Title :- PHYSICAL SPACE AND ITS DIMENSIONS

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Abstract

An attempt is made to study the multidimensional aspects of space. These are discussed in the light of Classical Mechanics, Theory of Relativity, Kaluza – Klein Theory, String Theory, M – theory and Quantum Mechanics. Some related mathematical perspectives have also been highlighted. Topological Fibre space is also taken into consideration. Finally, conclusions have been arrived at in respect of emergence of dimensions, revealing of higher dimensions and convertibility of dimensions. It is anticipated that the approach may enlighten the multidimensional aspects of space at base.

Keywords : Dimensions, Emerge, Revealed, Convertible.

1 Section

Introduction:- Extra dimensions of physical space draw interest in studies of physics since long back. Existence of more than four spacetime dimensions draws our interest present. Our basic question arises, are dimensions any fundamental property of space, or do those emerge from laws of physics? Another basic question is, how can we realize the existence of higher spatial dimensions? Furthermore, it is also of a great interest, whether dimensions are convertible or not. Dimension refers to the structure of space and spatial construction of objects in space. Dimensions may have correlation with particle and field. Various numbers of dimensions have been assigned to space in various theories. Recent theories relate higher dimensions. Extra dimensions of space enlighten the path towards a unified theory.

2 Section

Theories on dimensions of space:- In Classical Mechanics, the basic assumptions regarding space are:- space is Euclidean and isotropic, Newton's laws of motion hold in inertial system and Newton's law of gravitation is valid. In Einstein's Special Relativity, the basic assumptions are:- space is isotropic and uniform, the fundamental laws of physics are identical for any two observers in uniform relative motions, and the speed of light is same in all frames of reference in uniform relative motion [2]. Theories of relativity work in four-dimensional Minkowski space, which incorporates time as a dimension. Special relativity describes the structure of "spacetime" whereas General relativity describes the geometry related to gravitation [1]. Kaluza – Klein theory attempts to unify gravitation and electromagnetism. Kaluza extended General relativity to a five dimensional spacetime. Klein proposed that the fourth spatial dimension is curled up in a very small circle [8]. String theories correspond the following spacetime dimensions:- Bosonic type – 26, I type – 10, IIA type – 10, IIB type – 10, HO type – 10, HE type – 10. M-theory suggests 10 space and 1 time, i.e. 11 dimensions [9,11]. Again, the state – space is considered as an infinite dimensional functional space in Quantum Mechanics [3].

3 Section

Discussions:- Andrew Zimmerman Jones (About.com Physics) said, "Physics does not exist in a vacuum, of course (though some physics is practiced in a vacuum)" [12]. The results of CERN LHC experiment dated 10/12/2011 even supports the existence of extra dimensions. Let me make an attempt to enlighten the matter sequentially.

Galilean transformation:- Time of an event read in an inertial Cartesian coordinate system moving at a constant velocity relative to a specific inertial Cartesian coordinate system is equal to the time of the event in the system mention later. Experiment confirms the case the velocity is much less than the velocity of light [7].

Newtonian relativity:- According to Newton, "absolute motion is the translation of a body from one absolute place to another absolute place." But the significance of absolute space was not described. Motion and passage of time are involved at the root. Newton said, " Absolute, true and mathematical time, of itself and by its own nature, flows uniformly on, without regard to anything external." According to him, a single time scale would be valid everywhere [2,7].

Einstein's relativity:- In relativity, time shares the fate of space. Relativity reveals that space and time are not independent of each other. Relativity refers to the four-dimensional continuum, the Minkowski space or the spacetime continuum or four space. Here, space can be converted to time and time can be converted to space. Einstein's conception of space is: "Space is positional quality of the world of material objects." He replaced the substantial concept of space and time of Classical mechanics by attributive or rational concept. The consequences of Special relativity are: relativity of simultaneity, time dilatation, length contraction, mass – energy equivalence, finiteness of maximum speed etc. The consequences of General relativity are: gravitational time dilatation, bending of light in presence of gravitational field, "frame dragging", expansion of universe etc. General relativity reveals gravitation as curved space. According to General relativity, spacetime has form and structure influenced by matter and energy, matter and energy determine curvature of spacetime and spacetime directs movement of matter. General relativity geometrised uniform field theories and relativistic cosmology. In Cosmology, spacetime is a manifold consisting of events. Ch. Misner and J.A. Wheeler suggested [2,4,5]:-

(i) The spacetime continuum serves only as arena for the struggle of fields and particles. These entities are foreign to geometry. They must be added to geometry to permit any physics.

(ii) There is nothing in the world except empty curved space. Matter, charge, electromagnetism, and other fields are only manifestations of the bending of space.

Kaluza – Klein theory:- Here, the extra fifth dimension is considered to be cyclic group which may be replaced by a general Lie group. Kaluza – Klein consider a more general case of curved spacetime [8]. But the general Lie group considerations, called Yang – Mills theories, work in a flat spacetime. Kaluza – Klein theory appear just like ordinary gravitation in free space, but phrased in five dimensions. It is said that fifth dimension may be revealed by mini black hole.

String theory:- String theory combines Quantum mechanics and General relativity. The levels of magnification in String theory are: Macroscopic level (matter), molecular level, atomic level (proton, neutron, electron), two subatomic levels (electron and quark) and string level [9,11]. String theory evolved to incorporate Superstring theories. String theory is the first candidate for the so – called Theory of everything. It is said that dark energy may be lurking in hidden spatial dimensions.

M – theory:- It is a suggested unification of all Superstring theories [9,11].

Quantum spacetime:- Loop quantum gravity, black – hole etc. predict quantum spacetime [3].

Let me make an attempt to enlighten some qualitative aspects of higher dimensions. A usual higher dimensional body can be squeezed to a lower dimensional body by means of projection [1]. Again, topological considerations [9,11] enlighten the path to understand singular role, e.g. Penrose – Hawking singularity theorem.

There are two main proposals in respect of higher dimensions:-

(i) Rolling up of extra dimensions, called Kaluza – Klein compactification.

(ii) Making extra dimensions very big, but constraining matter and gravity to propagate in a three dimensional subspace (named three brane)., called braneworlds.

Thomas A. Manz (<tom[a]space-mixing-theory.com>) predicted that "physical space is a discrete continuous dual space of varying connectivity dimensionality field that transcends variable – based mathematics" [13]. United States Patent RE 36840 (Multi – dimensional graphing in two dimensional space – http://www.freepatentsonline.com/RE36840.html) described "a computerized method and system for displaying a function in two dimensions where the function is made up of numerous independent variables and at least one dependent variable" [14]. Jan de Leeuw and George Michailidis (Graph layout techniques and multidimensional data analysis – http://www.stat.ucla.edu/papers/preprints/248/248) explored "the relationship between multivariate data analysis and techniques graph drawing or graph layout" [15]. Eric Bonabeau (Graph multidimensional scaling with self – organizing maps – Information and Computer Science, Vol. 143, Issue 1 – 4 (June 2002)) said that "self – organizing maps (SOM) are unsupervised, competitive neutral networks used to project high – dimensional data onto a low – dimensional space" [10].

4 Section

Conclusion:- However, seeing and perception are not the same. There are two sides of perception, object and subject. Sensation and perception are related. Although no attempt is being made to say whether we can experimentally "see" evidence of higher spatial dimensions, some conclusions may be arrived at. P. Yogananda predicted "presence of infinite power behind the doors of your awareness." He said, "I will behold the invisible in the visible forms… " [6]. From the foregoing discussions, the following conclusions may be arrived at:-

(i) Dimensions emerge from laws of physics.
(ii) Higher dimensions are revealed in presence of appropriate physical fields.
(iii)
(iv) Dimensions are convertible, probably through some operators of conversion.

This approach may enlighten the multidimensional aspects of space at base.

5 Section

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