All talks will be held in the **IT building** (sometimes also called INIT), located at **535 W. Michigan St.** on the IUPUI campus.

Plenary speakers

Heath Emerson / University of Victoria

Christopher Felder / Indiana University

Priyanga Ganesan / University of California San Diego

Tao Mei / Baylor University

Xiang Tang / Washington University St. Louis

Jinmin Wang / Texas A&M University

Invited talks

Palak Arora / University of Florida

Hung V. Chu / University of Illinois, Urbana-Champaign

Forrest Glebe / Purdue University

Colton Griffin / Purdue University

Lucas Hall / Michigan State University

Zhen-chuan Liu / Baylor University

Meenakshi McNamara / Purdue University

Daniel Wallick / Ohio State University

Plenary talks: IT 252. Parallel talks: IT 273/274.
Coffee: IT 2nd Floor atrium.

Saturday, November 12th

9:30–10:00 ☕ Coffee

10:00–10:50 Xiang Tang – Helton-Howe trace, Connes-Chern character, and quantization

11:00–11:50 Priyanga Ganesan – Quantum graphs and colorings

12:00–2:00 Lunch break

2:00–2:50 Heath Emerson – Heisenberg triples and transverse foliations

3:00–3:25 Zhen-chuan Liu – An unconditional decomposition of the Schatten-p classes (IT 273)

3:00–3:25 Meenakshi McNamara – Quantum chromatic numbers of lexicographic products of quantum graphs (IT 274)

3:30–4:00 ☕ Coffee

4:00–4:25 Palak Arora – An optimal approximation problem for noncommutative polynomials (IT 273)

4:00–4:25 Daniel Wallick – An algebraic quantum field theoretic approach to toric code with gapped boundary (IT 274)

4:35–5:25 Christopher Felder – The Berezin range

Sunday, November 13th

9:00–9:30 ☕ Coffee

9:30–10:20 Tao Mei – L^p-unconditional decompositions of free group von Neumann algebras

10:30–10:55 Hung V. Chu – Geometry of Schreier spaces (IT 273)

10:30–10:55 Forrest Glebe – A recipe for almost representations that are far from genuine representations (IT 274)

11:05–11:30 Colton Griffin – Approximating projections by quantum operations (IT 273)

11:05–11:30 Lucas Hall – The modular Stone - von Neumann theorem (IT 274)

11:40–12:30 Jinmin Wang – Lipschitz control of topological K-theory and decay of scalar curvature

Palak Arora – An optimal approximation problem for noncommutative polynomials

Motivated by recent work on optimal approximation by polynomials in the unit disk, we consider the following noncommutative approximation problem: for a polynomial f in d noncommuting arguments, find an nc polynomial p_n, of degree at most n, to minimize $c_n := \|p_n f - 1\|^2$. (Here, the norm is the ℓ^2 norm on coefficients.) We show that $c_n \to 0$ if and only if f is nonsingular in a certain nc domain (the row ball). As an application, we give a new, elementary proof of a theorem of Jury, Martin, and Shamovich on cyclic vectors for the d-shift.

Hung V. Chu – Geometry of Schreier spaces

A collection $\mathcal{F}$ of subsets of $\mathbb{N}$ is said to be regular if $\mathcal{F}$ is hereditary, spreading, and compact. The combinatorial space corresponding to $\mathcal{F}$, denoted by $X_{\mathcal{F}}$, is defined to be the completion of c_{00} with respect to the norm

$$\|(x(1), x(2), \ldots)\| := \sup_{F \in \mathcal{F}} \sum_{n \in F} |x(n)|.$$

We consider, in particular, the Schreier families $\mathcal{S}_\alpha$, where α is a nonzero countable ordinal, and show the λ-property for all spaces $X_{\mathcal{S}_\alpha}$. This extends a result by Shura and Trautman in 1989 and provides new examples that solve a problem posed by Lindenstrauss in 1966. Along the way, we characterize extreme points of the p-convexification of $X_{\mathcal{F}}^p$ and of the dual space $X_{\mathcal{F}}^*$. Furthermore, we characterize all isometries of $X_{\mathcal{S}_n}$ for $n \geq 1$. It turns out that the isometries of $X_{\mathcal{S}_n}$ are diagonal operators, which are more restrictive than those of c_0 and ℓ_1.

Heath Emerson – Heisenberg triples and transverse foliations

To a pair of transverse foliations we associate a spectral triple with underlying noncommutative space a certain 'homoclinic' C*-algebra associated to the pair. I will describe this construction and the connection to KK-duality for the C*-algebras, mainly in dimension 2. I also discuss some analysis of the meromorphic continuation properties of the zeta function of the triple. This appears to be connected to dynamical cohomology.

Christopher Felder – The Berezin range

We will begin with a short introduction to reproducing kernel Hilbert space (RKHS) and then move quickly to the main subject of the talk–the Berezin transform. This operator transform can encode many foundational properties of the operator, including invertibility and compactness. We will survey some of these results and then discuss some of the geometric properties of the range of the Berezin transform for certain operators. Time permitting, we will pose some open problems. Joint work with C. Cowen.

Priyanga Ganesan – Quantum graphs and colorings
Quantum graphs are an operator space generalization of classical graphs that have appeared in different branches of mathematics including operator algebras, non-commutative topology and quantum information theory. In this talk, I will introduce a quantum input-classical output non-local game that captures the coloring problem for quantum graphs. Using this framework, we show that every quantum graph has a finite quantum coloring and is four-colorable in the algebraic model. The winning strategies of the quantum-to-classical non local coloring game leads to a combinatorial characterization of quantum graph coloring. We will use this to obtain lower bounds for the chromatic numbers of quantum graphs and show generalizations of well-known classical bounds, such as the Hoffman's bound, to the quantum graph setting.

Forrest Glebe – A recipe for almost representations that are far from genuine representations
A group is matricially stable if every function from the group to unitary matrices that is "almost multiplicative" in the point-operator norm topology is "close" to a genuine unitary representation in the operator norm. Frobenius stability is defined similarly, except the operator norm is replaced by the Frobenius norm. A result due to Dadarlat shows that many groups with non-torsion integral even cohomology are not matricially stable, but the proof does not lead to explicit examples of almost representations that are far from genuine representations. In the first part of this talk I will explain how to explicitly construct almost multiplicative maps, in operator norm, that are far from multiplicative maps for a large class of groups with non-torsion integral 2-cohomology. In the second part of the talk I will explain how similar methodology can be used to show that torsion-free, finitely generated, non-cyclic, nilpotent groups are not Frobenius stable. We will give explicit examples of almost representations that are far from genuine representations for some example groups.

Colton Griffin – Approximating projections by quantum operations
Using techniques from semidefinite programming, we study the problem of finding a closest quantum channel to the projection onto a matricial subsystem. We derive two invariants of matricial subsystems which are related to the quantum LovÃąsz theta function of Duan, Severini, and Winter.

Lucas Hall – The modular Stone - von Neumann theorem
After a brief review of the (more or less) classical Stone - von Neumann theorem, we explore recent developments concerning dynamical representations on Hilbert modules which directly generalize the Hilbert space setting. In particular, we classify C*-correspondences over elementary C*-algebras and provide applications to the study of actions and coactions of a locally compact group over an elementary C*-algebra.

Zhen-Chuan Liu – An unconditional decomposition of the Schatten-p classes

My story will be about the (complete) boundedness of the Schur multipliers on the Schatten p-classes. In 1980âĂŹs, J. Bourgain proved a Marcinkiewicz-type testing condition for Toeplitz type Schur multipliers. In a recent joint work, we show that an analogue of J. BourgainâĂŹs theory holds for non-Toeplitz type Schur multipliers as well. As an application, we obtain an unconditional decomposition for the Schatten-p class with $1 < p < \infty$. This talk is based on joint work with Chian Yeong Chuah and Tao Mei.

Meenakshi McNamara – Quantum chromatic numbers of lexicographic products of quantum graphs

We provide a brief introduction to quantum graphs and the quantum chromatic number of quantum graphs, which is closely tied to quantum error-checking problems. Quantum graphs are a generalization of graphs using operator C^*-algebras, and quantum colorings are defined in terms of random strategies for non-local games using entanglement. We discuss existing bounds on quantum chromatic numbers and our work to expand upon these bounds. In particular, we discuss the extension of various graph products to quantum graphs, and define the lexicographic product of quantum graphs. We then investigate bounds on the resulting quantum chromatic number of these graph products, and demonstrate an upper bound for the quantum chromatic number of the lexicographic product of general quantum graphs. Finally, we define the quantum b-fold chromatic number from which we derive a stronger upper bound on the quantum chromatic number of the lexicographic product of quantum graphs.

Tao Mei – L^p-unconditional decompositions of free group von Neumann algebras

Let $F_n, n \in \mathbb{N} \cup \{\infty\}$, be the non-abelian free group of n-free generators, and $F_n^{(i)}$ be the subset of F_n consisting of reduced words starting with the i-th generator. In a recent joint work with E. Ricard, we show that the decomposition $F_n = \cup_i F_n^{(i)} \cup \{e\}$ is unconditional with respect to the noncommutative L^p-norm associated with the group von Neumann algebra. That is to say, for P_i being the projection onto the components $F_n^{(i)}$ and any $\varepsilon_i = \pm 1$, the map $\sum_i \varepsilon_i P_i$ extends to a completely bounded map with respect to the noncommutative L^p norm. It is a mystery whether the group von Neumann algebra of F_n with $n < \infty$ admits a similar L^p-unconditional decomposition with infinitely many components satisfying some elementary algebraic properties. In this talk, I wish to introduce further work in this direction. Part of the talk is based on a joint work with E. Ricard and Q. Xu.

Xiang Tang – Helton-Howe trace, Connes-Chern character, and quantization

In the early 70s, Helton and Howe proved a beautiful formula for the trace of commutators of Toeplitz operators. In the 80s, Connes greatly generalized the Helton-Howe trace formula using cyclic cohomology. The Connes-Chern character contains the Helton-Howe trace as the top degree component. In this talk, we will study the Connes-Chern character for the Toeplitz extension from the viewpoint of quantization. As an outcome, we will establish the Helton-Howe trace formula for Toeplitz operators with C^2-symbols for all weighted Bergman spaces. This talk is based on joint work with Yi Wang and Dechao Zheng.

Daniel Wallick – An algebraic quantum field theoretic approach to toric code with gapped boundary

Topologically ordered quantum spin systems have become an area of great interest, as they may provide a fault-tolerant means of quantum computation. One of the simplest examples of such a spin system is Kitaev's toric code. Naaijkens made mathematically rigorous the treatment of toric code on an infinite planar lattice (the thermodynamic limit), using an operator algebraic approach via algebraic quantum field theory. We adapt his methods to study the case of toric code with gapped boundary. In particular, we recover the condensation results described in Kitaev and Kong and show that the boundary theory is a module tensor category over the bulk, as expected.

Jinmin Wang – Lipschitz control of topological K-theory and decay of scalar curvature

In this talk, I will present a theorem on the topological K-theory of simplicial complex. The main result is that every element in the topological K-theory admits a Lipschitz representative with a controlled Lipschitz constant. Our approach is to develop a quantitative K-theory with Lipschitz control. I will also talk about its application that the positive scalar curvature on uniformly contractible spaces with finite asymptotic dimension decays at a specific rate. This is joint work with Zhizhang Xie and Guoliang Yu.