AM05

Partial Differential Equations II: Dispersive Equations and Spectral Theory

Ecuaciones en Derivadas Parciales II: Ecuaciones Dispersivas y Teoría Espectral

Organizers **Organizadores** **Antolatzaileak**

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Biagio Cassano
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Description **Descripción** **Deskribapena**

The session "Partial Differential Equations II: Dispersive Equations and Spectral Theory" is distinguished by its interdisciplinary nature. It has long been recognized that there is significant overlap and interesting interplay between Dispersive Equations and Spectral Theory. Nevertheless, most events on these topics tend to focus on one area at the expense of the other. In contrast, this session brings together young scientists from both fields with the goal of fostering new connections, inspiring collaborations, and drawing mutual inspiration.

La sesión "Ecuaciones en Derivadas Parciales II: Ecuaciones Dispersivas y Teoría Espectral" se distingue por su carácter interdisciplinario. Se ha reconocido desde hace tiempo que existe una gran superposición y una interacción interesante entre las Ecuaciones Dispersivas y la Teoría Espectral. Sin embargo, la mayoría de los eventos sobre estos temas tienden a centrarse en un área en detrimento de la otra. En cambio, esta sesión reúne a jóvenes científicos de ambos campos con el objetivo de fomentar nuevas conexiones, inspirar colaboraciones y extraer inspiración mutua.

MSC Codes **Códigos MSC** **MSC Kodeak**

35P05

(primary)

35Q40; 81Q10; 47N20; 47A10

(secondary)

Slots **Bloques** **Blokeak**

1.A (Aula 0.15); 1.B (Aula 0.15); 1.C (Aula 0.15)

QR Code **Código QR** **QR Kodea**

Session Schedule **Horario de la Sesión** **Saioaren Ordutegia**

L13 | 17:30-17:50 | 0.15
Spectral properties of the magnetic Laplacian in the context of surface superconductivity
Germán Miranda (Lund University)

L13 | 18:00-18:20 | 0.15
A 3D Schrödinger operator under magnetic steps with applications in superconductivity
Emanuela Laura Giacomelli (LMU)

L13 | 18:30-18:50 | 0.15
Pointwise Convergence of the Klein-Gordon Flow
Pablo Merino San José (BCAM & UPV/EHU)

L13 | 19:00-19:20 | 0.15
Energy decay for strongly damped wave equations
Borbala Gerhat (Institute of Science and Technology Austria)

M14 | 15:00-15:20 | 0.15
Spectral gap of generalized MIT bag models
Joaquim Duran Lamiel (Centre de Recerca Matemàtica & Universitat Politècnica de Catalunya)

M14 | 15:30-15:50 | 0.15
Stability of thermodynamic equilibria for the Hartree-Fock equation with exchange term
Elena Danesi (Politecnico di Torino)

M14 | 16:00-16:20 | 0.15
Weighted Poincarè inequality and Hardy improvements related to some degenerate elliptic differential operators
Lorenzo D'Arca (Università degli Studi di Roma "La Sapienza")

M14 | 16:30-16:50 | 0.15
Intertwining Operators beyond the Stark Effect
Ying Wang (BCAM)

M14 | 17:30-17:50 | 0.15
On Neuman-Poincaré operators and self-adjoint transmission problems
Badreddine Benhellal (Carl von Ossietzky Universität Oldenburg)

M14 | 18:00-18:20 | 0.15
High-energy eigenfunctions of the Laplacian with a point-pertubation
Santiago Verdasco-Ramos (Universidad Politécnica de Madrid)

M14 | 18:30-18:50 | 0.15
On the Bäcklund transformation and the stability of the line soliton of the KP-II equation on $\mathbb{R}^2$
Lorenzo Pompili (Universität Bonn)

M14 | 19:00-19:20 | 0.15
Uniform counterexample to the convergence problem for periodic dispersive equations with a polynomial symbol
Daniel Eceizabarrena (BCAM)

Monday 13	**Lunes 13**	**Astelehena 13**
17:30-17:50	**17:30-17:50**	**17:30-17:50**
[Room 0.15]	**[Aula 0.15]**	**[Gela 0.15]**

Spectral properties of the magnetic Laplacian in the context of surface superconductivity

Germán Miranda
(Lund University)

When a superconducting sample is submitted to an applied magnetic field the behaviour around the third critical field reduces to the study of the Neumann self-adjoint realization of the magnetic Laplacian. In this talk, we will discuss how the geometry of the sample or the applied magnetic field affect the distribution of surface superconductivity. In particular, we will focus on the case of a cylindrical sample which is connected with the magnetic Laplacian on the disc.

Monday 13	**Lunes 13**	**Astelehena 13**
18:00-18:20	**18:00-18:20**	**18:00-18:20**
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A 3D Schrödinger operator under magnetic steps with applications in superconductivity

Emanuela Laura Giacomelli
(LMU)

This talk presents a semiclassical problem in a bounded three-dimensional domain, involving the magnetic Neumann Laplacian with a piecewise-constant field. We establish localization of the semiclassical ground state near magnetic discontinuities by introducing an effective Schrödinger operator on the half-space. We expect our result to provide insights into identifying the magnetic field strength at which a superconductor transitions to the normal state, marking superconductivity's breakdown.

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18:30-18:50 | **18:30-18:50** | **18:30-18:50**
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Pointwise Convergence of the Klein-Gordon Flow

Pablo Merino San José
(BCAM & UPV/EHU)

I will present a nonlinear pointwise convergence theory for the case of the 3d cubic Klein-Gordon equation. Namely, we address the following question, considering the initial datum in $H^s(\mathbb{T}^3) \times H^{s-1}(\mathbb{T}^3)$: which is the minimal regularity s such that the solution of the aforementioned equation converges, as time goes to 0 and almost everywhere in space, to the initial datum? Using deterministic and probabilistic frameworks, we provide two different answers.

Joint work with Renato Lucà.

arXiv:2402.10105

Monday 13 | **Lunes 13** | **Astelehena 13**
19:00-19:20 | **19:00-19:20** | **19:00-19:20**
[Room 0.15] | **[Aula 0.15]** | **[Gela 0.15]**

Energy decay for strongly damped wave equations

Borbala Gerhat
(Institute of Science and Technology Austria)

For wave equations with damping unbounded at infinity, essential spectrum may cover the whole negative semi-axis. One can thus not expect the semigroup norm to decay exponentially in time and a more delicate analysis needs to be done. We derive bounds for the resolvent norm along the imaginary axis and thereby obtain the corresponding polynomial decay rates of the semigroup. This generalises a result by R. Ikehata and H. Takeda obtained by a different approach based on PDE analysis methods.

Joint work with A. Arnal, J. Royer and P. Siegl.

Tuesday 14 | **Martes 14** | **Asteartea 14**
15:00-15:20 | **15:00-15:20** | **15:00-15:20**
[Room 0.15] | **[Aula 0.15]** | **[Gela 0.15]**

Spectral gap of generalized MIT bag models

Joaquim Duran Lamiel
(Centre de Recerca Matemàtica & Universitat Politècnica de Catalunya)

We study spectral properties of generalized MIT bag models. These are Dirac operators H_τ ($\tau \in \mathbb{R}$) acting on domains of $\mathbb{R}^3$ with confining boundary conditions. Their lowest positive eigenvalue is of special interest, and it is conjectured to be minimal for a ball among all domains with fixed volume. Studying the resolvent convergence of H_τ in the limits $\tau \longrightarrow \pm\infty$, some spectral properties of the limiting operators $H_{\pm\infty}$ are inherited throughout the parameterization.

Joint work with A. Mas.

Tuesday 14 | **Martes 14** | **Asteartea 14**
15:30-15:50 | **15:30-15:50** | **15:30-15:50**
[Room 0.15] | **[Aula 0.15]** | **[Gela 0.15]**

Stability of thermodynamic equilibria for the Hartree-Fock equation with exchange term

Elena Danesi
(Politecnico di Torino)

The Hartree-Fock equation admits homogeneous states that model infinitely many particles at equilibrium. The aim of this talk is to present a result on their asymptotic stability in large dimensions.This has been obtained for the equivalent formulation of the equation in the framework of random fields and it includes the exchange term for the first time in the study of these stationary solutions.

Joint work with C. Collot, A.S. de Suzzoni, and C. Malézé.

Tuesday 14	**Martes 14**	**Asteartea 14**
16:00-16:20	**16:00-16:20**	**16:00-16:20**
[Room 0.15]	**[Aula 0.15]**	**[Gela 0.15]**

Weighted Poincarè inequality and Hardy improvements related to some degenerate elliptic differential operators

Lorenzo D'Arca
(Università degli Studi di Roma "La Sapienza")

We analyze two fundamental inequalities, Hardy's and Poincaré inequalities. Our approach avoids symmetric rearrangement arguments, simplifying their analysis in Euclidean and non-Euclidean contexts. We characterize the sharp constant and maximizing functions for weighted Poincaré inequalities. These results are used to derive L^p generalizations of the Brezis-Vázquez improvement of Hardy's inequality.

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Intertwining Operators beyond the Stark Effect

Ying Wang
(BCAM)

In this talk, we study the Schrödinger operators in scaling-critical electromagetic field. First, we use eigenfunction expansions and Hankel transforms to construct two intertwine operators W. And then, we prove that they are bounded on $L^p(\mathbb{R}^d)$ for certain values of p. As applications, we show the dispersive estimates, uniform resolvent estimates and Bochner-Riesz means, etc.

Joint work with Luca Fanelli, Xiaoyan Su, Junyong Zhang and Jiqiang Zheng.

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17:30-17:50	**17:30-17:50**	**17:30-17:50**
[Room 0.15]	**[Aula 0.15]**	**[Gela 0.15]**

On Neuman-Poincaré operators and self-adjoint transmission problems

Badreddine Benhellal
(Carl von Ossietzky Universität Oldenburg)

We study the self-adjointness in the L^2 setting of operators of the form $-\div \cdot h\nabla$, where h is piecewise constant with a jump across a Lipschitz hypersurface Σ, without assumptions on the sign of h. Sufficient conditions for self-adjointness of the operator with H^s-Sobolev regularity are provided, based on the jump value and geometric properties of Σ. A key step is the connection to the Fredholm properties of the Neumann-Poincaré operator on Σ.

Joint work with K. Pankrashkin.

Tuesday 14	**Martes 14**	**Asteartea 14**
18:00-18:20	**18:00-18:20**	**18:00-18:20**
[Room 0.15]	**[Aula 0.15]**	**[Gela 0.15]**

High-energy eigenfunctions of the Laplacian with a point-pertubation

Santiago Verdasco-Ramos
(Universidad Politécnica de Madrid)

High-energy eigenfunctions of the Laplacian on a closed Riemannian manifolds exhibit behaviors related with the geodesic flow on the manifold. Invariant subsets in phase space appear in the limit, and in some cases, even closed geodesics. We will talk about how many of these subsets are lost after a point-perturbation on the Laplacian is made, in addition to the spectral properties of this new operator.

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18:30-18:50	**18:30-18:50**	**18:30-18:50**
[Room 0.15]	**[Aula 0.15]**	**[Gela 0.15]**

On the Bäcklund transformation and the stability of the line soliton of the KP-II equation on $\mathbb{R}^2$

Lorenzo Pompili
(Universität Bonn)

Is it possible to decompose a nonlinear wave into its various components (solitons, radiation)? Integrable PDEs possess such a structure: they admit soliton addition maps that allow to superpose a soliton on another solution of the same PDE. We study the soliton addition map of the KP-II equation on $\mathbb{R}^2$ and recover codimension-1 stability of the line soliton in L^2 in a weighted space. We discuss the meaning of the codimension-1 condition and the multisoliton case.

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19:00-19:20	**19:00-19:20**	**19:00-19:20**
[Room 0.15]	**[Aula 0.15]**	**[Gela 0.15]**

Uniform counterexample to the convergence problem for periodic dispersive equations with a polynomial symbol

Daniel Eceizabarrena
(BCAM)

For the free Schrödinger equation, what is the minimum Sobolev regularity for the data such that the solution converges to the data a.e.? We know since 2019 that the right exponent in $\mathbb{R}^n$ is $n/(2(n+1))$. We do not know if changing the dispersion relation alters the result. I will show a periodic counterexample that proves that the exponent $n/(2(n+1))$ is necessary for the periodic equation with a power of the Laplacian Δ^k, $k \in \mathbb{N}$, independently of k.