Published in the New Age Journal of Physics

www.cthepjo.wordpress.com

The Spine Model: Relativistic Generalization to any N-dimensional spacetime

Shreyak Chakraborty (shreyak.rekshda@gmail.com)

Independent researcher

Abstract:

We propose a semi-classical approach to string theoretic techniques in N-dimensional spacetimes. We name this 'The Spine Model'. This approach enables us to flexibly model particle dynamics in any given spacetime. We conjecture that fundamental strings (as described in standard string theories) are produced by more fundamental objects called "fibers". We also formulate the dynamics of these "fibers" using relativistic notations. We revisit and refine the overall structure and the concepts discussed in [1.] and redefine the basic assumptions in the model. Finally we calculate the total energy of a single fiber and show that under certain conditions, these fibers can produce particles/strings and using a relativistic formulation also show the Lorentz Transformations for the fiber equations in 4-manifolds.

Introduction:

We make the following assumptions for this model-

1. Particles are considered to be oscillations on strings. This is similar to standard string theories.
2. The model applies to any N-dimensional spacetime with N-1 spatial dimensions and such that N-3 spatial dimensions are compactified into a very small volume which is not directly detectable.
3. All equations of physics hold true in this spacetime.
4. After strings are produced, the behavior of strings in this model are governed by equations of superstring theory when N=11

This model actually links existing string field theories to the formation of these strings from the very geometry of spacetime.

The spaces are expressed in terms of sets in this model for the sake of simplicity. Relativistic notations are used wherever possible.

Consider an n-dimensional space given as

$$X_n = \{a_1, a_2, \dots \dots .\}$$

And $a_k = (x^0, x^1, \dots \dots, x^n)$ a_k being the general point in the space.

We define a 4-dimensional subspace of the above space as

$$X_D = \{a_1, a_2, \dots \dots .\} \quad (1)$$

And $a_k = (ct, x, y, z)$ is a general point in that subspace

The subspace X_D represents our 4-dimensional spacetime.

In Einstein Notation,

$$a_k = (x^0, x^1, x^2, x^3) \quad (2)$$

The concept of Grids and fibers:

We define a 'grid' as a 4-manifold in the 4-space in (1) using Assumption 2. In set form,

$$X_G = \{g_1, g_2, \dots \dots.\}$$

Any point in the grid is clearly of the form (2)

Grids are also defined as a 4-manifold **M** in the following form

$$M(x, y, z, ct) = 0$$

Consider a set 'F' of any 4 points on the grid

$$F = \{g_1, g_2, g_3, g_4\}$$

The above set **F** represents a fiber on the grid **M.**

So, a fiber is a collection of 4 grid points on a 4-dimensional grid.

***"Fibers are fundamental objects that are capable of producing strings that are described in string theory."* (Argument I)**

Consider four grid points A, B, C and D on a 4-dimensional grid **M** with coordinates of the points as

$$A(x_1, y_1, z_1, ct_1), B(x_2, y_2, z_2, ct_2), C\left(x_3, y_3, z_{3,} ct_3\right), D(x_4, y_4, z_4, ct_4)$$

A fiber through the points is written in matrix form as

$$\chi_f = \begin{pmatrix} x_1 & y_1 & z_1 & ct_1 \\ x_2 & y_2 & z_2 & ct_2 \\ x_3 & y_3 & z_3 & ct_3 \\ x_4 & y_4 & z_4 & ct_4 \end{pmatrix} \quad (3)$$

In 4 dimensions a fiber can be represented as a 4X4 matrix.

Also since $F \subset X_G$, hence grids are composed of fibers. (Argument II)

Note: - Fibers exist on any 4-manifold of any arbitrary configuration. Any 4-manifold with 4 spacetime dimensions that is composed of fibers is a grid.

The size of a grid is of the quantum scale and single grids cannot be used to explain macroscopic objects. Using Argument II, we can say **that given a 4-dimensional grid in a 4-dimensional spacetime, the spacetime can be considered to be composed of fibers that are defined by (3). This is Argument III.**

The dynamics of fibers and grids:

The matrix in (4) is called the Fiber Matrix. The determinant of the Fiber Matrix will be

$$|\chi_f| = \begin{vmatrix} x_1 & y_1 & z_1 & ct_1 \\ x_2 & y_2 & z_2 & ct_2 \\ x_3 & y_3 & z_3 & ct_3 \\ x_4 & y_4 & z_4 & ct_4 \end{vmatrix} \quad (4)$$

Every fiber has a certain orientation in the grid and every orientation is represented by a unique Fiber Matrix. The determinant of any fiber matrix gives the orientation number (o) for that fiber. The orientation number quantitatively determines a fiber's orientation in a 4-dimensional grid.

The orientation number is a scalar associated with a fiber. Therefore,

$$o = |\chi_f| \quad (4)$$

Points on a fiber are called vertices. A fiber in an n-dimensional grid (described as an n-manifold) always contains n number of vertices.

Orientation Energy is the energy associated with a given orientation of a fiber. A fiber can produce a fundamental string only when its orientation energy is changed (by changing its orientation).

Orientation Energy of a fiber is directly proportional to its orientation number.

$$\boldsymbol{o_E} \propto |\chi_f|$$

$$\boldsymbol{o_E} = \boldsymbol{k_0}|\chi_f| = k_0.o \qquad k_0 \in R - \{0\}$$

$$\& \ o_E = E_f$$

$$\therefore E_f = \boldsymbol{k_0}|\chi_f| \qquad (5)$$

Equation (5) is the **general equation of a fiber which** relates the total energy of a fiber (LHS) to the orientation number (RHS). If E_1, E_2, E_3 and E_4 are the individual vertex energies for a fiber, then total energy for the fiber is the algebraic sum of the individual vertex energies.

$$E_f = E_1 + E_2 + E_3 + E_4$$

The energy of a fundamental string produced by a fiber is directly proportional to the change in orientation energy of that fiber.

$$E_{st} \propto \Delta o_E$$

$$E_{st} = J.\Delta o_E \qquad (6)$$

J is the **String Producer Constant**

$$\therefore \boldsymbol{J} = \frac{\boldsymbol{E_{st}}}{\boldsymbol{k_0(o_2 - o_1)}} \qquad (7)$$

Equation (6) gives energy of the string produced. Hence, the frequency of the fundamental string will be

$$\upsilon_{st} = \frac{E_{st}}{h} = J.\frac{k_0}{h}(|\chi_{f2}| - |\chi_{f1}|) \qquad (8)$$

We now show the Lorentz Transformation for the fiber equations that involve the determinant of the fiber matrix. We also prove that under special conditions, a trivial grid exists that can be treated as a 3-manifold!

Consider a grid defined as a manifold **M** with 3 spatial dimensions and 1 time dimension as done earlier too (in this paper).

$$M(ct, x, y, z) = 0 \qquad (9)$$

Using notations,

$$M(x^0, x^1, x^2, x^3) = 0$$

If $ct = 0 \quad \Rightarrow x^0 = 0 \quad \Rightarrow \quad dx^0 = 0 \quad \Rightarrow \quad c.dt = 0$

Hence $\quad dt = 0 \qquad (10)$

That is, using (9) and (10) there s no flow of time inside the grid. Therefore, (9) can be rewritten as

$$M(x, y, z) = 0 \qquad (11)$$

Equation (11) shows the 3-manifold nature of the grid in the absence of a time coordinate which can happen at the centre of a black hole. This type of grid is called a **Trivial Grid.**

Hence, **at the centre of black hole or in regions of infinite spacetime curvature, grids behave as 3-manifolds.**

Now consider two fiber matrices in a 4-dimensional grid.

$$\chi_f = \begin{pmatrix} x_1 & y_1 & z_1 & ct_1 \\ x_2 & y_2 & z_2 & ct_2 \\ x_3 & y_3 & z_3 & ct_3 \\ x_4 & y_4 & z_4 & ct_4 \end{pmatrix} \text{ And } \chi'_f = \begin{pmatrix} x'_1 & y'_1 & z'_1 & ct'_1 \\ x'_2 & y'_2 & z'_2 & ct'_2 \\ x'_3 & y'_3 & z'_3 & ct'_3 \\ x'_4 & y_4 & z'_4 & ct'_4 \end{pmatrix}$$

Now let us take the Lorentz Transformations from [1.] for the fiber vertices generalized as

$$x' = \gamma(x - \beta ct)$$

$$ct' = \gamma(ct - \beta x)$$

$$y' = y$$

$$z' = z$$

Applying these to the matrices above, we get

$$|\chi'_f| = (\gamma^2 - \beta^2)|\chi_f| \quad (12)$$

The above equation gives the Lorentz Transformation for the fiber matrix in 4-dimensional spacetime.

Solving (12) with $\gamma = \frac{1}{\sqrt{1-\beta^2}}$, $\beta = \frac{v}{c}$

$$|\chi_f| = \left(\frac{1}{c^2}\right)\left(\frac{c^2}{c^2 - v^2} - v^2\right)|\chi_f| \quad (13)$$

References:

[1.] Shreyak Chakraborty," The Spine Model: Introduction and Basic Structure", www.vixra.org/abs/1304.0121