算子代数研究中心

Research Center for Operator Algebras

Special Week on Operator Algebras

June 7th – June 11th , 2021

East China Normal University

SHANGHAI·CHINA

Calendar

Remark:

The time beneath the speaker's name represents the speaker's local time when he/she should start the talk (only for reference). Please double check.

Location of the conference:

The Zoom meeting ID is 810 3619 7947, Password:202106.

Offline conference room: 文附楼 402 (Wednesday), 405 (Thursday).

Beijing time Chair (AM/PM)	Monday 6.7 Huaxin Lin/Qin Wang	Tuesday 6.8 Jianchao Wu/Hang Wang	Wednesday 6.9 Zhuofeng He/Qin Wang	Thursday 6.10 Huaxin Lin/Hang Wang	Friday 6.11 Jianchao Wu/Valerio Proietti
9:00-10:00	George Elliott 6.6 (Sun.) 21:00-22:00	Aaron Tikuisis 6.7 21:00-22:00	Ping Wong Ng 6.8 20:00-21:00	Guoliang Yu 6.9 21:00-22:00	Guihua Gong 6.10 21:00-22:00
10:30-11:30	Rufus Willett 6.6 16:30-17:30	Zhuang Niu 6.7 20:30-21:30	Jianchao Wu	Valerio Proietti	Yasuhiko Sato 6.11 11:30-12:30
14:00-15:00	Yasuyuki Kawahigashi 6.7 15:00-16:00	Ja A Jeong 6.8 15:00-16:00	Chunlan Jiang	Huichi Huang	Yanli Song
15:30-16:30	Soren Eilers 6.7 9:30-10:30	Magdalena E. Musat 6.8 9:30-10:30	Chi-Keung Ng	Mikael Rordam 6.10 9:30-10:30	Siegfried Echterhoff 6.11 9:30-10:30
16:35-17:35	Xin Li 6.7 9:35-10:35	Piotr Nowak 6.8 10:35-11:35	Zhengwei Liu	Hang Wang	Jiawen Zhang

Organizers:

Huaxin Lin (University of Oregon)
Qin Wang (East China Normal University)
Hang Wang (East China Normal University)
Jianchao Wu (Texas A&M University)

Speakers:

Siegfried Echterhoff (University of Munster)
Soren Eilers (University of Copenhagen)
George Elliott (University of Toronto)
Guihua Gong (University of Puerto Rico)
Huichi Huang (Chongqing University)
Ja A Jeong (Seoul National University)
Chunlan Jiang (Hebei Normal University)
Yasuyuki Kawahigashi (University of Tokyo)
Xin Li (University of Glasgow)
Zhengwei Liu (Tsinghua University)
Magdalena Musat (University of Copenhagen)
Zhuang Niu (University of Wyoming)
Chi-Keung Ng (Nankai University)
Ping Wong Ng (University of Louisiana at Lafayette)
Piotr Nowak (University of Warsaw)
Valerio Proietti (East China Normal University)
Mikael Rordam (University of Copenhagen)
Yasuhiko Sato (Kyushu University)
Yanli Song (Washington University in St.Louis)
Aaron Tikuisis (University of Ottawa)
Hang Wang (East China Normal University)
Rufus Willett (University of Hawaii)
Jianchao Wu (Texas A&M University)
Guoliang Yu (Texas A&M University)
Jiawen Zhang (Fudan University)

Schedule

Location of the conference:

Zoom meeting room for all lectures:
810 3619 7947, Password:202106.

Offline conference room:
文附楼 402 (Wednesday), 405 (Thursday).

The time for discussion at the main meeting room will be limited. Speakers and participants wishing to have longer discussion may use the breakout rooms if needed.

Schedule of the talks (Beijing time):

Monday, 7 June	
Chair: Huaxin Lin	
9:00–10:00	George A. Elliott: *A brief summary of classification theory*
10:00–10:30	*Tea Break*
10:30–11:30	Rufus Willett: *Controlled KK-theory,decomposable C*-algebras, and the UCT*
Chair: Qin Wang	
14:00–15:00	Yasuyuki Kawahigashi: *Tensor networks, commuting squares and higher relative commutants of subfactors*
15:00–15:30	*Tea Break*
15:30–16:30	Soren Eilers: *Refined moves for structure-preserving isomorphisms between graph C*-algebras*
16:30–16:35	*Break*
16:35–17:35	Xin Li: *Generalizations of Thompson's group V arising from left-cancellative small categories*

Tuesday, 8 June	
Chair: Jianchao Wu	
9:00–10:00	Aaron Tikuisis: *Classifying embeddings of C*-algebras*
10:00–10:30	*Tea Break*
10:30–11:30	Zhuang Niu: *Structure of Transformation Group C*-Algebras*
Chair: Hang Wang	
14:00–15:00	Ja A Jeong: *AF-embeddable C*-algebras of labeled graphs*
15:00–15:30	*Tea Break*
15:30–16:30	Magdalena E. Musat: *Factorizable quantum channels, non-closure of quantum correlations and the Connes Embedding Problem*
16:30–16:35	*Break*
16:35–17:35	Piotr Nowak: *On property (T) for Aut(F_n)*

Wednesday, 9 June	
Chair: Zhuofeng He	
9:00–10:00	Ping Wong Ng: *Purely infinite corona algebras and extensions*
10:00–10:30	*Tea Break*
10:30–11:30	Jianchao Wu: *Quasi-representations and controlled K-homology*
Chair: Qin Wang	
14:00–15:00	Chunlan Jiang: *Geometric invariants of operators*
15:00–15:30	*Tea Break*
15:30–16:30	Chi-Keung Ng: *Dual spaces of operator systems*
16:30–16:35	*Break*
16:35–17:35	Zhengwei Liu: *Quantum Fourier Analysis*

Thursday, 10 June	
Chair: Huaxin Lin	
9:00–10:00	Guoliang Yu: *Quantitative operator K-theory and positive scalar curvature*
10:00–10:30	*Tea Break*
10:30–11:30	Valerio Proietti: *Noncommutative algebraic topology of some dynamical systems*
Chair: Hang Wang	
14:00–15:00	Huichi Huang: *Strongly independent matrices and measure rigidity on n-torus*
15:00–15:30	*Tea Break*
15:30–16:30	Mikael Rordam: *Irreducible inclusions of simple C*-algebras*
16:30–16:35	*Break*
16:35–17:35	Hang Wang: *K-homology and K-theory for pure braid groups*

Friday, 11 June	
Chair: Jianchao Wu	
9:00–10:00	Guihua Gong: *On the classification of simple stable projection-less C^*-algebras of finite nuclear dimensions*
10:00–10:30	*Tea Break*
10:30–11:30	Yasuhiko Sato: *Uncountably many flows which are not approximately inner on Z-absorbing C*-algebras*
Chair: Valerio Proietti	
14:00–15:00	Yanli Song: *Orbital integral and Cartan motion group*
15:00–15:30	*Tea Break*
15:30–16:30	Siegfried Echterhoff: *Amenable C*-dynamical systems and the weak containment problem*
16:30–16:35	*Break*
16:35–17:35	Jiawen Zhang: *Quasi-local algebras and their K-theories*

Abstracts

Siegfried Echterhoff (University of Munster)

Title: *Amenable C*-dynamical systems and the weak containment problem*
Abstract:The notion of amenable actions by discrete groups on $C*$-algebras has been introduced by Claire Amantharaman-Delaroche more than thirty years ago, and has become a well understood theory with many applications. So it is somewhat surprising that an established theory of amenable actions by general locally compact groups has been missed for a very long time. We now present a theory which extends the discrete case and unifies several notions of approximation properties of actions which have been discussed in the literature. We also discuss the weak containment problem which asks wether an action $\alpha : G \to \mathrm{Aut}(A)$ is amenable if and only if the maximal and reduced crossed products coincide.

In this lecture we report on joint work with Alcides Buss and Rufus Willett as well as on some recent results due to Bearden and Crann and Ozawa and Suzuki on this topic.

Soren Eilers (University of Copenhagen)

Title: *Refined moves for structure-preserving isomorphisms between graph C*-algebras*
Abstract:In work with Restorff, Ruiz and Sorensen, we recently provided a complete description of the equivalence class on the set of graphs with finitely many vertices and at most countably many edges induced by stable isomorphism of their associated graph $C*$-algebras. This description was a list of "moves" that generate the equivalence relation in the sense that two such graphs are stably isomorphic if and only if one may transform one into another by a finite number of such moves. A concurrent program pioneered by Kengo Matsumoto has established strikingly strong rigidity results for Cuntz-Krieger algebras when one considers them not just as $C*$-algebras, but also take finer structure (such as a certain Abelian subalgebra and a certain circle action) into account, showing in a multitude of ways that operator algebraic objects completely remember the dynamics underlying their definition.

Since the Cuntz-Krieger algebras lie in the class of graph $C*$ -algebras, it is a natural question if a similar combinatorial description may be obtained for the finer equivalence relations induced by structure-preserving isomorphism of the graph $C*$ -algebras, and we present a list of moves which we conjecture solves this problem in the very satisfactory sense that

the subset of moves preserving extra structure in fact also generates the relevant equivalence relation. We can prove the conjecture for all graphs defining simple Cuntz-Krieger algebras, but there are still a great many mysteries beyond that I wish to present. The core results presented are joint with Efren Ruiz.

George A. Elliott (University of Toronto)

Title: *A brief summary of classification theory*

Abstract: The overall idea of classification usually involves just parametrizing isomorphism classes of some mathematical structure (e.g., vector spaces, elliptic curves) by a nice parameter. There are lots of cases where this is not possible (e.g., topological spaces), but, miraculously (it seems), there are cases where it is still not possible, but something else is possible, namely, classification by simpler objects, by means of a classification functor (i.e., a functor such that the abstract object associated to a given object is a complete invariant: isomorphism of the invariants implies isomorphism of the given objects). I only know of two categories for which a functorial classification is possible: amenable von Neumann algebras with separable predual, and simple separable amenable (= nuclear) $C*$-algebras of finite nuclear dimension (satisfying the possibly redundant Universal Coefficient Theorem). (There are also results for interesting but restricted classes of non-simple $C*$-algebras.) In the von Neumann algebra setting the functor only respects isomorphisms—which of course is enough! For $C*$-algebras, it is crucial (for the proof) that the functor also respects homomorphisms. Interestingly, in the two settings the functors are amazingly similar—although the invariants are of course quite different objects. For both the definition is essentially K-theoretical, namely, based on the idea of Murray-von Neumann equivalence. This after all should perhaps not be surprising as the similarity in general between von Neumann algebra theory and $C*$-algebra theory is very deep. In the von Neumann algebra setting the invariant is a flow, and an arbitrary one (on a commutative von Neumann algebra with separable predual). In the $C*$-algebra setting (the stable case) the invariant can be expressed as a pair of countable abelian groups, together with a metrizable simplicial cone paired with the first group. This system of objects is also arbitrary.

Guihua Gong (University of Puerto Rico)

Title: *On the classification of simple stable projection-less C^*-algebras of finite nuclear dimensions*

Abstract: I will report the joint work with H. Lin on the classification of simple stable projection-less $C*$-algebras of finite nuclear dimensions. The work depends on our previous joint papers of Elliott-Gong-Lin-Niu.

Huichi Huang (Chongqing University)

Title: *Strongly independent matrices and measures rigidity on n-torus*
Abstract: We develop the concept of strongly independent matrices over a field F. On one hand, we give an existence result for strongly independent matrices. On the other hand, we prove that there are no strongly independent matrices over an algebraically closed field. Then we prove a measure rigidity result on n-torus by using strongly independent matrices. This is joint work with Hanfeng Li, Enhui Shi and Hui Xu.

Ja A Jeong (Seoul National University)

Title: *AF-embeddable C^*-algebras of labeled graphs*
Abstract: AF-embeddability, quasidiagonality, and stable finiteness are known to be equivalent for certain classes of C^*-algebras. The crossed products $C(X) \rtimes_\sigma \mathbb{Z}$ and $AF \rtimes_\alpha \mathbb{Z}$ are such classes as known by Pimsner and Brown, respectively. Schfhauser recently proves the equivalence for C^*-algebras of compact topological graphs, and similar results for k-graph algebras are obtained by Clark, an Huef, and Sims.

We discuss the equivalence for labeled graph C^*-algebras $C^*(E, \mathcal{L})$. From the structural results of Bates, Pask, and Willis on the crossed products formed by group actions on labeled graphs, we obtain that the above three finiteness conditions are all equivalent for $C^*(E, \mathcal{L})$. Motivated by Schfhauser's result, we then consider labeled graphs over a finite alphabet and provide another equivalent condition that labeled paths must satisfy. This condition is easy to check and our result implies that if $C^*(E, \mathcal{L})$ is simple, then it is AF-embeddable if and only if labeled edges have disjoint ranges.

This is a joint work with G. H. Park.

Chunlan Jiang (Hebei Normal University)

Title: *Geometric invariants of operators*
Abstract: In this report,we will show that curvature;the second fundamental form;chern polynomials are similarity invaiants of a class of Cowen-Douglas operators,and positive answering two open questions raised by R.Douglas.In addition,we will also show some application of the above results.

Yasuyuki Kawahigashi (University of Tokyo)

Title: *Tensor networks, commuting squares and higher relative commutants of subfactors*
Abstract: Suppose we have a finite dimensional commuting square producing a subfactor of finite depth. It gives a bi-unitary connection and subsequently a 4-tensor appearing in a recent work of Bultinck-Marien-Williamson-Sahinoglu-Haegemana-Verstraete on 2-dimensional

topological order and anyons in condensed matter physics. They have a special finite dimensional projection called a projector matrix product operator and study physical significance of its range. We prove that the range this projection of length k is naturally identified with the k-th higher relative commutant of the subfactor arising from the commuting square. This gives a further connection between 2-dimensional topological order and subfactor theory.

Xin Li (University of Glasgow)

Title: *Generalizations of Thompson's group V arising from left-cancellative small categories*
Abstract: Thompson's group V is a by now classical example of an infinite simple group. The construction has been generalized in many ways. In this context, the notion of topological full groups of groupoids has attracted attention because it produces new examples of infinite simple groups with interesting properties. My talk will discuss topological full groups arising from left-cancellative monoids and small categories. I will present several concrete examples, explain the connection to operator algebras, and focus on homological properties of these topological full groups.

Zhengwei Liu (Tsinghua University)

Title: *Quantum Fourier Analysis*
Abstract:Quantum Fourier Analysis is a subject that combines an algebraic Fourier transform (pictorial in the case of subfactor theory) with analytic estimates. This provides interesting tools to investigate phenomena such as quantum symmetry. In this talk, we will introduce its background, development and perspectives, based on selected examples, results and applications.

Magdalena Musat (University of Copenhagen)

Title: *Factorizable quantum channels, non-closure of quantum correlations and the Connes Embedding Problem*
Abstract: Factorizable quantum channels, introduced by C. Anantharaman-Delaroche within the framework of operator algebras, have proven to have important applications in the analysis of quantum information theory, leading also to reformulations of the Connes Embedding Problem. In recent work with M. Rørdam, we show that (infinite dimensional) von Neumann algebras are, indeed, needed to describe such channels. The proof uses analysis of correlation matrices arising from projections, respectively, unitaries, in tracial von Neumann algebras. We also establish a new view point on factorizable channels, leading to central questions in $C*$-algebra theory.

Zhuang Niu (University of Wyoming)

Title: *Structure of Transformation Group $C*$-Algebras*

Abstract: Consider a minimal and free action of a discrete amenable group on a compact metrizable space. The corresponding crossed product $C*$-algebra is a simple unital separable stably finite $C*$-algebra, and in the talk I will focus on the structure of this $C*$-algebra. In particular, I will talk about the classifiability and radius of comparison in terms of the mean dimension of the dynamical system, and I will also talk about the stable rank of this $C*$-algebra.

Chi-Keung Ng (Nankai University)

Title: *Dual spaces of operator systems*

Abstract:The aim of this article is to give an infinite dimensional analogue of a result of Choi and Effros concerning dual spaces of finite dimensional unital operator systems. An (not necessarily unital) operator system is a self-adjoint subspace of $\mathcal{L}(\mathfrak{H})$, equipped with the induced matrix norm and the induced matrix cone. We say that an operator system T is *dualizable* if one can find an equivalent dual matrix norm on the dual space T^* such that under this dual matrix norm and the canonical dual matrix cone, T^* becomes a dual operator system. We show that an operator system T is dualizable if and only if the ordered normed space $M_\infty(T)^{\mathrm{sa}}$ satisfies a form of bounded decomposition property. In this case,

$$\|f\|^{\mathrm{d}} := \sup\left\{\left\|[f_{ij}(x_{kl})]\right\| : x \in M_n(T)_+; \|x\| \leq 1; n \in \mathbb{N}\right\} \quad (f \in M_m(T^*); m \in \mathbb{N}),$$

is the largest dual matrix norm that is equivalent to and dominated by the original dual matrix norm on T^* that turns it into a dual operator system, denoted by T^{d}. It can be shown that T^{d} is again dualizable. Furthermore, we will verify that that if S is either a C^*-algebra or a unital operator system, then S is dualizable and the canonical weak-*-homeomorphism from the unital operator system S^{**} to the operator system $(S^{\mathrm{d}})^{\mathrm{d}}$ is a completely isometric complete order isomorphism. Consequently, a nice duality framework for operator systems is obtained, which includes all C^*-algebras and all unital operator systems.

Ping Wong Ng (University of Louisiana at Lafayette)

Title: *Purely infinite corona algebras and extensions*

Abstract: We report on recent joint work with Gabe and Lin. Among other things, one of the main results, for the elegant continuous scale case, has been completed.

Piotr Nowak (University of Warsaw)

Title: *On property (T) for $Aut(F_n)$*

Abstract: The goal of this talk is to present the recent proof that $Aut(F_n)$, the automorphism

group of the free group on n generators, has Kazhdan's property (T) for $n \geq 5$. This is joint work with Marek Kaluba and Taka Ozawa (n=5) and with Kaluba and Dawid Kielak ($n \geq 6$). Our proof uses a characterization of property (T) via an algebraic notion of positivity in the group ring, due to Ozawa, and computer assistance in the form of semidefinite programming (i.e. convex optimization over positive definite matrices). As applications we confirm the explanation of the effectiveness of the Product Replacement Algorithm predicted by Lubotzky and Pak, as well as obtain new asymptotically optimal estimates of Kazhdan constant for $Aut(F_n)$ and $SL_n(Z)$.

Valerio Proietti (East China Normal University)

Title: *Noncommutative algebraic topology of some dynamical systems*
Abstract: Ruelle defined Smale spaces in order to capture the key topological properties of Smale's Axiom A systems. I'll discuss the homotopy and homology invariants of such spaces, both from a "classical" and noncommutative point of view.

Mikael Rordam (University of Copenhagen)

Title: *Irreducible inclusions of simple $C*$-algebras*
Abstract: The literature contains interesting examples of inclusions of simple $C*$-algebras, typically arising from dynamical systems, with the property that all intermediate $C*$-algebras are also simple. One can argue that this property of an inclusion of $C*$-algebras is the natural $C*$-analog of an irreducible inclusion of von Neumann algebras (i.e., one with trivial relative commutant). I will present an intrinsic description of when an inclusion of $C*$-algebras is $C*$-irreducible, and relate this to the parallel situation of von Neumann algebras. I will further show how $C*$-irreducible inclusions can arise from groups, dynamical systems, inductive limits (and AF-algebras), and tensor products.

Yasuhiko Sato (Kyushu University)

Title: *Uncountably many flows which are not approximately inner on Z-absorbing $C*$-algebras*
Abstract: For a given compact set K of real numbers containing zero, we construct a flow on the Jiang-Su algebra Z for which the set of possible inverse temperature is K. Consequently, it is shown that, up to outer conjugacy, any unital stably finite Z-absorbing $C*$-algebra has uncountably many flows which are not approximately inner.

Yanli Song (Washington University in St.Louis)

Title: *Orbital integral and Cartan motion group*
Abstract: Attached to any reductive Lie group G is a "Cartan motion group" G_0 -a Lie group

with the same dimension as G, but a simpler group structure. There exists a natural one-to-one correspondence between the irreducible tempered representations of G and the unitary irreducible representations of G_0 and a deformation procedure. In this talk, we will discuss the orbital integral of generators in K-theory of the group $C*$-algebra of G_0 and show they are independent of the deformation.

Aaron Tikuisis (University of Ottawa)

Title: *Classifying embeddings of C*-algebras*

Abstract: Understanding and classifying *-homomorphisms between C*-algebras is both a natural problem in its own right and the usual approach to proving isomorphism theorems. In joint work with J. Carrion, J. Gabe, $C.$ Schafhauser, and S. White, we have classified full nuclear *-homomorphisms using minimal (and abstract) hypotheses on the domain A and codomain B: A can be any separable exact $C*$-algebra satisfying the UCT, and B can be any separably Z-stable $C*$-algebra with compact tracial state space and with strict comparison with respect to traces. I will discuss our approach.

Hang Wang (East China Normal University)

Title: *K-homology and K-theory for pure braid groups*

Abstract: We produce an explicit description of the K-theory and K-homology of the pure braid group on n strands. We describe the Baum-Connes correspondence between the generators of the left- and right-hand sides for $n = 4$. Using functoriality of the assembly map and direct computations, we recover Oyono-Oyono's result on the Baum-Connes conjecture for pure braid groups. This is joint work with Sara Azzali, Sarah Browne, Maria Paula Gomez Aparicio, and Lauren Ruth.

Rufus Willett (University of Hawaii)

Title: *Controlled KK-theory, decomposable C*-algebras, and the UCT*

Abstract: I'll describe a new class of $C*$-algebras that we call decomposable: roughly, this means that the $C*$-algebra can locally be cut into two finite-dimensional subalgebras with well-behaved intersection. Examples include Cuntz algebras and crossed products associated to Cantor minimal systems. The motivation for this is to better understand the problem of whether all nuclear $C*$-algebras satisfy the universal coefficient theorem (UCT): I'll explain a characterization of this in terms of decomposability. I'll explain some of the ideas that go into this, including some new (controlled) models for KK-theory.

This is mainly based on joint work with Guoliang Yu, and also some joint work with Arturo Jaime.

Jianchao Wu (Texas A&M University)

Title: *Quasi-representations and controlled K-homology*

Abstract: Generalizing the intriguing phenomenon of Voiculescu's almost commuting unitary matrices is the notion of a quasi-representation of a group (or a $C*$-algebra). This notion also has a close relationship with almost flat (vector) bundles, a concept introduced by Connes, Gromov and Moscovici in their study of the Novikov conjecture. Moreover, there are topological obstructions to perturbing quasi-representations into representations or flattening almost flat bundles. In particular, one natural way to see if a topological space supports almost flat but non-flat bundles is to consider K-theory classes that are represented by almost flat bundles. We introduce a new approach focusing on the quasi-representation side instead, based on a variant of Willett and Yu's newly developed theory of controlled K-homology. We apply this to predict nontrivial quasi-representations of hyperbolic groups. The talk is based on a joint project with Shmuel Weinberger and Guoliang Yu.

Guoliang Yu (Texas A&M University)

Title: *Quantitative operator K-theory and positive scalar curvature*

Abstract: I will give an introduction and overview of recent results on quantitative K-theory and its applications to positive scalar curvature. In particular, I will discuss progress on several open problems proposed by Gromov. This is joint work with Hao Guo, Jinmin Wang and Zhizhang Xie.

Jiawen Zhang (Fudan University)

Title: *Quasi-local algebras and their K-theories*

Abstract:Roe algebras are $C*$-algebras associated to metric spaces, which encode their large scale structures. These algebras play a key role in higher index theory, providing a bridge between geometry, topology and analysis. We introduce a strongly quasi-local perspective on Roe algebras, which leads to a larger class of index algebras called the strongly quasi-local algebras. We also study their K-theories and show that they have the same K-theories as Roe algebras provided the underlying space has bounded geometry and can be coarsely embedded into a Hilbert space. This is a joint work with Hengda Bao, Xiaoman Chen and Kun Gao.

About Us

Research Center for Operator Algebras is under the direct auspices of East China Normal University and was founded in 2010. Currently, it is located on the 5th floor of Science Building A in ECNU ZhongShan North Road campus, Shanghai, China.

This center focuses on the research related to operator algebras and functional analysis. It attaches great importance to collaboration home and abroad. So far it has set up frequent academic relationships and links with several well-known institutes and research centers in terms of scientific researches and cooperations.

Quite a few international conferences and symposiums on operator algebras have been held here. Every year, a number of famous mathematicians are invited to give lectures and conduct researches in the center.

To promote the developments in operator algebras and related fields, we welcome students and visiting scholars all over the world to come for study and work (for either long term or short term).