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Computer-Based Interactive Material for Teaching Special and General Relativity

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Spacetime has fascinated both specialist and layman for over 100 years. Spacetime geometry is a difficult topic for student understanding despite popularizations such as Albert Einstein's *Relativity* and Edwin Abbott's *Flatland*. There are many reasons to create computer-based material for relativity. Special relativity is the first topic presented in modern physics. It is full of (apparent) paradoxes, and, like quantum mechanics, captivates students interest in physics. Because relativity focuses on abstract concepts, visualization is especially valuable. We report the development of new simulations that allow the exploration of spacetime and the role of the observer. Special relativity examples include: visualizing simultaneity, length contraction, time dilation, and spacetime diagrams. General relativity examples include the gravitational red shift, trajectories of particles and light rays, and the observers view in the vicinity of non-spinning black holes. Programs are available from the Open Source Physics website <http://www.opensourcephysics.org>. This work is supported by the National Science Foundation (DUE-0126439).