Physics Colloquium

Black Holes and Quantum Gravity

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The concept that black holes behave as thermodynamic objects was first realized after the formulation of the laws of black hole mechanics by Bardeen, Carter and Hawking during the 1970's. Since then, black hole temperature and entropy have provided an ample testing bed for most current competing theories of quantum gravity. The widely accepted forms of these thermodynamic quantities are:

$$\begin{cases} T_H = \dfrac{\hbar\varkappa}{2\pi} \text{ Hawking Temperature} \\ S_{BH} = \dfrac{A}{4\hbar G} \text{ Bekenstein} - \text{Hawking Entropy}' \end{cases}$$

where A is the black hole surface area, $\varkappa$ the black hole surface gravity, $\hbar$ is Planck's constant and G is Newton's constant. It is widely believed that any viable ultraviolet completion of general relativity (quantum gravity) should reproduce some variant of the above equations. To date there is a plethora of different approaches for arriving at these formulae, with string theories and loop quantum gravity the predominant competitors. However, no candidate approach has ever yielded a complete formulation of a possible quantum gravity theory and there seems to be no clear consensus which approach to prefer over the other.

In this talk we will outline the problem of quantum gravity, why black holes behave as thermodynamic objects and why they are a useful tool in the study of a yet unsolved problem. In particular we will highlight the *AdS=CFT* approach pioneered in string theories, for studying two dimensional near black hole horizon quantum conformal field theories relevant to four dimensional black hole thermodynamics.

Everyone Welcome! Refreshments Provided.