

Workshop Schedule

Events for:
Monday, June 17th - Friday, June 21st

Monday, June 17th

10:00am **Feng Xu - SCGP 102**

Speaker: Feng Xu

Title: Rigorous results about relative entropy in QFT

Abstract: We will present some rigorous results about Relative entropy in QFT, motivated in part by recent physicists work which however depends on heuristic arguments such as introducing cut off and using path integrals. In the particular case of CFT, we will discuss interesting relations between relative entropy, central charge and global dimension of conformal net.

11:00am **Coffee Break - Simons Center Cafe**

11:30am **Masaki Izumi - SCGP 102**

Speaker: Masaki Izumi

Title: A topological approach to the classification of discrete amenable group actions on nuclear C^* -algebras

Abstract: A topological approach to the classification of discrete amenable group actions on nuclear C^* -algebras. The classification of discrete amenable group actions on injective factors was completed in the last century by many hands, Connes, Jones, Ocneanu, Takesaki, Kawahigashi, Sutherland, and Katayama. In contrast, its C^* -counterpart is still a far less developed subject though we can say that the classification of nuclear C^* -algebras is a matured subject now. One reason is probably topological complication of the automorphism groups of C^* -algebras, which never came into the picture in the von Neumann algebra case. In this talk, I report on our recent work with Hiroki Matui on the classification of poly- \mathbb{Z} group G -actions on a Kirchberg algebra A . We reduce the classification problem to that of principal $\text{Aut}(A)$ -bundles over the classifying space BG , or equivalently, to the classification problem of continuous fields of A over BG . As an application, we completely determine the number of cocycle conjugacy classes of outer \mathbb{Z}^n -actions on the Cuntz algebras.

12:30pm **Lunch - Simons Center Cafe**

2:00pm **Nima Lashkari - SCGP 102**

Speaker: Nima Lashkari

Title: Local Unitaries in Quantum Field Theory

2:30pm **Coffee Break - Simons Center Cafe**

3:00pm **Seung-Hyeok Kye - SCGP 102**

Speaker: Seung-Hyeok Kye

Title: Roles of exposed indecomposable positive multi-linear maps in quantum information theory

Abstract: Positive multi-linear maps play essential roles to detect multi-partite entanglement in quantum information theory. We need indecomposable positive maps in order to PPT entanglement. We discuss what kinds of map do we need to detect nonzero volume of PPT entanglement. Exposedness arise naturally in this context. We exhibit several examples of exposed indecomposable positive maps in $3 \otimes 3$ and $2 \otimes 2 \otimes 2$ cases. We also discuss how these maps can be used to study the structures of the convex set consisting of separable states.

3:35pm **Arthur Parzygnat - SCGP 102**

Speaker: Arthur Parzygnat

Title: Non-commutative disintegrations

Abstract: By diagrammatically reformulating the notion of a disintegration, which is sometimes called a regular conditional probability or an optimal hypothesis, we are able to abstract the idea to a variety of categories without using our classical intuition. We will specialize this abstraction to the category of finite-dimensional C^* -algebras and completely positive maps, a setting for non-commutative spaces and quantum information theory, where the meaning of a disintegration is interpreted as a sort of time reversal and recovery map. Our main result is a necessary and sufficient condition for the existence and uniqueness of such disintegrations. As a corollary, we reproduce a familiar theorem in the commutative (classical) setting. We will also discuss some no-go results for quantum processes. This is joint work with Benjamin Russo at SUNY Farmingdale.

4:30pm **Wine and Cheese - SCGP Cafe**

Tuesday, June 18th

10:00am **Vaughan Jones - SCGP 102**

Speaker: Vaughn Jones

Title: Unitary representations of Thompson groups

Abstract: Thompson groups are groups of local scaling transformations of the interval and the circle. I will give a method of constructing unitary representations of these groups using a categorical approach, and another speculative way using second quantization as one would for the diffeomorphism group.

11:00am **Coffee Break - Simons Center Cafe**

11:30am **Dietmar Bisch - SCGP 102**

Speaker: Dietmar Bisch

Title: Degrees of Noncommutativity for Subfactors

Abstract: The standard representation of a subfactor generates a certain unitary C^* -tensor category, or planar algebra, that is a complete invariant for amenable, hyperfinite subfactors. However, generic subfactors are not amenable, and one typically does not know how to distinguish them. There is a natural notion of „noncommutativity“ for a subfactor that is not captured by the planar algebra. I will explain a theorem that gives the first examples of „very noncommutative“, irreducible, hyperfinite subfactors. In particular, these will be non-amenable. I will also discuss how these ideas might be of interest for quantum information theory.

12:30pm **Lunch - Simons Center Cafe**

2:00pm **Claudia Pinzari - SCGP 102**

Speaker: Claudia Pinzari

Title: Weak quasi-Hopf algebras, quantum groups, and conformal field theory

Abstract: Weak quasi-Hopf algebras have been introduced by Mack and Schomerus as generalizations of Drinfeld's quasi-Hopf algebras, and may be regarded as general group like structures among fusion categories. In my talk, I shall discuss semisimple examples associated with quantum groups at roots of unity and a relation with the question of unitarizability of certain fusion categories arising from conformal field theory. The talk is based on joint work in progress with Sebastiano Carpi and Sergio Ciamprone.

2:30pm **Coffee Break - Simons Center Cafe**

3:00pm **Gerardo Morsella - SCGP 102**

Speaker: Gerardo Morsella

Title: UV finiteness and adiabatic limit on Quantum Spacetime through perturbative Algebraic QFT

Abstract: We define a scalar interacting QFT on Quantum Spacetime (QST) replacing the fields at a point in the interaction Lagrangian by the fields at a quantum point, described by an optimally localized state on QST; the resulting Lagrangian density agrees with the one of Bahns, Doplicher, Fredenhagen, Piacitelli (2003) after spacetime integration, but gives rise to a different interaction hamiltonian. But now the methods of perturbative Algebraic Quantum Field Theory can be applied, and produce an ultraviolet finite perturbation expansion of the interacting observables. If the obtained theory is tested in an equilibrium state at finite temperature the adiabatic cutoff in time becomes immaterial, namely it has no effect on the correlation function at any order in perturbation theory. Moreover, the spatial adiabatic cutoff can be removed and the interacting vacuum state can be obtained in the vanishing temperature limit. (Joint work with S. Doplicher and N. Pinamonti.)

3:35pm **Arnaud Brothier - SCGP 102**

Speaker: Arnaud Brothier

Title: Jones action of the Thompson groups

Abstract: Motivating in constructing conformal field theories Jones recently discovered a very general process that produces actions of the Thompson groups F , T and V such as unitary representations or actions on C^* -algebras. I will give a general panorama of this construction illustrated by examples and present applications to group theory and lattice theory (e.g. quantum field theory). Those are joint works with Vaughan Jones and Alexander Stottmeister.

Wednesday, June 19th

10:00am **Detlev Buchholz - SCGP 102**

Speaker: Detlev Buchholz

Title: Classical dynamics, arrow of time, and the Heisenberg commutation relations

Abstract: The assumption that time evolves only in one direction and mechanical systems can be described by a classical Lagrangean can be expressed in terms of a dynamical C^* -algebra for nonrelativistic particles at atomic scales. This algebra relies only on macroscopic concepts and does not incorporate any "a priori" quantization rules. Nevertheless, it is inherently non-commutative. The Heisenberg commutation relations for position and velocity measurements are derived from it and Hilbert space representations of the algebra lead to the standard formalism of quantum mechanics. This scheme leads also to a reformulation of the Haag-Kastler framework of quantum field theory, incorporating dynamics. (Joint work with Klaus Fredenhagen.)

11:00am **Coffee Break - Simons Center Cafe**

11:30am **James Tener - SCGP 102**

Speaker: James Tener

Title: A unified perspective on 2d chiral CFT

Abstract: There are two heavily studied axiomatisations of 2d unitary chiral conformal field theory: unitary vertex operator algebras and conformal nets. These notions are expected to be equivalent under some mild hypotheses. A complete rigorous mathematical proof of this equivalent has been elusive, however, although the recent work of Carpi-Kawahigashi-Longo-Weiner has brought new clarity to the task. In this talk, I will show how the notion of functorial conformal field theory (in the sense of Segal) can be modified contain both the data of a vertex operator algebra and a conformal net. I will also discuss how to use functorial and geometric notions to approach the problem of establishing equivalence between VOAs and conformal nets.

12:30pm **Lunch - Simons Center Cafe**

2:00pm **Kasia Rejzner - SCGP 102**

Speaker: Kasia Rejzner

Title: Constructing the net of von Neumann algebras for the sine-Gordon model

Abstract: In this talk I will present recent results on the construction of the net of local algebras for the sine-Gordon model. The approach I will present is that of perturbative algebraic QFT, in which the interacting fields are constructed using formal S-matrices. It has been shown that in sine-Gordon model these formal S-matrices can be realized as unitary operators in certain Hilbert space representation, appropriate for massless scalar field in 2 dimensions.

2:30pm **Coffee Break - Simons Center Cafe**

3:00pm **Vincenzo Morinelli - SCGP 102**

Speaker: Vincenzo Morinelli

Title: Scale and Möbius covariance in 2d Haag-Kastler nets

Abstract: In this talk we investigate on the relation between conformal and dilation covariance in QFT. Although many models which are dilation covariant are indeed conformal covariant a complete understanding of this implication in the algebraic approach to QFT is missing. We will present the following result: Given a two-dimensional Haag-Kastler net which is Poincaré-dilation covariant with additional properties, we prove that it can be extended to a conformal (Möbius) covariant net. Additional properties are either a certain condition on modular covariance, or a variant of strong additivity. We further discuss counterexamples. The talk is based on a joint work with Yoh Tanimoto.

6:30pm **Workshop Banquet**

Thursday, June 20th

10:00am **Karl-Hermann Neeb - SCGP 102**

Speaker: Karl-Hermann Neeb

Title: Finite dimensional endomorphism semigroups of standard subspaces

Abstract: Let V be a real standard subspace of the complex Hilbert space H , i.e., $V \cap V = \{0\}$ and $V + iV$ is dense. Such subspaces arise in Tomita-Takesaki theory by applying the hermitian elements of a von Neumann algebra to a cyclic separating vector. Further, let $G \subseteqq U(H)$ be a finite dimensional Lie group of unitary operators containing the modular group $(\Delta_V^t)_{t \in \mathbb{R}}$ and invariant under the modular conjugation J_V . We are interested in the subsemigroup $S_V = \{g \in G : gV \subseteqq V\}$ of endomorphisms of V in G . Our main result is a concrete description of its Lie wedge $L(S_V) = \{x \in L(G) : \exp(R_+ x) \subseteqq S_V\}$, i.e., the generators of its one-parameter subsemigroups. In particular, $L(S_V)$ is contained in a \mathbb{Z} -graded Lie subalgebra in which it can be determined explicitly in terms of the involution τ of $L(G)$ induced by J_V , the generator h of the modular group Δ_V^t , and the positive cone of the corresponding representation.

11:00am **Coffee Break - Simons Center Cafe**

11:30am **Terry Gannon - SCGP 102**

Speaker: Terry Gannon

Title: Modular invariant partition functions return from the dead

Abstract: Modular invariant torus partition functions are the simplest quantity associated with the full (as opposed to chiral) rational conformal field theory. In 1986, Cappelli-Itzykson-Zuber classified these for the theories with chiral algebra coming from $\mathfrak{sl}(2)$, and found they fall into an A-D-E pattern: they are the Wess-Zumino-Witten models associated to $SU(2)$ (these form the 'A'), to $SO(3)$ (these are the 'D'), along with 3 exceptionals (these are the 'E'). In the 1990s Galois methods were introduced, and the $\mathfrak{sl}(3)$ classification was done and related to Jacobians of Fermat curves. At the turn of the century subfactor people, led by Ocneanu, introduced new techniques, notably alpha-induction. In my talk I'll explain how combining the old and the new allows for classifications to be completed for all Lie algebras of rank up to 8 or so.

12:30pm **Lunch - Simons Center Cafe**

2:00pm **Roberto Conti - SCGP 102**

Speaker: Roberto Conti

Title: Automorphisms and endomorphisms of simple C^* -algebras generated by isometries

Abstract: The study of the automorphisms and of the endomorphisms of the Cuntz algebras and of some closely related C^* -algebras provides an endless source of challenging problems. We will give a short overview of the subject largely based on our own contributions (old and new) and, if time permits, discuss a selected list of open problems.

2:30pm **Coffee Break - Simons Center Cafe**

3:00pm **Hans Wenzl - SCGP 102**

Speaker: Hans Wenzl

Title: Coideal Algebras and Subfactors

Abstract: Coideal algebras of type AI have appeared both as centralizer algebras for spinor representations and, in a rather indirect way, in the construction of generalizations of Goodman-de la Harpe-Jones subfactors. Using q -skew-Howe duality and its analog for spinor representations, we find a more conceptual way how to construct these subfactors. This also suggests a method how to construct subfactors from coideal algebras of other types such as e.g. Type DIII. These would correspond to analogs for fusion categories of the embedding of $U(N)$ into $SO(2N)$.

3:35pm **Corey Jones - SCGP 102**

Speaker: Corey Jones

Title: A survey of G-crossed braided fusion categories

Abstract: Braided fusion categories emerge naturally as DHR categories for low dimensional algebraic quantum field theories. In the presence of a finite group of global symmetries, G-crossed braided fusion categories arise as natural generalizations of DHR categories, motivating their abstract study. In this talk, we will give an overview of the mathematical theory of G-crossed braided fusion categories. We will present recent results concerning existence, construction and classification of these objects, as well as some new applications to 1+1 D chiral conformal nets.

Friday, June 21st

10:00am **Dan Voiculescu - SCGP 102**

Speaker: Dan Voiculescu

Title: A hydrodynamic exercise in free probability: free euler equations

Abstract: The Euler equations for a flow which preserves the Gaussian measure on Euclidean space can be translated in terms of Gaussian random variables, which raises the question about an analogue in free probability. We derive these free Euler equations by applying the approach of Arnold for Euler equations to a Lie algebra of infinitesimal automorphisms of the von Neumann algebra of a free group. We then extend the equations to noncommutative vector fields satisfying only certain weaker noncommutative smoothness conditions. We also introduce a cyclic vorticity and show that it satisfies appropriate vorticity equations and that it gives rise to a family of conserved quantities.

11:00am **Coffee Break - Simons Center Cafe**

11:30am **Yasuyuki Kawahigashi - SCGP 102**

Speaker: Yasuyuki Kawahigashi

Title: Anyons, matrix product operator algebras and subfactors

Abstract: We show that a family of flat connections arising from a subfactor with finite index and finite depth gives an example of tensors for a matrix product operator algebra describing a family of anyons. This gives a precise relation between a recent work Bultinck et al. and subfactor theory.

12:30pm **Lunch - Simons Center Cafe**

2:00pm **Christian Jäkel - SCGP 102**

Speaker: Christian Jäkel

Title: CFT on two-dimensional de Sitter space

Abstract:

2:30pm **Coffee Break - Simons Center Cafe**