Title and Abstract

Functional Analysis Symposium

22nd - 24th December, 2023, IIT Guwahati

(ST-1) Title: Unitary invariants and an application to quantum solutions of Euler's 36 officers problem

Vijay Kodiyalam
I. M.Sc, Chennai

Abstract

We will describe how an old result on complete unitary invariants comes in handy to show that Euler's 36 officers problem has infinitely many distinct quantum solutions.

(ST-2) HIGHER-ORDER SPECTRAL SHIFT MEASURES IN SEVERAL VARIABLES

Arup Chattopadhyay
IIT Guwahati

Abstract

In recent years, higher-order trace formulas of operator functions have attracted considerable attention to a large part of the perturbation theory community. In this talk, I will discuss estimates for traces of higher-order derivatives of multivariable operator functions with associated scalar functions arising from multivariable analytic function space and, as a consequence, derive higher-order spectral shift measures for pairs of tuples of commuting contractions under Hilbert-Schmidt perturbations. These results substantially extend the main results of [*Trace Formulas for Multivariate Operator Functions,* Integr. Equ. Oper. Theory. **81** (2015), no. 4, 559–580], where the estimates were proved for traces of first and second-order derivatives of multivariable operator functions. This is a joint work with Chandan Pradhan and Saikat Giri.

(ST-3) Title: Selfadjoint-Ideal Semigroups for Bounded Operators

Sasmita Patnaik
IIT Kanpur

Abstract

A selfadjoint-ideal semigroup for bounded operators, acting on a separable complex Hilbert space, is a multiplicative semigroup which is closed under adjoints; and in which every ideal is closed under adjoints (SI semigroup, for short). This is a new concept motivated by Heydar Radjavi's question on the solvability of certain operator equations in a multiplicative semigroup. The investigation for SI semigroups is equivalent to the solvability of certain bilinear operator equations over a semigroup of bounded operators. In this talk, we shall focus on some SI semigroup characterizations for the singly generated selfadjoint semigroups generated by special classes of operators. These characterizations reveal the connection of seemingly unrelated algebraic and analytic phenomena of these SI semigroups and their generators.

(ST-4) Title: de Branges-Rovnyak spaces which are complete Nevanlinna-Pick spaces

Bata Krishna Das
IIT Bombay

Abstract

Complete Nevanlinna-Pick (CNP) space is a reproducing kernel Hilbert space for which matrix valued Pick interpolation holds. CNP spaces are of significant interest over the last two decades. The hardy space over the unit disc and the Drury-Arveson space over the unit ball in $\mathbb{C}^n$ are the prototype examples and, in fact, many important properties of these spaces hold true for CNP spaces. In 1994, McCullough gave a characterization of CNP spaces in terms of kernels. In this talk, we shall consider de Branges-Rovnyak spaces of different reproducing kernel Hilbert spaces and find a characterization for them to be CNP spaces. Such a characterization takes a rather concrete form in the particular case of the Bergman space over the disc or the Hardy space over the polydisc $\mathbb{D}^n$. In the later case, we shall witness a sharp difference between $n = 2$ and $n > 2$.

This talk is based on a joint work with Hamidul Ahmed and Samir Panja.

(ST-5) Title: Algebraic aspects and functoriality of the set of affiliated operators

Soumyashant Nayak
Indian Statistical Institute, Bangalore Centre

Abstract

An unbounded operator on a Hilbert space $\mathcal{H}$ is closed if and only if it is of the form $B^\dagger AE^\dagger$ for bounded operators $A, B, E \in \mathcal{B}(\mathcal{H})$ with E a projection, where $(\cdot)^\dagger$ denotes the Kaufman inverse. If the above statement looks exciting, then you should attend the talk to learn its proof and see analogues for von Neumann algebras. We will give an algebraic picture of the set of affiliated operators, M_{aff}, for a von Neumann algebra, M, which is conceptually simple (making no mention of the commutant) and expands the scope of the traditional definition due to Murray and von Neumann. We will see why the construction, $M \mapsto M_{\text{aff}}$, is functorial and transfer a few results known for closed operators on $\mathcal{H}$ to operators affiliated with properly infinite von Neumann algebras via 'abstract nonsense'. This is based on joint work with my PhD student, Indrajit Ghosh.

(ST-6) Smoothness of the integrated density of states (IDS) for the Anderson model on the Bethe lattice

Dhriti Ranjan Dolai
IIT Dharwad

Abstract

We consider the Anderson model (random Schrödinger operator) on Bethe lattice $\mathbb{B}$ with absolutely continuous single site distribution (SSD) μ. We will show that the integrated density of states (IDS) $\mathcal{N}(\cdot)$ is as smooth as the density of μ (SSD), in high disorder. Here, the SSD μ is a probability measure on $\mathbb{R}$ with density and the IDS $\mathcal{N}(\cdot)$ measure the number of states (eigenvalues) per unit volume. The Bethe lattice $\mathbb{B}$ is an infinite connected graph with no closed loops and a fixed degree $K+1$ (number of nearest neighbours) at each vertex.

(ST-7) ON SYMMETRIC EMBEDDING OF PURELY ATOMIC VON NEUMANN ALGEBRAS

Debabrata De
NISER Bhubaneswar

Abstract

In this talk, we discuss symmetric embedding of von Neumann algebras and characterize purely atomic von Neumann algebras. This talk is based on a recent joint work with P. Bikram, K. Mukherjee and Chinmay Tamankar.

(ST-8) Title: Non-commutative Neveu decomposition and associated ergodic theorems

Diptesh Saha
ISI Delhi

Abstract

In ergodic theory, depending on the sense of convergence, there are mainly three different kinds of ergodic theorems, namely mean ergodic theorems (convergence in norm), pointwise ergodic theorems (a.e convergence), and stochastic ergodic theorems (convergence in measure). To study Krengel's stochastic ergodic theorem for a (not necessarily measure preserving) dynamical system, Neveu decomposition is an essential tool.

In this talk we will discuss some of this theorems in the non-commutative setting. We will begin with non-commutative Neveu decomposition. Then we will briefly discuss pointwise ergodic theorems in non-commutative L^1-spaces associated to the dynamical system (M, G, α), where M is a von Neumann algebra, G is either a group of polynomial growth, or $\mathbb{Z}_+^d$, or $\mathbb{R}_+^d$, or a finitely generated free group, and α denotes the action of G on M.

Finally, we combine the Neveu decomposition and the pointwise ergodic theorems discussed above to show a stochastic ergodic theorem. This is a joint work with Dr. Panchugopal Bikram.

(ST-9) Title: Classification of crossed product C*-algebras of noncommutative tori by cyclic groups

Sayan Chakraborty
IAI, TCG CREST, Kolkata

Abstract

In this talk I will consider the crossed product C*-algebras arising from higher dimensional noncommutative tori with actions of cyclic groups. I will discuss the K-theory of those C*-algebras and how the computation of the K-theory plays a role in classifying the C*-algebras.

(ST-10) Title: A family of new subfactors arising from Hadamard matrices

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Abstract

Given a pair of inequivalent 4×4 complex Hadamard matrices we construct an infinite family of new subfactors of the hyperfinite II_1 factor R. All these subfactors are irreducible with Jones index $4n$, for $n \geq 2$. Most of these subfactors are of infinite depth. This is a joint work with Satyajit Guin.

(ST-11) Title: Centres of certain tensor products of Banach algebras

Ranjana Jain
University of Delhi

Abstract

For C^*-algebras A and B with centres $Z(A)$ and $Z(B)$, there is a natural identification of the centre of the $*$-algebraic tensor product $A \otimes B$ with $Z(A) \otimes Z(B)$. It is thus natural to ask for which tensor norms α, the centre of $A \otimes_\alpha B$ is precisely $\overline{Z(A) \otimes Z(B)}^{\|\cdot\|_\alpha}$. Over the last five decades or so, affirmative answers have been obtained by several prominent operator algebraists for different tensor norms (W^*, C^* as well as non-C^*).

In this talk, after a quick review of those results, we present our contributions in the context of Banach space projective tensor product, and of operator space projective tensor product. In the due process, we shall also discuss the centre of the generalized group algebra $L^1(G, A)$, G being a locally compact group and A being a Banach algebra, which enables us to answer this question for some non C^*-algebras. We shall also present some interested applications of these identifications.

This talk is based on some articles written in collaboration with Ajay Kumar, Ved Prakash Gupta or Bharat Talwar.

(ST-12) Mixed q-deformed Araki-Woods von Neumann algebras

Rahul Kumar R
IIT Kanpur

Abstract

Constructing non-amenable von Neumann algebras and studying their properties have been the trend for over a decade. In this talk we introduce a new class of von Neumann algebras named as Mixed q-deformed Araki-Woods von Neumann algebras. They are the type III analogues of those von Neumann algebras constructed by Bożejko-Speicher and generalizations of those by Hiai. We discuss the structural properties of these algebras such as factoriality, type classification, non-amenability and Haagerup approximation property.

This is a joint work with Panchugopal Bikram and Kunal Mukherjee.

(ST-13) Title: BEURLING QUOTIENT MODULES ON THE POLYDISC

Monojit Bhattacharjee
BITS Goa

Abstract

Let $H^2(\mathbb{D}^n)$ denote the Hardy space over the polydisc $\mathbb{D}^n$, $n \geq 2$. A closed subspace $\mathcal{Q} \subseteq H^2(\mathbb{D}^n)$ is called Beurling quotient module if there exists an inner function $\theta \in H^\infty(\mathbb{D}^n)$ such that $\mathcal{Q} = H^2(\mathbb{D}^n)/\theta H^2(\mathbb{D}^n)$. We present a complete characterization of Beurling quotient modules of $H^2(\mathbb{D}^n)$: Let $\mathcal{Q} \subseteq H^2(\mathbb{D}^n)$ be a closed subspace, and let $C_{z_i} = P_{\mathcal{Q}} M_{z_i}|_{\mathcal{Q}}, i = 1, ..., n$. Then $\mathcal{Q}$ is a Beurling quotient module if and only if

$$(I_{\mathcal{Q}} - C_{z_i}^* C_{z_i})(I_{\mathcal{Q}} - C_{z_j}^* C_{z_j}) = 0 \qquad (i \neq j).$$

If time permits, we present two applications: first, we obtain a dilation theorem for Brehmer n-tuples of commuting contractions, and, second, we relate joint invariant subspaces with factorizations of inner functions. All results work equally well for general vector-valued Hardy spaces. It is a joint work with Dr. Ramlal Debnath, Prof. Batakrishna Das and Prof. Jaydeb Sarkar.

(ST-14) Classification of pairs of commuting isometries with compact normal cross commutators

Sandipan De
School of Mathematics and Computer Science, IIT Goa

Abstract

A very general and fundamental problem in the theory of bounded linear operators on Hilbert spaces is to find classifications and representations of commuting tuples of isometries. In the case of single isometries this question has a complete and explicit answer (due to H. Wold and J. von Neumann): An isometry on a Hilbert sapce is simply a unilateral shift or a unitary or a direct sum of a unilateral shift and a unitary. Unlike the case of isometries, the general structure and tractable invariants of pairs of commuting isometries are largely unknown. The goal of this talk is to present a complete and explicit classification of pairs of commuting isometries (V_1, V_2) acting on some Hilbert space such that

(i) $V_1 V_2$ is a shift (such pairs are called BCL pairs after the names of Berger, Coburn and Lebow),
(ii) The cross commutator $[V_2^*, V_1] := V_2^* V_1 - V_1 V_2^*$ is a compact normal operator.

This is a joint work with Prof. Jaydeb Sarkar, Dr. Sankar T. R. and Dr. P Shankar.

(ST-15) Title: TBA

Kunal Krishna Mukherjee
IIT Madras

Abstract

TBA

(ST-16) Title: The Effros-Marechal topology on the space of von-Neumann algebras

Issan Patri
ISI Delhi

Abstract

The Effros- Marechal topology allows us to study the Borel complexity of various sets of subalgebras of a given von-Neumann algebra. In this talk, we will explain this topology, show that it is Polish and study the complexity of various sets of subalgebras, including those satisfying approximation properties and sets of MASAs. A primer on Borel complexity theory will also be given.
