#35: Symplectic Structures in Geometric Analysis, Room **W120**

Tuesday **22 September 2015**		**Wednesday** **23 September 2015**	
Morning **10:30-12:30**	**Afternoon** **14:00-15:00**	**Morning** **10:30-12:30**	**Afternoon** **14:00-15:00**
10:30-11:00 Abbondandolo, Sharp systolic inequalities in Reeb dynamics **11:00-11:30** Markvorsen, Geometric potential analysis for minimal surfaces and foams **11:30-12:00** Lesch, Modular curvature and Morita equivalence **12:00-12:30** de Gosson, Maximal symplectic covariance properties for classes of pseudo-differential operators	**14:00-14:30** Schulz-Baldes, Index theorems for symplectic projections **14:30-15:00** Azzali, Relative spectral invariants and operator algebraic point of view **19:30:** **Ristorante Terzetto** Bundesstraße 31, see map on back cover	**10:30-11:00** Bär, An index theorem for Lorentzian manifolds **11:00-11:30** Portaluri, Index theory in celestial mechanics: recent results and new perspectives **11:30-12:00** Furutani, Isospectral but non-diffeomorphic nilmanifolds attached to Clifford modules **12:00-12:30** Ørsted, Symplectic areas of triangles and the Maslov index	**14:00-14:30** Wahl, On the noncommutative Maslov index **14:30-15:00** Nest, Deformations of coisotropic submanifolds and index of a class of Fourier integral operators
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Organizers: ***Bernhelm Booß-Bavnbek*** **[booss@ruc.dk],** ***Nils Waterstraat*** **[N.Waterstraat@kent.ac.uk]**

Symplectic Structures in Geometric Analysis. The aim of this Minisymposium is to bring together specialists from symplectic geometry, global analysis, nonlinear differential equations, and mathematical physics. The emphasis is on recent applications of symplectic invariants to problems in geometric analysis. The topics covered will include spectral invariants of operators of Dirac- and Laplace-type and other geometrically defined differential operators, (weak) symplectic structures in Banach spaces, Conley-Zehnder and Maslov indices, as well as applications to bifurcation theory, Hamiltonian systems, the *N*-body problem, boundary value problems, (closed) geodesics, and minimal varieties.

Tuesday
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10:30 ***Sharp systolic inequalities in Reeb dynamics***

Alberto Abbondandolo
University of Bochum, Germany [alberto.abbondandolo@rub.de]

Can the minimal period of closed Reeb orbits on a contact three-sphere be bounded from above in terms of the contact volume? I will discuss positive results and counterexamples related to this question, together with applications in symplectic and Finsler geometry. This talk is based on a joint work with B. Bramham, U. Hryniewicz and P. Salomão.

11:00 ***Geometric potential analysis for minimal surfaces and foams***

Steen Markvorsen
Technical University of Denmark, Denmark [stema@dtu.dk]

We survey some recent results obtained with A. Hurtado, V. Gimeno, and V. Palmer, concerning comparison geometric aspects of the Dirichlet spectrum and the mean exit time moment spectrum for extrinsic balls in minimal submanifolds. Possible extensions to foam structures and to similar comparison geometric results in Finsler spaces will also be discussed.

11:30 ***Modular curvature and Morita equivalence***

Matthias Lesch
University of Bonn, Germany [ml@matthiaslesch.de]

We prove that the modular curvature of a conformal metric structure on the noncommutative torus T^2_θ $(\theta\notin\mathbf{Q})$ is invariant under Morita equivalence. More precisely, the curvature associated to a Hermitian structure on a Heisenberg bimodule E realizing the Morita equivalence between $A_\theta=C(T_\theta)$ and $A_{\theta^\vee}$, with $A_{\theta^\vee}$ identified to the algebra of endomorphisms $End_{A_\theta}(E)$, coincides with the intrinsic curvature of the conformal metric on T^2_θ with corresponding Weyl factor.

The main analytical tool is the extension of Connes' pseudodifferential calculus to Heisenberg modules, the novel technical aspect being that the entire computation is free of any computer assistance. This is joint work with Henri Moscovici.

12:00 ***Maximal symplectic covariance properties for classes of pseudo-differential operators***

Maurice A. de Gosson
University of Vienna, Austria [maurice.de.gosson@univie.ac.at]

We show in this talk that the symplectic group is a maximal symmetry group for covariance properties of Weyl pseudodifferential operators. We thereafter address the case of Shubin and Jordan operators, and show that the corresponding pseudodifferential calculi are covariant under the action of certain subgroups of the symplectic group. We relate these symmetry properties to those of the Wigner transform in the Weyl case, and to the Cohen class in the more general case.

14:00 ***Index theorems for symplectic projections***

Hermann Schulz-Baldes
University of Erlangen-Nürnberg, Germany [schuba@mi.uni-erlangen.de]

In an operator algebra furnished with an anti-linear involution it is possible to consider Lagrangian projections which specify KR-group elements. Pairing such projections with KR-cycles leads to index theorems which can be $2\mathbf{Z}$- or $\mathbf{Z}_2$-valued. The heart of the argument is based on methods from symplectic linear algebra and leads to a new type of Kramers degeneracy argument. Applications concern topological condensed matter systems.

14:30 ***Relative spectral invariants and operator algebraic point of view***

Sara Azzali
University of Potsdam, Germany [azzali@uni-potsdam.de]

Atiyah, Patodi and Singer constructed the relative K-theory class $[\alpha]$ associated with a flat unitary vector bundle over a closed manifold. This class is related to the spectral invariant rho of a Dirac operator by the so called index theorem for flat bundles, which computes the pairing between $[\alpha]$ and the K-homology class $[D]$ of the Dirac operator. The pairing is in turn equal to a type II spectral flow, as proved by Douglas, Hurder and Kaminker.

In this talk we will focus on the operator algebraic point of view on these relative invariants by showing how the construction of $[\alpha]$ can be seen as a consequence of Atiyah's L^2 index theorem. We will also give new relative K-theory construction obtained in joint work with Paolo Antonini and Georges Skandalis that generalize the class $[\alpha]$ to a noncommutative setting.

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10:30 ***An index theorem for Lorentzian manifolds***

Christian Bär
University of Potsdam, Germany [baer@math.uni-potsdam.de]

We prove an index theorem for the Dirac operator on compact Lorentzian manifolds with spacelike boundary. Unlike in the Riemannian situation, the Dirac operator is not elliptic. But it turns out that under Atiyah-Patodi-Singer boundary conditions, the kernel is finite dimensional and consists of smooth sections. The corresponding index can be expressed by a curvature integral, a boundary transgression integral and the eta-invariant of the boundary just as in the Riemannian case. There is a natural physical interpretation in terms of particle-antiparticle creation. This is joint work with Alexander Strohmaier.

11:00 ***Index theory in celestial mechanics: recent results and new perspectives***

Alessandro Portaluri
University of Turin, Italy [alessandro.portaluri@unito.it]

In the last decades a zoo of new symmetric periodic collision-less orbits for the n-body problem appeared in the literature as critical points of the Lagrangian action functional. Certainly one of the important features of such orbits, for a better understanding of the dynamics, is the knowledge of the Morse index as well as their linear (in)stability properties. A central device for computing this index is a Morse-type index theorem and a refined computation of the Maslov index. However, a key role in order to penetrate the intricate dynamics of this singular problem is represented by the collision orbits. In this talk, after a presentation of a new variational regularisation of the Lagrangian action functional, we will show how to define a suitable index theory for a special class of colliding trajectories. This is a joint work with V. Barutello, X. Hu and S. Terracini

11:30 ***Isospectral but non-diffeomorphic nilmanifolds attached to Clifford modules***

Kenro Furutani
Tokyo University of Science, Japan [furutani_kenro@ma.noda.tus.ac.jp]

I will introduce several new examples of isospectral but non-diffeomorphic nilmanifolds. These nilmanifolds are constructed from Clifford modules. Their classification leads us to such examples, not only just pairs, but any given number of such manifolds.

12:00 ***Symplectic areas of triangles and the Maslov index***

Bent Ørsted
Aarhus University, Denmark [orsted@math.au.dk]

For bounded symmetric domains in complex Euclidian Space there is a natural notion of areas of geodesic triangles; this is related to the Maslov index. In this lecture we shall explain this and also discuss some generalizations to other complex manifolds.

14:00 ***On the noncommutative Maslov index***

Charlotte Wahl
Leibniz Bibliothek Hannover, Germany [wahlcharlotte@gmail.com]

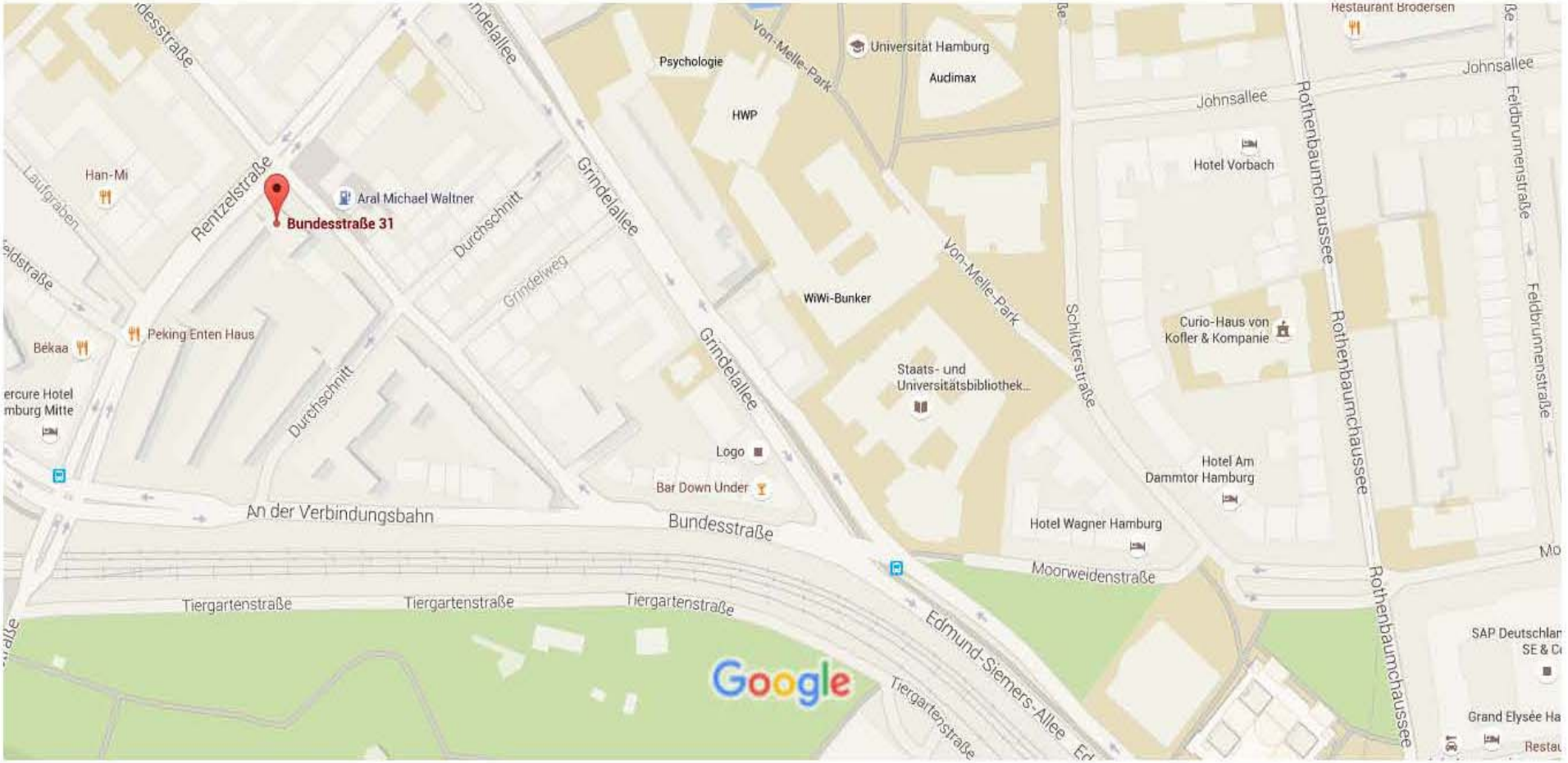
We will explain the definition and properties of the noncommutative Maslov index for projective modules over C^*-algebras and its connection to recent work of Barge and Lannes, who studied a Maslov index over commutative rings. In particular we correct and make more precise a statement on the dependence of the choices contained in our previous work on the subject. All this generalizes classical work of Cappell, Lee and Miller. The proofs involve index theory over C^*-algebras.

14:30 ***Deformations of coisotropic submanifolds and index of a class of Fourier integral operators***

Ryszard Nest
University of Copenhagen, Denmark [rnest@math.ku.dk]

Given a conic coisotropic submanifold B of a cotangent bundle of a manifold X, Guillemin and Sternberg associated to it a certain algebra A of Fourier Integral Operators on X. We will explain how the deformation of B relates to the full symbol calculus of the elements of A and show how to deduce an index theorem for Fredholm operators belonging to A.

Google Maps **Bundesstraße 31**



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Bundesstraße 31

20146 Hamburg
Germany