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RADAR TESTING OF THE RELATIVE VELOCITY OF LIGHT IN SPACE

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ABSTRACT: *Published interplanetary radar data presents evidence that the relative velocity of light in space is c+v and not c .*

INTRODUCTION

There are three main theories about the relative velocity of light in space. The Newtonian corpuscular theory is relativistic in the Galilean sense and postulates that the velocity is c+v relative to the observer. The ether theory postulates that the velocity is c relative to the ether. The Einstein theory postulates that the velocity is c relative to the observer. The Michelson-Morley experiment presents evidence against the ether theory and for the c+v theory. The c theory explains the results of this experiment by postulating ad hoc properties of space and time. John G. Fox has examined all the previous evidence in a reasonably unbiased manner and concludes that there is no direct evidence that disproves either of the remaining theories.[1]

RADAR TEST OF RELATIVITY

Interplanetary radar presents the first opportunity to overcome technological limitations and perform conclusive ex-

periments. The radar observations are capable of measuring the distance with an accuracy of ± 1.5 km, the only important variable being the relative velocity of light in space. The Earth's rotation could cause a maximum difference in calculated distance between the two theories of 260 km when two radar stations, one on either side of the Earth, observe Venus at the same time during inferior conjunction. This difference would increase as the distance between the Earth and Venus increased. The incorrect theory would show Venus to be at different geocentric distances at the same time. Published interplanetary radar analysis presents evidence against the c theory.[2] The Lincoln Laboratory has made a complete c analysis of all the radar data up to 1966. The Einstein General Relativity time delay goodness-of-fit for the U.S. Massachusetts radar station was 1.57, the value for the Puerto Rico station was .97, the value for the U.S.S.R. Crimean station was 7.10. The article states "Although not apparent from inspection of Fig. 4, the residuals of the U.S.S.R. time-delay are systematically negative relative to the Arecibo and Lincoln Laboratory residuals during the time period (June 1964) when all three groups were observing Venus. This incompatibility cannot be removed by assuming simply that different units of time were used by the different observatories. The apparent discrepancy of up to five times the quoted measurement error thus remains unexplained." The incorrect theory would also show changes in calculated distances that would be proportional to variations in the relative radial velocity of a single radar station and Venus. The c theory predicts an insignificant variation due to the estimated maximum amount of intervening plasma, while the c+v

theory predicts a significant variation. Radar again presents evidence against the c theory. A published c analysis of all the Lincoln Lab's 1961 radar data on Venus, showed graphed variations in the calculated values of the a.u. that were far larger than their maximum estimate of all possible errors.[3] *They contain a daily component that is proportional to the velocity changes due to the Earth's rotation, a 30-day component that is proportional to changes in the Earth-Moon rotation, and a synodic component that is proportional to changes in the relative solar orbital velocities. These changes could not possibly be due to gravitational variations because the Lincoln Lab's complete c analysis showed planetary mass values extremely close to those used by Newcomb when he calculated the ephemeris used in the a.u. calculations. The Lab eliminated these variations when evaluating the data by using the least-mean-square curve fitting method. In their book "Radar Astronomy" page 159, Irwin I. Shapiro states "If the theory is wrong, the values of the parameters will usually be selected from the data in a manner that tends to cover up the inadequacies of the theory (for example, if least-mean-square curve fitting is employed)."*[4] *Page 170 of this book shows that the amplitude of the 1961 30-day variation made at 440 Mc/s is about five times larger than the amplitude of the 30-day variation in later data made at 1295 Mc/s. This presents evidence that part of the 30-day variation is due to intervening plasma. The amplitude of this variation is far too large to be explained in terms of c and is what one would expect to find if the velocity of light was c+v. Shapiro has published an article in "Scientific American" in which he presents evidence that supports Einstein's*

prediction that the Sun's gravity will decrease the speed of light when the radar photons pass close to the Sun.[5] Since Einstein based this prediction on a photon having the particle like property of mass, it tends to confirm the Newtonian corpuscular model as well as the $\underline{c}$ model.

I made both a $\underline{c}$ and c+v analysis of eight of the published 1961 observations.[6] Equation (1) was used to calculate the distance from the radar station to the surface of Venus for the $\underline{c}$ theory.

$$D_E = tc/2 - tv/2 \qquad (1)$$

Here t is the radar beam's transit time; $v = dc/2f$ the relative radial velocity, positive during approach and negative during recession; d is the Doppler shift; f is the frequency; D_E = $tc/2$ during the instant of reflection which is $t/2$ in the $\underline{c}$ theory but not in the c+v theory.

Equation (2) gives the distance for the c+v theory and is based on the fact that $c + (c+2v) = 2(c+v)$. The second term of both equations (1) and (2) corrects the distance to the time the beam returned to the transmitter. If it is made positive it will correct the distance to the time the beam left the transmitter.

$$D_G = t(c+v)/2 - tv/2 = tc/2 \qquad (2)$$

The additional data and most of the formulas used were taken from "The American Ephemeris and Nautical Almanac" and its "Explanatory Supplement." The value of the a.u. used was

149,597,850 km, the same as used by the Lincoln Lab in their analysis. Since it was determined during inferior conjunction, the $\underline{c}$ value should be close to the c+v value because the relative solar orbital velocity would have been zero.

FIG. 1 is a graph of the difference between the mean heliocentric radius vectors of Venus as calculated from Newcomb's tables, and Newcomb's perturbed radius vectors N and the calculated radar distances E ($\underline{c}$) and G (c+v) as transformed into heliocentric radius vectors. The mean values form a mathematically pure ellipse, so any variations in the values of the differences could not be due to them. Since a complete $\underline{c}$ analysis of all the radar data gave values of planetary masses extremely close to those used by Newcomb, and Newcomb's time corrections for the optical data were based on $\underline{c}$, the E curve should fit the N curve within the maximum possible estimated error of the radar data. The radar data presents evidence against the $\underline{c}$ theory because the N - E differences are far larger than any possible error, and they are proportional to changes in the relative radial velocity of the radar station and Venus.

The points on the G curve of FIG. 1 represent values from an ephemeris I made using Cowell's method of numerical integration of orbits and Newcomb's values for planetary masses. Note the close fit between Newton's Laws and his c+v corpuscular theory. This is in spite of the fact that Newcomb's values for planetary masses were based on $\underline{c}$ time corrections, and no attempt was made to correct the distances for the larger effects of intervening plasma since data at different frequencies for the same time and station were not available. The relatively

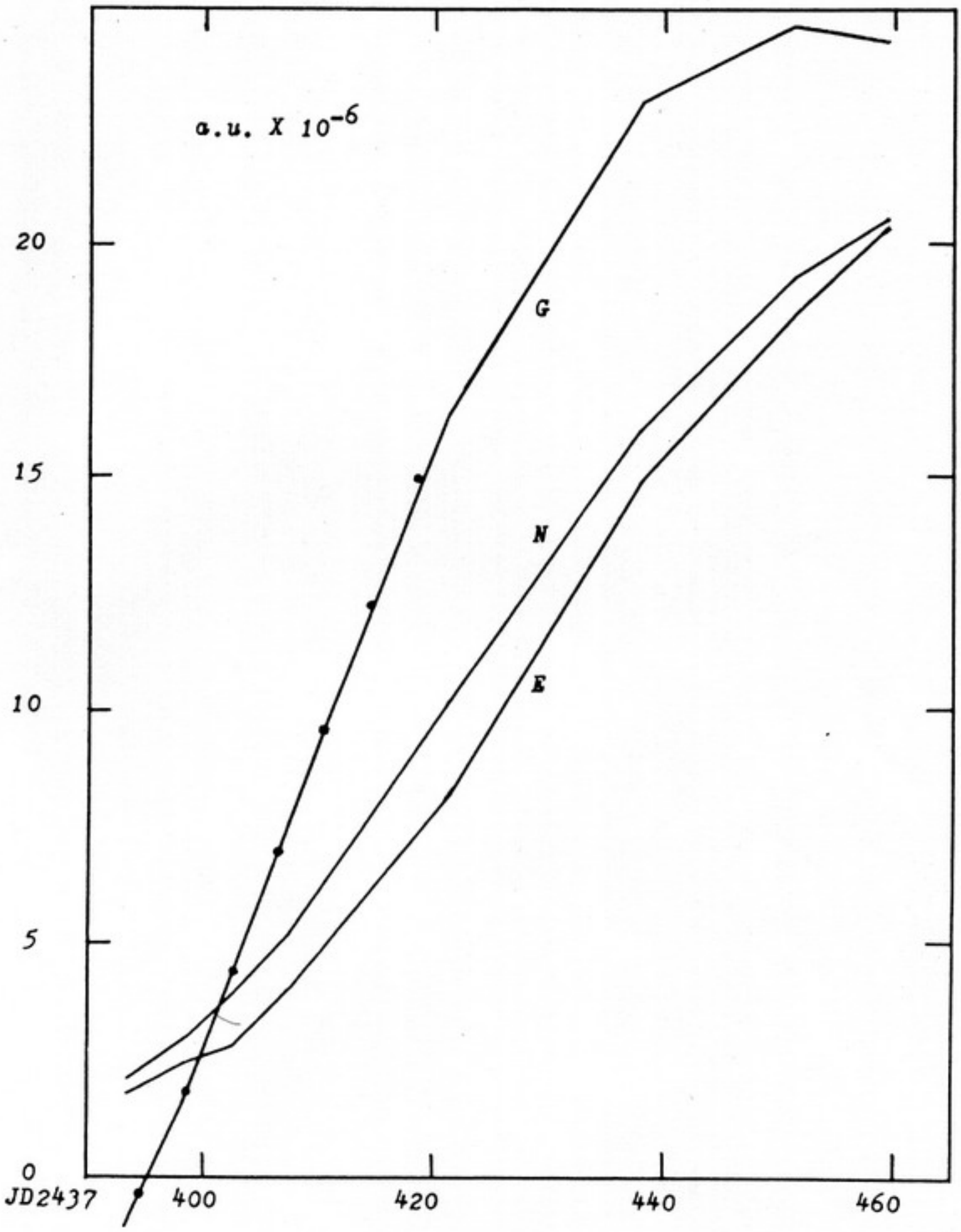

FIG. 1

The difference between the mean heliocentric radius vectors of Venus as calculated from Newcomb's tables, and Newcomb's perturbed radius vectors N and the calculated radar distances G (c+v) and E (c) as transformed into heliocentric radius vector.

close fit between the data and Newton's Laws is evidence in favor of Newton's c+v corpuscular theory.

CONCLUSION

In recent correspondence, Shapiro has shown an interest in collaborating in a full investigation of the relative velocity of light in space. He writes that the Lincoln Lab has been undergoing a severe "belt-tightening." It is my hope that funds will eventually become available and that the Lincoln Lab will make a full investigation of c+v. Although analysis to date presents strong evidence against c and for c+v, I don't think it can be considered reasonably conclusive until a full c+v investigation is made.

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