"Microlocal Analysis and Inverse Problems" In honor of the 80th birthday of Vesselin Petkov

lundi 14 novembre 2022 - mardi 15 novembre 2022

Institut de Mathématiques de Bordeaux

Programme Scientifique

Monday November 14

13h30-14h30 : N. Tzvetkov

14h30-15h30 : G. Popov

15h30-16h : Coffee Break

16h-17h : P. Stefanov

17h-18h : G. Rivière

Tuesday November 15

9h30-10h30 : L. Stoyanov *

10h30-11h : Coffee Break

11h-12h : G. Uhlmann

12h-13h-30 : Lunch

13h30-14h30 : G. Perelman

14h30-15h30 : J. Sjöstrand

15h30-16h : Coffee Break

16h-17h : J.-F. Bony

*= Par zoom

Résumés

J.-F. Bony : **New phenomena in resonance theory**

With S. Fujiié, T. Ramond and M. Zerzeri, we have recently obtained the semiclassical asymptotic of the resonances generated by homo/heteroclinic trajectories. These results allow to test the opinions in resonance theory and show new behaviors. In this talk, I will give examples of such phenomena.

Galina Perelman : **Global well-posedness for the derivative nonlinear Schrödinger equation**

I will review some recents results regarding global well-posedness of the derivative nonlinear Schrödinger equation. The talk will be based on joint work with Hajer Bahouri.

Gueorgui Popov : **KAM theorems with parameters spectral asymptotics and applications**

Given a smooth one parameter family of Hamiltonians close to a Kolmogorov nondegenerate completely integrable Hamiltonian, we prove the existence of smooth one parameter families of KAM tori and provide global estimates in the scale of Hölder spaces. This leads to a construction of smooth one parameter families of quasimodes for the corresponding semiclassical operators. Applications to spectral rigidity of Laplace-Beltrami operators are obtained.

Gabriel Rivière :***Orthospectrum of convex bodies and Poisson formulas.***

I will start by decribing two "variants" of the Poisson formula that are due to Guinand
and Meyer. I will then show how these two formulas can be interpreted in terms of the orthospectrum (a family of characteristic lengths) of two convex bodies. With that interpretation in mind, Guinand-Meyer's formulas correspond to the case where the convex bodies are reduced to two points. I will explain how this formula can be extended to two general (strictly) convex bodies, how it relates this orthospectrum with the spectrum of a certain magnetic Laplacian on the torus and how it encodes certain geometric quantities (mixed volumes). This was obtained in a joint work with Nguyen Viet Dang and Matthieu Léautaud.

Johannes Sjöstrand : **Scattering for certain ∂, \overline ∂ systems**

This talk is based mainly on joint works with C. Klein and N. Stoilov. In electrical impedance tomography and in the integrable Davey-Stewartson II equations there appears a scattering problem with ∂, \overline ∂ equations on C, depending on a potential q and a spectral parameter k □ C. We study the asymptotics of the solutions for large values of the spectral parameter k in the case when q has some limited Sobolev regularity and power decay,and in the case when q is the characteristic function of a strictly convex open set with smooth boundary. In the latter case we discuss two term asymptotics for the reflection coefficient as well as numerical simulations showing the applicability of the asymptotic formulae.
At the end of the talk we discuss some very preliminary work with C. Klein and M. Zerzeri about ∂, \overline ∂ systems with q replaced by the reflection coefficient. Here we wish to understand the asymptotics when applying the inverse scattering method to the evolution problem.

Plamen D Stefanov : **Weakly nonlinear geometric optics for the Westervelt equation and recovery of the nonlinearity**

We study the Westervelt equation modeling nonlinear acoustic wave propagation. In case there is no diffusion, we show that the physical nonlinear effects, predicted and observed, appear in the so-called weakly nonlinear regime: when the amplitude is of the same order as the wavelength. Then the leading transport/profile equation is of Burgers type and the tilt of the wave recovers

uniquely the X-ray transform of the nonlinearity along the way, hence the nonlinearity itself. In the diffusive case, we suggest an asymptotic regime which is in line with what is expected and known in acoustics. That part is work in progress.
Ultrasound imaging is already in the nonlinear regime, creating artifacts if the model is linear. On the other hard, the nonlinearity creates higher order harmonics used by the engineers to increase the resolution and reduce strong backscattering siignals. The mathematical analysis of the implications for ultrasound imaging however is left for future works. The talk is based in a joint work with Nikolas Eptaminitakis.

Luchezar Stoyanov : **Ruelle operators, zeta functions and large deviations**

I will discuss several joint results of Vesselin Petkov and myself obtained in the last 10 years concerning strong spectral estimates for Ruelle transfer operators for hyperbolic systems and their applications to study zeta functions and obtain sharp large deviation results.

Nikolay Tzvetkov : **The 2d nonlinear Schrödinger equation with a white noise potential**

Using an approach introduced by Hairer-Labbé, we construct a unique global dynamics for the NLS on T^2 with a white noise potential and an arbitrary polynomial nonlinearity. We build the solutions as a limit of classical solutions (up to a phase shift) of the same equation with smoothed potentials. This is a joint work with Nicola Visciglia (University of Pisa).

Gunther Uhlmann : **Seeing Through Space-Time**

Abstract: We will consider the question on whether we can determine the structure of space time by making measurements near the worldline of an observer. We will consider both active and passive measurements. For the case of passive measurements one measures the fronts of light sources near the observer. For the case of active measurements we couple Einstein equations with matter or electromagnetic fields and formulate the question of determining the structure of space time as the problem of recovering the metric from observations of waves near the observer, The method applies to several other inverse problems for nonlinear equations, for example the equations of nonlinear acoustics. No previous knowledge of Lorentzian geometry will be assumed.
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