

CALIFORNIA STATE UNIVERSITY, LONG BEACH  
THE MATHEMATICS COLLOQUIUM

presents

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speaking on

**Special Relativity and the Einstein Train, part 2.**

**Friday, May 8, 2009**

**12:00PM-1:00PM**

**FO3-200A**

**Abstract:**

1905: Einstein's paper on special relativity is published. Einstein gives a unified framework for the ad hoc results of Lorentz, Poincaré and others. The Einstein train example is born. 1908: Minkowski reframes relativity in hyperbolic 4-space, where Lorentz transformations play a central role. Einstein, Lorentz, Poincaré reject this out of hand as too complicated. The Einstein train example does not work in this context. 1909 to 1912: Einstein slowly adopts Minkowski spacetime, but still uses separate geometric and kinematic arguments. By 1912 Einstein has completely adopted the 4-space framework.

The Einstein train example does not work. I will explain why, and how to fix it. I will also show how by simple geometric arguments we can get all the standard relativity results. From one picture we will establish time dilation, simultaneity paradox, space contraction, symmetry of time dilation. Once we have this, we will get mass dilation and  $E = mc^2$ .