General Relativity
Relativité générale

(Org: **Spyros Alexakis** (University of Toronto) and/et **Mihalis Dafermos** (Princeton University))

STEFANOS ARETAKIS, University of Toronto
Horizon hair of extremal black holes and measurements at null infinity

I will present the precise late-time asymptotics for solutions to the wave equation on extremal black holes. The derived asymptotics, apart from showing the sharp decay rates for scalar perturbations, allow us to obtain important information as to how one can use measurements at null infinity to measure the horizon instability.

CARLA CEDERBAUM, Tübingen University
On foliations related to the center of mass in General Relativity

In many situations in Classical Mechanics, understanding the motion of the center of mass of a system is key to understanding the general trend of the motion of the system. It is thus desirable to also devise a notion of center of mass with similar properties in General Relativity, as well as the corresponding center of mass coordinates.

However, while the definition of the center of mass via the mass density is straightforward in Classical Mechanics, there is a priori no definitive corresponding notion in General Relativity. We will pursue a geometric approach to defining the center of mass, using foliations by hypersurfaces with specific geometric properties. I will first illustrate this approach in the (easier) classical Newtonian setting and then review previous work in the relativistic situation, most prominently a fundamental result by Huisken and Yau from 1996. After introducing the foliation approach, I will discuss explicit counter-examples (joint work with Nerz) and discuss the analytic, geometric, and physical issues they illustrate. I will then present a new approach (joint work with Cortier and Sakovich) that remedies these issues. Moreover, I will briefly explain the construction of center of mass coordinates which is joint work in progress with Metzger.

PAU FIGUERAS, Queen Mary University of London
Black hole instabilities and violation of the weak cosmic censorship conjecture in higher dimensions

Rapidly rotating asymptotically flat black holes in higher dimensions can be unstable to gravitational perturbations of the Gregory-Laflamme type. By evolving these instabilities into the fully non-linear regime using numerical relativity, we find that these black holes develop fractal horizons that pinch off in finite asymptotic time, giving rise to naked singularities. Since these instabilities are generic, they therefore constitute potential counter-examples to the weak cosmic censorship conjecture in higher dimensional asymptotically flat space. These results should also apply to sufficiently small black holes in global anti-de Sitter space.

BENJAMIN SCHLEIN, University of Zurich
Invariant measures for nonlinear Schrödinger equations as limit of many body quantum states

We prove that Gibbs measures associated with nonlinear Schrödinger equations arise as high-temperature limit of appropriately modified thermal states in many-body quantum mechanics. In dimensions d=2,3 these Gibbs measures are supported on singular distributions and Wick ordering of the interaction is necessary. Our proof is based on a perturbative expansion in the interaction, organised in a diagrammatic representation, and on Borel resummation of the resulting series. This is a joint work with J. Fröhlich, A. Knowles and V. Sohinger.

YAKOV SHLAPENTOKH-ROTHMAN, Princeton University
The asymptotically self-similar regime for the Einstein vacuum equations

We will dynamically construct singular solutions to the Einstein vacuum equations which are asymptotically self-similar in that successive rescalings around the singularity converge to a self-similar solution. Connections both to Christodoulou's bounded variation solutions of the spherically symmetric Einstein-scalar field system and to the ambient metric construction of Fefferman and Graham will be elaborated on. This is joint work with Igor Rodnianski.

ANDRAS VASY, Stanford University
The stability of Kerr-de Sitter black holes

In this lecture, based on joint work with Peter Hintz, I will discuss the proof of the stability of slowly rotating Kerr-de Sitter black holes, which are rotating black holes in a universe with a positive cosmological constant, i.e. they are explicit solutions (in 3+1 dimensions) of Einstein's equations of general relativity, parameterized by their mass and angular momentum. I will concentrate on the interaction of analysis and geometry in the proof.