MINKOWSKI'S FOUNDATIONS OF SPACETIME PHYSICS AND SDSS DATA MOTIVATE REASSESSMENT OF ΛCDM COSMOLOGY

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Although special relativity (SR) incorporates the unphysical conception of 'flat' spacetime, that idealization holds to commensurate arbitrarily-high accuracy for an arbitrarily-small volume of space in free fall, which model accuracy for a given volume is inversely related to local field strength (i.e., curvature). In accord with the Minkowski metric,

$$\mathrm{d}\tau = \sqrt{\mathrm{d}t^2 - \mathrm{d}x^2 - \mathrm{d}y^2 - \mathrm{d}z^2}\,, \tag{1}$$

we model such a differential volume with four basis vectors, one of which represents the *local* proper time coordinate (i.e., representing a valid physical measurement of time exclusively within the volume of space bounded by the other three defining basis vectors: $\mathrm{d}\boldsymbol{x}, \mathrm{d}\boldsymbol{y}, \mathrm{d}\boldsymbol{z}$). As such, the measurable local proper time coordinate $\mathrm{d}\boldsymbol{t}$ is clearly a *geometric object*, being the local normal in R^4 to measurable 3-space in free fall.

A sound cosmological model is based on the singular rational foundation of a finite, boundaryless, symmetric cosmic volume incorporating a universally-conserved amount of mass-energy; no other approach can be fruitful. Translated into the language of pure mathematics (i.e., *geometry*) such a volume constitutes a Riemannian topological 3-sphere, having a total volumetric bounding area of $2\pi^2R^3$ and a closed spatial geodesic, which is the circle C of circumference $2\pi R$ in R^4. The indirectly-measurable Cosmic radius R may be conveniently normalized.

Combining the two foregoing ideas yields a parsimonious geometric model of the Cosmos. Two of the three spatial dimensions being suppressed, it incorporates a single dimension of *local* space that is given maximum cosmological extension (thus yielding the circle C) and also a strictly-local relativistic time coordinate: At each unique point on C, the local radial (i.e., the local normal to space) represents the local proper time coordinate there. The inherent non-parallelism between any two such local-time-coordinate vectors in R^4 reflects a symmetric relativistic time dilation between their respective locations that is quantified by the inverse dot product

$$\frac{\mathrm{d}t}{\mathrm{d}\tau} = \frac{1}{\cos\chi} = \sec\chi \qquad \left(\angle\chi = \frac{r}{R}\right)\,, \tag{2}$$

where r is the distance between a reference observer on C with local proper time coordinate $\mathrm{d}t$ and a remote location with distinct local proper time coordinate $\mathrm{d}\tau$. As in SR, the relationship is symmetric; there are no preferred locations on C.

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Given the definition of redshift induced by time dilation

$$z = \frac{\mathrm{d}t}{\mathrm{d}\tau} - 1\,, \tag{3}$$

then combining Eqs. (2) and (3) yields a distinctly non-linear redshift-distance relationship:

$$r(z) = R\cos^{-1}\left(\frac{1}{z+1}\right) \tag{4}$$

This simple new approach, which rests exclusively on Minkowski's geometric interpretation of special relativity (1908) and Riemann (1854), yields a predictive redshift-distance formula (4) that is notably consistent with Willem de Sitter's 1917 exact solution to the Einstein field equations (EFE):

$$\mathrm{d}s^2 = -\mathrm{d}r^2 - R^2\sin^2\frac{r}{R}\left(\mathrm{d}\psi^2 + \sin^2\mathrm{d}\psi\mathrm{d}\theta^2\right) + \cos^2\frac{r}{R}c^2\mathrm{d}t^2 \tag{5}$$

For fixed distance r between observers ($\mathrm{d}r = \mathrm{d}\psi = \mathrm{d}\theta = 0$),

$$\mathrm{d}s^2 = \cos^2\frac{r}{R}c^2\mathrm{d}t^2 \quad \to \quad \mathrm{d}\tau = \cos\frac{r}{R}\mathrm{d}t\,, \tag{6}$$

which formula is identical to Eq. (2), the former equation having been derived independently of the EFE from the two aforementioned simple geometric considerations.

A likely initial subjective 'problem' with this predictive formula is the obvious conflict with decades of published data asserting small error bars and claiming to confirm a linear redshift-distance relationship in support of the 'Hubble law.' According to all of that prior literature, Eq. (4) is inconsistent with empirical observation, yet at one time a similar majority opinion, supported by centuries of academic literature, held for heliocentric orbits. Modern, objective, statistically-significant astrophysical data, primarily sourced from the Sloan Digital Sky Survey (SDSS) shows that Eq. (4) and correlated predictive formulas provide an essentially perfect fit to that data, which was not driven by a theoretical agenda and associated confirmation bias. Contrariwise, the 'Hubble law' is definitively falsified.

In support of this brief abstract submitted to the *Second Hermann Minkowski Meeting on the Foundations of Spacetime Physics*, a comprehensive self-study slide deck is available with additional information on the topic; meeting participants may benefit from a personal critical review of that information, prior to attending the author's anticipated talk:

sensibleuniverse.net/slides