Himeji Conference on Partial Differential Equations
Titles and abstracts 2022

KAIZUKA, Koichi (Nippon Medical School)

Title: **A note on the Dirac operator on symmetric spaces**

Abstract: We develop the spectral analysis for the Dirac operator on symmetric spaces of noncompact type based on harmonic analysis on Lie groups. In harmonic analysis on Lie groups, the Dirac operator have been deeply studied to characterize discrete series representations of Lie groups. In this talk, we compute the continuous spectrum of the Dirac operator on irreducible symmetric spaces of noncompact type. We show that the continuous spectrum has a spectral gap if and only if the symmetric space is isomorphic to a coset space of the special pseudo-unitary group of odd matrix size. Furthermore, we give a uniform weighted resolvent estimate for the Dirac operator with respect to spectral parameter.

ZHOU, Xiaodan (Okinawa Institute of Science and Technology)

Title: **Horizontal quasiconvex envelope in the Heisenberg group**

Abstract: Various notions of convexity of sets and functions in the Heisenberg group have been studied in the past two decades. In this talk, we focus on the horizontally quasiconvex (h-quasiconvex) functions in the Heisenberg group. Inspired by the first-order characterization and construction of quasiconvex envelope by Barron, Goebel and Jensen in the Euclidean space, we obtain a PDE approach to construct the h-quasiconvex envelope for a given function f in the Heisenberg group. In particular, we show the uniqueness and existence of viscosity solutions to a non-local Hamilton-Jacobi equation and iterate the equation to obtain the h-quasiconvex envelope. Relations between h-convex hull of a set and the h-quasiconvex envelopes are also investigated. This is joint work with Antoni Kijowski (OIST) and Qing Liu (Fukuoka University/OIST).

FUKUSHIMA, Shota (The University of Tokyo)

Title: **Propagation of singularities for Schrödinger equations on manifolds with ends**

Abstract: We employ radially homogeneous wavefront sets, which are introduced by Ito and Nakamura (Amer. J. Math., 2009), in order to investigate the propagation of singularities for Schrödinger equations. The main theorem in my talk is that the wavefront set propagates to the radially homogeneous wavefront set under the time development by the Schrödinger equation. The method of the proof is applicable to both cases of asymptotically conical and hyperbolic manifolds.

INOUE, Hideki (University of Lyon)

Title: **Topological Levinson's theorem with two Hilbert spaces: from finite graphs to insulators**

Abstract: Levinson's theorem is a fundamental result in quantum mechanics, which relates the scattering matrix to the number of bound states of the underlying quantum system. Topological methods for this relation has been considerably developed for the last about ten years. In this talk, we provide a modification of the method for a scattering problem with two Hilbert spaces. The model consists of possibly infinitely many conducting wires attached to an interesting quantum system, which is driven by a self-adjoint operator satisfying a weak gap type condition on the conducting band of the wires. We give an explicit formula for a component of the wave operators, which acts on the Hilbert space of the wires. Topological version of Levinson's theorem is established in the already existing C*-algebraic framework. This talk is based on a joint work with Johannes Kellendonk (University Lyon 1) and Hermann Schulz-Baldes (University Erlangen-Nuernberg).

MIRANDA, Pablo (Universidad de Santiago de Chile)

Title: **Asymptotic behavior of the Spectral Shift Function for a discrete Dirac type operator in $\mathbb{Z}^2$**

Abstract: In this talk, we consider a Dirac type operator in the graph $\mathbb{Z}^2$. This is a matrix difference operator defined on the vertices and edges of $\mathbb{Z}^2$, together with a perturbation given by a potential that decays at infinity. We are interested in the spectral properties of this operator, which we will study through the analysis of the spectral shift function. Our main theorem describes the asymptotic behavior of this function near the thresholds in the spectrum.

The main novelty of this work is related to the nature of the thresholds of our model, for which the spectral shift function has not been studied before. In particular, we consider parabolic and hyperbolic thresholds as well as Dirac points.

This talk is based on a joint work with Daniel Parra and Georgi Raikov[†].

MIYAZAKI, Hayato (Kagawa University)

Title: **Long-range scattering for a homogeneous type nonlinear Schrödinger equation**

Abstract: We consider a homogeneous type nonlinear Schrödinger equation with a time-decaying harmonic oscillator. The nonlinearity of the equation is the homogeneous type with the long-range critical order in the sense of long-time behavior. As for the standard NLS with the nonlinearity, namely, without the harmonic oscillator, it is known that the asymptotic behavior of solutions is determined by the shape of the nonlinearity. On the other hand, under the gauge-invariant nonlinearity of the critical order, Kawamoto (2021) proves that the NLS with the harmonic oscillator admits a solution that behaves like a free solution with a logarithmic phase correction.

In this talk, we give a sufficient condition for the shape of the nonlinearity for that the homogeneous type NLS with the harmonic oscillator admits a solution that behaves like a free solution with or without the phase correction. This talk is based on joint work with Masaki Kawamoto at Ehime University.

NISHII, Yoshinori (Osaka University)

Title: **Energy decay for the semilinear wave equations with weakly dissipative structure**

Abstract: We consider the Cauchy problem for semilinear wave equations in two space dimensions. The null condition is a well-known sufficient condition for the small data global existence and asymptotic free behavior. Since around 2000, several weaker structural conditions than the null condition were studied. The Agemi condition which introduced by Hoshiga (2008), Kubo (2007), Katayama-Matsumura-Sunagawa (2015), etc., is one of them. Roughly speaking, this includes not only the classical null condition but also nonlinear dissipative terms. In this talk, we show that the energy of the solution decays with time when the Agemi condition is satisfied but the null condition is violated. This talk is based on the joint work with Hideaki Sunagawa (Osaka City University) and Hiroki Terashita.

TARAMA, Daisuke (Ritsumeikan University)

Title: **Sub-Riemannian geodesic flows on the spheres**

Abstract: This talk deals with the normal geodesic flows with respect to a certain sub-Riemannian structure on spheres from the viewpoint of Hamiltonian systems. The case of trivializable rank five sub-Riemannian structures on the seven-dimensional sphere is particularly studied and its complete integrability is discussed. The talk is based on a joint work with Wolfram Bauer (Leibniz Univ. Hannover).

PINCHOVER, Yehuda (Technion-Israel Institute of Technology)

Title: **Positive solutions of the A-Laplacian with a potential**

Abstract: Criticality theory for the $\mathcal{A}$-Laplacian plus a potential in a Morrey space will be presented. Prototypes of such operators are the p-Laplacian, the (p, A)-Laplacian, and the pseudo-p-Laplacian plus a potential term. In particular, I will discuss the existence, uniqueness, and simplicity of the principal eigenvalue in a bounded domain, the Agmon-Allegretto-Piepenbrink theorem, as well as certain characterizations of criticality and subcriticality, the removability of isolated singularity, and the existence of positive minimal Green functions.

This is a joint work with Yongjun Hou (GTIIT) Antti Rasila (GTIIT).

TADANO, Yukihide (Tokyo University of Science)

Title: **Continuum limit problem of discrete Schrödinger operators**

Abstract:

We consider asymptotic behavors of discrete Schrödinger operators $H_h = -\Delta_h + V|_{h\mathbb{Z}^d}$ on the square lattice $h\mathbb{Z}^d$ with mesh size $h > 0$, where Δ_h is the discrete Laplacian and $V : \mathbb{R}^d \to \mathbb{R}$. It is natural that H_h "converges" to the Schrödinger operator $H = -\Delta + V$ as $h \to 0$, however there are few mathematical studies of continuum limits of H_h. In this talk we show that, under relatively weak assumptions of the potential V, H_h converges to H in the generalized norm resolvent sense and that the spectrum $\sigma(H)$ and eigenfunctions of H can be approximated by those of H_h. This talk is based on a joint work with Shu Nakamura (Gakushuin University).

ITAKURA, Kyohei (Ritsumeikan University)

Title: **Strong radiation condition and stationary scattering theory for Stark operators**

Abstract: We present the stationary scattering theory for a perturbed one-body Stark operator. We deal with several topics on the stationary scattering theory: existence and completeness of the stationary wave operators, constructing the associated generalized Fourier transforms, which diagonalize a perturbed Stark operator and characterization of asymptotics of the generalized eigenfunctions with minimal growth order in terms of the stationary scattering matrix. A key ingredient of our procedures is the use of an improved version of radiation condition bounds obtained previously. Such a stronger, possibly optimal, radiation condition bounds are proved by a new scheme of proof. This talk is based on a joint work with Adachi Tadayoshi (Kyoto Univ.), Ito Kenichi (Univ. of Tokyo) and Skibsted Erik (Aarhus Univ.).

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