# Southern Ontario Operator Algebra Seminar 2019
SCHEDULE

All talks will be in the main Fields Institute lecture hall, and all breaks will be nearby.

## Saturday February 16th, 2019

- 9AM-10AM: Isaac Goldbring (University of California, Irvine), Part 1.
- 10AM-11AM: Break
- 11AM-12PM: Sven Raum (Stockholm University), Part 1.
- 12PM-2PM: Lunch Break
- 2PM-3PM: Omer Tamuz (California Institute of Technology), Part 1.
- 3PM-4PM: Break
- 4PM-5PM: Ian Charlesworth (University of California, Berkeley).

## Sunday February 17th, 2019

- 9AM-10AM: Isaac Goldbring (University of California, Irvine), Part 2.
- 10AM-11AM: Break
- 11AM-12PM: Sven Raum (Stockholm University), Part 2.
- 12PM-2PM: Lunch Break
- 2PM-3PM: Omer Tamuz (California Institute of Technology), Part 2.
- 3PM-4PM: Break
- 4PM-5PM: Eli Shamovich (University of Waterloo).

## Abstracts

Ian Charlesworth (University of California, Berkeley)
*Free Stein Information*
I will speak on recent joint work with Brent Nelson, where we introduce a free probabilistic regularity quantity we call the free Stein information. The free Stein information measures in a certain sense how close a system of variables is to admitting conjugate variables in the sense of Voiculescu. I will discuss some properties of the free Stein information and how it relates to other common regularity conditions.

Isaac Goldbring (University of California, Irvine)
*Existentially closed objects in operator algebras*
The notion of an existentially closed object is the model-theoretic generalization of the notion of an algebraically closed field. Much of my work over the last few years has been, in some way or another, related to the understanding of existentially closed objects in operator algebras. In the first talk, I will introduce the notion of an existentially closed object, focusing primarily on the case of C*-algebras and tracial von Neumann algebras, and discuss the connection between them and various embedding problems (e.g. the Connes Embedding Problem). Along the way, I will introduce the powerful tool of model-theoretic forcing, otherwise known as building models by games, which yields existentially closed objects with extra properties. Many of the embedding problems have nice reformulations in terms of these games. The second talk will discuss two other contexts-operator spaces and projectionless abelian C*-algebras-as well as the fundamental notion of model companion, which essentially asks if the class of existentially closed objects is itself axiomatizable. No prior knowledge of model theory will be assumed

and I will attempt to describe most things in a semantic (i.e. logic-free) way. Much of the work involved is joint with various co-authors, including Christopher Eagle, Bradd Hart, Martino Lupini, Thomas Sinclair, and Alessandro Vignati.

## Eli Shamovich (University of Waterloo)

*Operator algebras and noncommutative analytic geometry*

The Hardy space $H^2(\mathbb{D})$ is the Hilbert space of analytic functions on the unit disc with square summable Taylor coefficients is a fundamental object both in function theory and in operator algebras. The operator of multiplication by the coordinate function turns $H^2(\mathbb{D})$ into a module over the polynomial ring $\mathbb{C}[z]$. Moreover, this space is universal, in the sense that whenever we have a Hilbert module $\mathcal{H}$ over $\mathbb{C}[z]$, such that $z$ acts by a pure row contraction, we have that $\mathcal{H}$ is a quotient of several copies of $H^2(\mathbb{D})$ by a submodule.

There are two multivariable generalizations of this property, one commutative and one free. I will show why the free generalization is in several ways the correct one. We will then discuss quotients of the noncommutative Hardy space and their associated universal operator algebras. Each such quotient naturally gives rise to a noncommutative analytic variety and it is a natural question to what extent does the geometric data determine the operator algebraic one. I will provide several answers to this question.

## Sven Raum (Stockholm University)

*Superrigidity for group operator algebras and classification of Cartan subalgebras*

It is a classical problem to recover a discrete group from various rings or algebras associated with it, such as the integral group ring. By analogy, in an operator algebraic framework we want to recover torsion-free groups from certain topological completions of the complex group ring, such as the reduced group C*-algebra. Groups for which this is possible are called C*-superrigid.

My first talk will discuss how a group can be recovered from its group rings, before I introduce the reduced group C*-algebras and describe the state-of-the-art in C*-superrigidity. I will end with a short account on other kinds of superrigidity for group operator algebras putting the subject into a bigger perspective. The second talk will, starting with a motivation from C*-superrigidity for Bieberbach groups, describe the classification of Cartan subalgebras in dimension drop algebras.

## Omer Tamuz (California Institute of Technology)

*Proximal Actions of Countable Groups*

The notions of proximal and strongly proximal topological actions were introduced by Glasner in the 1970s. After a long hiatus, they have again enjoyed interest due to newly discovered connections to group operator algebras. In these talks I will provide a gentle introduction to this topic and discuss some of the recent results, including a characterization of groups that admit faithful minimal proximal actions (joint with Joshua Frisch and Pooya Vahidi Ferdowsi).