



**CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY**

Name(s) Mark D. Canning	Project Number S1904
Project Title A Study of the Effect of the Curvature of Spacetime on the Speed of a Graviton as Perceived by an Outside Observer	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This project was designed to test the theory of the Graviton, the theorized elementary particle predicted by the standard model of physics that mediates the force of gravity. The theory would be tested by measuring the speed that gravitational force propagates, and seeing if gravitational time dilation occurs, which would support the theory of the graviton.</p> <p>Methods/Materials A PC equipped with Microsoft Excel and Maple 7 was used. Data was taken from the NASA JPL HORIZONS ephemeris. The position vector, velocity, and light-time were retrieved from the ephemeris. The sets varied in time span and interval between points. The vectors of gravitational acceleration acting on the Earth due to each object were determined, and summed. The Earth's acceleration vector and a vector of the rate of change in the acceleration of the Earth were calculated. A value equal to the light-time would provide support for the hypothesis, a value equal to the distance to the sun divided by c would provide support against my hypothesis. Any other value would be inconclusive.</p> <p>Results The first set of data showed the average time delay to be $1.77E+3$ seconds, and had a standard deviation of $2.68E+5$ seconds. The second set of data showed the average time delay to be $8.18E+3$ seconds and had a standard deviation of $2.42E+6$ seconds. The third set of data showed the average time delay to be $1.07E+5$ seconds and had a standard deviation of $2.11E+6$ seconds. The fourth set of data showed the average time delay to be $-4.87E+3$ seconds and had a standard deviation of $1.32E+6$ seconds.</p> <p>Conclusions/Discussion Overall, the total data was inconclusive for support of my hypothesis. All four sets of data had too high of a statistical uncertainty to provide clear evidence. The largest cause of error was likely due to the lack of knowledge of the Earth's instantaneous acceleration and rate of change of acceleration. Further research suggests that, while gravity is not likely to propagate at the speed of light, the gravitational field of the solar system is not changing, making the propagation speed of gravity appear to be infinite to any experiment of this nature. In a further experiment testing this hypothesis it would be necessary to either measure the values for systems that are rapidly losing mass, or to measure the speed of gravitational waves.</p>	
Summary Statement To study the effect of the curvature of spacetime on the observed speed of a graviton.	
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