Institute for Research in Fundamental Sciences

School of Physics
Ph.D Defense Session

Title:

Conserved charges, surface degrees of freedom, and black hole entropy

Candidate:

Ali Seraj, IPM

Venue:

Class C, Second Floor

Time:

(چهارشنبه، ۷ بهمن‌ماه ۱۳۹۴–ساعت ۱۴:۰۰)

14:00, January 27, 2016

Abstract:

In this thesis, we first study the Hamiltonian and covariant phase space description of gravitational theories. The phase space represents the allowed field configurations and is accompanied by a closed nondegenerate 2 form- the symplectic form. We will show that local/gauge symmetries of the Lagrangian formulation will fall into two different categories in the phase space formulation. Those corresponding to constraints in the phase space, and those associated with nontrivial conserved charges. We argue that while the former is related to redundant gauge degrees of freedom, the latter leads to physically distinct states of the system, known as surface degrees of freedom and can induce a lower dimensional dynamics on the system. These ideas are then implemented to build the phase space of specific gravitational systems: 1) asymptotically AdS3 spacetimes, and 2) near horizon geometries of extremal black holes (NHEG) in arbitrary dimension. In the AdS3 phase space, we show that Brown-Henneaux asymptotic symmetries can be extended inside the bulk of spacetime and hence become symplectic symmetries of the phase space. We will show that in the NHEG phase space, surface gravitons form a Virasoro algebra in four dimensions, and a novel generalization of Virasoro in higher dimensions. The central charge of the algebra is proportional to the entropy of the corresponding extremal black hole. We study the holographic description of NHEG phase space and show that the charges can be computed through a Liouville type stress tensor defined over a lower dimensional torus. We will discuss whether surface gravitons can serve as the microscopic origin of black hole entropy.

Address: Institude for Research in Fundamental Sciences (IPM), next to Kouhe Nour Building, Farmanieh Av.

Tel: (21) 22 28 06 92, 22 29 09 34

Fax: (21) 22 28 04 15