



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

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Project Title Time Flies When You're Having Fun Making a Long Story Short	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The objective of this project is to measure two effects predicted in Einstein's special theory of relativity: time dilation, in which a clock moving at a speed close to that of light will be observed to "slow down"; and length contraction, in which a meter stick moving at the same speed will be observed to shorten in length. The scaling factor for these effects is predicted to be gamma, equal to the inverse of the square root of $1 - \beta^2$, where beta is the ratio of the moving object's velocity to the speed of light. These effects are measured using relativistic particles created in high-energy particle collisions.</p> <p>Methods/Materials The experiment described here involves rapidly moving radioactive particles known as K-shorts (K_s^0). K_s^0 are produced in high-energy collisions. In this experiment, the average lifetime of the particle was used as the "ticking" of the clock while the decay distance provides the relative length scale. The K_s^0 particles used in this experiment were produced in 90 GeV (billion electron volts) e^+e^- collisions at the Stanford Linear Accelerator Center (SLAC) and observed in a very large collider detector (SLD) surrounding the interaction region.</p> <p>Results K_s^0 particles emerge from the interaction region with a wide range of speeds up to 0.9997 times the speed of light. The ticking of the clock and the decay length are measured as a function of the velocity of these particles. Time is observed to slow down and length is seen to contract by up to a factor of about fifty. These measured results are compared with those predicted by Einstein's special theory.</p> <p>Conclusions/Discussion Time intervals are shown to expand by the factor gamma, while length intervals are shown to contract by gamma, over a very wide range of gamma. The measured effects agree well with those predicted by Einstein's special theory.</p>	
Summary Statement This experiment uses radioactive particles produced in high-energy particle collisions at the Stanford Linear Accelerator Center (SLAC) to measure the relativistic effects of time dilation and length contraction.	
Help Received Members of the SLD experiment provided me with the data and taught me about the spectrometer and data analysis; in particular, Dr. David Muller and Dr. Ken Baird helped me in accessing the data and Dr. Blair Ratcliff taught me about the data analysis.	