West Coast Operator Algebra Seminar

University of Denver

November 1st and 2nd, 2014

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Welcome

We wish to welcome you to the twenty-second edition of the *West Coast Operator Algebra Seminar*. We are very thankful for your participation, and it is our honor to be your host. We wish to thank our speakers for accepting the invitation to give a presentation to our conference, and the scientific committee members for their greatly valued time and help in organizing this event. We look forward to a great conference, and to see all of you at our complimentary reception on Saturday, November 1^{st}, at 6pm, in the Fritz Knoebel School of Hospitality Management.

This brochure includes a schedule of presentations, a program with abstracts, and some additional local information to help you with your stay. Your welcome package also includes some forms for financial support. We are available to provide any help we can in order to make your stay as agreeable as possible. For emergency matters, you may contact us at:

See printed brochure.

Welcome to Denver!

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Schedule

All presentations will be given in **Olin Hall 105** and last 45 minutes.

Saturday, November 1st

TIME	SPEAKER AND PRESENTATION TITLE
9:00–9:45am	Karen Strung *Classification of C*-algebras of minimal homeomorphisms on odd dimensional spheres*
10:00–10:45am	Heath Emerson *Poincaré duality for C*-algebras and applications*
11:00–11:45am	Tron Omland *On simplicity and uniqueness of trace for reduced twisted group C^*-algebras*
12:00–2pm	Lunch Period
2:00–2:45pm	Raphael Ponge *Noncommutative Geometry and Conformal Geometry*
3:00–3:45pm	Gene Abrams *An introduction to Leavitt path algebras, with connections to C^*-algebras and noncommutative geometry*
4:00–4:45pm	Rufus Willett *Exotic Crossed Products*
5:00–5:45pm	Zhizhang Xie *Higher signature on Witt spaces*
6:00–8:00pm	Reception in the Atrium of the Fritz Knoebel School of Hospitality Management.

Sunday, November 2nd

TIME	SPEAKER AND PRESENTATION TITLE
9:00–9:45am	Shane Farnsworth *Rethinking Connes' approach to the standard model of particle physics via non-commutative geometry*
10:00–10:45am	Ami Viselter *On positive definiteness over locally compact quantum groups*
11:00–11:45am	Eusebio Gardella *Rigidity results for L^p-operator algebras*
12:00–12:45pm	Brent Nelson *Free monotone transport without a trace*

Program

An introduction to Leavitt path algebras, with connections to C*-algebras and noncommutative geometry

GENE ABRAMS

University of Colorado at Colorado Springs

Date: Saturday, November 1st Time: 3:00pm. Room: Olin Hall 105

ABSTRACT: Since 2005, a class of algebras, the *Leavitt path algebras* $L_K(E)$ (for K any field and E any directed graph), has been the focus of significant research attention. The $\mathbb{C}$-algebra $L_{\mathbb{C}}(E)$ can be viewed as forming the algebraic underpinnings of the graph C*-algebra $C^*(E)$. In this talk I'll define these Leavitt path algebras, and give some of their general properties. I'll describe two instances where results about Leavitt path algebras have led to a deeper understanding of the structure of graph C*-algebras. Then I'll describe some of the current lines of investigation in the area. One such line is the search to understand the still-mysterious similarities between structural properties of $L_{\mathbb{C}}(E)$ and those of $C^*(E)$. Another such line is the search for an analog to the Kirchberg Phillips Theorem in this context. Finally, I'll describe how the algebras $L_K(E)$ arise naturally in the context of various questions about noncommutative algebraic geometry.

Poincaré duality for C*-algebras and applications

HEATH EMERSON

University of Victoria

Date: Saturday, November 1st Time: 10:00am Room: Olin Hall 105

ABSTRACT: Poincaré duality in homology is exhibited by smooth, compact, oriented manifolds. One application of duality is to the Lefschetz fixed-point formula and its variants. An important observation in the context of Index Theory was that, suitably formulated, Poincaré duality is present in K-theory as well, if the orientation assumption on the manifold is strengthened suitably. As noncommutative geometry has developed, a number of examples of noncommutative C*-algebras exhibiting K-theoretic duality have emerged as well. What about the Lefschetz fixed-point formula? We state a general analogue of the Lefschetz fixed-point formula for C*-algebras satisfying duality, which works equivariantly as well, and which when specialized to the commutative case, generalizes the classical formula – making it equivariant with respect to an action of a connected compact Lie group, and applying to smooth correspondences, rather than just maps.

Rethinking Connes' approach to the standard model of particle physics via non-commutative geometry

SHANE FARNSWORTH

Perimeter Institute

Date: Sunday, November 2nd Time: 9:00am Room: Olin Hall 105

ABSTRACT: Connes has argued that non-commutative geometry (NCG) more aptly describes the standard model Lagrangian. Although his papers have generated enormous interest, many physicists are skeptical because: (i) NCG relies on a long list of axioms whose meaning is obscure to them; and (ii) the NCG construction of the standard model Lagrangian relies on a fishy step where 7 problematic terms must be set to zero, essentially by hand, to get the desired result. In this talk I discuss a simple reformulation of Connes' ideas with two key advantages: (i) it fixes both above mentioned problems: the axioms are dramatically simplified and unified, while the 7 problematic terms are precisely eliminated; and (ii) it immediately generalizes from non-commutative to non-associative geometry. (arXiv:1401.5083, arXiv:1408.5367)

Rigidity results for L^p-operator algebras

EUSEBIO GARDELLA

University of Oregon

Date: Sunday, November 2nd Time: 11:00am. Room: Olin Hall 105

ABSTRACT: Algebras of operators on L^p-spaces (for $1 \leqslant p < \infty$) have recently received a great deal of attention. Their systematic study initiated by Phillips was soon followed by the work of other authors (Pooya-Hejazian, G.-Thiel, G.-Lupini, Phillips-Viola, and more). Despite the absence of adjoints, much of the theory so far developed resembles and is inspired by the theory of C*-algebras. Nevertheless, it is becoming apparent that L^p-operator algebras, for $p \neq 2$, are far more rigid objects than C*-algebras, even when they "look like" C*-algebras.

In this talk, we will discuss some rigidity results concerning L^p-operator algebras, focusing on the L^p-analog $F^p_\lambda(G)$ of the reduced group algebra of a locally compact group G. (These algebras were introduced a long time ago by Herz, who called them algebras of p-pseudofunctions on G.) The main result of the talk is that for $p, q \in [1, \infty) \setminus \{2\}$, and for second countable locally compact groups G and H, there is a contractive isomorphism $F^p_\lambda(G) \cong F^q_\lambda(H)$ if and only if p and q are either equal or conjugate, and G is isomorphic to H. For $p = q = 1$, this result was proved by Wendel in the 60's.

This is based on joint work with Hannes Thiel (University of Muenster).

Free monotone transport without a trace

BRENT NELSON

University of California at Los Angeles

Date: Sunday, November 2nd Time: 12:00pm. Room: Olin Hall 105

ABSTRACT: Classically, transport between probability spaces (X, μ) and (Z, ν) is a measurable map $T : X \to Z$ such that $T_*\mu = \nu$. Consequently, $f \mapsto f \circ T$ is an integral preserving embedding of $L^\infty(Z, \nu)$ into $L^\infty(X, \mu)$. Free transport extends this idea to non-commutative probability spaces (e.g. pairs (A, φ) of von Neumann algebras/C^*-algebras and states) to produce state-preserving embeddings and even isomorphisms between non-commutative probability spaces. In this talk, we will discuss how to construct non-tracial transport by solving a non-commutative differential equation known as the Schwinger-Dyson equation and, time permitting, applications to q-deformed Araki-Woods algebras and finite depth subfactor planar algebras.

On simplicity and uniqueness of trace for reduced twisted group C^*-algebras

TRON OMLAND

Arizona State University

Date: Saturday, November 1st Time: 11:00am Room: Olin Hall 105

ABSTRACT: In this talk, we consider pairs (G, σ) of a discrete group G and a two-cocycle σ of G, and discuss sufficient conditions for the reduced twisted group C^*-algebra associated with (G, σ) to be simple and/or have a unique tracial state.

The topic has been studied a lot in the untwisted situation, where recent development (by Breuillard, Kalantar, Kennedy, and Ozawa) shows that uniqueness of trace for $C^*_r(G)$ is equivalent to G having trivial amenable radical, which holds whenever $C^*_r(G)$ is simple. However, this result does not carry over to the twisted case, where also amenable groups play an important role.

In particular, we will show that the twisted group C^*-algebras associated with so-called FC-hypercentral groups are simple (resp. have a unique tracial state) if and only if Kleppner's condition is satisfied (meaning that all nontrivial σ-regular conjugacy classes are infinite). The FC-hypercentral groups form a large subclass of elementary amenable groups containing for example all virtually nilpotent groups.

Finally, by using a decomposition involving the FC-hypercenter of a group (which in any group is a normal subgroup), we can give conditions ensuring simplicity and/or uniqueness of trace for larger classes of groups.

This is joint work with Erik Bedos (University of Oslo).

Noncommutative geometry and conformal geometry: local index formula and conformal invariants.

RAPHAËL PONGE

Seoul National University

Date: Saturday, November 1st Time: 2pm. Room: Olin Hall 105

ABSTRACT: This will be report on a series of joint papers with Hang Wang (U. Adelaide, Australia). The general aim of these papers is to use tools from noncommutative geometry to study conformal geometry and some noncommutative incarnations of conformal geometry. In this talk, I will present two main results. The first main result is a reformulation of the local index formula in the setting of conformal-diffeomorphism invariant geometry. The second main result is the construction of a new family of global conformal invariants taking into account the action of the group of conformal-diffeomorphisms. These invariants are not of the same type as the conformal invariants considered by Spyros Alexakis in his celebrated solution of the Deser-Schwimmer. The arguments leading to both results heavily rely on noncommutative geometry. In particular, a crucial use is made of the conformal invariance of the Connes-Chern character. However, the main results are ultimately stated in differential-geometric fashion.

Classification of C*-algebras of minimal homeomorphisms on odd dimensional spheres

KAREN STRUNG

Institute of Mathematics, Polish Academy of Sciences

Date: Saturday, November 1st Time: 9:00am Room: Olin Hall 105

ABSTRACT: I will discuss my recent work on C*-algebras of products of minimal dynamical systems with Cantor minimal systems. In particular, I will show how taking such a product leads to the classification by tracial state spaces of the C*-algebras associated to minimal homeomorphisms on odd dimensional spheres.

On positive definiteness over locally compact quantum groups

AMI VISELTER

University of Alberta and Haifa University

Date: Sunday, November 2nd Time: 10:00am Room: Olin Hall 105

ABSTRACT: Positive-definite functions over locally compact groups are a very fundamental tool in abstract harmonic analysis and related areas. They are tightly connected with various aspects of the group, such as representations, group properties (amenability and other approximation properties, property (T), etc.), the algebras associated to the group and many more.
The concept of positive-definite functions in the setting of locally compact quantum groups (LCQGs) has lately appeared in a few papers in relation to other notions. This stimulated a very recent work of Daws and Salmi, in which they examined several ways to define "(completely) positive-definite functions over LCQGs", and proved that, under some mild assumptions, they are all equivalent. We continued this line of research, generalizing some known results about positive definiteness over groups to the quantum setting. These will be presented in the talk, after brief introductions to LCQGs and positive-definite functions. This is joint work with Volker Runde.

Exotic Crossed Products

RUFUS WILLETT

University of Hawaii

Date: Saturday, November 1st Time: 4:00pm Room: Olin Hall 105

ABSTRACT: C*-algebraists usually consider two crossed products associated to a group action on a C*-algebra: the full crossed product and the reduced one. However, there are in general many other crossed products that come 'between' these two standard examples, and that capture interesting representation theoretic and dynamical properties of the group. I'll characterize some useful properties of exotic crossed products, and some examples that connect with representation theory. I'll also discuss which crossed product is the 'right' one to use in the Baum-Connes conjecture. Most of this is joint work with Alcides Buss and Siegfried Echterhoff, and some is joint work with Paul Baum and Erik Guentner.

Higher signature on Witt spaces

ZHIZHANG XIE

Texas A & M University

Date: Saturday, November 1st Time: 5pm. Room: Olin Hall 105

ABSTRACT: The signature is a fundamental homotopy invariant for topological manifolds. However, for spaces with singularities, this usual notion of signature ceases to exist, since, in general, spaces with singularities fail the usual Poincaré duality. A generalized Poincaré duality theorem for spaces with singularities was proven by Goresky and MacPherson using intersection homology. The classical signature was then extended to Witt spaces by Siegel using this generalized Poincaré duality. Witt spaces are a natural class of spaces with singularities. For example, all complex algebraic varieties are Witt spaces. In this talk, I will describe a combinatorial approach to the higher signature of Witt spaces, using methods of operator algebras. This is based on joint work with Nigel Higson.

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Financial Support for Participants

The Department of Mathematical Sciences of the National Science Foundation has generated provided its support, through grant DMS 1445373, in order to defray some of the costs of attendance for WCOAS 2014.

Funds will be dispensed to registered participants at the conference. Priority will be given to speakers, then graduate students, followed by postdoctoral fellows and then tenure-track faculty members. We will cover travel costs with the highest priority, followed by lodging costs. Other costs may be reimbursed if funds permit. While we will make every effort to maximize our support of the attendees, we also will operate within the constraint of our budget and the priority guidelines provided here, so we can not guarantee any specific amount for any given participant.

In order to be reimbursed, we ask that you please follow these procedures.

1. Please register for the conference at `http://wcoas.org`. Select the option "Yes, I wish to be considered for financial support" and click the `Register` button. You will then be prompted for optional information to help expedite your reimbursement. *This data will help us process your reimbursement more quickly.*

2. Please fill the *Reimbursement form* in your welcome package. The form requires that you give some information already included in your online registration, which is useful for verification purposes and to track your receipts.

3. Please attach receipts for each item you are requested reimbursement from.

4. Please file an IRS form. This step is *mandatory*. Select the appropriate form:

   a) If you are a U.S. Citizen or U.S. Permanent Resident, please use the **W-9** form.

   b) Otherwise please use the **W-8BEN** form.

   We may not proceed with your reimbursement until you have completed the IRS form and returned it to us with the rest of your reimbursement documents. Both forms are included in your welcome package.

5. Send the Reimbursement form, IRS form, and your receipts to:

   Frédéric Latrémolière, Ph.D.
   Department of Mathematics
   Aspen Hall 719C
   University of Denver
   Denver CO 80208

   by **January** 1^{st}**, 2015**, which is the deadline for our NSF grant.

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Local Information

5.1 Contact Information

This conference is organized by Frédéric Latrémolière, who can be reached at:

Cell Phone: See printed brochure,

Email: frederic@math.du.edu.

5.2 University of Denver Campus Security

Campus Security Emergency Number: (303) 871-3000. *Please dial 911 first for serious emergencies.*

Campus Security non-emergency number: (303) 871-2334.

5.3 Wireless

Wireless internet connection is available by selecting the *DU Guest Wireless* network. Once connected, open your web browser and click on *Guest Login*. You will then be asked to accept the terms and conditions before been able to use the network.

5.4 Conference Web Site

The web site for this conference is `http://wcoas.org`.

5.5 Conference Room

All the talks for this conference will be given in Olin Hall 105. *Olin Hall* is located south of Iliff street, and is building number 52 at `D-7` on the map. The room is on the first floor of the building.

5.6 Reception

The reception for this conference will be held in the Atrium of the *Fritz Knoebel School of Hospitality Management*. The food is complimentary and the first drink is on us as well!

5.7 Local Restaurants

Many lunch and dinner options are available in Denver, including in the neighborhood of the university. Here are a few locations with many options and easily reachable from campus.

- the closest options are located near Evans Avenue, north of the conference building, and cutting our campus from east to west. You may find restaurants near the intersection of South High Street and Evans Avenue on the west of campus, or near the intersection of University Boulevard and Evans Avenue, on the east of campus. This is the preferred location for lunch options.

  An annotated map of local restaurants is included in your welcome package.

- Cherry Creek North, accessible from campus by riding the bus line 24 (northbound, Gate D at the light rail station University of Denver, every half hour, for a fifteen minute ride), has many restaurants. You may access this area, which is next to the Cherry Creek mall, by going north on University Avenue from our campus, for about fifteen minutes.
- Downtown Denver can be reached by taking the light rail northbound. Line E will drop you north of the sixteen street mall, at Union Station, while Lines F and H will drop you in at California and sixteenth street, in the middle of the sixteenth street mall. A light rail ride to downtown takes about twenty minutes, with trains every fifteen minutes or so.
- Park Meadows Mall can be reached using the light rail southbound in about half an hour from campus, by riding line E or F southbound to County Line Station. There are several restaurants outside and around the mall.
- If you are a bit more adventurous, some options can be found near the Southmoor light rail station or the Belleview station (light rail line E, F, southbound). Within about a mile, there are some interesting restaurants: *India*, a mile or so walking on Hampden eastward from the Southmoor station, and *YaYa*, a mile or so waling from the Belleview station.

We will have a reception on Saturday, November 1^{st}, on campus, in the Atrium of the Fritz Knoebel School of Hospitality, a department in our school of business. This reception, from 6pm, will offer complimentary food and drinks, the first of which will also be free. It is not, properly speaking, designed to be a dinner.

5.8 Local Shopping

A Seven-Eleven is located east of campus at the corner of University Boulevard and East Wessley Avenue. A Safeway is located about one mile west from campus, at the intersection of Evans Avenue and South Downing Street. If you reside in a hotel south of campus, accessible via light rail, a King Soopers (grocery) is located north and very near Southmoor Station. If you reside in a downtown hotel, there are many shopping options; the closest standard grocery is near the Colfax at Auraria Station.

5.9 Public Transportation

The public transit system in the Denver metro area is called RTD (Regional Transportation District).

1. The light rail station located north of campus allows for a direct ride downtown (Northbound trains) or to the southern neighborhoods, including Denver Tech Center (lines E, F southbound).
2. Light Rail fare can be purchased at any station, using vending machines which accept cash, and most credit cards and debit cards. Fares start at $2.25 and depend on your origin and destination.
3. Bus fare must be given in Cash ($2.25 for most buses, requires exact fare) or using tickets. Please ask the organizer to obtain some tickets, or obtain them from a King Soopers shop or from the stations at Union Station or Civic Center.
4. When paying for a bus, please ask for a transfer, which you can use on other buses or on the light rail within the time window displayed on the transfer. Light rail tickets obtained at the vending machines in each light rail station can be used as transfers as well — they also carry an expiration time on them.
5. *Skyride* is a bus service offered by RTD to and from the Denver International Airport. You may catch the `AF` bus from the Union Station (from the University of Denver, ride the light rail line E, northbound, to the end), for $11. You may also ride the `AT` bus from the Araphaoe at Village Center Station (from the University of Denver, ride the light rail line E or F, southbound), for $13, or from the Nine Mile Station (from the University of Denver, ride line H, southbound), for $9.00.

6. For schedules and other information, you may visit:

   `http://www.rtd-denver.com`

   or call (303) 299-6000.

7. Bus Stops in Denver are small red panels on a pole. They bear the numbers of the bus(es) which stop(s) at that particular location, as well as a special five digit number. If you call RTD at (303) 299-6000 and, when prompted, enter this bus stop code, then you will get a list of the next few scheduled buses stopping at your location.

5.10 Taxis and Shuttles

We recommend that, as much as you can, you favor public transportation to taxis, which can be expensive, and shuttles, which can be slow. RTD provides buses to the airport, which take no longer than cabs (and are often quicker than shuttles), are cheap ($13 or less), and are a more comfortable ride than other options. If you travel light, then it is a nice option.

The following options for taxis and shuttles are available:

Taxis: **Metro Taxi** Phone: (303) - 333 - 3333

Yellow Cab Phone: (303) - 777 - 7777

Taxi companies also provide apps for smart phones for reservations. A ride to the airport can cost $80.

Shuttle Services to DIA If you must use a shuttle to go to the airport, we recommend *Super Shuttle*, (303) 370-1300, `http://www.supershuttle.com/`. Prices, while variable, should be around $30 per person.

Note: some shuttle services at DIA will offer rides at or above $60*. Do not take these rides! They are overpriced.*

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Participants

This list includes all the participants who registered online at *wcoas.org* prior to 10/24/2014 .

- Gene Abrams, *University of Colorado at Colorado Springs* (Noncommutative rings and their categories of modules, Leavitt path algebras)
- Konrad Aguilar, *University of Denver* (Noncommutative Geometry)
- Alvaro Arias, *University of Denver* (operator theory and Banach spaces)
- Bruce Blackadar, *University of Nevada, Reno* (C*-algebras)
- Jeff Boersema, *Seattle University, University of New Mexico* (C*-Algebras and K-theory)
- Valentin Deaconu, *UNR* (Operator Algebras)
- Geraldo De Souza, *Auburn University* (harmonic Analysis and Related areas)
- Dorin Dumitrascu, *Adrian College* (K-theory for C*-algebras, non-commutative geometry, geometric group thoery)
- Heath Emerson, *University of Victoria* (Operator algebras, index theory, hyperbolic groups)
- Shane Farnwsorth, *Perimeter Institute* (Cosmology,Mathematical Physics,Particle Physics)
- Adam Fuller, *University of Nebraska - Lincoln* (Operator Algebras)
- Eusebio Gardella, *University of Oregon* (C*-algebras, noncommutative dynamics.)
- Elizabeth Gillaspy, *University of Colorado - Boulder* (Groupoid C*-algebras and their K-theory)
- Philip Gipson, *University of Nebraska – Lincoln* (C*-Algebras and C*-Modules)
- Michael Hartglass, *UC Riverside* (Free Probability, Subfactors, Operator Algebras)
- George Herrmann, *University of Denver* (Noncommutative Geometry)
- Steve Kaliszewski, *Arizona State University*
- Jerry Kaminker, *University of California at Davis* (Noncommutative Geometry)
- Andre Kornell, *UC Berkeley* (noncommutative geometry)
- Alex Kumjian, *University of Nevada, Reno* (Operator Algebras, Groupoids)
- Frédéric Latrémolière, *University of Denver* (Noncommutative Metric Geometry)
- Matilde Marcolli, *California Institute of Technology* (Noncommutative Geometry)
- Joseph Migler, *University of Colorado, Boulder* (K-theory, operator algebras)
- Wonhee Na, *Texas A&M* (von Neumann algebra, Free probability theory)
- Brent Nelson, *UCLA* (Free probability)
- Zhuang Niu, *University of Wyoming* (classification of C*-algebras)

- Joseph Noles, *Texas A&M University* (Operator Algebras)
- Tron Omland, *Arizona State University* (Group C*-algebras)
- Patrick Orchard, *Texas A&M University* (C*-algebras)
- Judith Packer, *University of Colorado, Boulder* (Functional and harmonic analysis)
- Mira Peterka, *University of Kansas* (C*-Algebras/ Noncommutative Geometry)
- Chris Phillips, *University of Oregon* (Classification of C*-algebras)
- Raphael Ponge, *Seoul National University/UC Berkeley* (Noncommutative Geometry)
- Sorin Popa, *University of California at Los Angeles* (von Neumann Algebras)
- Benjamin Purkis, *Rhodes College* (Projective Multiresolution Analyses)
- Ian Putnam, *University of Victoria* (C*-dynamical Systems)
- John Quigg, *Arizona State University* (C*-algebras)
- Timothy Rainone, *Texas A&M University* (C*-Algebras, Noncommutative Dynamics.)
- farrokh Razavinia, *National Research University Higher School of Economics* (quantum groups)
- Marc Rieffel, *University of California at Berkeley* (Noncommutative Geometry)
- Min Ro, *University of Oregon* (C*-algebras)
- Travis Russell, *University of Nebraska-Lincoln* (Operator Spaces and Operator Systems)
- Christopher Schafhauser, *University of Nebraska - Lincoln* (C*-Algebras, Graph Algebras)
- Jack Spielberg, *Arizona State University*
- Karen Strung, *Institute of Mathematics, Polish Academy of Sciences* (Classification of C*-algebras)
- Gabor Szabo, *Wilhelms Univeritat* (Classification and Dynamics)
- Xian Tang, *Washington University in Saint-Louis* (Groupoids)
- Peter Teichner, *Max Plank and U.C. Berkeley* (Quantum Field Theory)
- Vardan Tepoyan, *Institute of Mathematics of National Academy of Sciences of Armenia* (C*-algebras)
- Andrew Toms, *Purdue University* (Classification)
- Belisario Ventura, *California State University San Bernardino* (Opeartor Algebras)
- Ami Viselter, *University of Alberta, Canada & University of Haifa, Israel* (Operator algebras, locally compact quantum groups)
- Qingyun Wang, *University of Toronto* (C*-algebras and dynamics system)
- Rufus Willett, *Univesity of Hawaii* (Index Theory)
- Zhizhang Xie, *Texas A&M* (K-theory of operator algebras, index theory, noncommutative geometry)

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Organizers

Scientific Committee

- *Jerry Kaminker*, University of California at Davis,
- *Matilde Marcolli*, California Institute of Technology,
- *Chris Phillips*, University of Oregon,
- *Sorin Popa*, University of California at Los Angeles,
- *Ian Putnam*, University of Victoria,
- *Marc Rieffel*, University of California at Berkeley.

Local Organizer

- Frédéric Latrémolière, Associate Professor, Mathematics, University of Denver

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- *the office of the Dean of Natural Sciences and Mathematics* at the University of Denver (*Andrei Kutateladze*, Dean),
- *the office of the Associate Provost for Research* at the University of Denver (*Corinne Lengsfeld*, Associate Provost),
- the *National Science Foundation*, Department of Mathematical Sciences (grant DMS 1445373).

Thanks

We also wish to thank, for their help in organizing this conference:

- *Alvaro Arias*, Professor, Mathematics, University of Denver,
- *Nancy Sasaki*, Associate Dean, Natural Sciences and Mathematics, University of Denver,
- *Konrad Aquilar*, Ph.D. student, Mathematics, University of Denver,
- *George Hermann*, Ph.D. student, Mathematics, University of Denver,
- *Liane Beights*, staff, University of Denver,
- *Jason Myers*, staff, University of Denver.

LEGEND