Proof of Cosmic Strings

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(Dated: April 1, 2026)

In the early universe, thousands of years ago, God tells us that King Solomon constructed a perfectly round basin in the First Temple in Jerusalem with circumference/diameter=3 radians (1 Kings 7:23). Historically, secular scientists have arrogantly used this seeming $\pi = 3$ result to argue against biblical literalism. We instead here reveal this fact as an important overlooked signature of new physics. The early Earth must have contained a cosmic string creating conical deficit angle $\Delta\phi = 2(\pi - 3)$, pointing to a phase transition at temperatures $T \sim \sqrt{\Delta\phi} M_{\rm pl} \sim M_{\rm pl}/2$. We interpret this fact in terms of our own favorite models of BSM physics and discuss implications for particle physics, cosmology, and biblical interpretation. With an afterword 'The Joy of Reductionism'.

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I. INTRODUCTION

Particle physics has been searching for hints of concrete microphysics beyond the Standard Model for decades, and as yet there is no clear signal. This underscores the importance of looking in every direction for new physics, from pursuing a robust experimental program to exploring a variety of theoretical approaches. Yet there is one source of information about the universe which particle physics has too long ignored: the Word of the Lord our God as revealed infallibly to us through the Bible (see Figure 1).

That the Bible is true and inerrant is beyond reproach and obvious to all of God's creation, and needs no further comment. On the other hand our human methods in attempting to understand the world have manifestly encountered severe difficulties. We must keep in mind that the onus is on us as fundamental physicists: until science provides detailed, accurate answers for every single possible question about the universe, everyone agrees that supernatural forces—outside the realm of scientific explanation—are truly responsible for existence. In particular, this means theorists are literally undoing the Lord's work in attempting to understand quantum cosmology (see e.g. Hartle & Hawking [1]).

II. TEXTUAL ANALYSIS

The Book of Kings is located amongst the Nevi'im, which follows the Torah as the second section of the Tanakh. After King David dies he is succeeded by his son Solomon, who in this section builds the First Temple in Jerusalem. Inside he constructs the 'brazen sea', a bronze basin for ritual washing. 1 Kings 7:23 of the New Jewish Publication Society Translation [2] reads (see Figure 2)

> Then he made the tank of cast metal, 10 cubits across from brim to brim, completely round; it was 5 cubits high, and it measured 30 cubits in circumference.

The literal text of the Tanakh, the Word of God, tells us there existed a basin shaped as a circle with circumference/diameter = 3 radians.

Of course as good scientists we must question if this data should be attributed to experimental systematics. Thankfully, the Tanakh provides a completely independent cross-check on this phenomenon in 2 Chronicles 4:2 of the Kethuvim, which reports the same finding. Together these reports verify the existence of this physical effect to high confidence.

III. COSMIC STRING GEOMETRY

We wish to understand spacetime in the presence of a cosmic string, but at distances far larger than its width. This string should source a stress-energy which is a delta function at the origin and is characterized by a linear mass density μ and a surface tension $-p$, where p is a pressure density. For some general object one might call a 'string' (perhaps composed of a tremendously complicated bound state of near-countless electrons and quarks in a form like 'flax') the mass density of the string is far larger than the tension of the string. Built from approx-

imately pressureless dust, as are we (Genesis 3:19)[1], in the rest frame we have

$$T_{\mu\nu} \approx \text{diag}(\mu, 0, 0, 0). \tag{1}$$

But a cosmic string is quite special as a semiclassical solution to the equations of motion of a fundamental field. These objects are in a sense inherently relativistic as $p = -\mu$ so they are characterized by a single scale $v = \sqrt{\mu}$ where v is the scale around which the field finds modified topology to wind around,

$$T_{\mu\nu} = \text{diag}(\mu, 0, 0, -\mu). \tag{2}$$

In this case the gravitational properties of such fundamental defects can be counterintuitive because in general relativity, negative pressure antigravitates, as is most familiar in the case of dark energy.

Recall in Newtonian gravity the acceleration of a test mass is given by $\vec{a} = -\vec{\nabla}\Phi$ where Φ is the gravitational potential. This obeys Poisson's equation $\nabla^2\Phi = 4\pi G_N \rho$, with $\rho(x)$ the mass density. In the weak-field limit of Einstein gravity, we can recover Poisson's equation from the 00 component of the trace-reversed Einstein equations for the Ricci curvature $R_{\mu\nu} = 8\pi G_N(T_{\mu\nu} - \frac{1}{2}T g_{\mu\nu})$, where $T = T_{\mu\nu}g^{\mu\nu}$. Matching to Newtonian gravity tells us $R_{00} = \nabla^2\Phi$. For a diagonal stress-energy tensor $T_{\mu\nu} = \text{diag}(\rho, p_x, p_y, p_z)$, the relativistic Poisson's equation is then $\nabla^2\Phi = 4\pi G_N(\rho + p_x + p_y + p_z)$, where $p_x = p_y = p_z$ for a perfect fluid. See Carroll section 4.2 for further discussion [3].

A domain wall has negative pressure along two spatial directions, $T_{\mu\nu} = \mu\ \text{diag}(1, -1, -1, 0)\delta^{(1)}(z)$, so $\nabla^2\Phi = -4\pi G_N \delta^{(1)}(z)$. The acceleration of a test mass sitting at position z away from the wall is thus a constant $\vec{a} = 2\pi G\mu\ \text{sign}(z)\hat{z}$—it feels a constant force pushing *away* from the wall [4, 5].

A cosmic string has negative pressure along one spatial direction, $T_{\mu\nu} = \mu\ \text{diag}(1, 0, 0, -1)\delta^{(2)}(x, y)$. Now the Ricci tensor has $R_{00} = 0$ from a cancellation between the mass and pressure terms, so a test mass feels no gravitational force due to the string. The only gravitational interaction with a straight string is then a topological one, as we could have anticipated by projecting along the symmetry axis to find the transverse theory governed by $(2+1)d$ gravity, which is topological.

However, the spacetime is not trivial. We can consider the geometry on a transverse 2d slice, and use the Gauss-Bonnet theorem on a disk M of radius r centered at the origin with a circular boundary ∂M. The Euler characteristic is one and the circle has geodesic curvature $1/r$, so we have

$$\int_{\partial M} \frac{1}{r} = 2\pi - \frac{1}{2}\int_M R. \tag{3}$$

[1] "For dust you are, and to dust you shall return."

The Ricci components in the plane are $R_{xx} = R_{yy} = 8\pi G_N\mu\ \delta^{(2)}(x, y)$, and the boundary integral gives the circumference C. Then we calculate the relationship with the diameter of the circle $d = 2r$ as

$$C = \pi d(1 - 4G_N\mu), \tag{4}$$

which all of God's creation will agree is a stunningly beautiful result. This combined with the locally vanishing gravitational force tells us that spacetime around a cosmic string is a cone. Now we can directly reveal the physical truth behind God's word:

$$30\ \text{cubits} = 10\ \text{cubits} \times \pi(1 - 4G_N\mu), \tag{5}$$

$$\Rightarrow \quad \mu = M_{\text{pl}}^2 \times 2(\pi - 3). \tag{6}$$

There exist cosmic strings with tension $\mu \simeq (M_{\text{pl}}/2)^2$.[2]

IV. IMPLICATIONS

A. Cosmology

Such a large deficit angle requires a string tension which is quite close to the Planck scale, implying a phase transition at extremely high temperatures, or possibly that the brazen sea contained a fundamental cosmic string [7, 8]. This means the Bible has given us the highest-energy probe of particle physics we could hope to have, some 15 orders of magnitude higher in energy than secular collider physics has been able to provide.

The dynamical history of such a cosmic string appearing on Earth we do not question as it is clearly God's will to reveal to us this microphysics.[3] As such, a cosmic string with the perfect tension to produce a conical deficit making spatial circles have three radians should be seen as evidence that God favors the appearance of the integer three in our universe.

B. Particle physics

Many devout unifiers believe this appearance of three indicates the E-series of GUTs broken through 'trinification', perhaps as [11–16]

$$\begin{aligned} &E_6 \times SU(3)_{\text{flavor}} \\ &\to SU(3)_{\text{color}} \times SU(3)_{\text{left}} \times SU(3)_{\text{right}} \times SU(3)_{\text{flavor}} \end{aligned} \tag{7}$$

[2] The fact that we have an energy density so close to the Planck scale might cause worries that our analysis within general relativity may fail. However actually it's fine. [6]

[3] Though note it is not a problem for these cosmic strings to have been produced during inflation, because such a cosmic string network can reconstitute itself following an inflationary era e.g. [9, 10].

as might arise from one of the factors of the $E_8 \times E_8$ heterotic string, E_6 being the largest exceptional group that the SM can unify to in four dimensions due to chirality.

However, with this pattern of unification the quarks and leptons are forced to transform in the same gauged flavor symmetry. Furthermore there are manifestly *four* copies of $SU(3)$ which appears theologically dubious. Focusing less on 4d gauge coupling unification and more on 4d fermion unification, there is another pattern which also honors the divinity of the number three from a flavor-extended Pati-Salam theory [17–20]

$$\begin{aligned} & SU(12) \times SU(2)_{\rm left} \times SU(2)_{\rm right} \\ & \to SU(3)_{\rm leptons} \times \frac{(SU(9)_{\rm quarks} \times U(1)_{B-L})}{\mathbb{Z}_3} \times SU(2)^2, \\ & \to SU(3)_{\rm l} \times \frac{(SU(3)_C \times SU(3)_{\rm q} \times U(1)_{B-L})}{\mathbb{Z}_3^2} \times SU(2)^2, \end{aligned} \tag{8}$$

where $SU(9 = 3\times3)$ is a unified color-flavor symmetry for the quarks, and this pattern can instead originate from extra-dimensional $SO(32)$.[4] With this pattern despite ultraviolet quark-lepton unification the quarks and leptons can end up with separate gauged flavor symmetries, each of whose instantons may resolve SM naturalness issues [21–24]. Furthermore now we have *three* factors of $SU(3)$ gauge symmetry, which is obviously preferred.

This divine favor of the number 3 may also explain new physics appearing in the early [25] or late [26] universe (anti)nuclei abundances as the result of the Standard Model's exact $\mathbb{Z}^B_{N_g}, \mathbb{Z}^L_{N_g}$ symmetries, where N_g is the number of generations [27, 28]. This means that not only is a fourth generation empirically disfavored, but its presence is theologically impossible.

C. Biblical interpretation

This work reinterpreting an otherwise inconsistent Biblical passage in terms of real fundamental physics effects should usher in a new era of Biblical literalism. We must scour every word of spiritual texts anew with the benefit of our modern understanding of fundamental physics to uncover further clues. Can the plague of thunderstorm (Exodus 9:23-24) be attributed to MACRO dark matter raining down through the atmosphere [29]? Was the Red Sea parted (Exodus 14:21-22) with a domain wall repelling the water? Could the 'pillar of fire' which guided the Israelites out of Egypt (Exodus 13:21) have been this same cosmic string, with the large energy perhaps coming from baryon decay catalysis [25, 30]?[5]

Yet still we must ask: Why did God direct the construction of this basin around a cosmic string? Depending on the fermionic zero modes of such a cosmic string, it could be capable of generating enormous amounts of energy for free by catalyzing baryon plus lepton number violation. Confining such a cosmic string would enable essentially unlimited energy production.

The brazen sea would also trap this important clue about ultraviolet physics to allow for further study. Then, what of this cosmic string today? Unfortunately this important data set is lost as the Chaldeans destroyed the basin during the razing of the First Temple (2 Kings 25:13), those heretics. So much for Babylonian science.

V. CONCLUSIONS

We believe that our new development will be a brand-new historical event that opens a new era for humankind [32].

ACKNOWLEDGEMENTS

I could not have written this were it not for my parents, Dr. Edward J. Goodwin and God. This manuscript was written during my personal time and has not been supported by any university resources nor other funding sources. My thanks to S. Alipour-fard, I. Allali, D.W.R. Ho, W. Liu for their comments on and laughter at a draft of this manuscript. The afterword 'The Joy of Reductionism' can be read on my website here.

[4] Unpublished work of SK to appear later this year.

[5] Note that Brennan, Grewal, Yang have recently claimed this effect does not occur [31], but we have faith that it does [6]. Also their results do not apply to the case where the cosmic strings have fermionic zero modes, which in the magnetic monopole analogue are crucial to the catalysis effect.

FIG. 1. This specific document is literally true because while I was first learning how to comprehend the world the adults I most trusted told me it was.

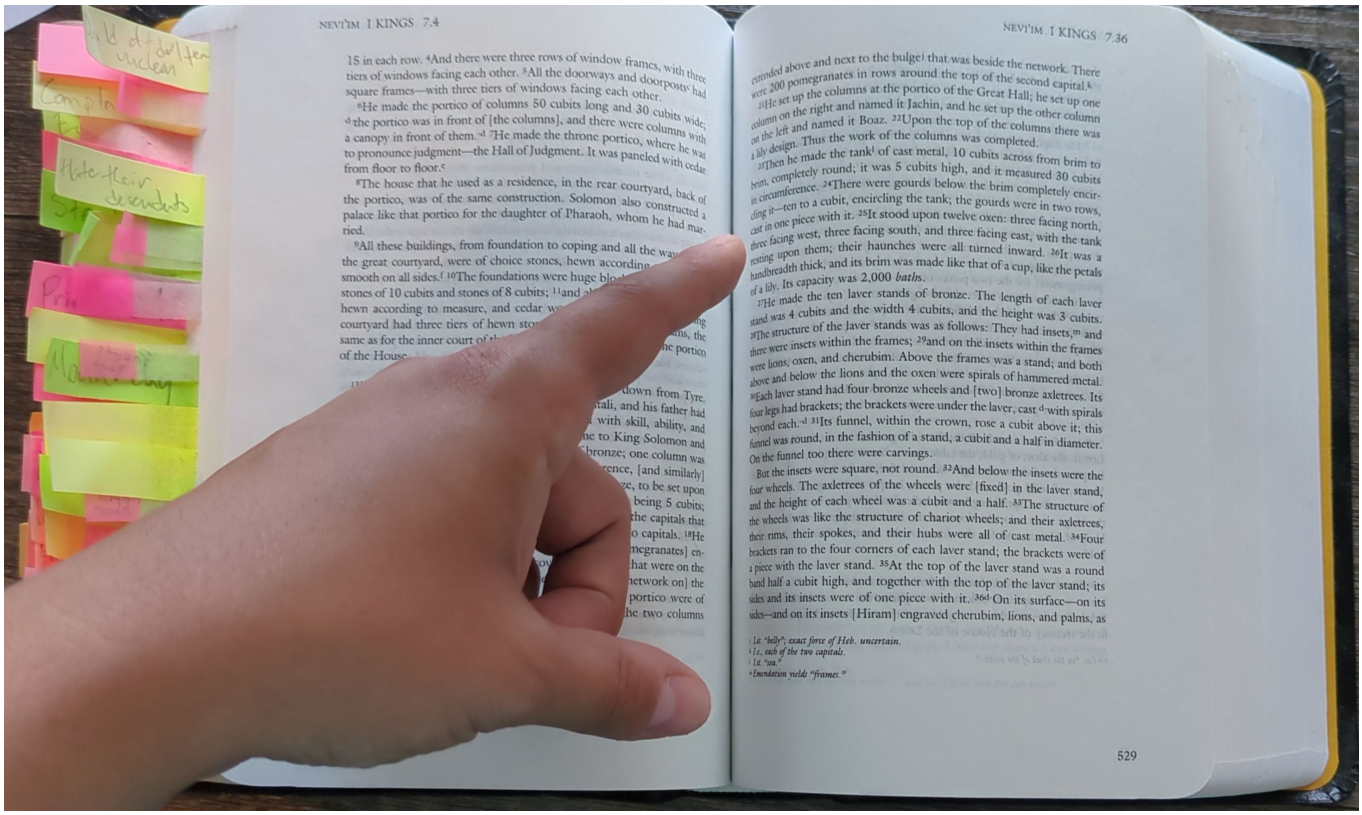

FIG. 2. Look it's right there!

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