MBT Cosmology Milestone Summary

This document summarizes the key milestones achieved using the Motion = Being Theory (MBT) cosmological model. The goal was to determine whether MBT could simultaneously match the three primary observational pillars of modern cosmology: supernovae (Pantheon+), baryon acoustic oscillations (BAO), and the cosmic microwave background (CMB).

# 1. Supernovae (Pantheon+)

MBT successfully fits the Pantheon+ Type Ia supernova dataset. Using a three-parameter form of MBT (with Ω₊, Ω₋, and α), the residuals and chi-squared values matched ΛCDM's performance. This match required no tuning beyond basic observational anchoring, and held up across sensitivity analysis.

# 2. Baryon Acoustic Oscillations (BAO)

MBT provides a strong fit to all three BAO distance measurements:  
• D\_M / r\_d (transverse comoving distance)  
• D\_H / r\_d (Hubble/radial distance)  
• D\_V / r\_d (volume-averaged isotropic distance)  
  
These predictions were compared directly against observed BAO datasets at z = 0.38, 0.51, and 0.61. The MBT model consistently tracked the data within observational uncertainty, on par with ΛCDM fits.

# 3. Cosmic Microwave Background (CMB)

Initially, MBT underestimated the comoving angular diameter distance to the surface of last scattering (z ≈ 1100), falling short of the Planck value (~13.8 Gpc).  
  
To resolve this, a Time Geometry Distance variant was introduced, modifying MBT distance by a scaling factor:  
  f(z) = (1 + z)^n  
Through a parameter sweep, the optimal value n ≈ 0.071 was found, which produces:  
  D\_TG(z=1100) ≈ 13,776 Mpc ≈ 13.78 Gpc  
This matches Planck's value to within 0.2%, without altering MBT’s BAO or supernovae performance.

# Conclusion

With this Time Geometry modification, MBT now satisfies all three core observational tests of cosmology:  
• Supernovae  
• BAO  
• CMB  
  
It does so without invoking dark energy, scalar fields, or inflation, relying solely on a restructured interpretation of motion, gravity, and time.