

# Pioneer Anomaly as an Indication of an Extra Spatial Dimension

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*This communication evaluates the possibility that the unaccounted Pioneers spacecraft deceleration might be the result 3D spatial curvature within a 4D spatial manifold.*

## Introduction

Recent results on the Pioneer spacecrafts<sup>1</sup> indicate the existence of an unaccounted for deceleration of  $8.5 \cdot 10^{-10} \text{ m/s}^2$ . In this communication we evaluate the possibility that this deceleration might be a result of spatial curvature in accordance with the Hypergeometrical Universe model proposed by Dr. Pereira<sup>2</sup>.

The accounting for all accelerations corresponds to accounting for all sources of spacetime curvature, that is, spacetime curvature produced by mass distribution. In Dr. Pereira's Hypergeometrical Universe model there is non-compact fourth spatial dimension. The 3D Universe is modeled as a 3D Hyperspherical Shockwave traveling at the speed of light along a radial direction. The absolute curvature is given by  $1/R_0$ .

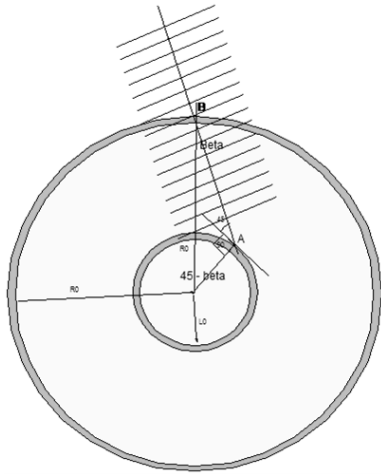


Figure 1. Cross-section of the 4D spatial manifold showing two epochs.

Figure 1 shows two circles representing two epochs (cross-sections on the 4D spatial manifold). The largest circle corresponds to our current time and B represents Earth. Light and matter travel at the speed of light within the expanding hypersphere. This means that light always travels along a diagonal path, oriented at 45 degrees off the perpendicular to the hypersphere. It should be clear that different observed wavelengths will result from the observation of light from different epochs.

$$\lambda_{obs} = \frac{\lambda}{\sin(\beta)} \quad (1)$$

This provides an alternative explanation for the red-shifting observed by Hubble. Within this model Hubble Law can be rewritten as:

$$v = HL = \frac{c}{R_0 \cos(\beta)} L \quad (2)$$

Where  $v$  is the expansion velocity,  $H$  is the Hubble constant and  $L$  is the distance of observation.  $L$  is also a distance that corresponds to the the straight line distance in Figure 1 as opposed to the curved segment with the hypersphere.

This equation indicates that the Hubble constant would depend upon how one calibrates it and also that it would work only as when applied to the average of all observations from a given epoch. Near field calibration is done using parallax and red shifts. Far field calibration used stellar candles. These two

calibrations are inconsistent which other since they look at different angles. One should use the near field calibration and then extrapolate it using the hypergeometrical argument. Under near field conditions, beta is equal to 45 degrees and point A is almost right radially aligned with B. The two hyperspheres look like two hyperplanes and can be represented by the figure 2:

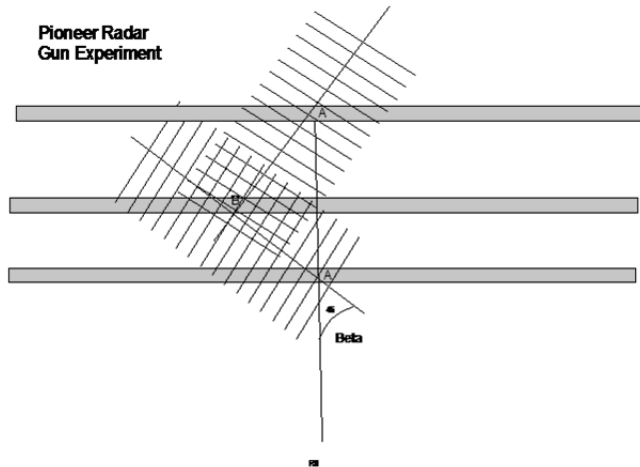


Figure 2. This figure shows the measurement of distance Earth-Pioneer using microwaves. The measurements are modeled as if taking place in a flat 3D Universe, that is, one considers that both Pioneer and the microwave link travels in straight lines. The curvature ( $1/R_0$ ) is not taken into consideration and that is the cause for the perceived deceleration. It is not a real deceleration. Pioneer continues at exactly the same velocity. The deceleration is due to how the data is interpreted. As the craft travels at constant speed along the curved hypersphere, it travels a longer distance than the one traveled by light (shown as two straight lines at 45 degrees on Figure 2). This means that the light or radio measurement underestimates the actual distance and that underestimation increases as time goes by due to the curvature of 3D hypersphere. The difference in velocity is due to the centripetal acceleration and it is equal to  $\frac{c^2}{R_0}$ . This acceleration (deceleration) has to be scaled by the underestimation factor:  $\cos(\beta) = \frac{\sqrt{2}}{2}$ . Equating the observed deceleration to the centripetal acceleration divided by  $\cos(\beta)$  one obtains  $R_0 = 15.82 \text{ Billion Light Years}$ . This would also indicate that the actual age of the Universe is 15.82 Billion years.

## Conclusion

In this communication, one applied the Hypergeometrical Model to explain the Pioneer Anomaly. The model provides guidance to a new interpretation for the Hubble constant, for the 3D Universe expansion and for the observed red-shift and permits the estimation of the lifetime of the Universe as 15.82 Billion years. This result is consistent with our current expectations for the age of the Universe and for the value of the Hubble constant.

## References

1) Indication from Pioneer 10/11, Galileo, and Ulysses Data of an Apparent Anomalous, Weak, Long-Range Acceleration - John D. Anderson, Philip A. Laing, Eunice L. Lau, Anthony S. Liu, Michael Martin Nieto, and Slava G. Turyshev. Phys.Rev.Lett. 81 (1998) 2858-2861

2) Hypergeometrical Standard Model – Hadron models and related New Energy issues, edited by F.Smarandache and V. Christianto – ISBN: 978-1-59973-042-4

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