Delft-Würzburg Workshop 2022

Representation Theory and Differential Geometry

21. January 2022

Contents

MILAN NIESTIJL (TU DELFT)

Positive Energy Representations of Gauge Groups With Support at a Fixed Point

21 January 2022, 10.30

Abstract

Let $\mathcal{K} \to M$ be a locally trivial smooth bundle of Lie groups equipped with an action of the Lie group P by bundle automorphisms. Complementing recent progress B. Janssens and K.H. Neeb on the case of a fixed-point free action of P on M, projective unitary positive energy representations $\overline{\rho}$ of the locally-convex Lie group $\mathcal{G} := \Gamma_c(\mathcal{K})$ are considered which factor entirely through the germs at some fixed point $a \in M$ of the P-action. Under suitable assumptions, it is shown that the kernel of a particular quadratic form on $\mathbb{R}[[x_1, \cdots, x_d]]$ generates an ideal in $\mathfrak{G} := \mathscr{L}(\mathcal{G})$ on which the derived representation $d\rho$ must vanish. This leads to sufficient conditions for $d\rho$ to factor through a finite jet space $J_x^k(\mathcal{K})$ or through $J_a^\infty(N, \mathcal{K})$ for a suitable 'center submanifold' N. If time permits, I will discuss some problems that I would still like to understand.

MICHAEL HEINS (JMU WÜRZBURG)

Eigenfunctions of the Laplacian in one complex variable: A unifying framework

21 January 2022, 13.00

Abstract

By virtue of its simplicity, yet deep structure, the Laplace-Beltrami operator is ubiquitous throughout mathematics and physics. Typically, every complex number is an eigenvalue and specifying a domain singles out certain eigenfunctions, which then constitute a Schauder basis. The spherical harmonics, infamous for their appearance in the quantum mechanical description of the hydrogen atom, are one such example. From a conformal perspective, the uniformization theorem reduces the relevant cases for one variable to the hyperbolic disk $\mathbb{D}$, the Riemann sphere $\hat{\mathbb{C}}$ and Euclidean space. Formally replacing $\overline{z}$ with a second complex variable w leads to a two dimensional open submanifold of $\hat{\mathbb{C}}^2$, which unifies the three cases in numerous, albeit not all, regards. We discuss its geometry and show that every of its non constant holomorphic functions can not be extended further. Enhancing a theorem of Helgason, we moreover construct a Schauder basis of the eigenspaces for fixed eigenvalue by means of the Poisson kernel. Finally, using the classical derivatives of Peschl-Minda in their differential geometric incarnation, we recover a classification of the invariant eigenspaces originally due to Rudin. This is work in progress with Annika Moucha and Oliver Roth.

LUKAS MIASKIWSKYI (TU DELFT)

Local-to-global principles for cohomology theories

21. January 2022, 14.30

Abstract

In this talk, we will discuss local-to-global principles for various cohomology theories over smooth manifolds, or in other words, how to extract global information about a cohomology theory from its form on small open sets. We begin with a short introduction to sheaf & cosheaf theory, and proceed with a discussion of double complexes and how to use them to relate different

cohomology theories. As a conclusion, we shall outline various applications, such as alternative strategies to calculate Hochschild and cyclic cohomology of smooth functions, and to construct spectral sequences for continuous Lie algebra cohomology of gauge algebras and vector fields.

GERRIT VOS

Relative Haagerup property for arbitrary von Neumann algebras

21 January 2022, 16.00

Abstract

We introduce the relative Haagerup approximation property (rHAP) for a unital, expected inclusion of sigma-finite von Neumann algebras, taking time to introduce the necessary concepts such as L2-implementations and relative compactness. We explore how the definition depends on the choice of state or conditional expectation, and look at some variations of the definition. It turns out that the rHAP always holds if the subalgebra is finite dimensional, which implies that the rHAP is stable under taking free products with amalgamation over finite-dimensional subalgebras. This result is new even for the original Haagerup property. Finally, we illustrate some examples coming from Hecke-von Neumann algebras and free orthogonal quantum groups. This is joint work with Martijn Caspers, Mario Klisse, Adam Skalski and Mateusz Wasilewski.

1 The Schedule of the Talks

Time	Title	Speaker
10.30	Positive Energy Representations of Gauge Groups With Support at a Fixed Point	Milan Niestijl
13.00	Eigenfunctions of the Laplacian in one complex variable: A unifying framework	Michael Heins
14.30	Local-to-global principles for cohomology theories	Lukas Miaskiwskyi
16.00	Relative Haagerup property for arbitrary von Neumann algebras	Gerrit Vos

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