the life of *jiva* proceeds from impure state to pure state. This has important scientific implications as described below.

The *parāmāṇu*, which is much smaller than the smallest particle known to science, has certain attributes. The energy corresponding to these attributes can be divided in three groups for our purpose as follows.

1. Thermal energy.
2. Electric charge (energy)
3. Motion-kinetic energy

The electric charge binds the *parāmāṇus* in large groups to produce the particles known to science. Besides this, other forms of matter and energy known as *vargaṇās*[1], both massless and having mass, are also produced by *parāmāṇus*.

[1] *Varganā* is aggregate form of *paramanus*– Ed.

Jain philosophy has described the properties of *parāmāṇu* in detail. It describes various kinds of motions of *parāmāṇus*, and speeds that can vary from zero to astonishingly high magnitudes so as to cross the entire universe almost instantaneously. Such high velocities of *parāmāṇus* are not realized when it exists in bonded states like that of a photon, electron or other particles.

The *parāmāṇu* can change its energy modes so that one form of energy changes into another form spontaneously. It is not clearly spelled out what causes such changes, but the *parāmāṇu* does not stay in the same mode for a very long time. In particular, the thermal energy may change into electric energy and vice versa.

4 Entropy and Cosmology

The second law of thermodynamics conventionally describes physical systems. An important law of physics, the second law of thermodynamics, states that the entropy of any system cannot decrease except insofar as it flows outward across the boundary of the system. As a corollary, in an isolated system, the entropy cannot decrease. By implication, the entropy of the whole universe, assumed to be an isolated system, cannot decrease; in fact the entropy of the universe is always increasing. It has been speculated that the universe is fated to a heat death in which all the energy ends up as a homogenous distribution of thermal energy, so that no more work can be extracted from any source.

However, the role of entropy in cosmology remains a controversial subject. Recent work has cast extensive doubt on the heat-death hypothesis and the applicability of any simple thermodynamic model to the universe in general. Although entropy does increase in the model of an expanding universe, the maximum possible entropy rises much more rapidly – thus entropy density is decreasing with time. This results in an "entropy gap" pushing the system further away from equilibrium. Other complicating factors, such as the energy density of the vacuum and macroscopic quantum effects, are difficult to reconcile with thermodynamic models, making any predictions of large-scale thermodynamics extremely difficult.

Entropy has often been associated with the amount of order, disorder and/or chaos in a thermodynamic system. Entropy serves as a measure of how close a system is to equilibrium that is, to perfect internal disorder. The value of the entropy of a

distribution of atoms and molecules in a thermodynamic system is a universe of the disorder in the arrangements of its particles. Solids which are typically ordered on the molecular scale usually have smaller entropy than liquids, and liquids have smaller entropy than gases and colder gases have smaller entropy than hotter gases. At absolute zero temperature, crystalline structures are approximated to have perfect "order" and zero entropy.

Mathematically, entropy S is defined as

$$S= -K \Sigma \pi \ln \pi \qquad (1)$$

The sum runs over all microstates consistent with the given macrostate, and π is the probability of the i^{th} microstate and, K is a constant. According to this definition, highly-ordered states have low entropy and disordered states may or may not have high entropy. For a microcanonical system where all accessible microstates have the same probability, equation (1) gives

$$S= K \ln W \qquad (2)$$

Where W is the number of possible states in which a system can be found.

Some scientists have questioned the relationship between entropy and disorder. If entropy is associated with disorder and if the entropy of the universe is headed towards maximum entropy, then many are often puzzled as to the nature of the "ordering" process and operation of evolution. In the recent book *SYNC* – The Emerging Science of Spontaneous Order, Steven Strogatz writes "Scientists have often been baffled by the existence of spontaneous order in the universe. The laws of thermodynamics seem to dictate the opposite; nature should inexorably degenerate towards a state of greater disorder, greater, entropy. Yet all around us we see magnificent structures like galaxies, cells, ecosystems, human beings etc., that have all somehow managed to assemble themselves."

The most general interpretation of entropy is as a measure of our uncertainly about a system. The equilibrium state of a system maximizes the entropy because we have lost all information about the initial conditions except for the conserved variables; maximizing the entropy maximizes our ignorance about the details of the system. This uncertainty is not of the everyday subjective kind, but rather the uncertainly inherent to the experimental method and interpretive model.

Locally, the entropy can be lowered by external action. This applies to machines such as a refrigerator, where the entropy in the cold chamber is being

reduced, and to living organisms. This local decrease is, however, only possible at he expense of entropy increase in the surroundings.

4. Entropy and Life

Some scientists draw a parallel between physical systems and biological systems. As a biological ecosystem evolves by the process of natural selection, it disperses energy, increases entropy, and moves towards a stationary state with respect to its surroundings. According to them whether an object is animate or inanimate, science does not make a distinction. In both cases, energy flows towards a stationary state, or a state of equilibrium, in the absence of a high-energy external source.

Erwin Schrödinger in his 1944 book '*What is Life?*' explains that most physical laws on a large scale are due to chaos on a small scale. He calls this principle "order-from-disorder". He states that life greatly depends on order and that a naive physicist may assume that the master code of a living organism has to consist of a large number of atoms. He further states "... living matter, while not eluding the "laws of physics" as established up to date, is likely to include "other laws of physics" hitherto unknown, which however, once they have been revealed, will form just as integral a part of science as the former."

Schrödinger concludes the book with philosophical speculations on determinism, free will, and the mystery of human consciousness. He is sympathetic to the view that each individual's consciousness is only a manifestation of a unitary consciousness pervading in the universe. In the final paragraph, however, he emphasizes the uniqueness of each human being's store of memories, thoughts and perceptions.

The argument of Schrödinger that life feeds on negative entropy or negentropy served as a stimulus to further research. In the popular 1982 textbook *Principles of Biochemistry* by American biochemist Albert Lehninger it is argued that the order produced within cells as they grow and divide is more than compensated for by the disorder they create in their surroundings in the course of growth and division. Thus, according to Lehninger, "living organisms preserve their internal order by taking free energy from their surroundings, in the form of nutrients or sunlight, and returning to their surroundings an equal amount of energy as heat and entropy.

In a study titled "Natural selection for least action" published in the *Proceedings of the Royal Society* A.Ville Kaila and Arto Annila of the University of

Helsinki describe how the second law of thermodynamics can be written as an equation of motions to describe evolution, showing how natural selection and the principle of least action can be connected by expressing natural selection in terms of chemical thermodynamics. In this view, evolution explores possible paths to level differences in energy densities and so increase entropy most rapidly. Thus, an organism serves as an energy transfer mechanism, and beneficial mutations allow successive organisms to transfer more energy within their environment.

Entropy has been associated with disorder, and disorder has been linked to disorganization by some workers; higher entropy means higher disorder and also higher disorganization. But this kind of relationship has been questioned by others, particularly in context of living systems. Living creatures are a very significant sub-class of open systems. An individual cell continuously takes up metabolites through its enclosing membranes and this material undergoes chemical reactions within the cell interior resulting in a variety of low- and high-molecular weight products, some of these pass out of the cell: others contribute to the cell's growth and to its eventual division. It is really difficult to make an accurate entropy balance on an organism with its environment. But the experimental evidence available does not reveal any violation of the second law.

K.G. Denbigh has cited an example of a fertile bird's egg inside an incubator. The latter contains a sufficiency of air and was initially raised to a temperature high enough for the hatching of the egg. The incubator was thereafter surrounded by perfect thermal insulation so that its total entropy can only increase or remain constant. However there remain two possibilities concerning a different aspect of the system's temporal development: (1) the egg dies; (2) the egg lives and eventually gives rise to a live chick. Now it is true that in case (1) there is an entropy increase accompanied by a process of disorganization, localized in the egg. But the opposite is the situation in case (2): for although the egg is certainly a highly organized system, the live chick must surely be deemed to be much more so. Entropy again increases but now there is an increase in the degree of organization as well. This example thus provides a clear instance of its being false to suppose that entropy increase is equivalent to a process of disorganization. This does not mean that organisms operate in a manner contrary to the second law. That is not the case at all. The irreversible processes of metabolism, heat conduction etc., occurring within organisms are

entropy producing like any others. It is only to say that changes in amount of organization and of entropy can occur quite independently of each other.

A similar conclusion was reached by Denbigh about changes or 'orderliness' and of entropy being mutually independent. He thinks that in addition to entropy there may well exist other 'one-way functions' which add to the overall description of the worlds' temporal development.

5. Natural Systems

According to Jain philosophy the smallest constituent of all matter and energy is *parāmāṇu* which has three kinds of energy as described above. The modes of energy of the *parāmāṇu* change spontaneously[2] and so we have *parāmāṇus* in which the electric energy is very small compared to thermal energy and also *parāmāṇus* in which the thermal energy is very small compared to electric energy. So theoretically we can describe the cosmos in three ways.

1. Thermal cosmos – a thermal system having limited role of electric energy.
2. Electric cosmos – an electric (or magnetic) system having limited thermal activity.
3. General cosmos - a system in which both thermal and electric (or magnetic) energy are important for processes.

The *parāmāṇus* form clusters known as *vargaṇās*. The *vargaṇās* are classified according to the number of *parāmāṇus* in the cluster which generally is in the range of infinity. Although *vargaṇās* could be of many types, 23 main types are distinguished. The initial few types of *vargaṇās* are massless and have specific functions such as in constructing the invisible bodies of organisms and supporting other life functions. The remaining types of *vargaṇās* are mass type where the *parāmāṇus* are bonded due to their electric charge. Some of these *vargaṇās* are described as *śunya vargaṇā*, meaning thereby that they perhaps escape detection by any means. The last or 23rd type of *vargaṇā* is supposed to constitute all the matter present in the cosmos.

The state of a free *parāmāṇu* is unpredictable, it can move with different velocities, from zero to very high velocity, and can occupy any position in the cosmos. The *paramanu* is thus associated with highest uncertainty. With the formation of clusters in a *vargaṇā* the freedom of motion of the *parāmāṇu* is subjected to

[2] Spontaneous means "by itself, or without any outside influence", and has nothing to do with speed.

restriction thereby reducing its uncertainty. This reduction in uncertainty gives rise to some order in the arrangement of *parāmāṇus* in the *vargaṇā*. The order is increased in those *vargaṇā*, which have *paramanus* in the bonded state. The order is still high in matter which is comprised of largest mass type *vargaṇā*.

The bonding between two *parāmāṇus* takes place when the difference in their electric charge exceeds a minimum level. This shows that a high electric charge (or magnetism) increases order in the system.

The processes taking place in *vargaṇās*, like clustering, *declustering*, bonding and separation are spontaneous. In the smaller massless *vargaṇās* the *parāmāṇus* simply cluster without bonding and *decluster* easily. The process is going on randomly and is not expected to change the overall order in the cosmos. In the larger mass type *vargaṇās*, which are in the form of energy, bonding and *debonding* is an electrical activity, which must be reversible in nature without disturbing the overall order in the system. Scientific theories indicate that 70 percent mass in the universe is in the form of dark energy. According to Jain philosophy the *vargaṇās* must comprise this part of energy. We therefore expect that this 70 percent mass does not change order in the universe.

The other 30 percent mass in the universe is supposed to come from matter, about 25 percent of which is said to be dark matter and the remaining 5 percent is visible (luminous) matter. We know very little about the dark matter and our knowledge of the applicability of the laws of science is limited to the visible matter. Over 99 percent of the visible mass is contained in the stars and therefore their activities are important from the view of prevailing order in the universe.

The thermal processes taking place in matter are subjected to the second law of thermodynamics, according to which in an isolated system like the universe the entropy is always increasing, pushing the system towards an equilibrium state where no useful work is possible. We have stated above that the universe can be regarded both as a thermal system and an electrical system and that the system can change its mode from one type to another spontaneously. This has important implications regarding the overall order in the universe.

There is scientific evidence that verifies a spontaneous change in the mode of a system. In a process known as adiabatic demagnetization a reversible change in temperature of a suitable material is caused by exposing the material to a changing

magnetic field. In this type of refrigeration process, a sample of solid such as chrome-alum salt, if which the molecules are equivalent to tiny magnets, is inside an insulated enclosure cooled to a low temperature, typically 4 Kelvin or 2 Kelvin, with a strong magnetic field being applied to the container using a powerful external magnet, so that the tiny molecular magnets are aligned forming a well-ordered "initial" state at that low temperature. The magnetic alignment means that the magnetic energy of each molecule is minimal. The external magnetic field is then reduced, a removal that is considered to be closely reversible. Following this reduction, the atomic magnets then assume random less-ordered orientations, owning to thermal agitation, in the "final" state. The "disorder" and hence the entropy associated with the change in the atomic alignments has clearly increased. In terms of energy flow, the movement from a magnetically aligned state requires energy from the thermal motion of the molecules, converting thermal energy into magnetic energy. Yet, according to the second law of thermodynamics, because no heat can enter or leave the container, due to its adiabatic insulation, the system should exhibit no change in entropy. The increase in disorder, however, associated with the randomizing directions of the atomic magnets represents an entropy increase? To compensate for this, the disorder (entropy) associated with the temperature of the specimen must decrease by the same amount. The temperature thus falls as a result of this process of thermal energy being converted into magnetic energy. If the magnetic field is then increased, the temperature rises again.

One variant of adiabatic demagnetization is nuclear demagnetization refrigeration (NDR). In NDR the cooling power arises from the magnetic dipoles of the nuclei of the refrigerant atoms, rather than their electron configurations since these dipoles are of much smaller magnitude, they are less prone to self-alignment and have lower intrinsic minimum fields. This allows NDR to cool the nuclear spin system to very low temperatures, often 1μK or below.

The above example of adiabatic demagnetization shows that:

(1) The thermal energy and magnetic energy can mutually interchange spontaneously in an adiabatic system.

(2) The order in the system depends on both the thermal energy and magnetic energy.

(3) At low temperature the thermal energy and magnetic energy have opposing effect on ordering.

These observations though made under specific conditions do support the hypothesis of Jain philosophy that the universe can be regarded both as thermal system and electrical (or magnetic) system and that the overall order in the universe is jointly determined by these two modes.

Study and speculations on the performance of dark matter have not been conclusive. Jacob Bekenstein and Stephan Hawking have shown that black holes have the maximum possible entropy of any object of equal size. Hawking has, however, recently changed his stance on this aspect. As far as Jain philosophy is concerned it must apply to dark matter as well.

6. Living Systems

Living systems are characterized by soul. We know that in the development process the soul initially exists in an impure state and takes birth as one-sensed being. At this stage the soul can take birth anywhere in the universe making its occurrence highly uncertain. From this point of view the life as one-sensed being is a highly disordered system. As the soul develops and progresses on its journey the regions and scope of its birth are subjected to restrictions, the uncertainty is reduced and the order is increased. Finally when the soul is liberated [after having taken innumerable forms of all types of being – Ed.] the soul cannot take birth again and the uncertainty is reduced to zero giving a perfectly ordered system. Thus life in the universe proceeds temporally from a highly disordered system to a perfectly ordered system.

The above hypothesis is supported by history of evolution of species on Earth. Biodiversity found on Earth today is the result of 4 billion years of evolution. Until approximately 600 million years ago, all life consisted of bacteria and similar single-celled organisms. The cell structure was prokaryotic [i.e. cells had no well-defined nucleus – Ed.]. More complex creatures arose sequentially after this prokaryotic beginning, first eukaryotic cells [with nucleuses], perhaps about two billion years ago, then multicellular organisms about 600 million years ago. These were, within the animal kingdom, followed by the invertebrates. Then in sequence we saw the age in which fishes came into existence and dominated, then the age of reptiles, the age of mammals and finally came the humans. The complexity of DNA increased through these sequences starting from simple DNA found in a virus to highly developed DNA in humans. The structure of DNA can be considered as a representative of order in the living being and we find that evolution of life on Earth has proceeded from disorder to

order. Some scientists are of the view that this order in the world must be the result of intelligence (or an intellect being).

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. The discovery that life in its essence is information inscribed on DNA has greatly narrowed the question of life's origin. 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 processes. Indeed, the only evidence we have is that it takes intelligence to produce the high information order.

DNA is an organic superconductor that can work at normal temperatures. Artificial superconductors require very low temperatures of between 200^0K and 140^0K to function. All superconductors are able to store light and thus information. This is further explanation of how the DNA can store information. Another important discovery is that all living systems emit a weak light current of some photons, called biophotons. Some scientists believe that the weak bio-photon current may well suffice to take the role of regulating the whole biochemistry and biology of life. This light results in properties like high efficiency of energy transfer and transformation which often approaches 100%; the ability to communicate at all levels within cells, between cells, organization of metabolic activities within the cell, the operation of the immune network and host of other biological functions. The biophoton is trapped and reemitted by DNA, which undergoes physical resonance.

The above scientific information helps us to understand how life proceeds from disorder to order. First, some scientists also find it necessary to believe in the presence of intelligence in life, which we know is the property of the soul. Second, amazing structure, like superconductors, DNA holding large amounts of information, and a weak light in DNA accomplishing feats like 100% energy transfer and transmission efficiency, and superb organization of metabolic activities in the cell etc., are features which minimize entropy increase and maintain order in a living being. This kind of performance is not expected of innate matter; clearly it is the soul whose powers produce the order in DNA and organization in the cell. As the soul progresses in its journey from one-sensed microorganism it creates better order and organization in the biological systems which we see as evolution on Earthlike planets. After the

stage of human beings further increase in order has not been explored by science as yet as this falls in the realm of spiritual progress. According to Jain philosophy the order continues to increase in spiritual personalities, hopefully producing improved metabolic and other biological states which are endowed with many kinds of supernatural powers. The journey of progress ends in liberation, a state of perfect order of the soul. Such a state is not possible with a physical body, which has inherent limitations, and therefore the soul drops the body at the last stage, becoming free forever. The total number of liberated souls is infinite and to their number is added as more souls get liberated.

According to Jain philosophy one-sensed microorganisms are found all over Loka [the knowable universe – Ed.] which has a volume of 343 cubic rājū (rājū is a very large measure of distance whose magnitude is not exactly known but it should be more than 1.45×10^{21} miles according to one estimate). Mobile [i.e. non-sessile – Ed.] beings, that is 2-sensed to 5-sensed beings, are found in the central region of loka which is 13 cubic rājū. All there organisms produce order from disorder as has been rightly recognized by Schrödinger. They take in matter and energy in various forms from the environment and assemble them in order to produce the body structure. The body is maintained with minimum increase in entropy. The processes taking place in body are primarily electrical and chemical both of which are energetically more efficient than thermal processes. Thus organisms are means of producing order from disorder.

7. Spatial and Temporal Variations in Order/Disorder

A relationship between order/disorder and quality of life can be established. Forests are order producing systems for they receive thermal energy from sunlight and convert it into chemical and electrical energy with the help of nutrients. As chemical and electrical systems are better ordered than thermal systems, plants produce order from disorder. Burning of fuel converts chemical energy into thermal energy and increases disorder. Atomic energy power plants convert electrical bonding energy into thermal energy and also increase disorder. A forest based life style where all requirements of living beings are met from forests conserves order in the environment. From this consideration animals do not contribute to disorder. Human beings burning fuel produce disorder, the magnitude of which increases with increasing rate of burning fuel, as is the case with industrialization using fossil fuels and atomic energy. We know that industrialization adversely affects the quality of life

in various ways, particularly through environmental pollution. As industrialization increases disorder a higher disorder is associated with a low quality of life and vice versa.

Jain philosophy describes in detail the quality of life in the universe. There are two types of lands in the universe, the lands of enjoyment where the life is forest based, and lands of action where the living beings employ various kinds of skills for living, which may involve burning of fuel. The lands of action are found only in that part of universe that is inhabited by human beings, and human beings are found only in a small part of the universe, which is comprised of Jambūdvīpa and two more similar regions in the neighborhood. Jambūdvīpa and these two lands have not been identified in the modern context, but in my opinion they are our Milky Way Galaxy, Andromeda Galaxy and a part of Triangulum Galaxy. In this part of the universe there are 15 lands of action and our planet is one of them. This means that there are 15 planets or regions in the universe, 3 being in the Milky Way Galaxy and six each in Andromeda and Trianglulum Galaxy, where human beings employ advanced skills for living. Most of the lands of action maintain a constant standard of quality of life, at different levels, but there are few others, like our Earth, which experience a temporal cyclic change in the quality of life. We are presently passing through the descending phase of the quality cycle that is the quality of life is going down. This means that on our planet's disorder is increasing, a fact that cannot be disputed. This downward trend is, according to the Jain calculation of cycles, supposed to continue for about 40,000 years when the disorder shall reach the maximum level and the quality of life shall be at a minimum level. Thereafter a reversal in the trend shall occur and disorder shall start decreasing, eventually producing conditions for better quality of life.

In those lands of action which maintain a given quality of life, the human beings must be wiser not indulging in activities that increase disorder. As stated above human beings are found only in a small part of the universe, in the remaining part only animals are supposed to exist, where life must be forest based, producing no disorder. Thus the scenario which emerges is that in most parts of the universe the living systems produce no disorder, only the natural systems may disturb the balance of order and disorder. As the natural systems involve electrical and chemical processes, besides thermal, there is a good possibility of order/disorder being maintained at a constant level on a galactic scale.

From above we see that Jain philosophy allows for local variation in disorder, as we find on Earth, but that should not be a matter of alarm as far as the universe is concerned. The universe being endless maintains a stable condition of order/disorder and life is respectfully maintained on a continuous basis.

8. Is the Universe Expanding?

The Big Bang theory, which is widely accepted by scientists, is also predicted by red shift given by Hubble's law based on 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.

A photon is made of *vargaṇās* of the mass category. A photon is supposed to be charge less and so it must be an aggregate of two or more *vargaṇās* (a *vargaṇā* has a charge). In fact photons of different frequency must contain differing number of *vargaṇās*. These and other kinds of *vargaṇās* of both the massless and the mass categories are found all over middle *loka*. These *vargaṇās* travel in all directions at any given location. A photon traveling in space may encounter and collide with other photons or *vargaṇās* traveling in different directions. The possibility of collision will certainly exist when the travel is on galactic scale stretching over millions of light years. As a result of such collisions it is expected that some of the *vargaṇās* or *parāmāṇus* will be knocked off reducing the number of *parāmāṇus* and hence the energy of the photon. A photon with less number of *vargaṇās* or *parāmāṇus* also becomes less dense and shall occupy more space than before. Consequently, the frequency of the photon shall decrease and the wavelength will increase, when considering travel of photons on a galactic scale. The frequency decrease can be expected to be more with greater distance of travel and a greater number of collisions of photons. Thus there is no need to make an unrealistic assumption of expansion of space to explain the Hubble's law. Jain philosophy supports a steady state universe; the concept of expanding universe is unrealistic and uncalled for.

Ākāśa 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 imaginary and did not take place.

9 Conclusions

The active universe is comprised of two basic components, (1) matter and energy and (2) *jīva*, the living substance. The state of the universe is jointly determined by these two components. The inanimate component is bigger than the animate component. The 70 percent of the inanimate component is recognized as dark energy by scientists, and not much is known about it. According to Jain philosophy this part of inanimate energy must consist of *vargaṇās* which are clusters of *parāmāṇus*, some of them are in bonded state and others are unbounded. The bonding between *parāmāṇus* is an electrical activity and therefore *vargaṇās* are not supposed to contribute to disorder in the system.

The luminous matter, made up of one specific type of *vargaṇā*, ultimately consists of *parāmāṇus*, whose total energy comprises of electric energy, thermal energy and kinetic energy of motion. The *parāmāṇu* undergoes self-transformation and one mode of energy may change into another mode spontaneously. The second law of thermodynamics applies to thermal processes of gross matter that increases entropy in the universe. This is supposed to increase disorder. However the processes taking place in electrical mode are seen to increase order in the system (like ordering of molecular magnets). There remains a possibility of change of matter from thermal mode to electrical mode in some part of the universe producing order from disorder.

Organisms are systems that produce order from disorder. The order and organization seen in cells is not possible in non-living systems and it is surely a result of intelligence contained by the soul. The soul which proceeds from a highly disordered state to a perfectly ordered state also produces order in the body it occupies. It is because of the soul that the processes in the body are highly efficient minimizing entropy production in the environment. In most part of the universe organisms do not disturb the order; there are only a few regions where human beings resort to activities that increase disorder.

So, we have systems producing order from disorder and disorder from order in the universe. The galaxies, star systems, cells, organisms, etc. are examples of beautiful order in the universe. The two components living and non-living together

give a steady and stable universe according to Jain philosophy and there is no chance of heat death or end of the universe.

10. References

1 Kachhara, Dr. N.L.: *Satdravya ki Vaigyanik Mimansa*, Prakrit Bharati Academy, Jaipur, 2007

2 Wikipedia: Entropy

3 Wikipedia: Entropy (order and disorder)

4 Wikipedia: What Is Life?

5 Denbigh, K.G., Note on Entropy, Disorder and Disorganization

6 Wikipedia: Magnetic Refrigeration

7 Kachhara, Dr N.L.: *Jain Metaphysics and Science: A Comparison*" Prakrit Bharati Academy, Jaipur, under publication.