Recent Advances in Operator Theory and Operator Algebras OTOA 2014

Sponsored by:

Indian Statistical Institute

JNCASR, Bangalore, And

National Centre for Mathematics

Conference Part
December 15-19, 2014

Titles and Abstracts

Sudeshna Basu. George Washington University, USA.
Title: *A p-adic version of Hilbert-Schmidt operators and applications*
Abstract: We characterize p-adic Hilbert-Schmidt operators defined in a p-adic Hilbert space E defined over an ultrametric valued field. As applications we consider the unilateral shift and several other examples.

Monojit Bhattacharjee. IISc, India.
Title: *Operator positivity and analytic models of commuting tuples of operators*
Abstract: We develop an analytic model for doubly commuting n-tuples of operators and investigate their applications to joint shift co-invariant subspaces of reproducing kernel Hilbert spaces over polydisc. Here the key idea is to use the "simple tensor product" structure of one variable dilation maps

to the class of doubly commuting tuples of operators. This talk is based on joint work with J. Sarkar.

Alexander Belton. Lancaster University, UK.
Title: *A limit theorem for quantum random walks via semigroup decomposition*
Abstract: (Joint work with Michal Gnacik and J. Martin Lindsay) The issue of convergence for quantum random walks is a fundamental problem in the field of non-commutative probability, and many authors have contributed results in this area. The proof of the strongest convergence theorem presently known is somewhat lengthy, and involves the approximation of quantum Wiener integrals by certain discrete versions. Recently, a new method of proof has been found, which is much simpler and more direct; it exploits the semigroup decomposition of quantum stochastic cocycles. This talk will explain the new proof and then present some applications of the resulting theorem.

Chafiq Benhida. University of Lille 1, France.
Title: *On generalized criss-cross and near commutativity and common spectral properties*
Abstract: For two bounded linear operators A and B on a Banach space, "I-AB is invertible if and only if I-BA is invertible" is known as Jacobson's lemma. We'll discuss here a generalization of it and its n-tuple versions and consequently the common spectral properties shared by the involved operators.

Panchugopal Bikram. Ben-Gurion University of the Nagev, Israel.
Title: *On the classification and modular extendability of E_0-semigroups of factors*
Abstract: In this talk we study modular extendability and equimodularity of endomorphisms and E0-semigroups on factors with respect to f.n.s. weights. We show that modular extendability is a property that does not depend on the choice of weights, it is a cocycle conjugacy invariant and it is preserved under tensoring. We say that a modularly extendable E0-semigroup is of type EI, EII or EIII if its modular extension is of type I, II or III, respectively. We prove that all types exist on properly infinite factors. We also compute

the coupling index and the relative commutant index for the CAR flows and q-CCR flows. As an application, by considering repeated tensors of the CAR flows we show that there are infinitely many non cocycle conjugate non-extendable E0- semigroups on the hyperfinite factors of types II_1, II_∞ and III_λ, for $\lambda \in (0,1)$. This is a joint work with Daniel Markiewicz.

Piotr Budzyński. University of Agriculture in Krakow, Poland.
Title: *Dense definiteness of domains of powers of subnormal weighted shifts on directed trees*
Abstract: We will discuss recent results concerning subnormality of weighted shifts on directed trees and dense definiteness of domains of their powers. In particular, we will present a surprsing example of a subnormal weighted shift on a directed tree whose square has a trivial domain.

The talk is based on a joint work with P. Dymek, Z. J. Jabłoński, I. B. Jung and J. Stochel.

Dariusz Cichoń. Jagiellonian University, Poland.
Title: *Analyticity and subnormality of operator-valued functions*
Abstract: This is an account of a paper [1].

Given a class of bounded Hilbert space operators it is tempting to know when linear combinations of its members remain within this class. If the class of subnormal or hyponormal operators is taken into consideration, then the above question has an intimate connection with commutativity. Surprisingly, in the case of subnormal operators even the commutativity of two operators does not ensure their sum to be subnormal. On the other hand, there exists a pair of *noncommuting* subnormal operators whose all linear combinations are subnormal [2]. This, however, is impossible for normal operators, even if linear combinations are replaced by (ranges of) analytic operator-valued functions [3]. Roughly speaking, normality and analyticity implies *joint normality*. In our talk, inter alia, we try to figure out to what extent this remains true for subnormal operators. As shown in [2] analyticity of subnormal-operator-valued functions does not help us establish their joint subnormality. It turns out that "joint subnormality" is a proper substitute for "normality" as long as analogues the main result of [3] are concerned. In fact, an analytic operator-valued function (defined on a region) whose restriction to a set of uniqueness is jointly subnormal must necessarily be

jointly subnormal. This phenomenon does not occur if the set of uniqueness has empty interior and "joint subnormality" is replaced by "normality".

When exploring the topic of joint subnormality of an analytic operator-valued function it is natural to investigate some basic questions like analyticity of minimal normal extensions and the relationship between the function and its Taylor coefficients subject to both joint subnormality and minimality of normal extensions. We intend to study specific perturbations of unitary operators and subnormal partial isometries, which has important consequences for families of normal or subnormal operators. If time allows, we will include an explicit matrix construction of normal extensions of perturbations being considered. Some open question will be stated.

[1] D. Cichoń, J. Stochel, Subnormality, analyticity and perturbations, *Rocky Mountain J. Math.* **37** (2007), 1831-1869.

[2] X. Catepillán, W. Szymanski, Linear combinations of isometries, *Rocky Mountain J. Math.* **34** (2004), 187-193.

[3] J. Globevnik, I. Vidav, A note on normal-operator-valued analytic functions, *Proc. Amer. Math. Soc.* **37** (1973), 619-621.

Prakash A. Dabhi. Sardar Patel University, India.

Title: *Multipliers on weighted semigroups and associated Beurling Banach algebras*

Abstract: A weighted semigroup (S, ω) is an abelian discrete semigroup S with a positive real valued function on S representing size or frequency of elements of S. We shall discuss interrelation between semigroup multipliers on (S, ω) and the algebra multipliers on associated Beurling Banach algebras. We shall also discuss the vector valued case.

B. Krishna Das. Indian Statistical Institute, India.

Title: *Star-generating vectors of Rudin's quotient modules*

Abstract: In this talk we will consider a class of quotient modules, namely Rudin's quotient modules, of the Hardy space over the polydisc and de- scribe a way to compute their star-generating vectors. This leads us to compute the co-rank of a quotient module in this large class. At the end of this talk

we will discuss an open question, earlier raised by Douglas and Yang, related to the rank of a submodule of the Hardy space over the bidisc. This is a joint work with A. Chattopadhyay and J. Sarkar.

Michael Dritschel. University of Newcastle upon Tyne, UK.
Title: *Rational and H^∞ dilation*
Abstract: It is well known that the von Neumann inequality holds over both over the disk and bidisk. The inequality can be thought of as saying that certain representations of the polynomial algebras over these sets, or more generally, of the disk and bidisk algebras, are contractive. The Sz.-Nagy and Ando dilation theorems then imply that these representations are completely contractive. These observations led Halmos to pose the rational dilation problem: if a bounded domain is a spectral set for an operator or commuting tuple of operators (that is, a version of the von Neumann inequality holds), do we have a dilation to a normal operator or tuple of commuting normal operators with spectrum supported on the boundary of the domain? Arveson showed that this was equivalent to asking if unital contractive representations of analogues of the disk algebra are completely contractive. We begin by discussing recent work in this area on spectral sets which are "distinguished" varieties of the bidisk. One might naively expect that as we are dealing with subvarieties of the bidisk, rational dilation should hold, but this is not necessarily so. There is a problem which turns out to be indirectly related, and as it happens, one that while quite naturally posed, has proved to be intractible until recently: Is every unital contractive representation of $H^\infty(\mathbb{D})$ completely contractive? There is no problem if the contractive representation is weak-$*$ continuous. Difficulties arise more generally because of the complex nature of the maximal ideal space in this setting. While trying to construct a counterexample, we instead discovered that this statement is in fact true, at least for finite dimensional representations.

This is joint work with Michael Jury and Scott McCullough.

Miroslav Englis. Institute of Mathematics of the Czech Academy of Sciences, Czech Republic.
Title: *The Fock space, quantization, and Hermite (and other) polynomials*
Abstract: We describe an unexpected orthonormal basis of the Fock-Segal-Bargmann space arising from Hermite polynomials, with some physics ap-

plications in Berezin-Toeplitz quantization. Analogous developments for Laguerre and Legendre polynomials will likewise be discussed, as well as some open problems. (Joint work with S.-T. Ali, Condordia University, Montreal.)

Priyanka Grover. ISI Delhi, India.
Title: *Birkhoff-James orthogonality in some Banach spaces*
Abstract: Let $\mathbb{X}$ be a complex Banach space and let $x \in \mathbb{X}$. Finding best approximations to x from a given subspace $\mathbb{W}$ of $\mathbb{X}$ are of importance in approximation theory and have intrigued many authors in the past few years. A particular case is when $\mathbb{W}$ is spanned by a single element y. One important question here is when is zero a best approximation to x from this subspace, that is, when do we have: $\min_{\lambda\in\mathbb{C}} \|x - \lambda y\| = \|x\|$? In other words, under what conditions do we have

$$\|x + \lambda y\| \geq \|x\| \text{ for all } \lambda \in \mathbb{C}? \tag{1}$$

An element x is said to be Birkhoff-James orthogonal to y if (1) holds. When $\mathbb{X}$ is a Hilbert space, this is the usual orthogonality. We find necessary and sufficient conditions for Birkhoff-James orthogonality when $\mathbb{X}$ has other structures. We shall investigate this notion of orthogonality in the space of square matrices, which can be used to obtain some interesting distance formulas, which we shall describe. Further, we shall characterize the Birkhoff-James orthogonality for elements of a Hilbert C*-module in terms of states of the underlying C*-algebra.

Ved Prakash Gupta. Jawaharlal Nehru University, India.
Title: *Drinfeld center of subfactor planar algebras*
Abstract: We shall first have a quick overview of the notions of subfactors, their planar algebras and the affine representations of planar algebras. The ideas of quantum double of a Hopf algebra and its categorical generalization, the Drinfeld center of a tensor category, are well studied in literature. After giving a brief overview and the relationship between these two ideas, we shall discuss the analogue of this relationship that we established in the theory of subfactors and planar algebras. This relationship was conjectured by Vaughen Jones and Kevin Walker and the talk will be mainly based on a

joint work with Paramita Das and Shamindra Ghosh.

Robin Hillier. Lancaster University, UK.
Title: *Loop groups and noncommutative geometry*
Abstract: We establish a natural connection between loop groups and noncommutative geometry. More precisely, we propose a construction of a family of nonunital spectral triples for a given loop group, giving rise to JLO even entire cyclic cocycles and a pairing with K-theory. This pairing identifies irreducible representations of the loop group up to unitary equivalence, and the fusion ring of representations acts on the cocycles as a Kasparov product.

Zenon J. Jabłoński. Uniwersytet Jagielloński, Poland.
Title: *Unbounded Quasinormal Operators*
Abstract: The class of bounded quasinormal operators was introduced by A. Brown. Two different definitions of unbounded quasinormal operators appeared independently by Kaufman in 1983 and a few years later by Stochel and Szafraniec. The first definition says that a closed densely defined operator C in a complex Hilber space $\mathcal{H}$ is quasinormal, if $CC^*C = C^*CC$. The second definition says that a closed densely defined operator C in a complex Hilber space $\mathcal{H}$ is quasinormal, if C commutes with the spectral measure $E_{|C|}$ of $|C|$, i.e., $E_{|C|}C \subseteq CE_{|C|}$. As was shown in [**1**], both of these definitions coincide.

The lecture will be a survey of results concerning bounded and unbounded quasinormal operators. The results presented here are contained in [**1,2**].

[**1**]. Z. J. Jabłoński, I. B. Jung, J. Stochel, *Unbounded quasinormal operators revisited*, Integral Equations Operator Theory **79** (2014), 135-149.
[**2**]. P. Budzyński, Z. J. Jabłoński, I. B. Jung, J. Stochel, *A multiplicative property characterizes quasinormal composition operators in L^2-spaces*, J. Math. Anal. Appl. **409** (2014), 576-581

Anil Kumar Karn. National Institute of Science Education and Research, India.
Title: *Orthogonality in C^*-algebras*
Abstract: Two elements a and b of a C^*-algebra A are said to be algebraically

orthogonal, if

$$ab = 0 = ba = a^*b = ab^*.$$

Recall that for every self adjoint element $x \in A$ there exists a unique algebraic orthogonal pair $a, b \in A^+$ such that $x = a - b$. In this talk we discuss some of the geometric properties of algebraic orthogonality in an order theoretic set-up.

Elias G. Katsoulis. East Carolina University, USA.
Title: *Topics in the theory of non-selfadjoint operator algebras*
Abstract: TBA.

David Kerr. Texas A&M University, USA.
Title: *Dynamics and dimension*
Abstract: The notion of dimension within the context of amenable groups and their actions has become an important tool both in the classification theory of nuclear C^*-algebras and in the study of the relation between K-theory and asymptotic geometry. I will present a combinatorial perspective on this dimension theory and speculate about its applications in ergodic theory and operator algebras.

Nirupama Mallick. ISI Bangalore, India.
Title: *Nilpotent Completely Positive Maps.*
Abstract: The theory of majorization provides a way of comparing real vectors. This notion appears in a wide variety of fields. Jordan block sizes of nilpotent linear maps obey a bunch of inequalities coming from Littlewood-Richardson rules, including majorization inequalities. In the context of nilpotent completely positive maps, we prove a new type of majorization.

Daniel Markiewicz. Ben-Gurion University of the Negev, Israel.
Title: *Tensor algebras and subproduct systems arising from stochastic matrices*
Abstract: The tensor algebra associated to a Hilbert space H is the non-self-adjoint closed subalgebra generated by the left shift operators on the full

Fock of H. This is a well-understood and familiar object, which has played an important role in operator theory.

In analogy with the Hilbert space case, given a subproduct system X in the sense of Shalit and Solel, one can also define a *tensor algebra* associated to X. It is the non-selfadjoint operator algebra generated by shift operators over the Fock W*-correspondence of X.

In this talk we will be interested in the subproduct systems and the tensor algebras associated to stochastic matrices over countable state spaces (possibly infinite). We will discuss the classification of the tensor algebras in this case, and how much they remember about the matrices. More precisely, let P and Q be two stochastic matrices over the same state space, with tensor algebras $\mathcal{T}_+(P)$ and $\mathcal{T}_+(Q)$ (these are infinite dimensional even when the state space is finite). We show for example that if P and Q are recurrent, then $\mathcal{T}_+(P)$ and $\mathcal{T}_+(Q)$ are isometrically isomorphic if and only if P and Q are the same up to permutation of indices. We also show that an algebraic isomorphism between $\mathcal{T}_+(P)$ and $\mathcal{T}_+(Q)$ is automatically bounded, leading to strong results on classification up to algebraic isomorphism when the state space is finite.

This talk is based on joint work with Adam Dor-On.

[1] A. Dor-On and D. Markiewicz, "Operator algebras and subproduct systems arising from stochastic matrices", *Journal of Functional Analysis* 267 (2014), no. 4, pp. 1057-1120.

Gadadhar Misra. IISc, India.
Title: *Curvature, representations of the automorphism groups and Cowen-Douglas class operators*
Abstract: TBA

M N Namboodiri. CUSAT, Cochin, India.
Title: *Non Commutative Haar Condition and Čebešev systems*
Abstract: This lecture is about the theory of Čebesev subspaces of C*-algebras and Haar-type (called Non Commutative Haar Condition) criterion for identifying such spaces. The connection with Korovkin systems is also investigated,analogous to the classical case for function spaces. .

[1] A.Haar, *Minkowskische geometrie und die annaherung an stetige funktionen*, Math.Ann /8 (1918), 294-311.

[2] M. N. N. Namboodiri, *Developments in noncommutative Korovkin-type theorems*, RIMS Kokyuroku Series [ISSN1880-2818]737-Non Commutative Structure Operator Theory and its Applications, 2011.

[3] G.K.Pedersen, *Cebysev subspaces of C^*-algebras*, Math.Scand. 45 (1979); 147-156.

[4] M.N.N.Namboodiri,S.Pramod and A.K.Vijayarajan *Finite dimentional Čebesev subspaces of C^* algebras*,J. Ramanujan Math. Soc. 29, No.1 (2014) 6374.233-236.

[5] A.G.Roberston and D.Yost, *Chebyshev subspaces of operator algebras*, J.Lond.Math.Soc.(2)19(1979), 523-531.

[6] I.Singer, *Best approximation in normed linear spaces by elements of linear subspaces*,Publ.House.Acad.Soc.REp.Romania,Bicharest(1967) [Romania].English translation:Publ.House Acad Soc .Rep Romania,Bucharest and Springer Verlag,Berlin, New york,(1970)

Hiroyuki Osaka. Ritsumeikan University, Japan.

Title: *The Jiang-Su absorption for C*-algebras*

Abstract: In this talk we will report the Jiang-Su absorption for unital simple C*-algebras, in particular, for an inclusion of separable simple unital C*-algebras $P \subset A$ with finite index in the sense of Watatani. Now the Jiang-Su absorption plays an important role in the classification theorem for amenable C*-algebras.

We introduce the tracial Rokhlin property for an inclusion of separable simple unital C*-algebras $P \subset A$ with finite index and show that A belongs to a class of Jiang-Su absorbing C*-algebras, then P belongs to the same class. We also show that an action α from a finite group G on a simple unital C*-algebra A has the tracial Rokhlin property in the sense of Phillips if and only if the canonical conditional expectation $E\colon A \to A^G$ has the tracial Rokhlin property for an inclusion $A^G \subset A$. When an action α from a finite group on a (not necessarily simple) unital C*-algebra has ther Rokhlin property in the sense of Izumi, the Jiang-Su absorption and related results are proved in [H.

Osaka and T. Teruya, *Strongly self-absorbing property for inclusions of C*-algebras with a finite Watatani index*, Trans. Amer. Math. Soc. **366**(2014) no. 3, 1685–1702] and [H. Osaka and T. Teruya, *Nuclear dimension and pureness for an inclusion of unital C*-algebras*, preprint, arXiv:1111.1808].

This is a joint work with Tamotsu Teruya.

Sourav Pal. ISI Delhi, India.

Title: *Subvarieties of the tetrablock and von-Neumann's inequality*

Abstract: We show an interplay between the complex geometry of the tetrablock $\mathbb{E}$ and the commuting triples of operators having $\overline{\mathbb{E}}$ as a spectral set. We show that $\overline{\mathbb{E}}$ being a 3-dimensional domain does not have any 2-dimensional distinguished variety, every distinguished variety in the tetrablock is one-dimensional and can be represented as

$$\Omega = \{(x_1, x_2, x_3) \in \mathbb{E} \,:\, (x_1, x_2) \in \sigma_T(A_1^* + x_3 A_2 \,,\, A_2^* + x_3 A_1)\}, \qquad (2)$$

where A_1, A_2 are commuting normal matrices of the same order satisfying a norm condition. The converse also holds, i.e, a set of the form (2) is always a distinguished variety in $\mathbb{E}$. We show that for a triple of commuting operators $\Upsilon = (T_1, T_2, T_3)$ having $\overline{\mathbb{E}}$ as a spectral set, there is a one-dimensional subvariety Ω_Υ of $\overline{\mathbb{E}}$ depending on Υ such that von-Neumann's inequality holds, i.e,

$$f(T_1, T_2, T_3) \leq \sup_{(x_1,x_2,x_3)\in\Omega_\Upsilon} |f(x_1, x_2, x_3)|,$$

for any holomorphic polynomial f in three variables, provided that $T_3^n \to 0$ strongly as $n \to \infty$. The variety Ω_Υ has been shown to have representation like (2), where A_1, A_2 are the unique solutions of the operator equations

$$T_1 - T_2^* T_3 = (I - T_3^* T_3)^{\frac{1}{2}} X_1 (I - T_3^* T_3)^{\frac{1}{2}} \text{ and}$$
$$T_2 - T_1^* T_3 = (I - T_3^* T_3)^{\frac{1}{2}} X_2 (I - T_3^* T_3)^{\frac{1}{2}}.$$

We also show that under certain condition, Ω_Υ is a distinguished variety in $\mathbb{E}$.

Santhosh Kumar Pamula. IIT Hyderabad, India.

Title: *Spectral theorem for compact normal operators on quaternionic Hilbert spaces*

Abstract: In this article the spectral theorem for right linear compact normal operators on quaternionic Hilbert spaces is proved. Though the version of spectral theorem for such operators in quaternionic Hilbert space is appeared in recent literature using the left multiplication and considering the Hilbert space to be slice complex linear, we present a different approach, which is similar to the classical setup. In our method we do not use the left multiplication and work with single operator throughout. It is observed that the whole spherical spectrum of a compact normal operator is determined by the standard eigenvalues and deduce that the spherical spectrum of any n n quaternion matrix has exactly n- complex eigenvalues. We illustrate our method with an example and compare it with that of the method given by Ghiloni etal.

Rashmirekha Patra. Sambalpur University, India.
Title: *A result on Nijenhuis Operator.*
Abstract: Construction of Nijenhuis Operator on generalized Tangent bundle $(TM \oplus T^*M)$ of a Differentiable manifold M and trivial deformation on its maximally isotropic subspace using Nijenhuis Operator has been done in the light of Dorfmann's work.

Pawel Pietrzycki. Jagiellonian University, Poland.
Title: *The equality $C^{*2}C^2 = (C^*C)^2$ is not sufficient for quasinormality of a composition operator C in L^2-space*
Abstract: It is proved that a closed densely defined operator C is quasinormali if and only if the equality $C^{*n}C^n = (C^*C)^n$ holds for $n = 2, 3$. Let W be bounded injective weighted shift which satisfies the equality $W^{*n}W^n = (W^*W)^n$. We prove that operator W is then quasinormal. We will construct examples of bounded, non-quasinormal operator C which satisfies equality $C^{*n}C^n = (C^*C)^n$. An example of such a operator is given in the class of weighted shifts on directed trees. What is important, the directed tree used in the construction is rootless and therefore the operator in example is unitarily equivalent to a composition operator in L^2-space.

Marek Ptak. University of Agriculture in Krakow, Poland.
Title: *C-symmetric operators and its preanihilator*

Abstract: Let $\mathcal{H}$ be a complex separable Hilbert space. Let C be an isometric antilinear involution in $\mathcal{H}$. A bounded operator $T \in B(\mathcal{H})$ is called C-symmetric, if $CTC = T^*$. Let $\mathcal{C}$ denote the set of all C-symmetric operators.

C-symmetric operators and the whole set $\mathcal{C}$ was intensively studied recently. There were many examples of C-symmetric operators such as Jordan blocks, truncated Toeplitz operators, Hankel operators ect. The aim of the talk is to present the description of the preanihilator of the space of all C-symmetric operators. It will be shown that the subspace of all C-symmetric operators is transitive and 2-reflexive or even 2-hyperreflexive. It means that the preanihilator of $\mathcal{C}$ does not contain any rank-one operators and rank-two operators are dense in the preanihilator. Moreover, the description all rank-two operators in this preanihilator is given.

Joint work with K. Kliś-Garlicka.

Yoshihiro Ryu. Ritsumeikan University, Japan.
Title: *A Non-Commutative Version of Finite Discrete-Time and Finite State Model in Mathematical Finance*
Abstract: In this talk I provide a non-commutative (or quantum) version of a simple model in mathematical finance and study the first fundamental theorem of mathematical finance on this model. I will start with an introductory review of mathematical finance, especially of the arbitrage theory. Then I reformulate the model by using the language of quantum probability theory and obtain a theorem which can be seen as a non-commutative version of the first fundamental theorem of mathematical finance.

Guy Salomon. Technion, Israel.
Title: *Strong algebras*
Abstract: In this talk I will introduce algebras which are inductive limits of Banach spaces and carry inequalities which are counterparts of the inequality for the norm in a Banach algebra. The case where the inductive limit consists of one Banach space gives a Banach algebra, while the case where the inductive limit is of infinite number of Banach spaces gives some other "well behaved" topological algebras. I will then show that the well-known Wiener theorem can be generalized to the setting of these algebras, and also consider factorization theory. Finally, I will focus on the case where the multiplication is a convolution of measurable functions on a locally compact group.

This talk is based on joint work with Daniel Alpay.

[1] D. Alpay and G. Salomon. On algebras which are inductive limit of Banach algebras. *p*reprint on arXiv, 2013.

[2] D. Alpay and G. Salomon. Topological convolution algebras. *Journal of Functional Analysis*, 2013.

[3] D. Alpay and G. Salomon. Non-commutative stochastic distributions and applications to linear systems theory. *Stochastic Processes and their Applications*, 2013.

Haripada Sau. IISc, India.

Title: *Admissible Fundamental Operators*

Abstract: A pair of commuting bounded operators (S, P) with the symmetrized bidisk

$$\{(z_1 + z_2, z_1 z_2) : |z_1| \leq 1 \text{ and } |z_2| \leq 1\}$$

as a spectral set is called Γ-contraction. If was proved in [1] that every such pair possesses a fundamental operator F, which is the unique solution of the operator equation

$$S - S^* P = D_P F D_P.$$

The adjoint (S^*, P^*) of a Γ-contraction (S, P) is again a Γ-contraction as can be checked by the definition. Given two bounded operators F and G on two Hilbert spaces, we shall investigate when there is a Γ-contraction (S, P) such that F is the fundamental operator of (S, P) and G is the fundamental operator of (S^*, P^*)

This [2] is a joint work with Professor T. Bhattacharyya and Professor S. Lata.

[1] T. Bhattacharyya, S. Pal and S. Shyam Roy, *Dilations of* Γ*-contractions by solving operator equations*, Advances in Mathematics, Volume 230, 2012, 577-606.

[2] T. Bhattacharyya, S. Lata and H. Sau, *Admissible Fundamental Operators*, to appear in J. Math. Anal. Appl.

Ajit Iqbal Singh. ISI Delhi and INSA Honorary Scientist, India
Title: *Partial traces and partial transpose vis-à-vis completely entangled and completely positive*
Abstract: We will begin with definitions and examples of the notions of partial trace, partial transpose, completely positive maps and completely entangled subspaces. We shall display certain classes of states that can be determined by their partial traces. Entanglement is a powerful resource in Quantum information and communication. Separable states satisfy the Peres test of positivity under partial transpose (PPT) but there is an abundance of non-PPT (NPT) entangled states. Completely entangled subspaces of multipartite quantum systems viz., subspaces of the tensor product of finitely many finite-dimensional Hilbert spaces containing no non-zero product vector, have received attention by many researchers beginning with Bennett et al [1999] via (mutually orthogonal) unextendable product bases. They also note that the projection operator on a completely entangled space so obtained is PPT entangled. The general case was taken up by Wallach, Parthasarathy, Bhat, Skowronek and a few others over the time. Johnston proved that, in the bipartite set-up, a positive operator with range in a completely entangled space constructed by him is NPT. After giving this development, we will generalise a part of this in the multipartite set-up as done in my joint paper with Arvind and Ritabrata Sengupta. A quantum channel is a completely positive map that is trace-preserving. We will display various classes of channels that preserve or break entanglement of different states. We will conclude with an idea of the situation for Gaussian channels.

Kalyan B Sinha. SERB, JNCASR, IISc and ISI, India
Title: *Hyponormal Operators and Krein's Trace Formula*
Abstract: For a large class of hypo-normal operators, one has the Helton-Howe type trace formulae while for a pair of self-adjoint operators, one has the Krein trace formula . It will be shown that for such hypo-normal operators , one can have a Krein-type trace formula for a suitable class of functions and

for perturbations of non-additive type.

M. A. Sofi. Kashmir University, India.
Title: *Intersection of balls and extendability of maps*
Abstract: The close connection between the intersection of balls and the geometry of Banach spaces is an old and a well known theme in functional analysis. The present talk is devoted to a discussion/survey of the interface between several notions involving the intersection of balls and the possibility of extending maps (both linear and nonlinear) acting between Banach spaces. This leads to the identification of several important classes of Banach spaces including Hilbert spaces and injective Banach spaces which can be described in terms of intersection of balls on the one hand and of extendability of maps on the other.

Baruch Solel. Technion, Israel
Title: *Matricial families and Weighted Shifts*
Abstract: Let $H^\infty(E)$ be the Hardy algebra of a W^*-correspondence E over a W^*-algebra M. These algebras are generated by a copy of M and shifts (defined by the elements of E). Each element $F \in H^\infty(E)$ gives rise to a family $\{\widehat{F}_\sigma\}$ of analytic operator valued functions where σ runs over the normal representations of M and $\widehat{F}_\sigma$ is defined on the (open) unit ball of the operator space $E^{\sigma *}$ (associated with E and σ). Such a family exhibit "matricial structure" that we studied in previous works (inspired by works of Joseph Taylor, Kaliuzhnyi-Verbovetskyi and Vinnikov, D. Voiculescu and others).

In this talk I will show that one can study matricial families of operator-valued functions defined on more general matricial sets (not necessarily unit balls) by studying Hardy algebras generated by a copy of M and *weighted* shifts. This work generalizes some results of G. Popescu.

The talk is based on joint work with Paul S. Muhly.

R. Srinivasan. CMI, India.
Title: *Cohomology for super-product systems*
Abstract: Super-product system is a generalization of product system of

Hilbert spaces introduced by Bill Arveson. They arise naturally in the theory of E_0-semigroups on factors. We propose a cohomology theory for spatial super-product systems, and describe the 2-cocycles for some of the basic examples. This consequently classifies a family of E_0-semigroups on type III factors associated with canonical anti-commutation relations. This is a joint work with Oliver T. Margetts.

Serban Stratila. Institute of Mathematics of the Romanian Academy, Romania.
Title: *Commutation Theorems and Splitting Theorems in von Neumann Algebras.*
Abstract: TBA

Jan Stochel. Jagiellonian University, Poland.
Title: *Subnormality of composition operators over directed graphs with one circuit: exotic examples*
Abstract: We discuss a question of subnormality of composition operators in L^2-spaces. Our main interest is in investigating composition operators over possibly simplest (excluding classical weighted shifts) discrete measure spaces. We restrict ourselves to the case of composition operators built over connected directed graphs (induced by mappings) whose vertices, all but one, have valency one. This includes the class of weighted shifts on directed trees with one branching vertex and with infinite trunk, as well as the class of composition operators over the directed graph with one branching vertex, a circuit of length $\kappa+1$ and η branches. The former class has been intensively studied since 2012. The latter class is new. It has unexpected properties. In particular, we will show that there exists a nonhyponormal composition operator in the L^2-space built over a directed graph with one loop ($\kappa = 0$) and two branches ($\eta = 2$), which generates Stieltjes moment sequences.
Coauthors: Piotr Budzyński, Zenon Jan Jabłoński, Il Bong Jung.

Dan Timotin. Institute of Mathematics of the Romanian Academy, Romania.
Title: *Schur coupling and other equivalence relations for operators on a Hilbert space.*

Abstract: For operators on Hilbert spaces, we show that several equivalence relations actually coincide. In particular, Schur coupling coincides with matricial coupling. We also provide a concrete description of this equivalence relation in several cases, for instance for compact operators. The analogue question for general Banach spaces remains open.