



Theory Seminar

Monday, March 5, 2012 2:10pm 831 Pupin

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Black Holes: Probes of the Cosmos and Fundamental Physics

The class of spacetimes with event horizons contain some of the most fascinating solutions to the equations of general relativity. Over the past few years, numerical simulations of the field equations have begun to reveal some of the more dynamical, strong-field solutions not amenable to exact analytical or perturbative treatments. In this talk, I will describe 3 such scenarios.

First, the inspiral and merger of two black holes, which is thought to occur frequently in the universe. Such events are powerful emitters of gravitational waves, and a concerted world-wide effort is currently underway to observe the universe through gravitational waves.

Second, I will discuss the ultra-relativistic collision of two solitons. Arguments suggest that at sufficiently high velocities gravity dominates the interaction, causing a black hole to form regardless of the internal structure or nature of any non-gravitational interaction. These arguments underlie claims that the Large Hadron Collider will produce black holes in speculative large extra dimension scenarios.

Finally, I will show results elucidating the fate of a black string in 5 dimensions, subject to the Gregory-Laflamme instability. Rather remarkably, the event horizon exhibits dynamics akin to a low viscosity fluid stream suffering the Raleigh-Plateau instability, where the horizon starts to form spherical "beads" connected by ever thinner string segments that are themselves unstable, and the instability unfolds in a self-similar cascade. This process reveals arbitrarily large spacetime curvatures to an external observer, culminating in naked singularities. This is therefore a generic example of cosmic censorship violation in higher dimensional Einstein gravity.