

## **Microlocal Day # 2**

December 3, 2010

Imperial Analysis Group

Organisers:

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We kindly acknowledge the support of the Department of Mathematics, Imperial College.

# 1 Programme

**Friday,  
03/12/10**

**Room 642**

10:40 Coffee  
11:00 – 11:05 Opening ceremony  
11:05 – 11:45 Naohito Tomita (Osaka University)  
*A Hörmander type multiplier theorem for multilinear operators*  
11:55 – 12:25 Ilia Kamotski (University of Bath)  
*Boundary value problems in irregular domains and applications*  
12:30 – 13:00 Mirko Tarulli (Imperial College London)  
*On the smoothing-Strichartz estimates*  
13:00 – 14:00 Lunch in room 139

**Room 139**

14:00 – 14:40 Fumihiko Hirosawa (Yamaguchi University)  
*On the energy estimates for second order homogeneous hyperbolic equations with Levi-type conditions*  
14:50 – 15:30 Jens Wirth (Stuttgart University)  
*Phase space analysis for hyperbolic systems*  
15:40 – 16:20 Naoto Kumano-go (Kogakuin University)  
*Path integrals for Gaussian processes as analysis on path space by time slicing approximation*  
16:30 – 16:50 Coffee  
16:50 – 17:30 Tokio Matsuyama (Tokai University)  
*Dispersion for 3D wave equation with a potential in an exterior domain*  
17:40 – 18:20 Mitsuro Sugimoto (Nagoya University)  
*On some  $L_p$ -type estimates for evolution operators*  
18:30 Closing ceremony  
19:00 Dinner

## *1 Programme*

## 2 Abstracts

### **On the energy estimates for second order homogeneous hyperbolic equations with Levi-type conditions**

FUMIHIKO HIROSAWA  
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We consider the energy estimates for the Cauchy problem of second order homogeneous strictly hyperbolic equations with time dependent coefficients. In particular we focus the smoothness and interactions of oscillating coefficients, which are crucial for the energy estimates; we shall call them a kind of Levi-type conditions.

### **Boundary value problems in irregular domains and applications**

ILIA KAMOTSKI  
University of Bath  
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We discuss some aspects of boundary value problems in irregular domains, some challenges and applications.

## **Path integrals for Gaussian processes as analysis on path space by time slicing approximation**

NAOTO KUMANO-GO  
Kogakuin University  
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We introduce the path integrals for Gaussian processes as an analysis which has functional integrals and smooth functional derivatives. More precisely, we give a fairly general class of functionals so that the path integrals for Gaussian processes have a mathematically rigorous meaning. For any functional belonging to our class, the time slicing approximation of the path integral converges uniformly on compact subsets of the configuration space. Our class is closed under addition, multiplication, translation, real linear transformation and functional differentiation. The invariance under translation and orthogonal transformation, the interchange of the order with Riemann-Stieltjes integrals and limits, the integration by parts and the Taylor expansion formula with respect to functional differentiation, and the fundamental theorem of calculus hold in the path integrals.

Reference: [1] Naoto Kumano-go, Path integrals for Gaussian processes as analysis on path space by time slicing approximation, *Integration: Mathematical Theory and Applications*, Vol. 1, No. 3 (2010), pp.253-278 (Free download).

## **On some Lp-type estimates for evolution operators**

MITSURO SUGIMOTO  
Nagoya University  
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Mapping properties of unimodular Fourier multiplier describing various type of evolution operators will be discussed. It is known that they are bounded on modulation spaces while not on Lp-spaces except for the case  $p=2$ . In this talk, the boundedness between Lp-Sobolev spaces and modulation spaces will be mainly considered. For the purpose, the inclusion relations between Lp-Sobolev spaces and modulation spaces will be determined explicitly.

## **Dispersion for 3D wave equation with a potential in an exterior domain**

TOKIO MATSUYAMA  
Tokai University  
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In this talk I will introduce the dispersive estimates and Strichartz estimates for 3D wave equation with a potential in an exterior domain. The dispersive estimates will be proved by interpolating between pointwise estimates for the propagator and  $L^2$  estimates. The pointwise estimates will be proved by using the spectral representation of the propagator. The key lemma is the representation formula for the perturbed resolvent of the Schrödinger operator in terms of the free resolvent in the whole space. By  $TT^*$  argument we will get the Strichartz estimates.

## **On the smoothing-Strichartz estimates**

MIRKO TARULLI  
Imperial College London  
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We present some a-priori estimates for evolution equations in mixed smoothing-Strichartz spaces. As an application we discuss Strichartz estimates for magnetic Klein-Gordon.

## **A Hörmander type multiplier theorem for multilinear operators**

NAOHITO TOMITA  
Osaka University  
tomita@math.sci.osaka-u.ac.jp

In this talk, we consider a Hörmander type multiplier theorem for multilinear operators. The multipliers in our problem have only the limited smoothness.

## **Phase space analysis for hyperbolic systems**

JENS WIRTH

Stuttgart University

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In this talk some aspects of phase space analysis for hyperbolic systems will be discussed. The main focus will be on diagonalisation and decoupling of pseudo-differential hyperbolic systems in adapted symbol classes taking care of the structure of the problem at infinity.