Report for the Canadian Operator Symposium, 2011

Scientific Description:

The Thirty-ninth Canadian Operator Symposium was held at the University of Victoria May 24 to 28, 2011. The program featured a wide variety of talks covering many aspects of operator theory, operator algebras of great current interest.

Ken Davidson (Waterloo) and one of his students presented work which adapted techniques from algebraic geometry to the study of problems (some rather old and some new) in operator theory and non-self-adjoint algebras. This general program has been going for some time, promoted by Ron Douglas of Texas A & M, but Davidson has made some very interesting progress on a specific class of examples which are non-self-adjoint analogues on the Cuntz algebras which have played an important part in C^*-algebra theory over the past decades.

There were a substantial number of talks on topics covered under Alain Connes' program of noncommutative geometry. These ideas include using operator algebra techniques to study conventional geometric problems, and also to provide essentially noncommutative analogues of classical objects. In the former category, there is an old problem from symplectic topology to show that second quantization commutes with reduction via a subgroup. This was solved by Meinrencken in the 1990's. Nigel Higson (Penn State) gave one his usual beautiful lectures on his recent work providing an approach to this through K-homology of C^*-algebras. In the second category, Masoud Khalkhali (Western) presented work generalizing the Gauss-Bonnet Theorem to noncommutative tori. This is extremely computationally complex and complements work of Alain Connes on the same problem. There were also talks dealing with quantum groups, quantum projective spaces and an example of Spanier-Whitehead duality for C^*-algebras arsing from hyperbolic dynamics.

Of course, there were a number of talks dealing with the structure of operator algebras and related topics. One particularly interesting one was given by Doug Farenick (Regina) on his work on operator systems. These are structures which share many properties with operator spaces, which have

become an important tool in various aspects of noncommutative analysis, including quantum computing. Another topic which has received considerable interest in recent years has been the discovery that the solution to several major open problems in C^*-algebra theory depend on the choice of set theory axioms used. A leader in this area is Ilijas Farah (York), who comes from set theory. He gave a fascinating lecture on various problems for C^*-algebras which could be formulated in rather different terms using a set theory viewpoint.

Wilhelm Winter (Nottingham, on his way to Münster) is arguably the leading young researcher in the program of George Elliott to use K-theory invariants to classify amenable C^*-algebras. This program has been a major undertaking over the past thirty years and the results of Winter and his collaborators have revolutionized the subject. He will be giving the main lecture series at a CBMS conference next year in Louisiana. He gave an excellent lecture on the most recent progress. This also showed how notions coming from the classification program which may have really novel applications in dynamical systems. There was also a lecture by Chris Phillips (Oregon) on extending the classification of purely infinite amenable C^*-algebras (due to himself and Kirchberg and one of the high water marks in the classification program) to actions of finite groups on these C^*-algebras. George Elliott himself gave a presentation. There were also several really fine talks by graduate students and post-docs on aspects of the program.

There were a number of talks of the connections between operator algebras and dynamical systems (including Winter's mentioned above). One of the most fascinating was by David Kerr (Texas A & M). A few years ago, Lewis Bowen showed how a number of very deep concepts in ergodic theory could be extended beyond the realm of amenable groups to actions of so-called sofic groups. This was a startling development. Up to Bowen's work, it was generally thought that ideas such as entropy and finite approximation (i.e. Rohlin towers) relied on amenability in a crucial way. Kerr, with his collaborators, has been making great progress in this area by using the framework and ideas from operator algebras in an essential way. Other dynamical topics which were covered included graph C^*-algebras, C^*-algebras associated with aperiodic tilings and noncommutative dynamical systems in the sense of semigroups of operator algebras.

The subject of free probability, initiated by Dan Voiculescu, is studied by researchers at Queen's University and there were talks by some of their (current and past) students. With the recent realization that a quantum

computer is a completely positive map on a C^*-algebra, Man-Duen Choi (Toronto) has found, rather to his surprise, that he is a leading expert on quantum computing. He gave a stimulating talk relating his old work with current new developments, problems and his recent work in this area.

Practical Description:

The symposium was attended by over sixty participants and there were thirty-eight talks in all. Unfortunately, two of our invited speakers were forced to cancel due to personal reasons. (This resulted in us having a little money left over.) The following countries were represented: Canada, the United States, Australia, France, Germany, Poland, Norway, Great Britain, Ireland and Denmark.