

# Temporal Mesh Conjecture

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**Abstract:** Based on ER=EPR Correlation, in an existent maximally entangled wormhole or Einstein-Rosen bridge, there are two black holes having been spatially different, however, these  $N$  black holes, the wormholes having  $N/2$  entanglement parameters, the corresponding meshwork be temporally conjectured to be at the junction point  $J$  which when evolves through time  $T$ , the evolution creates a quantum excitation fields that functions capturing the spatially embedded  $\mathcal{R}^2$  topologies inside the Anti de-sitter boundary of  $\mathcal{R}^3$  space having a negative definite curvature resulting an inflation  $I$  splitting into  $I = N/2$  split holes  $S$  that acts the transporting inflated point  $I(T)$  into buffer points which are so spatially excited that, the relativistic frame dragging due to the excess vibrations leads to an instantaneous field of cosmic strings where time itself evolved locally like a *Closed-Timelike-Curve* (CTC). This inflated buffer zones  $Z_{I(T)}$  having a boundary conditions  $\partial Z_{I(T)}$  self gravitating like a rotating *Tipler cylinder* could be a microscopic way of transporting dust from one part of the universe to the other provided the gravitating regions must asymptotically die in some non-local perturbations leading topological defects on the  $\partial Z_{I(T)}$  thereby creating a diverging gravity fields acting as a repulsive gravity pouring out of pores  $P\{\partial Z_{I(T)}\}$  making it traversable capturing the locally moving dusts without violating *Null-Energy-Conditions* (NEC).

Soliton Points – Einstein-Rosen Bridge – Buffer Zones – Inflated Points – Hypermembrane - Strings

**Introduction:** It is in a state of confusion, rather not properly known, whether, any arbitrary advanced civilization will use compact surfaces like singularities of a black hole, or non-compact surfaces like the self made time machines, to travel back and forth in time. Still, its been feasible that, any non-compact regions have more degrees of freedom, as compared to compact surfaces while travelling through time and also its been safer. Here, we will consider the non-compact surfaces as a means of time travel. This idea generates from cosmic strings which are 1-dimensional defects of topology during the symmetry breaking phase transitions of the early universe, when the symmetry breaking of the topology of the vacuum manifold was not simply connected. For, one Hubble volume, it can be expected to have at least one cosmic strings. The string theory models of the early universe dictates that, cosmic strings originates from the phase transitions that occurred during inflation period and they are millions of light years long stretching from one end of the universe to the other end. Angular deficit is an important part of the cosmic strings which dictates those strings having positive masses, however, negative mass cosmic strings are also probable, and if they warped around an wormhole, in the early universe, then the wormhole being stabilized may exist till now, however, no such proofs have been found till date. This negative mass implies exotic matters, however, in the later part of the paper, we will discuss that the de-stabilization of a wormhole can also be generated by the generators of diverging gravity, thereby prevents the mouths from collapsing. Cosmic strings arises from the F-strings in string theories which are fundamentally perturbed and are related to the D-strings by means of a Strong/Weak S-Duality, where repeated cycles occurs regarding compactification, thereby left one dimensions non-compact and that dimension is related to the inflation points  $I$  evolved through time  $T$  as  $I(T)$  thereby, creating the buffer zones which are eminent for studying the theoretical aspects of this paper. Given, the diameter of the strings, it can be said, that its equal to 1 fermtometer, the size of a proton, which can be studied as a zero width under Nambu-

Goto actions, that is equivalent of Nambu-Goto approximations from the Polyakov actions contributing to the Bosonic sector of the superstring theory. However, the thinner the strings are, there have a massive density and calculations suggest that, a 1 Kilo meter strings would be as massive as Earth. But, according to the General theory of Relativity, the weight approximations of gravity is zero, rather the cosmic strings gravitates in a different way, and it's the deflection of the vibrating strings that makes the objects around the strings to move from its natural position, make the stringy motion gravitable through acceleration, and they are accompanied by loops of strings in the early universe, which yields in forming galactic super clusters. If such strings can connect two distinct parts of the universes, millions of light years apart, putting the length scale of these strings to be huge then this strings can correspond to the quantum channels of the entanglement as per ER=EPR correlation. This entangled channels connecting distinct portions of a maximally entangled states makes them behave like a Einstein-Rosen Bridges for transporting matters through them. This obviously means that, the strings have some hollow regions, but that not permissible by string theories, hence if one strings warped around another strings cyclically making a non-compact dimensions near the loop where several strings pass, and compact dimensions faraway where there are distant parts of the connected universe, it is feasible to say that, these cosmic strings teleported dusts (or matters) from a non-compact large dimensions to a compact dimensions by means of an Anti de-sitter spaces. The spatial dimensions can be 6 compactified at the far ends while 1 non-compactified at the junction points  $J$  that, we will come later on. Based on the ER=EPR correlation, if the distinct black holes, spatially far away are really connected, then the entanglement channels between them could be expressed by the following formulas,

Given  $H_A \otimes H_B$  as the product of two Hilbert spaces, if the basis vectors representing black hole of  $H_A$  is  $\{|0\rangle_A, |1\rangle_A\}$  and of  $H_B$  be  $\{|0\rangle_B, |1\rangle_B\}$ , the relation expressed as,

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$$\zeta = \frac{1}{\sqrt{2}}(|0\rangle_A \otimes |1\rangle_B - |1\rangle_A \otimes |0\rangle_B)$$

Several of these entangled channels  $\sum_{N/2} \zeta$ , where  $N/2$  is the number of the wormholes, it is sufficient to say that, this denotes a mesh-work of Einstein-Rosen bridges, with a junction point  $J$  in the middle connecting all the loops of the entangled strings of the universe. These strings would be a special type consisting of two probabilities,

- An AdS Space where there is 1 time dimensions and many space dimensions all being compactified up to a certain degrees of freedom except at the junction point  $J$  where the dimensions are inflated.
- A warping of one cosmic strings over the entangled pairs that suffice to give enough exotic matters as to make the wormholes traversal for the dusts to transport or teleport over space-time's largest spans.

This entanglement states dictates a form of a spatial coherence between two ends of a large cosmic strings, or the two mouths of a ER bridge connecting two black holes to be temporarily uniform, whereas, each state cannot be defined uniformly of the other. This same thing has been pointed out by Albert Einstein-Nathan Rosen-Podolsky as the famous EPR paradox or "spooky action at a distance".

Now, to say at least for now, it is difficult to determine the size of the whole universe, rather we have only achieved to determine the size of the observable universe as 93 billion light years wide, lights from further distances are yet to come to us. Therefore, this suffices, there can be many black holes and the population creates a mixed entangled assemblies which is a bipartite quantum states given by the relation only when the total BH population is  $N$  while the wormhole strength is  $N/2$  which is as same as the number of entangled pairs with one half BH spin as  $+C$  while the other half as  $-C$  giving us a mixed ensemble through the equation,

$$\begin{aligned} \bar{v} &= \sum_i \rho_i \left( \sum_j \tilde{d}_{ij} |\alpha_{ij}\rangle \otimes |\beta_{ij}\rangle \right) \left( \sum_k \tilde{c}_{ik} |\alpha_{ik}\rangle \otimes |\beta_{ik}\rangle \right) \\ \sum_j |\tilde{d}_{ij}|^2 &= 1 \\ \sum_k |\tilde{c}_{ik}|^2 &= 1 \end{aligned}$$

Where  $\alpha$  and  $\beta$  are the states of  $+C$  and  $-C$  on the Hilbert space  $H_A \otimes H_B$ .

Hereto, speaking of the possible shape of the universe, as the correct shape is not yet known or yet to be known, we can address this as a  $\mathcal{R}^3$  topology space as a sphere. An exciting point to note here, is the 2<sup>nd</sup> dimension of time. Although its not readily used by scientific communities to express time as a 2-dimensional entity, it can be so, if we can cleverly make 1 dimensions hidden. That's the true nature of the reality. Time as always been presented or perceived locally as a 1-dimensional line, proceeding linearly through past, present and future, in non local tern time can take a 2-dimensional circular topology of a  $\mathcal{R}^2$  closed curve, and that curve, if be a circular ensemble, then, these circles if share a common centre point as the whole spherical universe (as assumed before), then those  $\mathcal{R}^2$  circles are embedded on the surface boundary of the  $\mathcal{R}^3$  spheres. Perceived non-locally  $\mathcal{R}^2$  exists as a co-dimensionality of  $\mathcal{R}^3$  but locally these hidden  $\mathcal{R}^2$  silently behave as  $\mathcal{R}^1$  linear arrows progressing through time as we expressed every now and then, automatically making the assumptions that we are living on the surface of the universe. Now, the junction points of the strings  $J$  or ER-Bridge that exists in 4-dimensional space-time has a huge excitations because of

the way, different vibrating strings meets at a single points of a  $N/2$  parameter of  $N$  black holes. This can denote the fact, that, the excitation at  $J$  makes it having an interesting geometry which owing to large fluctuations of the surrounding fields (excited due to them!) could have an interesting geometry to produce gravitational waves as per the magnitude of the fluctuating fields ambient to the strings by matter deflecting gravitation. Here from, we will use a N-P Null Tetrad formalism  $\{\ell, n, m, \bar{m}\}$  of  $(-, +, +, +)$  signature where  $\{\ell, n\}$  are 2-real and  $\{m, \bar{m}\}$  are 2-complex co(vectors). The important contribution comes from the  $\Psi_4$  Weyl-NP Scalars among the other 5 as given by,

$$\Psi_4 = -C_{abcd} n^a \bar{m}^b n^c \bar{m}^d$$

In empty space, the Einstein-Field-Equations reduce  $R_{ab} = 0$  which from the definition of Weyl tensor, if augmented here with  $\Psi_4$  then, this equals Riemann Tensor, such that  $R_{abcd} = C_{abcd}$ , then we can make the standard choice of the infinite null vectors as tetrads to infinitely long entangled wormholes as per the below equations,

$$\ell^\omega = \frac{1}{\sqrt{2}}(\hat{t} + \hat{r})$$

$$n^\omega = \frac{1}{\sqrt{2}}(\hat{t} - \hat{r})$$

$$m^\omega = \frac{1}{\sqrt{2}}(\hat{\theta} + i\hat{\psi})$$

The relation between the linear gravitational waves with the Riemann tensor in transverse-traceless gauge is accounted by 2 equations as,

$$\frac{1}{4}(\ddot{h}_{\hat{\theta}\hat{\theta}} - \ddot{h}_{\hat{\psi}\hat{\psi}}) = R_{\hat{r}\hat{\psi}\hat{r}\hat{\psi}}$$

$$\frac{1}{2}\ddot{h}_{\hat{\theta}\hat{\psi}} = R_{\hat{r}\hat{\theta}\hat{r}\hat{\psi}}$$

Combining these with the radial propagation of  $\hat{r}$ , the Weyl-NP Scalars could be represented by,

$$\Psi_4 = \frac{1}{2}(\ddot{h}_{\hat{\theta}\hat{\theta}} - \ddot{h}_{\hat{\psi}\hat{\psi}}) + i\ddot{h}_{\hat{\theta}\hat{\psi}} = -\ddot{h}_+ + i\ddot{h}_\times$$

All the entangled links  $\mathcal{L}$  are intersected in the junction  $J$  whose boundary  $\partial J$  is the source of the scattering gravitational waves. To parameterize the intervals on the junction points  $J$  as  $[-n, \dots, +n]$ , it is implicit to define buffer zones  $Z_{I(T)}$  having a boundary  $\partial Z_{I(T)}$  marked from *left to right* as follows,

$$f(x) = \begin{cases} -n, \dots, \dots, 0, & \text{Left} \\ 0 & J \\ 0, \dots, \dots, +n & \text{Right} \end{cases}$$

$$\mathcal{L}: ([0] \xrightarrow{\text{mapping the intervals}} [+n, -n])$$

$J$  is the point of severe excitation, if a volume integral can be computed closed to  $J$ 's boundary then we can find the inflation points  $I$  as,

$$I = \iiint J dx dy dz$$

This  $I$  is the region of intense quantum excitation and gravitational polarization, as it's the junction point  $J$  where different links  $\mathcal{L}$  intersects, in other words it is the region of high quantum excitation and

deflating surrounding particles by strings gravitating vibrations. And as all  $\mathcal{L}$  from  $N$  black holes are summed up, the region inflates and this inflation flows from this regions to the buffer zones. This makes the buffer zones of high fluctuations concentrated on the buffer intervals  $[-n, \dots, +n]$  having boundaries  $\partial Z_{I(T)}$ . This is a time evolving factor  $I(T)$ , the links  $\mathcal{L}$  getting excited from the inflation points  $I$  at the junctions  $J$  with high field excitations, all are ultimately distributed to the buffer zones  $Z$ , and these buffer zones got punctured by pores  $P$  because of high gravitational radiation acting on the boundary  $P\{\partial Z_{I(T)}\}$  making a region of gravitational divergence, or in else, a region of repulsive gravity that acts as the exotic matters. When, in some case, the intervals of the buffer zones  $P\{\partial Z_{I(T)}|-n, \dots, +n\}$  lies close to one another, i.e., soliton points exists as if one buffer zone is touching another buffer zone, then, a field of excitation blows up the pores in the form of a toroidal repulsive gravity fields that acts as the region or the domain of the dusts to enter in between the wormhole boundaries, all surrounded by a hypermembrane of compactified boundary dimensions as discussed earlier. Here, the diverging gravity field would make the energy values locally to the buffer zones as positive definite acting as a repulsive gravity without violating the Null-Energy-Conditions. The toroidal flow because of the close buffer intervals on the links helps in capturing the ambient space-time which are obviously non-inertial and thereby makes a relativistic frame dragging phenomena in which the  $\mathcal{R}^2$  - second dimensions of time are attracted to it, just like gravity slows time, which leads to the separation of  $\mathcal{R}^2$  from  $\mathcal{R}^3$  - making the second temporal dimensions visible on the ambient interval boundaries  $P\{\partial Z_{I(T)}|-n, \dots, +n\}$  that classifies as the CTC or the *Closed-Timelike-Curves* to transport the dust from one point in space-time to the other point keeping the value of the stress-energy momentum tensor integral as positive definite all along the links given by the equation,

$$\oint_{\mathcal{L}} T^{\mu\nu} dx_{\mu} dx_{\nu} \geq 0$$

However, to make the above claim, we need a modified versions of General theory of Relativity, where we can show that the toroidal flow of the soliton points makes a shift of defocusing and refocusing to maintain a gravity divergence field gradient which will blow up the pores boundary  $P\{\partial Z_{I(T)}\}$  of the links  $\mathcal{L}$  as a scenario to maintain NEC. The generalized field equations given in terms of additional geometric modifications of the wormhole suffices to,

$$g_1(\Omega^i)(G_{\mu\nu} + \xi_{\mu\nu}) - g_2(\Omega^i)T_{\mu\nu} = \epsilon^2 T_{\mu\nu}$$

Where  $\xi_{\mu\nu}$  is the additional parameters of field theory of gravity, having  $\Omega^i$  under consideration is a multiplicative factors to modify the geometric scalars of the fields having  $i = 1, 2$  having an induced property to alter the curvature of the generic scalar fields of the Einstein tensor  $G_{\mu\nu}$ , along with  $g_2$ , the coupling of the invariant curvatures with the stress-energy momentum Tensor  $T_{\mu\nu}$  which also accompanied on the right hand side as a cumulative affine parameter  $\epsilon^2$ . Therefore, the effective EFE can be written as,

$$T_{\mu\nu}^{eff} = \frac{1 + \widetilde{g}_2(\Omega^i)}{g_1(\Omega^i)} T_{\mu\nu} - \xi_{\mu\nu}$$

Where  $\epsilon^2 = g_2(\Omega^i)/\widetilde{g}_2(\Omega^i)$  and  $G_{\mu\nu} \approx \epsilon^2 T_{\mu\nu}^{eff}$  defined for notational convenience as a affine term to  $T_{\mu\nu}$ . Analogously, the wormholes in the solutions of modified gravity also satisfies the violation of ANEC just as in original Einstein solutions, the modified solutions being,

$$T_{\mu\nu}^{eff} < -\frac{1}{2} T^{eff}$$

Therefore, there has to be a bound on  $T^{\mu\nu} dx_{\mu} dx_{\nu}$  that can be satisfied by the identity,

$$\frac{1 + \widetilde{g}_2(\Omega^i)}{g_1(\Omega^i)} \left[ T_{\mu\nu} l^{\mu} l^{\nu} - \frac{1}{2} T \right] < \xi_{\mu\nu} l^{\mu} l^{\nu} - \frac{1}{2} \xi$$

Now, for GTR, if  $\widetilde{g}_2(\Omega^i) = 0$  and  $g_1(\Omega^i) = 1$ , the solutions obtained as,

$$\left[ T_{\mu\nu} l^{\mu} l^{\nu} - \frac{1}{2} T \right] < \xi_{\mu\nu} l^{\mu} l^{\nu} - \frac{1}{2} \xi$$

Now, to satisfy NEC, the above relation can be modified by imposing the following conditions as,

$$T_{\mu\nu} l^{\mu} l^{\nu} = \frac{g_1(\Omega^i)}{1 + \widetilde{g}_2(\Omega^i)} (\xi_{\mu\nu} l^{\mu} l^{\nu} + G_{\mu\nu} l^{\mu} l^{\nu}) \geq 0$$

By taking  $\epsilon^2 = 1$  in the above relation with  $\widetilde{g}_2(\Omega^i)$  in modified norms. This entails the relationship,

$$T_{\mu\nu} l^{\mu} l^{\nu} \geq 0$$

Therefore, the energy density with the 4-velocity  $x_t^{\mu}$  imposes a constrains  $T_{\nu}^{\mu} = \text{diag}[-\rho(r), p(r), p(r), p(r)]$  as  $\geq 0$ . This imposes an energy condition, that is positive definite in all frames of reference taken into consideration.

The motion of the dust in the 2 time dimensions should be given by a coordinate structure like,

$$x^{\mu} = \left( r \cdot f \left( \frac{ct}{\sigma} \right) \right) (ct, X)^T \text{ with } x \in \mathcal{R}^3$$

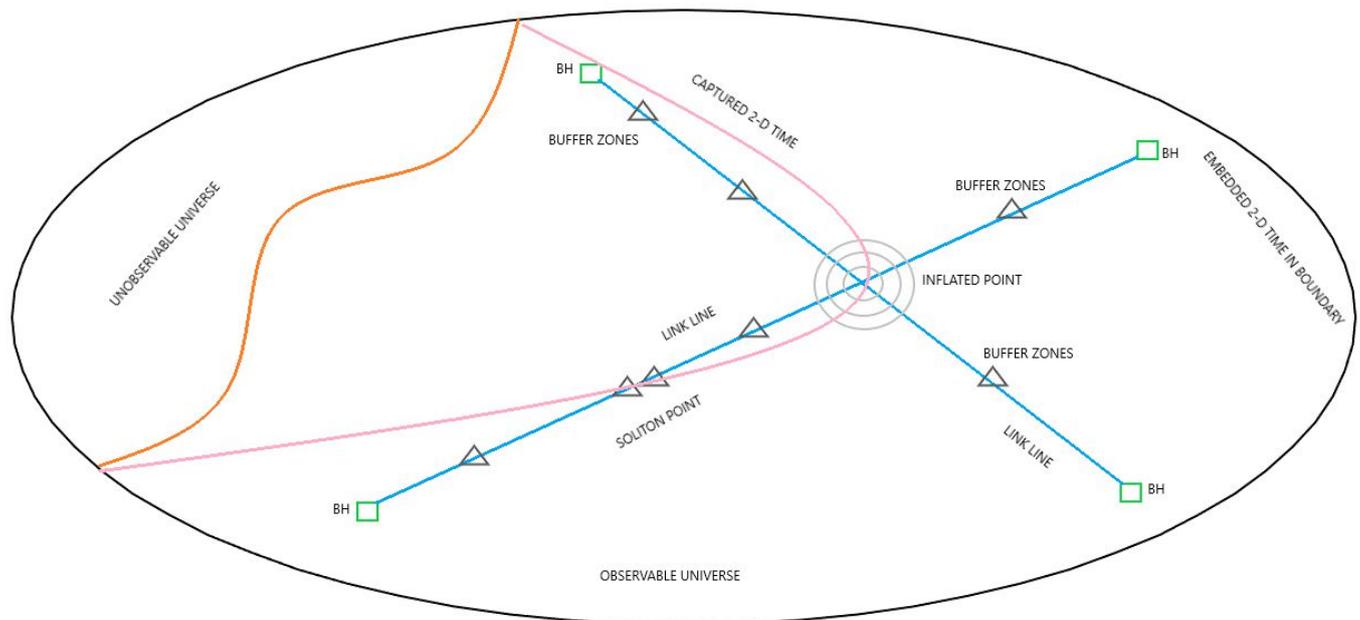
$\tau$  is the 2<sup>nd</sup> time dimensions extended by an additional timelike coordinate as the previous equation, where  $t, r \in \mathcal{R}$  is the 2<sup>nd</sup> time dimensions having  $\varphi$  as the velocity equivocal to  $c$ .  $f$  is the shape factor of the 2<sup>nd</sup> time dimension and  $\sigma \in \mathcal{R}$  is a normalization parameter such that  $\left( \frac{\varphi\tau}{\sigma} \right)$  is dimensionless.  $x^{\mu}$  can be further decomposed by  $x_t^{\mu} + x_r^{\mu}$  having the respective values as,

$$\begin{pmatrix} ct \\ 0 \\ \eta X \end{pmatrix} \text{ and } \begin{pmatrix} r \cdot f \left( \frac{\varphi\tau}{\sigma} \right) \\ (1 - \eta)X \end{pmatrix} \text{ with } \eta \in (0, 1)$$

Therefore, the Lagrangian of the velocity becomes,

$$L(x, x, x', t, r) = \frac{r}{\sigma} \sqrt{\dot{c}^2 t^2 - \eta^2 \dot{X}^2 + 2ct\dot{c}} \sqrt{\varphi'^2 \tau^2 + \varphi^2 + 2\varphi\varphi' r \left( \frac{df}{dz} \Big|_{z=\frac{\varphi\tau}{\sigma}} \right)^2} - (1 - \eta)^2 X'^2$$

Thus with the 2-time coordinate, and without violating NEC, the dust would move at large distances spanning over a huge network of temporal mesh, where the CTC's are spontaneously created and destroyed depending on the gravitational gradient of the toroidal flow in soliton points. This mesh creates a network of microscopic wormholes throughout the universe embedded in a hypermembrane.



A single picture depicts the Black Holes (BH) in the divided universe (unobservable = observable), the BH being in the observable part along with link lines and their intersection as inflated points, this results in buffer zones, that got identified by a strong buffer point (2 buffer zones being close to each other) as soliton points, that catches the CTC (closed timelike curves) which otherwise is embedded in the boundary.

**Conclusion:** This ER=EPR will open a new avenue of physics by amalgamating General theory of Relativity with Quantum Mechanics, the much awaited unification, along with this process a leap forward for "A theory of everything". However, in this paper, we have shown, the refocusing and defocusing bundle of gravitational radiation that can puncture a wormhole, thereby diverge the gravity fluxes to contemplate for the exotic matter by creating a repulsive gravity gradient thereby making the wormhole traversal for the dusts. This traversality is restricted not only to the microscopic scales that moves forward or backward in space and time, but also agrees on the principle of capturing 2<sup>nd</sup> time dimensions as a CTC for any object to trace back its path in time, the only think that's feasible from this theory is that, the whole wormholes, or the string bundles (one strings warped over other in possible cases) is always behaves like a Einstein-Rosen Bridges as a maximal entangled pair with the inflation and soliton points covered by a hypermembrane.

**Acknowledgement:** We are grateful to Dr. Ande Murali Varaprasad (Ex-DRDO Scientist and Director of Centre for ISRO GNSS Studies at SACET) for his constant support and motivation to help young researchers like us, to publish our papers.

**Declaration of Interest:** The authors of this paper declared that they do not have any competing interests as related to this paper.

**Funding:** There are no fundings associated with this research work.

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