Physics Department Seminar

3pm February 7, Physical Sciences room 301

DR. JOSEPH MITCHELL

Recently of UC Davis

Where are the BTZ Black Hole Degrees of Freedom?

Over forty years have passed since Hawking and Bekenstein showed that black holes are thermodynamic objects with temperatures and entropies. A particularly interesting case is the BTZ black hole, which is a black hole in 2+1 dimensions. Although general relativity is greatly simplified in 2+1 dimensions, the BTZ black hole shares many properties of higher dimensional black holes, such as a Bekenstein-Hawking entropy proportional to one quarter of the horizon area. The entropy can be derived from many approaches, but a particularly simple and elegant derivation exploits the conformal symmetry at spatial infinity, which allows the use standard techniques from conformal field theory. However, there are some conceptual hurdles. In particular, why are the degrees of freedom associated with spatial infinity? A more appealing location is the black hole horizon, but even the horizon is somewhat strange when one considers that in 2+1 dimensions general relativity has no local degrees of freedom. This brings into question why any particular surface should be treated as special. I will discuss how, with a suitable set of boundary conditions, a conformal symmetry is found to exist at all spatial locations. In particular, two copies of the Brown and Henneaux central charge $c^{\pm} = 3l/2G$ are recovered and the microcanonical Cardy formula is used to calculate the correct Bekenstein-Hawking entropy.