



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Michael H. Fischer	Project Number S1206
Project Title Solitonland: A Complete Mathematical and Physical Relativistic Soliton Universe	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals One of the fundamental principles of modern science is that the speed of light is constant in every inertial frame of reference. In this science project we do not postulate this principle but instead show why this principle is true. To do so, we construct a scale-model universe, both mathematically and physically, which we call Solitonland. In this model universe, all laws of physics are controlled by the Sine-Gordon equation, a single nonlinear partial differential equation that has soliton solutions. Solitons have many distinguishing characteristics that make them ideal for this project and also for optical communications. Our goal is to understand the relativistic structure of our own physical universe by building and studying a simplified relativistic model.</p> <p>Methods/Materials We engineered and constructed a new type of nonlinear discrete model of the Sine-Gordon equation using 50 nonlinear oscillators coupled together elastically. We study this model both physically and numerically using optical and computer aided digital photographic measuring systems. We focus on the behavior of moving kinks and breathers as they collide and interact. Our results are presented graphically and three-dimensionally when viewed through suitable anaglyph glasses.</p> <p>Results We construct measuring rods and clocks in Solitonland called kinks and breathers using special soliton solutions. We show theoretically and experimentally that when boosted, these kink measuring rods undergo Lorentz contractions and these breather clocks undergo time dilations, exactly as in our own physical universe. We show precisely both mathematically and physically that as measured by the Solitonlanders using their measuring rods and clocks, these two effects exactly cancel each other out. Thus the resulting speed of Solitonland light is constant in every inertial system, exactly as it is in our own physical universe.</p> <p>Conclusions/Discussion We extrapolate these results to our own real physical universe, or in fact to any universe, either real or imagined. In any such universe, we show that the speed of light, as measured by the rods and clocks of that universe, is constant in every inertial system. From this conclusion we can explain why the speed of light in our own real physical universe is independent of the inertial system. Our results have applications to the use of optical systems and to the teaching of fundamental aspects of physics.</p>	
Summary Statement A scale model relativistic universe is constructed mathematically and physically in order to understand the structure of our own real physical universe.	
Help Received My teacher Mr. Steely helped me organize the presentation of my work.	