# EINSTEIN'S NONPHYSICAL GEOMETRY

Terence R. Witt

**Abstract**: General relativity is a major driving force in the pursuit of modern cosmology. In this paper the author argues that its geometry should not be taken literally as the physical representation of space and time.

## I. EINSTEIN'S NON-PHYSICAL THEORY

The General Theory of Relativity is lauded not only for its predictive power but also for its mathematical eloquence. The foundation of this theory is the ultimate expression of simplicity. It originates from our inability to experimentally distinguish:

- The simultaneity of two events separated in space.
- The difference between an accelerating observer and the presence of a gravitational field.

The complete mathematical rendering of this concept is too involved to present as an overview, but a brief description of one of its metrics follows.

### DIFFERENTIAL GEOMETRY

The Lorentz transform demonstrates a relationship between measured space and time in terms of a single dimension. The generalization of this concept to three dimensions is:

$$ds^2 = c^2 dt^2 - \left(dx^2 + dy^2 + dz^2\right) \tag{1}$$

where a differential interval of space-time *ds* has competing components of space and time.

Since space and time are the primary components and our only interest is in radially symmetric fields, this can be simplified to:

$$ds^2 = c^2 dt^2 - dr^2 \tag{2}$$

Minkowski space is the mathematical formalization of the relativity of simultaneity. Two events in space-time are separated by a certain amount of distance, a certain amount of time, or a combination of both. They are considered simultaneous if the time difference between them is zero ($dt = 0$). In this case the space-time distance between them is described strictly in terms of space. This is called the *proper distance*, and it is equal to:

$$dL = \sqrt{-ds^2} \tag{3}$$

Substitution of Equation (2) into this expression with ($dt = 0$) yields a difference of space:

$$dL = dr \tag{4}$$

The maximum passage of time occurs when there is no change in space. This is called the *proper time*, and is equal to:

$$d\tau = \sqrt{\frac{ds^2}{c^2}} \tag{5}$$

when ($dr = 0$). Proper distance represents two events simultaneous in time; proper time represents two events simultaneous in space.

Although time is often interpreted in relativity theory as a fourth dimension external to space, the Minkowski metric actually demonstrates this is not true. If time were truly an extension of space then the distance between any two events would have the form:

$$dw^2 = c^2 dt^2 + dr^2 \tag{6}$$

where differences in space and time compound and compliment each other. This is not the case. A difference of time occurs at the expense of a difference in distance, *because time is a contextual difference of space*. This is consistent with space as an infinite three-dimensional volume as derived by Null principles, and is the basis of Equation (2) above:

$$ds^2 = c^2 dt^2 - dr^2 \tag{7}$$

Distance and space-time distance for four events are shown in the figure below:

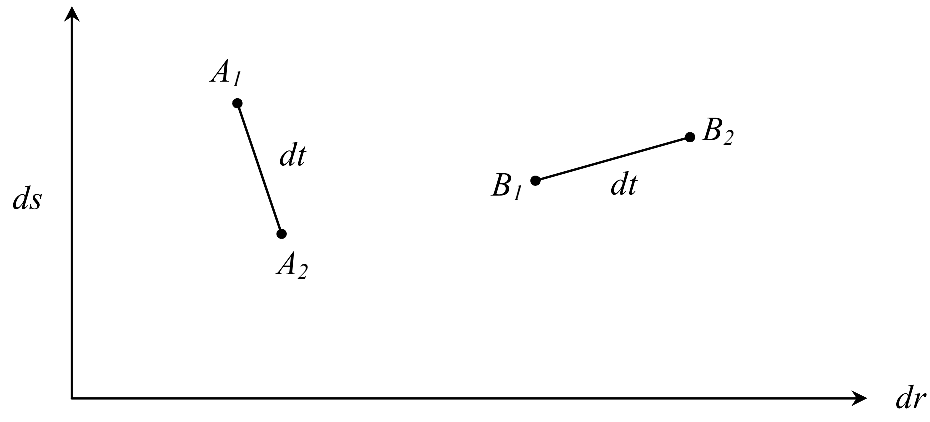


Figure (1) Minkowski space depicts time as a dependent dimension

If two events such as $\mathbf{A}_1$ and $\mathbf{A}_2$ are close in space, yet distant in space-time, then there is a large temporal difference between them. Conversely, if two events $\mathbf{B}_1$ and $\mathbf{B}_2$ are about the same distance apart in either space or time, then the space-time distance between them is quite small even though they may quite remote from each other. What this means is all events along a photon's path are virtually indistinguishable because the *ds* interval is zero. Minkowski space is a direct reflection of the Null Axiom. It is yet another way to express the interdependence (closure) between the space and time of the universe.

## II. THE SCHWARZSCHILD METRIC

The General Theory of Relativity describes how the metric of Equation (2) is distorted in the vicinity of massive objects. Space is typically portrayed as being stretched radially toward the center of the field as it is compressed laterally, and time experiences a general dilation. Although there is no brief explanation of the derivation of the equations of General relativity, many of their solutions are fairly straightforward. The simplest is the field around a non-rotating spherical object. It is called the *Schwarzschild metric*:

$$ds^2 = \left( cdt\sqrt{1 - \frac{2GM}{rc^2}} \right)^2 - \left( \frac{dr}{\sqrt{1 - \frac{2GM}{rc^2}}} \right)^2 - (rd\theta)^2 - (r\sin\theta d\phi)^2 \tag{8}$$

where *ds* is a differential unit of length in four-dimensional space-time as presented above and $\theta$ and $\phi$ are polar coordinates in space.

This can be further simplified by restricting it to the space-time extending normal to the surface of the spherical body ($d\theta = d\phi = 0$). The metric along any radial distance from the center of the object is given by:

$$ds^2 = c^2dt^2\left(1-\frac{2GM}{rc^2}\right)-\frac{dr^2}{\left(1-\frac{2GM}{rc^2}\right)} \tag{9}$$

This will be referred to as the *radial Schwarzschild metric*.

Note this is merely a modified version of the undistorted metric of Equation (2):

$$ds^2 = c^2dt^2 - dr^2$$

What Equation (9) says is time contracts and distance expands in the presence of a gravitational field. Unlike the radial field equations associated with a particle's core, Equation (9) only relates differential lengths at various positions within a distorted metric. There is no absolute metric. It can, however, be converted into a field of spatial deflection for comparative purposes. The magnitude of spatial distortion in the Schwarzschild metric can be isolated by restricting it to a coordinate system simultaneous in time ($dt = 0$).

Applying this constraint to Equation (9) results in:

$$ds^2 = -\frac{dr^2}{\left(1-\frac{2GM}{rc^2}\right)} \tag{10}$$

Here the only differences between its points are purely spatial. Applying Equation (3) yields a distance metric of the form:

$$ds = dL = \frac{dr}{\sqrt{1-\frac{2GM}{rc^2}}} \tag{11}$$

The distended length between two radii is the integral of the $dL$ length element:

$$L = \int_{r=R_1}^{R_2} dL = \int_{r=R_1}^{R_2}\left(\frac{dr}{\sqrt{1-\frac{2GM}{rc^2}}}\right) \tag{12}$$

The change in length per unit length is the slope of the internal deflection distribution along space, similar to the external slope of the particle field:

$$t_r'(r) = \frac{\int_{r=R_1}^{R_2}\left(\frac{dr}{\sqrt{1-\frac{2GM}{rc^2}}}\right) - (R_2 - R_1)}{(R_2 - R_1)} \tag{13}$$

where the term $t_r$ will be used to denote a relativistic difference of space along space, and will be referred to as *relativistic deflection*. In the limit $(R_2 - R_1) \to dr$ this becomes *relativistic slope*:

$$t_r'(r) = \frac{1}{\sqrt{1-\frac{2GM}{rc^2}}} - 1 \tag{14}$$

When $r \to R_S$, the Schwarzschild radius of $(2GM/c^2)$, slope goes to negative infinity. When $r$ is large in comparison to $R_S$, Equation (14) resolves to:

$$t_r'(r) \to \frac{GM}{rc^2} \tag{15}$$

To obtain the magnitude of the deflection of space along space from Equation (15), integrate with respect to $r$:

$$t_r(r) = \left(\frac{GM}{c^2}\right)\left(\ln(r) - \ln(R_{\{0\}})\right) \qquad \{r >> R_S\} \tag{16}$$

where the constant of integration is defined in terms of the logarithm of a radius $R_{\{0\}}$. This will be called the *zero deflection radius*, for when $r$ is equal to this radius relativistic deflection is equal to zero. The deflection in this expression is positive as a matter of convention.

Equation (16) demonstrates a curious aspect of General Relativity. It describes a deflection field *increasing without bound with distance*. Another way to look at this is in terms of the deflection at some radius $R$ relative to infinity:

$$t_r(R >> R_S) = \int_{r=R}^{\infty} t_3' dr = \int_{r=R}^{\infty} \frac{GM}{rc^2} dr = \frac{GM}{c^2}\left(\ln(\infty) - \ln(R)\right) = \infty \tag{17}$$

Since the deflection at infinity does not converge, the actual magnitude of deflection at any location in the field is undefined with respect to infinite range. Unlike the deflections of a unit polarvolume field which have a specific value at a given radius, decreasing to zero at infinity, spatial deflections in the General theory do not converge with increasing values of $r$. *The presence of a finite mass in space adds an infinite amount of distance between any two infinitely remote points in its field*.

The following graph shows relativistic deflection from Equation (16) as a function of radius in the vicinity of the sun, where zero deflection occurs at its surface:

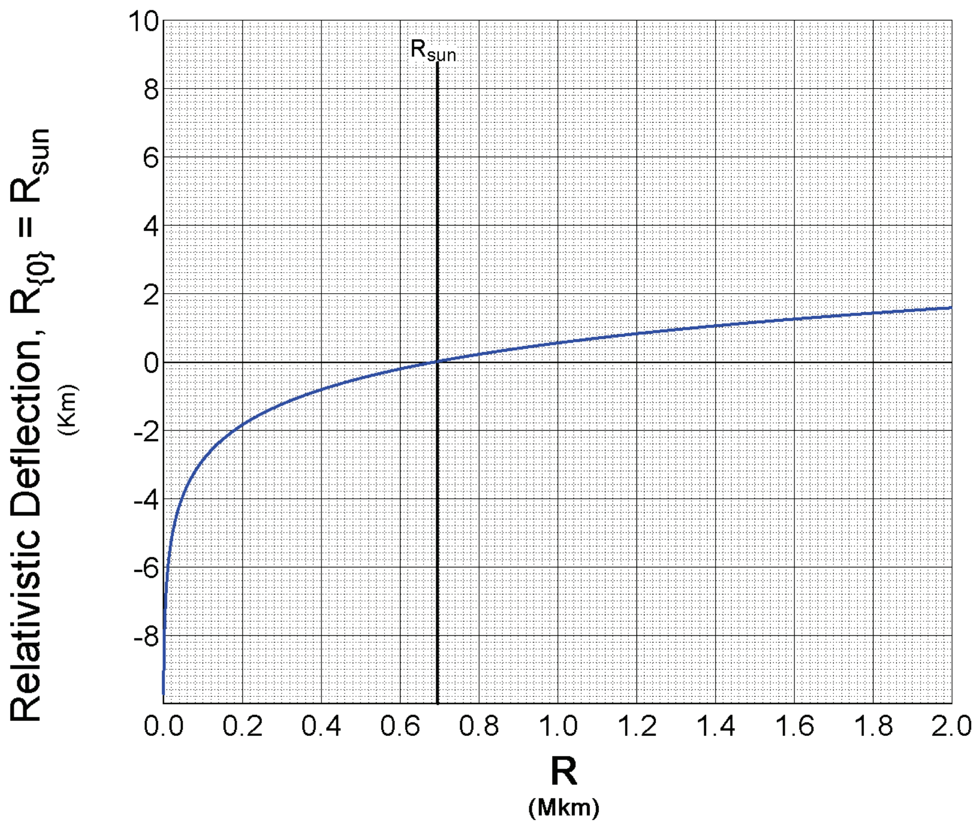


Figure (2) Relativistic deflection as a function of radius

Interior to the sun, deflection is negative and decreases until our condition of ($r >> R_S$,) is no longer valid. Beyond the sun's surface deflection is positive, increasing with no limit to positive infinity. Choosing different values for $R_{\{0\}}$ moves the radius of zero deflection, *but the Schwarzschild metric is non-convergent regardless of the value of* $R_{\{0\}}$. Yet this curious property isn't the most compelling reason why the distortion described by the General Theory has no correspondence to actual spatial displacement. *Relativistic deflection is not an accurate portrayal of the physical spatial deflection because it contains no causative agent for its variation with distance*.

The General Theory does not contain a single questionable or unreasonable assertion, and it results in a spectacularly accurate portrayal of gravitational interaction. But it also fails to show us the source of the fields it describes. It can never access this information because it is isolated from deep reality by its own postulates. Gravitational phenomena are an indirect consequence of the underlying matter field; they do not define this field.