A ‘creationeering’ perspective on dark matter

Tichomir Tenev

Among creationists, dark matter (DM) is often brought up in the context of rebutting the big bang model. But, in such a context, DM is actually tangential to the origins debate and needlessly controversial. The gravitational anomalies commonly attributed to DM, henceforth *dark matter effect* (DMe), have been readily observable for decades. Yet, in another context, DMe is highly relevant. As shown in Tenev and Horstemeyer,[1] DMe is likely evidence for the macroscale structure of space, and therefore reveals design and purpose.

This is why I advocate for a *creationeering* perspective on DM. Horstemeyer[2] coined the term to describe the combined application of engineering design principles and entrepreneurial purpose. Engineering creates functionality, and entrepreneurship creates value. God is therefore the greatest engineer and entrepreneur. Incorporating design and purpose into our scientific research will yield more fruit to society by which we glorify the Creator and demonstrate the authority of His Word.

Background

DM ideas date back to the 1920s and 1930s,[3–9] but it wasn’t until the 1970s and 1980s that DM became popular as it was used to explain anomalous rotational curves of galaxies[10,11] and gravitational lensing.[12] Only later, the big bang (BB) model co-opted DM to align BB predictions with observations and provide an explanation for early structure formation.[13] Therefore, as Faulkner admonishes,[14] young-earth creationists should not view DM as merely a rescue device for the big bang. At the same time, all attempts to directly confirm the existence of DM have failed after decades of searching.[15] Therefore, while we acknowledge the abundance of observed DMe, we should look elsewhere for its explanation, not at DM.

In a recent paper advancing a non-DM explanation for DMe, Li[16] argued that the DMe apparent in the Milky Way galaxy resulted from underestimating the gravitational effects of its non-spherical mass distribution. During the 1980s, Milgrom[17] proposed an adjustment to Newton’s second law of motion, a.k.a. Modified Newtonian Dynamics (MOND), to explain the larger-than-expected accelerations observed at galactic edges. A common challenge for these types of explanations is that they do not generalize well.[18] Nevertheless, MOND may be a clue to a more satisfactory explanation as discussed below.

A clue from MOND: DMe may be a geometric effect

MOND postulates that in the regime of very small accelerations $a \ll a_0$, the force that caused a is no longer proportional to it, but to its square. The constant $a_0 = 1.2 \times 10^{-10}\text{m/s}^{-2}$, also known as the MOND parameter, is determined from fitting the model to observations of galactic rotation curves. With this modification, MOND is able to explain the observed excess centripetal acceleration at the edges of galaxies. Not surprisingly, there are many outlier galaxies that do not fit MOND’s predictions, but remarkably many do! A single-parameter model like MOND, should not be able to fit the data so well unless the parameter has ubiquitous physical significance.

The MOND parameter a_0 behaves as a kind of a length-scale parameter, except that is acceleration and not length. However, there is a natural way to understand acceleration in geometric terms (see figure 1) and show that a_0

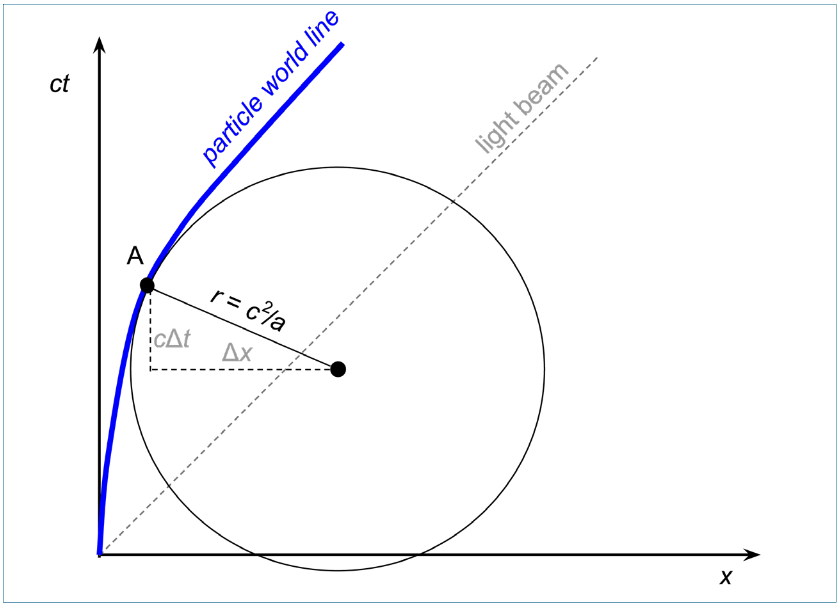

Figure 1. Geometric interpretation of acceleration on a space-time chart. A particle, the world line of which is illustrated accelerates at a point with acceleration $a = c^2/r$, where r is the radius of the tangent circle. Note that the radius must be calculated using a relativistic metric where time and space figure with opposite signs. For example, assuming nearly flat (Minkowski) spacetime: $r^2 = \Delta x^2 - c^2\,\Delta t^2$.

is indeed a length-scale parameter in disguise.

Thus, the length value r_0 corresponding to the MOND parameter is: $r_0 = c^2/a_0 = 7.49 \times 10^{26}$ m. This value is uncannily comparable to the Hubble radius $r_H = 1.36 \times 10^{26}$ m, which is the distance to the edge of the observable universe (without adjusting for expansion). It appears that MOND's apparent success points to a cosmos-sized geometric effect, while MOND's misses may be due to second-order local, galaxy-sized geometric effects.

By way of analogy, consider the geometric effect of Earth's curvature on road construction planning: it only begins to matter at continent-sized projects. At the same time, local geometric effects due to the relief of the terrain contribute on a local scale and may enlarge or reduce the geometric effect of Earth's curvature. Could DMe be likewise the result of superimposed local + global geometric effects of physical space itself?

DMe due to the inherent structure of space

In Tenev and Horstemeyer,[1] we demonstrated that a region of physical space with non-flat neutral curvature will amplify the gravity of the matter placed in it. We called this the *inherent structure hypothesis* (ISH) explanation for DMe. ISH is illustrated in figure 2, where physical 3D space is visualized as bending into an extra fourth spatial dimension w. Per Newton's Law of Gravity, the gravitational acceleration at point P due to mass M_B centred at point B should have been $a_P = GM_B/l^2$ where $l = |BP|$. However, we can show[1] that the actual acceleration is greater, namely:

$$a_p = \frac{GM_B}{r^2} > \frac{GM_B}{l^2} \qquad (1)$$

where r is the flat projection of l. In other words, in pre-curved space, gravity attenuates slower than the inverse square distance.

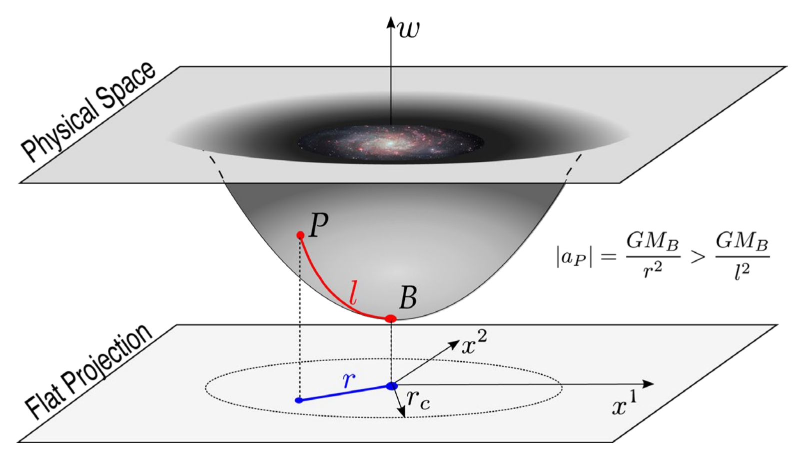

Figure 2. Dark matter effect (DMe) due to the inherent structure of physical space (after Tenev and Horstemeyer, ref. 1)

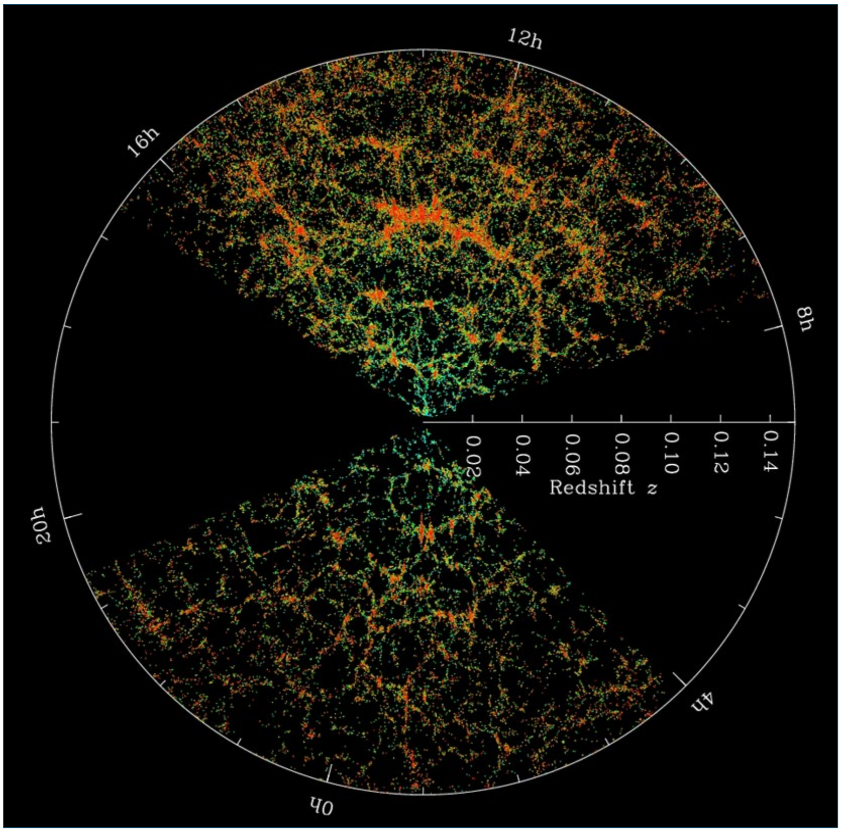

Figure 3. The large-scale structure of the universe consisting of filaments and voids could be revealing the underlying inherent structure of space. Each dot is a galaxy; the colour bar shows the local density.

Image: From the Sloan Digital Sky Survey; sdss4.org

Here is an intuitive explanation for the modified inverse-square law in eqn (1) that is simpler than the more rigorous derivation in reference 1. Pretend that gravity is a force field, as per the Newtonian model, and imagine its flux lines emitting from a point source at B in figure 2. The strength of the field at point P is proportional to the flux density at P, which, in turn, is inversely proportional to the surface of the sphere centred at B and passing through P. (In figure 2, which omits a spatial dimension, such a sphere can be visualized as a hoop through P that circles the 'dimple'.) In a flat space, the surface of said sphere would have been proportional to the square of the radius $|PB|$, which is how we get the familiar inverse-square law. But, in a positively curved space, as in figure 2, the sphere will be smaller, and thus the flux density stronger. More precisely, the sphere surface through P is proportional to the flat projection of $|PB|$ that is r on the figure, which is how we get to eqn (1).

Taking a step back, here is the picture that emerges: there is a cosmos-sized curvature at the length-scale of the Hubble radius that amplifies tiny gravitational accelerations leading to a first-order DMe, which is what MOND captures. In addition, there are local, galaxy-sized spatial distortions that further amplify or reduce the cosmic-sized DMe. The superposition of the cosmic-sized and galaxy-sized spatial curvature form the inherent structure of space. The observed DMe is a manifestation of this inherent structure and not of some hidden mass.

What other evidence is there for space having structure? Figure 3 shows the large-scale structure (LSS) of matter in the cosmos according to measurements from the Sloan Digital Sky Survey.[19] One observes galactic matter shaped into filaments and sheets with huge voids between them. The size of these structures is too large for gravity alone to have influenced them. But 'folds' and 'dimples' comprising the inherent structure of space could in fact account for them. Likely, LSS is yet another manifestation of the inherent structure of space besides DMe.

Figure 4. Design principle: constitution + structure = behaviour.

The creationeering perspective for dark matter and for all of cosmology

We study conventional engineering artifacts through understanding of (1) the materials, (2) the constitutive relations governing those materials, and (3) the material structures. These three determine the behaviour of the artifact, which, in turn, points to its purpose. Hooke's Law is an example of a constitutive relationship between the stresses and deformation of a material that depends on the nature of the material. Furthermore, while the same constitutive law governs both a flat sheet of metal and a truss made of the same metal, these two differ in behaviour because their structures are different (see figure 4).

In the same way, we should study the cosmos according to its

1. material-like elements, which are physical space and different types of matter, its' here
2. constitutive relations, which are the laws of physics, like the equations of General Relativity (GR), and its'
3. structures, which are discerned in the distribution of matter and curvature of space.

Why is this a reasonable perspective? It is evident that conventional matter can be shaped. We also know from Scripture, and more recently from GR, that space, too, has measurable geometry that matter affects. While it is commonly presumed that the neutral shape of space (when no matter is present) is flat, this need not be the case. In fact, perfect flatness is a unique configuration for a material-like thing, and, as such, it is the exception, not the norm.

We need to see the cosmos as a work of engineering similar to, for example, how one looks at a building construction. This necessarily involves questions about purpose and design. What purpose is served by the inherent structure of space that is revealed in LSS and DMe? Perhaps, just like in a house, structure is needed for stability, communications, transportation, and the support of life in general.

References

1. Tenev, T.G. and Horstemeyer, M.F., Dark matter effect attributed to the inherent structure of cosmic space, *Int. J. Modern Physics D* **28**, no. 06, 1950082, 2019.
2. Horstemeyer, M.F., Creationeering™: a K-12 educational system that integrates engineering-business from a biblical perspective, *Proceedings of the 9th International Conference on Creationism*, p. 631, 2023.
3. Kapteyn, J.C., First attempt at a theory of the arrangement and motion of the sidereal system, *Astrophysical J.* **55**:302, 1922.
4. Oort, J.H., Observational evidence confirming Lindblad's hypothesis of a rotation of the galactic system, *Bulletin of the Astronomical Institutes of the Netherlands* **3**:275, 1927.

5. Oort, J.H., The force exerted by the stellar system in the direction perpendicular to the galactic plane and some related problems, *Bulletin of the Astronomical Institutes of the Netherlands* **6**:249, 1932.
6. Zwicky, F., The redshift of extragalactic nebulae, *Helv. Phys. Acta* **6**:110–127, 1933.
7. Zwicky, F., On the Masses of Nebulae and of Clusters of Nebulae, *Astrophysical J.* **86**:217, 1937.
8. Holmberg, E., Investigation of binary and multiple galaxies together with an investigation of some general metagalactic problems, *Ann. Lund Observatory* **6**:3–173, 1937.
9. Smith, S., The mass of the Virgo cluster, *Astrophysical J.* **83**:23, 1936.
10. Rubin, V.C. and Ford, W.K. Jr, Rotation of the Andromeda nebula from a spectroscopic survey of emission regions, *Astrophysical J.* **159**:379, 1970.
11. Rubin, V.C., Ford, W.K. Jr, and Thonnard, N., Rotational properties of 21 SC galaxies with a large range of luminosities and radii, from NGC 4605/R = 4kpc/to UGC 2885/R = 122 kpc, *Astrophysical J.* **238**:471–487, 1980.
12. Lynds, R. and Petrosian, V., Giant luminous arcs in galaxy clusters, *Bulletin of the American Astronomical Society* **18**:1014, 1986.
13. Liddle, A., *An Introduction to Modern Cosmology*, Wiley, 2015.
14. Faulkner, D.R., How should recent creationists respond to dark matter and dark energy? *Proceedings of the 9th International Conference on Creationism*, p. 1, 2023.
15. Liu, J., Xun, C., and Xiangdong, J., Current status of direct dark matter detection experiments, *Nature Physics* **13**(3):212–216, 2017.
16. Li, E., Dark matter or additional gravitational forces generated by non-spherical mass distributions? *Reports in Advances of Physical Sciences* **1**, no. 2, 1750004, 2017.
17. Milgrom, M., A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis, *Astrophysical J.* **270**:365–370, 1983.
18. Randriamampandry, T. and Carignan, C., Galaxy mass models: MOND versus dark matter haloes, *Mon. Not. Roy. Astron. Soc.* **439**(2):2132–2145, 2014.