Titles and Abstracts

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TBA

Leading-order term expansion for the Teukolsky equation on subextremal Kerr black holes

Pascal Millet
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The study of wave propagation on black hole spacetimes has been an intense field of research in the past decades. This interest has been driven by the stability problem for black holes and by questions related to scattering theory. In the analysis of Maxwell's equations and the equations of linearized gravity, the focus often shifts to the study of the Teukolsky equation, which offers the advantage of being scalar in nature. I will present a result providing the large time leading-order term for initially localized and regular solutions and valid for the full subextremal range of black hole parameters. I will also discuss some aspects of the proof which relies on recent advances in spectral and microlocal analysis.

A simple model of supersonic shocks in quasilinear waves

Pieter Blue
The University of Edinburgh

Singularity formation is a central phenomenon in the study of nonlinear, dynamical PDE. In the study of fluids, supersonic shocks are expected, and the Euler equation, for example, can be recast as a quasilinear wave. This will talk will present a very simple model of an initial value problem for a quasilinear wave in which the following hold: A singularity forms on a codimensions 2 set. A Cauchy hypersurface emanates from the singularity in one characteristic direction. In the other characteristic direction, there is a surface up to which there is a unique smooth solution. However, in this region, there is also a weak solution, satisfying an entropy condition, that has a supersonic shock, with a singularity that interrupts the smooth solution.

On the predictability of Einstein equations inside black holes

Marc Casals
Leipzig University

All black holes in the Universe are believed to be rotating. This poses interesting questions, since rotating black hole solutions of Einstein's equations of General Relativity possess a so-called Cauchy horizon in their interior, beyond which Einstein's equations cease to be predictable (i.e., the Cauchy value problem is no longer well-posed). However, these exact solutions may not model sufficiently accurately black holes in Nature, which have classical matter in their neighbourhood and, furthermore, are inevitably surrounded by a quantum vacuum (which, in the exterior, is responsible for Hawking radiation). On the classical side, it has been found that the Cauchy horizons of some black holes become irregular under classical field perturbations whereas the Cauchy horizons of other black holes (e.g., in a Universe with a positive cosmological constant) seem to remain regular. On the quantum side, effects on Cauchy horizons due to quantum fields are believed to be generally stronger than those due to classical fields. In this talk, we will review some results on the linear (mode) stability of Cauchy horizons of black holes and we will present recent results on semiclassical effects due to a quantum field on the Cauchy horizon of a rotating (Kerr) black hole. In particular, we will show that the (renormalized) fluxes from a quantum scalar field generically diverge on the Cauchy horizon of a Kerr black hole that is evaporating via the emission of Hawking radiation.

On the instability of naked singularities in general relativity

Junbin Li(黎俊彬)
Sun Yat-sen University

The weak cosmic censorship, one of the central open problems in general relativity, states that naked singularities cannot appear in gravitational collapse generically. In this talk, I will report some research progress on the instability of naked singularities.

Gluing at infinity of two dimensional asymptotically hyperbolic manifolds

Piotr Chrusciel
University of Vienna

I will review the "Maskit gluing" construction at conformal infinity for general relativistic initial data sets with a negative cosmological constant, and show how it applies to two-dimensional initial data sets. It turns out that the notion of mass in this last case is more interesting, as compared to higher dimensions, as the group of asymptotic symmetries acts in a non-trivial way on the mass aspect function.

Dynamics of apparent horizon and progress toward weak cosmic censorship

Xinliang An
National University of Singapore

In this talk, I will report some recent results on dynamics of apparent horizon and progress toward weak cosmic censorship within and without spherical symmetry.

Bulk-boundary correspondence for vacuum asymptotically Anti-de Sitter spacetimes

Arick Shao(邵崇哲)
Queen Mary University of London

The AdS/CFT conjecture in physics posits the existence of a correspondence between gravitational theories in asymptotically Anti-de Sitter (aAdS) spacetimes and field theories on their conformal boundary. In this presentation, we prove a rigorous mathematical statement toward this conjecture in the classical relativistic setting. In particular, we show there is a one-to-one correspondence between aAdS solutions of the Einstein-vacuum equations and a suitable space of data on the conformal boundary (consisting of the boundary metric and the boundary stress-energy tensor), provided the boundary satisfies a geometric condition. This is joint work with Gustav Holzegel, and builds upon joint works with Athanasios Chatzikaleas, Simon Guisset, and Alex McGill.

Newman-Penrose Formalism and Black Hole Uniqueness Theorems

Naqing Xie(谢纳庆)
Fudan University

We discuss a uniqueness result of the electro-vacuum Einstein-Maxwell equations near the null infinity. This talk is based on a recent joint work with Xiaokai He (Hunan First Normal, Changsha) and Xiaoning Wu (AMSS, CAS, Beijing).

Some recent results on the cubic Dirac equations

Shijie Dong(董世杰)
Southern University of Science and Technology

We are interested in the cubic Dirac equations in two and three space dimensions, known as the Soler model. We aim to present: 1) global existence with small data that is uniform in the mass parameter; 2) global existence and asymptotic behavior for this model with a class of large initial data. This is joint with Kuijie Li and Jingya Zhao.

The nonlinear stability of Kerr for small angular momentum

Jeremie Szeftel
Sorbonne University and CNRS

I will introduce the celebrated black hole stability conjecture according to which the Kerr family of metrics are stable as solutions to the Einstein vacuum equations of general relativity. I will then discuss the history of this problem, including a recent work on the resolution of the black hole stability conjecture for small angular momentum.

On mathematical analysis of hard phase fluid with free boundary in relativity

Shuang Miao(缪爽)
Wuhan University

The hard phase model is an idealized model for a relativistic fluid where the sound speed approaches the speed of light. In this talk I will first review our results on the well-posedness for the free boundary problem of this model, then I will present our recent work on linear (in)stability for a family of steady states to this problem. This talk is based on joint works with Sohrab Shahshahani, Sijue Wu and Zeming Hao.

A perspective on numerical relativity

Joerg Frauendiener
University of Otago

Over the last decades, numerical simulations in general relativity have made tremendous strides. Starting with small (unstable) codes for head-on collisions in the early 1970s we now have full-scale codes that are used in everyday calculations to produce new or confirm measured wave forms for the gravitational wave detectors. Over the years, most of the effort went into the binary black hole problem, the "grand challenge" of the 1990s. However, there are many general relativistic scenarios for which numerical simulations are still lacking. In this talk, I will present a (subjective) view on the numerical methods and issues that are relevant for relativistic simulations, and I will discuss some work outside the binary black hole problem that is inspired by developments in mathematical relativity.

Decay estimates for the Chern-Simons-Higgs equation

Shiwu Yang(杨诗武)
Peking University

In this talk, I will present a work in progress with D. Wei on the long time dynamics for solutions to the Chern-Simons-Higgs equation with a pure power defocusing nonlinearity in two space dimension. We show that the potential energy decays inverse polynormially in time. Sharp pointwise decay estimate also holds for sufficiently large power of nonlinearity. The proof relies on vector field method and a sharp geometric trace theorem developed by Klainerman-Rodnianski.

New Div-Curl Lemma and applications to nonlinear wave and Schrodinger equations

Yi Zhou(周忆)
Fudan University

We derive a new div-curl type Lemma. Combining it with energy and momentum balance law, we obtain several new result on nonlinear wave and Schrodinger equations.

Wave equations on (asymptotically) hyperbolic spaces

Xuecheng Wang(王成波)
Zhenjiang University

In this talk, I will discuss our results for linear and nonlinear wave equations on hyperbolic spaces and asymptotically hyperbolic spaces. In particular, we will discuss the dispersive estimates, Strichartz estimates, as well as their applications in the analogs of the Strauss conjecture. It is based on my joint works with Yannick Sire, Christopher D. Sogge, Junyong Zhang, as well as Xiaoran Zhang.

Wave-Klein-Gordon systems in 1+2 dimensional spacetime with strong coupling terms in non-divergence form

Yue Ma(马跃)
Xi'an Jiaotong University

In this presentation I will talk about the wave-Klein-Gordon system in 2+1 dimensional spacetime. I will especially concentrate on the so called strong coupling terms, which are the pure Klein-Gordon quadratic terms coupled in the wave equation. We will see that when these terms are not in divergence form, new difficulties arise when one tries to establish the sharp pointwise estimates as well as the global existence result. An ODE type argument will be introduced in order to cope with these terms.

Stable and unstable behaviour in relativistic fluid so ncosmo logical spacetimes

Todd Oliynyk
Monash University

Relativistic fluid swit hlinea requation so fstat $p = K\rho$ on cosmological spacetimes can display stable and unstable behaviour. The most well analysed situation is that of FLRW fluid filled cosmologies with a positive cosmological constant, which have been rigorously shown to be nonlinearly stable to the future for sounds speed within the range $0 \leq K \leq 1/3$. After reviewing these results, I will present some recent results regarding the future stability of FLRW cosmologies on spacetimes with nonaccelerated expansion for sounds speeds satisfying $0 \leq K < 1/3$, and the future stability of a family of homogenous, but not isotropic, solutions to relativistic Euler equations on exponentially expanding spacetime for sound speed within the range 1/3 < K < 1. Additionally, I will discuss a recent result that rigorously establishes the future instability of the homogenous and isotropic family of solutions to the relativistic Euler equations on an exponentially expanding spacetime for sound speeds satisfying 1/3 < K < 1. This instability is characterized by the blow-up of the fractional density gradient at timelike infinity , a behaviour that was first conjectured by Renda in 2004. If time permits, I will conclude the talk by discussing similar phenomena that occur in the contracting direction.

Nonlinear stability of the Vlasov-Poisson system in R^3

Xuecheng Wang(王学成)
YMSC

We consider the stability problem for the 3D Vlasov-Poisson system in the whole space around the spatially homogeneous nontrivial equilibrium. In particular, we give linear stability for a class of general equilibrium and nonlinear stability for a special equilibrium, which is the so-called Poisson equilibrium. This talk is based on joint works with A. Ionescu (Princeton University), B. Pausader (Brown University), and K. Widmayer (University of Zurich and University of Vienna).