University of Potsdam, February 10-14, 2020 University Campus Neues Palais, Am Neuen Palais 10, D-14469 Potsdam Haus 9, Room 1.02

International Conference

Microlocal and Global Analysis, Interactions with Geometry

ABSTRACTS

Organizers:

Wolfram Bauer (Hannover) Bert-Wolfgang Schulze (Potsdam) Alfonso Garmendia (Potsdam) Jörg Seiler (Torino)

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Sylvie Paycha (Potsdam) Ingo Witt (Göttingen)

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	Tuesday	Schulze	Schrohe		Grieser		Khalile		Azzali	Sanchez	Fulsche		Kutsenko
	Monday	Paycha	Yunken		Braverman		Zanelli		Bauer	Baldare	Bandara		Galkin
	\mathbf{Times}	Chair	$9{:}00{-}9{:}45$	$9{:}45{-}10{:}00$	10:00-10:45	$10:45{-}11:15$	11:15-12:00	12:00-13:15	Chair	$13:15{-}14:00$	14:00-14:45	14:45-15:15	$15:15{-}16:00$

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Conference Dinner

- All lectures will take place on the Campus Neues Palais, Haus 9, first floor, room 2. (1.02)
 The breaks will take place on the same building, second floor, room 3.
 The Conference Dinner will be held at the restaurant Krongut Bornstedt in Potsdam.

(1) Discussion about future perspectives.

UNIVERSITY OF POTSDAM, FEBRUARY 10-14, 2020

Azzali Sara

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TITLE: Discrete group actions and the Baum–Connes conjecture.

The Baum–Connes conjecture can be seen as a far reaching generalisation of the Atiyah–Singer index theorem. Given a locally compact group G, the conjecture predicts an isomorphisms between a topological and an analytic object constructed from G.

One of the main motivations of the Baum–Connes conjecture comes from the case of discrete groups, where it implies the Novikov conjecture on the homotopy invariance of higher signatures.

We first give an introduction to the topic and, giving some examples, we describe the framework of Kasparov?s bivariant K-theory, which is at the base of many of the known results for the two conjectures.

We then describe the advantages of introducing real coefficients in bivariant K-theory, and present a variant of the Baum–Connes conjecture which is localised at the unit element of a discrete group. The localised conjecture is weaker than the classical one, but still implies the Novikov conjecture. Joint work with Paolo Antonini and Georges Skandalis.

BALDARE ALEXANDRE

Hannover University, Germany alexandre.baldare@math.uni-hannover.de

TITLE: Index theory for leafwise G-transversally elliptic operators on foliations.

In this talk, I will introduce an index class for G-transversally elliptic longitudinal operators. I will start by recalling the classical case of a G-transversally elliptic operator on a smooth compact manifold. Then I will discuss the case of families of G-transversally elliptic operators and the properties of the index class. I will finish with the case of foliation. This is joint work with Moulay Benameur.

BANDARA LASHI

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TITLE: Boundary value problems for general first-order elliptic differential operators.

The Bär-Ballmann framework is a comprehensive machine useful in studying elliptic boundary value problems (as well as their index theory) for first-order elliptic operators on manifolds with compact and smooth boundary. A fundamental assumption in their work is that an induced operator on the boundary can be chosen self-adjoint. Many operators, including all Dirac type operators, satisfy this requirement. In particular, this includes the Hodge-Dirac operator as well as the Atiyah-Singer Dirac operator. Recently, there has been a desire to study more general first-order elliptic operators, with the quintessential example being the Rarita-Schwinger operator on 3/2-spinors. In general dimensions, every induced boundary operator for the Rarita-Schwinger operator is non self-adjoint.

In this talk, I will present recent work with Bär where we extend the Bär-Ballmann framework to consider general first-order elliptic operators by dispensing with the self-adjointness requirement for induced boundary operators. The ellipticity of the operator allows us to understand the structure of the induced operator on the boundary, modulo a lower order additive perturbation, as bi-sectorial operator. An essential tool in our work is the bounded holomorphic functional calculus, coupled with pseudo-differential operator theory, semi-group theory as well as methods arising from the resolution of the Kato square root problem. This perspective also paves way for studying non-compact boundary, Lipschitz boundary, as well as boundary value problems in the L^p setting.

BEI FRANCESCO (LAST MINUTE CANCELATION)

Sapienza Universita di Roma, Italy bei@mat.uniroma1.it

TITLE: On L^1 -cohomology, curvature and topology of stratified spaces.

Thom-Mather stratified psudomanifolds provide an important class of singular spaces that arise in several contexts. For instance singular complex projective varieties or orbit spaces of proper Lie groups actions belong to this class. In this setting an important topological invariant is the well known intersection cohomology introduced by Goresky and MacPherson at the end of the seventies. In this talk we will focus on a compact Thom-Mather stratified pseudomanifold X whose regular part, reg(X), is endowed with an iterated conic metric g. As we will see these are an important class of incomplete Riemannian metrics defined on reg(X) whose asymptotic nearby the singular locus of X is adapted to the geometry of the underlying space. In the first part of this talk we will consider bounded differential forms on reg(X) and we will show that the cohomology of the corresponding complex, that is the L^1 -de Rham cohomology of (reg(X); g), is isomorphic to the top perversity intersection cohomology of X. Then in the second part, requiring suitable curvature conditions on (reg(X); g), we will use the above isomorphism to show some inequalities between dim($H^k(X; R)$) and dim($\Im H^k(X; R)$), where the former group is the singular cohomology of X whereas the latter one denotes the (upper or lower) middle perversity intersection cohomology of X.

BRAVERMAN MAXIM

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TITLE: Geometric quantization of b-symplectic manifolds.

We introduce a method of geometric quantization for compact b-symplectic manifolds in terms of the index of an Atiyah-Patodi-Singer (APS) boundary value problem. We show further that b-symplectic manifolds have canonical Spin-c structures in the usual sense, and that the APS index above coincides with the index of the Spin-c Dirac operator. We show that if the manifold is endowed with a Hamiltonian action of a compact connected Lie group with non-zero modular weights, then this method satisfies the Guillemin-Sternberg "quantization commutes with reduction" property. In particular our quantization coincides with the formal quantization defined by Guillemin, Miranda and Weitsman, providing a positive answer to a question posed in their paper. (joint work with Yiannis Loizides, andYanli Song)

Brüning Jochen

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TITLE: "Equivariants" of elliptic differential operators.

This is joint work with Ken Richardson.

Given a compact smooth manifold, M, possibly with boundary, and a smooth complex vector bundle, E, over M, then an elliptic differential operator, D, acting on $C^{\infty}(M, E)$ provides analytic invariants of importance, notably the index of D, ind D. This index can be presented locally, as an integral over a specific differential form, as shown by Atiyah and Singer in their fundamental work.

Now we add a compact Lie group, G, that acts on M and E, hence also on $C^{\infty}(M, E)$, by a representation σ . We fix an irreducible representation, ρ , with representative space V_{ρ} of finite dimension, $d\rho$, and with character $\chi_{\rho}: g \to Tr(\sigma(g))$. Then the ρ -isotypical subspace, $C^{\infty}(M, E)\rho$, is defined by the projection

$$P_{\rho} := d\rho \int G\chi_{\rho}(g-1)\sigma(g)dg: \qquad C^{\infty}(M,E) \to C^{\infty}(M,E)\rho.$$

Finally, we require that D commutes with P_{ρ} such that $D_{\rho} = P_{\rho}D = DP_{\rho}$ is also an elliptic differential operator and has an index, $\operatorname{ind} D_{\rho}$, too. But this index does not arise from a local quantity by integration. In the talk, we will be mainly concerned with various interpretations of $\operatorname{ind} D_{\rho}$.

Côme Rémi

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TITLE: Fredholm conditions for restrictions of invariant pseudodifferential operators to isotypical components.

I will present a joint work with Alexandre Baldare, Matthias Lesch and Victor Nistor. We consider a finite group Γ acting on a compact manifold M, together with a Γ -equivariant, order-m differential operator P acting on the sections of an equivariant vector bundle $E \to M$. The Sobolev spaces $H^s(M; E)$ admit a decomposition into Γ -isotypical components:

$$H^{s}(M, E) = \bigoplus_{\alpha \in \hat{\Gamma}} H^{s}(M, E)_{\alpha}.$$

This leads to the following question: for a fixed $\alpha \in \hat{\Gamma}$, when is $P: H^m(M, E)_{\alpha} \to L^2(M, E)_{\alpha}$ Fredholm? We define an α -principal symbol for P and a corresponding notion of α -ellipticity. This relies on a careful study of the primitive spectrum of the C^* -algebra of equivariant symbols.

DAVE SHANTANU

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TITLE: The heat asymptotics for geometric hypoelliptic operators.

On a Riemannian manifold, the heat asymptotics of positive elliptic operators encode many important topological and geometric in variants. These include the dimension of the manifold, its volume, the Einstein-Hilbert action, the index of the elliptic operator. In this talk we will discuss the heat asymptotics of some hypoelliptic (but not elliptic) operators. These hypoelliptic operators appear in the presence of more general geometric structures such as CR-structures which are more sophesticated than a Riemannian metric. However, the heat asymptotics has an identical form analogous to positive elliptic operators. Consequently we derive precise Weyl?s laws and describe the spectral zeta functions precisely.

DREHER MICHAEL

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TITLE: Thermoelasticity, Lyapunov Functionals, and Algebra.

The exponential stability of solutions to evolution equations such as models from thermoelasticity can be shown by means of a Lyapunov functional, which are being constructed in a process that consists of several steps and depends on careful choices of large and small parameters. This talk intends to shed some light into this procedure using concepts from real algebraic geometry.

Fulsche Robert

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TITLE: Correspondence theory on Fock spaces with applications to Toeplitz algebras.

In [2] Reinhard Werner established a correspondence theory between certain subspaces of $L^1(\mathbb{R}^{2n})$ and $\mathcal{L}(L^2(\mathbb{R}^n))$. We will describe this correspondence theory in the Fock-Bargmann representation, i.e. on spaces of holomorphic functions over \mathbb{C}^n which are square-integrable with respect to certain Gaussian measures. We will discuss some extensions of this correspondence theory and demonstrate how it can be applied to obtain structural results on certain Toeplitz algebras over Fock spaces. We obtain simple proofs of some known results, e.g. the compactness characterization of operators on the Fock space by Bauer and Isralowitz [1] or Xia's theorem which states that the full Toeplitz algebra is just the closure of the set of all Toeplitz operators [3], and will also discuss several new results.

References:

•[1] W. Bauer and J. Isralowitz, Compactness characterization of operators in the Toeplitz algebra of the Fock space F_{α}^{p} , J. Funct. Anal. 263 (2012), 1323-1355.

•[2] R. Werner, Quantum harmonic analysis on phase space, J. Math. Phys. 25 (1984), 1404-1411.

•[3] J. Xia, Localization and the Toeplitz algebra on the Bergman space, J. Funct. Anal. 269 (2015), 781-814.

GALKIN VALERII

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TITLE: Geometric Problems of Modeling Structures in the Porous Space.

We consider the porous medium as a network of intergrain channels formed by internally connected intermediate spaces between particles (see. Fig. 1).



FIGURE 1. Local structure of the porous space

Natural examples of above problems investigated in description of global structures produced by connected pores in matrix of oilcontaining sands and similar problems arise in research of materials of nuclear reactors under influence of neutron flow. They are similar to the description of structures in multidimensional billiard game and include complicated geometry of fluid dynamics in such media (for example, blood dynamics in capillary system). These problems of graphs connectivity directly related to the description of neural nets and models of artificial intelligence. The good experience for controlled dynamics in such composite media gives us neutron physics in theory of nuclear reactors. The description of global structures in the above examples connected with solutions of Smoluchowskii kinetic Equation [1,2], which is directly leads to the following non-local Hopf Equation

$$\frac{\partial F}{\partial t} + [F - F(0, t)] \frac{\partial F}{\partial p} = 0, (p > 0, t > 0),$$

for density distribution function of global conductivity paths in structure of porous medium. Theorem. The local singularities on the surface of the solution for the non-local Hopf Equation makes up global connectivity in porous space.

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Acknowledgments:

The Russian Foundation for Basic Research supported this work, project nos. 18-47-860005, 18-01-00343 **References:**

1. V. A. Galkin. Analysis of Mathematical Models: Conservation Law Systems, Smoluchowski and Boltzmann Equations Moscow : BINOM, 2009. 408 p. [in Russian].

2. V. A. Galkin. Smoluchowski Equation (FIZMATLIT, Moscow, 2001) [in Russian].

GRIESER DANIEL

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TITLE: The Calderón projector and Dirichlet-Neumann operator for fibred cusp operators.

The Calderón projector is a classical object in the study of boundary value problems for a (uniformly) elliptic operator P on a compact manifold with boundary. If the order of P is m then the Calderón projector is a projection in the space of m-tuples of functions on the boundary to the subspace of Cauchy data of solutions u of the equation Pu = 0. An important result is that it is a pseudodifferential operator. We study the Calderón projector in the case where the boundary and operator have singularities that can be described by the fibred cusp (or phi-) geometry introduced by Mazzeo and Melrose. This includes geometric operators on the following types of geometry: 1. fibre bundles with boundary over asymptotically Euclidean spaces, 2. certain types domains in locally symmetric spaces and 3. the exterior domain outside the union of two touching strictly convex bounded domains in \mathbb{R}^n . Our main result is a uniform description of the Calderón projector and Dirichlet-Neumann operator near the singularity: they are phi-pseudodifferential operators. In the talk I will introduce the necessary background on the phi-calculus. This is joint work with K. Fritzsch und E. Schrohe.

HARTUNG TOBIAS

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TITLE: ζ -regularized vacuum expectation values.

Computing vacuum expectation values is paramount in studying Quantum Field Theories (QFTs) since they provide relevant information for comparing the underlying theory with experimental results. However, unless the ground state of the system is explicitly known, such computations are very difficult and Monte Carlo simulations generally run months to years on state-of-the-art high performance computers. Additionally, there are various physically interesting situations, in which most numerical methods currently in use are not applicable at all (e.g., the early universe or setting requiring Lorentzian backgrounds). Thus, new algorithms are required to address such problems in QFT.

In recent joint work with K. Jansen (NIC, DESY Zeuthen), I have shown that ζ -functions of Fourier integral operators can be applied to regularize vacuum expectation values with Euclidean and Lorentzian backgrounds and that these ζ -regularized vacuum expectation values are in fact physically meaningful. In order to prove physicality, we introduced a discretization scheme which is accessible on a quantum computer. Using this discretization scheme, we can approximate ground states on a quantum device and henceforth compute vacuum expectation values. Furthermore, the Fourier integral operator ζ -function approach is applicable to Lattice formulations in Lorentzian background.

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Hosseini Mehran

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TITLE: Secondary Invariants of Positive Scalar Curvature Metrics on Manifolds with Boundary.

After recalling the coarse geometric approach to higher index theory and its applications to the existence and classification of positive scalar curvature metrics on closed manifolds, I will introduce variants of Roe algebras for spaces with cylindrical ends and discuss how they can be used in relative higher index theory. In particular, I will define secondary invariants for positive scalar curvature (psc) metrics on manifolds with boundary, which, apart form providing a simple proof of the vanishing of the relative higher index of manifolds with boundary admitting a psc metric, can be used for classification of such metrics.

JÄH CHRISTIAN

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TITLE: Towards dispersive estimates on homogeneous Lie groups.

The main goal of this talk is to give an overview of recent work on dispersive estimates for wave- and Schrödinger equations on homogeneous Lie groups. We shall first give a very quick review of homogeneous Lie groups and Fourier Analysis on such groups. We shall focus on the special cases of the Heisenberg group \mathbb{H}^n , *H*-types groups, and general Lie groups of step 2. To finish, we will give some insight in ongoing join work with Ingo Witt, which extends the approaches to Rockland wave equations to general graded Lie groups.

KHALILE MAGDA

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TITLE: Optimization of the lowest Robin eigenvalue on 2-manifolds.

We study the problem of geometric optimization of the lowest eigenvalue of the Laplacian with an attractive Robin boundary condition acting on a compact, simply-connected two dimensional manifold with boundary under a constraint of fixed perimeter. While this problem is well-understood in the Euclidean case, our aim is to generalize it to the sub-class of 2- manifolds with Gauss curvature bounded from above by a constant $K_o \ge 0$. We are able to prove that, in this setting, the geodesic disk of constant Gauss curvature K_o is a maximizer. Adapting our methods to Robin Laplacians acting on unbounded three-dimensional cones, we show that under a constraint of fixed perimeter of the cross-section, the lowest Robin eigenvalue is maximized by the circular cone. This talk is based on a joint work with Vladimir Lotoreichik.

KUTSENKO ANTON

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TITLE: Operators in the 'Quantum Cubic World' or in the 'Minecraft World'.

'Minecraft World' (MW) consists of a finite number of disjoint cubes of the same size. The original (Lego?) computer interpretation of this world can be found in https://www.minecraft.net/. Sometimes, this is a good approximation of the real world, especially when the size of the cubes tends to 0. What operators are possible in the "Minecraft World"? These are averaging (integral) operators along the edges of the cubes, and operators that move values from one cube to another. Usually, various combinations of such elementary operators cover most of the needs of practical applications in mathematics, mechanics and physics.

The typical problems for these operators are as follows:

- How to find the spectrum of the operators?
- How to find unknown u in the operator problem Au = f, or how to find the inverse A^{-1} ?
- How to find the square root of \mathcal{A} , or, generally, how to construct the functional calculus on the algebra of operators in MW?

(Yes, obviously, the algebra contains all the possible combinations of elementary operators in MW.)

In order to answer these questions, we need to have a good representation of the algebra \mathscr{A} generated by the operators acting on MW. One of the results we would like to present is that the C^* -algebra \mathscr{A} is isomorphic to the direct product of simple matrix algebras

$$\mathscr{A} \cong (\mathbb{C}^{p \times p})^{2^N},$$

where p is the number of cubes in MW and N is the dimension (number of non-parallel edges of the cube) of MW. The isomorphism has a non-trivial but explicit form. Thus, the operator problems in the "Minecraft World" are reduced to the matrix problems. Note, that most of the operators, including some of integral operators, are infinitely dimensional and non-compact, but the algebra \mathscr{A} generated by them is finite-dimensional. As an application, we find explicitly the wave function for 3D Schrödinger operator acting on the infinite medium with planar, guided, local potential defects, and point sources. We also apply the results to construct the functional calculus on the algebra of extended Fredholm integral operators. Finally, we discuss the problems of approximation of continuous integral kernels by piecewise constant ones. Maybe, we provide a categorial classification of the direct limit of C^* -algebras of operators in MW when the cubic size tends to 0.

Mougel Jérémy

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TITLE: Manifolds with corners and C^* -algebras: Application to the N-body problem.

To study the N-body problem, Vasy built a compactification of \mathbb{R}^n using blowups of manifolds with corners with respect to a convenient family of submanifolds. This construction is based on Melrose's work and was generalised by Kottke. Before that, Georgescu built also a space to study the N-body problem. Georgescu's space is the spectrum of a commutative C*algebra. In this talk, I will recall the construction of each of these spaces and present their advantages. I will then describe a canonical map that goes from Vasy's space to Georgescu's space. In a joint work with V. Nistor and B. Ammann, we have proved that this map is a homeomorphism.

NAZAIKINSKII VLADIMIR

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TITLE: Symplectic reduction and semiclassical asymptotics for equations with degeneration on the boundary.

Let X be a compact manifold with smooth boundary. Consider the wave equation on X in which the squared velocity is a smooth function on X positive in the interior of X and vanishing (with first order) on the entire boundary. We are interested in short-wave asymptotics of solutions of this equation and of other PDE with this type of degeneration. To this end, we represent X as the quotient of a closed manifold M by a semifree circle action. The equations in question can be lifted to M, where the asymptotic solutions can be written by standard methods. The solutions of the original equations are just the fiberwise constant solutions of these new equations. Now the nonstandard phase space corresponding to degenerate PDE of this kind can be defined as the Marsden?Weinstein symplectic reduction of the cotangent bundle of M by the circle action. The surprisingly simple implementation of this approach provides a complete analysis of asymptotic solutions of the original equations and simple efficient formulas for these solutions. The results have applications to the theory of run-up of long waves on a shallow beach (including tsunami waves generated by a localized source, waves trapped by the coast, or seiches).

The talk is based on joint work with S.Yu. Dobrokhotov. The research was supported by the Russian Science Foundation under grant no. 16-11-10282.

Piazza Paolo

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TITLE: Positive scalar curvature on stratified pseudomanifold.

I will report on recent work in collaboration with Boris Botvinnik and Jonathan Rosenberg about the existence of iterated conic metrics of positive scalar curvature (PSC) on a stratified pseudomanifold. First, building also on joint work with Albin and Gell Redman, I will present index theoretic necessary conditions for the existence of such PSC metrics. Then I will explain under which additional hypothesis these necessary conditions are also sufficient. I will end the talk by discussing the moduli space of such metrics.

ROOS SASKIA

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TITLE: Dirac operator under collapse to a smooth manifold.

We consider a sequences of spin manifolds with bounded curvature and diameter that collapses to a smooth manifold. In that setting we show that a part of the spectrum of the Dirac operator converges to an explicitly given twisted Dirac operator with a symmetric potential. Moreover, we give an example of collapsing sequences where the spectrum of the Dirac operator converges to the spectrum of the Dirac operator on the limit space.

SANCHEZ YAFET

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TITLE: The singularities of the causal propagator.

In this talk, I will give a description of the singularity structure of the causal propagator for the wave equation on smooth Lorentzian manifolds. Then, I will comment on current work in progress with E. Schrohe regarding the singularity structure when the smoothness condition is relaxed.

Schrohe Elmar

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TITLE: Degenerate Elliptic Boundary Value Problems with Non-smooth Coefficients.

On a manifold of bounded geometry with boundary we consider a uniformly strongly elliptic second order operator A that locally is of the form

$$A = -\sum_{j,k} a_{jk} \partial_{x_j} \partial_{x_k} + \sum_j b_j \partial_{x_j} + c$$

together with a degenerate boundary operator T of the form

$$T = \varphi_0 \gamma_0 + \varphi_1 \gamma_1,$$

where γ_0 and γ_1 denote the evaluation of a function and its exterior normal derivative, respectively, at the boundary, and φ_0 , φ_1 are smooth functions on the boundary with $\varphi_0 \ge 0$, $\varphi_1 \ge 0$ and $\varphi_0 + \varphi_1 \ge c_0 > 0$. Unless either $\varphi_0 \equiv 0$ or $\varphi_1 \equiv 0$ this problem is not elliptic in the sense of Lopatinskij and Shapiro.

We show that the realization A_T of A in $L^p(\Omega)$ has a bounded H^{∞} -calculus whenever the a_{jk} are Hölder continuous and b_j as well as c are L^{∞} . For the proof we first treat the operator with smooth coefficients on \mathbb{R}^n_+ . Here we rely on an extension of Boutet de Monvel's calculus to operator-valued symbols of Hörmander type $(1, \delta)$. We then use H^{∞} -perturbation techniques in order to treat the non-smooth case.

As an application we study the porous medium equation.

(Joint work with Thorben Krietenstein, Hannover)

TARAMA DAISUKE

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TITLE: Geometry and analysis for the Kirchhoff equations under the Clebsch-Weber conditions.

This talk concerns the Kirchhoff equations modelling the motion of a rigid body in a ideal fluid under some special conditions posed by Clebsch. One can regard these equations as Hamiltonian systems on the six-dimensional Euclidean space with respect to a Lie-Poisson structure, which is in fact completely integrable in the sense of Liouville. The dynamical behavior of the system is analyzed around the equilibria and its relation to the "momentum mapping" is explained. Under a further condition posed by Weber, there appears a family of Kummer surfaces, which form a typical class of K3 surfaces. The relation between this family of Kummer surfaces and the "momentum mapping" is also studied. The talk is based on the joint project with Jean-Pierre Françoise at Sorbonne Université.

WEI YAWEI (LAST MINUTE CANCELATION)

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TITLE: Existence of classical solution for mean field game system.

Mean field game is to study strategic decision making among large population of rational agents, with the idea that each interacting agent alone is insignificant compared to the very large population but are significant when aggregated together. Then it is only need to consider interaction between an agent and the population and how population changing affair the interactions. J.-M.Lasry and P.Lions in 2007 described the mean field games with a coupled system of Hamilton-Jacobi equation and Fokker-Plank equation. This talk will first introduce the motivation and basic concept of Mean field game system, and then will talk about the applications of mean field game models in finance and macroeconomics. Finally, the main part of this talk is about the existence of classical solution for the first order mean field game system.

WITT INGO

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TITLE: On a class of hyperbolic totally characteristic boundary problems with an additional degeneracy.

We study hyperbolic totally characteristic boundary problems with an additional degeneracy appearing at the edge $\{t = 0, x = 0\}$ formed of lateral boundary $\{x = 0\}$ and initial hypersurface $\{t = 0\}$. Here, the spacetime domain is $(0, T) \times \mathbb{R}_+ \times \mathbb{R}^d$ with coordinates (t, x, y). The prototypical example is provided by the second-order scalar differential operator

$$L = \partial_t^2 - \sigma^2(t, x) \,\partial_x^2 - \Delta_y,$$

where $\sigma(t, x) = \sqrt{t^2 + x} - t$. Notice that, for a fixed $0 \le t \le T$,

$$\sigma(t,x) = \begin{cases} \sqrt{x}, & t = 0, \\ x/(2t) + O(x^2) \text{ as } x \to +0, & 0 < t \le T \end{cases}$$

The solution to the Cauchy problem for the operator L is found in a class of adapted 2-microlocal spaces. Here, no boundary conditions are required due the fact that the boundary is totally characteristic.

Such problems arise when steady supersonic flow turns a sufficiently large bend and a vacuum region is formed. In this situation, σ has the physical interpretation of speed of sound, with x > 0 being the distance to the vacuum. Notice that $\sigma \asymp \sqrt{x}$ is typical of a moving interface, while one has $\sigma \asymp x$ for a stationary interface that separates the flow from the vacuum.

This is joint work with Zhuoping Ruan (Nanjing University).

YANG ZHIPENG

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TITLE: Existence and concentration behavior of solutions for some fractional Schrödinger-Poisson systems.

We are concerned with the ground state solutions for the fractional Schrödinger-Poisson system

$$\begin{cases} \varepsilon^{2s}(-\Delta)^s u + V(x)u + \phi u = f(x,u) & \text{in } \mathbb{R}^3, \\ \varepsilon^{2t}(-\Delta)^t \phi = u^2 & \text{in } \mathbb{R}^3, \end{cases}$$

where $\varepsilon > 0$ is a small parameter, $(-\Delta)^{\alpha}$ denotes the fractional Laplacian of order $\alpha = s, t \in (0, 1)$ and satisfies 2t + 2s > 3. Under different conditions on the potential function V and nonlinear function f, we obtain some existence results and concentration behaviour of these solution as $\varepsilon \to 0$. This is a joint work with Fukun Zhao and Yuanyang Yu.

YUNKEN ROBERT

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TITLE: Pseudodifferential operators from tangent groupoids.

We will discuss the following principal: In order to construct an algebra of pseudodifferential operators adapted to a given geometrical situation, it suffices to construct an appropriate tangent groupoid. This idea leads to a simple new construction of many different pseudodifferential calculi, such as the Heisenberg calculus, Mellin's filtered calculus, and Melrose's b-calculus. (Joint work with E. van Erp).

Zanelli Lorenzo

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TITLE: Semiclassical estimates for eigenfunctions of toroidal Pseudodifferential operators.

We provide some estimates describing the semiclassical localization in the phase space for eigenfunctions of toroidal Pseudodifferential operators. In particular, we show the link of this result with respect to the coherent states decomposition in this periodic setting.

Zenobi Vito

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TITLE: Singular spaces, groupoids and metrics of positive scalar curvature.

In this talk I will present a Lie groupoid approach to the study of higher K-theoretical invariants on singular spaces. In particular we shall consider fibered corner metrics along with the associated Dirac operators on stratified spin manifolds. We will then construct (under full ellipticity condition) the fundamental K-homology class and the higher index of such an operator. Moreover, by means of the adiabatic deformation groupoid, we will be able to construct higher secondary invariants on the space of concordance classes of fibered corner metrics with positive scalar curvature.

UNIVERSITY OF POTSDAM, FEBRUARY 10-14, 2020

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