Himeji Conference on Partial Differential Equations Titles and abstracts 2023

WROCHNA, Michal (Cergy Paris Université)

Title: Complex powers of the wave operator on asymptotically Minkowski spaces

Abstract: The spectral theory of the Laplace–Beltrami operator on Riemannian manifolds is known to be intimately related to geometric invariants. This kind of relationships has inspired many developments in relativistic physics, but a priori it only applies to the case of Euclidean signature. In contrast, the physical setting of Lorentzian manifolds has remained problematic for fundamental reasons until very recently.

In this talk I will present results that relate functions of the wave operator on asymptotically Minkowski spacetimes (or Lorentzian scattering spaces) to invariants such as the scalar curvature. The proof uses the essential self-adjointness result of Vasy and Nakamura–Taira and a microlocal parametrix for the resolvent. (based on joint works with Nguyen Viet Dang)

MURAMATSU, Ryo (Tokyo University of Science)

Title: Wave front set of solutions to Schrödinger equations with time-dependent magnetic fields

Abstract: The wave front set is the subset of $\mathbb{R}^{2n} \setminus \{0\}$ which describes the position of the singularity of function and the direction in which it propagates. In the work of Mao (2011, 2012), the wave front set of the solutions to the Schrödinger equations with constant magnetic fields is investigated. In this talk, we characterise the wave front set of the solutions to the Schrödinger equations with time-dependent magnetic fields by initial values using wave packet transform. Thanks to wave packet transform, we can treat the case of magnetic fields which depend on t and x more generally. This talk is based on joint work with Fumihito Abe at Tokyo University of Science. DUONG, Anh Tuan (Hanoi University of Science and Technology)

Title: Optimal Liouville-type theorems for system of parabolic inequalities

Abstract: In this talk, we first establish optimal Liouville-type theorems for the system of parabolic inequalities

$$\begin{cases} u_t - \Delta u \ge v^p \\ v_t - \Delta v \ge u^q \end{cases}$$

and for the scalar inequality

 $w_t - \Delta w \ge w^p$

in the whole space $\mathbb{R}^N \times \mathbb{R}$ and in $\mathbb{R}^N \times (0, \infty)$. Our optimal Liouville-type theorems are proved for two different classes of solutions, consisting of the nontrivial nonnegative and the positive ones.

We then discuss the analogous results for the fractional parabolic inequality

$$w_t + (-\Delta)^s u \ge w^p$$

and the system of fractional parabolic inequalities

$$\begin{cases} u_t + (-\Delta)^s u \ge v^p \\ v_t + (-\Delta)^s v \ge u^q \end{cases}$$

where $p, q \in \mathbb{R}$ and 0 < s < 1. This talk is based on the joint works with Quoc Hung Phan and with Van Hoang Nguyen.

ISHIDA, Hiroto (University of Hyogo)

Title: The Poisson problems on domains with holes concentrated at subsets of a domain

Abstract: We consider solutions u^{ε} to Poisson problems $-\Delta u^{\varepsilon} = f$ with Dirichlet condition on domains Ω_{ε} with holes concentrated at subsets of a domain Ω non-periodically. We show u^{ε} converges to a solution u to $(-\Delta + V)u = f$ on Ω with a simple function V. This is a generalized result given by Cioranescu and Murat (1997). They showed for case that holes are distributed at Ω periodically.

MERZ, Konstantin (Technische Universität Braunschweig / Osaka University)

Title: Random Schrödinger operators with complex decaying potentials

Abstract: We estimate complex eigenvalues of continuum random Schrödinger operators of Anderson type. Our analysis relies on methods of J. Bourgain (Discrete Contin. Dyn. Syst., 2002, Lecture Notes in Math., 2003) related to almost sure scattering for random lattice Schrödinger operators, and allows us to consider potentials which decay almost twice as slowly as in the deterministic case. The talk is based on joint work with Jean-Claude Cuenin.

TANAKA, Yohei (Shinshu University)

Title: A topological index for one-dimensional quantum walks with asymptotically periodic parameters

Abstract: I will explain how an analytic index can be naturally assigned to a chirally symmetric unitary operator with a spectral gap in this talk. This index is useful in the sense that its absolute value gives a lower bound for the number of so-called edge-states. We consider a discrete-time quantum walk on the one-dimensional integer lattice satisfying certain periodic conditions as a concrete example. The purpose of this talk is to show that the analytic index associated with this model admits a topological characterisation.

TANDA, Mika (Kwansei Gakuin University)

Title: The asymptotic expansions of the hypergeometric function with respect to parameter

Abstract: We consider the hypergeometric differential equation from viewpoint of exact WKB analysis. It is known that the hypergeometric function $_2F_1(a, b, c; x)$ is a solution of this equation. Moreover, there are 24 standard solutions of this equation which are called Kummer's solutions. The hypergeometric function $_2F_1(a, b, c; x)$ is one of Kummer's solutions in the neighborhood of the origin and others are expressed in terms of it. On the other hands, introducing a large parameter in the parameters contained in this equation, we can construct WKB solutions of this equations. It is known that the WKB solutions normalized appropriately are Borel summable and the Borel sums are analytic solutions to the equation. The hypergeometric function can be expressed explicitly as a linear combination of the Borel resummed WKB solutions. Using the above relation, we show that we get the asymptotic expansions of the standard solutions in the neighborhood of the origin at this equation. This is a collaboration with Takashi Aoki and Toshinori Takahashi.

GOTO, Yukimi (Kyushu University)

Title: Spontaneous mass generation and chiral symmetry breaking in a lattice Nambu-Jona-Lasinio model

Abstract: In quantum chromodynamics, without interactions, quarks have no mass and a conserved quantity called chirality. In reality, quarks have mass and chiral symmetry is broken. This is thought to be the result of spontaneous symmetry breaking by the interaction. In this talk we consider a lattice version of the Nambu-Jona-Lasinio model with interacting staggered fermions in the Kogut-Susskind Hamiltonian formalism. In a strong coupling regime for the four-fermion interaction, we prove that the mass of the fermions is spontaneously generated at sufficiently low temperatures. This implies that the chiral symmetry is spontaneously broken if the continuum limit exists. For the proof, the reflection positivity for fermions and the infrared bound method are crucial. This talk is based on joint work with Tohru Koma.

TAIRA, Kouichi (Ritsumeikan University)

Title: Remarks on spectral theory and self-adjointness of wave operators

Abstract: Recently, the spectral theory of non-elliptic operators has been studied in various contexts including Dynamical Theory and Quantum Field Theory. However, it is more difficult to construct a general theory for non-elliptic operators than for elliptic ones. So it seems important to study many concrete examples of non-elliptic operators. In this talk, I will introduce some examples of non-elliptic operators and discuss about these spectral properties.

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