Titles and Abstracts of the invited Talks

Prof. Nicolas Burq

Title: Second-microlocalization for the stabilisation and control of wave equations

Abstract: In this talk I will present some results of control and stabilisation of wave equations on manifolds, when the control (or stabilisation) region is the characteristic function of geodesic polygons. In some situations which are at the edge of the geometric control condition, the micro local analysis of the problem requires to understand finely how solutions to wave equations can concentrate on geodesics (in particular how concentration occurs with respect to the (co)-normal variables to the geodesics.

Prof. Jean-Marc Delort

Title: Modified scattering for odd solutions of cubic nonlinear Schrödinger equations with potential in dimension one

Abstract: We show that the global odd solutions of a cubic Schrödinger equation with potential, with small smooth decaying initial data, do not scatter in one space dimension. More precisely, we obtain for the asymptotics of such solutions an explicit expression, involving a logarithmic modulation in the phase of oscillation. This property has been known for long in the potentialless case. In the presence of a (generic) potential, some commutation issues of the Klainerman vector field like operator used in order to exploit dispersion appear. Our method of proof uses the wave operators of the stationary Schrödinger operator, in order to reduce the problem to an equation without potential, but with a variable coefficients pseudodifferential nonlinearity. Exploiting the fact that we are working only with odd solutions, we may overcome the commutation issues alluded to above, and, using semiclassical analysis, deduce from the PDE an ODE, whose analysis provides the wanted asymptotics of the solution.

Prof. Jiansheng Geng

Title: A KAM theorem for two-dimensional nonlinear Schrödinger equations

Abstract: We prove an infinite dimensional KAM theorem. As an application, we use the theorem to study the two-dimensional nonlinear Schrödinger equation

$$iu_t - \Delta u + |u|^2 u + f(x)|u|^4 u = 0, \qquad t \in R, x \in T^2$$

with periodic boundary conditions, where $f(x)$ is a real analytic function. We obtain for the equation a Whitney smooth family of small--amplitude quasi-periodic solutions with a nice linear normal form. This is a joint work with S. Xue.

Prof. Zhen Lei

Title: Strong null condition and incompressible fluids

Abstract: We introduce the notion of strong null condition/structure for hyperbolic type systems and discovered that some incompressible fluid system inherently satisfy such a condition. This enables us to prove the global existence of incompressible elastodynamics in two dimensions, which was open since the (independent) work of Chrisodoulou and Klainerman on 3D scalar wave equations with null condition. We will also review the (independent) work of Agemi and Sideris on 3D compressible elastic waves and the work of Alinhac on 2D scalar quasilinear wave equations.

Prof. Galina Perelman

Title: Near soliton dynamics for the energy critical NLS.

Abstract: We consider the focusing energy critical nonlinear Schrodinger equation in R^d with radial initial data close to a ground state. We show that for d sufficiently large, the solutions that during their lifespan stay close in the energy space to the ground state family, are global and scatter to a member of this family.

Prof. Peng Qu

Title: System of hyperbolic conservation laws with periodic initial data

Abstract: This report would focus on the subject of hyperbolic conservation laws with periodic initial data. The main difficulties caused by periodicity and nonlinear resonance would be presented, then global existence of entropy weak solutions with bounded periodic initial data are considered for the system of weakly nonlinear gas dynamics.

Prof. Baoxiang Wang

Title: Local well-posedness for the derivative nonlinear Schrödinger equations in subcritical modulation spaces

Abstract: We study the Cauchy problem for the derivative nonlinear Schrödinger equation (DNLS)

$$\mathrm{i}\,\mathrm{u}_\mathrm{t} + \partial_{xx}^2\mathrm{u} = \mathrm{i}\mu\,\partial_\mathrm{x}(|\mathrm{u}|^2 u),$$
$$\mathrm{u}(0,\mathrm{x}) = \mathrm{u}_0(\mathrm{x}).$$

It is known that DNLS has a critical Sobolev space $\mathrm{H}^{\frac{1}{2}}$ so that it is locally well-posed and ill-posed in H^{s} if $\mathrm{s} > 1/2$ and $\mathrm{s} < 1/2$, respectively. On the other hand, its scaling critical space is L^2, which means that there is a gap between L^2 and $\mathrm{H}^{\frac{1}{2}}$ for the local well-posedness of DNLS. We will show its local well-posedness in modulation spaces $\mathrm{M}_{2,p}^{\frac{1}{2}}(\mathbb{R})$ $(2 \le \mathrm{p} < \infty)$. Noticing that $\mathrm{M}_{2,p}^{\frac{1}{2}} \subset \mathrm{B}_{2,p}^{\frac{1}{\mathrm{p}}}$ is a sharp embedding and $\mathrm{B}_{2,\infty}^{0}$ has the same regularity as L^2, our result contains a class of subcritical data in L^2. This is a joint work with S. M. Guo and X. F. Ren.

Prof. Chengbo Wang

Title: Long time existence for semilinear wave equations on asymptotically flat space-times

Abstract: In this talk, we will talk about the long time existence of solutions to semilinear wave equations of the form $(\partial_\mathrm{t}^2 - \Delta)\,\mathrm{u} = |\mathrm{u}|^\mathrm{p}$, for small data with sufficient regularity and decay, of size ε, on a large class of (1+n)-dimensional Lorentzian nonstationary asymptotically flat backgrounds (M, g). Under the assumption that uniform energy bounds and a weak form of local energy estimates hold forward in time, we obtain the sharp lower bounds of the lifespan for three dimensional subcritical and four dimensional critical cases. For the most delicate three dimensional critical case ($\mathrm{p} = \mathrm{p_c}$), we obtain the existence result up to $\mathrm{e}^{\mathrm{c}\,\varepsilon^{-2(\mathrm{p}-1)}}$, for many space-times including the nontrapping exterior domain, nontrapping asymptotically Euclidean space and Schwarzschild black hole space-time. The global existence for the problem with $\mathrm{p} > \mathrm{p_c}$ and n=3,4 has been proven in our previous joint works with Hans Lindblad, Jason Metcalfe, Mihai Tohaneanu and Chris Sogge.

Prof. Huicheng Yin

Title: Semilinear generalized Tricomi equations and related topics

Abstract: In this talk, I mainly focus on the semilinear generalized Tricomi equations and their applications in compressible fluid dynamics, semilinear wave equations with time-depending damping, compressible Euler equations with time-depending damping and so on. These works are joint with Prof. Ingo Witt, Prof. Xu Gang, Dr. Ruan Zhuoping, Dr. He Daoyin and Dr. Hou Fei, respectively.

Prof. Jiangong You

Title: Asymptotics of spectral gaps of quasi-periodic Schrödinger operators

Abstract: For non-critical almost Mathieu operators, and for every Diophantine frequency, we establish the exponential asymptotics on the size of spectral gaps. Based on the estimates, we show that the spectrum of such operators is homogeneous. We also prove the homogeneity of the spectrum for (measure-theoretically) typical quasi-periodic analytic Schrödinger operators. As a consequence, we verify the discrete version of Deift's conjecture on the solution of Toda lattice with subcritical analytic quasi-periodic initial datum. These results answer a series of open problems of Damanik-Goldstein et al and Kotani. (Joint work with Martin Leguil, Zhiyan Zhao and Qi Zhou.)

Prof. Bingyu Zhang

Title: Non-homogeneous boundary value problems of nonlinear dispersive wave equations

Abstract: In the past three decades, harmonic analysis has played important roles in the rapid advances of the study of nonlinear dispersive wave equations. In particular, many new tools have been developed to establish various well-posedness results for the pure initial value problems of nonlinear dispersive wave equations. However, how those harmonic analysis based tools can be used effectively to study non-homogeneous boundary value problems of nonlinear dispersive wave equations is still yet to be investigated. In this talk, I will introduce the concept of the boundary integral operators and show how they can play important roles in studying non-homogeneous boundary value problems of nonlinear dispersive wave equations. Especially I will demonstrate through examples of the KdV equation and the Schrödinger equation how the boundary integral operators can enable us to use those harmonic analysis based tools to study non-homogeneous boundary value problems effectively.

Prof. Ting Zhang

Title: Dispersive effects of the incompressible and compressible fluids

Abstract: In this talk, we consider the Cauchy problem of the N-dimensional incompressible viscoelastic fluids with $N\geq 2$. It is shown that, in the low frequency part, this system possesses some dispersive properties derived from the one parameter group $e^{\pm it\Lambda}$. Based on this dispersive effect, we construct global solutions with large initial velocity concentrating on the low frequency part. Such kind of solution has never been seen before in the literature even for the classical incompressible Navier-Stokes equations. The proof relies heavily on the dispersive estimates for the system of acoustics, and a careful study of the nonlinear terms. And we also obtain the similar result for the isentropic compressible Navier-Stokes equations. Here, the initial velocity with arbitrary $\dot{B}^{\frac{N}{2}-1}_{2,1}$ norm of potential part $\Pe^\bot u_0$ and large highly oscillating are allowed in our results. (Joint works with Daoyuan Fang and Ruizhao Zi)